York. Mr. F. Craig's Orchard on the Avon.

PART I. E. W. Hilgard

The West Australian Settler's Guide and Farmer's Handbook.

Descriptive Notes on the Agricultural Areas and Crown Lands open for Selection.

An enumeration of the productive possibilities of the Golden West.

Issued by direction of the Bureau of Agriculture.

Edited by L. LINDLEY-COWEN, Secretary.

1897

E. S WIGG & SON., PRINTERS, PERTH.

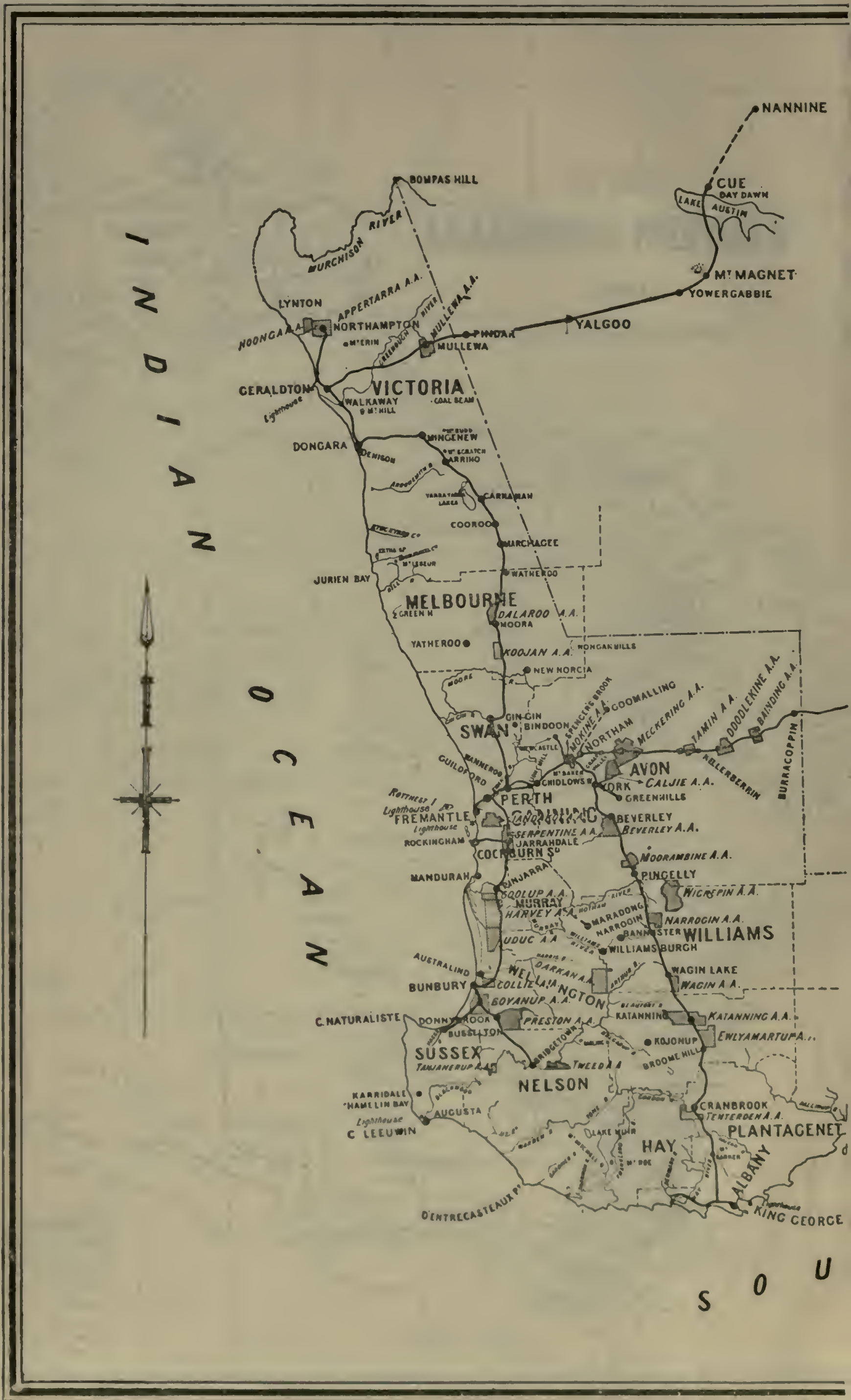
PREFACE.

It was at first intended to issue the SETTLER'S GUIDE AND FARMER'S HANDBOOK as a whole in one volume, complete, but the parts have so insensibly outgrown the limits originally fixed for them, and the demand for information about the cultural resources and prospects of Western Australia is so great, that it has been deemed expedient to issue the book in parts. As will be seen on perusal, Part I. consists chiefly of a description of the agricultural areas and Crown lands open for selection, with an account of the early settlement and progress of the pastoralists and agriculturists of the colony. An endeavor has been made—it is to be hoped not unattended with success—to write a plain, unvarnished tale, and yet in such language as to make it interesting even to those whose thoughts are not on settlement bent. The early history of Western Australia and its pastoral pioneers is most interesting, but not nearly so interesting as the country itself as we know it now, when every dawn discovers new features, and each succeeding day discloses new avenues for industrial enterprise, and offers renewed encouragement to the able-bodied, active, capable settler, whether miner, farmer, or mechanic, to "go in and win." Western Australia may be likened to a huge pie, the crust of which has only, as yet, been nibbled round the edges. Of the treasures that are hidden underneath that thick and somewhat forbidding crust, we have as yet only the faintest conception. We want Jack Horners here to pull out the plums, and plums there are undoubtedly for men of all avocations. But the men who come to Western Australia, with the intention of making it their home, must be men firm of heart and stout of body, men of mind as well as muscle, and it is this class of men that the SETTLER'S GUIDE is, in part, designed to attract and the Bureau of Agriculture is anxious to assist after they have arrived here. There is, it may be safely said, no country in the world that offers at the present moment the same inducements to the settler as Western Australia. The permanence of its mineral resources is now beyond question, only their immense value and the vastness of their extent having yet to be determined. The agronomic possibilities of the colony are equally promising, and only need the developing hand of time to place Western Australia in the van of the producing provinces of the Southern Hemisphere.

L. L-C.

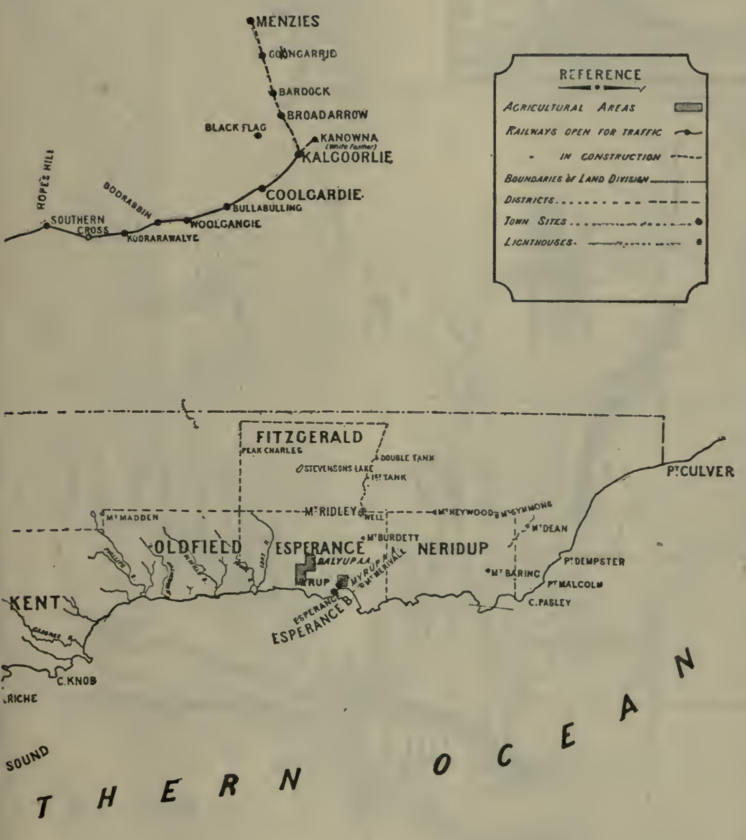
Perth, August 18th, 1897.


MAP OF
WESTERN AUSTRALIA
1897.
Scale of Miles
KIMBERLEY
DIVISN
KIMBERLEY
GOLDFIELD
BUCCANEER ARCHIPELAGO
DAMPIER'S ARCHIPELAGO
PILBARRA
DIVISN
W PILBARRA
GOLDFIELD
NORTH
WEST
ASHBURTON
GOLDFIELD
GASCOYNE G.F.
PEAKE HILL G.F.
CARNARVON
WESTERN DIVISION
EASTERN DIVISION
Tropic
Capricorn
MURCHISON
EAST MURCHISON G F
YALGOO
G.F.
Mt MARGARET G.F.
NORTH COOLGARDIE G F
YILGARN
COOLGARDIE
N.E. COOLGARDIE
G F
WEST
DIVISION
DIVISION
EUCLA
GREAT AUSTRALIAN BIGHT
ARCHIPELAGO OF THE RECHERCHE
INDIAN
OCEAN
SOUTHERN
OCEAN
SOUTH
AUSTRALIA
PERTH
SUSSEX
KENT
VICTORIA
REFERENCE


INDIAN OCEAN
SOU
NANNINE
CUE
DAY DAWN
LAKE AUSTIN
MT MAGNET
YOWERGABBIE
YALGOO
BOMPAS HILL
MURCHISON RIVER
LYNTON
APPERTARRA A.A.
MULLEWA A.A.
NOONGAA A.A.
NORTHAMPTON
PINDAR
MULLEWA
GERALDTON
Lighthouse
VICTORIA
WALKAWAY
COAL SEAM
DONGARA
DENISON
MINGENEW
ARRINO
CARNAMAH
COOROO
MARCHAGEE
JURIEN BAY
WATHEROO
MELBOURNE
DALAROO A.A.
MOORA
YATHEROO
KOOJAN A.A.
WONGAN HILLS
NEW NORCIA
GIN GIN
BINDOON
SWAN
GOOMALLING
MOKINE A.A.
NORTHAM
MECKERING A.A.
TAMIN A.A.
DOODLEKINE A.A.
BAANDING A.A.
BURRACOPPIN
KELLERBERRIN
AVON
CALJIE A.A.
GUILDFORD
CHIDLOWS
YORK
GREENHILLS
PERTH
Rottnest I.
Lighthouse
FREMANTLE
SERPENTINE A.A.
JARRAHDALE
BEVERLEY
BEVERLEY A.A.
ROCKINGHAM
COCKBURN SD
MOORAMBINE A.A.
PINGELLY
MANDURAH
PINJARRA
COOLUP A.A.
MURRAY
HARVEY A.A.
WICKEPIN A.A.
MARADONG
NARROGIN
NARROGIN A.A.
BANNISTER
WILLIAMS
UDUC A.A.
WILLIAMSBURGH
AUSTRALIND
WAGIN LAKE
WAGIN A.A.
BUNBURY
COLLIE
WELLINGTON
DARKAN A.A.
BOYANUP A.A.
KATANNING
KATANNING A.A.
C. NATURALISTE
DONNYBROOK
PRESTON A.A.
BUSSELTON
KOJONUP
EWLYAMARTUP A.A.
SUSSEX
BRIDGETOWN
BROOME HILL
TANJANERUP A.A.
TWEED A.A.
NELSON
KARRIDALE
HAMELIN BAY
AUGUSTA
Lighthouse
C. LEEUWIN
CRANBROOK
TENTERDEN A.A.
PLANTAGENET
LAKE MUIR
HAY
ALBANY
D'ENTRECASTEAUX PT
Lighthouse
KING GEORGE

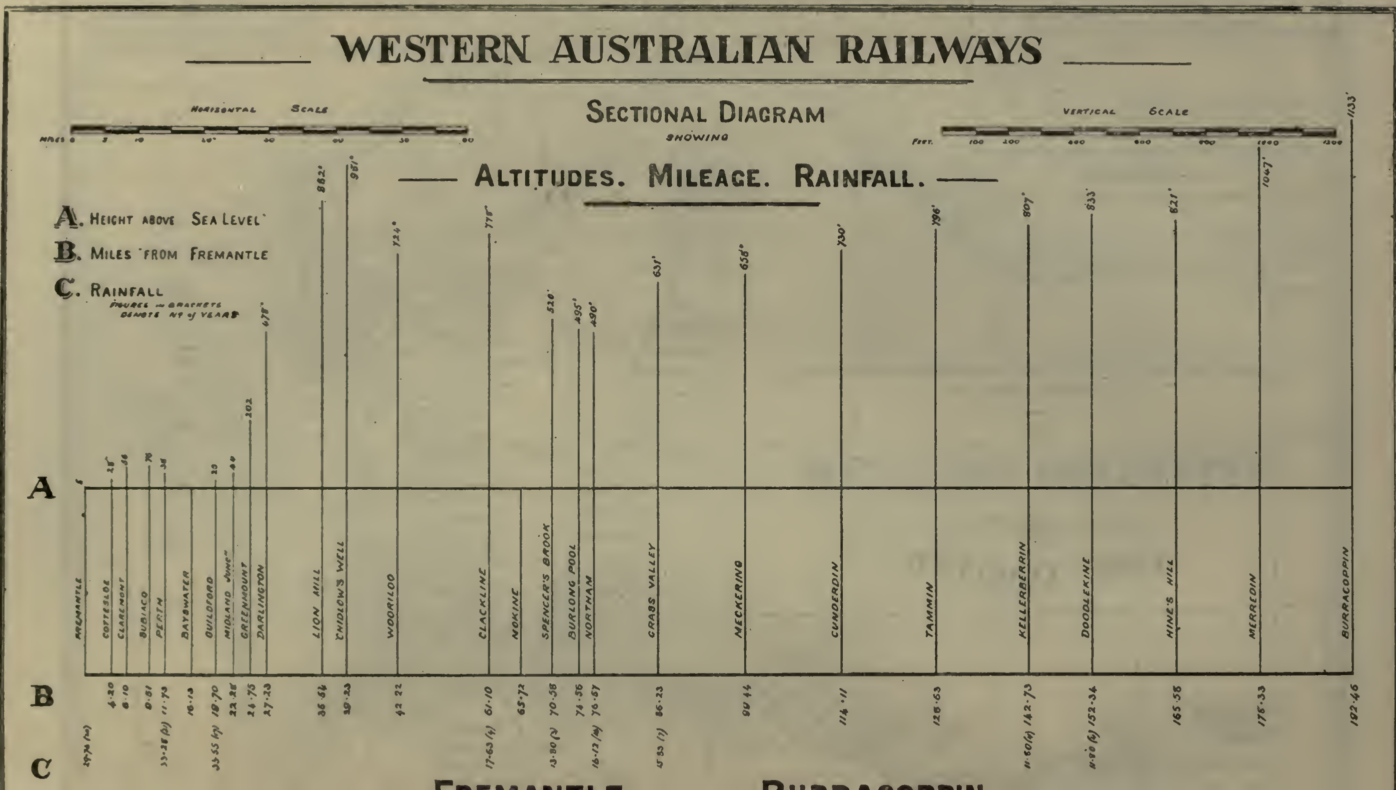
MAP OF
SOUTH WEST LAND DIVISION
OF
WESTERN AUSTRALIA

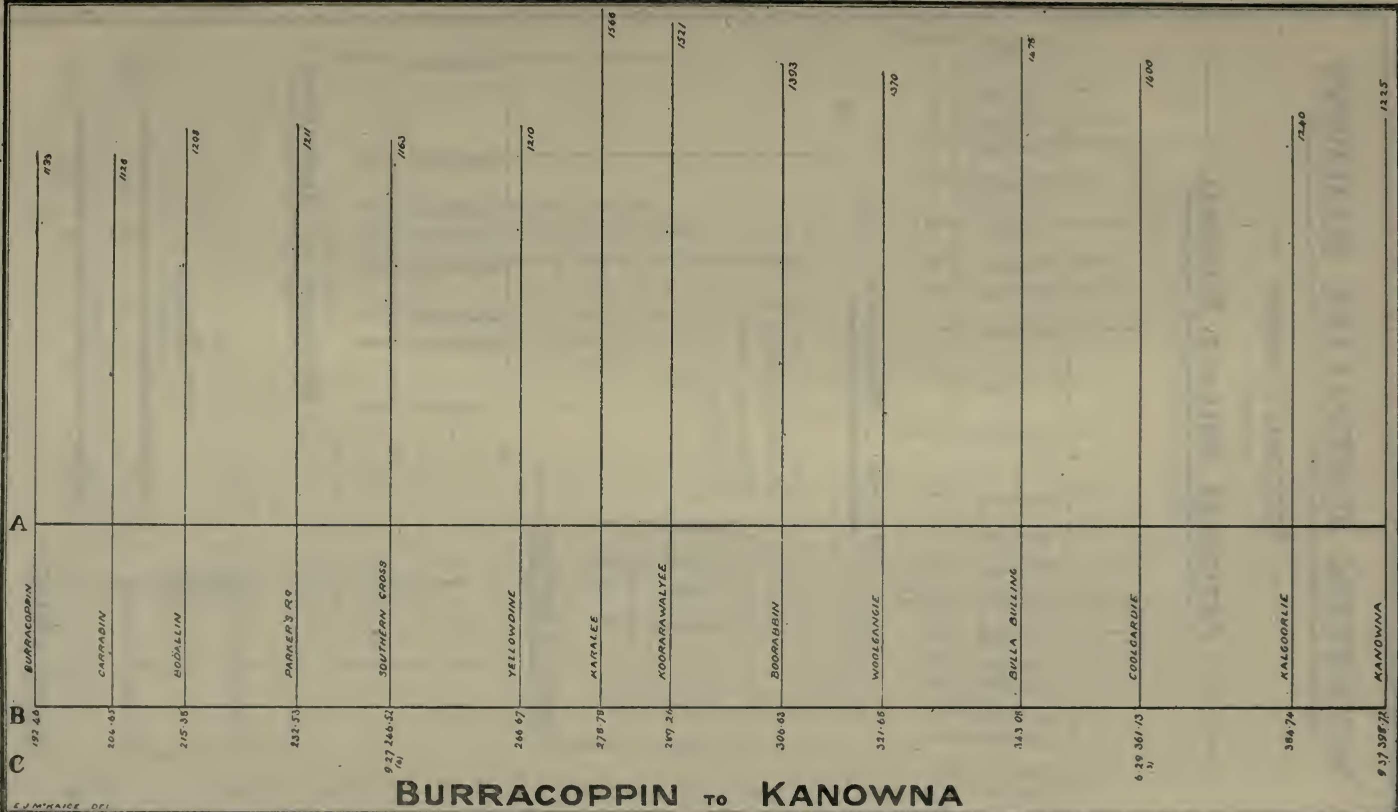
— *Scale 100 Miles to an inch* —



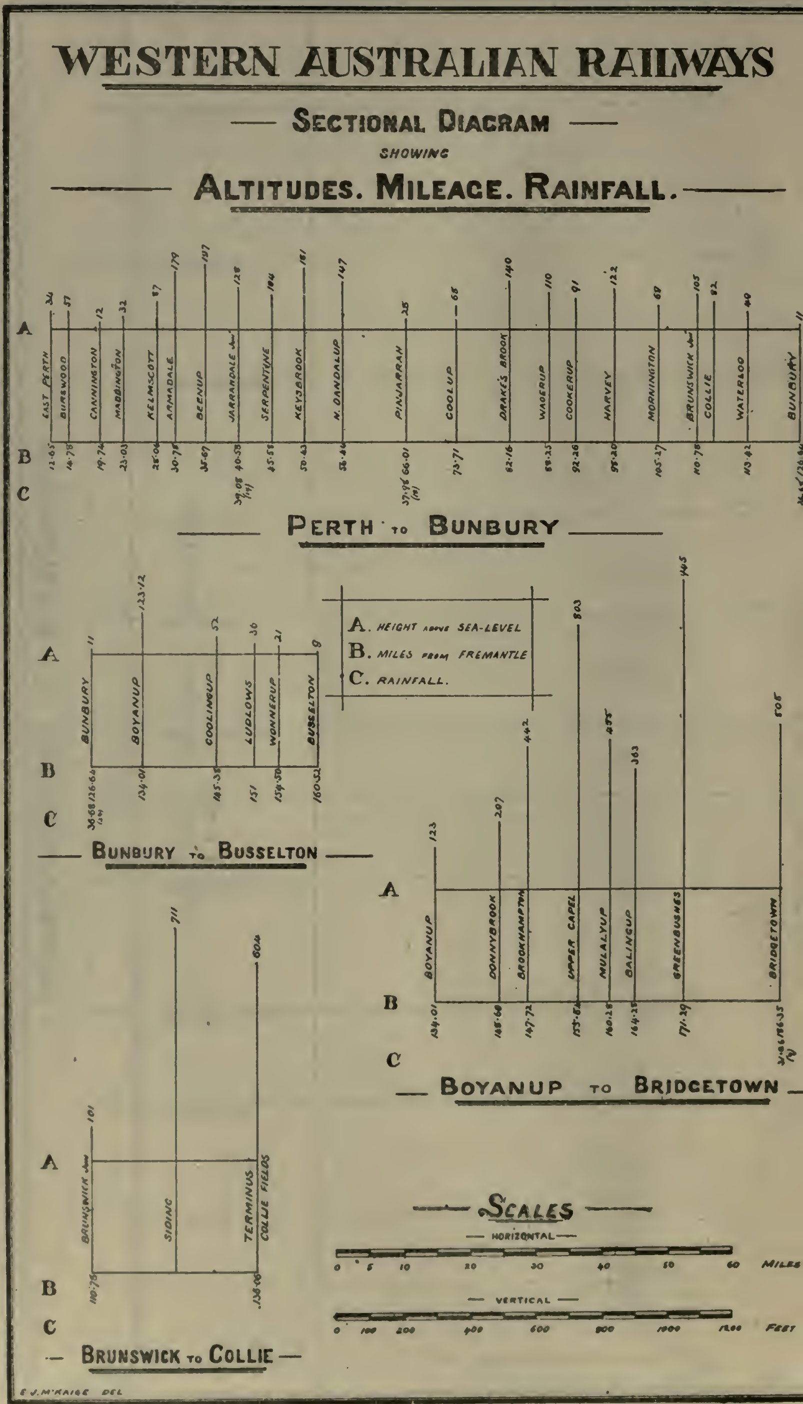

ENLARGED PLAN OF PART OF EASTERN RAILWAY
OCEAN
PERTH
FREMANTLE
YORK
NORTHAMP
Upper Swan
Midland Junction
Bellevue Junction
Chidlows well
Lion Mill
Sawyers Valley
Mundaring
Mahogany
Smith's Mill
Darlington
Greenmount
Gooseberry Hill
Bayswater
Leederville
West Perth
Cottesloe Beach
North Fremantle
East Fremantle
Claremont
Subiaco
Maddington
Kelmscott
Beenyup
Armadale
Wongong
Rockingham
Clarence
Newcastle
Key Farm
Coorinja
Lloyds Crossing
Mt Goires
Heddy's Well
Northam
Burlong Pool
Spring Hill Sid
Spencers Bk Jun
Mureek
Woodside
Gregsons
Burges Sid
Mackies Crossing
Hicks
Gilgering
Edwards Crg
Beverley
Coates
Werribee
Woorlloo
Byfields Mill
NANNINE
CUE
Day Dawn
LAKE AUSTIN
Noyagee
MT MAGNET
Yowergabbie
Yalgoo
Pinder
MULLEWA
Nicholson R.
Weld R.
Victoria
NORTHAMPTON
GERALDTON
Greenough Riv Cr
Northern Gully
Dongara
Yandanooka
Arrino
Three Springs
Carnamah
Coorow
Marchagee
Watheroo
Coomberdale
Mt Kenneth
LAKE BARLEE
LAKE MOORE
KNUTSFORD
MENZIES
Coonoarrie
Bardoc
Broad Arrow
Paddington
E A N


RAILWAY MAP
of
WESTERN AUSTRALIA
1897.
Scale of Miles
REFERENCE
Government Railways constructed shewn thus
under construction
proposed
Private constructed
Stations with distances in miles & chains
Height above sea level
Refreshment Stations
NOTE
Distances North of Walkaway are from Geraldton and Distances South of Walkaway are from Fremantle measured to centre of Platforms
Prepared and published under the authority of the Hon. F H Piesse, Commissioner for Railways Western Australia, July 1897.
INDIAN
OCEAN
EASTERN RAILWAY
GREAT SOUTHERN RAILWAY
SOUTH WESTERN
PERTH
FREMANTLE
YORK
BEVERLEY
NORTHAM
NEWCASTLE
GREENHILLS
BUNBURY
PICTON JUNCTN
BOYANUP JUNCTN
BRUNSWICK JUNCTN
JARRAHDALE JUNCTN
COLLIE COALFIELDS
KATANNING
ALBANY
ESPERANCE
ESPERANCE BAY
KALGOORLIE
COOLGARDIE
SOUTHERN CROSS
LAKE COWCOWING
LAKE LEFROY
MARADONG
C. Naturaliste
C. Leeuwin
AUGUSTA
HAMELIN HARBOUR
BLACKWOOD R.
Warren R.
Frankland R.
Brookton
Pingelly
Popanyinng Pool
Cuballing Pool
Narrogin
Wolwalling
Buchanan River
Wagin Lake
Lime Lake
Yarrabin
Broomehill
Tambellup
Pootenup
Cranbrook
Tenterden
Kendenup
Mt Barker
Hay River Rd
Marbellup
Koogan
Gillingarra
Mogumber
Wannamal
Cullala
Gingin
Chandala
Muchea
Mooliabeenee
Serpentine
Keysbrook
North Dandalup
Pinjarrah
Coolup
Waroona
Drakes Brook
Wagerup
Yarloop
Cookernup
Harvey
Nornington
Dardanup
Donnybrook
Brookhampton
Upper Capel
Mullalyup
Balingup
Greenbushes
Bridgetown
Dalgarup
BUSSELTON
Meckering
Cunderdin
Tammin
Kellerberrin
Walgoolan
Burracoppin
Merredin
Nangeenan
Hine's Hill
Mt. Kokeby
Edwards Crossing
Burlong Pool
SPENCERS BROOK JUNCTN
Walkaway
Mungari
Bulla Bulling
Woolgangie
Boorabbin
Yellowdine
Parker's Road
Golden Pig
Nulla Nulling
Koorkowie
Rockingham
Mandurah
Kelmscott
Beenup
Claremont
Cottesloe


WESTERN AUSTRALIAN RAILWAYS
SECTIONAL DIAGRAM
SHOWING
ALTITUDES. MILEAGE. RAINFALL.
HORIZONTAL SCALE
VERTICAL SCALE
A. HEIGHT ABOVE SEA LEVEL
B. MILES FROM FREMANTLE
C. RAINFALL
FIGURES IN BRACKETS DENOTE Nº of YEARS
FREMANTLE
COTTESLOE
CLAREMONT
SUBIACO
PERTH
BAYSWATER
GUILDFORD
MIDLAND JUNC^N
GREENMOUNT
DARLINGTON
LION MILL
CHIDLOW'S WELL
WOORILOO
CLACKLINE
NOKINE
SPENCER'S BROOK
BURLONG POOL
NORTHAM
GRASS VALLEY
MECKERING
CUNDERDIN
TAMMIN
KELLERBERRIN
DOODLEKINE
HINE'S HILL
MERREDIN
BURRACOPPIN
A
B
C
FREMANTLE
BURRACOPPIN



BURRACOPPIN TO KANOWNA



WESTERN AUSTRALIAN RAILWAYS
SECTIONAL DIAGRAM
SHOWING
ALTITUDES. MILEAGE. RAINFALL.
A
B
C
EAST PERTH
BURSWOOD
CANNINGTON
MADDINGTON
KELMSCOTT
ARMADALE
BEENUP
JARRAHDALE Jn
SERPENTINE
KEYSBROOK
N. DANDALUP
PINJARRAH
COOLUP
DRAKE'S BROOK
WAGERUP
COOKERUP
HARVEY
MORNINGTON
BRUNSWICK Jn
COLLIE
WATERLOO
BUNBURY
PERTH TO BUNBURY
A. HEIGHT ABOVE SEA-LEVEL
B. MILES FROM FREMANTLE
C. RAINFALL.
BUNBURY
BOYANUP
COOLINGUP
LUDLOWS
WONNERUP
BUSSELTON
BUNBURY TO BUSSELTON
BOYANUP
DONNYBROOK
BROCKHAMPTON
UPPER CAPEL
MULALYUP
BALINGUP
GREENBUSHES
BRIDGETOWN
BOYANUP TO BRIDGETOWN
BRUNSWICK Jn
SIDING
TERMINUS COLLIE FIELDS
BRUNSWICK TO COLLIE
SCALES
HORIZONTAL
0 5 10 20 30 40 50 60 MILES
VERTICAL
0 100 200 400 600 800 1000 1200 FEET
E. J. McKAIGE DEL.

INDEX.

	PAGE.
Advantages of Southern district -	137
Advantages of Swan district -	170
Advantages at Toodyay - -	82
Advice to fruitgrowers - -	114
Advice to prospective settler -	7
Agricultural area, Appertarra -	195
,, ,, Bainding -	63,66
,, ,, Beverley -	61,95
,, ,, Boyanup -	41
,, ,, Caljie - -	61
,, ,, Collie - -	28
,, ,, Coolup -	21
,, ,, Dalaroo -	190
,, ,, Dalyup -	151
,, ,, Darkan -	96
,, ,, Ewlyamartup	97
,, ,, Doodlekine -	63
,, ,, Harvey -	23
,, ,, Jandakot -	8
,, ,, Katanning -	96
,, ,, Koojan	190,192
,, ,, Meckering -	63
,, ,, Mourambine	95,98
,, ,, Mullewa -	196
,, ,, Myrup -	151
,, ,, Narrogin -	95
,, ,, Nonga - -	196
,, ,, Pallinup -	95,97
,, ,, Preston -	40
,, ,, Tammin -	63
,, ,, Tenterden -	97,127
,, ,, Tweed - -	41
,, ,, Uduc - -	27
,, ,, Wagin - -	95,96
,, ,, Weeranooka	196
,, ,, Wickepin -	95
Agricultural areas, descriptive notes - - - - - -	95
Agricultural areas, Southern district - - - - - -	130
Agricultural labor at York, difficulty of obtaining - -	53
Agricultural settlement at Newcastle - - - - - -	78
Agriculture: Southern district, opening for - - - - -	89
Agriculturists, openings for, in Southern district - - -	89

	PAGE.
Albany garden blocks - -	129
Albany, soil near - - -	94
,, cultivation suitable -	44
Amount of settlement Southern district - - -	130
Annual rainfall, Newcastle -	86
Annual show, York - - -	84
Apiary at York - - -	55
Appertarra agricultural area -	195
Application of shares principle -	85
Arable land, Southern district -	133
Arable land in Swan district -	169
Area recommended - - -	130
Area required, York district -	50
Artesian water supply, Swan -	165
Arthur river land - - -	102
Artificial grasses, Woongong -	18
Assistance to settlers, Katanning	119
Available land, York- - -	55
Badjelling, timber heavy near -	75
Barnado's boys, Dr. - - -	53
Beaufort river, land - - -	102
Bees near York - - -	57
Benefits of ring-barking - -	177
Best crops to grow, Southern district - - - - -	131
Beverley agricultural area -	95,61, 63,66
Beverley to King George's Sound, soil - - - - -	89
Blackwood country - - -	37
Blackwood, timber at - -	37
Blocks at Albany, garden - -	129
Boranning, yields at - - -	107
Boyanup agricultural area -	41
Boys, Dr. Barnado's - - -	53
Brassey's estate, Broomehill, Lord - - - - -	120
Bremer Bay district - - -	150
Bridges, estimates for roads and	59
Bridgetown - - - - -	38
,, climate of - -	39
,, railway - - -	38
Broomehill - - - - -	125
Broomehill, Lord Brassey's estate - - - - -	120
Broomehill suburban blocks -	125
Brunswick river, dairying at	27

PAGE.

Bunbury - - - - - 28
,, clearing, cost - - 29
,, facility for sale of crops 32
,, fertilisers suitable - - 32
,, rainfall - - - 30
,, vermin pests - - 33
,, yields of potatoes - - 30
Busselton, land and climate - 35,36
Butter market, Geraldton - - 195
Caljie agricultural area - - 61
Camballing forest - - 106
Canning Hills, soil at - - 16
Canning, orchard at - - 14
Capabilities of Esperance district 150
Cape weed - - - 85
Capital required by settlers - 120
,, ,, for settlers, Swan 166
,, ,, by Southern district settlers - - - 130
Capital required by settlers, York 50
Carlisle vineyard - - - 160
Cattle at Yatheroo - - - 179
Character of country, Midland district - - - 190
Character of soil in Southern district - - - 134
Characteristics of land on the Swan - - - 165
Cheriton estate, Gingin - - 174
Citrus fruits, Gingin - - - 178
Claims for York-Greenhills line - 54
Classification of land on Great Southern line - - - 124
Classification of soil, Yilgarn route - - - - 67
Clay land - - - - 5,6,15
Clearing at Bunbury, cost of - 29
,, cost of - - - 135
,, Esperance, cost of - 152
,, forest land, cost - - 52
,, Midland district, cost of 183
,, Swan district - - 172
,, and treatment of land - 141
,, at Williams, cost - - 115
Climate of Midland district - 189
,, Nelson district - - 44
,, and soil, Newcastle - 81
,, of Southern district - 93
,, Swan district - - 172
,, Vasse - - - 36
Close settlement in Southern district - - - 140
Close settlement, York, retarding of - - - 55
Coal deposits near Vasse - - 37
Coast change - - - 6
Collie agricultural area - 28
Colonisation Estates Co. - - 20

PAGE.

Colony, proposed Italian - - 191
Comparison of Victoria with Western Australia - - - 65
Competition for produce - - 131
Congenial place for lucerne - 10
Conservation of water, Yilgarn route - - - 68
Coolup agricultural area - - 21
,, drainage scheme - - 22
Coondle estate, Newcastle - - 79,80
Co-operative wineries on the Swan - - - 158
Corkscrew grass, Newcastle - 86
Cost of clearing at Esperance - 152
,, ,, forest land - 52
,, ,, Midland district 183
,, ,, Nelson district - 43
,, ,, Southern district 135
Cost of land, Greenhills - - 51
Country at Eucla - - - 201
,, at Marradong brook - 106
,, Midland district, characteristics of - - - 190
Country at Mount Barker - - 128
,, for orchards in Williams district - - - 109
Country at Wagin Lake - - 117
Creaton estate - - - 20
Crops at Eucla - - - 202
,, facility for sale - - - 32
,, in Nelson district - - 42,44
,, prices of, at Newcastle - 83
,, and soil at Harvey - - 25
,, Southern district, best - 131
Crops suitable for Esperance - 151
,, ,, Swan district 167
,, ,, Williams ,, 113
,, at Wagin - - - 99
,, at York, values - - 51
Cubbine district, rich land in - 73
,, timber heavy at - - - 75
Cultivation at Bridgetown - - 40
,, at Esperance - - 151
,, limits of safe - - 66
,, New Norcia - - 194
,, successful - - - 66
,, suitable for Albany district - - - 94
Cunderdin water supply - - 68
Dairying - - - 139
,, at Brunswick river - 27
,, Midland district - 180
,, in Swan district - 171
,, at York - - - 56
Dalaroo agricultural area - - 190
Dalyup agricultural area - - 151
Dandaraga, annual average rainfall - - - - 182

	Page.
Dandaraga, soil at - -	182
Dandelion - -	85
Dangin rainfall - -	75
,, rich land at - -	73
,, timber heavy at -	75
,, Toapin rocks - -	72
Dardanup - -	27
Darkan agricultural area -	96
Darling range - -	4
Daylerking - -	107
Deepdale, irrigation facilities at-	87
Deep river district - -	199
Deep river, forests - -	199
Department, roads and bridges -	59
Descriptive notes on agricultural areas - -	95
Desert land - -	72
Dr. Barnado's boys - -	53
Donnybrook, fruits at - -	43
Doodlekine agricultural area -	63
Dorakin, timber heavy at -	75
Drainage scheme, Coolup -	22
,, south-west - -	23
Drawbacks of York district -	52
Early sowing necessary -	66
Eastern areas, good land -	71
Eastern country, fruit, suitability for - -	70
Eastern country, vegetables, suitability for - -	70
Eastern country, vines, suitability for - -	70
Eastern division - -	46
Esperance - -	148
,, capabilities for settlement - -	150
Esperance, cost of clearing -	152
,, railway requirements-	150
,, rainfall at - -	152
,, selections at - -	152
,, soil, characteristics -	149
,, stock-carrying capacity - -	151
Esperance, suitability for crops -	151
Estate, Newcastle, The Coondle	79
,, ,, The Norman	79
Estates, retarding settlement, York - -	55
Estimates, roads and bridges department - -	59
Estates in Swan district -	163
Eucalyptus oil, extraction -	47
Exhausting land, warning -	51
Eucla, coast country - -	201
,, crops at - -	202
,, district - -	201
,, prospects as wheat country	204
,, water supply - -	201

	Page.
Ewlyamartup agricultural area -	97
Explanatory notes, poison lands	75
Facilities for irrigation, Newcastle - -	87
Farm site, model - -	121
Farmers, area required at York -	50
Farmers, capital requisite, York	50
Farmer and Government policy-	60
Farm servants, natives as -	69
Farming adapted for Williams -	113
Farming, progress of industry -	60
,, ,, Williams -	112
,, at Wagin Lake -	98
Feed, figs as - -	188
,, in Midland district -	186
Fencing, raspberry jam wood for	48
Fertility of soil, Yilgarn -	67
Fertilisers adapted for South -	142
,, for Bunbury - -	32
,, for light soils - -	51
Figs as feed for stock - -	188
,, at Lowlands - -	10
,, at Mandurah - -	9
Flats, Williams river - -	107
Floral wealth, Western Australian	58
Fodder question - -	10,11
Foods, value of imported -	105
Forest at Camballing - -	106
,, land, clearing cost -	52
Forests at Mount Barker -	128
,, Nelson district - -	43
Fruits, Gingin - -	178
,, grown, Swan district -	170
Fruit grown, York - -	50
Fruits, Wagin - -	99
Fruit, suitability of Eastern districts for - -	70
Fruitgrowers, advice to - -	114
Fruit-growing, Greenough -	195
,, prospects at York	56
,, York, adaptability for - -	49
Garden blocks at Albany -	129
Gardens, market - -	13,14
Gate, ingenious swing - -	120
Geography of Southern district -	93
Geraldton, butter market -	195
Gimlet gum country - -	48
Gingin district - -	174
,, pastures - -	177
,, soil at - -	177
Good land, Eastern areas -	71
,, at Hay river -	129
Good soil, Newcastle - -	86
Goomalling area - -	76
Gordon river, land open for selection - -	126
Gosse estate, Kelmscott - -	17

	PAGE.
Government and the farmer -	60
Grasses, artificial, Woongong -	18
Grass, corkscrew, Newcastle -	85
„ kangaroo, Newcastle -	85
„ silver, at Newcastle -	85
Grass Valley, water conservation	68
Great lone land - -	72
Great Southern, land classification	124
„ „ railway - -	88
„ „ „ promoters	97
„ „ „ purchase -	91
Greenhills, cost of taking up land	51
„ line, claims for -	54
„ „ York -	54
„ yield at - -	64
Greenough flats - -	195
„ fruit at - -	195
„ soil of - -	195
„ water supply -	195
Guidance of new settlers, suggestions for - -	142
Gum country, gimlet - -	48
„ „ salmon - -	47
„ danger signal, wando -	48
„ morrell, at York - -	47
„ wandoo, a danger signal -	48
„ white, country, Toodyay -	87
„ the York - -	47
Hackett, Hon. J. W., estate at Bridgetown - -	40
Harper, Mr. C., and the Harvey	24
Harvey agricultural area -	23
„ and Governor Stirling -	24
„ Mr. C. Harper's opinion	24
Harvey, soil and crops - -	25
Hay river, good land at- . -	129
Hotham river - -	106
Imported foods, value of -	105
Improvements, pastoral leases -	71
Industry, dairying, at York -	56
„ farming, progress of -	60
Index to land, timber an -	90
Information for new settlers -	50
Irrigation, orchards, Newcastle -	87
Irwin river valleys - -	194
Italian colony, proposed -	191
Jamwood for fencing - -	48
Jandakot agricultural area -	8
Jarrahdale - -	19
Kangaroo grass - -	85
Karri forests at Torbay - -	94
Katanning -	118,147
„ agricultural area -	96
„ classification of soils -	100
„ fertilisers for - -	118
„ hints for settlers -	120

	PAGE.
Katanning settlers assisted at -	119
„ settlement near -	123
Kelmscott, Gosse estate - -	17
King George's Sound and Beverley, soil between - -	89
Koojan agricultural area	190,192
near Newcastle - -	87
Labor, difficulty of obtaining -	53
„ native, on farms - -	69
Land, Arthur river - -	102
„ available for settlement, York - -	55
Land available for wheat, utilization of - -	122
Land bank - -	136
Land, clearing and treatment -	141
„ cost of clearing forest -	52
„ good, Eastern areas -	71
„ grants, resumption of Great Southern - -	93
Land in Great Southern district	89
„ Great Southern line, classification - -	124
Land, Greenhills, cost of -	51
„ Hay river, eligible -	129
Lands office, plans - -	69
Land open for selection at Gordon river - -	126
Land open for selection, Southern district - -	136
Lands, poison, necessity for fencing - -	52
Land, poison, provisions, etc. -	75
„ policy, Midland railway company - -	174
Land policy of Great Southern railway company - -	91
Land, rich, in Yilgarn district -	73
„ settlement on Midland railway - -	175
Land on shares principle -	85
„ Swan district - -	164
„ timber as index to -	90
„ under crop at Wagin -	99
„ Vasse - -	36
„ warning against exhaustng.	51
Leases, pastoral, rent of -	71
Lemon orchards, irrigation for, „ at the Williams - -	108
Light soils, fertilisers for -	51
Lime, value of, for vine - -	9
Limestone formation - -	5
Limits of safe cultivation -	66
Lotting spring - -	74
Lowlands, figs at - -	10,19
Lucerne at Bunbury - -	32
„ congenial place for -	10
„ Fremantle - -	11

	PAGE.
Lunatic Asylum, Whitby Falls -	18
Maize cultivation at Bunbury -	32
Mandurah, figs at - -	9
,, vegetables on coast -	11
Manna gum - -	49
Market for poultry - -	57
,, for produce on Swan -	167
,, gardens - -	13,14
Marradong brook country -	106
Marradong-Pinjarrah railway -	104
Marradong valley - -	108
Meckering agricultural area -	63
,, water supply -	68
Merredin water supply - -	68
Meckering, yield at - -	64
Midland district - -	173
,, ,, average yields -	187
,, ,, cattle - -	179
,, ,, climate - -	189
,, ,, country characteristics - -	190
Midland district, dairying -	180
,, ,, feed in - -	186
,, ,, pastoralists -	181
,, ,, pests - -	185
,, ,, rainfall - -	197
,, ,, rate of wages -	187
,, ,, roads - -	183
,, ,, seasons - -	188
,, ,, settlers - -	196
,, ,, timber country -	187
Midland railway - -	81,173
,, ,, Company and its land policy - -	174
Midland railway and settlement	175
,, ,, suggested purchase of - -	174
Millar Bros. and Torbay karri -	94
Mission station, New Norcia -	193
Mixed farming at Williams -	113
Model farm, site - -	121
Mokine, farming at - -	107
Morrell gum at York - -	47
Moulin, country at - -	74
Mount Barker country - -	128
Mountains of South-west -	4
Mooranoppin, desert near -	72
,, rainfall in 1895 -	65
Moorumbine area - -	95
Mueller, Baron V., floral wreath of colony - -	58
Mullewa agricultural area -	196
Municipal taxes, absence of -	59
Myrup agricultural area -	151
Narrogin agricultural area -	95
Natives as farm servants -	69

	PAGE.
Native vermin round York -	58
Necessity for fencing poison lands - -	52
Nelson district, land and crops -	42
,, ,, native pests -	42
,, ,, notes on -	41
,, ,, poison in -	42
,, ,, timber in -	43
New Norcia, cultivation at -	194
,, ,, mission - -	193
,, ,, olive oil manufactured at - -	194
New settlers, information for -	50
Newcastle - -	78
,, annual rainfall -	86
,, climate and soil -	81
,, Coondle estate -	79,80
,, crop values at -	83
,, facilities for irrigation near - -	87
Newcastle, Norman estate -	79,80
,, settlement at - -	78
,, soil of district -	86
Nonga agricultural area -	196
Northam - -	62,77
Notes on agricultural areas -	95
,, on poison lands, explanatory - -	75
Olive oil, manufacture, New Norcia - -	194
Openings for agriculturists in Southern district - -	89
Opportunities in Southern district - -	138
Orange, orchards at Newcastle, irrigating - -	87
Orchard area in Southern district - -	132
Orchard at Canning - -	14
,, country at the Williams	109
Orchards, Gingin - -	176
Orchard, orange and lemon, nr. Newcastle, irrigation for -	87
Orchard, prospect in York district - -	57
Orchards on the Swan - -	157
Pallinup agricultural area -	95
Pastoral leases, payment for improvements - -	71
Pastoral leases, rent of - -	71
Pastoralists in Midland district	181
Pasturage, Eucla district	202,203
Pastures at Gingin - -	177
Patterson estate, Creaton -	20
Pests of Midland district -	185
,, in Nelson district, native -	42
,, and poisonous vegetation -	132

PAGE.
Pests in Swan district - - 169
„ in Williams district - 110
Physical geography, Eucla district - - 202
Physical geography, Southern district - - 93
Pingelly and wheat growing advantages - - 98
Pinjarrah - - 30
Pinjarrah-Marradong railway - 104
Plains, the Victoria - - 192
Plans at Land office - - 69
Poison lands, provisions, etc. - 75
„ land, necessity for fencing 52
„ in Nelson district - 42
„ plants - - 132
„ at Williams - - 111
Policy of Government - - 60
„ of Midland railway co. - 174
„ of Great Southern railway company, land - - 91
Potatoes at Bunbury, yield of - 30
„ in Southern district - 139
Poultry farming, Southern dist. 140
„ market for - - 57
„ in York district, raising 57
Preston agricultural area - 40
Produce, market for - - 167
Prices obtained for crops at Newcastle - - 83
Produce in Southern district, competition for - - 131
Produce suitable for cultivation at Esperance - - 151
Proposed Italian colony - - 191
Productions of Southern district 143
Prospect before farmers - 50
Progress of farming industry - 60
„ „ at the Williams 112
Promoters of Gt. Southern rlwy. 90
Prospects of Eucla, wheat - 204
Propect for fruit growers, York 56
Provision for poison areas - 75
Purchase of Gt. Southern rlwy. 91
„ of Midland railway 174

Qualing rocks - - 74
Quandinning common - - 107
Quelquelling, yield at - - 64

Railway, Donnybrook to Bridgetown - - 38
Railway facilities at Esperance 150
„ Great Southern - 88
„ from Pinjarrah to Marradong - - 104
Railway, the Midland - - 81
„ purchase of Gt. Sthrn. 91
Rainfall at Bunbury - - 30

PAGE.
Rainfall at Dangin - - 75
„ at Esperance - - 152
„ Midland district - 197
„ at Mooranoppin (1895) 65
„ at Newcastle - - 86
„ Southern district - 137
„ of South-west - - 4
„ Southern Cross (1895) 65
„ in Swan district - 170
„ of Williams district - 109
„ at York - - 49
Raising poultry in York district 57
Raspberryjam wood for fencing 48
Range, Darling - - 4
„ Roe - - 4
Rate of wages, Midland district 187
Rates and taxes, absence of - 59
Roads and bridges, estimates for 59
Rent, pastoral leases - - 71
Reserve, the Toodyay - - 80
Resumption of Great Southern land grants - - 93
Requisites for new settlers - 140
Rich land in Yilgarn district - 73
Ring-barking beneficial - - 177
„ value of - - 49,102
River, farms at Hotham - - 106
„ land on Beaufort - - 102
„ land on Arthur - - 102
„ the Salt - - 74
„ of South-western district - 4
Roads in Midland district - 183
„ in Southern district - 129
„ in Swan district - - 166
Roe range - - 4

Safe cultivation, limits of - 66
Salmon gum country at Yilgarn 70
„ „ „ at York - 47
Salt river - - 74
Schools, Southern district - 130
Seasons in Midland district - 188
Serpentine, Lowlands estate - 19
Servants, natives as - - 69
Selections at Esperance - 152
Selection of land, Gordon river - 126
„ in Southern district, land available - - 136
Settlement on Midland Railway grants - - 175
Settlement at Newcastle, agricl. 78
„ in Southern district 130,140
„ capital required for - 130
Settlement at York, estates retarding - - 55
Settlement at York, land available - - 55
Settler, advice to prospective - 7
Settlers assisted at Katanning - 119

PAGE.

Settler's capital required for Swan district - - 166
Settler and the Govt. policy - 60
Settlers' guidance, suggestions for 142
„ information for the guidance of - - 50
Settlers in Katanning district, hints for - - 120
Settlers near Katanning - 123
„ in Midland district - 196
„ requisites for new - 140
„ success, factors for - 69
„ at Wagin, advantages for 100
Shares principle, lands farmed on 85
Shepherds, natives as - - 69
Show at York, annual - - 84
Silver grass - - 85
Sir John Forrest and the Bridgetown railway - - 38
Soil in Albany district - - 94
„ between Beverley and King George's Sound - - 89
Soil of Canning hills - - 16
„ character, Southern district 134
„ characteristics of Esperance 149
„ fertilisers for light - - 51
„ at Gingin - - 177
„ of Greenough - - 195
„ of the Harvey - - 25
Soils at Katanning, classification 100
Soil of Mount Barker district - 128
„ of Newcastle district - 81,86
„ of South-western district - 6,7
„ etc., Torbay - - 128
„ at Wagin - - 99
Soils at Wagin, classification - 100
Soil of Western Australia, Sir F. A. Weld on - - 16,17
Soil on Yilgarn railway route - 67
Sorghum at Bunbury - - 32
South-western district - - 3
„ „ drainage - 23
„ „ mountains 4
„ „ rainfall of 4
„ „ rivers of - 4
„ „ soil of - 6,7
„ „ yeoman of 27
Southern Cross, rainfall in 1895 65
„ district - - 88
„ „ advantages - 137
„ „ agricultural areas 130
„ „ amount of settlement - - 130
Southern district, arable land - 133
„ „ characteristics of soil - - 88
Southern district, best crops for 131
„ „ climate - 93

PAGE.

Southern District and close settlement - - 140
Southern district, land open for selection - - 136
Southern district, openings for agriculturists - - 89
Southern district, opportunities 138
„ „ orchard area 132
„ „ physical geography - - 93
Southern district, potato crops - 139
„ „ poultry farming 140
„ „ produce, competition for - - 131
Southern district, productions of 143
„ „ rainfall - 137
„ „ roads- - 129
„ „ schools in - 130
„ „ capital reqrd. 130
„ „ soil - - 134
„ „ timbers of - 89
„ „ vineyrds. area 132
„ „ water supply 89,133
„ „ yields in - 136
„ railway, Great - 88
Sowing early necessary - 66
Spring, the Lotting - - 74
Statistics of Williams district - 108
Stirling and the Harvey, Govr. 24
Stock, country for, Esperance - 151
„ in Midland district - 185
„ raising - - 137
„ „ in Yilgarn district 73
Suburban blocks, Broomehill - 125
Successful cultivation - - 66
Suggestions for guidance of new settlers - - 142
Suitability of Eastern country for vines - - 70
Summary Toodyay advantages 82
Supply of water, Southern district 89
„ water, question of - 70
Swan district - - 155
„ „ advantages - 170
„ „ arable land - 169
„ artesian water at - - 165
„ clearing at - - 172
„ climate of district - - 182
„ dist., co-operative wineries 158
„ crops suitable for - - 167
„ dairying at the - - 171
„ district, estates in - 163
„ „ fruits grown in - 170
„ „ land in - - 164
„ „ orchards in - 157
„ „ pests in - - 169
„ rainfall in district - 170
„ roads - - 166

	PAGE.
Swan water supply - -	170
„ wheat yield at - -	156
„ wine making on - -	158
Swing gate at Goblup - -	120
Tambellup - -	127
Tammin agricultural area -	63,70
„ water supply at -	68
Taxes, absence of - -	59
Tenterden agricultural area -	97,127
Timber at Badjelling, heavy -	75
„ in Blackwood district -	37
„ at Cubbine, heavy -	75
„ at Dangin, heavy -	75
„ at Dorakin, heavy -	75
Torbay and karri forest -	94
Timber, Deep river - -	199
„ an index of land -	90
Timbers of Midland district -	187
Timber in Nelson district -	43
„ in Southern district -	89
„ at Toapin, heavy -	75
Torbay, soil, etc. - -	128
Treatment of land - -	141
Toapin rocks - -	72
„ timber heavy at -	75
Toodyay district - -	78
„ reserve - -	80
„ summary of advantages	82
„ white gum country -	87
Tweed agricultural area -	41
Uduc agricultural area -	27
Utilization of wheat lands -	122
Valley of the Marradong -	108
Valuable soil, York - -	87
Values of crops, Newcastle -	83
Value of forest land - -	51
„ of ring-barking -	19,102
„ for wheat growing, Southern district land - -	94
Value of crops at York -	51
Vasse, the - -	35
„ coal deposits near -	37
„ land and climate -	36
Vegetables in coast country -	11,12,13
Vegetables, suitability of Eastern country - -	70
Vermin pests at Bunbury -	33
„ in York district -	58
Victoria : a comparison with Western Australia - -	65
Victoria Plains - -	192
Vine, limestone for - -	9
Vines : suitability of Eastern country - -	70
Vineyards area, Southern district	132
Wages, Midland district -	187

	PAGE.
Wagin agricultural area -	96
„ classification of soils -	100
„ Lake country - -	117
„ „ farming at -	98
„ and fruit - -	99
„ land under crops -	99
„ soil, character of -	99
„ and prospects for settlers	100
Wando gum : a danger signal	48
Warning against land exhaustn.	51
Water conservation at Cunderdin	68
„ „ Grass Valley	68
„ „ Meckering -	68
„ „ Meredin -	68
„ „ Tammin -	68
„ „ Yilgarn line	68
„ in Southern district -	133
„ supply, artesian, Swan -	165
„ „ Eucla - -	201
„ „ Greenough -	195
„ „ question - -	76
„ „ in Southern dist.	89
„ „ at the Swan -	170
„ „ at the Williams -	114
Weed, Cape - -	85
Weeranooka agricultural area -	196
Western Australia : floral wealth	58
Western Australian wine -	159
Wheat crops along Great Southern railway - -	94
Wheat growing, Eucla - -	204
„ lands, utilization of -	122
„ growing at Pingelly, advantages for - -	98
Wheat yields at Boranning -	107
„ yield on the Swan flats -	156
„ „ at Wagga - -	68
Whitby Falls - -	18
Whitegum country, Toodyay -	87
Wickepin agricultural area -	95
Wild dog pest in Bunbury dist.	33
Williams, best crops for -	113
„ district - -	104
„ cost of clearing -	15
„ land at -	108
„ and mixed farming -	113
„ district as orchard country - -	109
Williams district, pests of -	110
„ „ and poison -	111
„ progress of farming -	112
„ rainfall at - -	109
„ district, statistics -	108
„ river flats - -	107
„ water supply - -	114
Wine of Western Australia -	159
„ making on the Swan -	158
Woodbridge estate -	160

PAGE.

Wongong, artificial grasses 18

Yatheroo - - 179

,, cattle - - 179

Yeomen of South-west - - 21

Yields, Greenhills - - 64

,, at Meckering - - 64

,, Midland district, averages 187

,, Quelquelling - - 64

,, in Southern district - 136

,, of potatoes, Bunbury - 30

,, of wheat, Boranning - 107

,, ,, in Southern dist. 94

,, ,, Swan - - 156

Yilgarn, rich land in district - 73

,, route, soil - - 67

,, salmon gum country - 70

,, stock raising in district 73

,, route, water conservatn. 68

York, bees at - - 57

PAGE

York dairying - - 56

,, district - - 46

,, adaptability for fruit-growing - - 49

York annual show - - 84

,, area and capital required- 50

,, average rainfall - - 49

,, crop values - - 51

,, drawback of district - 52

,, estates retarding settlmnt. 65

,, fruit grown at - - 50,56

York–Greenhills line - – 54

York gum - - 47

York, labor scarce at - - 53

,, native vermin in district - 58

,, poultry raising - - 57

,, scarcity of available land- 55

,, value of crops - - 51

Youngedin, rich land - - 73

PART II.

INDEX.

	PAGE.
Accident cases - -	363
Antidotes to poisons - -	361
Arrangements of flower garden	336
Artificial respiration - -	362
Asthma - -	367
Axle grease, to make - -	369
Balancing accounts for the year	360
Barometer for farmers -	306
" how to read -	312
Barrows, capacity of - -	370
Beer, hop, to make - -	378
Beeswax, to prepare - -	369
Bird skins, curing - -	372
Bite, snake - -	363
Blacking - -	369
Book-keeping - -	342
Boot blacking - -	369
Botanical names of trees -	214
Boundary fencing - -	235
Breaking up new land -	258
Bruises - -	363
Building necessaries, quotations	305
Burning off - -	230
" out trees - -	227
Burns - -	363
Bush Fires Act - -	232
" strainer for fencing -	238
Calendar for vegetable garden	337
Capacity of barrows - -	370
" of carts - -	370
" of pumps - -	384
Capacities of windmills and reservoir - -	254
Carts, capacities of - -	370
Cases of accident - -	363
Case of drowning - -	362
Cattle, killing - -	375
" weight by measurement	391
Cement, diamond - -	372
" for mending - -	372
" for waterproof -	372
Chaff cutting - -	285
Change of seed - -	371
Clearing - -	224
" by explosives - -	228
" by traction engines -	229
" contract form -	225
" trees - -	227

	PAGE.
Clod crushers - -	270
Clouds and wind - -	309
Colic, or gripes - -	368
Comparative evaporative power of soils - -	372
Concrete - -	371
" tar - -	371
Constipation - -	368
Construction of gate - -	242
Contract form for clearing -	225
Convulsions - -	368
Cool house - -	298
Corns and warts, to remove -	384
Cow house, details - -	300
" easy device for leading -	370
Cream, furniture - -	374
Cross fertilization - -	371
Croup - -	367
Cultivation - -	258
" of flower seeds -	335
" of vegetables -	321
Cultivators - -	276
Curing bird skins - -	372
Diary for settlers - -	226
Dams, excavating - -	252
Day book - -	344
Details, cowhouse - -	300
" farm buildings -	300
" roofs - -	301
Device for leading a cow -	370
" for pickling - -	293
Diamond cement - -	372
Diarrhœa - -	368
Digging - -	373
" plough - -	260
Dimensions - -	300
Disinfectants - -	368
Dislocations - -	364
Dogs and dingoes, poisoning -	383
Drain, box - -	249
" surface - -	249
" table of depths -	248
" tile - -	249
Dressed cattle, weight of -	377
Dropper fence, sheep proof -	235
Drowning case, how to treat -	362
Dumoulin's liquid glue -	373
Dynamometer tests - -	267

	PAGE.
Ear, foreign bodies in - -	365
Easily made oven - -	210
Eggs, pickling - -	381
Elementary substances -	374
Emetics - -	362
Engine, judging an - -	383
Erecting fences - -	238
Evaporative power of soils -	372
Excavating dams - -	252
Excavation - -	373
Explosives for clearing -	228
Eyes, sore - -	366
Fallowing - -	275
Farmers, book-keeping for -	343
Farm buildings - -	296
„ hands, wages - -	255
„ laborer - -	255
„ roller - -	275
„ water supply - -	251
Feeding down - -	292
Fence, dropper, sheep proof -	235
„ how to erect - -	238
„ opossum proof -	240
„ specification for -	24c
„ vermin proof - -	240
Fencing - -	234
„ materials, prices -	247
„ timber used for -	234
„ with wires - -	235
Fly papers - -	374
Fertilization, cross - -	371
Fever, typhoid - -	366
Flower seeds and cultivation -	335
„ garden arrangement -	336
„ „ management -	337
„ seeds, sowing -	336
Forest devil - -	228
Fractures, bandages for -	363
Fractures of limbs - -	364
Furniture cream - -	374
Garden calendar - -	321
Gardening implements -	317
Gates, how to construct -	241
Gate, swing - -	244
Gates, whitewash for - -	243
Glue, liquid - -	373
Good swing gate - -	244
Grain harvesting - -	286
„ „ machinery -	287
„ phosphorised - -	383
Grease, axle, to make - -	369
Grease and paint from cloth, to remove - -	369
Gripes, or colic - -	368
Grubbing tools - -	211
Hard soda soap - -	385
Harness dressing - -	375
„ plough - -	266
Harrow, the cutaway - -	270
„ good spading -	270

	PAGE.
Harrowing - -	274
Harvesting hay - -	283
„ operations - -	279
Hay harvesting - -	283
„ rakes - -	283
„ stack - -	284
„ stack, to measure -	377
„ treatment of - -	284
Hemorrhage - -	363
„ from lungs -	363
„ from stomach -	363
Hints on ploughing - -	266
„ on vegetable growing -	315
Home-made soap - -	384
Home for settler, how to build it	296
Hop beer, to make - -	378
Horses, draught of - -	390
„ tractive force -	389
Horse power - -	286
House for settler - -	210
How to avoid typhoid - -	367
How to build a home - -	296
How to erect a fence - -	238
How to hang paper - -	303
How to keep the ledger -	352
How to make a leveller -	263
How to read the barometer -	322
How to read, the thermometer	313
Implements for gardening -	317
Implements for gardening -	317
„ for spraying -	318
Insensibility - - -	366
Indigestion - - -	368
Instructions to meteorological observers - - -	361
Journal - - -	345
Judging an engine - -	383
Kangaroo skins, tanning -	388
Killing quiet cattle - -	375
Kitchen garden - -	315
Labor book - - -	360
„ branch, bureau - -	255
Laborer, the farm - -	255
Land leveller, serviceable -	263
„ measuring - -	264
Ledger, how to keep - -	352
Leveller, how to make -	263
Levelling - - -	378
Levelling land before ploughing	263
Limbs, fractures of - -	364
Live and dressed weight of cattle	377
Liquid glue - - -	373
Lungs, hemorrhage - -	363
Machinery for grain harvest -	287
Making hop beer - -	378
Masters and Servants Act -	256
Management of flower garden-	337
Measuring a hay stack -	377
„ land - -	264
Medical and surgical hints -	361

PAGE.

Mending, cement for - 372
Mensuration - - 378
Meteorological Observers, instructions - - 311
Meteorological phenomena - 313
Meteorology - - 306
Method of stoving roots - 229
Miscellaneous - - 379
Moisture in the soil - - 276
Monthly calendar for vegetables 337
Mortar - - 380
Nipples, sore - - 365
Nostrils, foreign bodies in - 365
Observers, meteorological, instructions - - 311
Opossum proof fence - - 240
Oven, easily made - - 210
Outfit for selectors - - 209
Pain - - 368
Paint, base for - - 302
„ from cloth, to remove - 369
Paints - - 381
„ recipes - - 301
Paper-hanging, paste for - 375
„ tools for - 302
Paper, how to hang - - 303
Paste for paper-hanging - 375
Pavement, concrete - - 389
„ tar - - 388
Percentage of elementary substances - - 374
Phosphorised grain - - 383
„ pollard - 384
Pickle for seed - - 293
Pickling, device for - - 293
„ eggs - - 381
„ seed - - 292
Piles - - 366
Plants per acre - - 295
Plough harness - - 266
Ploughing, hints on - 266
Ploughs - - 260
Poisons and antidotes - 361
Poisoning wild dogs - 383
Pollard, phosphorised - 384
Post and rail fence - - 236
Polish, stove - - 388
Preparing beeswax - - 369
Prices for fencing materials - 247
Prices for wire netting - 247
Pumps - - 253
„ capacity of - - 384
Putty - - 387
Quantity of seed per acre - 295
Quotations for building necessaries - - 305
Rain gauge - - 309
Reaping machinery - - 281
Recipes for paints - - 301
„ sickness - - 362

PAGE.

Reservoirs, capacities - - 254
Respiration, artificial - - 362
Retention of urine - - 365
Ringbarking - 214-223
Roller, useful farm - - 275
Roofs, details - - 301
Rough base for paint - - 302
Seed, change of - - 371
„ per acre, quantity - 295
Seeds, flower, and their cultivation - - 335
Seed, pickle for - - 293
„ pickling - - 292
„ sowers - - 272
Selector's outfit - - 209
Serviceable leveller - - 263
Setting the thermometer - 313
Settler's diary - - 226
„ home - - 201
Sheep proof fence - - 235
Soap, hard soda - - 385
„ home made - - 384
Soldering - - 386
Soils, evaporative power - 372
Soil, moisture retained by - 276
Sore eyes - - 366
„ nipples - - 365
„ throat - - 368
Smut, pickling to prevent - 292
Stove polish - - 388
Stoving stumps - - 229
Stretching wire netting - 241
Stripping grain - - 287
Stump-jump plough - - 227
Sub-soiling with the plough - 268
Suitable land for vegetables - 316
Swing gate - - 244
Snake bite - - 363
Sowing flower seeds - - 336
„ seed - - 272
Spading harrow - - 270
Specific gravities - - 398
Specification for fence - - 239
Sprains - - 365
Spraying implements - - 318
Stacking hay - - 284
„ wheat - - 290
Staining wood - - 382
Stomach, hemorrhage - - 363
Storing grain - - 291
Table of depths for drains - 248
Tanks, dams and wells - 251
Tanning kangaroo skins - 388
Tar concrete - - 371
Thermometer for farmers - 307
Thermometers, how to read - 313
Thermometers, setting - 313
Throat, foreign bodies in - 365
Timber for fences - - 234
To avoid typhoid - - 367

PAGE.

Tools for building - - 212
„ for grubbing - - 211
„ for paperhanging - 302
Traction engine and clearing - 229
Tractive force of horses - 389
Treatment of hay - - 284
Trees, clearing - - 227
Trees, common and botanical names - - 214
Tree puller - - - 228
Typhoid fever - - 366
„ to avoid - - 367
Unusual meterological phenomena - - - 313
Urine, retention of - - 365
Valuation book - - 357
Vegetables, cultivation of - 321
Vegetable growing, hints on - 315
Vegetables, suitable land for - 316
Vermin proof fences - - 240
Vinegar - - 391
Vomiting - - 368
Wages for farm hands - - 255
Waggon jack - - 391
Wall papering - - 302

PAGE.

Warts and corns, to remove - 384
Washington whitewash for gates - - 243
Waterproof cement - - 372
Water supply on the farm - 251
Weight of cattle by measurement 391
„ live and dressed cattle 377
Weights and measures - - 393
Wheat, stripping - - 287
„ stacking - - 290
Whipple trees - - 265
White-wash for gates - - 243
Whitlow - - 365
Wind and clouds - - 309
Windmills - - - 253
Windmills, capacity of - 254
Winnowing - - 289
Wire for fencing - - 235
„ netting, how to stretch - 241
„ „ prices - - 247
Wire strainers - - 238
Wood stains - - 382
Wounds - - 363
Yeast - - 392
„ cakes - - 392

PART III.

INDEX.

	PAGE.
African purslane - -	488
Agrostis alba - -	529
„ vulgaris - -	526
Agrostocrinum stypandroides	589, 590
Alexandrine clover - -	476
Alfalfa - -	459
Alfilaria -	444
Alfilarilla - -	444
Allionia incarnata - -	432
Alopecurus pratensis -	526
Alpine clover - -	476
Alsace clover - -	477
Alsike clover - -	477
Alsyke - -	531
Amaranthus - -	432
Anagallis arvensis - -	554
„ coerulans - -	554
Andropogon bombycinus -	405
Annual cat's ear - -	551
Anthisitiria avenacea -	405
„ ciliata - -	405
„ membranacea -	409
Anthoxanthum odoratum -	529
Anthyllis vulneraria - -	432
Apios tuberosa - -	432
Apple of Sodom - -	559
Arabian snail clover -	459
Arachis hypogœa - -	433
Area suited for potato cultivation	510
Argemone Mexicana -	535
Arrow grass - -	483
Artichoke - -	449
Artichokes, Jerusalem -	494
Articum majus - -	543
„ minus - -	543
Artificial pasturage - -	524
Asparset - -	462
Astragalus - -	434
Astrebla pectinata - -	409
Atriplex canescens - -	435
„ cinerea - -	421
„ confertifolium -	436
„ halimoides - -	421
„ hortensis - -	539
„ semibaccata -	423
„ stipitata - -	423
„ vesicaria - -	423
Australian fodder plant for arid land - - -	488
Australian millett - -	414
Avena elatior - -	527
Banana field pea - -	444
„ stock pea - -	444
Bastard alkanet - -	559
„ clover - -	477
Bathurst burr - -	554
Beans - -	496

	PAGE.
Bear grass - -	485
Beckwith's clover - -	476
Beggar weed - -	442
Bell fountain - -	471
Beet, manures for - -	504
„ preparation of seeds -	504
„ preparation of soil -	504
„ ripening - -	506
„ seeds, germination of -	504
„ sowing - -	505
„ stacking - -	506
„ sugar - -	502
Bermuda grass - -	526
Berry poison - -	580
Bersine clover - -	476
Bigweed - -	432
Birdsfoot trefoil - -	531
Bird vetch - -	485
Bitter vetch - -	452
Black-berried nightshade -	559
Black currant - -	559
„ medick -	458, 530
Bladder clover - -	476
Blessed thistle - -	544
Blind poison - -	588
Bloom poison - -	582
Blue flowering thorn apple -	556
„ poison - -	590
Bœhmeria nivea - -	436
Bokhara clover - -	531
Bourgoyne - -	462
Box poison - -	581
„ „ experiments -	591
Brabant, sugar beet, green top -	503
Brassica nupus - -	436
„ oleracea - -	438
Broad bean - -	446
„ clover - -	531
„ leaved plaintain -	554
„ winged saltbush -	426
Broom corn - -	500
„ poison bush - -	579
Bromus unioloides - -	526
Brown clover -	476, 481
Buckhorn clover - -	483
Buckwheat -	446, 495
Buffalo clover - -	482
„ pea - -	434
Burr clover -	541, 457, 459
Burr medick - -	541
Burweed - -	553
Butterweed - -	444
Cabbage - -	438
California clover - -	459
Canada field pea - -	467
Candyup poison - -	589
Cape cotton - -	554

PAGE.
Cape dandelion - - 548
„ weed - 548
Caper spurge - 538
Capsella bursa pastoris - 537
Carex retrorsa - - 438
Carduus arvensis - - 544
„ lanceolatus - - 544
„ marianus - - 544
„ pycnocephalus - 544
Carnation clover - - 478
Carob bean - - 439
„ tree - 439
Carolina clover - 476
Carrots - - 493
Carthamus lanatus - 551
Cassava - - 456
Cat clover - - 476
Cat's milk - - 538
Catchfly - - 539
Castor oil plant - - 538
Centaurea calcitrapa - 545
Centaurea melitensis - 546
„ solstitialis - 547
Centrosema virginianum - 439
Cerastium vulgatum - 539
Ceratonia siliqua - - 439
Cheeses - - 537
Chenopodium - - 439
„ album - 539
„ ambroscoides - 540
„ murale - 540
Cherry bean - - 485
Chestnut brown clover - 476
Chewing's fescue - - 529
Chick pea - - 439
„ weed - - 539
Chicken vetch - - 485
Chicory - 439, 499
Children's clock - - 553
China grass plant - - 436
Chinese vetch - - 485
Chinese yam - 444
Chufas - - 440
Cicer arietinum - - 439
Cichorium endivium - 439
„ intybus - - 439
Clot burr - - 553
Cloth plant - - 436
Clover trefoil - - 479
Coastal saltbush - - 428
Cockle burr - - 553
Cock's foot - - 528
„ head - - 442
Cockspur thistle - - 546
Coffee bean - - 447
„ pea - - 439
Comfrey - - 474
Common buckwheat - 446
„ field bean - - 446
„ fumitory - - 535
„ groundsel - - 552

PAGE.
Common kidney vetch - 432
„ melilot - - 461
„ sow thistle - 552
Convolvulus edulis 439
Corn gromwell - 559
„ spurry - 539
Couch grass - - 526
Cow clover - - 479
„ grass - 479, 531
„ horn - - 483
„ pea - 485
Crab - - 540
Cranesbill - - 444
Creeping bent - - 529
„ burr - - 541
„ fescue - - 528
„ trifolium - - 482
Crested dogstail - - 525
Crimson clover - 478
Crotalaria juncea - - 440
Cryptostemma calendulacea - 548
Cultivation of rape - - 506
Cynodon dactylon - - 526
Cynosurus cristatus - - 525
Cultivation of tobacco - 517
Culture tobacco, field - 519
Curing tobacco - - 522
Cuscuta trifolii - - 556
Cyperus esculentus - - 440
„ strigosus - - 441
Cytisus proliferus albus - 441
Dactylis glomerata - - 528
Dakota millet - - 497
Dandelion - 475, 553
Danthonia seminnualaris - 409
Dasylirion texanum - - 442
Datura stramonium - - 556
„ tatula - - 556
Deerweed - - 450
Desert poison - - 578
Desmodium tortuosum - 442
Desmodium triflorum - 443
Destruction of weeds necessary 533
Devil's apple - - 556
„ fig - - 535
„ trumpet - - 556
Dhoura - - - 497
Dioscorea batatas - - 444
Distributing agencies, weed - 535
Ditch burr - - 553
Dodder - - 556
Dolichos multiflorus - - 444
Dooryard grass - - 467
Double-gee - - 540
Drooping yellow-flowered wood sorrel - - 537
Duckweed - - 467
Dutch clover - - 482
Dwarf Essex rape - - 436
Early amber cane - - 497
Early clover - 479, 480

	PAGE.
Early red skin sugar beet -	503
Earth nut - -	433
Effect of poison plants on stock	583
Eglantine - -	543
Egyptian clover -	476, 478, 531
Egyptian corn - -	497
Egyptian millet - -	499
Elegant clover - -	477
Elliott's sida - -	473
Emex Australis - -	540
Encephalartos Fraserii -	587
Endive - -	439
Erigeron canadensis - -	444
Eradication of poison plants -	584
Erodium cicutarium - -	444
„ moschatum -	444
Ervum lens - -	445
Esparcette -	462, 498
Euchlæna Mexicana - -	497
Euphorbia helioscopia -	538
Euphorbia lathyris - -	538
„ peptus - -	538
Eurotia lanata - -	445
Evergreen millet - -	497
Everlasting pea - -	452
Experiments with box poison -	591
Fagopyrum esculentum -	446
Farm, special products of -	492
Fat hen - -	539
Fava vulgaris - -	446
Feed, saltbush good for -	419
Feeding rape, precautions necessary in - -	509
Fenugreek - -	483
Fertiliser for rape - -	509
Festuca duriuscula -	525, 529
„ elatior - -	526
„ heterophylla -	528
„ ovina - -	527
„ pratensis - -	528
„ rubra - -	529
Field cabbage - -	500
„ clover -	475, 476
„ culture, tobacco -	519
„ pea -	467, 485, 496
„ trifolium - -	476
Filaree - -	444
Filaria - -	444
Fiorin - -	529
Fireweed - -	444
Flax - -	499
Florida beggar weed -	442
„ clover -	442, 471
Fodder and forage plants -	432
„ plant for arid land -	488
„ grasses - -	402
Forage, weeds in - -	535
Foreign poison plants -	564
Fox clover - -	483
Franseria dumosa - -	446
French clover - -	478
French honeysuckle -	449
„ sugar beet - -	503
Fumaria officinalis - -	535
Furze -	483, 543
Gaffron thistle - -	551
Galactia glabella - -	446
„ pilosa - -	446
Galega officinalis - -	446
Galinsoga parviflora - -	550
Garden orache - -	539
Gastrolobium bilobum -	577
„ callistachys -	577
„ calycinum -	578
„ grandiflorum -	578
„ ovalifolium	579, 582
„ oxylobioides -	579
„ spinosum -	580
Genista scoparia - -	447
German clover - -	478
German mammoth clover -	478
Germination of beet seeds -	504
Giant burdock - -	543
„ knotweed - -	468
„ spurrey -	474, 498
„ white clover - -	477
Gilybum marianum - -	544
Glasswort - -	472
Gleditschia triacanthos -	447
Glycine hispida - -	447
Goat's clover - -	446
„ horn - -	483
„ rue - -	446
Gold colored clover - -	475
Golden clover - -	475
Gomphocarpus fruticosus -	554
Goober - -	433
Goosefoot - -	439
Gorse -	483, 543
Gram - -	439
Graphalium luteo-album -	549
Grass, laying down land to -	524
„ seeds, sowing - -	524
Grasses, fodder - -	402
„ undesirable - -	402
„ Western Australian -	402
Grey winter pea - -	467
Greaswood - -	472
Greek hay - -	483
Green top Brabant sugar beet -	503
Grey clover - -	476
Grey salt bush - -	421
Ground almond - -	440
Ground nut - -	432
Growth of rape - -	507
Guildford grass - -	563
Gunaninpil - -	432
Hair clover - -	476
Hairy vetch - -	485
Half berried salt bush -	423
Halimus-like saltbush -	423
Hard clover - -	476

	PAGE.
Hard fescue -	525
Hare clover - -	476
Hare's little paw - -	476
Haresfoot clover - -	476
Hart's clover -	461
Harvesting tobacco - -	521
Heart clover - -	459
„ leaved poison -	577
Hedge nettle - -	559
Hedysarum coronarium -	449
„ onobrychis -	498
Helianthus annuus - -	449
„ tuberosus -	449
Hemp - -	501
Heraldic Scotch thistle -	551
Hippocrepis comosa -	450
Hoffmanseggia - -	450
Hognut - -	440
Holcus lanatus - -	526
Holy thistle - -	544
Homeria lineata - -	561
Honeysuckle -	449, 482
„ clover -	482
„ grass -	482
Honey locust - -	447
Hop clover	458, 475, 481, 530
„ trefoil - -	481
Horse bean - -	446
„ shoe vetch - -	450
„ weed - -	444
Hosackia glabra - -	450
„ purshiana -	451
Hungarian clover - -	479
Hybrid clover -	477, 531
Hypochoeris glabra -	551
Indian corn - -	494
Indigenous grasses - -	403
Ink plant - -	541
Inula graveolens - -	551
Ipecac weed - -	471
Iron weed - -	540
Italian clover - -	478
„ rye grass - -	527
„ scarlet clover - -	531
Japan clover -	452, 531
Japanese buckwheat - -	446
Jelly leaf - -	537
Jersey cudweed - -	549
Jerusalem artichokes - -	494
Jerusalem corn - -	498
Johnson grass - -	497
Jointed sharlock - -	537
June clover - -	480
Kaffir branching corn -	497
Kale, thousand headed -	500
Kangaroo grass - -	405
Kentrophyllum lanatum -	551
Kentucky blue grass - -	527
Kidney fruited salt-bush -	423
„ vetch - -	432
King's clover - -	461
Kitten plant - -	476
Klein-Wanzleben sugar beet -	503
Knot grass - -	540
„ weed -	467, 540
Kochia planifolia - -	426
„ villosa - -	426
Kohl rabi - -	493
Lady's fingers - -	432
Lamb's quarters - -	439
„ tail - -	476
Landsborough grass - -	409
Land suitable for potato cultivation -	511
Land to grass, laying down -	524
Lantana - -	560
„ camera - -	56c
Large American clover -	479
„ clover - -	479
„ golden clover - -	475
Late fruited sedge - -	438
Lathyrus cicer - -	451
„ macrorhizos -	452
„ polymorphus -	452
„ sativus - -	452
„ splendens - -	452
„ sylvestris wagneri -	499
„ hirsutus - -	452
Laying down land to grass -	524
Leafy prairie clover. -	467
Lentil - -	445
„ vetch - -	485
Lespedeza striata -	452, 531
Lesser clover - -	481
Linseed - -	499
List of foreign poison plants -	564
„ Western Australian poison plants -	590
Lithosperum arvense -	559
Little yellow hop clover -	476
Lolium Italicum - -	527
„ perenne - -	530
Long-stalked kidney bean -	467
Lotus Americanus - -	450
„ corniculatus - -	531
„ tetragonolubus -	452
„ uliginosus - -	453
Low hop clover - -	481
Lucerne - -	459
„ clover - -	459
„ medicago - -	459
Lupulina - -	458
Lupinus albus - -	453
Macrozamia - -	587
Mad apple - -	556
Madder - -	472
Malta thistle - -	546
Malva sylvestris - -	537
Maltese clover - -	449
Mammoth clover - -	479
Mangold wurzel - -	493
Manihot aipi - -	456

PAGE.
Manures for beets - - 504
Manure for potato crop - 515
Maria thistle - - 544
Marsh mallow - - 537
Mayad clover - - 483
Meadow clover - - 479
„ fescue - - 528
„ foxtail - - 526
Medic burr - - 457
„ clover - - 457
Medicago denticulata 457, 541
„ falcata - - 458
„ lupulina - 458, 530
„ maculata - - 459
„ sativa - - 459
Medium red clover - - 480
Melilot clover - - 461
Medium clover - - 479
Melilotus officinalis - 461
„ leucantha - 531
Melons, pig - - 502
Mentha pulegium - - 559
Mesquite tree - - 470
Mexican clover - - 471
„ poppy - - 535
Milkbush - - 489
Milk pea - - 446
„ thistle - - 544
Modiola - - 461
„ decumbens - 461
Mountain spinach - - 539
Mouse clover - - 476
„ ear - - 539
Myrtle spurge - - 538
Narrow-leaved poison - 582
New Dakota millet - - 499
„ Hungarian forage grass - 530
New Zealand spinach - 478
Nettle leafed goosefoot - 540
Nicotiana glauca - - 556
Nodding saltbush - - 430
Nonesuch - - 458
Noogoora burr - - 553
Nopal - - 463
Noxious weeds - - 532
Onobrychis sativa - - 462
Onopordon acanthium - 551
Opium poppy - - 502
Opuntia engelmanni - - 463
„ vulgaris - - 543
Orchard grass - - 528
Ornithopus sativus - - 466
Our Lady's thistle - - 544
Oxalis cernua - - 537
Oxylobium parviflorum 575, 580–1–2
„ retusum - 582
Paddocks, size recommended - 404
Paddy's lucerne - - 537
Palm poison - - 587
„ zamia - - 587
Panicum decompositum - 414

PAGE.
Panicum gracile - - 414
Parsnips - 494
Paspalum dilitatum - 530
Pasturage, artificial - - 524
Pea - 485
Peanut - 433
Pea vine clover - 479
Pearl millet - 499
Pencillaria spicata 499
Pennsylvania clover - 482
Pennyroyal - - 559
Perennial hybrid clover - 477
„ red clover 479, 531
„ rye grass - - 530
„ thistle - - 544
Petalostemon - - 467
Petty spurge wort - - 538
Phaseolus helvolus - - 467
„ perennis - - 467
Phleum pratense - - 529
Phytolacca octandra - - 546
Pig melons - - 502
Pigeon weed - - 471
Pig weed 432, 439
Pin clover - 444
Pin grass - 444
Pin weed - - 444
Pisum arvens - 467
Plantain - - 467
„ herb - - 467
Plantago lanceolata - 467, 525, 554
„ major - - 554
Planting tobacco - - 520
Plaster clover - - 461
Poa aquatica - - 529
„ nemoralis - - 527
„ pratensis - - 527
„ trivialis - - 527
Pod clover - - 477
Poisons, tolerance of - - 586
Poison plants and eradication - 584
„ „ foreign - - 564
„ „ symptoms produced 583
„ „ treatment of stock 584
„ „ of Western Australia 573
Poisonous plants, list of Western Australia - - 590
Pollina fulva - 414
Polygonum aviculare - 467, 540
„ erectum - - 468
„ sachalinense - 468
Poorman's weatherglass - 554
Poor toe - - 471
Portulaca oleracea - - 469
Portulacaria Afra - - 488
Potato crop, potash for - 515
„ cultivation - - 510
„ land suitable for - 511
„ preparing seed - 512
„ seed - - 513
Potash for potato crop - 515

	PAGE.
Prairie clover -	467
„ grass - -	526
Precautions when feeding rape	509
Preparation of the seeds, beet -	504
„ of soil for beets -	504
Preparing seed potatoes -	512
Prickly comfrey - -	474
„ pear	463, 543
„ poison - -	580
„ poppy - -	535
Pride of California - -	452
Propagation of saltbush -	419
Prosopis juliflora -	470
Pumpkins - -	502
Purple medick - -	459
„ prairie clover -	467
„ star thistle - -	545
Purslane - -	469
Pusley - -	469
Pussywort -	476
Rabbitfoot clover - -	476
Ramie - -	436
„ grass - -	436
Ram's horn - -	439
Rape - -	436
Rape as feed, caution necessary	509
„ fertiliser for - -	509
„ growth of -	507
„ uses and cultivation -	506
Raphanus raphanistrum -	537
Rattle pod - ·	434
Recommended size for paddocks	404
Red clover -	480, 531
„ fescue - -	528
„ goat clover -	483
„ hair clover -	483
„ perennial clover -	479
„ pimpernell - -	554
„ skin sugar beet, early -	503
„ top clover - -	480
„ „ grass - -	526
Reddish clover -	483
Reversed clover -	482
Rhagodia billardieri - -	428
„ nutans - -	430
Rib grass -	467, 525, 554
„ herb -	467
Ricenus communis -	538
Richardsonia scabra - -	471
Ripening beet - -	506
Ripple grass - -	467
Rock poison - -	577
Romulea rosea - -	563
Rosa rubiginosa - -	543
Rough-stalked meadow grass -	527
Rubia tinctoria - -	472
Rumex acetosella - -	540
Running buffalo clover -	483
„ clover - -	483
Russian vetch - -	485
Sachaline - -	468

	PAGE.
Saghalin polygonum - -	468
Sainfoin -	462, 498
Saleratus weed -	472
Salicornia herbacea - -	472
Saltbushes - -	418
Saltbush, broad-winged -	420
„ coastal - -	428
„ as feed - -	414
„ grey - -	421
„ half-berried -	423
„ halimus-like -	422
„ kidney-fruited -	423
„ nodding - -	430
„ propagation of	419
„ silky - -	428
Samphire - -	472
Sand clover -	432, 479
Sandplain poison - -	581
Sand spurrey - -	473
„ vetch -	485
Sapling clover -	479
Sarcobatus vermicularis	472
Sarcostemma Australe -	489
Scarlet clover -	478
Scotch broom - -	447
„ thistle - -	551
Screw bean - -	470
Seaside arrow grass -	483
Seed beds, tobacco - -	519
Seeds, germination of beet -	504
Seed potatoes, preparing -	512
„ preparation, beet -	504
Senecio vulgaris - -	552
Serradella - -	466
Seven seed - -	483
Shad scale -	435, 436
Shamrock - -	458
„ clover -	481, 482
Sheep's fescue - -	527
Shepherd's purse - -	537
„ weather glass -	554
Shore thistle - -	544
Sida elliottii - -	473
„ rhombifolia - -	537
Silene gallica - -	539
Silky head grass - -	405
„ saltbush - -	428
Silver-hull buckwheat -	446
Size of paddocks - -	402
Slender clover - -	476
„ panick grass -	414
„ stalked clover -	476
„ thistle -	544
Small burdock - -	553
„ flowered clover -	476
„ „ galinsoga -	550
„ nettle - -	539
„ red clover - -	480
Smooth milk pea - -	446
Soil, preparation of for beet	504
„ suited for tobacco	517

	PAGE.
Soiling clover	479
Soja bean	447
Solanum nigrum	559
„ sodomaeum	559
Sonchus oleraceus	552
Soola clover	449
Sorghum halapense	497
„ saccharatum	498
Sorrell	540
Sotol	442
Sour dock	540
Southern cow pea	485
Sow thistle, common	552
Soy bean	447
Spanish bayonet	485
„ clover	471
„ pea nut	433
„ radish	537
„ sanfoin	449
„ trefoil	459
Spear thistle	544
Special products of the farm	492
Species of grasses	402
Spekboom	488
Spergula arvensis	473, 539
„ maxima	474, 498
Spinach, New Zealand	475
Spotted medick	459
„ thistle	544
Spring vetch	485
Spurred butterfly pea	439
Spurrey	473
Square pod pea	452
St. Barnaby's thistle	547
„ John's bread	439
„ Mawe's clover	459
Stachys arvensis	559
Stacking beet	506
Stagger weed	559
Star thistle	545
Saucy sack	546
Stinging nettle	538
Stinking goose foot	540
„ roger	553
Stinkweed	556
Stinkwort	551
Stockpea	485
Stock, and poison plants	584
„ treatment of poisoned	584
„ zamia palm poisonous	588
„ „ poisoning, treatment	588
Stone clover	476, 482
Storksbill	444
Straight bean	446
Strawberry clover	476
„ headed trefoil	476
Stypandra glauca	588, 589
Suckling clover	476
Sugar beet	502
„ early redskin	503
„ French	503

	PAGE.
Sugar beet greentop brabant	503
„ Klein-Wanzleben	503
„ white improved vilmorin	502
Sugar beet, white redtop	503
„ grass	414
Sulla	449
Sulphur clover	479
Sunflower	449, 502
Sun hemp	440
„ spurge	538
Swamp horn clover	453
Swedes	492
Swedish clover	477
Sweet briar	543
„ cassava	456
„ potato	439
„ sage	445
„ scented vernal	529
Symphytum asperrimum	474
Symptoms produced by poison plants	583
Tagetes glandulifera	553
Tall meadow oat grass	527
„ oat grass	405
„ fescue	526
Tamarix gallica	482
Tanner's curse	540
Taraxacum dens leonis	475, 553
Tares	485
Teosinte	497
Tetragonia expansa	475
Thorn apple	556
Thousand headed kale	500
Thread clover	476
Three cornered jack	540
Tick trefoil	442
Timothy grass	529
Tagasaste	441
Tobacco cultivation	516, 517
„ curing	522
„ harvesting	521
„ planting	520
„ seed beds	519
„ soil suitable	517
„ varieties suitable	518
Tolerance of poisons	586
Toothed medick	457, 541
Treatment for zamia poisoning	588
Treatment of poisoned stock	584
Tree tobacco	556
Trefoil	530
Trifolium agrarium	475
„ alexandrinum	476, 531
„ alpinum	476
„ amphianthum	476
„ arvense	476
„ badium	476
„ beckwithii	476
„ carolinianum	476
„ filiforme	476

PAGE.

Trifolium fragiferum - - 476
„ furcatum - - 477
„ hybridum - 477, 531
„ incarnatum 478, 531
„ involucratum - 479
„ medium - - 479
„ megacephalum - 479
„ microcephalum - 479
„ minus - 479
„ ochroleucum - 479
„ pannonicum - 479
„ pratense - 480, 531
„ pratense perenne - 531
„ procumbens - 481
„ reflexum - - 482
„ repens - 482, 531
„ resupinatum - 482
„ rubens - - 483
„ sabrotundum - 483
„ stoloniferum - 483
„ tridentatum - 483
Trigonel - - 483
Trigonella fænum-græcum - 483
Triglochin maritimum - 483
Tripteris clandestina - - 553
Tula grass - - 441
Tule - - 441
Tumble weed - - 432
Turnips - - 492
Ulex Europæns - 483, 543
Undesirable grasses - - 402
Upright knotweed - - 467
Urtica dioica - - 538
„ arens - - 539
Uses and cultivation of rape - 506
„ of rape - - 507
Variegated thistle - - 544
Varieties of tobacco - - 518
Various leafed fescue - - 528
Vetch - 485, 496
„ bird - - 485
„ chicken - - 485
Velvet bean - - 444
Vicia Americana - - 484
„ cracca - - 484
„ sativa - - 485
„ sylvatica - - 485
„ tetrasperma - - 485
„ villosa - - 485
Vigna catjang - - 485
Vilmorin, white improved, beet 502
Wallaby grass - 409
Water meadow grass 529
„ parsley - - 471
Wavystemmed clover - 479
Weeds and their distribution - 535
„ „ „ destruction - 533

PAGE.

Weeds development of - 533
„ introduced in forage - 534
Welsh clover - - 476
West India honeysuckle - 442
Western Australian poison plants 573
Whin - 483, 543
White clover - 482, 531
„ Dutch clover - - 482
„ goose foot - - 539
„ improved Vilmorin sugar beet - - 502
White lupine - - 453
Wild marigold - - 553
White mustard - - 502
„ prairie clover - - 467
„ red top, sugar beet - 503
„ sage - 436, 445
„ sharlock - - 537
„ Swedish clover - 477
„ trefoil - - 482
Wild kidney bean - - 467
„ laburnum - - 461
„ radish - - 537
„ vetch - - 451
Winter fat - - 445
„ lentil - - 445
Winged thistle - - 544
Winter flat pea - - 451
„ rape - - 436
„ vetch - - 452
Wire grass - - 540
Wood meadow grass - - 527
„ vetch - - 485
Woolly soft grass - - 526
„ thistle - 551
Wound clover - - 432
„ wort - - 432
Xanthium spinosum - - 554
„ strumarium - 553
Yam - - 444
Yellow clover 458, 475, 479, 481
„ hop clover - - 475
„ lucerne - - 458
„ meadow trefoil - 475
„ moon trefoil - 458
„ sand trefoil - - 432
„ star thistle - - 547
„ suckling clover - 476
„ sweet clover - - 461
York road poison - - 578
Yorkshire fog - - 526
Yucca baccata - - 487
Zamia palm - - 587
„ poisoning, treatment for 588
„ poisonous to stock - 587
Zigzag clover - 479

PART IV.

INDEX.

PAGE.

Adaptation of sheep to natural surroundings - - 608
Advantages of silage - - 623
Advice to buyers - - 608
Age for breeding - - 618
Anthrax - - 647
„ inoculation for - 647
„ symptoms of - 647
Art of breeding - - 614
Australian millet - - 628
Bad fences - - 630
Barn and woolshed - - 637
Benefit of salt licks - - 644
Border Leicester sheep - 600
Branched panic grass - 628
Branding sheep - - 638
Breeding - - 609
„ art of - - 614
Bush fires - - 630
„ hay - - 622
Calculating contents of tank - 626
Care during lambing - 642
„ necessary during post mortem - - 643
Castration - - 642
Castrating lambs - - 640
Cheviot sheep - - 607
Classing wool - - 613
Coast disease - - 648
Conditions of life - - 607
Conservation of fodder - 620
„ of water - 624
Contents of tank, calculating - 626
Cotswold sheep - - 600
Cotton grass - - 628
Crossbreeding - - 615
Culling flock - - 612
„ hints - - 613
Cure for footrot - - 645
„ for scab - - 651
„ of fluke doubtful - 646
Cuts, dressing for - - 635
Cutting the lambs - - 640
Dam - - 624
Difficulties to contend with - 606
Dishley sheep - - 607
Dishorning rams - - 609
Dentition - - 639
Devil's grip in wool - - 613

PAGE.

Dipping for lice, trough for - 648
Diseases of sheep - - 643
Dog and sheep - - 632
Downs sheep - - 601
Droving, use of dog in - 632
Draughting sheep - - 631
„ yard, plan - 632
Dressing for cuts - - 635
„ for footrot - - 645
Earmarking - - 637
Easily made dip - - 648
English Leicester sheep - 600
Environment - - 607
Essential points in a sheep - 596
Evils of overstocking - 620
Ewes - - 612
„ age for breeding - 618
„ when lambing, good feed for - - 640
Excellence, standard of - 614
Feed for sheep, native - 627
Feeding sheep on straw - 624
Fences - - 629
Fibre of wool - - 635
Fighting rams - - 611
Fire branding - - 639
Fire breaks - - 630
Fleece of ram - - 610
„ how to roll - - 635
„ treatment of - - 635
Flies - - 649
Flock, foundation of - - 605
„ management of - 621
Fluke - - 646
„ cure of, doubtful - 646
„ lick for cure of - - 646
„ life history - - 646
„ symptoms of - - 647
Fodder, conservation of - 620
Footrot - - 644
„ remedies for - - 644
„ treatment - - 644
„ trough for dressing - 644
Foundation of the flock - 605
Gestation, period of - - 619
Good feed for lambing ewes - 640
„ points in the ram - 609
„ qualities of merinos - 596
Hampshire down sheep - 601

	PAGE.
Healthy sheep, pulse of -	643
Hides for market, preparing -	653
Hints on culling - -	613
,, on founding a flock -	605
How to tell the sire - -	618
Hydatids - -	652
Immature animals as rams -	610
Improving the pasture -	627
Inbreeding - -	617
Influencing the sex - -	619
Ink marking - -	639
Inoculation for anthrax -	647
Johnson grass for sheep -	628
Lambs, castrating - -	640
,, cutting - -	640
,, at marking time -	642
Lambing -	617, 640
,, shelter during -	618
,, time - -	617
,, ,, troubles -	642
Leicester sheep - -	600
,, ,, border -	600
,, ,, in France -	607
Lice - -	648
,, remedy for - -	648
Lick for fluke - -	646
Life history, fluke - -	646
Lincoln merino cross -	615
,, sheep - -	600
Liver rot - -	646
Locality to be studied -	596
Longwools - -	600
Lung worm, remedy for -	650
Machine shearing - -	634
Management of ewes and lambs	640
,, of the flock -	620
Market, preparing wood, etc. -	653
Marking the lambs - -	642
Merino, good qualities of -	596
,, sheep - -	596
,, wool - -	596
Mutton, sheep good for -	601
Native fodder plants - -	627
,, grasses - -	622
Natural surroundings, adaptation to - -	608
Overstocking - -	620
Pasture, improving - -	627
Pedigree - -	611
Period of gestation - -	619
Plan of draughting yard -	632
,, of woolshed - -	636
Post mortem examinations -	643
Preparing wood, skins, etc., for market - -	653
Press for wool - -	636
Prevention of weevil in skins -	631
Prickly pear as fodder -	628
Pulse of healthy sheep -	643
Qualities of merinos - -	596
Ram, dishorning the - -	609
Ram good points of - -	609
,, breeding, etc. - -	611
,, immature, as stock-getter -	610
,, selection of - -	609
,, stags - -	642
,, quality of fleece - -	610
Rams, to prevent fighting -	611
Recipe for brands - -	638
Remedies for footrot - -	644
Remedy for lice - -	648
,, for lungworm -	650
,, suggested for worm -	650
Rickets - -	649
Riverina and sheepfarming -	606
Rolling the fleece - -	635
Romney Marsh and Leicester cross - -	607
Romney Marsh sheep -	600
Salt licks beneficial - -	644
Scab - -	651
,, cure for - -	651
Selection of types of sheep -	595
Sex, influencing the - -	619
Shearing - -	634
,, proper season -	634
Season for shearing - -	634
Sheep and their diseases -	643
,, branding - -	638
,, draughting - -	631
,, farmers, terms used by -	652
,, farming in Riverina -	606
,, feeding on straw -	624
,, for home use - -	631
,, good mutton - -	601
,, native feed for -	627
,, to skin properly -	631
,, types of - -	595
,, yarding - -	631
Shelter ewes during lambing -	618
Show rams - -	610
Shropshire sheep - -	601
Skinning sheep - -	631
Skins for market, preparing -	653
,, prevention of weevil -	631
Silage - -	622
,, advantage of - -	623
Silkyheads - -	628
Sire, how to tell the - -	618
,, size of - -	612
Size of sire - -	612
Southdowns - -	601
Spider grass - -	628
Stags - -	642
Standard of excellence -	614
Stomach worms, symptoms of -	650
Straw, feeding sheep on -	624
Stud ram - -	612
Study the locality - -	596
Suggested remedies for worms -	650
Symptoms of anthrax - -	647
,, of fluke - -	647

	PAGE.
Symptoms stomach worms	650
Tank	625
„ calculating contents of	626
Tape worm	652
Tar brands injurious	638
Teeth, positions, diagram	639
Terms used by sheep farmers	652
Ticks	648
Time for lambing	617
Treatment for footrot	644
„ of the fleece	635
Trough for dipping	648
„ for footrot remedy	645
Type of sheep	595
Umbrella grass	628
Uniformity	605
Vermont sheep	610
Wash for weevil	631
Water conservation	624
Waterproof marking for sheep	638
Weevil, wash for	631
Wells	626
Wire fences	629
Wool classing	613
„ fibre	635
„ merino	596
„ preparing for market	653
„ press	636
„ shed	637
„ shed, plan of	636
„ spoiled by devil's grip	613
„ spoilt by tar branding	638
„ washing	635
Worm, remedy suggested	650
„ in sheep	649
Yarding sheep	631

PART V.

INDEX.

PAGE.
Absorption of gases by soils - 665
Absorption of water - - 663
Absorption of water, per centage 663
Absorptive power of soils - 685
Ammonia - - 673
Analyses, field - - 676
Analyses of soils - - 667
Animal guano - - 699
Artificial manure - - 702
Artificial manures, protection against adulteration - 730
Ascertain condition of soil - 678
Ash of plants - - 681
Average composition of cattle foods - - 692
Bacteria in the soil - - 672
Barley - - 743
Basic slag - - 709
Beans and peas - - 747
Beetroot - - 745
Biological action of lime - 729
Blood manures - - 699
Bone ash - - 705
Bonedust - - 704
Bonemeal - - 704
Bones raw - - 703
Cattle foods, composition of - 692

PAGE.
Chemical action of lime - 728
Chemical composition of soils - 666
Clay soil, to make porous - 674
Clover crop - - 724
Composition of farmyard manure, per cent. - - 688
Composition of soil, chemical - 666
Condition of soil, to ascertain from crops - - 678
Constituents of plant foods - 680
Coprolites - - 705
Cover the manure heap - 691
Crop requirements - - 679
Crops and manures - - 737
Crops, rotation of - - 734
Decomposed granite - - 662
Denitrification - - 685
Derivation of organic matter - 684
Derivation of phosphates - 683
Device for manure tank - 697
Dissolved mineral phosphates - 706
Draining the soil - - 675
Effect of water on rape - 664
Estimate of original manure value - - 694
Evaporation in the soil 664, 685
Excreta - - 688

PART VI.

INDEX.

	PAGE.
Acidity of curd - -	817
Action of churning - -	798
Advantage of the pit for silage -	786
Appliances for printing -	811
Artificial feed a necessity -	769
Beater churns - -	799
Benefits derived from silage -	783
Box churns - -	801
Breeding of stock - -	777
Buildings for the dairy -	768
Butter and its treatment -	806
„ boxes - -	812
„ causes of tainted -	761
„ factory m-chinery -	813
„ fat and food - -	779
„ making - -	805
„ „ and cream -	794
„ prints - -	811
„ working - -	807
Buy the best possible breed -	774
Care requisite in disease -	788
Cattle for dairying - -	773
Channel Islands cattle -	775
Character of cattle required -	773
Characteristics of various breeds	777
Cheddar cheese - -	816
Cheery's churn - -	799
Cheese making - -	814
„ „ plant - -	814
„ press - -	815
Choice of district - -	764
Churn construction - -	804
Churns - -	798
„ old and new - -	798
Churning, loss of butter in -	803
„ when to stop -	806
„ with sweet cream -	796
Churns and materials -	804
Clean the churn - -	805
Cleanliness and milk - -	794
„ requisite - -	790
Coloring matter in cheese -	816
Composition of milk - -	788
Concussion churn - -	800
Constituents of cow's milk -	788
Cooking the curd - -	815
Cool the new milk - -	791
Cost of feeding ensilage -	785

	PAGE.
Cream for butter making -	793
„ percentage for churning	796
„ stage of ripeness -	795
„ temperature of -	761
Crops for silage - -	784
Curd knives - -	817
„ proper acidity - -	818
„ vat - -	815
Curing room for cheese -	816
Dairying and the future -	763
„ buildings - -	768
Dairyfarmer's mainstay, the silo	767
Dairying, kinds of - -	773
„ laying out the farm -	764
„ methods - -	760
„ stock and fences -	766
„ under new methods -	762
Dairy yards, how to plan -	765
Disease germs, care required -	788
District, suitability of for dairying - -	764
Ensilage - -	782
„ and its cost - -	785
„ a mainstay - -	767
Establishing the dairy herd -	774
Experiments and increase of milk - -	780
Factory churns - -	802
„ machinery - -	813
„ system of cheese making	816
Fat globules in milk - -	792
Feed for different seasons -	780
„ return from - -	779
Feeding dairy cattle -	779
Fences and their uses -	776
Fermentation in cream -	795
Food and its effect on milk -	779
Forms of churns - -	778
Fresh cream and churning -	796
Future of dairying industry -	763
Germs in milk - -	788
Grasses for the dairy - -	770
Herd, establishing the dairy -	774
Holstein-Fresian cattle -	776
„ milk yield -	776
Hot iron test - -	818
How to plan the yards -	765
Increase of milk, experiments -	780

PAGE.

Infection, sources of - - 789
Keep a stack of silage - 780
Kerry and Dexter kerries - 776
Kinds of dairying - - 773
Laying out the dairy farm - 764
Live stock on the farm - 772
Loss in churning - - 803
Making cheese - - 814
Making the silage - - 786
Material in churns - - 804
Merit and uniformity of butter - 762
Method of weighting the stack - 787
Methods, old and new - 760
Milk, composition - - 788
„ constituents - - 788
„ cooler - - 791
„ and cream - - 788
„ records - - 774
„ specific gravity - - 792
„ tainted by ensilage - 784
Milking, cleanliness, etc. - 794
Necessity of artificial feed - 769
New methods of dairying - 762
Notable qualities of Channel Island cattle - - 775
Old and new methods - 760
Operation of milking - - 794
Packing butter - - 811
Percentage of cream for churning - - 696
Pit for silage, advantages of - 786
Plant for cheese making - 814
Pressing the cheese - 816, 818
Printing butter - - 811
Process of butter working - 807
Quality of milk and food - 779
Rate to churn - - 805
Records of milk yields - 774
Rennet and its uses - - 814
Ripeness of cream, test for - 817
Roofing the dairy building - 768
Salt for use on the farm - 782
Salting butter - - 808
„ the curd - 815, 818

PAGE.

Scalding the milk - - 795
Seasons and feeding - - 780
Separator in the dairy - 794
Silage always a standby - 787
„ crops suitable for - 784
„ making - - 786
„ and milk taint - - 784
„ ration - - 785
„ in stacks - - 786
„ weight of - - 787
Silo, its benefits - - 767
Simple test for ripeness of cream 817
Sources of infection - - 789
Specific gravity of milk - 792
Speed of churn - - 805
Stacks for silage - - 786
Stage of ripeness for cream - 795
Supply of water - - 771
Tainted butter, probable cause - 761
Temperature of crea - - 761
„ of curing room - 816
„ required to scald milk - - 796
Testing curd - 815, 818
„ milk - - 792
Thermometer, use of, essential - 797
Treatment of butter in churn - 806
„ of new cheese - 816
„ of new milk - 791
Types of butter worker - 808
Underground dairy - - 769
Uniformity and merit of butter 762
Use of silage - - 783
Use the thermometer - - 797
Various breeds and their characteristics - - 777
Washing the butter - - 806
Water supply essential - 771
When to stop churning - 806
Weight of silage - - 787
Weighting the stack - - 787
Working butter - 761, 807
Ventilation in the dairy - 768
Yield of Holstein-Fresian cattle 776

PART I.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

DESCRIPTIVE NOTES ON THE AGRICULTURAL AREAS AND CROWN LANDS OPEN FOR SELECTION.

THE following notes on the agricultural areas and Crown lands available for selection in the South-west Land division of the colony have been specially prepared for this publication. It is impossible to do more than faintly outline, in a few hundred pages, the vast agronomic possibilities of even so small a portion of the great territory of Western Australia as the division under review. It would take many volumes the size of the present one to adequately describe, and to completely enumerate, the many advantages that Western Australia, with its diversity of soils and climate, offers to the sturdy agriculturist of mind and muscle.

For the purposes of description, the large land division has been subdivided into districts. The statements contained in the following pages are all founded on fact and experience, and no attempt has been made to unduly magnify the good, or minimise the bad, features of the colony's lands. Western Australia is not all sand ; neither is it all soil of exceptional fertility. Between the two extremes there is a happy mean, and it is the object of these notes to briefly and truthfully point out that, in spite of many detractors, this happy mean does exist to a very great extent in this colony. In proportion to its area—an area greater than many European Kingdoms—the South-west Land division of the colony—the chief cultivable portion—contains a very small proportion of land that cannot be put to some good purpose ; a very large proportion that only awaits the potent agency of the plough to become productive.

CHAPTER I.

THE SOUTH-WESTERN DISTRICT.

For the purposes of definition in this chapter, the south-western district will be deemed to be all the country along the coast west of the road between Fremantle and Albany. This is a very large section of what is known as the South-west Land division, within which is comprised all the territory that, prior to the discovery of the Yilgarn goldfields, was regarded as being suitable for cultivation. The south-western district, with which we are now dealing, embraces Jandakot, Canning, Armadale, Woongong, Beenup, Jarrahdale, Serpentine, Dandalup, Pinjarrah, Coolup, Drakesbrook, Wagerup, Cookernup, Harvey, Brunswick, Collie, Picton, Bunbury, Donnybrook, Boyanup, Busselton, Blackwood, Bridgetown, and further south to the shores of the Southern ocean. The country east of the Albany road to the boundary of the south-west division from Beverley to Albany, will be dealt with as the southern district, as the Great Southern railway runs through almost the centre of it. These lines of distinction have been drawn, not only artificially by roads and railways, but naturally by divergences of soil, timber and rainfall. The contrast between the two territories is tersely and clearly described in the *Descriptive Notes Respecting Agricultural Areas in Western Australia*, officially compiled and issued by authority of the Hon. Commissioner of Crown Lands :—"In dealing with the areas along or adjacent to the South-western railway and its extension to Donnybrook, a totally different class of land is found to that of the areas along the Great Southern railway. While the latter areas are specially suitable for cereals and fruit culture, the former include land that is more adapted for fruit and vegetable growing and for dairy farming. In some places the country is heavily timbered, costing a considerable sum to clear ; but against this must be placed the fact that smaller areas are sufficient for a selector, the land being capable of intense culture. It is also, for the most part, well watered, whilst the rainfall is regular and considerable. The highest hopes are, indeed, entertained in regard to these areas, and much thriving settlement is looked for in the south-western district. There are nine areas in this locality, comprising 283,588 acres, of which 57,255 acres have been selected by 226 applicants." What is meant by a "totally different class of land" is deserving of a more detailed description, so that from these pages the reader may be in a position to determine where he would be most at home ; but it must be understood that no other district is being decried in pointing out the advantages of the south-west. Every part of the colony where agricultural areas have been allocated has its recommendations, to which attention will be drawn in reviewing them.

The mountains and rivers of the south-west are among its chief physical features. The Darling range, commencing at Yatheroo, north of Perth, in the midland district, runs south right through the middle of the south-west for a distance of 300 miles to Point D'Entrecasteaux, near Cape Leeuwin. The range runs parallel to the coast line at a distance of about 18 to 20 miles, and the highest peak in this range is about 1,500 feet. Mount William, in the Murray district, between Bridgetown and Albany, one of the mountains of the Roe range, attains an elevation of 3,000 feet above sea level. The Darling and the Roe ranges extend in the same north and south line, but the latter is more to the eastward. Many rivers have their sources in these ranges; notably the Swan, Helena, Canning, Serpentine, Murray, Brunswick, Collie, Preston, Blackwood, Warren, Margaret, and Vasse rivers, which rise in the Darling range and, running from east to west, empty themselves either into the Southern and Indian oceans, the Harvey estuary, or the Leschenault inlet, between Fremantle and Bunbury. The Tone, Balgarup, Forth and Weld rivers have their sources in the Roe range. All these rivers, together with innumerable watercourses, which are known as brooks, supplied by thousands of springs which have their rise in the enormous catchment area of the ranges, in July and August, when they are at their highest, not infrequently flood some of the lower levels of the flat country through which the streams flow on their way to the sea. In order to obviate the recurrence of these floods the Government has undertaken an extensive scheme of drainage which will be pushed on to completion this year, and will relieve Collie and Harvey settlers of a too bountiful supply of water at a time of the year when it is not required.

The rainfall of the south-west is, as the records of years prove, consistent and considerable. The rains are not as a rule experienced here earlier in the autumn than in the eastern districts, but they are very much more copious and frequent when they commence, and are prolonged generally well into October, and frequently into the beginning of November. The result is that the rainfall registered at the meteorological stations from Fremantle to the Vasse is more than double that of places eastward from York, Northam, and Newcastle. The following figures may be considered as a fair average rainfall at the places mentioned: Fremantle, 30 inches; Jarrahdale, 41 inches; Pinjarrah, 38 inches; Bunbury, 36 inches; Busselton, (otherwise known as the Vasse), 37 inches; Bridgetown, 40 inches; Augusta, (near Cape Leeuwin), 39 inches. This large rainfall keeps most of the rivers in the south-west flowing all the year round, while the smaller streams leave a sufficient number of pools in their beds in the height of summer to meet all requirements except those of extensive irrigation, which could however be carried out on a large scale if the surplus water that runs into the sea in the winter season, was impounded. So far the settlers have been satisfied with the crops they can grow unaided by an artificial water supply. There are many spots in the south-west division admirably adapted to intense culture under irrigation, and these before long are bound to attract closer settlement. Hitherto, to use a biblical illustration, the vineyard has been large and the laborers few. Up to the date of the acquisition of self-government, and the almost simultaneous development of the goldfields, the demand for produce was not large enough to stimulate the inception of enterprise of a special kind. Now that producers have before them a sphere of great profit opened up by the demands of an ever-expanding market, the south-west, which has lain comparatively idle, is in great requisition by the class of husbandmen for whom the Homesteads' Act was passed; that is to say, by those who desire to get a small holding, and to improve it to its utmost capacity. To these a garden that could be irrigated from the waters of a brook at midsummer, when all kinds of table vegetables are at a premium, would prove to be a most valuable possession, and one that, in its virgin state, as we shall show in the course of this chapter, is only waiting hands to claim it.

Next to the exceptional rainfall of the south-west and the great possibilities which a practically unlimited water supply carry with it, the district is famous for its timber, which, however, will be very briefly glanced at here, as it is more fully dealt with elsewhere. Typical scenes from the magnificent jarrah and karri forests that are doing so much to build up a great export trade for the colony, have been selected for insertion in this work, and give an excellent idea of the country in its natural state.

The country lying between the Darling range and the sea is curiously compounded of limestone formation and of soil that is so deficient in lime and salt that cattle kept a few miles inland have occasionally to be sent to runs which border on the coast for a change. The limestone formation is so far destitute of all the constituents that are necessary for the maintenance of stock in the fullest vigor, that they have to be sent back a few miles from the salt water to what is called the "clay land," to fatten. The stay of the cattle on the new pasturage need only be for six or eight weeks in each year, and if they are shifted regularly they are kept fat, and in the spring put on flesh readily. Stock kept exclusively either close to the coast or on the clay lands, become, in course of time, more or less debilitated. For a year or two they may do fairly well on the well grassed frontages of the Darling range, but they slowly fall away unless they get the occasional rough lime and saline-impregnated herbage, which is a wonderful tonic, even though it may be of the coarsest fibre.

The coast change and its effects have been referred to in order that the frequent references to the clay land and the limestone formation may be clearly understood. Until this line of demarcation in the character of the soils of the territory lying between the Darling range and the Indian ocean is fully appreciated, the reader will have a difficulty in following clearly what has still to be written about the characteristics of the south-western district, and the diverse uses to which the different formations are best adapted. Although the phrase, line of demarcation, has, for want of a better one, been used to denote the separation of the limestone from the clay country, the line is so sinuous and erratic in its course that the word is almost misleading, for the two kinds of country run into each other and not infrequently overlap. The south-west districts are remarkable for the diversity of their soils, and this statement finds a direct and early application when one gets a few miles out of Perth and at the Canning discovers oneself in the clay country. But one does not leave the limestone behind at this point; on the contrary, the South-western railway between Perth and Bunbury will be found to cut it at several points much further inland, until we come upon it again at Creaton, 15 miles from the coast. In places the limestone formation disappears almost at the ocean's edge, while in one place, below Mandurah, no limestone can be found at all on a big stretch of country which has the sea for its western boundary, although it is possible that an impregnation of lime would be found in the soil. The reason why so much emphasis is laid upon the uncertain or crooked course of the boundaries of the two kinds of soils is that limestone is a main ingredient in ensuring the success of special kinds of cultivation which are highly recommended to be carried upon land where it is found, and it would be a misfortune if a selector rashly took up a block under the belief that it had a limestone bed, because it was as near the coast as other land upon which the presence of this strata had been proved by actual investigation; in other words, proximity to the ocean is not to be accepted as attesting the possession of limestone, and distance from the coast is not to be regarded as showing that a certain block is destitute, or nearly so, of that constituent.

After the foregoing explanation it will be realised that we only speak in terms of the most general approximation in setting it down that of the strip of country eighteen or twenty miles wide, which intervenes between the Darling range and the sea, half of it is of limestone formation, and the other of heavy clay or loam land. Probably the statement is pretty nearly correct if it is understood to be applied in the same way that the same measurements would be found in the hands of a man who inserted his right and left fingers one between the other, and thus formed one surface composed equally of different members. In this way the limestone interlaces the clay, and the clay—which is often not clay at all, but loam—the limestone. The clay derives its name from a clayey sub-soil, and is generally denoted by the thick growth of blackboys or grass trees. The advice which one of the most experienced and capable men who have courteously contributed information would give to a prospective settler is:—"If you want to grow corn or fruit trees, find a place in which redgums and blackboys cluster thickly—where the blackboys do not have only one head, as they do when found on the limestone, if they appear there at all, but a number of arms or limbs, each crowned with a head. If the short thick girth of the trunk, whence the arms spread out, makes a shade like a young bay tree, under which cattle may shelter from the sun and rain, then put your pegs in and make tracks for the nearest Lands' office, for land that will grow blackboys to perfection will grow heavy marketable crops. You need look no more, for there is no better land to be found in Western Australia—with the exception of the swamp lands—for vegetables, or maize, or lucerne. Settle where the blackboys and the redgums thrive, and if you are not afraid of hard work, you will thrive too."

Having now given a general idea of the soil of the south-western district, it may be as well to take a flying survey along the course of the railway that joins Perth to Bunbury, to see what is being done. The line cuts the very heart of the district, and there are to be found in it examples of the best forms of cultivation—orchards, farms, vineyards and vegetable gardens. The trip will indicate the good beginning that has been made towards making "the earth to yield her increase." All that is to be deplored and remedied is that there is not one occupier for every score that this fertile tract is capable not only of supporting, but of maintaining in a state of comfort. Here will be found the avenue to a progressive career that within reasonable bounds will only be limited by the energy and resources of each holder to clear additional land, to crop it, to buy implements and stock shrewdly, and to exercise sound judgment in their use and management. It may be safely said that if a man takes up a piece of the best of the land in the south-west without any surplus cash, but enough to make a successful start, if he puts his mind, his heart and his muscles into his task, the first years will not be easy ones, but his success is practically assured. The best land of Western Australia, unlike that of some of the eastern colonies (but which has long since been alienated), is not found ready cleared by the indulgent hand of nature, or, to speak more truly, is denied a growth of timber. Our best spots are in our heaviest forests of red gum, York gum, salmon gum, peppermint, and blue gum, or are in paper bark swamps, and have to be wrested from thick, deep-rooted, primeval owners, before the idyllic dream is realised of every man sitting in the shade of his own vine and fig tree and none daring to make him afraid. The settler who has grappled with and effaced the forest trees, who can look out upon a broad expanse of stubble land after harvest, would need to be very improvident to be afraid of meeting any creditor; but between the taking up of the block allotted to him and the accomplishment of this task there is before him many a day when he will literally fulfil the old scriptural mandate and earn his bread by the sweat of his brow. If he shrink from the weight of his labor he can find an easier vocation in taking up the more lightly timbered lands along the Great Southern railway, or beyond Greenhills or Goomalling, with his eyes open to the fact that there the rainfall is much lighter, that the climate is for some months dry and hot, and the conditions of life not so pleasant; while in the south-west a crop has never, with ordinary care, been known to fail, or a fruit tree to die for want of water. Here there is little or no need to conserve water for stock; little or no expense in sinking wells or scooping out dams; no anxious watching for the thundercloud to burst to save driving cattle or sheep perhaps for miles to the nearest watering place to slake their thirst. In giving the settler a wide range of choice as to the peculiar natural gifts he shall desire to bestow upon himself, Western Australia is almost unique. No district has a monopoly of advantages, but there is in their distribution a nice balance and equipoise of merits and demerits. The south-west has the unfailing and plenteous rainfall, and the heaviest clearing; in many places the smallest areas of first class land in one piece. The eastern division is nearer the goldfields market; it has very large stretches that could be placed under crop without a break, and a beginner can readily clear a nice piece of jam country to get in a crop in his first year that will cheer him on his way. The south-west is more intractable; it resists the advances of civilization; the forest is not easily subdued, and the land that can soon be reclaimed will prove disappointing in the end.

Before booking at Fremantle for Bunbury, the enquirer for Crown lands on agricultural areas should have a look at Jandakot, which is situated 10 miles east from Fremantle, and which was thrown open for selection in August, 1890. It comprises 36,000 acres, mostly of a light sandy nature. There are, however, in the area a fair proportion of alluvial banks and swampy lands which are highly suitable for the production of vegetables, of which the Perth and Fremantle markets are lamentably bare for the greater portion of the year. The land is, however, imperfectly drained, and it is somewhat expensive to clear. Some of it would cost quite £10 per acre before seed could be sown; but, on the other hand, the productiveness of the soil, and the consequently small areas required, compared with what is necessary, say, at Meckering, for mixed farming, would compensate for this outlay. There

BUNBURY. MR. E. M. CLARKE'S VINEYARD ON THE SOUTH-WESTERN RAILWAY.

IT is established on yellow sand resting on coral limestone, originally under Tuart Gum forest. An abundant supply of moisture is drawn up to the surface by capillary force, and the roots find in that class of country a great feeding range.

E. W. Hilgard

is absolutely no water difficulty, water being, if anything, too abundant. Portions of this area have a limestone formation, which renders them of a special value. There is a site for a sewage farm upon the western side of this area, and a reserve for a townsite in its south-eastern corner. It is approached from Perth by Nicholson's road, which is now being macadamised, and from Fremantle by the Forrest road, which traverses the area, striking the Perth-Bunbury road at the fourteen-mile post. This latter road has lately been cleared about half its width from end to end. On the eastern side of the area, and about three miles from the nearest portion, runs the South-western railway. An undoubted drawback to the locality has been the comparative lack of good roads leading to it, or to serve as feeders to the railway ; but the works now in progress will, to a great extent, do away with this objection. The contiguity of the area to the Perth and Fremantle markets, and the richness of much of the land, are still, however, great elements of attraction, and out of the 36,000 acres of this area 34,300 are surveyed, of which seventy-eight selectors have taken up 16,539 acres. The present settlement is well distributed over the area. There are several farms and holdings in a highly improved condition.

The value of the limestone for the vine is exhibited on the property of Mr. W. D. Moore, on the Canning road about two miles out of Fremantle. The vineyard yields superb crops of grapes of the best wine and table varieties, and from a few acres the returns obtained would form a substantial income, if the proprietor were not a large merchant and a gentleman of affluent means, whose pleasure it is to have a rural home looking out upon one of the most flourishing gardens which skilled culture and a wise choice of site unite in forming. It is Mr. Moore's recreation to demonstrate, by the means of this plantation, that in the limestone having an easterly aspect the vine will do even better here than it will on the sunny slopes of France. Not only on Mr. Moore's estate, but also at Rockingham, where there is another splendid vineyard, as much as 12 tons of muscatels per acre have been picked and marketed. The vines at the latter place were planted on the site of a limestone quarry. The stone was taken out for building purposes and the excavation having been filled in with the soil of the neighbourhood, the cuttings were put in by way of experiment many years ago, when the capabilities of Western Australia as a fruit producing country were not as well known as they are to-day.

The fig is also a greedy feeder on the limestone, and asks for no more care than the native ecualyptus. A cutting thrust in the sandy soil grows like a weed, until it attains an enormous size and is so heavily laden with fruit that it is profitable to use it for fattening pigs. Mr. William Paterson, manager of the Agricultural Bank, is planting 40 acres near Mandurah with figs, in order to turn the fruit into bacon. At Lowlands, the estate of Mr. A. R. Richardson, 24 miles from Fremantle on the South-western railway, there are some fig-trees of great size, one of them measuring seven feet five inches in girth of trunk. Mandurah and Rockingham can show several nearly as large. Mr. Thos. Hardy, the well-known South Australian horticulturist, admired the fig plantations greatly when he visited the colony a few years ago. He said he had seen nothing nearly so fine of the kind anywhere else south of the line. Mr. Paterson, who is the first to undertake the culture of the fig on a large scale, is importing fourteen varieties. He estimates that in seven years time the yield will be of the value of £1 per tree; he is planting 2,000 trees. It is pointed out that such a plantation requires no grafting, pruning, or budding, and very little cultivation, while the cuttings are cheap and easily procured, and the trees, generally speaking, almost immune from disease. In his opinion the fig has been too much neglected in the west; if it had not grown almost wild and had a smaller yield of fruit, the satiated appetite would not have looked askance upon what he regards as being one of the most wholesome and appetising of fruits. In a country like Western Australia, where bacon brings 1s. per lb., he knows of no better or more profitable purpose to which to devote his Mandurah estate than to raise figs upon a large scale there in the limestone country. The olive also does remarkably well on the coast, and fine specimens of these trees may be seen anywhere between Fremantle and the Vasse.

The limestone country, which we have been inspecting before going into the clay districts further inland, grows several other crops that are valuable, although it is not recommended for general farming purposes. Lucerne, a fodder plant that is extensively cultivated in the eastern colonies, is in a congenial place among the limestone. Patches of it have been put in for test purposes, with most gratifying results. The roots go down to a great depth, and all through the summer it can be repeatedly cut after it has had twelve months to establish itself. The value of lucerne, and the important part it should take in the feeding of stock during the dry season, may be emphasised, for probably there is no part of the world where summer fodder is more required than in the neighbourhood of Fremantle and Perth. In the spring, indigenous and exotic grasses and clovers grow in the richest spots, and especially where the ground has been cleared and cultivated; but as the season advances these disappear, leaving the dairy herds of the metropolis and the chief seaport town of the colony to subsist mostly on rank scrub and imported bran, for which from 1s. to 1s. 9d. per bushel (according to market supplies) is charged.

There is another aspect of the fodder question which should be emphasised in connection with lands available for selection within reasonable distance of the metropolis, and that is the meat supply. In speaking of this subject official evidence can be adduced. The issue can be put in one short sentence:—The meat supply of Perth and Fremantle falls far below what it ought to be in quantity and quality, because there are not in the vicinity of those centres pasturage grounds that will for the greater part of the year maintain the drafts of the butcher in flesh. Hence, those drafts have to be small and intermittent; the purveyors cannot muster on the seaboard a reserve stock of sheep and cattle, because they would fall away in weight; they have to buy only for almost immediate needs, and the public have to pay in the added price of meat for this defective and precarious system. If the butchers had proper feeding places near the slaughtering yards, they could carry on their business and reinforce their supplies on a much sounder and more helpful basis, and the consumer would get the benefit of the margin of wasting and loss being greatly reduced. That is to say, if cattle brought from the Kimberley district, the chief breeding ground, could be rested and topped up after their journey, before being slaughtered, the retail price per pound of their carcases could be reduced, because there would be so many more pounds of meat per beast to sell. This was part of the evidence that was given by leading members of the trade and pastoralists before the Parliamentary Joint Committee of both Houses that, on the motion of Mr. Charles Harper, M.L.A., President of the Bureau of Agriculture, sat during last session. The committee was appointed to enquire into the causes of the present high price of meat and to suggest such means as may appear most desirable for the purpose of effecting a reduction in the price of good wholesome meat to the consumer, without too seriously endangering the future of the pastoral interests. It was shown in the course of the enquiry, which lasted several weeks and embraced all phases of the question, that the quality of the meat would be greatly improved if the cattle could be slaughtered on the pasture grounds, and that the nearest place where pasture grounds could be obtained was near Muchea, on the Midland line. So far the Government has not announced its intention to carry the recommendations of the committee into effect, and the position of affairs still offers great inducements to cultivators to lay down paddocks near Fremantle, or at Jandakot, for instance, with lucerne, which would tide the butchers over the dilemma. Another purpose for which the coast country between Fremantle and Mandurah is admirably adapted, and for which very few acres, comparatively speaking, are now employed, is the production of culinary vegetables. It might be made the South Brighton and Cheltenham of the west, for the soil is very similar to that south of Melbourne, which for twenty miles by about eight broad has been made a cabbage garden, or rather a thousand cabbage gardens, for none of the blocks are more than fifteen acres. and some of them have only five acres. The newcomer to the west, who takes the slightest interest in agricultural pursuits, is greatly impressed with the scarcity and the dearness of vegetables, the producing of which is the industry of an industrious and independent class of growers, who, as the result of a system of high tillage that is not excelled by the peasantry of France, are able to raise a great variety of crops in abundance. An acre of ground turns out 8,000 head of marketable cabbages, and other crops in similar profusion. The market gardeners of the South Brighton district form a strong guild both in numbers and aggregate wealth, and most of them till their own freeholds, upon which they have built comfortable and commodious houses. They return from market with their wains laden with nearly two tons of manure, which their stout and well-fed horses easily draw along a steel-plated track, which has been laid along the Brighton and Point Nepean road for about ten miles. Their work is done with American digging-ploughs and cultivators, which economise labor and turn it to the best account, while the crops, under the forcing influences of manure and a good rainfall, are refreshing to the eye, with their splendid growth and the hue of livid dark green that betokens the presence of a plethora of plant food. If you travel further afield to the confines of this blooming utilitarian garden land a desolate landscape is seen—a forbidding waste of desert sand dotted with stunted ti-tree and heath, which leaves a chilling sense of barrenness and irreclaimable solitude. Yet the desert is part of the same tract as those luxuriant beds of cauliflowers, turnips, potatoes, and onions, which we passed a while ago, changed only by the transmuting energy of the market gardener. Here around Fremantle and Perth there is hardly the germ of the great well-organised, well-equipped enterprise that is directed to the growing of table esculents in the east of Australia and elsewhere. A few Chinese, with spade and hoe but little in advance of the primitive delving tools of Adam's time, occupy some swamp lands and sell their cabbages by weight as carefully as though they were refined gold. But where are the men of English race who are grasping the prize of intense culture and the liberal rewards for it that are so close within their grasp? Is it not so? when the market gardener starting in Western Australia can get his land for nothing, as close to Fremantle as South Brighton is to Melbourne, instead of paying at least £20 per acre for it. Is there any exaggeration in saying that big profits are allowed to pass unheeded, when cabbages sell for twopence per pound, and in the other colonies twopence will buy the entire head? Can the most sceptical say that an acre of the swamp lands on the Jandakot agricultural area that is naturally irrigated, and which the Government will give as a free gift to any man who will crop it, is not more than equal, with similar treatment, to an acre of the Cheltenham sand, whose arid surface in the middle of summer can only be moistened from a tap and pipe that draw upon the Yan Yean reservoir, and which has to be paid for at so much per thousand gallons, according to the weekly reading of the meter by the officer of the Water Supply department? And let a simple calculation be made as to what 8,000 head of cabbages, at the average weight of 5 lbs., would amount to at twopence per pound, or even one penny per pound, grown on land close enough to the metropolis to be carted there without railway charges, and on land, which except for the £1 for registration, costs the gardener nothing.

It may, however, be said that the market for vegetables will soon be supplied when the epoch of the humble but hardworking Mongolian with his rake and his trowel gives way to a sturdy generation of British ploughmen who are the owners of Clydesdales and Planet Juniors and all the other paraphenalia and horse power of an up-to-date vegetable grower. Let those who may fear that they will not find elbow room in the business, that competition will quickly be supplied, and that the present prices, or an approach to them, be very evanescent, note the following counsel:—The demand for vegetables is not to be gauged by the present consumption, for vegetables are far more sparingly doled out at most tables than bread, simply because there are, to use a familiar phrase, "not enough to go round." If the supply increased the demand would spring in the same ratio, for although this is not the place in which to indite a treatise upon the bills of mortality, or the social well-being of the people, it is admitted by the medical faculty that in some respects—including that of eating plenty of vegetables, which are not now forthcoming—the hygienic conditions of the people of Western Australia could be much improved. Again, the colony is so large and the spheres of profitable industry it offers are so numerous that overcrowding is a very conjectural contingency, at any rate for many years to come. It may be said, however, that market gardening is an industry that is soon overdone, as the crops take comparatively but little time to mature. For this to occur the prices now realised would have to fall several hundred per cent. To show the unlikelihood of over-production in this industry within measurable time, supposing the population to increase ever so slowly, a great many credible witnesses could be called, but it will be preferable to take the records of Parliament. In the session of 1895 the Hon. E. McLarty, M.L.C., and a member of the Bureau of Agriculture, who speaks with mature knowledge of the Mandurah district, asked the assistance of the Legislative Council, by resolution, to foster the establishment of market gardens with a view to encouraging the establishment of canneries. His speech on the subject was so full of pith and cogent force that this chapter would be incomplete if some of his remarks were not quoted here. The motion which the hon. member moved in the Council on the 8th October, 1895, was as follows:—

That in the opinion of this House it is desirable that the Government should enquire as to the best steps to take to encourage the production and preservation of vegetables.

He said :—"In moving this motion, I may say that, unfortunately, the rules of the House prevent me from going as far as I wish to, otherwise I should have framed the resolution in favour of a substantial bonus being given to any establishment which might produce 25 or 30 tons of preserved vegetables in any one year. Hon. members are aware that we are now importing large quantities of preserved vegetables. Last year, I believe, the value of our imports in this direction amounted to between £8,000 and £9,000, and next year the amount will probably be larger. This fact I regret. I speak with some practical knowledge when I say that we can produce, at certain seasons of the year, at all events, any quantity of vegetables ; and I should like to see some encouragement given to their growth, so that we may supply our goldfields and our northern parts without resort to importation. At Mandurah one of the preserving establishments has already gone into the business, and it is turning out an article quite equal to anything that is being imported ; and all that is now required is that there shall be a supply of vegetables to enable us to produce all the preserves we require. I think a bonus should be given to enable the establishments I refer to to offer a sufficient price for vegetables to induce people to grow them. If that were done, it would, in time, save the colony the large amount which is being annually sent away for preserved vegetables, and it would instead be distributed among our own settlers. Only this week I have noticed how much land is being taken up ; but on a considerable portion of it people are planting fruit trees. These will take four or five years to mature, and if, in the meantime, some inducement could be offered to them to grow vegetables between the rows of trees, they would be much benefited. Vegetables will grow luxuriantly, and a return can be got in a few weeks from them." In bringing the motion (which was passed) before the Council, there is no doubt Mr. McLarty had chiefly in his mind's eye the rich flats that abound in the neighbourhood of Mandurah, which has since come even more prominently into notice as a highly desirable place for settlers on small holdings. At the time of writing (June, 1897), an agitation had declared itself in favor of the Government using the powers of the Agricultural Lands' Purchase Act to take over a portion of the Hall estate and cut it up for the benefit of fruit and vegetable growers.

A very short run from Perth by rail brings us to the Canning ; but so far on our trip southward we will take the road route, or we should miss the sight of what Mr. Wiedenbach has done to demonstrate the surprising capabilities of the Canning district to supply the metropolitan market, in which fruit is very scarce and dear, with the finest productions of the orchard. He took up what an expert describes as being to the eye of a novice " a very rough bit of country, that was quite repellent with its thick growth of blue gum, ti-tree, and stinkwood, and what appeared to be an ill-nourished surface of yellow clay." But Mr. Wiedenbach had been a skilful fruitgrower in another colony, and he perceived that this piece of ground was a diamond that only needed polishing. He sampled the soil and found it full of nodules of limestone ; he saw it was deep and well drained and sheltered, and he set to work six years ago to transform this wilderness into an orchard that confounds any detractor of the pre-eminent capacity of a well-chosen holding to respond to the transforming hand of man. Look at it to-day. You see a model and blooming orchard, the trees bright with foliage, and the limbs bearing down under the weight of apples, of apricots, peaches and plums, of superlative size, and whose size is almost as matchless as their taste. The well laid out rows of orange and lemon trees are grateful shady places to recline in on a blazing day, under the heavy dark green leaves which the clustering golden fruit disdains to be hidden by.

On leaving this orchard the vision is rudely disturbed, for beyond his fences there is revealed in all the stark plainness of their native hue, the dank unkempt thickets of ti-tree, the gaunt blue gums, the hard yellow clay that, but for the object lesson we have seen, would be prone to turn the land-seeker to some fairer prospect. It is not advisable even for an expert to be always deterred by externals in looking for a location in Western Australia, where there are, not infrequently, some kinds of country having no external attractions at first sight, yet on further acquaintance revealing great potentialities of profit. Mr. Wiedenbach's property has been introduced to lay stress upon the text laid down at the outset, that the Canning is a terribly neglected district—especially having regard to its closeness to the capital. It is so close to Perth as to be almost a suburb of that city ; it is capable of producing not only enough fruit for local requirements, but for export, and yet the invitation which it extends to the orchardist is, with the exception of the place to which reference has been made, almost entirely set at nought. This is the salient fact with which one is impressed in going through the heart of the Canning. It is evident that the nearer a perishable product like fruit is grown to market the less likely it is to be damaged in transit to the consumer, and that as it has been proved that orchards are very profitable, even when they may be 100 miles or more from the metropolis, the profit will be proportionately greater when the crop is raised at the thresholds of the people who are anxious to buy and consume it. The same conclusion applies to vegetables, which are grown by Mr. Wiedenbach in great abundance ; yet, nevertheless, the Canning is almost entirely a grazing ground which is much used by the dairymen of Perth and Fremantle as a clay change for their cows. No doubt it is an excellent thing for the cattle which have to provide milk for the inhabitants of those large centres, to be kept in health, but the absurd spectacle is presented of landowners receiving ninepence or one shilling per head weekly for the agistment of stock upon land that under orchard cultivation would foot up in the credit account of receipts to £200 per acre. It only remains to be added that there is land for sale at the Canning, and that it is understood the owners are in treaty with the Government for some of it to be added to the public estate for the behoof of settlers and close settlement. There are a few wheat crops to be seen at the Canning at harvesting time, but not one fifth of the land is in any better state than when it was the undisputed possession of the native tribe which hunted and fished within its boundaries. The very healthy upland plains of the Canning, a good height above sea level, have a most equable and agreeable temperature, the extremes of heat or cold being unknown, and the air is so pure that the medical faculty desiderate the establishment there of a convalescent home.

Among the Canning hills which fringe the river there are some spots where fruit and vegetables would thrive, but these patches are small and difficult of access, as the country is rough and steep. The larger part of the hills consists of ironstone ridges, the home of the jarrah, which is cut in large quantities by the Canning saw mills, whose line, starting from the Midland Junction near Guildford, runs southward to within four miles of Kelmscott on the South-western railway. At the junction of the river and the latter railway, there are some excellent pieces of country, which lie between the hills and the stream and beyond the Gosnell estate. One of these blocks, several thousands of acres in extent, belongs to Mr. Panton, P.M., of the City of Melbourne, Victoria, who is known not only as an expert in matters pastoral, but also as an artist and a patron of art. The railway bisects his property, the best of which is the clay country near the river. Further south it is of a light loam, merging into a sand plain ; but as the late Sir F. A. Weld said, when he was Governor of the colony—"West Australian sand is the most fertile in the world." Some further observations of His Excellency, who held the vice-regal office from 1869 until 1874, and under whose administration the colony made a decided advance, may be regarded as reliable testimony, for he took the greatest interest in agriculture, which he had studied in a practical spirit, and was well versed in geology and the chemical composition of soils. His Excellency was, therefore, competent, not only from a familiar knowledge of the colony, but also as an educated critic, to give evidence that is of value touching the subject of the settlement of the land, and the degree of success that is likely to attend it when it is intelligently and industriously followed. Sir F. A. Weld's general description of the physical features is so clear and concise and instructive that it will bear reproduction. He says :—"The whole of the settled district, nearly the size of France, is usually level, often undulating, but never mountainous. The western seaboard is generally comparatively flat country of a sandy character, composed chiefly of the detritus of old coral reefs, which has been again deposited by the action of water ; more inland is a formation which is here called ironstone, it appears to be chiefly a conglomerate of disintegrated granite, stained with iron ; granite, slates, quartz, pipeclay, and in places trap, are all found in this country. The Darling range, for instance, presents these characteristics ; it runs from north to south in the central district inland of Perth, and appears once to have formed the coast line. The whole country, from north to south, excepting the spots cleared for cultivation, may be described as one vast forest, in the sense of being heavily timbered; sometimes, but comparatively seldom, the traveller comes upon an open sandplain, covered with shrubs and flowering plants in infinite variety and exquisite beauty, and often, especially in the northern and eastern districts, low scrubby trees and bushes fill the place of timber. On the whole, the soil may be said to possess immense productive powers under favorable circumstances." It may be added that the late Sir F. Napier Broome, who succeeded the late Sir W. F. C. Robinson to the Governorship in 1882, on a public platform expressed his conviction that the agricultural land available for settlement was capable of maintaining a much larger population than the colony at present possesses. Of the colony and people he said :—"The more one sees and knows of Western Australia and its people the more they win upon the newcomer." In later speeches he set a still higher value on the colony, its resources and capabilities, as well as the energy of its "handful of inhabitants." A large population could be maintained if the magnificent paddocks of Colonel Ashburner (another absentee landlord), bordering the Canning river, were subdivided. There is here one of the largest and most desirable swamps that anyone can point to, and as one of its boundaries is the river, the expense of draining it would be comparatively light. What a potato field it would make for the raising of two crops in the year, and the heaviest in the summer, when supplies are dearest. A black, peaty mould, the depth of which has not been reached, fills the swamp with a sturdy growth of water-loving vegetation. Now we are at Kelmscott, and the Gosse estate, a wide spread of meadow lea, to which the redgums, sparsely scattered, lend a very park-like aspect. It is satisfactory to be able to state that this holding is being cut up and sold for orchard purposes, on the principle that suburban blocks, being much higher in price than more distant places, should be made to yield the largest possible sum per acre. The Gosse patrimony would grow corn to perfection, but it is too valuable for corn, while alongside a railway line a fruit producer could be sure that his fruit would be none the worse for travelling a dozen miles or so to the tables of the people. It was some of the choicest of this land on the rising grounds approaching the range, that Messrs. M. E. Jull (Under Secretary for Public Works) and W. L. Owen (Warden of Menzies) obtained, on which to establish what is now a most flourishing and encouraging vineyard and orchard.

At Woongong there is a fine bit of level country consisting mostly of flats nearly as level as a table, and about a mile wide. Here there is another oasis in the miles of virgin forest country that we have passed through, in the form of wheat fields, where about 300 tons of chaff was cut last year, and there is also a very nicely kept orchard. To the west, the Messrs. Bateman, the owners of 12,000 acres, have been sedulous in laying down pastures in artificial grasses, a branch of the improvement of land that is more neglected in the west than in any part of Australia. They are operating on a stiff, rather low lying clay soil that shares with the Canning the patronage of metropolitan stock owners in order to give their animals the essential annual clay change. The grazing paddocks of the Messrs. Bateman are especially good towards the end of the summer, when there is, as a rule, a scarcity of feed. On the Darling range, about three miles east of Woongong, Mr. Butchers has an orchard of a few acres, the prolific character of which will be realised when it is stated that this season he declined £100 for the fruit of four orange trees. He has also, on a plateau of the range, a patch of lucerne which makes a marvellously quick and continuous growth.

Passing Cardup an attractive farm of 1,500 acres under the shadow of the range, where now, just after the sowing season, the young corn is shooting through the chocolate soil with a bright, strong growth that augurs well for another ton and a half of hay per acre—the average of last year's reaping—Whitby Falls, one of the most notable properties in the south-west, is neared, and it is worth breaking the journey till next day to inspect what has been accomplished by means of irrigation, whose potent forces are almost unapplied in Western Australia. Whitby Falls was purchased 11 years ago by Mr. William Paterson, now manager of the Agricultural Land Bank, and has since been purchased by the Government as a site for a lunatic asylum. The orchard at that time was neglected, but when Mr. Paterson relinquished it a few months ago it was one of the most productive in the colony. The site has many natural advantages. From the range there trickled a rivulet of water that suggested great possibilities of watering the orchard by gravitation, but in the hot weather there was only a trickle. Ring-barking the timber, however, in the neighborhood of the orchard and along the course of the stream, greatly increased the supply and enabled artificial watering to be carried on all through the summer.

Leaving Whiby Falls, and still going south, some miles of country that is chiefly jarrah forest intervene before we are upon the scene of the next object lesson that is calculated to teach so much to an intelligent and receptive observer who wishes to see what others have done, and what the country will grow to the best advantage, before he starts work on his own account. The forest is occupied by the Jarrahdale sawmills, a large and powerful company who have laid down a branch line extending from the South-western railway to the main timber station in the ranges further eastward. Jarrahdale, as its name would indicate to any Western Australian, is not a place where granaries will ever be seen, but the wine press would have plenty of occupation if all the vine land could tempt the peasantry of one of the provinces of France to make of it a second Moselle. Pushing on to the Serpentine, Lowlands, the estate of Mr. A. R. Richardson, is an unique example of natural irrigation, for here the Serpentine river disperses itself over flats, percolates through the soil, and resumes its course in its bed at a point nearer the sea. The Serpentine is a second Nile in its fertilising effects, and it would be very hard to find a place where stock will fatten more quickly than on Lowlands. Mr. Richardson, who has only just retired from public life, after sitting in the Legislative Assembly for the De Grey and holding with much honor and usefulness the portfolio of Commissioner of Crown Lands, did not find Lowlands what it is to-day. When he became its owner it was densely overgrown with flooded gums and undergrowth, which were very hard to kill in the deep, strong, moist loam. As fast as the flooded gums were ringbarked they threw up saplings and suckers so plentifully that it seemed a sisyphean labor to try and wrest the territory from their grasp. But Mr. Richardson was not to be daunted by the assertion that is often made, that if a flooded gum has plenty of water it is impossible to vanquish it. He had perseverance, and, fortunately, he had means, for Lowlands has always been a place that demanded a liberal expenditure of money. The saplings and suckers were ruthlessly decimated, hacked, and grubbed and burned year after year, every inch of ground that was so hardly won was resolutely guarded from further encroachment, until at last the flooded gums gave up the fight. In the end Mr. Richardson could survey square miles of magnificent pasture ground, clothed during the hottest season of the year with a high close mat of couch, and he can now send his sheep and cattle prime fat to the butcher at a time when locally fattened stock is very scarce In making a success of Lowlands, where cereals and fruit are also produced, Mr. Richardson has only put into practice the maxim that land, like a good horse, must not be left to take care of itself if it is to do good work and be worth keeping. In speaking from his place in the Legislative Assembly on one occasion, he dwelt strongly upon the evils of earth hunger of a man taking up more land than he could improve and thus turn to profitable account. The gist of his speech was that five acres of which the most is made are better than hundreds that are only partially productive, and Lowlands exemplifies that Mr. Richardson is a man who can not only speak to the purpose, but carry his theories out in a most thorough, workmanlike and practical manner —practical in the sense that a satisfactory balance sheet can be produced at the end of the year. For nearly half a century the site of Lowlands remained unimproved in the hands of the Colonization Estates' Company; it was one of the best of their grants, but the pasture hidden from the sun and light and choked by the trees was sour and watery; the land looked more like a partly dry morass and was passed over by scores of stock owners, who looked to the north-west and the Murchison for their ranches, while within 35 miles of Perth there was, ready to their hands, an area that, cleared and sown with grasses, would top a beast to the acre. On a smaller scale, perhaps, the rule will be found to apply all through Western Australia, and especially in the south-west, that a superficial examination, a quick discouragement when a piece of land is found to be thickly timbered or badly grassed, may lead to the rejection of a really good location. On the west side of the Serpentine station there is a very eligible block, the owners of which are the members of a company in New South Wales. It is several thousands of acres in extent, and nearly all of it ought to be helping to make up the shortage in the local wheat supply. Nearer the Darling range the good land is in narrow strips. Pushing on to North Dandalup the way is through some thick red gum forests and blackboy growth that the selector would be fortunate to obtain if the country hereabout belonged to the Crown The river at North Dandalup runs throughout the year and intersects this estate, and so does the railway for several miles. Creaton, the estate of the Paterson family, was originally part of the grants. The Murray river, the Perth road and the Mandurah road, and also a belt of limestone, cut through Creaton, which embraces 12,000 acres, a very large proportion of which has been improved so highly as to be almost outside the pale of the Agricultural Lands Purchase Act, notwithstanding that the legatees are prepared to treat with a purchaser. Pinjarrah is, owing to its fertility, rainfall, and nearness to Perth, with which it is joined by rail, one of the safest districts for new men to get a prosperous foothold. The river flats of Creaton make splendid wheat paddocks, which have been cropped for many years. There are also some swamp lands upon which pigs are raised without any special attention, until they are wanted for the fattening pen on the approach of the bacon curing season. Some excellent fruit also comes from the banks of the Murray near the Creaton homestead.

The frontages to the Murray about Pinjarrah were among the first blocks to become the holdings of men who had the resources and the energy to convert them into squattages, pig farms, orchards and vineyards. The names of Edward and Duncan McLarty (Beamlelup), Duncan McLarty (Blythwood), Paterson (Creaton), Captain Thomas (Ravenswood park), and Captain Fa vcett (Pinjarrah park), are synonyms in the south-west for yeomen on a large scale, who worked hard themselves and employed a great deal of labor. They have been steadily enlarging their scope of work, adding field to field, barn to barn, until their places have become the convincing grounds for jaundiced sceptics who, visiting the colony in the course of a globe trotting tour, are occasionally prone to sneer at Western Australia as a producing country, simply because what Governor Broome called her "handful of inhabitants" have not been numerous enough to spread over her wide dominions and make everywhere blades of corn grow where only indigenous scrub grew before. Pinjarrah and its highly improved estates may be regarded as a land of promise, where those who have toiled and been successful, who have carved arable lands out of the giant forests, and who, long before a railway was thought of, had the pluck to cart wheat and hay to Perth, are enjoying the guerdon of their stubborn uphill march. At Coolup, a railway station within eight miles, we see men whose work is just commencing, whose conquest and secure independence in taking up the vocation of a farmer has yet to be achieved. The Coolup agricultural area contains 50,000 acres, which formed the northern portion of what was at first gazetted as the Harvey area. The surveyed section includes 30,005 acres, forming 217 allotments, of which about 50 have been taken up. The area, the northern portion of which is within two miles of Pinjarrah station, was thrown open in Sepember, 1893, and it is nearly midway between Perth and Bunbury. This land is the nearest to the city, suitable for a market gardener, that is available under the provisions of the Homesteads Act for the granting of a free farm of 150 acres, but the locality is not so well drained as could be desired, although there are facilities for draining it into the Murray which winds through it. Along the river there is a somewhat narrow line of superior loam which the residents, in some cases, are using for the rearing of fruit and vegetables. The larger proportion of the Coolup area consists of yellow clay, that forms indifferent grazing ground, but produces good crops of wheat when it is well broken up and dressed with bone dust. There are also light loamy tracts from which the surplus water, even in the hollows, readily disappears. Back from the river, wells have to be sunk to get water, which is obtained within 20 feet, if judgment is shown in picking out a likely spot. There are some large holdings on the area, notably those of Mr. Kirkham and the Messrs. Olsen Bros. Mr. Kirkham, who is on the Murray close to where the road from the railway station is surveyed to the river, is an English farmer of experience who knew his business so well that on selling out in order to emigrate to Western Australia he was able to bring with him a not inconsiderable sum of money. He bought out an original selector on the river frontage and, aided by a number of sturdy and willing sons, he soon cleared some hundreds of acres on his holding and is now cropping 100 acres. So far he has had occasion to be well satisfied with his yield of hay, which, during the first year after the plough was put in, was something in the nature of an experiment, as seed had never before been sown on the area proper, although Mr. Robert Herron, a squatter, on the opposite bank of the Murray, had for some years been tilling one of his home paddocks. This paddock, however, was stiff land, while Mr. Kirkham's is a soil of a much more friable nature. The success of Mr. Kirkham has given a great stimulus to the development of the area, but so far most of the work has been done either on the river banks or close to Pinjarrah, where some of the richest paddocks were taken up very soon after the declaration of the area. Here there is most cheering evidence that the legislature acted wisely in consenting to bestow 160 acres upon every *bona fide* settler, for the holdings close to Pinjarrah are nearly all of this class, and improvements in the effacement of timber and replacing red gums with fruit-trees are proceeding apace, as if each selector were vieing with his neighbour to see who will first be qualified to claim his title from the Crown by reason of having fully complied with all the conditions of the Act. The Messrs. Olsen Brothers, whose place is a few miles further to the south-east, being determined to lay a good foundation, have put in a well-concerted series of drains before hurrying on with the sowing of seed. Last year was, nevertheless, made good use of in the breaking of land in readiness for 1897, and, at the time of writing, not only had the drainage scheme been completed, but the fallowed land, which had been sweetening for 12 months, was disclosing a very healthy young crop, and the owners of it could contemplate it with a sense of security, no matter how heavy the rainfall might be, for the drains were faithfully doing their work. A serious drawback to the area is being removed in the erection of a bridge across the Murray. Up to the present time the only access to the railway station has been by means of a ford that is flooded in the winter, during which the settlers have to make a detour of 16 miles in order to cart loading to and from Pinjarrah. As soon as the disability was brought under the notice of Sir John Forrest by a deputation of the residents, the Premier, in pursuance of his policy to help the producer, put a sum on the Estimates to construct a substantial bridge, which is to cost, wi h the necessary making of the road leading to it, about £2,000. When these works are completed the selector on the Coolup area will be closer to his market than his compeers on any other area, with the exception of Jandakot; but if the Coolup railway station is to be considered as the market, for the carting ends there and the freights for the short run to Perth are very light, the Coolup grower is nearer than any other holder of a free homestead farm, for there is not a railway to Jandakot, although one has been talked of.

The Harvey agricultural area adjoins that of Coolup on the southern boundary of the latter. The Harvey area was thrown open for selection in January, 1893, and covers 43,000 acres. The survey takes in 155 blocks and 19,803 acres. More than 10,000 acres have been alienated. The area is 40 miles from Bunbury and 76 from Perth; the South-western railway is laid throughout its length. There is, perhaps, no area that would be so rapidly taken up if portions of it were not liable to be inundated by the storm waters from the higher country near the ranges. In spite, however, of this risk, settlement on the Harvey has been proceeding briskly, and happily, without untoward circumstances retarding the prosperity of the selectors, who for the last few years have been favored with very mild winters. Nevertheless, the danger has been the subject of earnest representations to the Government through the medium of the Producers' conferences, which in 1896 passed a resolution to the effect that it was expedient that a drainage scheme should be undertaken, in order to protect settlers from flood in the south-west. A somewhat tardy commencement was made by the Public Works department to accomplish the object aimed at in this manifesto, and the subject again came before the conference in the following year, when the South Murray Farmers' Agricultural Association sought to hasten the completion of the work. The Public Works department announced that surveys had been made, and that the most urgent precautions against flood would be immediately executed. In the discussion that ensued one delegate suggested that the drainage of the Harvey and Collie agricultural areas were only local issues, and that the conference should confine its attention to national questions, but this view was strongly combated by the Hon. E. McLarty, who, in the course of his address, submitted some important observations as to the broad matters of general concern to the welfare of the colony that were embraced in the topic, and supported his view by citing the following reasons for the position he took up: "I cannot agree with the argument that the motion dealing with the drainage of a large portion of the south-west is purely a local question, affecting one particular district. The object of these motions is to have a large area of fertile and cultivable land thrown open for, and made available to, settlement. Until the drains are cut there will be thousands of acres of Crown lands, otherwise eligible for settlement, but liable to flood in the winter, and, therefore, almost useless. It is the general impression among those who know the land, and in this belief I share, that if the flood waters could be thrown off the land at the Harvey it would be very productive. I have noticed that new settlers produced last year excellent crops on some portions of this land, but the reason was that we had a very mild winter. We did not have in the south-west the usual amount of rainfall, and the land was not swamped. Therefore, some magnificent crops, which I have never seen excelled, were grown, which proved that the land is rich, provided inundating water can be kept off it. It ought to be a very simple matter to get rid of the water, as there is a good fall to the estuary. The other day I had a conversation with the Minister of Public Works, and he asked my opinion on this matter. I had no hesitation in saying that the draining of the land would be a judicious expenditure and one that would do a great deal of good. I pointed out to him the magnificent crops that were grown there last season, which I attributed mainly to the fact that there had been a very mild winter. If, I added, there were drains to take the water off, similar crops could be produced every year. I am pleased to learn that the Government is going into the matter of having the drains made. The drains can be cut for a very small cost. The original estimate was 9d. per yard, but it has been found that with improved appliances the cost is reduced to 3d. per yard, which certainly would not be a very great item. I have the greatest confidence that if the Government carries out this work, it will be the means of settling a great many people on the land." Doubtless the low estimate given by Mr. McLarty in the foregoing extract, of the cost of making drains, will be noted by intending settlers on the Harvey agricultural area, as it shows even if they have to put in some auxiliary cuttings after the general scheme has been completed, the outlay is not one that need act as a deterrent to those, who in all respects, save that of drainage, may regard the Harvey country as a desirable location. There is also a large area of land to the west of the Harvey river that is eminently adapted for summer crops of potatoes. Here the intense cultivator would find his chance among the gullies and river bottoms that intersperse the range. These choice spots are not of large acreage, but that is immaterial when 10 acres are good enough to make a good living out of and provide, as well, for putting by something for a rainy day. These swamp patches can all be easily drained, as the brooks which are the tributaries of the Harvey and Murray rivers are on steep grades and of great width.

Speaking of a representative piece of the Harvey country that was chosen by Governor Stirling for his own use, when he had all the lands of Western Australia to choose from in 1829, Mr. Charles Harper, M.L.A., Chairman of the Bureau of Agriculture, said :—"The stranger travelling by the South-western railway, and getting out at the Harvey river station, is at once struck by the remarkable picturesqueness of the surroundings. Tall red gums here and there darken the sky with their heavy foliage, and battalions of blackboys are drawn up in picturesque array. The richness and density of the forest and other growth convey the impression that the land must be exceedingly rich and fertile, and capable of carrying other and more profitable vegetation. A few minutes' drive to the eastward takes you to the foot of the Darling range. A sparkling stream rushes out of the forest-covered hills which overlook the fertile plains below. Below the Harvey residence the river bank on the south side has been brought under cultivation, though many of the old giants of the forest stand in their gaunt and grim solitude, frowning on the smiling fields at their feet. The deep rich loam of these fields seems almost too good for cereal crops, and suggests that root crops and vegetables and fruit would here find a happy home. A little water laid on from the mountain stream would make this one of the loveliest spots in the district. Fruit trees seem to thrive hereabout vigorously, and with véry little attention, the citrous tribe being remarkable for their healthy and rapid growth, and are apparently blightless. There is a marked difference between the country here on the face of the range and the country correspondingly situated to the north of the Canning river. There is very little scrub, and not much rock. The quality of the soil at the foot of the hills, and on the spurs, and even to the crest of the range, is so good in many places as to be well adapted for cultivation. It is of a nature to be admirably adapted for the growth of the vine and the production of a high-class wine. A vineyard, ten acres in extent, has been planted with the carbenet sauvignon grape on one of the slopes, and although it has received only intermittent attention, such as the manager of the sheep, cattle, farm, and dairy could give it, many of the vines look capable of anything which vigorous growth can produce. It may safely be said that if gravelly and easily cultivated hilly slopes, blessed with an ample rainfall in winter, and bright skies in summer and autumn, go to make up the requirements of a good vine-growing and wine-producing country, these are all here in rich abundance. The country below the range may be generally described as a red gum forest, the trees varying from three to ten to the acre, with a considerable growth of blackboys, but nothing else in the way of the plough. . . . Opinions vary as to the corn-growing capabilities of the land. Some set down the yield at 15 bushels; some at 20 bushels to the acre; but all agree that a little bone dust produces a marked and lasting effect. A remarkable feature of this country for Western Australia is its evenness of character and generally unbroken nature. Once cleared, there would be nothing but a few watercourses to prevent the cultivation of 10,000 acres without a break. The tall trees and the blackboys are, as I have said, a testimony to the fertility of the soil; but whether the best return will come from cereals, grazing, dairying, or fruit, remains to be seen."

The expert testimony of Mr. A. Despeissis, M.R.A.C., who is in charge of the viticultural and horticultural departments of the Bureau of Agriculture, has been given of the merits of the Harvey. From his report we take the following conclusions, which will apply to the major portion of the south-west :—" Climate.—The climate is cool and temperate; the latitude is 33° S. From official returns I find the annual rainfall for a number of years is 37 inches per annum, being more than double what it is on the Avon. From Beverley, through York, Northam and Toodyay, where, even with the scanty rainfall, fruit growing and mixed farming are being profitably carried on, the rainy season sets in in April and practically terminates in October, although all through the summer occasional thunderstorms supply to vegetation an amount of moisture, which, although it does not interfere with the process of ripening of fruit or of harvesting, maintains the plant in a state of luxuriant growth. The Harvey runs all the year round and follows a winding course. Numerous springs, which could easily be developed after the clearing of the country, act as feeders to it, and make of the question of water supply an easy one, offering at the same time great advantages and facilities for summer irrigation and the successful raising of catch crops in the summer time. Owing to the proximity of the sea, 15 miles in a straight line, destructive frosts never harm potatoes and other tender crops, and the climate may be said to be well adapted for the pursuit of mixed farming as well as fruit growing, more especially fruit from the temperate climates, such as apples, pears, etc., as well also as trees requiring a greater amount of rainfall to mature to perfection, viz.—oranges and lemons. Grapes thrive admirably in this district. The nature of the soil varies from (a) a light loam with a good admixture of gravel in it, and is especially suitable for the purpose of vine growing. This land is now under red gum (*eucalyptus callophylla*) and jarrah (*E. marginata*), of fine growth, which testify to its quality; (b) a few patches of ironstone gravel overlying a strong subsoil (jarrah and white gum—*E. redunca*—country) on the top of hills and spurs from the Darling range; (c) rich red loam of volcanic origin, with a few boulders of basaltic rocks in it. This land is very fertile and especially adapted for fruit growing as well as mixed farming (red gums and blackboys or grass trees of very large size—*xanthorea*); (d) rich deep alluvial flats alongside the river banks and in between the spurs and undulations of the ground. This soil is under red gum and blackboys of very large size. Lucerne, root crops, heavy hay crops, as well as fruit trees of all sorts, from the apple, the pear, to the orange and lemon, do splendidly on such soil which, once cleared, is easy of cultivation and is of great fertility. The cost of clearing the land at the Harvey would amount, according to the means generally employed for that purpose through the country, from £6 to £10 per acre on an average, and if the trees were killed either by the methods of ringbarking or sapping, it would, a year or two after, cost from 25 to 30 per cent. less. The future of the place is the great possibility it offers as a fruit and vine growing colony, combined with mixed farming, comprising the cultivation of potatoes, lucerne, tobacco, corn for hay, maize, and also their conversion into pork, mutton and beef for the colonial market."

The Uduc agricultural area joins the south line of the Harvey area; it comprises 12,000 acres and was thrown open for selection in August, 1894. The survey includes 54 lots aggregating 8,415 acres, of which up to date 1,400 acres have been chosen by eight occupiers. Uduc is about five miles south-west from Cookernup townsite, 80 miles from Perth. The blocks could be worked under practically the same conditions as those described for the Harvey area. Many of the most central had been taken up before the land was subdivided, by people who are gradually applying for others to increase their holdings.

In the vicinity of the Brunswick river, which is crossed in going from Perth to Bunbury a few miles below the Uduc agricultural area, there are some dairymen who send butter to the city; but the quantity is so small that very few people of the colony ever taste the home-made article. The output of the Brunswick is chiefly consigned to large householders in easy circumstances, who do not cavil at paying 2s. per pound for a prime fresh local brand; but even this return has not so far encouraged many butter-makers to enter the field. In the late winter and spring some butter is made, but as soon as the flush of green feed has given place to the yellow tinge of the ripening summer the churn is put away as an implement that it will not pay to use. The dairyman who peruses this chapter and who is accustomed to modern methods of cream producing and butter making, will perceive that given a rainfall of at least 35 inches—38 inches would be nearer the quantity if we wished to press the point of plenty of moisture—and loam lands that can be watered in summer, he could do well in a country where milk is never less than sixpence per quart retail, nor butter less than fifteenpence per pound. If he should be in eastern Australia he will know that he would be well satisfied to receive one third of these returns, and that in places which are not so near market, where railways are not running almost past his door, as they are in the south-west district, and where land suitable for dairying costs very much nearer £10 per acre than the ten shillings per acre he would have to give in the west for any area in excess of the 160 acres comprising his free homestead farm. The truth is that Western Australia buys her butter abroad just as, speaking generally, she buys her wheat beyond her bounds, not because it does not pay to produce milk, butter, and wheat, but because she is too young—dating her birth from the inception of responsible government, which was her real starting point in national progress—to have had time to supply her needs from the fruits of the soil.

Beyond the Brunswick we are at Dardanup, the most notable estate in which neighborhood is Prinsep park, once the property of Mr. H. W. Venn, who for five years held the post in the Forrest Ministry of Commissioner of Railways and Public Works. Mr. Venn had a fine herd of Ayrshires, which was dispersed when he sold Prinsep park to an English syndicate, who have a belief that payable gold will be found in the locality. There is a fine expanse of fertile ground in the possession of the Australind, an English company that is merely nursing the princely present that was handed over by the Crown under the old location grant system. It still remains to be developed by the race of new settlers who are being drawn westward by a more liberal land law than obtains in any other part of the world. Journeying on, the Collie agricultural area is entered upon, and it extends to within eight miles of Bunbury, which is widely known as the birthplace of the Premier of the colony, the Right Honorable Sir John Forrest, K.C.M.G. The whole of the Collie area, which is a very popular one owing to its proximity to the port and market of Bunbury, where important harbor works are in progress at a cost of £100,000, has been selected, with the exception of two blocks, and the greater portion is under cultivation. The unoccupied allotments are of 100 acres each. The area embraces 7,150 acres, subdivided into fifty-one holdings. It has been available since February, 1892, and is served by both the South-western railway and the extension of the line to Busselton and Donnybrook. The soil is mostly of a stiff clayey character, on which fruit and vegetables do better than cereals. The land will be improved when some drains of a serviceable capacity are cut to carry the surplus rainfall into the Collie river. It has been found necessary to enlarge the original area, owing to the great eagerness that has been shown to select thereon. The drainage could be perfected at a very moderate cost, and the Government are now having the work done in response to representations that were made by the residents.

From Bunbury and Picton Junction, close to Bunbury, there branches out to the south-west and south-east respectively two new railway lines through two of the most important agricultural districts in the colony, namely, the Blackwood and Bridgetown districts, which call for notice in some detail, because of the large areas of eligible lands which are available there for selection. The districts form the continuation of the fertile country for which Bunbury is celebrated, and which contain some of the most notable examples of what can be wrought by the aid of capital, scientific cultivation and determination to make swamp lands which are dark and unprepossessing in their virgin state, blossom with the harvest of plenty. The best of the land of Bunbury is, in the estimation of one of the most respected authorities upon the agrononomical resources of the colony, Mr. William Paterson, (for it has been his duty to examine all parts in greater detail than other men) the best that is to be found anywhere in the west, from the Vasse to Geraldton, or from Fremantle to Meckering, and in support of his conviction he points to the vineyard and orchard of Mr. Ephraim Clarke, mayor of Bunbury, which are bowers of beauty and luxuriance. The land was heavily timbered before it was reclaimed. It is so fertile that it will grow to perfection anything that has been tried there, from cabbages, turnips and potatoes, to grapes, apples, and peaches. A very heavy crop of cereals, including maize, could be taken off it if the land were not too valuable for general farming. Mr. Clarke has taken the lead in showing what the district can do under proper treatment, but he does not possess a monopoly of the high class areas. There is besides, all the way from Bunbury to Mundurah, a great deal of land that for orchards and vineyards is not to be surpassed. It is of a sandy nature, with limestone subsoil. The great disability is that much of the best land was alienated from the Crown in the early days of the colony, and in too many instances it is left practically idle. This is the more to be regretted because the district is so well-watered that it is suitable for close settlement. It has the Collie, Preston, Capel and Harvey rivers and many affluents running through it, so that farmers are not put to the expense of making wells and the labor of drawing water for stock or domestic purposes; water can, however, be struck at from 10 ft. to 20 ft. In the driest season there is never any fear of drought, and the Boyanup and Dardanup plains could easily be irrigated. The Preston river furnishes an ample supply of water for the purpose, but it would have to be raised by pumping. Parts of the Harvey and Uduc agricultural areas also present facilities for irrigation. The general character of the soil around Bunbury cannot be described in a word or two, as it exhibits many varieties. There is a rich loam in the swamps along the coast, and further inland good red loam is met with, and ironstone ridges among the hills. Near the sea line some sand plains intersperse the more fertile country. The configuration of this division of the colony is as full of contrasts as the land, for from stretches of level flat the traveller can, without leaving the territory of Bunbury, get into mountainous country, rough enough to tax his bushcraft. These gravelly hills grow splendid jarrah; red gum indicates the superior chocolate loams; swamp gums shade the fringes of the rivers and the creeks; paperbark trees shaggily appear in the beds of the swamps; banksias in the sand plains; tuart on the limestone formation, and blackbutt on the deepest and most valuable spots of all—the pitch black loams that teem with practically inexhaustible plant food of every kind. With so much variety in the size and density of the timber it will be understood that the cost of clearing land ready for the plough has a range from £3 to £20 per acre, but the larger figure would only be demanded for the subjugation of small patches of the swamps, an acre of which, producing two crops per annum of potatoes, would be equal in its earnings to 20 acres of cereal paddocks. It should be noted by any student of the Bunbury district, that there is no more profitable rural industry at the present time than potato growing in well drained swamp land, if the precaution is taken before commencing operations of obtaining from the laboratory of the Bureau of Agriculture an analysis of the soil of the block selected, in order to make sure that the swamp is not too largely impregnated with salts to be profitable to work. The presence of saline deposits in swamps is not common along the south-western coast of Western Australia, but cases of the kind have come to light in one or two instances, and the defect has only been cured by treatment that is applied under the direction of the experts of the Bureau. With this reservation the most experienced residents about Bunbury recommend the potato as the staple crop in preference to wheat or oats. As much as eight tons of potatoes per acre are commonly dug, and the crop is worth from £8 to £10 per ton, while there is a railway to carry the produce to market after only a few miles of carting. The average yield of potatoes is four tons per acre, and of hay one ton per acre. Nearly all kinds of farming crops are grown, but not often in large quantities by any one cultivator. The settlers of Bunbury have so many aids in their climate, rainfall and excellent sale for produce, that they are, on the whole, a substantial and prosperous class of yeomanry, and there are still thousands of acres of Crown lands open for selection in the district on the various agricultural areas (except the Collie) within ten miles radius of either side of a railway line. Settlement has been steadily progressing during the last five years, and it has received a great impetus of late, as is shown by the returns which are regularly published. All descriptions of fruits—including those of the berry tribes, which do not thrive in the eastern division—are grown, but chiefly apples, oranges, grapes and stone fruits; these succeed well with reasonable care, if judgment has been shown in choosing the site of the orchard. The assistance of the Land bank has been mostly sought by new men, the older inhabitants being too well established to stand in need of loans, even when these are granted on the most liberal terms. As the rainfall is from 36 to 40 inches per annum, and it nearly all falls between April and October, the winters are very wet and the outlying roads become very sodden, so that some privation in this respect must be borne by those who go on to original holdings. There is, however, a long spell of fine weather during a somewhat protracted summer, and most of the heavy carting occurs while the roads are at their best. The seasons are mild and very regular, so that he who sows is sure to reap. Many of the farms are from 100 to 200 acres, and these are deemed to be quite large enough either to meet the needs of a man who has a family to rear in solid comfort, or to find employment, as a rule, for all his available resources of capital and labor. It is held to be a mistake for a man to burden himself with a large area of unimproved land. The concentration of improvements and cultivation multiplies the income, while the spreading of imperfect work—imperfect because more is undertaken than can be accomplished—over a great deal of ground fritters it away in non-productive outlay. The chief thing to be aimed at is to get some land cleared—even if it be only a few acres —and some crop in the first season. The amount of capital each man will require in going on the land cannot be stated on one uniform scale ; it will depend upon the individual thrift, good management, and the number of the family who will have to be supported while the preliminary work is being done and the first yield is as yet in the ground. The only safe general rule that can be formulated is that the sum in hand should be sufficient to buy tools, plough horses, stores, fencing wire, clothing and sundries for the first twelve months. That is to say, this rule will apply if a man has no intention to work half time at home and half time to assist in giving him a start wherever he can get employment in his neighborhood. This method of getting in the foundation of one's own homestead has been followed by some of the settlers in every district with the happiest results. A man who is determined to lift himself out of the grade of a laborer for hire into that of an independent cultivator, may have some difficulties to overcome and his headway will not be so rapid as that of others who have the potent leverage of means to help them to achieve their goal, but, nevertheless, the path is not an insuperable one to tread. Moreover, those who have the grit, the youth, and the foresight to choose it, are pretty sure to have the qualities that, as they get over the first struggle, will enable them to make a better use of their earnings and their opportunities than some of those who have never had to surmount so many obstacles in the way of their success. The man who, starting life with no adventitious aids, but, having a stout heart and a pair of arms that he is not afraid of using, puts his wages into the best of all banks in accepting 160 acres as a free homestead farm in Western Australia. He saves house rent, municipal taxes, water rates, and a bill for firewood and many other items of expenditure that drain the purse of the worker in the city, while he is stimulated not only by the freshness of the air in the country, but also by the knowledge that he is making a certain provision for middle life. The settler in the Bunbury district need have no qualms that his children will not be within easy reach of a school, or that the schoolmaster's fees will be an item that he will have to reckon among his bill of expenses, for the Government has made the most liberal provision for the gratuitous education of the rising generation. There are public schools in charge of certificated teachers at Bunbury, Picton, Waterloo, Brunswick, Cookernup, Yarloop, Coolingup, Boyanup, Dardanup, Ferguson, Donnybrook, and Upper Preston. Another question may arise—" How much land should I take up, supposing I select outside an agricultural area where there are no free homestead farms ?" The counsel of capable guides, touching the Bunbury district, is that not less than the minimum conditional purchase area—100 acres—should be obtained in preference to a " garden block " of smaller size, for several reasons, the chief of which are economy of early charges and great elbow room. Take the case of a piece of land which, 100 acres in extent, includes a swamp or other exceptionally good garden or orchard block. If the selector applies for the choicest few acres of this allotment, say, from five to twenty acres, he has to pay £1 per acre cash for them, or as much as would (supposing 25 acres to be bought) pay the conditional purchase rent of £2 10s. per annum of 100 acres for eight years, and at the same time the holder of the garden or orchard lot would have little or no grazing land for his working horses or family cow. Therefore, the case is plainly in favour of applying for the 100 acres as a conditional purchase, even by the intense cultivator who does not contemplate cropping nearly the whole of that area.

It surely is a great recommendation of the south-west that, instead of the seller of produce having to seek out the purchaser, in accordance with the customary law of trade, the farmer and orchardist is canvassed by the agents of the city and goldfields merchants, who desire to buy forward before the crop is off the ground. This is especially the case in regard to potatoes, chaff, and fruits in Bunbury and its environment, for when these products are to be had there, the quality is assured. The low railway freights, too, are another incentive to put as much land as possible under cultivation for what is held to be, at the present time, the best market in the world. The returns from land in good heart are so liberal that we are told the most profitable course is to keep it in that condition by using, every second year, a dressing of from 2 cwts. to 4 cwts. of bone dust per acre. Unless some fertiliser is employed the light sandy soils exhaust themselves, and although the alluvial river flats, swamps, and heavy loams could stand the drain for many years, it is not regarded as good farming to overdraw upon the resources of the ground. The most successful growers started with manuring, have continued it, and have not given their farms a chance to grow sickly crops. Every year the area under vines and fruits is being added to, as the profits are larger from these products than from the raising of cereals ; and to a man who takes a delight in having a charming and picturesque homestead, the care of a garden is more attractive than the ordinary round of sowing and reaping, which leaves the eye only fallow or stubble to rest upon for several months in the autumn and early winter. The cultivation of maize, as well as vegetables, sorghum, and lucerne, is strongly recommended by those who speak with the greatest knowledge as to the capabilities of the district. They hold that far too little has been done to utilise these sources of large profits and quick returns, which the heavy rainfall, the deep soils, and the temperate climate combine in making a large portion of the most congenial output of local production. It is also found to pay well to keep sheep in the cultivation paddocks after the harvest has been garnered ; store sheep fatten rapidly, and there is always a good demand for fat stock. One source of trouble is the wild dog, especially on the outlying boundaries. Eaglehawks also make away with a percentage of lambs, and boodie rats, opossums, parrots, and silvereyes do some damage among the fruit trees and cereal crops; but as settlement goes on, and the more stringent provisions for imposing a vermin rate and paying bonuses come into force, in accordance with the resolution of the Producers' conference, these pests may be fairly expected to almost wholly disappear. Happily, poison plants are almost unknown, but specimens, chiefly of the heartleaf variety, have been found. The note made by one well-informed authority on this subject says :—"There is poison in this district, but not to anything like the same extent as in many other parts of the colony." Bunbury is said, by those who have tried it longest, to be "a fair district for stock, particularly along the coast." The principal grasses are on the occupied lands near the coast, and comprise couch grass, several varieties of trefoil, prairie and rye grasses, all of which are spreading fast, as well as many valuable native grasses. The arable lands are in good sized blocks on the large private estates, but the selector must be content with paddocks of from 10 acres to 50 acres, all good and fit for the plough. Since the great flow of immigration commenced, four or five years ago, there has been a large influx of settlers, chiefly from the other Australian colonies. They are mostly men of English blood, with an infusion of Irish, Scotch, Germans, Italians, and Scandinavians. The value of modern implements of agriculture is becoming daily better recognised, and those of the older patterns are being put aside in favor of machines which are being largely ordered or have arrived. Double and treble furrow ploughs, reapers and binders, and steam plant for chaffing hay, are now in common use. It is desirable, according to the admission of the graziers, that more should be done for the improvement of flocks and herds. A few stations have imported pedigreed stallions, bulls, and rams, but there is still room for more attention and money being turned in the direction of raising the grades of draught horses, and obtaining larger beef and mutton carcases to contribute to the meat supply. The great essential for doing this rapidly and on a sound basis is to form artificial pastures, but until there is more than enough land cleared than is required for cropping, those who have contributed the data for this chapter say that there will be a reluctance to run stock on anything better than ringbarked land or fields of stubble. The statement exhibits how much scope there is for an enlarged scale of operations in the reclamation of land. Here again our informants point out that the labor trouble interposes itself. It is pointed out that there is more work in Western Australia than there are hands to accomplish within a few years. She wants to clear her forests and at the same time carry out a broad and enterprising public works policy, and the result is that able bodied men are in great demand. The farmers want them, and so do the contractors, and the competition sometimes causes the latter to outbid the former in the rate of wages they are willing to pay to get hands. So much the better for the over-crowded laborer of older communities, who has to hustle his neighbor in finding an employer and, therefore, young men, or those in the prime of life, and who get their living under the hardest of conditions elsewhere, should be eager to come to a country where they may get a higher rate of pay, and very often better food and healthier surroundings.

Now we come to a cardinal feature in the land settlement question of Western Australia, and one of our contributors has made some remarks upon it that are so pregnant and full of pith that they must be printed in extenso. He says:—"Nearly all the food supplies, which at the present have either to be imported or done without, could be produced in the south-western district. I do not see why we should have to rely on the other colonies for butter, cheese, bacon, jam and such things all the year round, and potatoes and onions for a great part of it. The supply of fruit is far below requirements, as can be seen from the absurdly high price it fetches. This (Bunbury) district will some day produce as much fruit as can be consumed by the whole of the colony." It is freely admitted that dairying is neglected. As has been previously mentioned, vegetables are not grown wholesale on all the good black swamp lands, but only on small widely-scattered plots, while there are places belonging to the Crown that would equally well repay the industry of the husbandman. There are, besides, private estates which await subdivision, and which are most advantageously situated in regard to railway communication, being only on the outskirts of the town of Bunbury. For some years, until the harbour works are completed, there will be a large local demand for vegetables, and the wants of the large numbers of holiday-makers, who make Bunbury their watering place in the summer season, will offer a good opening to those who work garden land judiciously. Besides, it is anticipated that the development of the Collie coal deposits within a few miles of Bunbury will ensure a large and permanent population. On the coast, frosts are no menace to the potato grower, and it is near the sea, fortunately, that the best land for this crop is mostly to be found. Further inland, frosts are occasionally very severe and damaging in their effects, especially from June to September. The best land in the Bunbury district is well adapted for close settlement, that is to say, for subdivision in ten to 20-acre blocks, if the holders are satisfied to do without grazing ground and will grow fodder for their horses and cows. The keeping of poultry is an adjunct to every steading, but fowls are not kept as a speciality; bees have no keepers, with one or two exceptions, and an isolated hive here and there. The chief requisites for the well doing of new settlers are set down as follow:—(1). A fair amount of capital. (2). Energy, perseverance, and a willingness to take advantage of the experience and advice of a successful neighbor. Ringbarking is recommended as the first step after selecting, to expedite the clearing of all the land that cannot be grubbed while it is green, in order to sow early and get a return in the first season. The better the land, the heavier the clearing ; but the greater yields obtained from what have been forest lands soon compensate for the initial cost in preparing them for cultivation, as contrasted with the lighter clearing and smaller returns that may be expected from the sandy areas. The favorite fertiliser has been bone dust, but superphosphate and desiccated nightsoil are coming into vogue as the result of experiments which have shown that they have the most appreciable effect in forwarding and enlarging the crop. Liberal manuring is always money well spent. So far as is publicly known, there are not around Bunbury any privately owned eligible properties that are open for subdivisional sale or for occupation under improvement leases, but there is plenty of choice on Crown territory. In conclusion, it is laid down as the outcome of the investigation that has been very carefully conducted by the direction of the Bureau of Agriculture, that the chief advantages of the Bunbury district are :—(1). Its mild and healthy climate, that makes it the congenial home of all but tropical vegetation. (2). The richness of the soil and plentiful supply of good building and fencing material. (3). Its regular and plenteous rainfall, and consequently well-nourished crops, and an abundant supply of water for man and stock.

Away to the south of Bunbury to what is colloquially known as the Vasse, which is designated on the map as Busselton, on the shores of Hamelin harbor, excellent country is passed through. Mr. William Paterson, whom we have more than once justly cited as an authority on the natural resources of the colony, says between Bunbury and Busselton there are thousands of acres as good as the site of the orchard of Mr. Clarke, which has been eulogised as an ideal place for fruit (including grapes) and vegetables. To avoid repetition, it may be said at once that this tract has every attribute for producing potato crops equal to those of Ireland, and that at present it is so sparsely populated that there is room there for several shiploads of immigrants, whom the people of Western Australia would welcome, if they bent their energies to the task of relieving them of the necessity of importing food supplies, the payments for which, of course, deplete the wealth of the community by those sums being withdrawn from local circulation. Busselton is 32 miles from Bunbury ; it is a picturesque seaport town, and has been compared with Bournemouth, both as regards its climate and extensive sea beach. Busselton is situated at the head of Geographe Bay. Cape Naturaliste, a bold headland, rises on the coast line to the south. As a summer resort, the Vasse, where excellent fishing is to be had, is connected with the South-western railway *via* Boyanup, and is in high repute as a watering-place, being regarded as the Tasmania of the west. It rivals Tasmania in growing remarkably fine fruits of all the English varieties, and the harbor is a safe and pleasant yachting ground. The choice is offered of swamp and forest lands, and if the clearing is rather heavy it is repaid by the fertility and stamina of the soil. It is well-known that the further the traveller goes south the broader becomes the stretches of superior land between the mountains and the sea, and this is well exemplified now that we have gone from Fremantle southward, nearly 200 miles, and are inspecting the grand territory in the neighbourhood of the Vasse. The land only wants working to yield a great increase ; but so far very little of it has been worked, the few settlers being content to use tolerably large holdings, chiefly for grazing, from which they have derived a comfortable livelihood, without doing a great deal of farming or orchard culture. The gifts of nature have been so prodigally bestowed that the inheritors of them could not grasp them all ; the horn of plenty is full and overflowing. Who will profit by it? Why should there be any poverty or hunger in the crowded communities of the old world, when there is such a splendid field for emigration—such bountiful offers from the state as that of free grants of land and loans of money to bring it into subjection and profit. If it were planted with apples, stone fruits, and raspberries, strawberries, and gooseberries, the Vasse country would be able to compete with the world ; its fruits could be shipped fresh to England and the Continent under the improved methods of packing and carriage that are now in vogue, and landed at the other side of the globe in perfect condition after only a four weeks' voyage, at the season when gourmets are depending upon the exotics of hot-houses to supply their tables with desserts. In being so much nearer the great markets of the world than the orchards of Victoria, South Australia and New South Wales, the Vasse, with its highly suitable soil and climate, is marked out as a specially favored fruit-growing ground ; with its copious rainfall it is independent of the costly scheme of irrigation which has threatened Mildura with disaster. Hence it is claimed that this division of the south-west has great potentialities for a productiveness that makes it resemble a payable lode into which the miner's pick has hardly been struck. So far we have only spoken of the Vasse from the point of view of its exceptional fruit-growing capabilities ; but it is almost equally to be recommended as the sphere of that scheme for the raising and canning of vegetables upon which Mr. McLarty addressed the Legislative Council two years ago. He showed that there was a lucrative market on the goldfields for this necessary article of diet ; that £8,000 or £9,000 is annually sent abroad to supply local needs, and that there were places in the south-west where every kind of esculent would grow like pumpkins in a compost heap. While Mr. McLarty, as in duty bound, spoke more directly of the capabilities of his own district, it can be demonstrated by our informants that Busselton is willing to enter the lists at any exhibition with vegetables of a size and flavour that would win the approval of the most impartial judges. Up till now, vegetables, which are luxuries in many parts of the colony, are always plentiful at the Vasse ; but if a preserving factory were started, there would be a demand for tenfold the output that is raised to-day. The chief crop now grown there is rye, which, both in straw and grain, finds a ready market. Some impetus has been given to the cultivation of garden blocks at the Vasse, owing to the establishment of timber stations cutting the superior jarrah and karri forests which form the subject of some striking photographs which appear in this volume, but what has been done is only a small beginning of what remains to be accomplished, particularly if artesian water is struck, as it has been at Perth and Guildford, within a depth of 200 feet. A SETTLER'S GUIDE is not the place in which to indite compliments to the beauty of the fair sex, but it may be set down in the practical spirit of a deponent who is desirous only of adducing a utilitarian fact, that the wonderful health-giving properties of the Vasse district is eloquently attested by the radiant clearness of the complexions of the ladies of the place, the lily and the rose striving with each other in their countenances.

Proceeding southward from Busselton, within a few miles of the coast line, we get into the Blackwood country, so called from the course of the Blackwood river, which empties itself into the Hardy inlet near Cape Leeuwin. The river has come down in a southwesterly course from the Darling range, passing through Bridgetown, which we shall visit by and by, when we have had a look at the land along the shores of the Southern ocean. This large and fertile tract is thickly timbered, notably with the giant karri and the umbrageous, handsome, evergreen and monopolising peppermint, which it is very difficult to destroy by ringbarking, owing to the gnarled and deeply indented surface of the trunks. In this territory, 50 miles south by west of the Vasse, is the large timber station known as Karridale. A tramway connects Karridale with Port Hamelin, from which the timber cargoes are shipped to many parts of the world. In the neighborhood of the sawmills are extensive swamps which, if drained, would make the best of garden ground. Now they are the resort of waterfowl. "A most interesting and peculiar natural phenomenon (says the *Western Australian Year Book*) is to be seen in the neighborhood. The walls, or banks of sand, from two to three miles long, and from 70 feet to 90 feet high, are gradually advancing from the seaboard over the land, at the rate of from one to three inches a year. Between this place and the Vasse signs of coal have been found in various spots, and from the rough work done by a tiffin bore excellent specimens have been brought to the surface ; but owing to the want of funds prospecting has ceased." Upon Cape Leeuwin, the most south-westerly point in the colony, 23 miles from Karridale, a lighthouse of the first class has been erected. The level coast lands which lie at the foot of the hills are held in large estates by proprietors who rear sheep and cattle upon them, but do very little cultivation. All that has been said of the advantages and possibilities of the Busselton district will apply to that of the Blackwood, for although boundaries have been set in mapping out the colony, the whole of the province from Busselton to Cape Leeuwin has the same natural features, speaking generally, and the same climate and rainfall. The Blackwood can therefore be summed up as a large tract that has been very little developed, that is as well endowed as Devonshire for the production of English fruits and vegetables, and that is large enough and contains enough Crown lands to give free homestead farms to all the agricultural population of that county, and still have some to spare.

Going almost due east from Karridale we pass through the Lower Blackwood and Nannup to Bridgetown, which is the terminus of the Donnybrook to Bridgetown railway that is now being constructed. An approximate, but clear idea of the situation of the areas of which we have been traversing since we left Bunbury, may be obtained if it is borne in mind that Bunbury, or rather Picton Junction, which is close to it, is the point of a triangle, of which Karridale and Bridgetown form the points of the base, the right hand side of which looking north is the route of the railway from Picton Junction and the South-western line to Bridgetown. Parliament did not authorise the extension to Bridgetown until the question had been before the Houses for two sessions and the work had been supported by all the strength of the Forrest government. The opponents of the proposal contended that the railway would not pay. They laid stress upon the paucity of the population, the limited amount of local land that was under crop, and the fact that there were some blocks nearer Perth that were still open for selection. In reply, Sir John Forrest said :—"The construction of this railway will further the object we all have in view, and that is to open up those portions of the country which are capable of producing. We have our mineral resources to the eastward, and the goldfields, which are being very quickly and extensively developed in accordance with the approved policy of the Government, but, at the same time, we should do all we can to encourage the agricultural districts to produce food supplies by giving them railway facilities to send their products to the goldfields markets. I think we are all agreed that it is our duty to give facilities of transit to all producing centres, and I am sure that no one will deny that the Blackwood district, of which Bridgetown is the centre, is an important agricultural district. It only wants a railway to make it of still greater importance. Without a railway a district like the Blackwood cannot compete with other agricultural districts which have this means of transit. And we must remember that this railway will establish a new centre of population, and to which all the settlers to the south-east and the south-west will take their produce for conveyance to the markets at the metropolis, while it will stimulate the settlers all round that district to greater efforts in cultivating their land. I entertain the most sanguine hopes for the future of that portion of the colony to which I have referred. The soil there is of a splendid character; it is seven feet deep and is capable of producing anything we require in the country. I look forward hopefully to the time when this railway will be run through that country beyond it, even as far as the magnificent port of Albany. In view of the rapid strides which the colony is making, I do not think that my hopes will remain unrealised for any lengthened period." Mr. A. Forrest in supporting the Bill bore testimony from personal knowledge, that should be very reassuring to intending settlers, as follows:—"In the Blackwood district we have a great fruitgrowing country, where the present production could be increased a thousandfold, and though there are only a few hundred acres under crop, yet, if hon. members visited it in the fruit season they would see the trees breaking down with loads of fruit, and would be convinced that the district is capable of supporting a large population in fruit growing. Another important factor in building this railway is that the whole of the land through which the line passes is Crown land. The railways in other agricultural districts have been made entirely through freehold land, whereas along this railway there is no freehold land worth speaking of—perhaps a few thousand acres in the whole length of 46 miles." Mr. A. R. Richardson, who then held the portfolio of Commissioner of Crown Lands, and who knows the country through which the railway will go as well as any man in the colony, put in a strong plea for the acceptance of the scheme. His speech is so full of instructive matter as to the recommendations of the soil, that some of the points he made ought not to be missed. He said:—"What I particularly wish to point out are some peculiar circumstances in the agricultural conditions of this district. Fortunately for us, it is a district that is capable of yielding those kind of products which other parts of the colony are not suitable for producing. We have a large amount of agricultural country opened up by railways now, and I think if this railway was to pass through agricultural country under exactly similar conditions, I should be inclined to say we were not justified in making this railway. But the other districts are wheat-growing, or mainly cereal producing districts, whereas in the Blackwood district we have a climate and soil which are favorable to the reproduction of many other kinds of products, such as potatoes, onions, English fruits, dairy produce, cheese, pork, bacon, and a large variety of agricultural products, which, to our disgrace be it said, we are importing from other countries in large quantities. Indeed, we are now sending away thousands of pounds annually to pay for agricultural products which the Blackwood district is particularly suitable for producing; but I do not think we shall ever produce these things in that, or other districts, in sufficient quantities for supplying the colony's wants, unless we make railways into those districts which are specially adapted to produce these articles. Another point is that many of the products for which the Blackwood district is suitable are of that description which will not stand long carriage. Such things as potatoes and onions, when carted a few miles, are so increased in cost that all profit is knocked out of them. You have the best climate at the Blackwood for producing potatoes and onions and other things that are heavy in carriage, but if you ask a producer to cart these things 20 miles you take away all the possibility of profit ; so that the only way to induce the production of these heavy articles is to make a railway. The same may be said of fruits in their green stage. The Blackwood climate is specially adapted for English fruits such as cherries, raspberries, strawberries, and those delicious and delicate fruits which many parts of our colony will not produce. Another argument which, I think, is a good one, is that the hon. member for Geraldton observed there are no poor people down there ; and I think no better testimony as to the fertility of the soil could be given as showing that people who have been isolated so long and have been so far from any market, are yet able to make a comfortable livelihood amid such unfavorable surroundings." The Government triumphantly carried their point, and the line, which will cost £170,000, is now well advanced towards completion. There was considerable division of opinion as to whether the route should be by way of Preston or the Thompson's brook. The latter, which is 11 miles the shorter of the two, was adopted. The line passes near a property belonging to the Hon. J. W. Hackett, M.L.C., which that gentleman has devoted to the growing of fruits and vegetables on a large scale and under the management of a skilful superintendent, who has practically had *carte blanche* as to the expenditure. The outlay has been very great, for most of the estate consists of swamp lands which grew exceptionally large and numerous trees, so that the block was scarcely one that a man of straightened purse would have attempted to reclaim. A few of the most intractable acres have only been wrested from their virgin wilds of trees and undergrowth at a cost of scores of pounds per acre, but they have proved to be surpassingly excellent when placed under crops of vegetables, strawberries, gooseberries, raspberries, cabbages, potatoes, cauliflowers, etc. The property is one that the faint-hearted have only to see in order to lose all their doubts as to the great natural resources of the south-western district.

The Preston agricultural area adjoins the Donnybrook railway terminus, where a townsite has been laid out. It is bounded on the north by the Preston river, which supplies a constant running stream of fresh water. The area, which includes large tracts of good alluvial soil, was thrown open for selection in August, 1894 ; it contains 51,545 acres, the whole of which is surveyed into 284 blocks. There are, according to recent returns, thirteen settlers on the area, holding between them 5,626 acres. The sub-division is 25 miles from Bunbury, and is adjacent to the Bunbury-Bridgetown main road; it is well watered by brooks, and has a rainfall of 38 inches annually. The clearing in places is heavy, and the average cost of this work is £6 per acre. The facilities which the railway offers, and the superior quality of most of the land, should lead to the speedy alienation of the area, which is exceptionally adapted for potato and other root crops, fruit culture, and dairying; also for pig raising.

The Tweed agricultural area is ten miles from Bridgetown, and 35 miles from Donnybrook; it has been available since March, 1893, and consists of 29,000 acres; 16,882 acres are surveyed into 92 blocks, and thirteen settlers hold 8,929 acres. It is interesting to note in regard to this area, which contains some of the finest agricultural and fruit growing land in the colony, that some of it was specially selected by the late Mr. Anthony Hordern, originator of the Great Southern railway scheme, as a site for his projected agricultural college and experimental farm. The land having been abandoned by his executors, was surveyed and subdivided by the Government, and thrown open for selection. The clearing in many places will be rather heavy, costing probably £6 per acre. There is here splendid alluvial soil and a heavy rainfall, while the river Blackwood, which contains large permanent pools of fresh water, runs through the area. This area is distant from Perth about 175 miles.

The Boyanup agricultural area, about 12 miles from Bunbury, was thrown open for selection in June, 1892. It contains 40,843 acres, the whole of which is surveyed into 284 blocks. There are 26 settlers on the area, holding between them 5,240 acres. It is served by the line between Bunbury and Donnybrook, which connects with the South-western railway. This area contains much land well adapted for cereals, fruit and vegetable growing, and dairying. The Bunbury-Busselton railway also runs through this area.

The following notes of the Nelson district, in which Bridgetown is situated, have been kindly supplied for publication in this volume by Messrs. J. Allnutt, (Acting Resident Magistrate of Bridgetown), Lewis C. Moulton, J. R. Walter, and James Inglis, whose names are a guarantee that the intelligence they convey is a thoroughly authentic statement concerning a part of the colony in which they have long resided as leading and enterprising settlers :—"There are not generally good roads to the land belonging to the Crown that is open for selection. Our main trunk roads are some of the best in the colony; all the settlers here have had to make their own roads to their homesteads. Latterly the Nelson roads board have assisted selectors with their bye roads, but this year the Government allowed us no funds for this purpose. The capital we consider essential for a successful start is £110 for a free homestead farm of 160 acres, and £350 for 500 acres conditional purchase—with the addition of plenty of pluck and energy. The Tweed agricultural area is mostly taken up and occupied. The schools in the Nelson district are situated at the following centres:—Bridgetown, Dwalganun, Dingun, Warren, Ballingup, and Greenbushes. The area we should recommend a man of small means (say from £100 to £200) to take up, would be a homestead farm of 160 acres, and about 100 acres of conditional purchase for grazing purposes. It would be advisable for all small farmers to keep a few sheep and pigs, and a cow or two for milking purposes. Cows would require some artificial food for the first six months in the year, and it would pay to feed them throughout the whole year. The buyers for wholesale houses eagerly seek for supplies of fruit; chaff is in good local demand, and for fat stock there is the best market possible. There is good sale for vegetables, poultry and pigs. The railway freights for produce are, as a rule, very low. The Western Australian farmer has one of the best markets in the world at present. The Nelson district grows fruit and vegetables to the best advantage, more especially what are termed English fruits. A close watch should be kept for the appearance of noxious weeds, such as stinkwort, thistle and sorrel, in order that they may be eradicated before they have time to take hold and spread. If the land is continually cropped with the same cereal it will exhaust itself, but not if it is given a rotation of crops. We have known some land to produce corn for 30 years without manure. This land after one year's fallowing produced the best crop of corn we have seen, and is still producing fine crops of hay. As a general rule, however, good manuring is the great secret of success, when it is combined with thorough cultivation, *i.e.*, fallowed, rolled and well ploughed and pulverised. We are great believers in fallowing. Some local cultivators are also sheep farmers, and the number of settlers who are adding this branch to the earnings of their farms is increasing. The Nelson district is very much troubled by native pests, such as dingoes, boodie rats, opossums, eaglehawks, &c. It is a disputed question whether eaglehawks do not do more good than harm by destroying ground vermin. There are poison plants of the heartleaf, bloom, York road, and prickly varieties in the district. The zamia palm, which is commonly regarded as the cause of "wobbles" in cattle and sheep, is dispersed generally throughout this part of the colony. Heartleaf poison is found in patches; York road poison prevails from Scott brook, on the Upper Blackwood, in a north and east direction. Prickly poison is found in rocky country only. Small patches of bloom poison are scattered over the south-east of the district. Nelson is a good district for stock, and it would be a much better one if there were fewer trees, or ring-barking were more largely practised; the country is too much shaded. If more land could be cleared and laid down with grass, which the climate makes it admirably adapted for, where one beast is now kept the pastures would support a hundred, and this is what the country must come to. The natural herbage of the country dies out in time when fed down by stock, and nothing good for stock grows in its place. On the best land indigenous grasses still grow. Replying to your enquiry as to what extent of arable land can be found in one piece in the Nelson district, we should say that the average of the locality would be fifty out of every hundred acres fit for the plough. The other fifty acres would be suitable for vines or fruit growing. The country is well watered, as a rule, but some seasons have much less rainfall than others, notably the last two or three years. The cost of conserving water by means of tanks, dams, and wells, need not be taken into account, as these devices are not necessary in the boundaries of the Nelson. In only the very driest season is there anything like a water difficulty, and then only the back blocks are affected. Back country is to be understood to mean away from the larger brooks and rivers. In well sinking water can be struck at from six to seventy feet, but this is very seldom resorted to. Many small areas near the rivers Blackwood and Capel. The general character of the soil is patchy in many places ; there are large stretches of ironstone gravel that are very good for vines. The configuration of this part of the country is hilly. The timber comprises magnificent forests of jarrah, red gum, blackbutt, karri, and blue gum. The cost of clearing per acre to put in a crop is from £2 to £15. The crops usually grown are fruit of all kinds, potatoes, hay, wheat, oats, barley, vegetables, green fodders of all kinds, and roots, such as beets, mangolds, turnips, etc. The average yield per acre is as follows :—Apple (matured trees), four tons ; grapes, four tons ; stone fruits, four tons ; potatoes, five tons ; wheat, 16 bushels ; oats, 25 bushels ; barley, 16 bushels ; hay, 25 cwt. ; green fodder, 13 tons ; root crops, ten tons. The facilities for the transport of produce to market are the railway that is now being made from Donnybrook to Bridgetown, and good trunk roads. The fruits grown are :—Apples, pears, quinces, medlars, persimons, plums of all kinds, peaches, apricots, nectarines, passion fruit, tomatoes, gooseberries, and Cape gooseberries, raspberries, currants, strawberries, rhubarb, grapes, oranges, lemons, citrons, walnuts, mulberries, blackberries, almonds, hazel nuts, cherries, loquats, and melons of all sorts. The climate is a little too cold and frosty for oranges and lemons to be cultivated to perfection. All the other fruits are grown with the greatest success. As an estimate of the quantity of Crown land open for selection, we may say that about three-fourths of the territory on either side of the Bridgetown railway station is still available, notwithstanding that settlement has been progressing steadily. The co-operation of the land bank has been availed of. The general character of the seasons is that the autumn rainfall starts in May and lasts till August, with frequent showers during the year. The driest months are from Christmas to the end of February. The average size of selections on Crown lands is from 100 to 200 acres. Nearly all the settlers are British subjects. The chief advantages of the Nelson district are soil, climate, and rainfall. The class of implements in general use is the most modern. Anything but the most up to date machinery and appliances have been discarded, and more of this class have been obtained during the last 12 months than in any previous year. What is being done in stock raising? The answer to this question is that shorthorn grades are being crossed with improved herds, such as Herefords and Devons, polled Angus, shorthorns and Jerseys. The sheep of the district are being improved by the introduction of imported strains of Lincolns and Shropshires; and pigs by some of the best blood of Tamworths and Berkshires. There is opportunity for a larger scope of work in planting vineyards, orchards, and in clearing the land. Is not dairying being neglected? Yes; partly because of the low prices of butter and the want of milkers. Men will not milk or engage as milking hands, and the women have discarded the milk pail altogether. They regard milking as too much drudgery; too great a tie; early and late, Sunday, as well as other days, cows have to be attended to with the precision of clock-work if dairying is to be a success. While wages are so high and other labor so plentiful, men are too independent to stick regularly to milking, and nothing but better prices will encourage people to dairy. There must also be a reinforced labor supply, so there may be a possibility of obtaining milkers. Vegetables could be more extensively grown if labor was cheaper and more plentiful. You cannot beat the despised Chinese gardener in growing vegetables. It is no use growing products if the labor is to cost more than the article produced, and this is now often the case. It is not the fault of the country that there is not more cultivation, but the scarcity of labor, its dearness, and often its want of skill. One of the best crops in our district, and one of the most profitable and readily saleable, is that of the potato, for the growth of which there is any quantity of Government land available at various distances from the railway line. The seller can get £7 10s. per ton, and he is usually paid on delivery. There is so much Government land obtainable that private land is not much enquired for, which may be given as a general answer to your interrogatory: "Are there any private lands available for the production of root crops; if so, state price and terms." Frosts are prevalent and destructive in our neighbourhood; these occur from May to October. As a rule, our district is not adapted for close settlement, that is, 10 or 20 acre men. But we believe around Bridgetown a large number of families could successfully settle. A small area of land well cultivated will produce more and pay better than 100 acres slovenly cultivated. Hereabout many men settle on a piece of land, and if they have any time they can spare away from it, they can always get remunerative work and earn money to spend on their own land. Fowls are being turned to account; bees are not kept, but they would do well if properly attended to, i.e., this had been proved. From our experience and observation the chief requisites for a new settler are to have means to employ labor and to be able to get it. Men with energy, who can and will work steadily and with judgment—not your eight hours per day men, who think more of pleasure than of work, and spend all their earnings in beer—need have no fear of failure to get employment in our part of the colony. The lessons of local experience in the clearing and treatment of the land are to clear well and to cultivate thoroughly. The best fertilisers have been found to be farmyard manure and bone dust; liberal manuring from the outset is profitable. There are not many large privately owned estates that would be available for subdivisional sale, or for occupation under improvement leases, and there is not much demand for them. In response to your invitation to make suggestions for the guidance of new settlers, we are of opinion that it is no use giving advice, as those to whom it is tendered generally take their own course, and in the end come to the ideas of those around them of older local experience."

CHAPTER II.

EASTERN DIVISION.

YORK, BEVERLEY, AND GREENHILLS DISTRICTS.

York, 66 miles from Perth on the Eastern railway, is one of the oldest and largest farming centres in the colony. Its fertile lands were discovered by an exploring party led by Captain Stirling, R.N., Lieut.-Governor of the colony. He named the territory in celebration of the fact that a number of persons from the county of York, England, were among the earliest immigrants when Western Australia was founded in 1829. Large grants of this fertile land were bestowed upon the newcomers. There are no Crown estates near York left for selection, but a splendid tract is being opened up beyond Greenhills, 15 miles further east, by the branch line that was authorised during the last session of Parliament. The town of York stands on the banks of the Avon, the chief stream in the eastern districts. The river in the summer time diminishes to a series of deep pools, which are ample, not only for the watering of stock and domestic requirements, but would in places serve to irrigate gardens and orchards. The course of the Avon is marked by a low range of hills, two of the principal of which, Mount Bakewell and Mount Browne, are the chief landmarks of York. From the Avon the country is undulating, and traversed by gullies or brooks, the tributaries of the river. Before the land was cleared in large areas for cultivation it grew, on varying soils, several kinds of timber. In Western Australia the forests are so true an index as to the suitability of the ground on which they grow for various tillage purposes, that it will be instructive to examine these aspects of the York country, especially as the same forest characteristics are found all over the eastern division, which is a very large one, embracing all the agricultural areas lying between Northam and Southern Cross.

The York gum—to use here only the vernacular names of the different trees—is pre-eminently the habitat of the best wheat lands. It grows on the eastern slopes of the Darling range, from north of Beejoording, south-east to the Pallinup river. The York gum is generally about 70 feet or 80 feet in height, is about two feet in diameter of trunk, and is dark and rugged in appearance ; the wood is very hard, heavy, and tough ; it is reddish in color and much esteemed for wheelwright's work. This tree usually grows in a rich loam, which with sufficient rainfall produces some of the heaviest crops of hay and cereals that are reaped in the colony. The salmon gum is also largely found in the country lying between York and Southern Cross, and the timber, which is hard, heavy and durable, is used upon the goldfields for mining purposes, and for the construction of bridges and culverts. The tree grows from 40 to 70 feet in height, with a trunk from 12 inches to 30 inches in diameter. The name, says Mr. Ednie Brown, Conservator of Forests for Western Australia (in his report presented to Parliament last session) refers to the color of the bark, which is of a reddish, burnt appearance, fairly smooth and somewhat persistent. The home of the salmon gum is a good stiff loamy soil, with a clay sub-soil, which, of course, is just what is wanted for wheat. For a long time the salmon gum country was neglected, for it had a most desolate appearance. It is the peculiarity of this tree that it destroys all herbage near it. But as soon as the trees have been killed by ring-barking, grasses grow luxuriantly. When this was discovered, thousands of acres of land, which had been regarded as useless, were selected for farming purposes. Hence some of the new men have been able to get better land than some of the oldest settlers. When the agricultural commission sat some years ago, evidence was given by a pioneer of the Greenhills area (Mr. Penny) that he had taken a great deal of pains to select land that did not grow salmon gums, because that land was no good. On the 16th of October last, the Premier, Sir John Forrest, in moving the second reading of the Greenhills Railway Bill, said he had seen Mr. Penny on the previous day, when that large cultivator had expressed much regret that he was finding that the places which he had excluded contained the best land. Such are the profitable lessons of experience from which the seeker of a fertile location may reap the benefit. The morrell gum is also commonly met with on the eastern agricultural lands, and is indicative of rich country. It reaches a height of 50 feet or 60 feet, and is from 12 inches to 18 inches in the bole, and thrives best on a loamy soil. It is also found in a good, strong, or what would be called in an English county, heavy land. The bark is light colored ; the timber dense and strong, and the leaves are especially rich in eucalyptus oil. This is extracted by Mr. Jonah Parker, at Dangin, about 100 miles further east than York, along the course of the line to Southern Cross. The product has been pronounced in English laboratories to be of a very superior quality. The manufacture would be proceeded with on a large scale on the property referred to, if the site were not 40 miles from a railway station. The wandoo, or white gum, unlike salmon, York or morrell, is a danger signal to the selector, for the country upon which it is found growing most luxuriantly, is, to use the words of Mr. Ednie Brown, "of a hard, uncompromising nature (decomposed granite), being flat, stagnant, sour, sandy on top, and invariably resting upon pipeclay. This is very boggy in winter and hard in summer." Moreover, the wandoo often grows among poison plants, and in country that is generally waterless unless shallow wells are sunk. It is a well balanced sturdy little tree, with a white trunk speckled with yellow. The timber weighs over 70 lbs. per cubic foot, and has been found very useful for railway trucks, receiving buffers, and other works requiring resisting strength. In the ground it will last 40 years or more as a fencing post. An average tree is one of 60 feet or 80 feet in height and 30 inches in diameter. The white gum is the principal tree on the eastern slopes of the Darling range. The gimlet gum, so called from its twisted or fluted shape, is the companion tree of the salmon gum. These are the only trees to be found on many miles of country in the dry territory east of the Darling range. The gimlet gum flourishes on a good retentive soil, stretching beyond Coolgardie, and where it has to be cleared to make way for the plough, the harvest is well worth reaping if the rainfall if sufficient. The timber is much of the same class as that of the salmon gum, and is in general use upon the goldfields.

Raspberry jam, an acacia well known in the York and Beverley districts, is a great friend to the settler in supplying him with cheap fencing, although it is fit for higher uses. According to the Conservator of Forests, it is a small tree of about 30 feet in height, with stems reaching to 1 foot in diameter and boles 10 feet to 12 feet in height. It is of a handsome rounded shape when allowed to spread out its branches, and the appearance of the leaves is bright green and somewhat pendulous. The vernacular name is derived from the peculiar scent of the wood, which is wonderfully similar to that of raspberries. An oil of this flavour is obtained from the wood by distillation. The wood in the ground seems to last for ever, and the smaller trees are used for fencing posts without splitting. It is a beautiful wood, impervious to white ants, dark in the middle, with a white margin on either side, very heavy, and would make an excellent timber for cabinet and ornamental work of all kinds.

The sandalwood of commerce, which is found occasionally intermixed with wandoo, York gum, and morrell, is an article of export that in the early days of the colony supplied many a farmer with stores and material. It has been so much sought after, as it was worth £7 or £8 per ton, that the Conservator of Forests advises that the exhausted districts will have to be replaced by plantations in suitable areas, if a supply is to be maintained. It grows most freely on barren soils, and is not gregarious.

Two other species of ecalypts, the flooded gum and the manna gum, are rare in the York district. The flooded gum is what is known as red gum in the other colonies. It only grows in wet situations, or along what have been watercourses. The wood is red, and, like the jarrah, is not decayed by water. What the York people call the manna gum is not to be found in the classification by the Conservator of the forest trees of Western Australia. Locally the manna gum patches are regarded as highly productive when placed under crop.

It will have been noted that only forest areas have been spoken of as being fit for cultivation, and, therefore, clearing is the first work of the settler. The cost of clearing is much lightened by ring-barking and burning off when the trees are dead, but in order to get a ready return a paddock has to be grubbed while the trees are green. While the crop is growing, the timber of the remainder of the holding, except a few trees reserved for shade, are ringbarked to hasten the work of their removal in subsequent seasons. Besides, ringing brings up the grass for the feeding of stock, so that mixed farming of the most profitable kind may be carried on. The jam tree is not injurious to pasture, and after this growth has been cleared sheep will feed down the shoots of jam and keep the cultivable ground clean. The destruction of the timber is also necessary in order to increase the water supply, which is not very abundant east of the river Avon. Returns obtained from all parts of the colony are unanimous in declaring that ringbarking should be done immediately ground is taken up, to obtain the three advantages of sweetening the soil, getting grass and obtaining water.

The average rainfall in the York district is 15 inches, which nearly all falls between April and September. The most has to be made of this inconsiderable supply by early sowing, and for the filling of tanks and dams. In preparing a dam, sheep are often driven into it to puddle the clay and make it watertight. In a dry season stock have, on some holdings, to be travelled some distance to water. In going further east the rainfall gradually diminishes. There is good summer feed among the edible scrub after the grasses have been fed down. In spite of the drawback of a light rainfall nearly all the farmers fatten a few sheep, and there are large sheep runs within a few miles of York. Cattle are not largely kept. Horse-breeding receives some attention. The frontages to the Avon were alienated many years ago, but the owners of them, nevertheless, allow the public free access to the water. It is admitted that a larger rainfall would be of incalculable advantage to a people who are on the highway to the goldfields, which furnish an excellent market for all they can produce.

For fruit-growing York is well adapted, both in regard to soil and climate, although there are no local orchards on a large scale, with the exception of that of Mr. Frank Craig on the confines of the town. Some fruit from the property of Mr. Kenneth Edwards was very highly praised in London. The only varieties of fruit that do not thrive are cherries, loquats, gooseberries, raspberries and strawberries. The prevalence of frosts and the scanty rainfall are not favorable to the potato, although in some spots small areas have yielded potatoes very largely. There are near the Helena, on the west of the Avon, some moist lands that are especially valuable for producing vegetables during the summer in a colony where cabbages and pumpkins are sold retail at 2d. per lb., and other esculents at a proportionate price. But this garden ground, as it is called, is mostly in private hands, and in Western Australia every man likes to be his own landlord and to purchase direct from the Crown, as has been proved by the experience of the Great Southern and Midland railway companies, whose land grants have not been nearly so readily taken up as the blocks belonging to the Government. But a visit to the land that Mr. Kenneth Edwards has devoted to the cultivation of vegetables affords very convincing proof of the value of intense cultivation in chosen spots. The land regulations provide for the sale of garden blocks at £1 per acre for 10 acres under certain improvement conditions.

The testimony furnished by men of experience in the York district at the instance of the Bureau of Agriculture for the guidance of new settlers, may be summarised as follows :—Although there are no Crown lands available near York, there is fertile forest country beyond Greenhills, 15 miles to the eastward, which it would be very advantageous to secure. There are also eligible private estates between York and Greenhills, the owners of which only require a fair inducement in order to open them for settlement under the provisions of the Agricultural Lands Purchase Act, which was passed last session, accompanied by a vote of £200,000, to enable the Government to put that statute into force for the purpose of augmenting the producing resources of the colony and adding to the national wealth. There is an excellent prospect before industrious men who possess, say, from £150 to £300, intelligence and industry, and who have some knowledge of farming, because in going into tillage they would have an assured market at good prices for their crops, railway communication to that market, and reasonable freights, besides the protection of the import duties. There are good roads to the railway and schools in every division, so that children are never beyond the reach of the schoolmaster. If a man is without capital it may be possible for him to become a settler by working for his neighbours, but his slow progress would be discouraging to anyone who had not a dauntless spirit. To farm on proper lines a man should take up 300 or 350 acres, because he must have some grazing ground, if only to turn his horses upon in the slack time of the year, while crops are growing.

It is further pointed out that while at present prices for all kinds of produce are remunerative, these rates are likely to be maintained. The population of the colony is rapidly increasing, and, so far, the farmers have not attempted to grow wheat, because of the high price and strong demand for chopped hay—known in the colony as chaff—which is used as fodder. When enough fodder is produced the wheat market will still have to be supplied. Just now most of the flour mills in the country districts are shut down because wheat cannot be had. This season wheat has brought 6s. per bushel, and chaff £7 per ton. At the time of writing, owing to the drought in the eastern colonies limiting their export of fodder, chaff is selling at £8 per ton, delivered at the railway stations. The demand has been so brisk that buyers' travellers have, during the past three seasons, been canvassing the York district for supplies for the produce trade of the goldfields, and of Perth and Fremantle. It has been found that wheaten hay pays better, in this district, than oaten. While the taking up of land, unless the selector has some money to commence fencing and clearing, is deprecated in ordinary circumstances, the loan obtainable from the Land bank of the state is deemed to be a compensation for this drawback, provided that the borrower is the right man in the right place. There is opportunity for a much larger scope of work than that which is now being done. Every year large numbers of the most improved implements are being used as a means of developing the agricultural resources of the district.

A warning is given against exhausting the land by cropping it every year without manure. This is a shortsighted policy which means poor harvests and false economy. Even what have been the best forest lands should be enriched the first year after they are cleared, and every season afterwards, unless a dressing of bone dust is very liberally applied, when the ground will be good for two years. The lighter soils, lighter in color and in quality, should be fertilised still more heavily with guano, bonedust, or phosphates. Nothing is better than stable manure, but it is not obtainable in sufficiently large quantities for big fields. Keep the land in good heart and it will keep gold in your pocket, is the maxim of the best farmers of York, and there are none better in Western Australia, nor any who crop a larger acreage. Many of them rest their land every alternate year and use it while it is out of cultivation for grazing. Under proper treatment the fields show no signs of exhaustion, although some of them were cleared and cultivated by the fathers of the men who are still turning them to good account. If a comparison is made of the value of improved lands and of the cost of clearing them, it will be seen that there is a substantial balance in favor of the settler. Let us give an example. The selector, taking up say some of the forest lands that will be tapped by the Greenhills line, has to pay only 10s. per acre in payments of sixpence per acre extending over 20 years, to entitle him to the Crown grant, subject to the fulfilment of the improvement conditions. The cost of clearing the most heavily timbered of this land will be £5 per acre. When cleared the land will yield a ton of hay per acre, which during the last three years has been worth £6 or £7 per ton, while the cost of putting in and taking off the crop and chaffing it, with bags included, does not exceed £2 per acre. Next year there will be no clearing to pay for. Compare these figures with the balance-sheet of the agriculturist in other parts of the world.

The drawbacks of the York district which weigh against the advantages of soil and situation—lying, as it does, between two markets—are a comparatively light rainfall, and in the long dry summers which prevail, some scarcity of water ; also the presence of poison plants which render it necessary to take precautions against danger to stock. As regards the rainfall, although the district would be a still better one if it were not so dry and had more than one river intersecting it, disastrous drought is unknown at York. The rainfall, albeit the average is several inches short of what could be desired, is well maintained, and the farmers being familiar with local meteorological conditions, adapt their operations and utilise them to the best advantage. They plough early, and not a shower is allowed to go to waste. The friable nature of most of the soil of the best wheat areas produces a fine tilth which is favorable to the retention of moisture. There are some very stiff soils to be found, notably blue or grey clayey lands, but these are in such a very small proportion as to be only an exception to the rule. The fact that the government returns show an average of 11 bushels of wheat to the acre may be taken as satisfactory evidence that the district is well suited for the requirements of the agriculturist.

The pastoralist, and the farmer who keeps stock, have two resources against losing their cattle and sheep by poison plants which, to use the common names, may be described as box, York road, and berry poison. It is necessary to fence out the poison, or to employ a shepherd or herdsman to keep the stock away from the deadly shrubs which grow on all kinds of land, but chiefly on white gum forests and on sand plains. In spite of all watchfulness, however, some losses are experienced. The poison plants are most deadly after country has been burned and the tender shoots are sprouting or during the season of blossoming. The poison areas have been made the subject of special legislation, under the provisions of which the Crown grant of infested land is obtainable when it has been cleared of the hurtful vegetation and been proved to be fit to carry stock. If the poison leasehold is fenced within three years, the lessee is granted 18 years longer to get rid of the poison. A great deal of land is held under the Act, but it remains to be seen how much of it will be declared free of poison when the term of the lease expires. West of the Avon, at Helena Vale, poison shrubs grow freely. East of York these pests are far less common.

Another minor drawback—for it is the design of this handbook to state both sides of the case fairly—is the difficulty of getting agricultural laborers at the rate of wages paid for this class of work in other parts of the world. This matter has been brought before the Legislative Assembly upon a resolution which affirmed that it was desirable for the Government to support assisted immigration to encourage the development of the farming industry. It was represented that it was useless to repine at the large sum of money that was sent out of the colony every year to pay for imported food products, while landholders were restricted in their operations by having to give 6s. or 7s. per day to their hands, and were not able to get enough of them even at that price. According to the advocates of the resolution plenty of labor could be got from the rural districts of England if their passages could be paid. Many of the men who were now available had not been brought up to the work, but being "down on their luck" took the employment temporarily till they could get a few pounds, when they left their employer suddenly, perhaps in the midst of harvesting, when they could not be easily replaced. In reply, Sir John Forrest expressed his sympathy with the object of the motion, but he saw two difficulties in the way of achieving it, even if parliament agreed to the system of assisted immigration. In the first place he doubted, from all he had been able to learn on the subject, whether England had any agricultural labor to spare; and even if men were brought to Western Australia the chances were that they would forsake the farms for the better paid service of contractors for public works, or to go to the goldfields, with which alluring tales of lucky finds were associated. So far Western Australia has not adopted a scheme of assisted immigration.

It may be of interest to those who are living in what has often been described as the overcrowded old world, to read that the lack of agricultural labor has on two occasions been voiced in influential quarters, in pressing a plea for introducing into the colony a number of the lads who have been cared for in the homes established by Dr. Barnardo. The first representation on this subject was made last year by Mr. Cookworthy, the then member for Sussex, who earnestly asked the Legislative Assembly to give to the boys who had been rescued from want the opportunity of pursuing a career of usefulness and good citizenship in a young country, where the honest and industrious servant has a good chance of rising in the world. He contended that the *protegés* of Dr. Barnardo had been well trained in the excellent institution with which that well-known philanthropist has so long been associated, and that it would be estimable to second his efforts by making Western Australia a field of emigrants for a band of young colonists, not only in their interests, but also for the behoof of those who were much in want of their services. The advocacy of Mr. Cookworthy was revived at the last annual conference of producers that was held at the chambers of the Bureau of Agriculture, Perth, in April, by the Brunswick Farmers' Club moving that, with a view to providing agriculturists with a suitable class of labor, the Government should facilitate the introduction into the colony of boys from the Barnardo homes and similar institutions in England. In discussing the motion, which was carried almost unanimously, several of the delegates spoke highly of the work and conduct of Dr. Barnardo's boys in Canada, and a suggestion was made that the proposal submitted to the conference might be improved upon by providing for the immigration of girls as well as boys. The subject is introduced here to show that able-bodied workers need not fear that they will fail to obtain employment at good wages, and also to disclose one of the difficulties which the settler has to face in not always being able to get enough assistance at the outset for the clearing of land to quickly get a very remunerative area under crop.

The policy of the Government to assist the producer is exhibited in the construction of the York-Greenhills line. This railway is the first agricultural line which the colony has made out of revenue. In moving in the Legislative Assembly, on the 16th October last, the second reading of the bill authorising the making of the line, the Premier, Sir John Forrest, said the railway would pass through good country, the praises of which had been sung by members of that House for years. It was a favored spot, from which proprietary farmers produced a large quantity of cereals. "I do not," he went on to say, "think that anyone who takes any interest in the agriculture of the colony, and who desires to see it encouraged in every possible way that it is possible to do so, will be able to oppose the railway on the ground that it is not required. The objects the Government have in view in recommending hon. members to build this line at the present time from York to Greenhills, is to give facilities to agricultural producers in that part of the country; we have no other object in view." The line is estimated to cost £40,000, without rolling stock. It was not undertaken by the government, as Sir John Forrest owned in making his financial statement on the 27th August last, without careful consideration and a personal inspection of the neighborhood. The ministerial party in making that inspection had occasion to express great regret that a large portion of the land lying between York and Greenhills is comprised in large privately owned estates, which are only used for grazing purposes. These estates were regarded by the Premier as an obstacle in the way of the close settlement and extensive cultivation that are essential to the making of a great agricultural district. In his financial statement, speaking of the line, he said :—"We know very well that this is an agricultural railway, and that new railways have to be viewed with very great care if there is nothing else but agriculture to depend upon for traffic. We know very well that unless the land is thickly settled and a large quantity is under cultivation, the chances are that an agricultural railway will not pay. Still, after having visited the locality, and having the benefit of the experience of persons who are conversant with the place, we think we will not be going very far wrong in asking this House to approve of this railway being built out of current revenue." In other words, reading between the lines, the Premier might have said :—There is land along the route that is highly suitable for the farmer, although the farmer has not, so far, been able to get possession of it. But the Government has obtained power from Parliament to buy this land, and may do so. There are also many settlers outside the large private estates who, as large and enterprising producers, are deserving of railway communication. Moreover, beyond Greenhills there is a first class unalienated territory that is now beyond the reach of settlers because it is so isolated from a market. Hence there are great possibilities before the district, and it is the duty of the Government, which is the farmer's friend, to carry out the work.

The estates retarding close settlement — which is the Premier's agrarian ideal—in the neighbourhood of York, comprise some of the earliest grants from the Crown. When the colony was founded immigration was encouraged by gifts of land, *pro rata*, upon the value of the stock, assets or capital which a pioneer brought with him to Western Australia. These lands were naturally chosen by the beneficiaries for their quality, and to-day are very valuable. Some of the old families, such as those of Parker and Burgess, crop hundreds of acres every year, and are always enlarging their clearings ; others are content with fencing, ringbarking and grazing. The estates through which Sir John Forrest travelled *en route* to Greenhills, were those of Messrs. Hardey Bros. and Messrs. Dalgety and Co. They consist for the most part of salmon gum, morrell, and jam country, and are enviously regarded by those who are looking for a location to settle upon, especially as they are almost adjoining the townsite of York. The Premier when he passed through them did not hesitate to express the opinion that the land was not being turned to the best account—that, in fact, it ought to feed people instead of sheep and cattle, and the day is looked forward to when the Crown, by purchase, will be able to open the ground to the entry of the producer. It is well known that a number of offers have been made by land owners to sell their properties to the state under the power conferred by the Agricultural Lands' Purchase Act, and by the time these lines are read in other parts of the world, the Government may be able to announce that some of "the eyes of the country," which have hitherto been inaccessible, are awaiting the cultivator. One beneficial result of the scarcity of land available near York is that what used to be regarded as inferior paddocks are being cleared and cropped, and the owners declare themselves well satisfied with the return they are getting from the experiment. It is admitted that the country is patchy—first and second class land being interspersed—and that the second class predominates in the ratio of two acres to one of the superior blocks. In other words it is the exception to find from 200 to 500 acres of uniform quality. The rule is that in taking up, say, 500 acres, the larger portion of it will be good grazing country, with enough forest country—that is growing salmon and morrell gums on a rich deep chocolate or blue soil—to give the grower as much or more ground than he can work, and a substantial income.

The dairying industry may be said to be unknown at York, although it is one that the tariff encourages by imposing a duty of twopence per pound on imported butter. The modern dairy, with its system of artificial feeding of cows, and the making of butter with refrigerating and other appliances, would be the only one that would be possible for the greater part of the year, but while hay sells for £7 per ton no one thinks of making ensilage or growing lucerne for the purpose of getting cream. The marvellous progress of the dairying industry in the other colonies has served to retard it in Western Australia, which, for the greater part, is content to use the factory brands of butter sent from the eastern colonies. Around York the presence of the poison plants, the long dry summer, and the strong demand for chaff, all check the establishment of dairies, and the facts are mentioned here in order that this book may be a SETTLER'S GUIDE in the fullest sense of the word. Another drawback is that owing to the precautions which the Government has deemed to be necessary to prevent the introduction into the herds of the colony of the destructive Queensland tick, a quarantine embargo of a month's duration has been placed on imported dairy stock. This practically amounts to prohibition, except in the case of pure bred stud animals, and without large drafts of dairy cows from the east, dairying will not be able to make a fair commencement in the west.

Leaving dairying on a large scale out of the question as one of the prospects of the York district, it can be said that it excels as a place for the fruitgrower. It has thousands of acres that are better suited for the production of nearly all kinds of fruits than for the growth of cereals or hay. Take the slopes of the Avon for example, where all the conditions of deep rich land, drainage, aspect and climate, combine to bring apples, apricots, peaches, oranges, and lemons to perfection. Then in the ironstone gravel country, where the jarrah grows, west of the Avon, the vine flourishes, and the grapes make "high-class wine; clean to the taste, rich in color, and of pleasant boquet." The loose formation of these areas, mixed as the gravel is with loam, not only allows surplus water to freely percolate through the soil, but also permits the roots of the vines to go deep for nourishment. The appearance of the land, and the heavy cost of clearing, are not prepossessing, but it has been found that the vineyards planted in such situations amply repay the money and the attention bestowed upon them. So far very little of the land that offers such advantages has been planted with fruit trees or vines, notwithstanding that there are four special inducements to embark in this enterprise :—1. That the local market, owing to the population of Western Australia having quadrupled during the last seven years, is insufficiently supplied with fruit, which is in especial demand on the semi-tropical goldfields. 2. That prices are very remunerative—grapes selling retail at sixpence to eightpence per lb. ; oranges, from 1s. to 3s. per dozen ; and apples at 1s. per lb. 3. That Western Australia is from four to nine days' sail nearer the London market—which Australian consignments reach at the dear time of the year—than the other colonies, viz., South Australia, Victoria, Queensland, New South Wales, and Tasmania. 4. That owing to the codlin moth being found in the other colonies, Western Australia prohibits the importation of apples.

The raising of poultry receives some attention in the York district. Nearly every farmer sends some birds to market every year, but there are no poultry farms on the large and organised scale adopted in England and France. Around York the birds are kept in a semi-wild state, having the run of the fields, and requiring little shelter in so mild a climate. Nor are fashionable strains, either for the table or laying qualities, much sought after. It is the common barn-door bird that is chiefly relied upon ; it is hardy, gives little trouble, is a fairly prolific egg-producer, and can always be sold at from 5s. to 6s. 6d. per couple. The goldfields' hotels are constant customers for all the poultry, including ducks and turkeys, which are not largely kept, that the farming population can supply, while there is never a glut in the poultry markets of Perth and Fremantle. The birds are profitable to those who rear them, because to a large extent they find their own food, having a great range of run and the ground never being heavily stocked. It is believed that the high price of grain would prevent the keeping of poultry in confinement at a profit. For this reason the rule is to send the birds away without fattening them in pens. This process is almost unknown anywhere in the colony, where the poultry served at table are, as a rule, somewhat spare, but, owing to the healthful conditions under which the birds are reared and the variety of their food on the farms, the dish is of excellent flavor and very wholesome.

In the territory of which we are writing the value of bees is almost entirely overlooked, as there is only one apiarist there. He has 80 hives at a place about 17 miles west of York, and he has only recently started bee-keeping. His neighbors are watching the result of his experiment with some interest, to see whether bees will do as well in the east as they do in the south of Western Australia. So far the apiarist is able to make an encouraging report, although he will not be able to form definite conclusions until he has had the experience of another season or two. Along the coast line, that is to say within 30 miles of the sea, in the south-west, bees have been kept with a surprising degree of success. As will be seen by the student of the report of the late Baron von Mueller, which appears in another chapter of this work, Western Australia is marvellously rich in both the variety and the number of her wild flowers, which, in the spring season, make even the roughest scrub paddocks at a little distance resemble a conservatory, and supply beautiful displays at the competitive shows which are held throughout the season in the chief centres. The flowers must be rich in saccharine juices, for the swarms of wild bees are able to lay up in the hollow trunks of trees large stores of honey, which become the prize of the splitter or the settler. The honey has a peculiarly piquant and agreeable taste, but, unfortunately, a great deal of it is wasted by the falling of the tree containing it, which breaks up the comb and drives into the honey the dust and the splinters of the cavity. Finding from the teachings of nature that the colony is admirably adapted to the bee, many settlers in the south have established hives with swarms of what have been wild bees, and have improved the stock by sending abroad for Italian and other queens. In two instances within the personal knowledge of the writer the bees have thriven so well and proved to be so prolific that the household expenses of the family are paid out of the profits of about 100 hives, and the income derived from the farm is devoted to the purchase of plant and the clearing of more land. What has been done in the south may be accomplished in the east, especially by immigrants who bring with them from other countries a knowledge of the proper system of bee-keeping, which the men referred to in the foregoing did not possess. They were in the early stages of their experience as apiarists indebted to Mr. R. Helms, the biologist of the Bureau of Agriculture, for the instruction which, aided by their own study and observation, has enabled them to obtain a material addition to the earnings of their properties.

Among the minor foes of settlement about York and Beverley the native vermin, both fur and feathered, have to be reckoned. The dingo, or wild dog of Australia, which would be mistaken for a fox if it were seen in an English county, is a great enemy to sheep, and among an unprotected flock is a terrible butcher. The dog will often worry as many as twenty sheep before feeding on one, and he is ruthlessly pursued by trap and poison, and sometimes run down by a well mounted stockman. The Government gives a reward of 10s. per head for each wild dog's scalp that is produced to the resident magistrate of the district. The Producers' conference has on two occasions voted this reward to be insufficient to lead to the extirpation of the dogs. A sheep owner will lay baits of meat or fat poisoned with strychnine, or occasionally set a trap if he finds that a dingo has been harrying his stock, but the dogs are allowed to breed in their fastnesses in the back country almost undisturbed. The delegates at the conference were of opinion that the reward should be raised to £1 per scalp in order to induce parties of professional dingo huntsmen to be organised to carry on the work of extermination. They were so impressed with the mischief and losses that are occasioned by the ravages of the dingo and other vermin that it was resolved that subject to the exercise of local option as to whether any district should join in the movement, the residents of any vermin infested territory should, in the form of a rate, subscribe pound for pound of the amount granted by the Government, to increase the bonuses for scalps. The wild dog is said to be increasing in the eastern districts, but it is not so numerous as to demand the folding of sheep at night, as is the case in some places further south. The eaglehawk, for whose head and claws a bonus of 2s. per bird is paid, is the cause of the loss of many a lamb; but at other periods of the year, after the lambing season, this species of vulture lives on the smaller ground vermin of the marsupial tribe which do damage in crops, orchards and vegetable gardens, and for this reason the eaglehawk is not without friends who deprecate the payment of a reward for its destruction. A bonus is also proposed to be given for the killing of opossums, boodie rats, parrots and silvereyes, chiefly in the interests of the fruitgrower. It may be added that the conference affirmed that it was not desirable to afford any protection to the kangaroos, which in some parts of the colony, particularly between Perth and Bunbury, are greedy among the crops.

A new arrival will note with satisfaction the absence of inroads upon his income in the form of the various municipal and other taxes that are generally levied in older communities. On an agricultural area there are no tithes to pay of any kind, except it may be a fee of 5s. per wheel of the vehicles employed on the farm, which sums form the nucleus of the revenue of the local roads' board. In municipalities rates are struck, but the Government comes to the aid of the resident in a new district by donating, under the authority of a vote of Parliament, liberal subsidies for the construction of roads. These subsidies amount to £300 or £400 per annum. There is also given, when good reason is shown, a special grant which, in the case of the goldfields Roads' boards, has amounted to very large sums, in addition to which, all large public works, such as the bridging of rivers or the making of roads, are put upon the estimates, and, on being passed, are carried out by and at the cost of the Public Works department, which employs a very large staff of architects, inspectors and clerks. For the financial year ending 30th June, 1897, the item on the estimates for roads and bridges amounted to £168,700. The total vote granted to the Works and Railways departments was £1,447,114, being an increase on the vote of the previous year for these departments of £541,745.

A visit to the York and Beverley districts affords convincing proof that, in spite of any untoward circumstances arising from a light rainfall, the existence of poison plants, and large private estates that are being used solely for grazing, the Avon district—within which York and Beverley and their surroundings are included—is in a highly prosperous condition, from the agriculturist's point of view. In all directions wheat fields are being reclaimed from the forests ; the trees are being grubbed and burned ; every grower, whether large or small, is extending his operations ; new and improved machinery is being purchased, and large sums of money are going into the pockets of local producers, instead of being sent to other colonies for food supplies. And yet only a beginning has been made ; the traveller can ride for miles through country as good as that from which heavy harvests are being reaped, but upon which nothing but ringbarking has been done. It is the aim of the Government and of all friends of Western Australia to settle these lands, to burst up large squattages; not by spoliation in the form of a penal land tax such as has been resorted to in other places that could be named, but by the making of an unconstrained bargain with the owner. They want to see the colony freed from the reproach which is often unjustly levelled by its detractors, that Western Australia is unable to grow sufficient wheat to feed the people. It is true that wheat is not largely grown, but that does not imply that it cannot be largely grown. The upspringing of the colony into a great and prosperous country has occurred so suddenly ; fleets of steamers from all parts of the world, but chiefly from the sister colonies, have been disembarking so many thousands of emigrants upon Western Australia's shores every year since 1892, that there has not been time to cater for their wants. As Sir John Forrest said, in declaring the policy of the Government on the approach of the general election which took place in June last, the colony is more than capable of doing that, and it would be done even if the Government had, for lack of a sufficient number of yoeman, to clear land and turn farmers themselves.

To anyone who has watched the progress of the farming industry in the Avon district nothing is more gratifying than to note the modern methods that have come in vogue. Until gold was discovered at Yilgarn, husbandry was for the most part conducted on a primitive scale ; single furrowed ploughs were in general use, a seed sower was unknown, and a steam chaffcutting plant quite a rarity. Now two or three furrow ploughs are always employed ; there are seedsowers, reapers and binders, and all the hay is chaffed by steam. The railway trucks are gay with the brightly painted devices on the implements of standard makers travelling to the homesteads of men who are earnest in their endeavour to grasp the advantages they enjoy and economise costly manual labor in increasing the output of their holdings. The Government, determined that the producers' tools of trade should go untaxed, has during the two sessions carried proposals for the remission of duty upon fencing wire, galvanised iron wire, and other material which is used by the man who is making a home upon the soil, and also for admitting all machinery free at the Customs house.

The only agricultural area that, at the time of writing, is open in the York district, is that at Caljie, containing 12,500 acres, which have been available since December, 1892. The south-west corner of the Caljie area is only about five miles from York. Most of the land is light, sandy, and inferior, and should be taken up in blocks of not less than 1,000 acres, as the larger proportion of it is only fit for grazing. It would cost about £3 per acre to clear the land.

Now that the Greenhills line is about to be made, an agricultural area is being surveyed beyond the terminus of the line which will tap a large tract of fertile country. No heavier crops are grown in the colony than those at Greenhills, and settlement beyond Greenhills has hitherto only been retarded by the long distance that produce would have had to be carted to York, the nearest railway station. The line will start about six miles south of York, and will be about 18 miles long. Tenders for its construction are now (June, 1897) being called for, and it is hoped that the rails will be laid in time to carry this season's harvest.

What has been written of the country around York largely applies to the adjoining Beverley district, which is nearer the port of Albany. The Great Southern line, after being made by a private company on the land grant system between Albany and Beverley was, in 1896, (with the sanction of parliament) purchased by the Government, together with the land grants appertaining to it. Those settlers who had obtained holdings from the company have been placed on the same footing as conditional purchasers from the Crown. Beverley is an important farming and grazing district. The Beverley agricultural area, containing 35,000 acres, lies along the Great Southern railway and fronts the Dale river, and was thrown open for selection in September, 1893; it contains some good land timbered with York gum and jam trees, but the greater portion of the area is a lighter quality of soil, and a large portion of it is still available for selection. The clearing of the forest country in this locality is estimated to cost from £3 to £4 per acre. The contiguity of the area to the railway line, and the comparatively large holdings that could be secured for mixed farming purposes, are in favour of this locality. The area is 103 miles from Perth, 238 miles from Albany, and five miles from the town of Beverley.

CHAPTER III.

NORTHAM, MECKERING, AND GOOMALLING DISTRICTS.

Northam, which, like York, Beverley and Newcastle, stands in the fertile valley of the Avon, is what Sir John Forrest has aptly described as "the gateway to the goldfields." It is surrounded by large estates which are gradually being turned into wheat fields. The sheep runs are amongst the best in the colony. The discovery of the Yilgarn goldfield made a great change in the history and development of Northam. It gave the town a railway, first to Southern Cross and afterwards into the heart of the auriferous country as far as Menzies, and it added a new corn-growing province to the colony. Beyond Northam lay 100 miles of country which had been deemed valueless for the farmer; much of it was grassless salmon gum country, and the rainfall was light; there were sheep raisers but no cultivators there. The peopling of Yilgarn when the prospector unearthed its treasure, caused attention to be turned to the unpromising areas of the east. There was a great market for produce close by, if produce could be grown. Moreover, there was no other Crown land near Northam that could fulfil the boast of the Premier that "every man who lands on the shores of Western Australia knows there is a block of 160 acres of land available for him; that there is also financial assistance to settle on the land, and that he may obtain the lands at 10s. per acre." All along the valley of the Avon the territory had been alienated years ago by men who were bringing the organisation of capital and skill to utilise them to the best advantage. If new comers were to avail themselves of the beneficent legislation of the colony to secure a homestead and help to build up the national wealth by adding to its productiveness, they must test the arid tracts which for half a century had been neglected. The experiment was worth making, for here, if corn would grow, was ample room and scope enough for an army of yeoman who would be nearer the consumers than the producers of other districts, and therefore they could afford to obtain a lower yield per acre than the moister districts and yet turn their holdings to good account. The test was made, and with the most successful results. As in the case of the despised mallee of Victoria and South Australia, what had appeared to be almost a desert proved to be splendid arable land when it was treated under conditions adapted to its peculiar situation and requirements. The Lands department saw its opportunity ; it cut up the Meckering agricultural area a few miles east of Northam, and when that subdivision was rapidly taken up others followed, and the work of settlement has within the last two or three years been proceeding with great rapidity. Tammin, Doodlakine, and Bainding areas were thrown open, and in spite of a very dry season, almost approaching to drought in 1894, the experiences of the settlers have been most propitious. Their crops have never failed, and men who went on the land, in some cases with very small means, or with the assistance of the Land bank, are to-day letting contracts for clearing, buying additional horses and machinery, and employing labor. It is calculated that there is a profit each season of £5 upon every acre cultivated, and unless exceptionally severe years should be experienced, what we have called the new wheat-growing province of Western Australia is likely to steadily grow in size and productiveness. From every point of view these newly-occupied agricultural areas are deserving of detailed notice in this SETTLER'S GUIDE. In the first place, there is plenty of land awaiting settlement there, which cannot be said of every district ; moreover, the land, or the best of it, cannot be excelled for the growth of wheat, and the holdings are easily cleared. The limited rainfall is compensated for, as far as possible, by summer ploughing and early sowing ; while the Public Works department on behalf of the Government is giving much attention to the conservation of water. These and other surroundings peculiar to farming in the far east are deserving of review.

The Meckering agricultural area commences 20 miles to the eastward of Northam, which is an important and flourishing town, near Clackline, the junction whence the Yilgarn line branches from the Eastern railway. The area contains 80,760 acres, and sixteen blocks were set apart as free homestead farms under the Homesteads Act, 1893, the remainder of the land being made available for conditional purchase. The blocks average about 150 acres, but it is competent for any selector to take up several of them, amounting in all to not more than 1,000 acres. The area is officially described as chiefly York gum, salmon gum, and jam country ; soil, loam, with clay sub-soil. Water is frequently found at a depth of about 20 feet ; ring-barking and clearing greatly increases the supply. Nearly all the settlers have blocks of several hundreds of acres, and keep some stock.

The Tammin agricultural area was gazetted open for selection in September, 1894. It is beyond Meckering, 50 miles east of Northam, and 117 miles from Perth, and is intersected by the Northam-Yilgarn railway. The survey includes 45,000 acres. It is heavily timbered forest country, the soil being a rich deep loam, growing salmon gum, gimlet wood, and morrell gums, which it costs £5 per acre to clear. Water has to be obtained from tanks or wells. The Doodlekine area is next passed through on the road to Coolgardie. This area was opened for selection in December, 1892, and comprises 40,000 acres about 75 miles from Northam, 142 miles from Perth, and is bounded on one side by the railway to Southern Cross. Here sand patches intersect the forest country. About 15 miles further on is the Bainding area, which has been available since December, 1894, and contains 55,000 acres, a larger proportion of which are of the esteemed forest country than is to be found on the Tamin and Doodlekine areas. In all these areas the one drawback is the small rainfall, which steadily diminishes the further east the settler goes. Some statistics may be given to enable the reader to judge of the extent to which the district is threatened with drought, which is occasionally relieved by the occurence of a thunderstorm which does not pass over the mountain ranges to the coast. Starting from 1888 the reports of the Government Astronomer show that this would have been an excellent season for wheat growing, as 100 miles beyond Northam rain amounting in all to about 14 inches fell regularly every month from March to September. The following year was also a good one, so excellent, in fact, that wheat and hay could have been harvested at Southern Cross where, so far, a seed furrow has never been cut. There was also a sufficient rainfall in 1890, but a check occurred in 1891, when the record at Southern Cross was only 5.20 and at Mooranoppin, near Doodlekine, 8.41. In 1891 there was more rain along the Yilgarn railway than in the Avon valley, the records being respectively, Northam 14·43, and Southern Cross 15·10, which was visited by some heavy local thunderstorms. During five weeks from April 17 to May 21, frosts prevailed at Mooranoppin. The 1893 season was the best of which any records have been kept, Mooranoppin registering 14·91, and Southern Cross 13·97, while portions of the Avon Valley were flooded. Quellquelling, Meckering, and Greenhills yielded in some paddocks as much as 40 bushels to the acre. The next season was the driest that has been known, Southern Cross getting only 5·11 inches of rain, and Mooranoppin 10·28 inches. But even in that year early sown crops in the east would probably have been worth reaping.

Some instructive evidence comes from Victoria as to the prospect of establishing permanently prosperous wheat-growing centres in the eastern agricultural areas of Western Australia, having regard to the occurrence of such unfavorable seasons as that of 1894, which did not furnish any guide, because at that time cultivation had not been begun any distance eastward of Northam. Comparisons can to some extent be made with the results achieved in Victoria during 1896, in that year of drought in the mallee country, which corresponds to the eastern forest lands of

Armadale Vineyards and Orchards. Sir A. Stepney, Bart., Mr. M. E. Jull, and Mr. W. L. Owen.

Houghton. Mr. C. W. Ferguson's Vineyard on the Swan, 15 miles from Perth.

Western Australia. The *Australasian* says :—"An illustration of the great benefit of good cultivation, combined with early sowing, in a very bad season, is furnished this year by Mr. Alexander B. Cobham's farm at Pine Hills, Waitchie. The crop consists of 40 acres of wheat which has a luxuriance of growth that would be remarkable in an ordinary season, but is something extraordinary in the present drought." Mr. Cobham says :—'The crop was sown the third week in March, but no rain fell till April. The rainfall with which it has grown is as follows:—April, 0.58 inches ; May, 1.06 inches ; June, 0.81 inches ; July, 0.21 inches ; August, 0.95 inches ; September, 1.58 inches ; October, (1 to 18), 0.10 inches ; total, 5.38 inches. This crop has therefore being grown with less than 5½ inches of rain, and has been subject to particularly trying weather, hot winds, for several weeks past, having been prevalent. We intend starting cutting the crop for hay to-morrow. We shall sell the crop as chaff, and expect to make a profit (that is after deducting the cost of seed and all labor) of about £5 per acre. This should satisfy anyone that there is money to be made in the mallee, even in a dry season. The rainfall of the year to date (18th October) amounts to 7.45 inches. The average rainfall of the district is over 13 inches, and it mostly falls before the end of October.' Some samples of this crop have been kindly sent us by the Rev. Mr. Patterson, to whom the letter from which we have quoted was sent. The wheat is remarkably well grown and is fully 4 feet 6 inches high. A single plant has sent up 118 stalks, each of which carries a head, save one, and the exception has a head just coming out. With the wheat plants is a sample of Cape barley, grown on the same farm. It is three feet high and remarkably well headed. On first looking at these samples their strong healthy growth gives one the impression that they are from irrigated land."

The point of this extract is that it goes to show that crops can be grown, with careful and early cultivation, with less than the rainfall which is generally considered essential to their success, and also that the eastern farming districts of this colony have not yet experienced anything like so dry a year as that which has been known in the mallee. The only month during which in 1894 the rainfall at Doodelkine did not greatly exceed that which produced Mr. Cobham's heavy yield at Waitchie, was September, when the returns respectively were :—1.59 ; Doodlekine .59 ; but an earlier sown crop at Doodlekine would have been already ripening in September, and therefore almost independent of rain.

Rain came very late in 1895. Early sowing proved to be of special value, but new ground could not be broken up in time to sow early, so that only fallowed land yielded well. The returns show Mooranoppin, 9.60 ; Southern Cross, 5.42. 1896 was a good season for early crops, heavy rain falling in March. Self-sown wheat, with the benefit of these showers, was wonderfully good, while crops that were put in early in March gave an abundant harvest. Mooranoppin had 13.98 inches, and Southern Cross 9.00.

"A careful study of the above records (writes the special correspondent of the *West Australian*, after a tour through the new eastern wheat-growing agricultural areas lying between Northam and Southern Cross), seems to warrant the following deductions :—(1) That the most vital point in successful cultivation is early sowing. If summer ploughing is impossible, there only remains for the farmer to fallow during the spring, and sow not later than March and April—the former for preference. (2) That a light rainfall, evenly distributed, is much more favourable to wheat growing than a heavier rainfall unevenly distributed. (3) That in dry seasons the rainfall out east perceptibly diminishes every ten miles. During such seasons success is possible only by early sowing—say in February—good seed and careful cultivation. (4) That, according to the *Australasian* record of successful wheat growing at Waitchie, the foregoing rainfall statistics show that out as far as 100 miles east of the Avon Valley, wheat cultivation should be successful even in our worst years. (5) That from 1887 to 1896, the rainfall statistics show the climate of the Avon valley and district to be admirably adapted for wheat cultivation. During none of the years within this period has the rainfall been so small as to cause a failure of the crops, except where late so ving was practised. (6) That in many years the ground during July, August and September, becomes flooded, and growing crops destroyed on the low-lying flats. For this reason a system of surface drainage is necessary. (7) That the rainfall registered in spots close to prominent hills is above the average for the locality. Thus the rainfall for York is above the average for the district ; and similarily Mooranoppin, which is located close under a high rock, is higher than Kellerberrin, situated more in the open. (8) That early sowing is only possible where a farmer has his own teams—the system of ploughing and seeding by contract invariably means late sowing and frequent failure."

The meteorological reports go to show that the limit of safe cultivation is 100 miles east of the Avon valley, a point that is marked by the Merredin peak, a vast granite rock which the railway department utilise as a catchment area. A dam has been constructed at the base of the peak to catch all the rain that falls upon the rock. The country near the peak varies from sandy stretches to the stiff red ground of strips of forest. The simile of a traveller is that the forest is interspersed with sand plains in the shape of the fingers of a hand. Where the country is so unequal the selector should endeavor to name his own boundaries. It is estimated that there are 25,000 acres of eligible forest land between Merriden and Hine's Hill and adjacent to the Yilgarn railway. The Bainding agricultural area intersects this forest. The area runs to within two miles of Hine's Hill railway station, and it is mostly first-class land. Close to a market and the railway, easily cleared and cultivated, it is alone deficient in water supply. A settler on the area says that the only way to get water is to camp close to a large granite rock and to build a tank at its base; but this would leave stock without a supply and it is highly desirable for the settler to keep sheep. It is expected that the ringbarking of the land will provide water. It has done so in other parts of the colony, but about two years have to elapse before the trees are all dead and water makes its appearance. Meanwhile the buying of stock could be deferred and reliance placed upon cultivation. The cost of ringbarking is handsomely repaid by increasing the feeding capacity of country and cheapening the cost of clearing. In the future the scheme of carrying water to the Coolgardie goldfields, which has received the sanction of Parliament, may assist the settlers *en route*.

"There is an excellent indicator," writes the special correspondent whom we have previously quoted in this chapter, "of the class of soil through which the Yilgarn railway passes, and that is the side of the permanent way. Thousands of bags of wheat, oats, and barley are yearly transported by the railway to the goldfields. The oscillation of the train shakes a small proportion of the seeds on to the railway line. This is well worked by the permanent way men and so becomes a perfect bed. The seed is in position for the first rains and has all those conditions that I referred to at the commencement of this article for the successful growth of cereals. It thus becomes instructive to watch the various portions of the railway line to see how the plants thrive. . . . All along the railway line right to past Merriden the wheat seeds stooled out into beautiful plants, on which ripened many ears of fine corn. Many experienced farmers have been struck by this circumstance, and have all said that what could be done on the railway line could be done elsewhere in the same locality in the same soil; and when men of experience and judgment say these things, it is very evident, that, given a good water supply, our eastern forest lands will be to this colony what the mallee lands have become to Victoria and South Australia. It may here be remarked that it has only been by the cultivation of their dry areas, as wheat fields, that these two colonies have been able to supply the needs of their own population. Take away the mallee country from Victoria, and the northern area from South Australia, and these colonies at once drop from wheat-exporting colonies to wheat-importing colonies. For this reason I have placed so much stress on the forest land of our eastern districts. Our great want as a nation is to produce our own breadstuffs. I believe that the cultivation of these forests will settle the problem."

It is related that in one paddock in the district under notice a thunderstorm in January germinated some wheat that had fallen to the ground while reaping was going on, and the plants grew vigorously, in spite of the time being midsummer, until the autumn rains fell. Last year a somewhat similar experience, we are told, happened to Mr. Packham, of Doongin, in the Tammin agricultural area, whose self-sown wheat plants stooled out so freely that one of them covered as much ground as half a dozen of those which were sown in the ordinary course. Mr. Packham's experience seems to bear out the experiments of the director of the Wagga state experimental farm in New South Wales, who sowed wheat at the rate of 4 lbs. to the acre, and obtained from 28 to 30 bushels to the acre, the conclusion arrived at being that light early seeding is much more productive than heavier sowings at a later time. "It is imperative that early sowing be practised in these eastern areas. Without it the selector may have keen disappointment in his crops. September and October are not reliable months for rain, real summer weather sometimes being experienced during them. It therefore naturally follows that the wheat plant, if possible, should be so well grown by September that the occurrence of a hot spell will not damage it." A beginning has been made in summer ploughing. The loamy soil from which the salmon gums and gimlet wood trees have been cleared is sufficiently friable to allow of the work being satisfactorily done. It is important to remember that it is land of this class that is offered to the man who desires to become a cultivator. The Crown Lands department is careful to pick out the choicest parts of the country that remain in its hands, to encourage settlement, and the new comer is invited to become the owner of the most eligible lots which, from personal inspection, shall commend themselves to his judgment. It is a great testimony in favor of the eastern territory that for the most part pastoral lessees who have their sheep runs there are a prosperous class, and there has been only one notable case of failure among them. In this instance the failure is ascribed to the paddocks being too large, so that the fences enclosed inferior and poison land.

One great measure of relief from the water difficulty is being carried out by the Railway department, which, having found the water of the Bulong pool to be so highly mineralised as to be injurious to the boilers of their engines, has resolved upon undertaking a large and costly scheme of conservation. The rocks within three miles of the line are being surveyed to ascertain the rainfall catchment area, and tanks are to be made to act as reservoirs, which, it is expected, will have some water to spare for settlers, who will only be asked to pay 2s. per 1,000 gallons. These tank sites have been chosen at Grass Valley and Meckering, while a dam has already been provided at Cunderdin, having 35 miles of drains; it cost £7,500 and it has a holding capacity of 12,000,000 gallons. Another one has been constructed at Merriden peak. The base of the peak and of the Cunderdin rocks is encircled with cement channels, and in the latter case a tunnel half a mile long is cut through the rock. A dam of 60,000,000 gallons capacity is being made at Tammin at an outlay of £11,000. There is also one which holds 3,750,000 gallons at Kellerberrin, and in this locality a second, to contain 20,000,000 gallons, is being surveyed about three miles north of the station. Merriden dam, which stores 8,000,000 gallons, cost £8,000.

Another important factor in the success of the settler in the east is that, when water is supplied, he will be able to get, in addition to some hundreds of acres of superior forest country for cultivation at 6d. per acre per annum (which, in 20 years, amounts to the purchase money of the block), a homestead leasehold for grazing purposes of 5,000 acres (or less) of third-class land at a rental of 1d. per acre for 15 years, and 2d. per acre for an additional 15 years. Enormous areas, on which coarse but nourishing shrubs grow, have been locked up for lack of watering places, which, to a large extent, are being supplied in meeting the requirements of the Railway department. These are very pressing, owing to the enormous development of the goldfields traffic that is expected to lead to the duplication of the line at no distant date. Plans may be obtained at the Perth Lands office, showing approximately, by means of both colours and surveyors' notes, the value of the different portions of a district and also all the mountains, rivers, watercourses, soaks and dams, together with a scale showing the distance of the various blocks from a railway line. The notes tell a plain, unvarnished tale, and the words "poison," "sand plain," "thick scrub," arrest the attention of the reader as boldly as "rich black (or chocolate) soil," "well-grassed land," "good forest," or "permanent water." Sheep can be very cheaply worked, as native shepherds are obtainable. The blacks are voluntarily assigned to those who employ them, and give their services for clothes, maintenance and tobacco. A great deal has been written of the alleged illtreatment of the aboriginal servants by their employers, but on investigation it will be found that these tales emanate from new arrivals in the colony, who make a visit to the north, and are unfamiliar with the habits of the natives and the conditions which govern their intercourse with the whites. This is not a fitting place in which to enter into the merits of the controversy on the subject of the protection and care of the blacks, which has formed the theme of voluminous correspondence between the Premier and the Secretary of State for the Colonies, and of animated debates in the houses of the legislature; but it may be pointed out that if no other motive than that of self-interest operated to ensure that the natives are properly treated by those who engage them, this incentive would be a very strong one. The natives are very useful, and possess a special skill as trackers and bushmen, which makes their services well worth retaining; while, on the other hand, if these retainers were dissatisfied with their servitude, there would be nothing to prevent the children of the bush from changing their environment in the summary fashion of the tribes who wandered all over their respective districts and lived by hunting before colonisation by the whites took place.

In so warm a climate as that of the east, it is satisfactory to know that fruit trees and vines and vegetables can be grown in abundance, if some discretion is shown in choosing the site for the orchard and garden and homestead near one of the large granite rocks, which always denote the presence of water at a very shallow depth. Another recommendation, that many people will regard as of the first importance, is the healthfulness of these dry table lands. A spare, wiry frame and longevity would appear to be the characteristics of the older settlers. During the greater portion of the year the heat is intense in the daytime, but as soon as the sun sets the air becomes cool and bracing, allowing of sound, refreshing sleep. The ill humors of a dyspeptic who could do a day's harvesting in the temperature of a Turkish bath would indeed entitle him to sympathy. To judge from the appearance and the endurance of some of the stalwart younger generation, a sanatorium established anywhere between Meckering and Southern Cross for asthmatic or consumptive patients would soon acquire a great reputation for its efficacy.

What has been written of the neglect of the salmon gum country in the York district applies with full force to the growers of Yilgarn, who were grossly deceived by appearances. Because the land did not grow anything except this species of eucalyptus it was considered to be barren, and it was only by an accident that its fertility was disclosed. When the route of the Yilgarn railway was cleared, the places where the trees had been threw up grass so thickly that it could not fail to attract attention. Then a patch or two of the forest was cleared to see whether it would produce wheat, and men who had been on the land for twenty years had to confess themselves astonished at the crop. A typical case is that of the Sewell's at Chureening, to the south of the railway, near Tammin. They had been cultivating the lighter jam tree soil, and four years ago they were induced to clear 12 acres of salmon gums, which for about 25 years had lain idly in their possession. The harvest was such an eye-opener that they have selected a large block in the Tammin agricultural area, and are getting it ready for cultivation. Nor is it only the local settler who has become a convert to the richness of the timbered tracts for cereals. A large slice of this territory has been acquired by an English syndicate, of whom Mr. Lowles, M.P., is a member. This gentleman recently visited the colony, and made a tour through the goldfields of Coolgardie and the surrounding centres. *En route* he inspected the Crown lands between Northam and Southern Cross, and was so impressed with their value that he took up an extensive location, of which 1,000 acres have already been got ready for ploughing. The syndicate have this season a large area under crop. The manager of the Land bank, Mr. William Paterson, whose judgment may be relied upon, for he is a large grower near the South-western line, recently saw the Tammin agricultural area, of which he highly approved. "What could not be done with this land with the rainfall of the south-west?" was his observation when he was given an opportunity of examining it. It has been so conclusively proved that the forest soil is superior to the jam country for farming purposes, that the latter should be set apart by the selector for fruit growing, for which it will be admirably adapted.

There is a great deal of valuable land in the eastern areas that has not yet been surveyed by the Lands department, and about which, therefore, less is known than Tammin, Meckering, Doodlekine, and Bainding. On these areas settlement is proceeding so rapidly that in a year or two the "eyes" of them will have been picked out, and it will be necessary for the seeker for an eligible homestead to go a little farther afield and inspect some of the pastoral runs which occupy some very choice country to the southward of the Yilgarn railway. A selector may take a block out of any pastoral leasehold, but must pay the value of any improvements which have been made by the lessee. In most cases the runs are unfenced, and may, therefore, be erroneously supposed by those who are looking for land to be private property. The policy of the land legislation of Western Australia is that the grazier occupying Crown lands must always give way to the cultivator. The farmer is the man to whom every encouragement is given, while the pastoralist has very little more than a premissive occupancy pending the arrival of the time when the land will be required to produce corn, hay, or fruit. Accordingly, the terms upon which pastoral leases are issued are almost nominal, but the leaseholder has no right to the soil or the timber, and may not even do ringbarking without the permission of the Minister. When that permission is given ringbarking is appraised as an improvement. Pastoral leases are granted in the eastern division in blocks of not less than 20,000 acres, at a rent according to the term for which the lease may be granted, as follows:—For each thousand acres or part of a thousand acres, two shillings and sixpence for each of the first seven years, and five shillings for each of the remaining years of the lease. If the land is so shut in by other holdings as not to contain twenty thousand acres, a lease may be granted for such lesser quantity; but in no case shall a lease be granted for less than £1 per annum. All pastoral leases expire on the 31st December, 1907. The fair value of any improvements existing upon any block applied for within an agricultural or special area is determined by the Minister, and the amount is added to the purchase money of the block which the conditional purchaser desires to obtain. He has to pay for the improvements in five yearly instalments, with interest added at the rate of five per cent. per annum, and the first payment has to be made when the land is applied for. Subject to these provisions there is, upon the sheep runs of the eastern pastoralists, a very wide choice of location by the agriculturist, for, as it might be supposed, the squatters, who are the pioneers of the district, marked out their boundaries with an eye to securing the most eligible properties. This will be apparent from the notes that have been made by surveyors, who have made themselves acquainted with the quality of the country that is held under grazing tenure. In the other colonies, with their larger populations and smaller territory, the class interests of squatter versus selector have excited a spirit of antagonism, and the cry, "Unlock the lands!" has led to the progress of land settlement, only after many a hard and bitter battle in the legislative chambers. Happily, in the magnificent range of this colony, there has been ample room for both the pastoralist and the producer, who, as a rule, have maintained amicable relations with each other.

A glance at the good country, or some of it, that lies outside the blocks surveyed and set apart for the farmer at Meckering, Tammin, Doodlekine, and Bainding, which may be deemed to have received sufficient description in the foregoing pages, will be instructive. The observations are the outcome of a tour through the several districts referred to by the special correspondent of the *West Australian*, and bear the impress of personal knowledge of a division of the colony that is but little known by the people of Western Australia, for before the goldfields' era few travellers had penetrated into what were commonly regarded as the waterless fastnesses of Yilgarn. To show that the country is not pictured in rose colors by the writer, his melancholy description of what he calls "The Great Lone Land," a desert 40 miles long and 12 wide, which he met with near Mooranoppin, would be worth quoting. This place of desolation is one of the largest sand plains in the eastern division. It is only relieved by one patch of rich salmon gum country. To the north of the Tammin agricultural area, which has practically all been taken up, there is a fine forest of about 3,000 acres, the bulk of which has also been selected. A creek at the foot of Cunderin peak, and on towards the Cunderin railway station, runs for seven miles through very fair land, which improves as the railway station is approached. Adjoining the station is a small but high-class gimlet wood and salmon gum forest, portion of which has been set apart as a water reserve. "One day in the winter of 1895," says the traveller, "I stood on the summit of the Toapin rocks, near Dangin, and obtained a fine view of the excellent country which abounds in that locality. The rains had been fairly abundant and the grass was growing healthfully, so that the surroundings were viewed under favorable circumstances. Acres upon acres stretched before the view, and but a slight fund of imagination would have been necessary for the observer to have peopled these fertile plains with budding homesteads and yellow wheat fields. With but a trifling exception the whole of these rich lands were untilled, unused and unpeopled. The rich, red soils, possessing all the elements of fertility, seemed to beg in mute eloquence for the transforming power of the human hand. Like the mallee lands of Victoria, it has been recently demonstrated that our forest lands, at one time entirely discarded, are to be a great source of national wealth. The returns this year (1896) from the forest lands are peculiarly encouraging. To those who have been through our back country this spring the conviction must have been forcibly driven home that the area of our agricultural lands is much wider than was formerly imagined. From all directions most gratifying reports from the holders of forest lands are to hand, and this class of country is rapidly growing in the estimation of our farmers. So largely is this the case that the margin of cultivation is yearly being forced back to regions where a scanty rainfall has hitherto developed the idea that successful wheat-growing was not practicable there." The first-class lands are surrounded by areas of second and third class country. These areas are admirably adapted for stock raising. In the white gum country and on the sand plains rough scrub and grasses grow, on which stock thrive. Mixed farming will have to be undertaken in this class of country. Wheat-farming alone, it is universally recognised, cannot pay in the long run. To work the ground satisfactorily the soil must be periodically rested and enriched by the droppings of the stock which are kept to feed down its stubble and its weeds. Suppose a farmer selects, say, 640 acres of first-class land under conditional purchase and a free homestead farm of 160 acres and 5,000 acres of third-class land under the homestead lease system, he will thus be able to grow abundant crops and keep a fair quantity of stock. Every farmer in the eastern districts practices mixed farming, and owing to the success of this season it may be expected that in a few years grazing country will be as eagerly sought after as the first-class forests are now. But in running stock through the white gum grazing lands the settler must beware of the poison plants, chiefly of the box species, which are especially dangerous in early summer. Where these occur the poison patches should be fenced out or grubbed out, or the sheep should be tended. By taking these precautions losses are avoided. The agricultural lands are not infested with poison, which is not greatly to be dreaded if the proper methods of managing stock where it is found are understood and carried out.

Some of the richest lands in Western Australia are to be found in the districts of Dangin, Cubbine and Youndegin, which lie between Greenhills and the Southern Cross line. When the railway from Greenhills (the first section of which from York to Greenhills is now being laid) is extended to the Yilgarn route, a splendid tract of country will be tapped. Hereabout some of the best blocks are held under what are known as pastoral poison leases—a system of land alienation which will be dealt with more in detail under a separate heading, with a view to pointing out what are deemed to be weak points of early legislation on this subject. While poison land was deemed to be suitable, after it was cleared of the noxious vegetation, for the raising of stock, the Cubbine poison leasehold is so fertile that most of it is capable of producing excellent crops, to which a great many acres are being devoted. Twenty-five miles east of Cuttening, from Darderring spring to Qualing, cultivation is being successfully done in an extensive forest area of the finest character. From the summit of Qualing rocks a fine view of the country is obtained, and the devious course of the dry bed of the Salt river, growing salt bush here and there, can be seen for miles. There was a great flood in this river in 1872, cutting off the squatters from their out stations, but it has not been running for years. Its bed, which is very broad, is superior pasture land, and it is lined with forests for a depth of from one mile to three or four, comprising a belt of valuable country that ought to be one day the "home of many a thriving settler, when the golden corn shall wave in the breeze, and the fattened sheep recline under the foliage of the shade trees." The country is dotted with granite peaks in all directions. At their base the greenness of the manna trees betoken moisture, and there is no doubt that in this locality abundant water supplies are to be procured in many places. The Salt river is one of the tributaries of the Avon or Swan river.

From Qualing to Moulien the distance is 15 miles in a westerly direction. For the first mile or two excellent forest is traversed, terminating in sand plain, which leads to Moulien homestead. Nangin hill is in the midst of a heavy forest on the bank of the Salt river. Thence north-east, superior agricultural country, some thousands of acres in extent, is passed through. There is room here for farms, and the country is certainly worth a visit from an intending settler. The whole of the country is parcelled out into pastoral leaseholds, varying in size from 20,000 to 120,000 acres. In order to see the country to advantage, a trip from Moulien to Toapin, *via* Dangin and York, is recommended. About 30,000 acres of superior land are embraced in a ride of ten miles, beginning at Moulien. It is probable that an agricultural area will be laid out here. The Wareening hills are good feeding country. A little to the west of these hills is the Lotting spring, in the midst of granite rocks, which are the source of the chief water supply of the east. The Lotting spring is on the eastern boundary of a large salmon gum forest, which extends westerly to the Salt river and northwards to the northern base of mount Stirling. Approaching the Moolyun homestead from Qualing, the homestead is found at the base of one of the huge granite rocks which are features of the landscape. The creek running through the stock yards is moist even in the hottest summer. The track from Moulien, after traversing the forest already referred to as the probable site of an agricultural area, crosses a lakelet known as the Jennebury pool. For four miles beyond the river the country is very eligible for selection. Through Badjelling, to Toapin, a stretch of good country extends to Dangin, but there are some poison patches in the neighborhood. Round about Dangin, Toapin, Badjelling, Cubbine, and Dorakin, there are some heavily timbered areas. The country is dotted with the granite ridges which indicate the presence of water, and which would, therefore, be chosen as homestead sites by the settler. On the west of Dangin there are some exceptionally sturdy jam trees which attest the goodness of the ground. This is one of the best spots for settlement, and there is plenty of scope for it. The white gum belts are, as usual, blemished with box poison, but the salmon gum country, which is the predominating timber, is free from this pest, as is generally, although not invariably, the case. In the Dangin district the attention of the Lands department is being directed to the merits of a large block suitable for an agricultural area. The correspondent adds :—" I have had many enquiries about the land at Dangin, for its fame has spread, and nowadays there is keen competition for rich forest lands possessing a good rainfall. The rainfall at Dangin is about 14 inches, and once the Greenhills railway is finished the district would be in great demand by would-be settlers. The case of the Meckering agricultural area need only be cited as a case in point. Until three years ago settlement there was comparatively slow. During the last year it has been most rapid, and now the area is almost entirely selected, while there are weekly enquiries for land at the Northam Land office. I foretell a great settlement in our eastern forest areas, and am certain that attention will be given to those in the mount Stirling district." From Warralling, which borders on a few hundred acres of cereal land, into Greenhills, the country is chiefly suitable as pasture ground.

So many references have been made to poison lands that it is desirable to supply some explanatory notes of the provisions under which these areas are acquired, and the terms under which they are defined. Under the Land Regulations, proclaimed on the 2nd March, 1887, poisoned land is defined to be land that, in the opinion of the Minister, is so infested with poisonous indigenous plants that sheep or cattle cannot be depastured on it. Poisonous plants are considered to be eradicated when it has been proved to the satisfaction of the Governor in Council that land originally infested has been rendered safe for depasturing cattle and sheep at all seasons, and has continued so for a term of not less than two years. The leaseholder of a poison block is required to pay for the survey of the same ; to select not less than 300 acres ; to pay an annual rent of £1 per 1,000 acres or part of 1,000 acres ; to produce evidence that the land applied for is poisoned land under the regulations ; to fence within three years, and to pay the stipulated rent for a period of 21 years ; whereupon, having given proof that he has eradicated the poison, he becomes entitled to a Crown grant of the land, or sooner if all the conditions of the leasehold have been fully complied with. The bulk of the land held as poison leaseholds was taken up under an earlier Act than the one which the regulations quoted amend, and which did not require the land to be fenced within three years. The result was that nothing has been done for the improvement of many of these holdings, but they cannot be forfeited until the expiration of 21 years from the date the lease was granted. It has also been found that some of the leaseholds comprise choice agricultural land ; notwithstanding that, it will be seen from the wording of the clause setting out that the blocks shall be made safe for the carrying of stock, the intention of Parliament was to limit the operation of the law to pastoral country.

The question of water supply, which is regarded as a most important one in facilitating the settlement of that part of the colony, has been receiving attention on the part of the roads board of the district. While it is recognised that when ringbarking has done its work and the forests have been killed there will be plenty of water on the Meckering area, the need of making immediate provision is of the first importance. The board has made overtures to the Commissioner of Crown Lands to resume four wells belonging to private owners, with a view to prevent stock being short of water in a dry season. These supplies were obtained before it became the rule of the Lands department to retain permanent supplies of water for the use of the public. The large increase of the population of the neighborhood is urged as a strong reason for the nationalisation of all the available water. The purchase of the wells would be only one step in advance of the action taken by the Government some years ago, when a water conservation board was formed on the Meckering area. The demand for water is all the greater, inasmuch as the soil is especially adapted for summer cultivation, which is necessary in order to get the seed germinated by the first rains. The water supply for the horses in ploughing alone is likely to make a great drain upon the slender resources of the settlers during the most trying time of the year. The best means of meeting the demand is under the earnest consideration of the Government, fully cognisant as it is of the fact that a bountiful water service will greatly facilitate the progress of settlement from Meckering to Bainding.

The Goomalling agricultural area, to the westward of Northam, is confidently expected to become a great farming centre, particularly as it is contemplated to make a railway in that direction. On this subject the views which Sir John Forrest expressed in the Legislative Assembly on the 27th August, 1896, when (as Colonial Treasurer) making his financial statement, carry the greatest weight, for perhaps no one has such a familiar knowledge of all parts of Western Australia as the Premier, who has been one of the most dauntless, indefatigable, and far-reaching of her explorers. Sir John Forrest said :—"We propose also to make a railway survey from Northam to Quelquelling. I am able to say, from personal knowledge, that there is no place in the colony where an agricultural railway would be likely to pay better. From Northam to Quelquelling is about 20 miles on the road to Goomalling, and the route runs through an agricultural country all occupied by farmers in small locations, and is one of the best, if not the best, area of agricultural land in the colony. It is just about the same sort of land as that at Greenhills, the only difference being that the line runs from York for some distance through large freehold properties, whereas the line from Northam runs through the land in the hands of small owners." The surveyor who is plotting out the Goomalling agricultural area, writes to the Lands department as follows in describing the country: "I have ridden over a large area of the country. I think you will be pleased to learn that I anticipate being able to forward a design for cutting up about 10,000 acres within a radius of six miles of reserve 1092, and having its extreme alignment about 15 miles east of Goomalling. Eighty per cent. of this land will be really first-class forest country, and a portion of the remainder very good. I have also examined the country 10 miles south from Goomalling, where two or three thousand acres of good forest country can be obtained. The Goomalling territory, free as it is from the water difficulty, needs no further encomium. Land is also available for selection near the Clackline railway station, which is the junction of the Great Southern and Yilgarn lines. The country in this locality is very hilly and more suited to the vigneron and orchardist than the yeoman. As a grape-growing district this section cannot be surpassed, the ironstone gravel of the slopes of the Darling range providing all the requisites for the flourishing vineyards of Mr. Edward Keane, Mr. Quinlan, M.L.A., (Cooringa), Messrs. Bull and Stevens, and others of smaller size, within the radius of a few miles. Those readers who are interested in this subject are referred to the chapters on the soils of Western Australia, and on vine and fruit culture, that appear in other portions of this volume.

Although this chapter has been entitled "Northam, Meckering, and Goomalling districts" very little has been said of Northam proper, for the reason that the land in its immediate vicinity is in private hands. In a treatise dealing with the great producing *entrepôts* of the colony Northam would have had a foremost place, for in the extensive area it has under cultivation, the modern methods of its cultivators, their progressive spirit and enterprise, and the quantity and value of their yields, it would be hard to find an example of greater achievements, not alone in the western colony, but in any other part of Australia. But this book is intended to furnish counsel to those who are desirous of establishing themselves in what, it is to be hoped, will prove a career of content, usefulness, and expansion, upon Crown lands; and therefore places like Northam which are in the possession of those who were in the van of settlement, obtain only passing, but appreciative, notice, as belonging to the sphere of realisation, rather than to the domain of the founder of new centres, and the beginner at work that still remains to be done.

CHAPTER IV.

THE TOODYAY DISTRICT.

Newcastle, the *entrepôt* of the Toodyay district, is picturesquely situated on the Avon about 50 miles east of Perth, at the terminus of a branch of the Eastern railway, 64 miles by rail from the metropolis. Like York, Northam, and Beverley, nearly all the land around Newcastle is in private hands, but some very eligible estates are now under offer to the Government, which is empowered to buy land in blocks of not less than 2,000 acres near a railway, for the purpose of promoting land settlement. This power was given by the passing of the Agricultural Lands Purchase Act. A sum of £200,000 was set apart by Parliament to carry out the provisions of the Act, which was one of the first measures introduced last session. In moving the second reading of the bill in the Legislative Assembly on the 22nd July, 1896, the Commissioner of Crown Lands, Mr. A. R. Richardson, said :—"Hon. members will recognise this bill as a somewhat important measure and also as a new departure in our legislation. I have very great pleasure in moving the second reading, because I believe the result will be a very considerable increase to our agricultural settlement, and it will give a great number of opportunities to those persons who are desirous of so doing, in the way of obtaining access to land close to railway and large centres of population, which they are now unable to obtain. Owing to the peculiar circumstances of this colony, we have, somewhat to our sorrow, considerable areas of valuable land, containing a fair proportion of agricultural land, placed in choice and eligible situations as regards transit and access to market, which it is now impossible for anybody to get hold of ; not because owners are unwilling to sell, but they decline to part with small portions. They will either sell the whole, or none at all ; and not many people are in a position to treat with owners for large areas of 7,000 or 8,000 acres. The Government have had brought under their attention a suggestion that it would perhaps be wise to undertake, under certain conditions, the repurchase of these lands, to cut them up in lots and offer them for sale, subject to special conditions as to improvements. The land so purchased must be recommended first by a board which has to report on all land it is considered desirable to acquire. There is also a very necessary precaution in providing that the land shall be situated in accessible places—for instance, near a railway—so that the Government are not likely to obtain much land that is placed at an inconvenient distance. I think the bill will give to the colony an increased area of land under cultivation ; in fact, during the last few years I have had an idea of this sort in my mind, but then the Government were not in a financial position to carry it out. Now I think it is a wise step to repurchase good land and cut it up for sale and improvement." The Coondle and the Norman estates are two choice properties, close to Newcastle, which have been offered for sale to the Crown, and the proposals are under consideration.

The Coondle estate is part of the famous Toodyay valley, which has a great reputation for the strength of its dark red soil. It was granted to the original proprietor in consideration of his rights as a pioneer, and comprises 7,000 acres five miles north of Newcastle. On the maps of the Lands department it is known as "Location No. 1," and it is one of the possessions of the Leake family, one of whose members was for many years Chief Justice of the colony. The land is undulating, and portions are almost mountainous ; but no country is better known for its excellence in the eastern division. Most of it is timbered with York and salmon gum. It is confidently expected that the estate will be acquired by the Government, and will be subdivided into holdings large enough to be sought after as farms by men possessing a few hundreds of pounds. There is a good road from the estate into Newcastle, and a sufficient supply of water for stock and household use. There is sure to be an eager demand for land at Coondle, if the aspiration of Newcastle is realised by it passing into the hands of the state. It is a source of great regret by the people of the district, that it is hidebound by the comparatively little use that is made of some of the choicest subdivisions, which only sustain sheep and cattle, instead of being converted into fields of wheat. It is pointed out that there is no lack of pastoral runs which do not offer great inducement to turn them into arable lands, and that it is a waste of good gifts to have the farmer shut out from such fair tracts as Coondle.

The Norman estate is a splendid property of 7,000 acres, adjoining Coondle, and is six miles from Newcastle. It was, in the early days, given as a Crown grant to Mr. R. Norman, and has passed as a legacy to Mr. Fenwick, an American gentleman, who, during a recent visit to the colony, intimated his willingness to sell it to the Lands department. The Norman is a fine agricultural block, and is watered by the Boyagerring brook. It is estimated that 500 acres without a break could be put under crop in more than one part of the grant, which grows York gum and jam ; in fact, the local land agent (Mr. A. N. Piesse) says that eight-tenths of it could be cultivated. There is no finer wheat land in the district. In the south-west corner, which is timbered with gum, there are patches of box poison, and also some York road poison, which also thrives on some parts of the commonage. After the first rains, local stock-owners find this vegetation to be most dangerous. East of Newcastle there is no poison within a distance of 20 miles. The chief pasture plants are corkscrew and silver grass, which are very fattening.

In addition to the Coondle and Norman estates the Toodyay commonage offers some scope for additional settlement near Newcastle. This area is 17,200 acres in extent; it is under the control of a board, and its nearest line is three miles north-west of Newcastle. The commonage is well adapted for fruit growing, and some of the largest oranges produced in the colony have been sent from the immediate neighborhood. The best of the soil is a chocolate loam that cannot be surpassed, but no large area in one piece is obtainable for the cultivation of cereals. Patches of good land, about 50 acres in extent, may be selected. The commonage is fairly well watered by soaks and springs. No blocks granted there have been thrown up. The board has power to refuse selectors' applications, but they never do so. The south-east corner of the commonage has been settled for several years by people who have prospered on their holdings.

The Toodyay reserve embraces the only other Crown lands in the district that it would be advantageous to take up. This block lies north-west of Newcastle, in the same line as the commonage; the reserve is a mile nearer Newcastle, and comprises an old townsite. The original area was 800 acres. As a townsite the land had no attractions for investors, as it was so close to Newcastle that the volume of trade was drawn to that place. For years it lay idle, while it was enviously regarded by fruit growers, who recognised in its deep well drained land and situation the ideal place for successful operations. As time went on and settlement came to a standstill in the district, as regards the development of fresh centres of industry, the Government were importuned to throw open the townsite for intense culture. The request was pressed by the present Commissioner of Crown Lands (Hon. George Throssell, M.L.A., of Northam), before he accepted the ministerial portfolio, in pursuance of the active interest he has always manifested in fostering the productive industries of Western Australia. He was supported by Mr. B. D. Clarkson (who, at that time, represented Toodyay in the Legislative Assembly), Mr. A. N. Piesse, Mr. O. Bull (one of the largest vignerons), and others, and so good a case was made out that the proclamation of the townsite was revoked in February, 1896. The land is now obtainable under special provisions which have regard to the valuable character of an area that has not only been proved to be remarkably well adapted for oranges, lemons, apples, peaches, and grapes, but is also within less than three miles of the Newcastle railway station. When a block is applied for the applicant has to lodge with the Government land agent 10 per cent. of the upset price of the land; which is £2 per acre. The application is advertised in the *Government Gazette* for one month, and the block is then submitted at auction and sold to the highest bidder. If the man who asked that the land should be put up should not be the purchaser, his 10 per cent. deposit is refunded. An idea of the exceptional quality of the property will be formed when it is stated that some of it has realised £13 per acre for the planting of oranges, lemons and vines, which it produces to perfection in the practically inexhaustible dark red soil which forms the slopes of this garden of nature. It is nearly surrounded by the Avon river, and grows grasses all through the summer most luxuriantly. Here the pasture ground is distinguished by being free from scrub, and if it were not fed down the silver grass could be mown at midsummer like a crop of hay. The average size of the holdings is about eight acres, and owing to the exceptional fertility of the spot an excellent living can be made off them from around Newcastle, if a location is wisely chosen; fruit-growing is regarded as the most profitable of all rural occupations. About one-third of what was the townsite has been selected, and in a few years, when the young orchards and vineyards laid out there have come to maturity, the place will be one of the features of the Newcastle district which a visitor will be anxious to see. The land also yields heavy crops of all kinds of vegetables, with the exception of potatoes, which suffer from the occurrence of frosts from April to September. It was what is now a vegetable garden that was sold for the top price of £13 per acre, and it was greatly coveted because it is moist even in the hottest part of the year. The supply of vegetables to the goldfields, where high prices are realised, is an industry that is as yet only in its infancy. The smallest block under cultivation on the townsite is one of six acres. There are nearly 300 acres of the land still available. Small paddocks for the keeping of a cow, in order that they may add fresh butter and milk to the comforts of the household, have been set apart by some of the settlers. As a contrast to the occupation of comparatively large areas for mixed farming, the close settlement and scientific cultivation of the fruit-growers of Newcastle are very instructive, as showing the very wide range Western Australia offers to the immigrant of every class, of skill, training, means and equipment, from an adaptation of the blocker system to grazing and farming on the largest scale.

The concessions granted to the Midland railway company, when the colony was not in the prosperous circumstances it enjoys to-day, have been very inimical to the progress of Newcastle. In consideration of the line being made by the company from Guildford, nine miles from Perth, to Walkaway, near Geraldton, a distance of 280 miles, it received a grant of 3,360,000 acres of land (6,000 acres per mile), which were cut out in alternate blocks to a distance of 40 miles on each side of the railway. The grants embraced all the Crown land within the 40 miles radius, and their existence has been deplored by every well-wisher who desires to hasten the day when the colony will grow her own wheat supply. It was the intention of the company to dispose of its lands, but several causes have militated against the realisation of this design, except to a limited degree. It became necessary to seek the assistance of the Government in order to complete the line, and a loan of £500,000 was guaranteed on the security of a mortgage upon the land grants. The mortgage has retarded the alienation of the company's estate, and selectors have always shown a preference for the easier terms granted to them by the Crown. Moreover, it would not be possible for the holder of a farm taken out of the Midland grants to obtain the assistance of the Land bank. Most of the land has therefore remained locked up, while there has been a demand for similar country held by the Crown Lands department. A strong agitation has commenced for the ceding to the Government of the Midland railway and its hereditaments, and the purchase of the Great Southern line and its estates, which also belonged to English shareholders, has given strength to the movement. If the step should be taken, enormous areas will be thrown open for selection, which are now unimproved. The best of them are to be found around Dongarra, near the Irwin River, which will be dealt with in writing of the country between Guildford and Mullewa ; but the encroachments made within the boundaries of Toodyay seriously operate to reduce the agricultural returns of the district.

A summary may be given of the evidence collated from reliable sources, of the advantages which Toodyay presents to those who are looking for a place possessing railway communication, a fair rainfall, and proximity to market, together with a soil that will profitably repay the labor and outlay expended upon it. As a rule there are excellent roads in every direction, and the number of schools that have been established reflects the greatest credit upon the Rev. R. K. Taylor, who has exerted himself to make it the boast of Toodyay that no child need grow up there without the benefits of education. It is considered essential that a man who does not propose to obtain more than 300 acres should have capital of about £1 per acre to start with. He can make a good beginning with less, but his progress will be comparatively slow, unless he can employ labor to clear the land quickly so as to be in a position to get the benefit of the high prices which are now prevailing for farm produce. As a rule cereals pay better than root crops, except in such swamp lands as those which have been described in speaking of the Helena Valley and parts of the Toodyay old townsite. If fertilisers are used, as they should be while a farmer's revenue is so large as it is at the present time, the land does not quickly exhaust itself. If there is enough cleared land to permit of cropping every alternate year the additional weight of the harvests would recommend this plan. For fruit-growing Toodyay is almost unrivalled. The fruits, quickly ripened in the bright sunshine and the dry air of the latitude, are of exquisite flavor and large size, while the vineyards produce very superior wine grapes. Most of the farmers keep a few sheep, which they purchase as stores and fatten for the butcher and the supply of their families. There are also several large graziers, notably Mr. B. D. Clarkson, who raise sheep on a large scale. Sheep thrive better than cattle. Dairying is neglected, and the want of improved strains of milch cows is keenly felt. Nor are the breeds of special merit. The cattle industry may be said to be a languishing one, and the first step towards a better state of things would have to be the importation of high class strains of short-horns, Herefords or Devons from the eastern colonies. The poison plants are a menace to any large expenditure on this enterprise. The dingo has not been exterminated, but the bonus of 10s. per scalp is paid upon about 100 heads of this pest of the sheep-breeder every year. The evil is not so great as to demand the shepherding of flocks, as would be the case in some of the rough but well grassed country of the south-west. If there are no hurtful shrubs and the wild dogs were all killed out, the district would be regarded as a first-class one for stock ; as it is, it is spoken of with some qualification in this respect. In a dry season water is not as plentiful as could be wished, but there is never any approach to disastrous drought. Well water can be struck at shallow depths. There are facilities for irrigating garden or orchard plots along the course of the Avon, but land for this purpose would have to be purchased from private owners. The general configuration of the country is undulating, while there are some hills so steep as to be only adapted for grazing. The timber consists of morrell, salmon, York, and white gums and jam trees, which costs from 35s. to £5 per acre to clear, the jam country which has been ringed for some years being indicated by the lowest figure and the virgin green forest areas in the higher one. Since horsefeed has been so greatly in demand very little save wheaten hay has been grown in Toodyay. This kind of crop is not only the most lucrative, but it demands less labor than wheat. The district is visited by buyers' travellers, who secure all the produce that growers are willing to part with. When the writer visited Newcastle to obtain the information which is now being printed, farmers were holding their hay, as the market had a strong upward tendency. About Christmas time chaff had been selling at £6 and £7 per ton, but short shipments from the other colonies, the result of a short harvest and a dry season, were making their influence strongly felt, and there was a disposition to keep the barns full until supplies would realise £8 or £9 per ton, but this may be regarded as a speculative quotation and due to special causes which would probably be of short duration. The facilities for the transport of the crops to market are all that could be desired, especially as the railway freights may be almost said to have been indulgently framed in favor of the farmer. Most of the small quantity of wheat that is reaped is kept for seed grain. Wheaten hay is preferred to oaten, not only for its extra weight, but also because it is better adapted to the climate, as it does not so quickly get overripe during harvesting and stands an unexpected spell of dry weather with less injury. The co-operation of the Land bank is not very largely availed of simply because the growers are too prosperous to require to borrow. They recognise its advantages, and would strongly commend them to those who had heavy preliminary expenses to incur in establishing themselves. But as most of the older settlers till their own land and have overcome all the early difficulties of re-claiming their fields from the forest before the bank came into existence, they have the profits of the sale of their crops to enable them to undertake further improvements and to buy plant, both of which are employing a lot of capital in Toodyay. The scene at harvesting time is very different now to what it was a few years ago, when old-fashioned implements of limited power were in vogue. Now more than one reaper and binder is to be seen in many paddocks, and all the hay is cut by steam instead of horse or hand power, the use of which it does not require a long memory to recall. The altered regime is fully recognised by the manufacturers of agricultural machinery in England, and they spare no effort to bring the latest additions to the resources of the farmer under the notice of so progressive a body of men as the producers of Toodyay, who know what they want, and have money to pay for it, without asking for long terms. An example of the goodness of the market of the Eastern districts for ploughs and reapers, and binders, harrows, scarifiers, and steam chaff-cutting plant, was afforded at a show held last year at York, and the illustration fully applies to Newcastle, where, however, the possession of an ample and well appointed show ground prevents exhibitors having to combat difficulties in displaying the latest triumphs of the designer, the engineer and the artisan. The show ground at York, stored as it was with many examples of the stock and the produce of so large and prosperous a district, was found to be too small to accommodate the machinery sections, and in this department the display had to be relegated to a piece of spare ground which the visitors passed on their way to the exposition. But, so far from umbrage being taken by the machinery firms at what they might have considered to be scant courtesy on the part of the show committee, seeing how expensive it is for exhibitors to send goods of heavy bulk such a distance from town, that every agrarian labour-saving invention that adorns the catalogues of the most up-to-date firms for the season of 1896-97, was displayed, it was evident that the opportunity was too good to lose, and anyone who would ascertain the number of machines of various kinds that have been introduced around Newcastle, Beverley, York and Northam, during the last three years, would be forced to the same conviction. A cry of something like commiseration is being raised on behalf of the farmers of Great Britain, whom high rents and foreign competition have been seriously depleting within the last few years. In Western Australia it is not too much to say that the producer in anything in a large way, is on the high road to independence.

It is worth while adducing another feature of the management of the large estates of Toodyay to show the spirit of independence that is abroad in the colony, and the determination of every man who gets his living off the land to be his own landlord. There are in the possession of private owners of large means, who have been able to clear very large paddocks, some extensive areas of arable lands of the most superior character. One of the best of these estates has been offered to a tenantry on the share principle, that is to say, the landlord is willing to take a portion of the crop in payment of rent; but during the present season (1897) none of the paddocks have been let, and stock have been turned into these corn lands, which have gone back to pasture, while almost every acre belonging to the Crown that will produce wheat is being sought out and applied for. It should be added that pasture land is marvellously improved by cultivation. Not only do the indigenous grasses, the best of which are of the silver and kangaroo varieties, spring thickly upon it, but the dandelion, or Cape weed plant, so thickly covers the ground that is a great assistance to the stock-owner in fattening his sheep in spring and early summer. The Cape weed was introduced to the colony some years ago by a vessel which carried hay from the Cape of Good Hope to Esperance Bay, and since that time the plant has been steadily making its appearance all over the settled districts of Western Australia, and is generally welcomed. It is true that the so-called dandelion, when it is in flower, imparts to butter made from the milk of cows despastured upon it, a slightly bitter taste, and injures the keeping qualities of the butter; but, on the other hand, it outstrips in rapidity of growth almost any other kind of herbage as soon as the rains of autumn fall. Cape weed is making great encroachments among the pastures of Toodyay, and as very few milch cows are kept there, it is encouraged. The silver grass, which may be ranked with dandelion for the shortness of its life each season, and for its fattening properties, is the almost universal feed for stock up to December, when, having shed its seed, it wilts away, and the thin parched shoots are scattered by the wind or so sodden by a thunderstorm as to be almost annihilated. But while it is green it is an invaluable fodder plant, not alone because it is succulent and nourishing, but also on account of its being found everywhere, although the best land produces it in the greatest abundance. Just before it seeds it is almost equal to hay in sustaining working horses and in giving to them a bright satin coat. The kangaroo grass, which is also a great mainstay, resembles English rye, and while it remains green is a luxury for the animals turned out where it is found. Its peculiar sweetness attracts to it the marsupial tribe in preference to any other, and it is well known that the kangaroo is a veritable epicure in his choice of diet. Wherever there is a patch of this grass or a sward of tender shoots of coarser kinds coming through burnt ground, or a wheat paddock that is unprotected, kangaroos will be found, where they have not been exterminated, as is the case in the Newcastle district, at any rate near the town, by the progress of settlement. The corkscrew grass is also very common about Newcastle. This is good fodder, but its sinuous spines, from which it derives its name, are troublesome to sheep, and injurious to the wool. Still, in a part of the colony like Newcastle, that is too dry for maize, and in which oats are only moderately successful, the corkscrew grass, which does not die off in the hottest season, is a serviceable root. Some oaten hay is grown, but chiefly for racing stables. Not only at Newcastle, but in the whole of the eastern districts, the staple hay crop is wheat, although it grows too thick a stalk to satisfy horse owners in its natural state. But after the wheat has been passed through a chaff-cutter, the cut of which can be adjusted to any length of the sample, from a quarter of an inch upwards, this process of artificial mastication prevents the coarseness of the stalk being objectionable.

The rainfall, which is about the same as York, namely, 15 inches, is less than the Newcastle people desire, especially as the Avon is the only watercourse of any note in Toodyay, and residents of back blocks have to resort to wells and dams to tide over the latter end of the summer. The cost of well-sinking is generally £2 per foot, and for excavating dams, 1/- per yard ; well water in most places is struck at a depth of 20 feet. The earliest rains are expected in April and the latest at the end of September, but there is occasionally a thunderstorm before the regular autumn rains set in, and sometimes a shower or two late in October or the beginning of November. But as the average season provides only a short, and not too abundant, rainy period, summer ploughing is in favour wherever it can be practised, that is, where the land is not too heavy and the teams available are strong enough to do the work. The soil of the district may be clearly defined as heavy and light ; the first is that which has been more than once referred to in writing of the eastern division as "rich forest land," that is to say, the country that grows the largest York gums, manna trees, and silver wattles. This formation can stand the strain of yearly cropping if it receives a dressing of from two to three cwts. per acre of bonedust, phosphates, or guano. It is only by continuous cropping and starving that such land can be exhausted. It produces from one to two tons of hay, or ten or eleven bushels of wheat, per acre, and those who possess cleared areas of this soil are justly regarded as fortunate men. And even of the rich forest country there are patches that are strangely and superlatively good. When the writer was at York, Mr. Parker, one of a family of very large farmers, and the owners of some of the most valuable and fertile agricultural lands of which Western Australia can boast, called my attention to what he called "the red streak" running in a line north and south for a mile or more across the stretch of broad acres, through which the young corn was making its appearance. The band of darker higher green to which Mr. Parker pointed was almost as vivid as a mark of blood upon a pallid face. The whole field had the health of a well-nourished crop, but the plants on the "red streak" stood above the rest of the wheat as though they had been sown three weeks earlier than those on the remainder of the rest of the ground. "That," said Mr. Parker, "is a wonderfully prolific belt of country which runs for miles as far as Northam. It always grows twice or three times as much as any other place on the farm. Last season we could not get the reaper and binder through it, yet it has received just the same treatment as the rest of the ground, and the whole of the crop was sown on the same day." The "streak" has been found like a line of reef in various properties, and it is Mr. Parker's belief that it could be traced without a break, if anyone took the trouble to follow it out of the cultivated lands, through the forest, a great deal of which still remains in a state of nature, notwithstanding that it is of such great fertility. Last year the Messrs. Parker were the largest producers of hay in the eastern districts, a result which they ascribe to the possession of cleared forest lands, thorough cultivation, and the fact "that they have a large slice of the potential 'red streak' right through their properties. The light soil is the jam country. This class of timber is never found on the best land. The jam tree soil yields from 15 cwt. to a ton of hay, and about eight bushels to the acre. Jam is usually found intermixed with morrell gums. There are a few red gums at Toodyay, but they are so rare that they are hardly to be taken into account as a guide to the good, strong loam in which they grow. Wattle and stinkwort is found in fertile hollows that would grow first-class fruit. As in the territory beyond Northam, white gum country in Toodyay is to be avoided by the farmer. An excellent rule for the stranger to follow is that the darker the ground the larger the crop that will be taken off it.

If any capitalist should desire to establish orange and lemon orchards of an ideal kind, he can do so by the aid of irrigation on the banks of the Swan river at Nardie pool, and at Deepdale, a few miles from Newcastle ; but he will have to buy the slopes of the river at these points from private owners. A great country for fruit of every kind. Western Australia can rival Spain in raising the citrous tribe for size, thinness of rind, and luscious quality. The oranges grown at Cheriton, near Gingin, are a marvel to visitors who have seen the bests fruits the globe can produce, and the younger trees planted at Newcastle bid fair to equal them when they reach their prime.

CHAPTER V.

THE SOUTHERN DIVISION.

THE SOUTHERN DISTRICT.

The southern district in these pages will be understood to be a belt of country, eighty miles wide, extending from Beverley to Albany, on the shores of Princess Royal harbor, and through the centre of which belt is laid the Great Southern railway, 243 miles in length. The Great Southern railway was the scheme of Mr. Anthony Hordern, a Sydney merchant, who placed his proposal before the Government of Western Australia in 1882. He asked that in consideration of constructing the line he should be granted a subsidy of 12,000 acres per mile, selected in alternate blocks within 40 miles east and west of the railway. Colonel McMurdo and Mr. Joubert made similar offers. The Legislative Council, which was the parliamentary institution in those days of Imperial Government, desiring to know more than had then been ascertained about the character of the country through which it was desired to make the line, sent out a survey party to make a reconnaissance. The members of the party were the Hon. the Surveyor-General, Mr. (now Sir Malcolm) Fraser, the deputy surveyor-general Mr. (now Sir John) Forrest, Mr. C. D. Price, inspecting surveyor, and Mr. H. S. Ranford, whose services and intimate knowledge of the district are commended in the deputy surveyor-general's report. They found that the section of country under review is a plateau having a mean surface level of about 1000 feet above the sea. The principal features of this plateau have some interest ; from it flow all the principal storm water channels of the southern part of the colony, including the Swan river, the upper portion of which is called the Avon, and its branches. It is a noticeable fe.ture of the physical geography of this part of the colony that it differs from that of other parts of the world. The best land is here high up away from the coast, whilst in other countries the rivers have made the lowlands fertile by what they have borne from the highlands. Doubtless, says Sir Malcolm Fraser, the fact of the highest country being near the coast accounts in a great measure for the lesser rainfall and a higher temperature in the interior during summer, as the moisture from the sea becomes precipitated before the clouds reach far from the coast ; both the position and the limits of the principal forests clearly support this supposition. The bed rock of the southern district is granite, "covered in parts by concretionary ironstone, sand plains, and clay flats." The deputy surveyor-general estimated there were about half a million acres of good agricultural land along the route as being available for occupation, in addition to 158,000 acres of similar land that had been parted with by the Crown. The Surveyor-General adds :—"I consider the block as a whole quantity of about three and a half million acres, now let for pastoral purposes, may compare favorably with any like quantity taken in a similar way in one block anywhere else in the central district of this colony." The survey party found that the country passed through presented no engineering difficulties of magnitude. The rivers and streams crossed are so near their source that bridges are small and far between. With the easiest of grades the line rises from 700 feet at Beverley to its greatest altitude, 1,277 feet, 75 miles south of York. It then alternates between 989 feet at Arthur river, to 1,250 feet at Yowangup, then down a gradual decline to 815 feet at Kendinup to the sea level at King George's Sound. Jarrah forests were found in the Darling range and abutting on the Gordon plains, southward of the Gordon river, and elsewhere to the westward.

The report which Sir John Forrest made 16 years ago as the result of personal inspection of the country between Beverley and King George's Sound, is a reliable guide for, as he says, he wrote from "careful examination," and he is a witness of special knowledge and experience of the geography and characteristics of Western Australia. Some extracts from his report may, therefore, be advantageously quoted :—"The soil within the area colored yellow on the maps is mostly of a light chocolate color, grows excellent grass in ordinarily good seasons, is timbered generally with *eucalyptus loxophleba* (York gum), *acacia acuminata* (raspberry jam trees), and *acacia microbotrya* (manna gum), and is well adapted for the growth of cereals. In the vicinity of Moojebup, Yowangup, Ettakup, and Martinup, etc., there is at present a better opening for agriculturists than in any other place between Beverley and King George's Sound ; the land is of the richest description, the clearing is tolerably easy, and the climate salubrious, and it must eventually be a large wheat producing district. It is within 100 miles of King George's Sound, being in that respect nearer a port than Moorumbine, which has for many years produced a large quantity of grain. In the vicinity of Staunton springs, Kechualling, Waggarrup, Collanilling, Dumbleyung, Coompetine, Moojebup, Camballup, Moordinup, Jackatup, etc., are also admirably suited for agriculture and, with increased facilities of transport, would no doubt provide the colony with large quantities of wheat and other cereals. The water supply along the route, although in some places scarce, may, I think, be considered as tolerably good, and in many places water is plentiful. The Palinup river has in the past been very deficient in this respect, and a fine country has been almost deserted in consequence. Recently, however, tanks have been made, and more fresh-water wells have been obtained; and I believe that with ordinary good seasons and renewed energy, the whole of the upper Pallinup will not only carry larger numbers of sheep, but will also be a wheat-producing district. Water is now secured and conserved in this neighborhood by wells, dams, and tanks, and generally with excellent results. The prevailing timber along the route and over the country examined is *eucalyptus redunca* (the Wandoo or white gum tree). 'This tree,' says Baron von Mueller in his excellent work on the forest resources of Western Australia, 'is so indifferent in regard to soil, as to prosper on cold, clayey, or poor gravelly flats, where humidity stagnates in the wet season,' and I may go a little further and say that it generally grows on that description of country. In the same way as *eucalyptus redunca* is an index of inferior land, so *eucalyptus loxophleba* (York gum), and *acacia microbotrya* (manna gum) are an index of the most fertile country. Within the limits reported upon, viz., 20 miles on each side of the supposed line, there are at the present time about 250 homesteads. These 250 settlers are for the most part industrious, hardworking men, and manage to make a fair living. A few of them have made a moderate competence; but as a rule they live on their homesteads, attend to their sheep, and do the work of laborers. Many of them began life as shepherds, and by care and industry have secured a small independence. The district seems in many places well adapted for the growth of fruit. The vine, plum, peach, and pear trees seen in the gardens on the elevated country along the water-shed of the Arthur and Gordon rivers, appear healthy, and to bear abundantly. There cannot be a doubt but that the whole of the country between Beverley and King George's Sound is capable of being more beneficially utilised than it is at present, and that as population increases and cultivation is more common a larger number of people will reside upon the land." After the report of the surveyors had been received, the overtures of Mr. Hordern for the construction of the Great Southern railway on the land grant principle were accepted, and he formed in London the company which carried out the project.

The land grant railway, for the making of which the company received in round numbers 3,000,000 acres of land, did not realise the hopes either of the shareholders or the people of the colony. The early death of Mr. Anthony Hordern prevented his colonisation schemes from being carried out. He had intended to establish experimental farms for training purposes, to provide advanced instruction in all branches of agriculture for students, the sons of men who were able to give them a start in life. These farms were to be under the control of professors, who, when the students had completed their course of instruction, would choose suitable land for them to establish their own homesteads upon, and assist them with direction and advice in order that they might make their ventures successful. The advantages of co-operation were to be secured by the experimental farm in each locality purchasing from the producers, milk, olives, and grapes, in order to manufacture these materials into butter, cheese, oil and wine. The company had other plans of land settlement which did not bear much fruit, while the experimental farms never assumed a more tangible shape than a descriptive report. For years, from 1884 till 1891, the country along the Great Southern railway was locked up, pending the selection by the company of its land grants in alternate blocks that should equally divide the frontage to the line with the Crown, and the progress of the district was greatly retarded. The old settlers who had come from York in search of new pastures for their flocks, lost their security of tenure ; an excessive value was placed upon the estate by the company, and the result was they obtained very few purchasers for a territory that has been looked to for funds to pay for the construction of the line. The shareholders received no interest on their investment, and the land has not developed in the way that had been expected and desired, because the land was appraised at from £1 to £2 10s. per acre, while the adjoining blocks belonging to the Government, were to be had at the uniform price, upon conditional purchase, of 10s. per acre, or as a free grant under the Homesteads Act. To buy from the company also meant that the settler was debarred from participating in the benefits of the Land bank, and to be subject to what was for a long time a less liberal freight tariff for the conveyance of produce than that which was ruling on the Government railway service. From time to time the company made overtures to the Government to purchase their railway and land grants, but it was not until October, 1896, that the Ministry saw their way to ask Parliament for the authority to enable them to accept an offer. The price was fixed at £1,100,000. The matter came before the Legislative Assembly on a motion moved by the Hon. Sir John Forrest. The Premier urged that it was the policy of the country that the railways should belong to the people of the colony. Although the land grant system of building railways had been adopted at a time when the colony was not so prosperous as it had since become, it was a matter for regret that one-half of a strip of country 80 miles wide, between Beverley and Albany, had been handed over to a private company. The arrangement had not proved satisfactory to the people of Western Australia, especially to the residents of the district through which the railway ran. The 3,000,000 acres, comprising the land grants, were a large portion of the temperate part of Western Australia, and of the south-western division, that had a good rainfall. The time had come when it was advisable for the country to hold these lands, in order that they might be developed under the liberal land laws of the state. The total quantity of land sold, or ageed to be sold, by the company, up to the end of February, 1895, in round numbers, was a quarter of a million acres ; so that there remained unalienated about two and three-quarter million acres still held by the company. This land would now come back to the Government, together with the 83,129 acres which had been sold by the company on deferred payment. Besides this, there was a large amount of property held by the company in the town of Albany. "I have no doubt," Sir John Forrest went on to say, "that if the Government possess themselves of this property, as we ask the House to authorise us to do, the settlement of the country along this railway will largely increase, and we will be able to throw open these lands, with the advantages of the Homestead Act and the Agricultural Bank Act applying to them, although they have not applied to these lands hitherto. The people who live there now, and those who may come there, will have all the advantages of the liberal land laws of the colony, including the facilities afforded by the Homesteads Act and the Agricultural Bank Act, and in which the people settled along that line have hitherto had no part or interest up to the present time, and were not able to avail themselves of these advantages and facilities. All along the line at the various towns we shall have many more land sales than the company have had in recent years, and the land revenues from this source will be considerable. I see no reason why the whole of the lands could not be thrown open to pastoral settlement, in those portions which are not required for agricultural." When the motion for the purchase of the line, having been agreed to in the Legislative Assembly, was considered by the Legislative Council, the Hon. C. A. Piesse, the member for the south-east province, felicitated the country upon the purchase, which would remove a blight from the district which he represented, owing to it having been vain to try and settle the country under the conditions laid down by the railway company. He proceeded :—"The old settlers who held only small holdings for the purpose of sheep farming, suffered most severely, because the company took it for granted that, having made their selection in the early days, they had got the best land available, and the company, thereupon, selected all around them, and deprived them of their runs. Fortunately, the Government are to get this land back, and I may tell hon. members that some choice spots will now be available for selection. There are some beautiful pools on the Williams which are never dry, and the land around them is only waiting for people to select. I should like to lay stress upon this point, because a feeling has got abroad that all the eyes have been picked out of the land. That is not so. In seven years working the company have only secured five new settlers in the district to which I refer, and these do not hold more than 5000 acres of land." The Houses having unanimously decided to buy the line and the estate of the company, a bill was passed the same session to give effect to that resolution, and hence there is to-day a very much widened area over which the man who desires to obtain land on easy terms may range, and cut his boundaries where he pleases, so long as he observes the condition of lying north, south, east, or west. The resumption of the Great Southern land grants have such an important bearing upon the inducements that are offered by Western Australia, that the short history that has been given of the career and operations of the company has been needed to elucidate the fact that there is, close to a main line passing through a territory 240 miles long, and possessing good soil, a temperate climate, and a fair rainfall, greater room for settlement than in any other quarter of the colony, owing to the locking up of the lands for about ten years. In other words, had the railway been laid by the Government, settlement would have been encouraged instead of being checked, as it was by the interposition of private ownership of the land, and desirable areas, which are now awaiting occupation, would have been beyond the reach of the selector. The advantages these areas possess will be appreciated before the close of this chapter is perused by the reader.

Professor William Brown, principal of the Longerenong agricultural college, Victoria, who travelled through the southern district in 1890, found that the country possessed a climate of the most delightful character for residence and certain agricultural productions. As there is a large water frontage, dense forests, and a great variety of aspect by hills and valleys, there are some of the most favorable conditions for rainfall and its conservation. Near Albany the temperature seldom goes over 85 degrees, and never under 36 degrees in the shade. The climate is therefore that of the south of England. Farther north the temperature gradually increases, until in summer it reaches about 100 degrees in the shade, at Beverley. "With such a geographical range, then, the variety of soil and shelter, the water supply, sea coast resorts, together with the abundance of timber and open valleys, there are attractions of the most substantial sort for settlement. Indeed, the question is one of 'What is it you want?' and not of 'What can I get?' It is evident, then, that any branch of farming and gardening can be entered upon under proper choice. On the sea coast and along the southern sections English grasses and green fodders will luxuriate, and thus induce to dairying as a leading pursuit, though there, also, culinary crops and some fruits will be successfully cultivated. The international seaport of Albany cannot fail in drawing out the capabilities of that district. Mount Barker, with its more suitable soil and climate, will unquestionably look to the production of fruit ; the Stirling range is decidedly one best adapted to sheep raising, while those of Broome Hill and Katanning are evidently for the cereals, and, indeed, if required, for any other thing in agriculture and gardening. The latter sections are of high value." To an interviewer, Mr. Brown stated that he had made a thorough examination of the south from a farmer's standpoint. His brief and strong statement is that "not the other colonies only, but even the people of Western Australia themselves, evidently do not know how much is waiting for development." He saw thousands of acres in contiguous blocks of fine chocolate lands, light clay loams, and peaty soils in all shades and situations. The very hilltops are covered with good soil which are all accessible to the plough, none being higher than 150 feet above their own valleys. The upper ranges have some natural grasses and healthy sheep and cattle runs. He saw several fresh water lakes and creeks that keep good all through the season, and that cannot fail to become an important element in the settlement of the country. Of the timber, as he confessed, he never, in all his American, Canadian, British or Australian experience, saw so much value per acre as stood upon some portions of the Millar Torbay property in the shape of karri trees—hundreds and thousands of acres of magnificent trunks 150 feet and 180 feet in height, without a branch, and as sound as a bell. The late farm manager of the agricultural college, Roseworthy, South Australia (Mr. M. Eastwood), has stated "that the land along the line, from an agricultural point of view, may be classed in two sections, that within the first 45 miles from Albany being rather wet, and the climate mild. The soil is a deep black sandy loam in the valleys, changing generally to light sand and ironstone on the hills. This land is well suited to the growth of English grasses, clovers, lucernes, etc., and on this account will be well adapted to dairying in all its branches. All kinds of market garden produce can be grown all the year round in abundance, and for fruit culture the climate and soil are admirably suited. Large quantities of green fodder may be provided throughout the year for cattle. Most of this land is rather heavily timbered with red gum and jarrah and is expensive to clear and cultivate. Some of the valleys within a few miles of Albany are almost clear of timber, but require drainage. Beyond the 45 miles the country rapidly changes, the climate becomes much warmer and drier, and the soil less sandy. The red gum and jarrah give place to white gum, York gum and jamwood, the two latter trees generally being indicative of good soil. Along this portion of the line the country is undulating in character, the soil varying in quality from rich chocolate loam in the valleys to light grey sand and often ironstone and gravel on the hills. The chocolate soil is well adapted to the growth of wheat and other cereals. The wheat crops growing in different settlements along the line this past season are as fine as I have seen in any of the eastern colonies, yielding from 18 to 25 bushels of grain of first class quality. This portion of the land (between Beverley and Mount Barker) I consider will be largely occupied by wheat growers. It is, in my opinion, specially adapted to wheat and sheep farming combined. The vine and fruit trees will also repay the settler for planting. Much of the poorer soils on the hills will, when partially cleared of timber by ringing and burning the undergrowth, grow good grass and make first class sheep runs."

Along the route of the Great Southern railway the Government have opened nine agricultural areas, comprising 450,328 acres.

The Pallinup area of 180,000 acres has been gazetted, but has not yet been thrown open for selection. The Beverley area, which is one of the nine referred to as being available for selection, is described in the references to the Beverley district. Of the others we avail ourselves of the particulars furnished in *The Descriptive Notes Respecting Agricultural Areas in Western Australia*, issued by the Lands department. This work says :—" It might be thought by some that the enterprising Western Australian Land company had exhausted all the best of the land along their line by their extensive selections ; but this is far from the case, as the land was selected by them along the line, subject to the condition that the Government should divide the frontage with the company." . . . " Of the areas thrown open 40,937 acres have been taken up (to January, 1897), principally at Katanning, by ninety-six settlers, a satisfactory number, when it is remembered that only one of these areas has been open just three years, while some of them have not yet been open twelve months. Lying, as they do, along the route of a splendid line of railway, between the capital of the colony and Albany, the port of call for the great ocean liners, with land admirably adapted for the growth of cereals, and in many places of fruit and vegetables, these areas possess many inducements to settlement."

The Moorumbine area was gazetted open for selection in July, 1893. It possesses the advantage of having the railway running directly through the middle of it, and adjoins the Brookton siding at Seabrook townsite, which by rail is about 223 miles from Albany, 20 miles from Beverley, and 118 miles from Perth. The land is much the same as that in the Beverley area—that is to say, it is mostly of a light loam, very suitable for the production of fruit and cereals. The timber on this country consists mainly of York gum and jam, and it is estimated that the average cost of clearing would be from £3 to £4 per acre. The land is well adapted for mixed farming, and it is recommended that for this purpose a square mile of country should be acquired. At the beginning of 1897 five selectors had taken up 1,754 acres of the Moorumbine area.

The Narrogin area was opened for selection in January, 1893. It contains 25,000 acres, of which 12,782 acres are surveyed into 42 blocks. There were, when the latest published returns were made up, 13 settlers on this area, who held in the aggregate 6666 acres. This is also a good corn growing area, and it directly adjoins the railway, and is distant only two miles from the Narrogin railway station, which is about 64 miles from Beverley, 179 miles from Albany, and 162 miles from Perth.

The Wickepin area was open for selection in March, 1893. It contains 97,000 acres, of which 37,195 are surveyed and cut up into 222 blocks. There are nine settlers upon this area, which is about ten miles from the railway, and they hold between them 5539 acres. This is regarded as an especially good area, much of the land being of an excellent description, and well suited for the growth of both cereals and fruit. The timber is chiefly York gum and jam, and the country would cost about £3 per acre to clear. Excellent roads lead from the railway to the area, which is served by the Cuballing siding; the siding is situated by rail about 55 miles from Beverley, 188 miles from Albany, and 153 miles from Perth. Good water has been obtained by sinking at shallow depths in this area.

The Wagin area was thrown open for selection in November, 1892, and contains 26,000 acres, of which 16,421 are surveyed. Only a limited portion is rich enough for the growth of cereals, but much of the land is suitable for fruit culture. At present there five settlers on this area, who hold between them 1287 acres. As the area is situated on the main trunk line adjoining the Wagin Lake townsite, and as there is already considerable settlement in the vicinity, on the land which belonged to the Western Australian Land company, no doubt there will be much enquiry for land in this area later on. Putaning townsite is situated within this area, consisting of 44 suburban lots averaging from four to thirteen acres each.

The Darkan area was opened for selection in April, 1894. It comprises 62,000 acres, of which 12,131 acres have been surveyed into 52 lots. This area is distant from the southern railway about 30 miles, and may be said to be situated between Wagin on the east and Bunbury on the west. There are good roads leading through the area, and on to the Wagin railway station, which is 95 miles from Beverley, 149 miles from Albany, and 192 miles from Perth. This area embraces a fair quantity of rich soil, and has a splendid rainfall. A branch of the Hillman river runs through it. The land would cost about £4 per acre to clear, and is well adapted for fruit and cereals. At present three selectors hold land to the extent of 865 acres.

The Katanning area is one of the largest and best agricultural areas in the colony, and settlers located thereon have already achieved a considerable measure of success. It was opened for selection in January, 1892, and contains 100,000 acres, of which 40,907 are surveyed into 282 blocks. Of this amount, 19,707 acres have been taken up by selectors; situated between Beverley and Albany, by rail about 127 miles from the former, and 116 miles from the latter place, and 225 miles from Perth, close to the central station and chief stopping place on the Great Southern railway, and a flourishing settlement thrown open by the Western Australian Land company, this fine area was bound to attract settlement; this it has already done in a marked degree. The suitability of this portion of the colony for cereals is largely demonstrated by the establishment of a first-class roller mill at the townsite of Katanning by Messrs. F. H. and C. A. Piesse. The land costs from £3 to £4 per acre to clear, and water is obtainable, especially after clearing. The railway runs right through the area. Besides a network of roads, running for the most part parallel and at right angles, three townsites

Toodyay. Avondale, Messrs. Bull & Stevens' Vineyard.

are laid out along the line within the area—Woodanilling, Moojebing, and Pinwernying, and for the encouragement of village settlement, 394 town and suburban lots of from three-quarters of an acre to one-eighteen acres have been surveyed. No doubt this is one of the best areas yet declared in the colony, and the settlement already taking place is encouraging. The peculiar suitability of this land for fruit culture is brought prominently before the notice of the public by the splendid orchards which have been planted close to Katanning townsite by Messrs. F. H. and C. A. Piesse, and the Western Australian Land company.

The Ewlyamartup area was gazetted as open for selection in March, 1893. It adjoins the railway in the vicinity of Broome Hill, which is an important settlement thrown open by the Western Australian Land company, situate by rail 139 miles from Beverley, 104 miles from Albany, and 237 miles from Perth. It contains 46,000 acres, of which 39,258 acres are surveyed and laid out in 198 blocks ready for selection, but as yet there are no settlers within this area, due undoubtedly to the greater attractions of the Yilgarn goldfields during the last two years. The timber on this country is chiefly York and white gum. The land is in parts very good, and suitable for corn-growing. It would cost, on the average, about £3 per acre to clear. There are good roads intersecting it, giving easy access to the railway line. The area is not particularly watered, but doubtless clearing would largely increase the supply, as in the cases of other localities. The ground in this area will no doubt be taken up when the good land in the Katanning area has all been applied for.

The Tenterden area is by rail 50 miles from Albany and 291 miles from Perth. It was opened for selection in November, 1892, and contains 30,000 acres, of which 19,750 acres are surveyed into 58 blocks. As yet there are only five selectors, holding 1,085 acres. The land is chiefly timbered with white gum, and is of the same average quality as that of the other areas along the Great Southern railway, much of it being suitable for corn growing, and more of it for fruit culture. A special feature in favor of this area is the large rainfall, which increases as a southerly direction is taken. This area has also been laid out and mapped with a view to village settlements, fifty-five town lots and 57 surburban lots having been surveyed and thrown open. Speaking once more in general terms of the areas along the Great Southern railway, they are essentially corn-growing areas and are easily and comparatively economically cleared, while in many places vines and fruit of all kinds will flourish abundantly. They are nearly all easily approached by the railway, which is well equipped by stations, sidings and rolling stock, and which maintains a daily train service.

The Pallinup area, the largest of the agricultural areas in the south, is situated about 30 miles to the south-east of Broomehill. This area comprises some 180,000 acres, but only portions along the various creeks are suitable for agricultural settlement. It is only partially surveyed at the time of writing (1897), and has not yet been thrown open for settlement. The area contains some good land, both for cereals and fruit-growing. Surface water is scarce, but supplies may be obtained by tanks and wells. It is intersected by the Pallinup river, and Warperup creek and many tributaries. This area is likely, when opened, to become a much sought after and valuable one.

Pingelly, 32 miles from Beverley, is a fine wheat-growing district which offers exceptional advantages to settlers, owing to a block of 191,400 acres, with an extensive frontage to the Hotham river, and close to the railway station, which belonged to the Western Australian Land company, being available for selection. The Moorumbine agricultural area, which has already been described, also runs up to a siding, so that the transportation of produce is well provided for. The *Advertiser* (Albany) furnishes some evidence of the fertility of the soil. That journal reports that Mr. J. N. Taylor, nine miles west of Pingelly, obtained 900 bushels of wheat from 30 acres of land, or at the rate of 30 bushels per acre. Off the field referred to, Mr. Taylor has taken never less than 22 bushels to the acre, and that only in very bad seasons. Some of the 900 bushels of wheat which is the subject of notice, was purchased by Mr. A. Y. Hassell, who pronounced it to be as good a sample of seed grain as he had ever seen. The next township going south along the railway is Narrogin, 63 miles from Beverley, which is surrounded by large areas of arable lands, which are extensively under cultivation. The conservation of water is rendered easy in this locality owing to the presence of many small watercourses, which can be dammed at a small expenditure of money and labor. Besides the unoccupied blocks of the Narrogin agricultural area, there are 9,180 acres of the resumed land grants to choose from. These grants adjoin the agricultural area, the railway station, and the townsite.

Wagin Lake, 95 miles from Beverley, is a very progressive scene of farming industry. It is studded with excellent farms, which are in an advanced state of improvement. Within the last six months the officers of the Lands' department have been kept busy in registering new applications for land, which inspection shows to be easily cultivated and capable of growing heavy crops. Among the chief settlers is the Hon. C. A. Piesse, one of the pioneers of the Arthur river settlement on the Perth-Albany road. When the Great Southern railway was opened, Messrs. F. H. and C. A. Piesse, who had been in business at the Arthur river, migrated to Katanning and Wagin Lake. They bought land largely from the Western Australian company, and have spent much money in utilising it for farms and orchards. It is their rule never to keep an acre of wholly unimproved land, the improvements ranging from fencing and ring-barking on grazing areas, up to the sowing of wheat in fertilised paddocks, and the laying out of vineyards and orchards which are among the most celebrated in the colony. They have manifested the utmost confidence in the Wagin Lake and Katanning districts, and their properties are calculated to inspire the same feeling of reliance in those who come to spy out the land. Messrs. F. H. and C. A. Piesse have altogether 6000 acres of land, for most of which they gave high prices to the company. They cut out their blocks close to the railway stations, abutting on the boundaries of the town-sites. In some cases they could admittedly have got superior country at a little distance from the line, but they preferred to save cartage expenses, and to spend those savings on manures. Of the 6000 acres, 1500 are cleared and under crop in alternate years, about 800 acres being thus harvested each season. The estates include 114 acres under vines and orchards, namely, 80 acres at Katanning, 29 acres at Wagin Lake, and 4 acres at the Arthur river settlement. A drive round the outskirts of Wagin Lake with Mr. C. A. Piesse furnishes a very instructive insight into the resources of the district. His homestead is built on a hill commanding a picturesque prospect of hill and dale, and a park-like expanse of jam and manna trees. The house, a very spacious one, is built of handsome grey granite, which is found on the crest of one of the local ranges. From the house slope the cornfields, vineyards, and orchards of the enterprising proprietor. He points to trees that are thriving on land which would be too poor to yield more than one or two crops of cereals, but which is capital for fruit production. The apples, apricots, peaches, plums, and cherries are, Mr. Piesse says, as large as those which are produced on the best chocolate soil of the Hon. F. H. Piesse at Katanning ; but the flavour is not quite so full or pleasant as that of the fruits of the richer loam, which is always the most profitable when placed under cereals. The great variety of the soils of the district is, Mr. Piesse says, very advantageous, although this natural feature of the south used to be decried. He remembers the time when superficial observers were prone to say that the York gum and manna country should be cultivated, and all the other soils left for pasturage purposes ; but the lessons of experience have vindicated the reputation of other kinds of land that was looked doubtfully upon. All that is necessary is to select the right kind of crop for each variety of ground, and every class—except the poorest gravel—will yield a profitable return. In the opinion of Mr. Piesse, it is beneficial to have such a diversity of natural conditions which conduce to the enlargement of the number of products which the district has to send to market. In other words, if all the land was of the richest chocolate or deep loams, there would be a reluctance to plant anything except wheat, or oats, whereas, since it has been found that fruit can be very profitably raised where the cereal harvest would, sooner or later, be scanty, every encouragement is given to extend the orchard acreage.

Mr. Piesse is much impressed with the facilities that are now presented to new settlers, in comparison with the harder lot of those who had to pay what are now admitted to have been oppressive prices for their holdings under the *regime* of the Western Australian Land company. To have the state as a landlord, offering cheap land, and cheap loans to improve it, instead of being under the rule of the owners of a private railway, whose freights, time table, and general regulations were beyond the control of the Parliament of the colony, is an object that Mr. Piesse has labored for. He endeavored for years to throw off a yoke that was repressing the settlement of the land and keeping down the growing of food supplies for the population of Western Australia. The thrall of private rule was creating class interests of the most injurious kind, the Government tenants being privileged to prosper, while their southern neighbors were galled by the rigor of their contracts. Now that the cause which was so long fought for has been won, Mr. Piesse submits that it is within the reach of the new men to do as much in twelve months, with the aid of the Land bank, as many of the older residents were able to accomplish in three years. Formerly Wagin Lake was the destination of men of means, whose substantial stone houses—more like suburban villas of the middle-classes than the humpies in which pioneers have lived in some parts of Australia—attest that they have come to stay ; but even some of these found it to be very exacting to pay as much as £2 per acre to the Western Australian Land company, instead of 10s. per acre to the Lands' department. To them the purchase of the land grants by the Government has brought a most sensible relief, for Sir John Forrest has announced that if Parliament approves of the step he will be in favor of remitting all payments beyond 10s. per acre, no matter how much the owners of the blocks agreed to give the company for them. This question is expected to come before Parliament during the ensuing session ; but as the Forrest Government is fresh from an appeal to the country, with a substantial majority behind it, no doubt is felt as to the vote upon the question as to whether the conditional purchasers from the company are to be placed on the same footing as those who dealt in the first instance direct with the Crown. So far, however, nothing has been said respecting the making of a refund to purchasers who have their titles, of the amounts which they paid in excess of 10s. per acre for their properties.

Mr. Piesse, who is entitled from his long and extensive experience on the subject, to speak with authority, makes the following classification of the soils of the district of Wagin and Katanning :—
(1). A light sandy soil, having a clay subsoil, on which chiefly grows white gums and patches of manna. This land will grow one or two successful crops of cereals in a good season, and if it is not then enriched it should be used for pasture or planted with fruit trees. A profitable use can be made of these areas by ploughing them in September and planting immediately crops of the squash tribe, which

yield abundantly, while the pumpkins, water melons, etc., do not appear to be any drain on the fertility of the land, which can be sown next autumn with wheat or oats. The only precaution that has to be taken in following the course here prescribed, is that the new land must not be broken up until the seed time for the squash has arrived, for the crop will not do well if the land is allowed to consolidate after ploughing before the squash seed is put in. By using some of their virgin paddocks for producing water-melons and pumpkins for the goldfields, the Messrs. F. H. and C. A. Piesse have had very lucrative returns which, after deducting expenses, in marketing the crop, have gone a good way towards defraying the cost of clearing the land on which the yield was grown. (2). An excellent chocolate loam, upon which the white gum is never seen ; this land grows York gums, manna, and jam, and it is the best that is found in the south. It is equally good for corn raising or orchards, and not only produces a heavy harvest, but is of great stamina, even where it is only fallowed by way of recuperation. (3). A red clayey soil carrying a small admixture of gravel. Here the salmon gum is mostly seen, and it has been usual to pass it by. The experience gained to the east of Northam, however, where salmon gum country has been tried with encouraging results, is tending to bring this territory into use about Wagin and Katanning. (4). There is a small proportion of a more friable chocolate soil on which small York gums, more than usually ragged in appearance, appear together with some manna trees, but no white gums. These spots are especially congenial to fruit trees. The places in which this characteristic are found are to the west, south and north of Wagin Lake, but none to the eastward of that centre. Land of this description is available for selection at distances varying from six to 20 miles from Wagin, Katanning, and Narrogin. (5). A white, cold, sterile gravel, carrying some ironstone, is found upon some of the higher levels. This sort of country has not yet been proved to be profitable for any cultivation. It might grow vines well enough ; but while there is so much better land, thoroughly adapted for vineyards, open for selection, vignerons naturally hesitate to risk their outlay and labor in making experiments, which, even if they were successful, would only be generally followed when there is ten times the present rural population in Western Australia. The gravel country is used for pastoral purposes, for which, when it is free of poison plants, it is fairly well adapted, if not too heavily stocked. On some of the lighter sandy loams near Wagin, the peculiarity is met with of patches of redgums, which only grow in heavy lands within the limits of the south-western district. One of these small forests is to be seen near the Tellanan brook, a watercourse that was utilised by the Western Australian Land company to supply water for the locomotives of the Great Southern railway. Mr. Piesse says that Mr. W. Fleay is settled upon a similar area near the Arthur river, and he has found the land very fertile.

The value of ringbarking as the initial work of the selector is lauded by Mr. Piesse, who estimates that at least 30 per cent. is saved in the subsequent cost of clearing if it is not necessary to do that work for a couple of years. As a case in point, the experience of Mr. Taylor, of Kechualling, is cited. Mr. Taylor, when he commenced work on his holding, paid £3 and £3 10s. per acre for clearing. He had a lot of his trees ringed, and this season he called for tenders for removing the dead trees, when there was competition for the job at 30s. to £2 per acre. If Mr. Piesse's advice is followed, selectors near Narrogin, Wagin, or Katanning, will clear only enough trees in the green state to make room for the first year's crop. They will, meanwhile, ringbark all their trees, with the exception of a few shade trees. When the course of decay has made clearing simple and economical, it will be carried out, and one crop of cereals or squash will be taken off the land that is intended for an orchard, before fruit trees are planted. Then the trees will have a clean nursery bed to thrive in, instead of one infested with white ants, which find shelter in the dead wood that lies about a paddock until the second season's ploughing and harrowing has enabled them to be removed. So far, owing perhaps to adopting this precaution, the orchards about Wagin and Katanning are very free of disease, the red scale of the citrus family being the only parasite that has made its appearance.

Mr. Piesse predicts a great future for the land on the Arthur and Beaufort rivers when the Pinjarrah-Marradong railway is carried on to join the Great Southern line somewhere near Wagin. Although this valuable territory has been cut into under the "poison" regulations of a former time, which allowed monopolists to get possession of blocks for 21 years and leave them unimproved, there is, according to our informant, enough left to give new impetus to settlement, whenever this fertile division is brought by the steam engine within reach of market. At present an enormous area of well-watered and superior land is only used as sheep runs, notwithstanding that it has a better rainfall than that which belongs to the Great Southern *route*. It will be possible for many selectors to get a river frontage, and to be within 130 miles of Perth. To get to Perth by rail now, the traveller has to travel east, instead of west, to Narrogin, Wagin or Katanning, and make almost a circle of his *route* before he is set down in the city. So it is not surprising that, with all its many recommendations, the tract of territory of which Mr. Piesse speaks so praisefully is entirely undeveloped by the husbandman who seeks to sell his produce. There are a few fields and orchards devoted to supplying the needs of the households of some of the old identities, but it is not incorrect to say that sheep-raising is the resource of the district. For the growth of soft fruits, the Williams district, lying west of the Williams road, is reputed to be fully equal to the Lower Blackwood. At Wandering Mr. Watts has succeeded in growing a first-class sample of dates.

He forwarded some of them to the Bureau of Agriculture, which placed the fruit on exhibition in the Chamber during the sittings of the last Producers' conference, and they were much admired by the delegates. The dates were shown in all stages of growth—from the germ-buds to the matured date in the fresh state, in which it is seldom seen south of the line. There were also samples of the fruit in a preserved condition. The size of the fruit, and the lustre of the portions of the tree that were forwarded with them, exemplified that the opinion held by Governor Weld, when he was at the head of the administration of the colony, that Western Australia, in its temperate regions, had the climate of the Mediterranean and the soil of South Africa, was a conclusion drawn from very accurate observation. In dwelling upon what a granary of the colony the southern district will be, Mr. Piesse desires to correct what he speaks of as a misapprehension existing among those who have not travelled from Beverley to Albany, except in the train, that the "eyes have been picked out of the several farming centres." The reply to this fallacy, said Mr. Piesse, is that the prohibitive prices set upon the land by the Western Australian Land company prevented the best portions being alienated. Had sales been made readily, there would have been no need for the Government to step in and buy back the grants in order that they might become available to the non-capitalist who desired to cultivate them. The newcomer to-day is the gainer by the loss the country sustained in shutting out selectors from 1884 till 1891, in order that the company might select their grants at leisure and with a full knowledge of the likeliest areas, and also, by that wholesale alienation of the public estate he is in as good a position to get a valuable holding adjacent to the railway—now that the colony is in the full tide of its goldfields' prosperity—as if he had arrived ten years earlier, when lucrative markets would not have been open to him to the same extent that they are now. If this statement is doubted, a day spent in the examination of the country under the guidance of Mr. H. S. Ranford, the Government land agent, whose headquarters are opposite the Katanning railway station, will dispel all misgiving.

CHAPTER VI.

THE WILLIAMS DISTRICT.

Intersected by the Perth-Albany road, which in a former chapter is treated as the eastern boundary of the south-western district, is the Williams district. The Williams territory is dealt with as part of the southern district—notwithstanding that it runs west beyond "southern" lines—because its soil, climate, and rainfall have more affinity with the features of the country along the Great Southern than that bordering on the South-western railway. That is to say, it is much drier than the section near the coast line, of which Pinjarrah and Bunbury are the principal centres; the soil is of a lighter character, the timber is smaller, and therefore cheaper to remove, the arable areas are larger, the natural herbage in its virgin state more scanty than will be seen in the south-west proper. The essential advantage which distinguishes the Williams from the southern division is that the former is the better watered. While there are hundreds of miles of fertile country near the Great Southern railway, which runs from Perth to Albany, that are solely dependent upon a conserved water supply, the Williams has the Hotham, the Arthur, Murray, Williams, and the Beaufort rivers, which never go dry, running east to west a few leagues apart from each other. Moreover, the Williams has 24 inches of rainfall, while the south has 16, but it partakes of the disadvantage of the latter in carrying poison in places. It is, however, one of the oldest settled farming places in the colony, and the residents mostly have large holdings on which they combine the raising of sheep with the growth of cereals. Two causes have operated against new settlement to any large extent—the lack of railway communication and large private estates. It will be necessary to examine these causes more closely than the mere naming of them, to see how far they are in process of being removed, lest the readers of this GUIDE may be led astray by being diverted from the Williams, under the impression that they cannot get a desirable foothold there.

A survey of the route of a railway from Pinjarrah to Marradong, which is about 45 miles from Pinjarrah to the Williams, is now being made. This is regarded as the first section of a line that will ultimately join the Great Southern railway at Wagin Lake. When this junction is made the journey between Albany and Perth will be reduced by about 100 miles, and a very large tract of country will be opened up, while easy transit to market will be given for a large quantity of produce which has now to be carted from 40 to

60 miles to the nearest railway station. The people of the Marradong and Williams have for years forcibly represented the undue burden they were carrying, in being outside the pale of the railway service ; they urged that the cost of cartage swallowed up the profits of their crops, and that it was more profitable for them to grow sheep than wheat while they were under this disability. The appeal was not lost upon the Government. " One of the principal planks of our platform," said Sir John Forrest in his inaugural address to the Producer's conference in 1896, " has been, and still is, to give better means of communication to the people of the colony, and especially to those parts of the colony which are capable of agricultural development." The Premier deplored the fact that every year Western Australia was paying an increasing sum for imported food ; that in 1895 £400,000 was expended on commodities which the colony ought to gather from her own lands ; he declared it was time more was done by Parliament and by the Government than had been before to lessen the importations. This declaration was made in April ; on the 27th August, in delivering his budget speech, Sir John made it clear that he had meant what he had said, and that he had had the Williams in his mind's eye when he addressed the Conference. In dealing with public works, he announced—" We propose to make provision for the survey of a railway line from Pinjarrah to Marradong, in the Williams district. We hope these surveys will be finished before the end of the financial year and that when we next meet it will be possible for us to go on with this work out of current revenue ; but we cannot make any promise with regard to that, as all will depend upon the amount of money required after the surveys are made, and also upon the money then available for the work. At the same time the Government hopes when this House meets after the general election it will be found possible to proceed with the work of construction." At the time of writing (July, 1897) the financial year which closed on June 30 for 1896-7 shows a credit balance of more than £500,000, so that the Government may be expected to include a Bill to authorise the construction of a railway from Pinjarrah to Marradong among its proposals for the ensuing session. The scheme will probably receive cordial support, because it will have an important source of revenue in the timber industry as well as in the carriage of produce. For 23 miles, beginning 11 miles from Pinjarrah, the line will pass through the magnificent jarrah forest of Camballing, which has been a revelation to all who have seen it. " When the world learns from the experiments which are being made in the wood-paving of the London streets (writes a special correspondent of the *West Australian*) what the value of jarrah is ; when public works and building enterprise, and mining requirements, have denuded the other forests of the colony, one of the largest and grandest of them all will make a railway pay of itself alone. If a man wants to see what jarrah timber is, let him see those towering

trunks on the road to Camballing. The jarrah of most other districts is puny compared with the goliaths of Camballing. And this magnificent forest, in which there are many trees ten feet thick at the base, is a virgin one. Except to clear the road, an axe has never so much as chipped the bark off any of the mammoth trees, that are so thick that the sun is sometimes shut out by the intertwining foliage." When the question is asked or debated in Parliament—" Will a railway to the Williams pay ?" it can be answered by interrogating the questioner—" Will it pay to carry jarrah ?" An estimate of the enormous value of this superb forest has been made by a Scotch syndicate represented by Messrs. Millar and Young. These gentlemen spent about a week looking for the cheapest and easiest *route* for a line to bring the timber from the forest, and it is understood that they are making representations, through their principal, which will result in the Government being approached with a view of obtaining large rights over this important national asset, which, so far, has been ceded to private firms in other portions of the Darling range upon merely nominal terms. But, remembering that the Premier has pronounced against private railways, and has said, on more than one public occasion, that all his influence will be exerted against private concessions being granted in a similar direction, Parliament will probably be asked to decide that the forest shall be utilised as the feeder of a railway belonging to the colony.

After passing through the Camballing forest the traveller reaches the Hotham, on the banks of which are some first-class farms. One of them is owned by Mr. F. Cowcher, who left Pinjarrah nearly 30 years ago to get more room. The father of ten sons, several of whom are selectors, he has cleared a large area of valuable river-flat which, in the absence of a railway, he finds it lucrative to use as a fattening ground for stock. To the reporter who collected information for these pages he said :—" To give you an idea of what I could grow here, I will tell you the produce of two acres of my garden, which are no better than nearly all of the farm. I got last year from those two acres, four hogsheads of wine, two tons of potatoes, half a ton of plums, a sack full of dried peaches, and a heavy crop of vegetables and garden stuff for the pigs. And that is the kind of soil that is 40 miles from a railway. My neighbor, Mr. Farmer, who has one of the best farms in the district on the river Murray, and who has been cropping his land for 30 years, with only an occasional rest, getting from 15 to 28 bushels of wheat per acre, will tell you, and show you, what sort of a corn-growing centre this will be when we get a railway." At present there is not one-tenth of the cultivable lands cropped. Leaving the banks of the Hotham, an ironstone timbered ridge exists for about five miles, and then the valley of the Marradong brook is reached. There is no need of a finger post to point it out, for suddenly there breaks upon the view an expanse of deep rich fallow land on the hillside, of a dark chocolate colour. Across the valley, and all along its course for ten miles, the same kind of soil extends, and it is closely settled, and largely under cultivation. There, full in view of the road, are the farms of men who have made farming pay, in spite of the absence of a railway ; whose homesteads, extensive barns, machinery sheds, and stacks of hay, attest the success of land settlement in Western Australia. Now, as to the profitableness of farming in the Marradong valley, which there is every reason to believe will not much longer remain isolated, Mr. James Munday, who is not ashamed to admit that he began with little or no capital except his brains, energy, and a strong pair of arms, says :—"I can crop at a profit here, 60 miles from Jarradale by road, and not only rear a family of nine young children, but get ahead a bit in the world, after selling my stuff delivered by wagon. I am clearing more land this year, and besides my own farm I have leased this year Captain Fawcett's property at Mokine. I made enough money out of last year's harvest to be able to buy this season a winnower, a double furrow stump-jump plough, a chaffcutter and horseworks." Onwards past Mokine another belt of five miles of forest is entered. Emerging from the forest, the trees in which suffer in comparison of those at Camballing, there is at the foot of the hill a superior blackboy flat in the valley, some selections upon which have lately been taken up. Thence the road passes through 2000 acres which have been reserved for the Quandinning common, and several large sheep pasturage properties. Sixteen miles from Marradong the Williams is crossed upon the Quandinning bridge, which has been erected by the Public Works department to make the stream passable for the settlers in the winter season when the river runs a banker. The flats of the river are well drained and yield heavy crops ; they are largely cultivated. Fifteen bushels of wheat per acre is reckoned a fair yield ; this quantity is often exceeded by early-sown crops. The clearing on the flats is heavier than it is away from the river, and corn is in cases grown among the dead trunks of standing trees that have been ringed. Three miles from Quandinning Daylerking is passed. There is a Government school there. Some excellent farms are in this neighborhood. Beyond, the country is chiefly occupied by sheep farmers, but some cultivation is also carried on. The largest holder of both freehold and leasehold estate is Mr. W. Lavender, at Boranning (otherwise known as Williamsburgh), 70 miles from Pinjarrah. He has about 200 acres cleared, out of a pastoral property of 70,000. His return is from 16 to 20 bushels per acre of wheat, and 25 to 30 bushels per acre of barley. When he is able to manure his land with stable refuse it yields from 25 to 30 bushels of wheat per acre. On fallowed ground he has harvested from 40 to 50 bushels of oats per acre. Some of his ground has been cropped for 25 years. He says that onions and potatoes would grow splendidly along the river flats. Mr. Lavender has some thousands of acres which are highly suitable for cultivation.

The valley of the Marradong through to the Williams river is a comparatively narrow strip of good land, 40 miles long, timbered with wando, white gum, blue and red gums. It also grows wattle, sapling gums, jam trees, and black boys. The soil is chiefly a light-colored loam that has been proved to be so good for the production of cereals that when the railway is made it will not pay to run stock upon the better parts of it. The land is easily cleared level enough to plough, yet is well drained, and has a clay sub-soil. For 30s. per acre all except the large trees can be taken out, and for £3 the wando and gum trees will be included in the grubbing. At Marradong the land is generally of a chocolate color, and this portion is regarded as the pick of the Williams district ; the heaviest crops are garnered there, as a rule. On the flats of the Williams, touching the river, Messrs. Hamersley, Cornwall, and others, in picked spots, get quite as good a return as any of the Marradong growers. This, however, is the exception, as the Williams land is more prone to run light both in color and quality, and to suffer from a bed of gravel intervening between the top soil and the clay. Where the light land is met with the timber is light also, so that what is saved in the cost of clearing might be advantageously expended on manure. So far, with the exception of a little stable manure, fertilisers have not been used owing to the distance which bonedust or guano would have to be carted. The practice is to crop the land only every third year, the fields being rested and fallowed for 12 months each in turn. During the resting year sheep are turned into the paddocks. The stock do well on the arable land, and their droppings help to keep the ground in good heart. The contour of the country between the hills, which are topped with ironstone ridges, is undulating enough to prevent any portion of it being soured by surplus water, yet not steep enongh in any part to allow the top soil to be washed away by a heavy rainfall. The valley is indeed a fertile river flat, high enough to escape danger in flood, and broad enough to make an immense cornfield.

The Crown Lands department has courteously furnished some statistics showing what scope there is for settlement in the Williams district. There are in the possession of private owners 100,000 acres, within five miles of the main road from Camballing to the Williams river, a distance of about 40 miles. Of this area 60,000 acres belong to farmers and graziers, and 40,000 acres, which were part of the land grants of the Western Australian Land company, as consideration for the making of the Beverley—Albany railway, have recently reverted to the Government owing to their purchase of the line. Between Camballing and Boranning, private estates comprise 19,000 acres, and prior to the resumption of the land grants the company held 26,000 acres in this neighbourhood. From Boranning to the Williams bridge, 22 miles further on, there are 41,000 acres selected, and the company had 14,000 acres, which may be chosen by new comers under the liberal land regulations of the colony, although up till the end of 1896 it would have cost three or four times the Crown price of 10s. per acre for conditional purchases, to have acquired them from the proprietors of the railway. The computation is made of land approximately within five miles of the main road from Pinjarrah to the Williams, because the road runs along the valley of the Hotham, and it is in the valley that most of the cultivable land adapted to the growth of cereals is to be found. Including the resumed land grants of the railway concessions the Lands department estimates that 60,000 acres of value to the farmer remain to be selected within five miles of the road. Most of these 60,000 acres are equal to the best of the blocks already alienated, but they are not in large areas. The day has gone by when an immigrant might hope to obtain in the Williams district more than 200 acres of fertile land in one lot, seldom, in fact, more than 100 acres. While the railway was being agitated for it was represented to the Government that 100 or 200 acres would be useless to a settler who was 50 or 70 miles from a railway station. His only prospect of success was to go where he could get, in addition to wheat fields for the sowing of cereals, grazing country to bring in an income from a wool clip and the sale of sheep to the butcher. Now, however, the construction of the promised line will give a man as good a living from the cultivation of 100 or 200 acres as he can now make from 1,500 to 2,000 acres while depasturing is his chief resource.

The rainfall of the Williams district, although not heavy, is sufficient. The average is 24 inches, and this quantity, in the temperate climate in that part of the colony, goes further than it would more to the north. The easy slopes prevent much of the rain running off the fields to swell the flow of water in the river. The friable soil easily allows the showers to enter it, and the clay subsoil stores and conserves the supply. The years 1894 and 1895 were the most unfavorable that have been experienced for many years, the record for 1895 being only 13 inches. But even under these adverse circumstances land, which owing to the cost of carting fertilisers and of taking crops to market has almost always to depend upon its own resources, has grown nothing less than seven bushels to the acre, while 30 bushels have often been harvested when the average rainfall has been registered. In 1896 rain fortuitously fell early in March, which enabled growers to sow early, with a corresponding increase in their returns.

As an orchard country the Williams district is hardly to be excelled, all kinds of fruits doing well, except citrus. Apricots, apples, peaches, muscatel grapes, and plums are produced, of large size and superior flavor. So far the fruit garden has merely been an appanage of the steading to supply family requirements, as so perishable a commodity as fruit could not be sent to market in presentable condition after being jolted over a road in a wagon for 50 or more miles; but with the advent of the locomotive it is expected that the natural advantages that are ready to assist the skill of the orchardist will be largely utilised. The principal places where trees of the kinds we have named are to be seen in a most thriving condition and, in season, laden with a highly remunerative yield of fruit, are Mr. W. Lavender's property at Boranning, and Mrs. Hamersley's estate near the Williams river. The latter estate is about two miles from the township ; the site rises abruptly from the river bank ; it is a picturesque, somewhat rugged glen, with large boulders of granite jutting out of the hillside, almost on the brow of which there are overspreading carob bean trees—a novelty in the colony—which were introduced many years ago. The close arching boughs and foliage form a cool arbor which the most searching noontide sun cannot penetrate. A young orchard was planted four years ago by the late Mr. Hamersley, one of the oldest settlers on the Williams, and the result has shown the excellence of his judgment in selecting the site, and the varities of trees best suited to the location. The trees have grown sturdily, and are large enough for a full year's growth beyond their age. The peaches and apricots are bearing heavily. Adjoining the orchard there is a small and flourishing vineyard. Three additional acres have been planted with apples since Mr. Hamersley laid out the ground. The only drawback is the bird pest, which the Producers' conference asked should be dealt with by the offer of liberal bonuses for the destruction of parrots and silver-eyes.

Another scourge is the wild dog. Dingoes are more numerous now then they used to be. The pastoralists say the wild dogs kill so many sheep as to seriously reduce the profits of wool-growing; they have, our informants add, taken to attacking rams, which is a proof of the boldness and ferocity of the pests. Unless shepherds are employed, at a cost in wages and rations of £65 per annum, per man, it is impossible to keep sheep, and the dingoes have even been known to attack the stock while they are yarded close to the shepherd's camp. The losses are so great, according to the statements of leading flockmasters, that the squatters want more people to take up land. Instead of settlers being regarded with the jealousy that exists between the runholders and the farmers in many parts of Australia, they will be welcomed, and the laying of the line is looked to as a means of bringing an agrarian population which will help to drive back the wild dogs. Mr. Francis Cowcher, who has suffered much from the raids of the wild dog, makes an instructive report, which should serve to discourage on the part of selectors the wholesale slaughter of kangaroos, a practice which helps to nourish and multiply the dingoes. He states :—" When I first knew this district, the dingo was generally a mangy cur. Now he is a fast, strong, gamesome, and well-fed animal—ready to kill sheep for the mere sport of the thing ; and there are three times as many dogs about as there used to be, in spite of all that are trapped and poisoned. The reason is that the kangaroo-hunters feed the dingoes and enable them to rear all their young. The hunters take the skin off a kangaroo, and the carcase is a rich feast of the best food for the first wild dog that comes along. A bitch with whelps, that would be too weak to kill much game for herself, finds a butcher has been in the bush for her. She eats as much as she wants, suckles her young strongly, and the whelps, as soon as they are able to run about, find plenty of kangaroo meat to rear them into sturdy, tigerish sheep-killers. Now, if a stop were put to the destruction of kangaroos, which are already very much scarcer than they were a few years ago, the dingoes would go more hungry than they do now, unless they got near a sheep fold, and there they would find plenty of strychnine baits to tempt their appetites. As it is now, the brutes can eat kangaroo without touching the baits, for the hunters will not poison the carcases of the animals their hounds run down, lest they should endanger their own dogs, so that when the dingo wants mutton he generally likes to kill it for himself. The worst of it is he does not kill one and make a meal of it, but will harry and seriously bite nearly a score if there is no shepherd about." Next to the value set upon a railway nothing was so strongly urged upon our reporter's notice, in travelling through the district, as the wise discretion it was urged the Government would exercise in raising the bonus for the scalp of the dingo from 10s. to £1 per head, even although a moiety should be furnished by levying a vermin rate upon the occupiers of land. It was pointed out that it is not only when the dogs were among the flocks that they should be hunted down, they should be pursued to their fastnesses in the hills and exterminated there. This could only be done by inducing hunters to form parties, and make scalp-getting their business.

The Williams district is not free of poison plants, which have been the means of enabling large areas to be held unstocked, unfenced, and unimproved. Under a law passed in 1871, but which has since been amended, it was permissible to hold "poison lands" for 21 years, subject only to the payment of a nominal rent and to the condition that the noxious growths should be eradicated by the end of that period. This led to the Western Australian Land corporation (not the Western Australian Land company, which constructed the Great Southern railway) and other large syndicates, making large selections, some of which have been sought to be made the subject of speculative dealings in London. Before the present regulations in regard to "poison lands" came into operation (providing that the holdings shall be fenced within three years) the valley of the Hotham was encircled with properties upon which York road poison grows unchecked—the propagating places of this vegetation—and which, had they not been alienated, might now be cleared and turned to account as farming land. The cost of eradicating the poison plant by grubbing it out is given at from 10s.

to 15s. per acre. A number of paddocks enclosed by a sheep proof fence have been effectually cleared of this danger to stock. The shrub is most deadly when it is making a new growth after a "burn," or when it is in the flowering stage.

Those who are entitled to speak with experience of the Williams district inform our representative that a great deal of progress is being made towards adding to its productiveness by providing supplies of wheat and fodder for home consumption. The railway policy of the Government is regarded as an earnest of Sir John Forrest's appeal to the farmers of Western Australia, and to others who desire an excellent opening to become farmers, to lessen the outflow of money for the food grown elsewhere ; it has given, we are told, a strong incentive to put more land every year under crop, and to farm it according to the most approved methods. "Five years ago," said Mr. Cornwall, who is one of the largest cultivators, "there was not a stump jump plough in the district ; now there are more than thirty of these implements between the Williams river and Camballing, all of two or three furrows." A plough made in the colony is preferred for its lightness, strength, and suitableness for finely breaking up the soil. Some superior heavy draught horses have been imported to expedite work on a large scale and enable sowing to be done early enough to allow the seed to be germinated by the first autumn rains. Besides wool, hay, and wheat, the minor resources of the district include pig-breeding. A good many fowls are also profitably kept, the birds finding their own living around the haystacks and in the stubble fields, for many months of the year. Many consignments of fowls are sent to supply the hotels and the shipping at Albany. The latitude and excellent drainage of the undulating valley of the Williams, are all in favour of the poultry-keeper, and when freight trains supersede the long journey of the wagon, which, in summer, greatly distresses the birds on their way to the market, the farmers assure us that they will make poultry-raising a larger auxiliary source of income than it is now.

A synopsis of the information collated in reply to the enquiries made by the reporter of the Bureau for the SETTLER'S GUIDE is here given :—The roads to the lands that are open for selection belonging to the Crown (and which have this year been greatly added to by the purchase of the Great Southern line) are in excellent order, unless the settler, in order to get an unusually good garden block, makes his way over the hills to the banks of one of the many brooks which feed the Hotham, or the other rivers which have been named. The Pinjarrah and the Williams Roads boards last year co-operated in clearing the main road between Pinjarrah and the Williams river over its entire length, in order to afford the greatest possible facility for the conveyance of produce to the railway station. This road is comparatively level, and as it was marked out to traverse as much ironstone—which is a naturally macadamised highway—as was practicable, without making too great a detour, the heavest loading can

FOR DESCRIPTION SEE BACK.

Blackbutt Flat.

Small groups of this tree *(E. pateus)* are found upon some of the rich flats and bottom lands of the watercourses that run through the Darling Ranges. It is very difficult to split or burn, and the high cost of clearing such land has been hitherto much against its settlement. It is generally associated with Blackboys of large size, as well as forest trees of various kinds, that testify to the general adaptability of the soil to plant growth.

travel over it. It is now the advice of the spokesmen of the district, that until the railway is laid, only men with a few hundreds of pounds to enable them to handle from 700 to 1000 acres, with a small flock of sheep, should seek to establish themselves in so isolated a part of the colony. When the freight trains are running, half as much land, with intelligent and industrious farming, will suffice. In this statement an exception is made in favour of the viticulturist, or the orchardist, who, if he possesses only small means, can, after planting his trees and while waiting for his fruit and the locomotive, maintain himself by doing work for the roads board, or on the larger holdings. There are no surveyed agricultural areas in the district. The selector can, however, mark his boundaries to please himself, as compensation for not being able to obtain a free homestead farm without at the same time applying for an additional 100 acres. Attention is drawn to the declaration in the deliverance of the Premier, Sir John Forrest, to the country at Bunbury prior to the last general election, that an early effort would be made by the Government to allow free homestead farms to be selected anywhere on Crown lands and to further liberalise the land laws in other respects. It is admitted that the Williams has not had a large share of the new settlement that has so rapidly taken place within the last five years in all farming localities that have the means of ready transit of crops to the consumer, but all things being equal, the evidence of the yields of cereals, fruit and vegetables are pointed to as proof that there is no more fertile or highly-favoured division in Western Australia. The want of more schools has been brought under the notice of the Education department, which undertakes to provide a school wherever there are not less than 15 children to attend it. The Williams is described by those who know it best as being well adapted for mixed farming; but if a large grazing area is desired, as well as an arable area, the selection will have to include a proportion of ironstone country and "poison" land. The buying agents of produce firms are to some extent deterred from canvassing for supplies, which they prefer to obtain nearer to a railway line, but when the stuff is taken to Pinjarrah or Jarrahdale on the west, or to Narrogin on the east, it finds a ready sale. The railway freights are considered to be very reasonable—especially as about four times the freight has been paid in wages, wear and tear, and horse feed before the station is reached. "We cannot compete, with any fairness to ourselves, with districts that are alongside the rails," is the form in which this argument of Sir John Forrest, on behalf of the producer, is corroborated. At the same time our informants concede that they know of no market so good as that of Western Australia for the cultivator near a line. The crops the district grows to the best advantage are wheat, oats, and fruit, and on the moist parts of the river flats, root crops and vegetables, but not much has been done to turn anything but wheat and oats to commercial account. Only the local demands have been met for other yields. The land does not soon become exhausted, as is proved by the fact that relying only upon resting and fallowing, fields are now producing well that have been under cultivation for nearly thirty years. As a vineyard and orchard area the Williams does not take a second place, even in comparison with Guildford or the Lower Blackwood, except that it is better adapted for stone than soft fruits, for which the Blackwood has a larger rainfall and a lower summer temperature. The fruitgrower is advised, with the utmost confidence, to inspect the vales and flats along the Murray, Hotham, Williams, Arthur, and Beaufort rivers before he settles elsewhere. In spite of dingoes and poison patches sheep are largely kept, in fact, they may almost be said to be the mainstay of the territory. The sheep are generally paddocked in enclosed blocks, from which the poison has been grubbed ; if on open country, the flock is always in charge of a shepherd. Eagle-hawks take a few lambs in the dropping season, and some chickens from the poultry yards ; but if the wild dog could be exterminated sheep owners would hardly begrudge the occasional depredations of the enemy of the boodie rat and other ground vermin. The mischief done by parrots and silvereyes in the fruit gardens is considerable. The country is one that stock thrive upon if they are guarded from poison. Not a great many cattle are kept, partly because deaths from poison are so much more serious than when sheep stray on to the dangerous ground. The principal grass is the silver-grass, which grows thickly, and to a great height ; dandelion, or Cape weed, has been making its appearance. Until Marradong is passed the extent of arable land in one piece is not more than about 100 acres. On either side the hills wall in the valley closely. Beyond the Marradong the valley widens out ; and around Boranning Mr. W. Lavender and others have hundreds of acres, without a break, if you wished to run a plough, from end to end. Until the land of the Great Southern company were acquired by the state, a newcomer would have accounted himself fortunate if he had been able to secure as much as fifty acres together, fit for cultivation. There is a better prospect at the present time, for the company, having an early choice of the lands of the district, picked most of the best that were available, and then put an almost prohibitive figure upon them. It should, therefore, our advisors state, be borne in mind that, owing to settlement having been retarded on some of the choicest sections, due to the operations of the railway company, a new arrival now has, in the Williams district, a chance that would have passed away had the Crown always been able to deal unrestrictedly in finding a suitable location for would-be producers. The country is so well watered by five rivers and their tributaries that the artificial conservation of water is not one of the initial difficulties of the conditional purchaser. Drought is unknown, in the sense of implying a scarcity of water for the use of man or of stock, but dry seasons which have had a prejudicial effect upon the harvest have been experienced. In so well watered a country the rivers present facilities for irrigation, in some places by gravitation, but not over any large extent of ground without pumping. The configuration of the country varies from uplands and mountain slopes and ridges to stretches that are almost level fells only a few feet above the margin of the streams. These are ideal places for what are known as "summer" gardens, *i.e.*, for the growth of vegetables from November to April without irrigation. During these months vegetables on the goldfields, and at Perth and Fremantle, reach the highest prices. There is also a good sale for water-melons and other varieties of the squash family, which on the river bottoms to which attention is now being called would give a large return. The timber varies from the smaller trees such as jam, wattle and sapling gums, to large wandos and red gums. The big trees are as often as not left standing after ringing, and their roots are evaded by using a stump jump plough. The cost of getting land ready for the stump jump plough is stated at from 30s. to £2 per acre. The borrowers from the Land bank have not come largely from the Williams district, which is a centre of an old settlement of pioneers who are past the initial outlay and time of difficulty. The Land bank's clients mostly are the younger race of men who have a career of achievement opening to them. The Williams has a short, mild winter, and a dry summer, in which the climate of what his Excellency the late Governor Weld described as that of the south Mediterranean, is enjoyed. The air is the foe of asthma. The residents are nearly all of British nationality, and most of them hold more than 400 acres. The chief advantages of the district are its rivers, rainfall, drainage, fertility, and the cheapness with which it can be cleared. The best farming aids are in general use, and thoroughness of cultivation is insisted upon by those who have made the most headway. The merino sheep is chiefly bred by flockmasters, who are now giving some attention to crossing with Lincolns and Leicesters, with a view to increasing the weight of the carcase and of the wool clip. There will be room for a much larger scope of farming work when the Pinjarrah-Marradong railway is opened for traffic, owing to the eligible areas of Crown lands that will be open for selection within five miles north and south of the railway. A little dairying is done for home consumption, but practically none for market supplies. Besides the public estate that is available for settlement, there are several desirable private properties that are open for sale or lease. The owners of these estates profess themselves as being willing to treat, on equitable terms, with applicants for holdings, on the share principle, for the cultivation of cleared land or the renting of unimproved blocks. The district is not deemed to be adapted for subdivision into blocks so small as ten or 20 acres, as there is no centre of population near enough to encourage specialists in intense culture. Mixed farming is held to be the better enterprise for the average immigrant, who, we are told, will do well enough if he is thrifty, hardworking, and possesses, with common sense, some knowledge of the work which he undertakes to do. The lesson of local experience in the clearing of land, is to ringbark first, and to get a return from the land before going to the expense and submitting to the delay in taking out all the largest timber. It is believed that bone dust would be the best fertiliser, and our informants look forward to using it freely when they can get it delivered by a freight truck. Their profit is expected to come in by being enabled to sow their land every year, when it is sustained by enrichment, instead of standing out of the return for their outlay in clearing for two seasons out of three, while the paddocks are depending upon the processes of natural recuperation and the running of sheep upon them to maintain their nutritive resources.

E. W. Hilgard

CHAPTER VII.

KATANNING, BROOMEHILL, TENTERDEN, MT. BARKER AND ALBANY DISTRICTS.

Between Wagin Lake and Lime Lake, eight miles southward, there are some first-class unoccupied areas of chocolate soil that are well deserving inspection by enquirers for land. This country is rather heavily timbered with morrell, salmon, and white gums. It is highly recommended by Mr. H. S. Ranford, the Government Land agent, who has a wide and accurate knowledge of the ground along the Great Southern line that is most suitable for settlement. There are thousands of acres awaiting the plough within five miles of the station. As Yaarrabin, 11 miles nearer Katanning, is approached, the aspect of the country becomes less inviting, a light sandy stretch replacing the ruddy land that wherever it has been tilled has proved the mainstay of the farmer. The conviction that must force itself upon anyone who makes the journey, is that with hay selling at £7 per ton, and the Katanning roller-mill idle for want of wheat at 5s. and 6s. per bushel, it is a great pity to see arable lands bounded by a railway, growing nothing but eucalyptus. "What a contrast is here presented," says the Land agent, "in the broad breadths of Western Australia to that of any of her neighbors, where men jostle each other at the ballot-box to get the chance of being the fortunate drawer of the number that will entitle one of a crowd of applicants to the coveted prize of a piece of Crown land ; or to the tedious proceedings of land boards, where the claims of from half a dozen to a score or more selectors who have pegged out the same block, are decided ; where the bachelor has no chance against the married man ; and the newly-married man has to stand aside for the father of a family. Here, equally good land can be had for the asking ; there, even when an applicant has, after vexatious delays and expense, got a holding, he has to pay £1 per acre for it, and go to an usurer, or at best a storekeeper, with a mortgage, in order to carry on, unless he has means. In Western Australia the selector can get advances from the state, through the agency of the Land bank, at 5 per cent., and instead of having to meet his creditor with a substantial instalment of the principal, after selling his first crop, he can reap five crops before the bank asks him for even a tithe of the loan. Moreover, as selection has had at least 30 years start of Western Australia in the other colonies, all the land near railway lines, and most of the best land, even where there is no railway within a score of miles, has passed into private hands. Let a new arrival look at the sectional maps of the Lands department, which plot the country between Beverley and Albany, and note the huge white spaces, intersected by the Great Southern line, marked 'Locn———, Western Australian Land company, limited.' He can squat where he likes on these spaces, on any of these great tracts that are fertile enough to tempt English investors to spend three quarters of a million of money to acquire them. The land grants, which are once more Crown estate, were the incentive that moved the company to construct a railway 243 miles long, at a time when the population of the country was only a fourth of what it is to-day, in the expectation that buyers for the grants would be attracted at prices from £1 to £2 per acre. The more liberal terms offered by the Government prevented the company making large sales, but notwithstanding that the Lands department gave away free homestead farms and sold conditional purchase blocks at 10s. per acre, there were some customers for the grants of the company. Surely then," says Mr. Ranford, bringing his argument to a point, " land similar to that which, in the hands of the company, realised up to £2 per acre, must be a great acquisition now that it is to be obtained from the Government for nothing, to the extent of 160 acres per man and at 10s. per acre for any balance up to 1000 acres per man."

Katanning is 222 miles from Perth ; it is the principal intermediate centre on the Great Southern railway, having a larger number of farms and a larger township than any other, with the exception of Beverley and Albany, the starting point and the terminus of the line respectively. The local Lands office, and the post and télegraph office are commodious buildings, and travellers are accommodated at a well appointed hotel. The chief private buildings are the warehouse of Messrs. Messrs. F. H., A. and C. A. Piesse ; their roller mill, built of brick, and equal to producing a very large output of flour, was erected before the Yilgarn goldfields created such a great demand for chaff as to induce nearly all the farmers to cut their wheat crops for hay. Katanning does, however, supply itself with flour, while Wagin buys flour from the other colonies at about £20 per ton for the year 1897. The Messrs. Piesse are anxious to encourage high-class farming. They have shown the way in the use of fertilisers, which are an innovation in the south. In 1895 the Messrs. Piesse used bonedust with success on their paddocks adjoining the railway line. This year (1897) they had tried Thomas's phosphate, drilling it in with 45 lbs. of seed to the acre. The reporter of the Bureau was taken to see the result of the experiment. The phosphate had been used in a field of light loam, within a quarter of a mile of the railway station. Some of the ground had not been manured. The difference in favour of the phosphate, which was applied in the proportion of two hundredweights to the acre, was most marked.

The crop was only of three weeks' growth ; the land had produced cereals for several seasons without a rest, and the part that had been left to nature showed some signs of exhaustion, the wheat plants being thin and somewhat pale in colour. The phosphates had sent up a strong growth which had stooled out so thickly as to suggest that less than 45 lbs. of wheat to the acre would have been an ample sowing. This part of the crop was from six to eight inches high ; the portion that had no phosphates was only half as high, and it had a straggling, not to say—by comparison—sickly appearance. The crop was put in with a Massey-Harris cultivator, an excellent machine in the estimation of the Messrs. Piesse, but they state that an improved implement that will sow the fertiliser and the seed in drills at one operation is now being manufactured by the firm mentioned from a design sent from Australia. A sample of the new machine will be at work at Katanning next year. The paddocks which we inspected are not representative of the better class of land that is to be seen on the properties of some growers a few miles out of the townsite; but a central position was of the first importance to the Messrs. Piesse, in order that they might be able to superintend their clearing and cultivating operations without losing time from the conduct of their large trade. They have assisted many a selector to get a start by supplying him with stores and implements on easy terms of payment. They had 500 acres of crop in when data was being collected for the GUIDE, and their enterprise in adding paddock to paddock was spoken of as having been a stimulus to others to imitate their success. In one year their harvest was threatened by an inundation from the railway dam, owing to the embankment of the line, which is close to their western boundary, not having been pierced to provide waterways. While the railway was in the hands of the company it was difficult for farmers to obtain relief from the danger of flood in a wet season owing to the lack of culverts, but the Government are prepared to make them wherever good reason can be shown. In addition to growing cereals, Mr. F. H. Piesse has laid out 80 acres adjacent to the railway station and the orchard of the Western Australian Land company, for the growth of fruit of nearly every kind. The orchard is a first-class one, on which money has been freely expended, and which is now coming into full bearing. Last year at the Newcastle show Mr. Piesse made a great display of apples, peaches and apricots, and was a leading prize-taker. The orchard is on the side of a hill, so that it is in a sunny, well-drained situation ; it is less than six years old, and as an example of the fruit-growing capabilities of the south it is sufficiently convincing. The adjoining orchard of the Western Australian Land company was planted as an object lesson of the same kind, and it is thriving well enough to fulfil its mission, if oranges and lemons are excepted from the list of fruits that Katanning produces in perfection. Another notable property is the estate of His Excellency Lord Brassey, Governor of the colony of Victoria, who, at a very early date in the history of the Western Australian Land company, purchased from that corporation 25,000 acres at Broomehill, and proceeded to establish a model sheep farm under the management of an experienced superintendent. Goblup is one of the best pieces of country in the south, and it is a very healthy sheep run. The merino sheep is bred, and much attention is paid to keeping the flocks up to an uniformly high standard. The paddocks have an ample supply of water from wells and dams, and the fencing and other improvements are of the most substantial description. Speaking of improvements, it may be mentioned that an economical substitute for a swing gate is to be seen leading into the paddock of a sheep farmer who hails from South Australia. Strands of wire are stretched between two hurdles eight feet apart. By an ingenious, but simple device on the lever principle, the bars of wire are drawn taut across the gateway. A catch being released, the wire and its wooden supports can be easily lifted aside, and the vehicle having passed through the opening, the portable grating is replaced, and forms an impregnable barrier against stock. A gate of this description can be made in an hour, and the only fittings required to complete its adjustment are two double loops of wire around the gateposts to hold the top and bottom of the hurdles, and an augur hole and a pin of iron to form the fulcrum of the lever. The system that is in vogue in some English counties, and in Tasmania, of feeding sheep on young crops of wheat and oats, is adopted by Mr. C. A. Piesse. He says that, provided the stock are not too long kept off the sprouting corn, or allowed to remain too long upon it, they do a great deal of good. The crop may be almost eaten bare up to the sixth week of its coming through the seed-bed, and the result will be a more even growth and better filled ears of corn. The stalk may not be so long, but the plants stool as the result of being fed down at the right time and with judgment, but the harvest is heavier than if the sheep had been kept off it, especially if the feeding down is followed by a liberal fall of rain.

Mr. A. Piesse, a younger brother of Messrs. F. H. and C. A. Piesse, is clearing land near the Katanning townsite, at a cost of £3 per acre, for the enlargment of his vineyard of 25 acres. In his opinion grapes are one of the most profitable crops to which a man can devote his attention, anywhere between Beverley and Kataning.

Mr. A. Piesse, who has been at Katanning ever since the old *regime* of the sheep squatters gave place to mixed farming and a large output of produce, was asked to state his experience of the amount of capital a man would require in order to make a hopeful start on the land in the district. In giving his answer, Mr. Piesse supported it with details which uphold his conclusions. He says :—" A man should have not less than £50. He should be content at first with a homestead farm of 160 acres, unless he takes it in a place where he is likely to be so shut in that he is not likely to be able to enlarge his holding when he has made some headway, for he will need about 500 acres more if he intends to keep stock, and in later years reach a plane of solid independence. A ring fence and sundry expenses, such as stores and tools, will make the £50 look very small, but with the land fenced the selector will be entitled to get a loan from the Land bank. If he is a worker and knows how to go about his clearing, the 50 per cent. of the value of his improvements which the bank will allow him to draw will not only keep him going but will give him something over. This balance, with a job or two on wages or a bit of a roads board contract, will find the money for a pair of horses. He can now get some stores on credit, and get a stump jump plough on a hire note, for which accommodation the crop he is about to put in is a good backing. While the crop is growing he can still be working for wages, and the seasons are so certain and regular that the harvesting of the first crop puts a man in a fair way. I have seen several men get going on the lines I have sketched, and have known of no failure. One man who started three years ago is not only straight with the world, after making enough to pay all his creditors, but he has a stack of hay and stock which he has no need to realise upon, and lately he has taken up a much larger block than the one he began upon. He came here with less than the £50 I have mentioned as the minimum of the necessary capital; certainly he got on to some very good country, and was a tiger to work, but there is plenty of good land to be occupied yet, and some of it is not far away." The Government have just thrown open a reserve of 6000 acres, which had been gazetted as the site of a model farm. The reserve was proclaimed at a time when it was deemed that a farm under skilled direction should be established to disclose the productiveness of the south; but that has been so fully demonstrated by the work of private hands that anything in the nature of an experiment is now deemed to be supererogatory. The reserve has been locked up for five or six years, and notice has been given that it will be available on a certain date. All the applications received on that day will be regarded as having been received at the same time, and if more than one application is received for one block the applicants will have to ballot to determine who is to have it. This course was followed when the long interregnum imposed by the terms granted to the West Australian Land company came to an end. The company had the right for some years to choose their selections, and in order that they might not be prejudiced in doing so the Crown consented not to alienate any of the country after the signing of the railway contract, until the company had got its full complement of land grants. This, of course, proved a great drawback to the development of the district. Meanwhile, people were spying out eligible spots, which they intended to apply for as soon as the embargo was removed. To prevent a scramble, and avoid disputes as to the priority of a budget of applications for certain sections, it was decided that all the applications made on the opening day of the restored rights of the people should be referred to the arbitrament of the drawing of lots. No more just way, one would think, could have been conceived, but some applicants adroitly made their success almost certain by getting their friends to put in papers for the land. The man who had only one string to his bow had little chance against a large combination, the successful member of which, not wanting the block, would transfer it to the *bona fide* selector in whose interests the application had been made. Mr. Piesse is satisfied that there will be enough corn grown in the colony during the next five or six years to keep imported wheat or flour out of the market. He points to the rapid influx of farmers from the other colonies, who desire to participate in benefits that are denied them in the more crowded and competitive spheres which they are leaving. If all the wheat lands in the south alone were utilised Mr. Piesse says Western Australia would have wheat to spare, instead of supporting the producers of other countries as she is doing now. He is a great advocate for the use of fertilisers on the rules of arithmetic in adding up his profits. "If," he says, "it costs £3 per acre to clear land, it is a mistake not to get as much off it as possible, for it costs as much to plough, to sow and to harvest poor land, as rich. The larger the crop the greater the margin between working expenses and profit. A ton of guano, bonedust or phosphates will cost £5 or £6, and it will give a fair dressing to from six to 10 acres, increasing the weight and value of the crop fully one-third. In other words, the manuring has cost from 8s. to 12s. per acre, and the enlarged yield is worth fully £2. Why then should land be left to nature, as it generally is in the south? We have found that bonedust or phosphates pays better than guano, unless what is known as 'live guano'—that is containing the ammoniacal salts unimpaired—can be obtained, but this sort of guano is a scarce article. The ordinary sample of guano contains too large a proportion of gravel to be the best value. Up to date Thomas's phosphate appears to take the palm for excellence, but its use is at present an uncompleted experiment. Although hay is the most profitable crop to grow just now, when the Meckering, Goomalling and Greenhills lands are opened up, our farmers will go back to growing wheat. In the east the new areas I have named have an advantage of 12s. 6d. per ton in supplying chaff for the Yilgarn goldfields, as compared with growers about Wagin Lake and Katanning, but we can compete with those places on equal terms in sending wheat and flour to the metropolitan and Fremantle markets. The Katanning roller mills alone could grind 80,000 to 100,000 bushels of wheat each year, if the corn were grown to keep it fully employed."

A ride of a few miles east of Katanning along the main road will take the visitor past some large and admirable farms, past broad cornfields (from May until the end of October), substantial steadings and out-buildings, and many other evidences of a prospering people. A flourishing estate is that of Mr. Andrew, a very old settler, who crops about 100 acres of rich chocolate loam. The paddocks are undulating, converging into a large creek that provides an ample water supply for the watering of stock. The ground that is under cultivation grew York gums and jam. Near the house, which is of brick, and commands from the eminence on which it stands a fine view of the property, there are still standing the trunks of some of the biggest specimens of what was at one time a very heavy forest, but which was well worth clearing. The soil is of a very bright, almost carmine hue. It breaks well under the harrow, and can be relied upon to produce a ton of hay and upwards, season after season, without manure, except what is removed from the sheep folds and stockyards. Beyond the fences the green timber is so close together as to shut out the sight of the ground, looking at it from a little distance. There is no more fertile spot around Katanning. Mr. Andrew had almost the first choice as a pioneer. He was formerly a pastoralist in another part of the colony, and is still the owner of a good many sheep and a few score head of cattle. His preference is decidedly in favour of sheep. The pasturage, he says, suits sheep better than cattle, for, except in the spring, it is not very long, and sheep by feeding close to the ground get a better living than cows or bullocks. There is nothing but merino sheep on the place. As a farmer Mr. Andrew has found the great merit of fallowing. It not only sweetens and strengthens the land, but the practice also enables him to get in his seed very early, and this it is one of his main objects to accomplish. The corn should get every shower of the season, is his maxim ; then if the season should prove to be a dry one, the crop is greatly helped to give a fair yield, and if there should be a normal or a plentiful rainfall, the harvest is above the average. In July, 1897, when these notes were collected by the representative of the Bureau, the fields were looking as well as even their owner could desire.

About two miles further on Mr. Westley Maley has established himself in a few years, with the aid of capital, as firmly as it would take the average settler half a lifetime to accomplish. But although Mr. Maley has smoothed his way by employing a great deal of labor, his place is none the less an object lesson of what may be accomplished on a smaller scale by those who do most or all their own work. Even before an axe or a plough was used on Mr. Maley's location its value was apparent to those who passed over it. A member of the survey party that plotted it was apprised that Mr. Maley, who was then well-known in commercial circles in the city, was willing to renounce the desk for a country life if he could get a very eligible holding. As the result of the special information, the southern district gained a settler who has not been content to move along well-worn ruts according to old fashioned rules of farming. Having got an area that is not better than many others along the

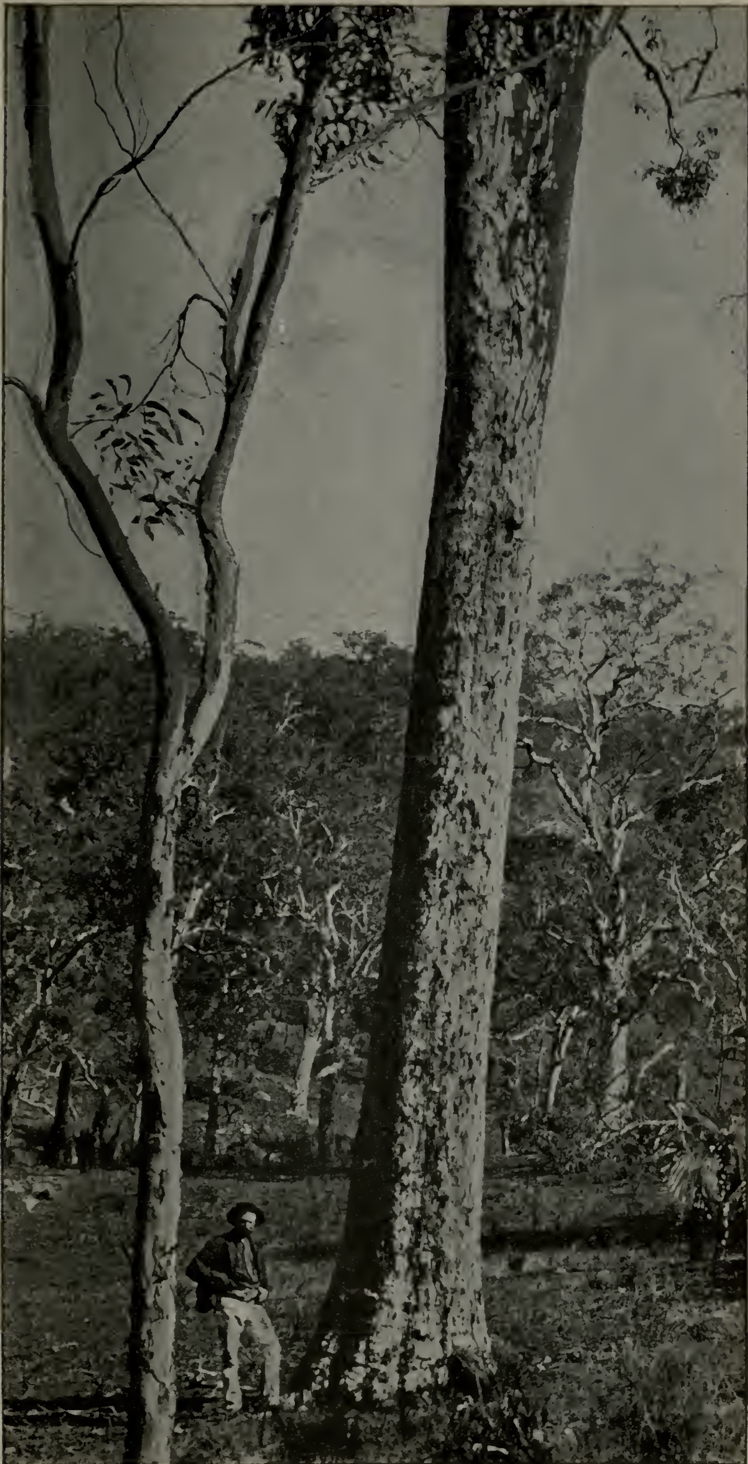
Great Southern line, but which has more superlatively good land for its acreage than is commonly found, Mr. Maley let large contracts for clearing, and imported white Tuscan and purple straw varieties of seed wheat, as well as the seeds of Johnson grass and of other herbage, which he judged would be especially well adapted to the district. Of the white Tuscan he says :—" If you do not sow it early it is an absolute failure ; if it is sown in time, the yield is larger than that of any other variety I have seen tried." He adds :—" The purple straw should be cut for hay, and it will then give a very satisfactory return. It is generally sown in South Australia, as it does well where the rainfall is light and the summer comes in early. I intend to stick to these two varieties of wheat ; they are popular with my neighbors, to some of whom I have sold purple straw wheat for seed at 7s. per bushel." Mr. Maley in reply to enquiries as to what he thinks of the country as a field for settlement, has made the following statement :—" There is, I believe, an excellent future before farmers here, but the one thing to be garded against is earth hunger. A man, where there is so much room to select and such liberal land laws prevail, can easily cripple himself by grasping too large an area, I mean more than he can profitably use. It is so easy to pay sixpence per acre per annum that there is a temptation to lose sight of the improvements, and also of the fact that unless the ground is fenced, ringbarked, and stocked, it is a drag instead of a help. The object to be put before all others is to make as much land as possible earn an income, not to scatter one's energies in trying to cover too much ground. Another point that I think it is well to bear in mind : that it is better to go a little farther from a railway station and get first-class land, than to have a train at the farm door, if the country is inferior. I do not say the ground right at Katanning is inferior, but it is not so good as it is here at my place, five miles away. There the soil is less than a foot deep, here it is two feet deep, but there is not an unlimited quantity of it. Not far outside my boundaries you come upon ironstone and poor gravel. That class of country is among the ranges, and the principal timber found upon it is white gum. I call it third-class country, useful, if lightly stocked, for carrying sheep. Wherever a chocolate soil above clay can be found it ought to be selected, as it is good for every kind of cultivation, and if laid down with artificial grasses, will support a lot of stock. I have been sowing Johnson grass, which does very well indeed, but not better than corkscrew grass—one of the native grasses—which cannot be excelled if it is given a chance on corn lands that are let go back to pasture. It is very drought-resisting and prolific, and I do not know a better friend of the stockmaster in the whole range of botanical research. Silver grass is also well worthy of encouragement ; although it is comparatively short-lived it is very luxuriant in the spring, and stock fatten rapidly upon it. After it ripens, if the paddocks have been saved, sheep thrive upon it." Mr. Maley, discussing methods of cultivation, states that he has found the sprinkling of lime over seed wheat, after it comes out of the pickling tub, to be very beneficial. It imparts a vigorous growth to the young crop as soon as it appears through the ground. A bushel of lime is sufficient for the treatment of enough seed for 100 acres. The use of lime was learned by him in South Australia, and trial has, in his opinion, proved its value wherever the crop is not grown on a limestone formation. The lime is not slacked, but used just as it comes from the kiln. The strength of the bluestone, which he approves of, is half a pound of bluestone mixed with enough water to immerse a bag of wheat. Another of his successful experiments is that of the tree lucerne, it needs no attention, grows quickly, and is greedily eaten by stock. He has had 120 acres cleared for £2 10s. per acre, and has always been able to get plenty of men to do the work. His greatest trouble has been the shortness of water, as the wells he has made have not in every case reached water. His counsel would be to make a dam in the first instance, and do without stock for a year or two until clearing has brought soaks into view. Fallowing is recommended by Mr. Maley, not only because of the wholesome effect it has upon the land, but also because it allows him to get a great deal of his ploughing done in the slack time of the year ready for early sowing. He learns a lesson in this respect from self-sown crops, which always yield heavily; one of them gave 20 bushels of wheat to the acre. Not only does the early sown crop yield more hay, but it stools out freely, and there are more ears of wheat than when the farmer gets behind with his ploughing by waiting for the autumn rains. Although he has not yet planted many fruit trees, he thinks highly of his district for vineyards and orchards as well as for cereals.

Broomehill, 139 miles from Beverley, is distinguished for a more liberal rainfall than that of the more northerly portions of the southern district. It has a salubrious climate, and a great tract of territory where farmers are doing well. Three miles to the west of the station is the settlement, where there are many desirable farms. Lord Brassey's property which has been previously referred to is in this vicinity. The climate and rainfall are so regular and the soil so fertile, that 18 to 20 bushels of wheat is an ordinary crop. On the east of the line, Mr. Powell, a late chairman of the Western Australian Land company, and Mr. Hassell, together purchased 34,800 acres, portions of which have been cleared and brought under cultivation. On Mr. Hassell's property water has been obtained at a depth of 12ft. from the surface. The company contemplated establishing a training farm at Broomehill, where young men would gain "colonial experience" with a view to placing them on farms suited to their means, when they are considered capable of managing on their own account. Surburban lots have been surveyed at Broomehill, and many of them have been purchased by railway employees in order that they may raise garden produce for the use of their families. These suburban blocks range from 10 to 15 acres and they are sold at 10s. per acre. The Western Australian Land company used to charge the purchaser with the cost of surveying suburban lots ; the charge had to be paid in instalments, the first of which was due when the application was approved. The Government makes no charge for surveying any Crown lands, except areas which are applied for under the poison regulations, in which case the consideration which the Lands department receives beyond the benefit that accrues from the clearing of the ground from poison is merely nominal. Ettacup was one of the first places in the southern district where settlement took place, some of the grants being nearly as old as those which are associated with the history of York, from which the early pastoralists came to settle nearer the coast. The Governor of the colony, having visited these settlers and their children in 1884, wrote :—" Many of the farmsteads I saw are such as their owners may well be proud of. They represented years of arduous toil and of courageous struggle with many difficulties. I found some of the grey-haired early settlers of the colony still strong and hale, although nearly half a century of colonisation had, I was rejoiced to see, enabled them to rest from their labors, and to enjoy increasing comforts and easier circumstances, while the farm or the station was looked to by the stalwart sons. Wherever I went I perceived that Western Australia, though not a country of rich men, is nevertheless a land in which the honest, energetic worker, of a shrewd wit, has rarely failed to gather round him, as time went on, the possessions which constitute a modest competence, and perhaps something more. . . I did not find feverish, brand-new, shifting, and disappointed communities. Each little township resembled an English village rather than the colonial assortment of stray atoms one is familiar with elsewhere." There is still a good deal of unoccupied land near Broomehill, for the Ewlyamartup agricultural area of 46,000 acres is in the vicinity of this farming centre. While this book was in the press Mr. W. H. Angove, surveyor, of the Crown Lands department, had recommended the Minister to subdivide part of Location 257, which formerly belonged to the Western Australian Land company, for agricultural purposes. The western boundary of this "location" is the Great Southern railway, and it is only a little to the east of Ettakup. The Gordon river touches the south-west corner of the land, which is of a superior quality. In Mr. Angove's opinion the "location" would make a first-class agricultural area. The Minister has Mr. Angove's proposal under consideration, and in the meantime the ground is open for selection in any sized block that will suit the applicant, who is not restricted by the survey lines in marking his boundaries. A little to the eastward of location 257 there are two large properties which Mr. J. F. T. Hassell and Mr. T. W. Powell bought from the West Australian

Land company, the former being 12,000 and the latter 21,560 acres in extent. These estates are used as sheep runs. South of location 257 the boundaries of the electoral district of Plantagenent, which is represented in the Legislative Assembly by Mr. A. Y. Hassell, are entered, and for 12 miles the line passes through Crown lands that did not form part of the Western Australian Land company's land grants, from which it may be inferred that the area is not of the best agricultural kind. There is some good agricultural and pastoral land in location 263, which is south-east of the Ewlyamartup agricultural area, and recently a number of blocks in this locality have been applied for. The Gordon river runs south through this location, which largely consists of a chocolate loam timbered with salmon gum, jam, and white gum. In the moist, low-lying places along the course or the river-paper bark trees are seen. The southern boundary or location 263 runs to within 91 miles of Albany. Here we get into open country that the West Australian Land company passed by, but there are some excellent arable lands in the neighborhood within six miles of the line. The nearest siding to this land is at Tambellup, between Tenterden and the Broomehill stations. There are between 3,000 and 4,000 acres adjacent. At the time of writing Surveyor Angove is examining and plotting this piece of country. By the time the GUIDE is before the public his plan and report will have been furnished to the Lands department. He is dealing with an area that extends to within 82 miles of Albany. It touches location 411, 12,000 acres, mostly pastoral country, some of which was obtained from the company by Mr. Hugh Climie and Messrs. Garrity and Co. for the pasturing of sheep. The next land grant still going south is No. 407; it takes in part of the Stirling range, and comprises 77,400 acres. The Stirling range is not rich country. This grant is, generally speaking, a sand plain. East of it, and divided from location 407, is the Tenterden agricultural area of 30,000 acres, one of the recommendations of which is that it has a larger rainfall than those further north. It has excellent railway accommodation, for the Pootenup siding, the Cranbrook station, and the Tenterden siding, are all within 17¾ miles of each other. Cranbrook is 175 miles from Beverley. A large tank, containing two and a quarter million gallons, was made by the company for the purposes of the railway. It soon became full of good fresh water, which shows how easily water can be conserved in the south at a moderate outlay. The Land company planted a wattle plantation for experimental purposes at Cranbrook. The descriptive prospectus of the Western Australian Land company says:—"From indications in the ranges of this district it is confidently anticipated that valuable mineral deposits will be discovered."

Mount Barker, after passing Kendenup siding, is the next railway station in the direction of Albany, from which it is 203 miles distant. About seven miles to the east of Mount Barker is the

Porongerup range, covered with a splendid karri forest. Some of the immense trees measure 70 feet to the first branch, and 18 feet in girth. The Messrs. Millar Bros., large sawmill owners, are cutting karri for home use and export. They have also purchased 5000 acres of very rich black soil, upon which yate is the chief timber. The ground about Mount Barker varies in character, much of it being particularly well adapted for fruit and cereals. The Porongerup ranges, besides being heavily clothed with karri, have a deep, rich soil, which has been taken advantage of by several settlers. Messrs. Dunn, Moir Brothers, and J. Knight, have selections in the ranges, and are growing fruit and vegetables, including heavy crops of potatoes, with much success. There was, by some freak of nature, a natural clearing on the crest of the range, so that the producers were not put to the expense of removing the giant trees, which stand in the way of the hills being rapidly and extensively tilled. The Western Australian Land company received 30s. per acre for the alienated blocks; adjoining land is now open for selection under the Crown. Mr. H. E. Warburton has a pastoral run of 10,000 acres, and sheep and cattle both do well in the hills. Between Mount Barker and Albany there are sandy stretches. The large farming areas have now been passed through, what remains to be seen is garden land which only needs high cultivation to be very remunerative when it is properly treated in small areas. At the nine-mile lake, or Torbay Junction, nine miles from Albany, there are what an official report describes as "alluvial flats of humus or peaty mould, well watered, sparsely timbered, and specially suited for root crops, garden produce, and dairy farming; its close proximity to Albany, where there is always a ready market, renders this place particularly suited to immediate settlement." To the westward of the lake Messrs. Millar Bros. have purchased 7000 acres which are being cleared prior to cultivation. A townsite has been laid out upon the northern slopes of a large fresh water lake. The Western Australian Land company reserved 100 acres on the west side of the lake for a public park. This station is the junction of the branch line laid by Messrs. Millar Bros. to Torbay for the purpose of developing the timber trade of the district. The neighborhood of the lake should be inspected by those who are in search of, say, 100 acres of land, which they can take up as a free homestead farm, with a view to supplying the vegetable market, which at Albany, owing to the important shipping trade of the port, is not an inconsiderable one. The soil is a deep black rich formation, and there is ample rainfall in this district to render artificial irrigation superfluous. There are sidings at Grasmere, Eastwood, and Gledhow, less than a mile and a half apart, so that the cost and labor of carting produce to Albany are reduced to the minimum. The land drains freely into the lake, and as it is naturally moist there is every natural advantage in this neighborhood which a skilled farmer would desire. The largest and most profitable crops would be cut in the summer,



FOR DESCRIPTION SEE BACK.

Wandoo Country.

Also widely known as White Gum. It has a very large range of habitat, and constitutes one of the principal forest trees on the Eastern slopes of the Darling Ranges. It delights in decomposed granite over a pipe-clay subsoil, cold in the winter, and in places boggy. When mixed with Jarrah and Blackboys the soil changes to a gravelly red loam, very suitable for horticultural purposes. The "York Road Poison" along gullies, and the Box Poison" on slopes and ridges often grow amongst the Wandoo.

when drier situations are not able to produce vegetables. Garden blocks are also obtainable at Oyster harbor, an inlet from King George's Sound, six miles to the eastward of Albany. On the eastern shore of Oyster harbor there are some growers making a good livelihood out of small areas of not more than 25 acres. There are also garden settlements on the King river, six miles to the north of Albany. Here there are some 50 acre surveyed allotments awaiting application. The Denmark railway branches off the Great Southern eleven miles from Albany and runs west through some excellent land which has been alienated, to the Denmark river, where the sawmills of the Messrs. Millar Bros. are established. There are some patches of superior land here still belonging to the Crown, and it is not to be excelled for orchards and root crops. Along the banks of the Hay river—a confluent of the Denmark river—a very eligible holding can be procured if quality is deemed to compensate for lack of quantity, for 100 acres of uniformly good rich, red land is the most that remains for the new comer. This Torbay country is regarded by some good judges as containing some of the choicest spots to be found in the whole of Western Australia, but it is heavily timbered with karri, a hardwood that has many excellent qualities, but that does not stand exposure to damp nearly so well as the jarrah. Torbay is 19 miles from Albany. A great deal of settlement is going on in the vicinity of the King and Kalgan rivers, which is one of the newest districts in course of agricultural development.

The following statement has been compiled from the answers of leading settlers to the questions addressed to them by the Bureau of Agriculture, namely :—(1.) "Are there good roads to the land belonging to the Crown open for selection ?" "The roads are good. The country is so level and hard on the surface before being tilled that natural highways over which wagons can travel are ready as soon as the track is cleared. The Roads boards have been energetic in making requisitions for funds upon the Treasury, and the Government, having been shown good reason for the expenditure, has granted the money. In the Wagin district the Roads board has been doing especially good work in clearing roads in all directions leading to the township. The work has been done for 1s. 6d. per chain. The roads converge like the points of a star to the centre ; they were marked out before the land was surveyed. Now that surveys are being made owing to the progress of settlement, the judgment shown by the Roads board in selecting the routes of the highways has been commended by the Lands department, and in every case those routes are being regarded in the surveys as proclaimed main roads. Another characteristic of the south which, while it improves the roads, has a countervailing effect of adding to the cost of conserving water, is that until the Arthur and the Beaufort are reached there are no considerable watercourses to cross. The result is that land may be selected even in outlying parts free from any misgivings on the part of strangers that they will be cut off from communication with the railway by impassable roads in the winter." (2.) "What capital do you consider essential for a successful start on, say, a free homestead farm of 160 acres, or on a conditional purchase of, say, 500 acres?" "A man who intends to stay on his land from the start until it will provide him with a living, and who has no intention of taking contracts or working for his neighbors, should have £1 per acre of the area he applies for. No doubt it would be possible to eke out a scanty subsistence after the first year on a smaller capital, but many serious disadvantages would have to be combated. For example the purchase of a double furrow plough and three horses will not leave a large balance out of £100, and without this equipment a man is always late in getting in his crop, even if he is fortunate enough to get it in at all on the hire or contract system, because no ploughs and teams are available until all the owners of them have finished their season's work. The plant and horses purchased, and the ground, or a part of it, fenced, a man by doing his own improvements can keep going with the 50 per cent. of their value that is advanced by the Land bank, and after his first harvest should be fairly on his feet. On the other hand, if a man goes on to his block with only a few pounds, he is kept back for two or three years in getting his place into an income-earning order." (3.) "Are there any surveyed agricultural areas in your district?" "Along the Great Southern railway there are the following agricultural areas:—Beverley, Moorumbine, Narrogin, Wickepin, Wagin, Darkan, Katanning, Ewlyamartup, Tenterden, and Pallinup. It is believed the Lands department will survey another agricultural area at Tambellup, near Mount Barker." (4.) "What settlement has taken place on these?" "The Katanning area is nearly all occupied; in fact, it would not be possible to get a good sized farm there of eligible land. Settlement on the areas has been going on steadily, but the resumption of the Great Southern land grants has so greatly enlarged the territory that selectors may apply for that; there are more blocks now being chosen outside than inside the proclaimed agricultural areas. While there is plenty of land on the areas still available, it is satisfactory to be able to say that a new population is arriving every week. Probably in no part of the colony would the returns of the Lands department show so rapid an influx of farmers as in the southern division." (5.) "What schools are there in the cultivable territory?" "Not as many as have been applied for as the result of the impetus that has of late been given to settlement. As a general summary the question may be answered by saying that most of the children are within three miles of a school; a few families are not nearer a teacher than five miles, but steps are being taken to open two new schools, which will place education within the reach of all." (6.) "What area would you recommend a man of small means, say from £100 to £200, to take up?" "Certainly not more than a free homestead farm of 160 acres on £100, and 100 conditional purchase, in addition, on £200." (7.) "Is not the produce competed for by buyers' travellers?" "A great deal of it is purchased by the Messrs. Piesse at market rates. Their roller mill, fitted with the latest machinery, renders it unnecessary for any other market to be sought for wheat, the supply of which has become so short since the price of chaff and hay went up that the mill does not get grain enough to grind for more than three or four months in the year." (8.) "Are not railway freights for produce especially low?" "The freights for produce are on the lowest scale of the Railway department, with the exception of minerals and manures, and there is no reason to complain of them." (9.) "Has the farmer in any part of the world as good a market as that of Western Australia?" "As far as our knowledge goes, prices for produce are higher in this colony than anywhere else, and there is no difficulty in getting a sale for anything we grow. On the other hand the cost of clearing has to be set against the advantage possessed by some of the farmers in other parts of Australia, who were fortunate in finding locations that grew no timber and into which the plough could be put as soon as the ground was fenced." (10.) "What will your district grow to the best advantage?" "In the majority of cases wheat, whether cut for hay or grain, pays best. Oats have been successfully grown, especially by Mr. F. T. F. Crosby, the secretary of the Katanning Farmers' association. He has grown heavy crops of oats on land that had become wheat sick. The district is a first-class one for fruit, as the orchards of the Hon. F. H. Piesse, Commissioner of Railways and Minister of Public Works, and also of the West Australian Land company, are bearing heavily for their age. Oranges and lemons are inclined to run thick in the rind, but stone fruits and apples produced here are of the best. Cherries, which run only to leaf in some parts of the colony, come to perfection around Katanning. Vegetables do well enough as long as the ground is moist, but there are no local swamp lands to carry summer crops. An attempt has been made to irrigate a small vegetable garden belonging to Mr. M. Cronin, who chiefly supplies Katanning with culinary plants during the dry weather. This experiment has only been tried upon a small scale, and it has been found to be satisfactory and profitable. The south is not a good place for root crops, but greenstuff, such as barley, does well with the aid of the winter rains." (11.) "What crops should be avoided?" "Those which are injured by frosts, such as potatoes, and those which require moisture when it is not to be had, such as summer vegetables." (12.) "Does the land quickly exhaust itself?" "Not the better class of chocolate loam if it is occasionally fallowed. The poorer flats, on which white gum chiefly grows, will not stand cropping for more than two or three seasons without manure, which, so far, it has not been the rule to apply. The Messrs. Piesse are setting an example in this respect by using bonedust and

Thomas's phosphate on their fields close to the Katanning railway station." (13.) "The orchard and vineyard area of the district?" "The area actually under vines and fruit trees is small. It is chiefly comprised in the properties of the Hon. F. H. Piesse, and of the West Australian Land company, although many of the farmers have a few vines and fruit trees growing in the garden plots surrounding their homesteads. But the area of land suitable for the vigneron and the orchardist can be computed by hundreds of thousands of acres, for the whole of the south, save only the very barrenest spots, is suited to peaches, apricots, and apples. It has been proved by growers that land that is not capable of growing cereals for many years without showing signs of deterioration, will produce fruit equal in size to that which is gathered on the richest deep red tracts, like those which comprise the cornfields of Mr. Andrew, Mr. Westley Maley, and others." (14.) "Are any of the local cultivators also sheep farmers?" "Yes; the large farms to which are attached pastoral leaseholds carry large numbers of sheep. Grazing, in these cases, is as leading a pursuit as cultivation. These cases are the exception. The rule is that the bulk of the settlers keep some sheep, but not many at a time. They buy stores and fatten them on the fields that are resting. They thus have their own meat supply, and from time to time send small lots to the butcher. Sheep are regarded as being very profitable where poison does not threaten their safety. As more land comes into cultivation sheep will be still more utilised on these improved pasture lands, on which there is not only superior feed but no fear of poison. It is the cost of shepherding to keep the flocks away from dangerous spots, and the losses which occur on untilled country in spite of all precautions, that greatly reduce the profit of sheep at the present time and discourage some land owners from going in for them. Where paddocks are resting, the running of sheep upon them is valued as an easy and cheap method of fertilising the ground upon which the following year's harvest will be grown." (15.) "Is your district much troubled by native pests such as dingoes, boodie rats, opossums, eaglehawks, etc?" "There are no dingoes here; only a few eaglehawks. Opossums, boodie rats, parrots, and silvereyes are troublesome." (16.) "Are there any poison plants in your division of the colony? If so, enumerate varieties and give some idea of the extent of country affected." "We meet with York road, box, and prickly leaf poison. Eleven miles north of Katanning there is some heart leaf poison." (17.) "Speaking generally, is it a good district for stock?" "It is a good district for stock, especially for sheep, which receive far more attention than cattle." (18.) "What is the character of the herbage? Name the grasses as far as possible." "On the York gum and red gum country, on a chocolate soil, the silver-grass is the principal herbage; it grows luxuriantly in the spring and early summer. After November the sun burns it off. The first rains in March bring up silver grass, and it is at its best in September and October. The wild oat and kangaroo grass are found in the best places on the banks of water-courses. On the best forest lands feed runs rather short towards the end of the summer. The white gum flats carry all through the hottest weather a good growth of pin grass. This is a coarse grass which is hardy enough to stand a long period without rain. It is a good friend to the sheep owner at the most trying time of the year. The inferior country also grows a number of shrubs and tussocks which are very acceptable when the more succulent feed has disappeared." (19.) "What extent of arable land can be found in one piece?" "From 700 to 1000 acres, if the white gum country is excepted. There are larger tracts of land growing this kind of timber than any other. Formerly the settlers would only put the plough in where the York, red gum, and manna trees stood, but now that an enlarged scope of work has to be provided for owing to the growing requirements of the colony, the white gum blocks are no longer passed over. They have been found to be more fertile than their early reputation gave them credit for, and with fertilization such as is common in the south-western and eastern districts, they are believed to be equal to be capable of amply recouping the cost of clearing. It is in favour of the areas under notice that, in many cases, they are closer to Katanning and Wagin Lake than the richer red soils, so that what is saved in carting can be put to the purchase of manures." (20.) "How is the country watered?" "Not very well; the limited water supply is one of the disabilities of a great part of the southern district. For the greater part of the year reliance must be placed upon dams, wells and tanks. The situation of the settler may be put in a few words. There is ample rainfall to provide sufficient water, short of what would be demanded for irrigation uses, if the rain is not allowed to run to waste. The first thing to be done in going on to a block of land is to look for a 'soak' and sink upon it. If there is no soak, a well must be sunk for household use, and a dam excavated for the watering of stock. This should be done before the ground is fenced or a house built. A tent will do for a time, but it is a great tax to have to cart water for miles. Ringbarking ought not to be delayed in order to increase the water supply. The killing of the trees will keep a soak going. If there is no soak, one or more will probably appear when the trees are not drawing upon the moisture in the ground." (21.) "What is the cost of conserving water (*a*) wells, (*b*) dams, (*c*) tanks?" "From 10s. to 30s. per foot for wells, according to whether rock is struck or not; 10d. to 1s. 6d. per yard for excavating dams; and tanks 2s. per cubic yard. To make the difference between the formation of a tank and a dam clear to non-Australian readers, it may be stated that a dam is a shallow saucer-shaped reservoir about 3 feet deep, while a tank is deep and square sided, like the soaking pits in a tanner's yard. If rock has to be taken out in making a tank the cost is from 3s. to 5s. per cubic yard, depending upon the hardness of the strata passed through." (22.) "Is there ever a water difficulty in a dry season ?" "There has been, but a great deal has been done to prevent a recurrence of the trouble. The settlers, warned by their unpleasant experiences, have been actively preparing to store the water during this (1897) winter. Wells have been sunk on nearly every farm, and at the time of writing excavators are being largely employed to cut out dams wherever there is a good catchment area, stock having been the chief sufferers in the dry years. The roads boards have been indefatigable in assisting to keep up a plentiful supply of water in the chief centres and on the main roads by the sinking of wells, the sites of which, strange as it may seem to some readers, have been chosen at the bidding of the 'divining rod.' The outlay has been provided by the Government in the form of special grants. There are public wells at Katanning and Wagin Lake, and at Kojunup, also on Brazier's road at Marracanda." (23.) "At what depth can well water be struck ?" "At from 20 feet to 70 feet." (24.) "Can you name any place where there are facilities for irrigation ?" "There are no irrigable places near the Great Southern railway ; sites for this purpose may be chosen when the Pinjarrah-Marradong railway is extended to the Great Southern, and the Irwin and Beaufort rivers are tapped. If, however, the experiments which the Government are about to make in boring for artesian water prove successful, irrigation may become possible on what are now commonly known as dry areas. Boring for artesian water is on the eve of being undertaken in the railway reserve at the Katanning station, and the result is being awaited with much interest by the surrounding yeoman population, to whom the tapping of a subterranean supply, if fresh, would be of incalculable value." (25.) "General character of the soil and configuration." "There are several kinds of soils which may be classified thus :—(1.) A sandy loam of shallow depth, upon a yellow and somewhat friable clay. This land, which is usually denoted by a thick growth of white gums, is considered the poorest for cereals of all the soils that are utilised for this kind of crop. (2.) A heavy black soil, which is highly prized and is comparatively rare. (3.) A rich chocolate loam, usually found carrying York gums and manna trees, and which, as it is found in areas up to 200 acres in extent, is regarded as being the staple farming land of the district. For the purposes of identification, it may be said that the holdings of Mr. Andrews, and of Mr. Westley Maley, are very largely composed of the country which is now being referred to. (4.) A very poor gravel, showing an admixture of ironstone, but lacking the vine-growing qualities of the ironstone gravel of the Darling range. This fourth-class land (although only three qualities are recognised by the Lands department) is of not much value as pastoral runs, and is useless for any other purpose. Mr. F. T. F. Crosby, who took up his land near the Katanning railway station from the Western Australian Land company, has the first three varieties of soils on his property. He has cropped on fields belonging to each class for several years, and furnishes the results of his experience as follows :—The first year the sandy loam produced only a small crop of wheat. The second year the yield of wheat was much better. After that the light loam went right off ; for three years the harvest (wheat) was hardly worth cutting. Then I tried oats, and with great success. The land that would not grow wheat is still doing well with oats, which I have sown upon it again this year. The heavy black soil, a patch of which is near my house, gave, the first year I cropped it, nearly two tons of wheaten hay to the acre. Next year for the same place I had 18 cwt. It was a very bad year—the worst we have had since I have been in the south—the year 1893. In 1894 I took ten bushels of wheat off the ground, and 1895 the same. I stripped for oats in 1896, and off 18 acres I got 67 bags ; this year I broke up the chocolate ground, the first crop was very disappointing, being no more than three bushels to the acre. The following season it yielded a ton of hay to the acre, and the year after 30 hundredweight, the corn standing over 4 feet high. That was the best yield I have had off my place. The field is sown with oats this year. We get 4s. per bushel for oats delivered at Katanning. The quotation for chaff was £6 per ton until lately. The price is now £7 5s. per ton, so that hay is the more profitable crop if the paddocks do not show a preference for producing oats. In sinking in the best country we often come on granite, which is one of the best indications that water is near at hand ; granite is never found underlaying a poor hungry soil. The granite formation is a likely place to find a soak, which is a great resource for the new settler. I have a soak which only failed me last March, just before the autumn rain began. To save the water a soak is only opened out a little at a time, and as the supply diminishes the water is followed down by scooping out the earth. The configuration of the country passed through by the Great Southern railway is undulating enough for the greater part to be well drained. In this division of the colony the ranges do not lie near the arable lands, and the hills are generally sterile." (26.) "The kinds and quantity of the timber ?" "York gum, wando, white gum, red gum (in small patches), manna trees, and jam, are the principal trees. The white gum is met with over a larger area and growing to a greater size than any other variety." (27.) "The cost per acre to clear ready for the plough ?" "The clearing of trees, large and small, costs about £5 per acre, but many of the paddocks are cultivated while the trunks of the big gums are ringed and left standing. If the 'thick sticks' are excepted from the contracts for grubbing, £2 per acre is paid for taking out York gums, manna, and saplings, as well as scrub and undergrowth. Where the small trees grow thickly as much as £3 per acre has been paid for preparing blocks for the reception of vines. An exceptional case is cited where the grubbing of white gums, morrell, and York gums was so heavy that £7 per acre was paid." (28.) "What crops are usually grown ?" "Mostly wheat, cut green for hay. This is the most profitable crop, and one that is produced with less labor than the threshing and bagging of wheat. Before the goldfields era wheat was relied upon by the farmers." (29.) "The average yield per acre." "Ten bushels of wheat, or a ton of hay. A self-sown crop of wheat at Smith's farm gave 20 bushels." (30.) "What are the facilities for the transport of produce to market?" "Good roads, and the Great Southern railway. Last season it was difficult to get trucks, but the department is now adding considerably to its rolling stock." (31.) "What fruits are grown?" "All English fruits—bananas, oranges and lemons do better in the eastern districts." (32.) "With what success?" "Peaches, apricots and apples thrive remarkably well, the trees making quick growth, and yielding large and excellent tasting fruit at an early age. The only drawback is the want of shelter from the north-west winds, which blow strongly during the winter months. There is exceptionally good orchard country to the eastward; its drainage is perfect." (33.) "How much Crown land is open for selection within a radius of 20 miles of the railway stations?" "To the eastward of Katanning there is a great deal of eligible country available which has not yet been computed or surveyed. In that locality the ground becomes more hilly than it is in Katanning proper, and water is struck much nearer the surface. Although this territory is 20 miles from the railway it has been attracting the attention of the friends and relatives of some of the more centrally situated settlers, because of the neighborhood not having been picked over and the best places alienated. The soil is of the deep chocolate kind that has been described in these notes in terms of praise, and the clearing is not heavy, the growth consisting largely of mallee and gimlet wood. One new settler has secured 2500 acres. Near Katanning, on the western side also, the best of the ground is in private hands, but a wide choice of desirable public estate awaits application about 20 miles from the Katanning post office." (34). "Has settlement been progressing?" "Yes, very rapidly, since the Crown bought the Great Southern railway and its hereditaments, as the returns of the Lands department show. More land has been taken up between Beverley and Albany during the last six months (from January to the end of June, 1897) than in any other division of the colony. The Government land agent, Mr. H. S. Ranford, on his periodical visits to Wagin Lake, has been kept busy till nearly midnight receiving applications and their accompanying deposits of rent. He is authorised to show enquirers for land the blocks that may be obtained, and is furnished by the department with a buggy and pair to travel with convenience and celerity. On the day that our reporter was at Wagin Lake Mr. Ranford received applications for conditional purchases and free homestead farms covering 2,373 acres, and he forwarded to the Treasury the sum of £170, which had been paid in for deposits and rents." (35.) "Has the co-operation of the Land bank been availed of?" "The bank is a great boon to the newcomers, who have to meet a great many preliminary expenses before the first crop is in the granary. At this early stage in the bringing of their land into cultivation, they could not obtain loans anywhere else, while the condition that the first instalment of the repayment of the loan is not payable for five years is a guarantee of safety that commends the terms of the bank to the beginner. Another advantage is the 5 per cent. interest rate, which gives the producer the benefit of the low price at which the Government is able to borrow in the London market. In the south the free grants of land and the lending of cheap money are deemed to be the two essentials necessary to enable any careful worker to make an independent home." (36.) "What is the local rainfall?" "The minimum annual rainfall has been 7½ inches, and the maximum 26 inches; the average is 14 inches. The rainfall usually commences at the end of March, and is nearly over by the end of October or the beginning of November. There are occasional thunderstorms in December, January, and February." (37.) "The character of the seasons?" "The climate is very temperate, never reaching the extremes of heat or cold. The purity and mildness of the air are very beneficial to invalids. Dr. Walter, of Perth, has taken up a 300-acre block, near Wagin Lake, as a site for a sanatorium." (38.) "The size of selections on Crown lands?" "These vary from 200 acres to 1000 acres. The larger holdings are devoted to sheep raising as well as cultivation. If less than 200 acres are taken up a man must expect to look almost entirely to the growth of cereals and fruit for his livelihood." (39.) "The nationality of immigrants?" "Since 1890 nearly all the incoming families have arrived from the other Australian colonies. They are almost, without exception, English, Scotch, or Irish, and have come well equipped for a new start on the land. Most of the men have sold out farms on the 'other side,' and have brought over their implements and horses ready to get a crop in without delay." (40.) "The chief advantages of your district?" "A good climate and rainfall, kindly and productive land, a local market or rainfall transit for produce if we desire to send the produce to Perth, Fremantle, the goldfields, or to the port of Albany. Another advantage is that there is in this district enough land open for selection to enable both farming and grazing to be carried on by the selector." (41.) "The class of implements in general use?" "Stump jump ploughs, cultivators, reapers and binders, winnowers, and steam chaff-cutting machinery, all of the latest make. The ploughs are nearly all two and three furrows; the latter are generally worked with a four-horse team, but three extra good draughts will do good work, except in new land where there are many roots and stones. First class farming implements have been coming to order nearly every week for the last couple of years." (42.) "What is being done in stock raising?" "Not a great deal in horses and cattle. No special attention is paid to improving the strains of either beef or dairy cattle, which are generally of a nondescript type. There are no large herds. People dread a mob getting on to a poison patch and suffering what is known as a 'smash.' If a flock of sheep get into this danger a few of them drop and give warning of the proximity of the poison, and the animals can be removed before there is more than a few pounds worth of damage done. It is not so with cattle and horses, which are, therefore, not raised on a large scale. For heavy horses we rely upon importations, the local breed not having much size or substance. The big imported horses stand being turned out on the paddocks in the slack season without losing much condition. Sheep do well, and some fairly large runs, such as the pastoral property of Lord Brassey, at Broomehill, are stocked with them to the number of a good many thousands. The farmers around Katanning and Wagin look to Lord Brassey for their stores. The manager of the place every year has culls drafted out of his flocks, which the farmers apply for in lots to suit their requirements. Some years ago, when Lord Brassey first established his place, the demand for the annual drafts was not very brisk, but now there is such a run on them owing to the increase in the number of settlers and it being found to be very profitable to keep sheep, that it is very hard to get stores from Broomehill." (43.) "The opportunities for a larger scope of work." "The scope of profitable farming operations can, in the south, be increased to an enormous extent. The territory is so large and the population so scattered that little more than a beginning can be said to have been made. There are vast tracts open for selection, both within and without the boundaries of agricultural areas. The reserve at Katanning that, having been set aside for an experimental farm, has just been thrown open for selection, is only one of the many opportunities that are presented for new comers to get suitable farming sites close to the railway. Not a third of the best corn lands already alienated have been tilled, partly because of the comparative scarcity of labor. If farm hands would emigrate from the old country, take up a free homestead farm and work half time for their neighbours and half time in improving their own holdings, the older settlers would hail their arrival with much satisfaction, and they could be sure of obtaining plenty of work at 6s. or 7s. per day. More land would already have been cultivated had there been less to do in the direction of conserving water. Mr. Westley Maley says :—'I could have cleared another 140 acres of ground with the money I have expended in sinking wells that never struck fresh or brackish water. At last I got a good supply ; but I should set to work differently if I were commencing again. I should ring the trees to help me to find soaks and springs, and make dams. Until I had plenty of water I would keep no stock, preferring to keep pegging away at clearing and cropping ; the water difficulty with the aid of dams and ringbarking would cure itself. If everyone had gone on these lines there would have been more land under tillage and greater progress. As it is, there is all the greater scope for the new work which your question touches. The man who wants to begin on 1000 acres will get them close to Katanning, but there are smaller areas that are very fertile awaiting an occupier.' Katanning, however, owing to its being the largest centre on the line, has had a greater demand for its Crown lands than Wagin Lake and the country lying between it and Katanning, which are almost as favorably situated, and where much of the land within sight of the train is of a high-class quality. Further south, around Tambellup, there are also excellent areas. The advice which is given to the intending settler is to make a tour through the district, or to ask Mr. H. S. Ranford, the Government Land agent, to indicate the choice vacant spots to him, and he is not likely to go away under the impression that there is not ample room for an enlarged scope of work." (44.) "Is not dairying being neglected?" "Yes; there is no dairying to supply even home requirements, except in a few cases, and in these only for a few spring and early summer months. There is too much labour, not enough profit, and artificial feed is too valuable to make dairying a general pursuit. It is preferred to let the cows rear their calves on the natural grasses, or, at best, to only milk the mothers once a day. Some of the leading producers, however, look forward to laying down English pasture plants, and so adding to the stocking capacity of some of their cleared lands that dairying may be encouraged. Mr. Westley Maley reckons that, as lucerne paddocks, some of his ground which is now growing cereals would return him a larger profit with less labour than cereals impose in the various stages of their production. He has also great faith in some of the indigenous grasses when they have the favoured condition of being nurtured on land which having grown trees is, after grubbing, able to hold all the rainfall for the benefit of the pastures. The value of corkscrew grass has impressed itself upon him; he believes it can be kept growing vigorously green and succulent in an unused cornfield of chocolate loam. The great summer grass of the south-west—couch or Indian doab—does not thrive in the south." (45.) "Are vegetables grown to any extent in the south?" "Only in the wet months. Mr. Cronin's garden, which is low-lying, gets some water in the summer from a large dam, which is connected with races communicating with the vegetable beds. The yield is very abundant, but water is too scarce in January and February for the example which Mr. Cronin has set to have been imitated by others. He also grows maize luxuriantly." (46.) "Do potato and other root-crops do well in your district?" "The ground is suitable for the growth of the potato if they are put in the red loam, but frosts are prone to cut down the young plants. On the higher levels, above the frost line, potatoes have been grown with excellent results; but in so level a territory as the south, hilly situations are not to be found adjacent to the railway. The early rose is the most prolific variety, especially when it is given a dressing of stable manure." (47.) "Is there any available Government land suitable for potato crops?" "None that could be recommended without qualification." (48.) "Are there any private lands available for this purpose? If so, state price and terms." "There are several superior blocks in private hands, but no public intimation has been given by the owners of their willingness to part with them." (49.) "Are frosts prevalent and destructive in your district?" "Yes; frosts do more damage in certain years, notably in 1891, which was a very destructive year. The potatoes planted early in February have done best whenever rain has fallen in that month." (50.) "Give approximate dates of earliest and latest frosts?" "May and August respectively." (51.) "Is your district adapted for close settlement, *i.e.*, 10 to 20-acre men?" "Only if they are going in exclusively for orchards or vineyards, and either possess enough money to keep things going for three years, or are willing to do occasional work for the roads boards or for farmers. Any able-bodied, experienced farm hand can get 7s. per day by going out in the ploughing or harvesting season to other holdings. There is always a job of fencing or dam or tank-making to be had. The established producers would be glad to have a local labor supply among those who are making a start without bringing in much capital, but who rely upon their industry in a colony where labor is well paid to enable them to pay their way." (52.) "Are fowls and bees being turned to account?" "Poultry are an adjunct to nearly every farm; they pay well, as they are at liberty and forage for a great deal of their pickings, and there is always sale for them at 5s. or 6s. per couple. Many are sent to Albany by a dealer who goes round collecting the birds. The favorite breeds are Spanish and Andulasians crossed with the barn-door. Those who have a strain of good layers can sell all the birds they can spare in the district for breeding purposes. The hardy life of the poultry, and the lack of overcrowding in their roosting-places, makes them very healthy. There is no trouble in keeping them free of parasites or disease, which is so apt to make its appearance when poultry are kept in confinement and cleanliness is neglected in their yards. In the summer the birds wholly feed themselves; in the winter they are fed morning and night, but not heavily. There are very few hives to be seen; the value of bees, if known, is not utilised. Wild swarms could be captured, but most people are content to cut down a tree and take their honey." (53.) "From your observation, what are the chief requisites for a new settler?" "(1.) To show judgment in selecting a piece of land that is suitable for the object in view. (2.) To cut a dam or open a soak as soon as a tent is pitched and stores secured. (3.) To put in a small patch of crop the first year in preference to losing twelve months without a return while clearing a larger paddock. (4.) To ringbark the remainder of the ground as soon as the first sowing is completed on the cleared portion. (5.) To hire appliances, such as a chaff-cutter, instead of sinking money in buying anything except a plough and horses at the start, when capital is one of the main levers of success. It will, however, be a mistake to depend upon hire for the plough and team, for no one will lend them until his own work is done, which means that the borrower is late in sowing, which will spoil his first harvest, upon which so much depends. (6.) A careful and skilled oversight of the crop, to determine whether it should be cut for hay or wheat. Not only may the suitableness of a yield for hay be indicated by a high heavy growth of stalk, or for wheat owing to the heads being well filled while the stalk is light and short, but a spot or two of smut which a heedless owner might overlook should be taken into account. The smut will not injure the fodder if the crop is put through the chaff-cutter, but it produces a dirty sample of wheat that will reduce its market value. (7.) The careful clearing of the ground of sticks or stones, which if left alone would endanger the reaper and binder and add to the bill for repairs. (8.) Special attention to drainage. A well-drained field of inferior soil is better than a rich flat over which a flood may sweep and ruin the young corn. (9.) Recourse to the Land bank, if means are wanted to carry out remunerative improvements. The bank being a State institution that has been specially devised to help settlement, its provisions are necessarily more liberal than private lenders could afford to adopt. If loans are spent on reproductive works, they should have earned their cost within the five years grace before the first instalment of the principal comes due, so that the improvements—if they have been carried out with discretion—cost their owner nothing in the end. (10.) Some struggling men have made a prosperous start by cultivating improved private lands on the shares principle. The advantages of this plan are that there is no risk and the outlay is small. The owner of the land gets no fixed rent, but his reimbursement depends upon the character of the season, while it will be a very bad year indeed in which the tenant is not better paid out of the proceeds of the crop than he could be by working for wages. A good year gives him something to start for himself on a free homestead farm." (54.) "What are the lessons of local experience in the clearing and treatment of the land?" "(1). That the utmost precautions must be taken against the spread of fire in burning off in the summer time. The provisions of the fires prevention Act are stringently enforced, and there have been several convictions for breaches of the Act. The resident magistrate has announced that future offenders will be fined £10, as serious loss through the burning of haystacks, homesteads, and fences, may be the result of careless ignition. In no case must a fire be lighted before the 1st of April unless a ploughed line has been made around the place where the fire is made, and notice has been given to neighbors. (2.) Ringbarking assists clearing when the land is not wanted for crop until the trees are dry, and it doubles the feed for stock. This work should be done at the earliest possible date. It should be the rule to grub no trees in the green state besides those which have to be removed as soon as the land is taken up, in order that there may be no delay in sowing. The cost of ringbarking is from 1s. to 2s. per acre. The latter figure was paid by Mr. Alexander Forrest for 1000 acres which he purchased from the Western Australian Land company, close to Katanning, and a portion of which is now under crop." (55.) "What fertilisers are best adapted to the land in the south?" "So little fertilising has been done that a definite answer cannot be given to this question. It is believed that nothing is better than bonedust, which has far more than paid for its cost wherever it has been applied. Only one or two producers have used any manures, and none of them largely. The Messrs. Piesse are trying Thomas's phosphate; it promises well, but as the wheat is now (July 1897) of less than a month's growth, comparative returns cannot be given. From the attention that is being turned to the subject, it would appear that the manuring of the soil will rapidly come into vogue." (56.) "Is not liberal manuring from the outset profitable?" "For the reason given in answer to the last question, namely, that resting and fallowing have been depended upon instead of manuring, there is not much data on this point. But if a conclusion is to be permitted to be arrived at from the great improvement noticeable wherever fertilisers have been used on ground that has been many times cropped, we should say that in the south, as elsewhere, the more that is put into the land the more, with interest for the outlay, is taken off it. At the same time profitable yields are taken off land that have had no dressing of any kind. The best crops are always those which are sown on fallow, with the first rain of the season to give the seed a start, and are strongly rooted before the cold weather sets in." (57.) "Are there any eligible large estates open for subdivisional sale, or available for occupation under improvement leases?" "Lord Brassey's is the chief of the eligible large estates in the south. It is so near the railway, and has been so well chosen for its natural advantages, that there is no doubt many first-class farms could be established upon it if the property were available, but, so far, it is being steadily improved as a sheep run. There have been sales in a few instances of subdivisional blocks out of the holdings of the old residents; but, as has been previously said in these notes, there is enough Crown land to pick from, so that there is no need to set longing eyes on that which has been alienated." (58.) "Can you make any suggestions for the guidance of new settlers?" "Place dependence upon surface water wherever practicable, for that which is got in wells, if not brackish, is often impregnated with magnesia to a greater degree than is agreeable to the palate. Do not buy stock until water and feed are secured so amply that they may be kept in health all the year round without anxiety to the owner, or the loss of his time in taking them to the public wells. Spare no effort to clear and cultivate a larger area every year, remembering that it is the difference in the quantity of the harvest, not in the number of unimproved acres, that creates most of the distinction between the large holder, who employs labour, and the small holder, who is fortunate if he has not to sell his labour during the first starting years in order to make ends meet."

Mr. W. H. Angove, surveyor, of the Crown Lands department staff, who has done a great deal of professional work in the southern district, and who knows it thoroughly, has kindly condensed the results of his experience and observation in the following statement :—"There are very good roads to the land belonging to the Crown that is open for selection all through the Broomehill and Kojonup and Plantagenet districts. In and around Albany the roads are not all that could be desired, but they are passable, and fast being brought into better order by the roads board. I consider that in taking up a homestead farm of 160 acres it would be essential for a successful start that a man should have not less than £100. If he takes up 500 acres he should have, in my judgment, £160. There are no surveyed agricultural areas near Albany. I have recommended the plotting of an area south-east of Broomehill, and shall recommend others, as there are many good sites to select from. There are schools at Broomehill, Kojonup, Cranbrook, Mount Barker, Denmark, King river, and Albany. I should recommend to a man of small means, having, say, from £100 to £200, from 160 acres to 600 acres. All the produce grown in the Broomehill district is readily sold, and I believe produce grown lower down around Mount Barker and districts in the neighborhood of Albany is readily disposed of. I do not consider the railway freights for produce are especially low, particularly as regards small parcels. At the same time, as far as my knowledge goes, I should say the cultivators of few countries have so good a market as that of Western Australia. Broomehill and Kojonup grow wheat, hay, and wool to the best advantage ; Mount Barker and Frankland river excel in wheat, hay, potatoes, and fruit, while root crops, vegetables, and fruit do exceedingly well on the Porongorup range, and at Denmark, Torbay, and the Albany district. The land in the Broomehill district requires manuring to some extent every year, or fallowing. When this is done good averages are obtained. I should think the land would soon exhaust itself otherwise. No one has made a specialty of orchard or vine-growing in the Broomehill and Kojonup districts. Nearly every farmer has a few acres of fruit trees ; I should say 200 acres would cover the two districts. Mount Barker, Frankland river (Yoouminiup), and Forest Hill districts have some old orchards, but not, I think, vineyards. The total orchard area would probably be about 100 acres. Around Albany there are a few small orchards ; the whole area would probably be no more than 100 acres. Many of the cultivators around Broomehill, Kojonup, Frankland river, Mount Barker, and Wilson's Inlet are also sheep farmers. Dingoes, opossums, and tamars are a nuisance in many parts of the Broomehill district. Dingoes and wallabies are too plentiful lower down towards Albany. A considerable extent of poison country exists in the Broomehill and Kojonup districts, infested with York road, box poison, and narrow leaf. I cannot say what is the aggregate acreage of the poison country, but I should think it would comprise about one-fortieth of the whole of the localities in question. There is very little poison in the Mount Barker district. Around Torbay and Denmark there are small patches of indigo poison, and on granite country in the neighborhood of Albany there are small quantities of the heart-leaf variety. Speaking generally, those portions of the south of which I am writing are good places for stock; of course, precautions have to be taken to keep them off the poison patches. At Broomehill, Pallinup, Kojonup and Cranbrook, the principal grasses are silver grass, pin and kangaroo grass, and native couch. There is silver grass and bush feed at Mount Barker, and bush feed in the Albany district. The extent of arable land that can be found in one piece is about 500 acres. For water, Broomehill, Kojonup, Pallinup, Mount Barker and Kendenup depend upon wells, tanks and waterholes. There are waterholes and creeks at Denmark, Torbay, King river, the Porongorup hills, and at Albany. The cost of conserving water is for sinking wells, 20s. per foot; tanks and dams, 9d. per cubic yard. There is never a serious water difficulty in a dry season. Well water can be struck at a depth varying from 12 to 60 feet. There are facilities for irrigation at the Frankland river and at Denmark. At Broomehill, Pallinup, and Kojonup the country is undulating. The best ground is a chocolate and brown soil found in what is known as 'cup and saucer' land. The medium soil is a light loam; the grassy lands are red sandy and light sandy. Mount Barker has a brown loamy soil and is rather hilly. The soil of the Albany district is sandy and peaty. Torbay and Denmark:—On the karri hills there is chocolate soil and in many valleys rich alluvial soil. The timber of Broomehill and Pallinup consists of raspberry jam, white gum, York, salmon, morrell and yate; at Kojonup the forests are of jam, white gum, York gum, yate and red gum. Mount Barker possesses red gum, yate, jarrah and white gum. Torbay, Denmark and Albany are timbered with karri, jarrah, red gum and yate. To clear land ready for the plough costs £1 10s. to £3 per acre at Broomehill, Kojonup and Pallinup; from £2 to £5 per acre at Mount Barker and district; from £2 to £5 at Albany, and from £2 to £10 at Torbay. The crops usually grown at Kojonup, Broomehill and Kendenup, are wheat and hay; the producers of Mount Barker, Frankland river and the Porongorup range, show a preference for hay and potatoes, and those of Albany and Torbay for potatoes and

FOR DESCRIPTION SEE BACK.

Tuart Country

Occupies a comparatively narrow strip of red sand and limestone belt which lies along the coast line from the Vasse to some distance north of Perth. This sandy loam is very fertile, and rests on a subsoil of a more retentive nature. This kind of soil constitutes one of the best vine lands of the country, and record yields of grapes are obtained from vineyards established on it.

vegetables. The general yield where wheat is grown is from 15 to 18 bushels ; it has been as low as 10 bushels ; their hay harvest is from one and a-half to two tons. The facilities provided for transport of produce to market are the railways to Albany and Coolgardie. The fruits locally grown are apples, peaches, apricots, pears, nectarines, quinces and grapes. The fruit yield is moderately successful at Broomehill and Kojonup ; probably the crop would be better if the orchards had the benefit of more skilful cultivation. The fruit of the Mount Barker and Frankland river districts is of superior quality. The Crown land open for selection within a radius of 20 miles of a railway station may be tabulated as follows :— Broomehill, 40,000 acres ; Tambellup siding, 10,000 acres ; Tenterden, 10,000 acres ; Mount Barker, 10,000 acres ; Albany, 10,000 acres ; Denmark and Torbay, 20,000 acres. Settlement has not been progressing, but it has lately received an impetus. So far the co-operation of the Land bank has not been availed of. The rainfall at Broomehill is 18 inches per annum ; at Kojonup, 20 inches per annum. The rainfall increases as you go south to Albany. For the last few years dry seasons have been experienced around Broomehill, Kojonup and Pallinup. Last year was a dry one in the southern districts of Mount Barker and Albany, where there are generally good seasons. The average size of selections on Crown lands is about 100 acres. The residents of the districts under notice are chiefly of Scotch and Irish nationality. The chief advantages of Albany and Mount Barker are their liberal and temperate climate. Denmark and Torbay are to be recommended for their rainfall, rich soils and excellent climate. Broomehill and Kojonup boast most of their healthy climate, being clean for stock, for the excellent land selected, and for the fertile and valuable areas that are still open for selection. The class of implements in general use are reapers and binders, strippers, single, double and treble furrow ploughs, and scarifiers. There are ample opportunities for a larger scope of work. In stock-raising nothing special is being done, every farmer merely depending upon the stock of his own rearing. Dairying is being neglected. It always has been in the Broomehill, Kojonup and Pallinup districts. Not much dairying either has been done around Mount Barker or Albany. Vegetables are grown to a considerable extent around Albany, . Grasmere, King river, and on the Porongorup hills. Potatoes and other root-crops do well there, and also at Mount Barker, Denmark and Torbay. There is Government land, suitable for vegetables and root-crops, to be found within the radius of the railway, which has been referred to in answering a previous question. There are eligible large estates open for subdivisional sale, if not available for occupation under improvement leases. The unimproved areas of the late T. W. Powell's estate around Broomehill, and his improved Pallinup estate, are open for sale ; but I do not know whether they are available for occupation under the improvement system. Mr. J. F.

T. Hassell advertises for persons willing to lease land on the share system of cropping. The land he refers to is at Kendenup. The terms upon which this land is available on the share system are obtainable on application to Mr. J. F. T. Hassell, Albany. Frosts are prevalent in the south from May to October, those months being the approximate dates of the earliest and latest frosts. Around Albany, Denmark, Torbay and Mount Barker, the districts are adapted for close settlement, namely, for ten and 20-acre men. Poultry is not largely kept in this part of the colony; bees not at all. From my observation the chief requisites for a new settler are the possession of not less than £100 for the taking up of 100 acres, a single and double furrow plough, two horses, dray and harness. A reaper and binder he can hire for the first year. The lessons of local experience in the clearing and treatment of the land are:—(1.) That although a total clearing by grubbing is the best, it is too expensive for the small man. (2.) It is better to grub the smaller trees and ringbark the big ones. (3.) My impression in Victoria was, and many Victorians bear me out in this, that the land is enriched by the timber being ringbarked for two years before being grubbed. It seems to give back to the soil some quality which it does not seem to have if the trees are grubbed and cleared right off. Besides being cheaper to wait till the trees are dead and dry, it is quicker to plough between them while they are dying, and a new man can consequently get more land under crop during the first few years after he goes upon his holding. The best results have been obtained from the use of bone dust; it is superior to any other fertiliser. Liberal manuring is certainly profitable from the outset. The suggestions I would make for the guidance of new settlers are:—(1.) They should get all the information they can from the Government land agents, who will be able to advise them where to select land. Probably by so doing they will not be disappointed. On reaching a district where they intend to look for land they should hunt up a Government surveyor, if there is one in the neighborhood, who will be able to fully advise them. Having secured their land, if the season is early, they will do well to grub the small trees only and ringbark the larger ones, putting in as much crop as possible the same year. (2.) Then the land should be fenced in while the seed is in the ground, if it is getting late in the sowing season, in order to save time. There will then be something coming in to keep the pot boiling. A larger area can then be got ready for cropping next year. Do not miss sowing for a year by trying to get too much ready for the plough all at once. (3.) The land should be well ploughed, not simply scratched over as is too often done, with the result of failure. I know of a man near Ettakup who ploughs his land well and harrows it properly; he never fails to get a good crop. (4.) The selector should also select a suitable site for a tank for the conservation of water. A good tank is seldom found wanting in a bad season."

The following recommendations have been made by Mr. H. S. Ranford, Government Land agent at Katanning, with reference to the areas in the southern district :—" Katanning, April 30, 1897. (1.) If the land along the Great Southern railway is to be settled and improved to any great extent, it is very necessary that the provisions under which second and third class homestead leases can be obtained should be legally amended, so that such leases might be granted throughout the south-west division. (2.) Taking the Hordern area, 80 miles wide, between Beverley and Albany, this would contain about 12,000,000 acres, and I consider that dividing the land into first, second, third class, and what might justly be called 'poison land,' we might fairly assume that we have 3,000,000 acres of each sort ; so the necessity for making provision for second and third class land is readily apparent. (3.) The classification should be made after selection, as the area is so vast and beyond our means to survey in sufficiently accurate manner to show in our plans as required by the present Act. Rent should be paid at second class rates, pending inspection. (4.) The sooner arrangements can be made to grant homestead leases, the better for these districts and the colony."

CHAPTER VIII.

THE ESPERANCE DISTRICT.

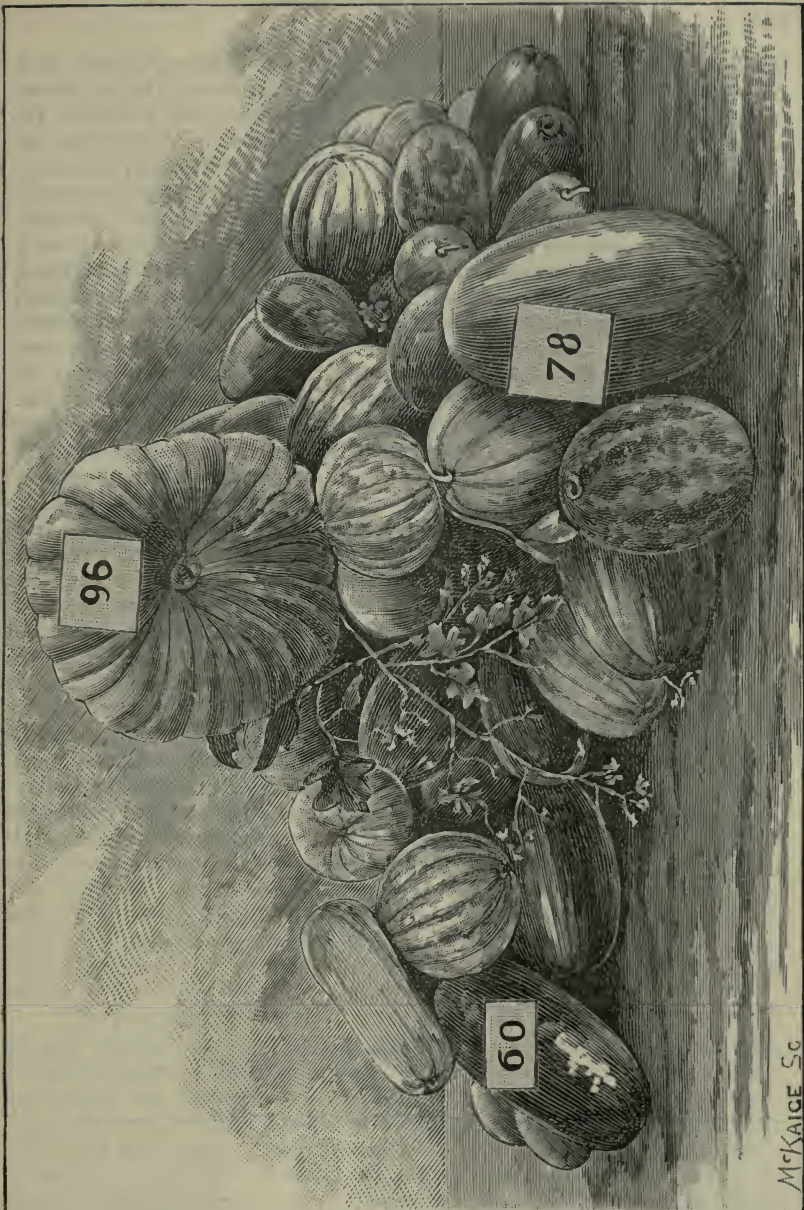
The Esperance district extends from the Hamersley river to Eucla, on the south-east, where the territory of Western Australia touches that of South Australia. Esperance is 237 miles east from Albany by sea, 120 miles from Dundas, and 140 from Norseman. There is at Esperance Bay a large and safe harbor; the port is so sheltered by numerous islands that it has, from the town, the appearance of being land-locked. The opening up of the Dundas and Norseman goldfields has given much value to the country near Esperance from a farmer's point of view. The great saving in the cost of sending locally grown produce to those goldfields, as compared with bringing it from a distance, is too patent to need any exemplification. Esperance is the nearest point to the Yilgarn goldfields. It has asked to be connected with Coolgardie by a direct railway, but in order that an intending selector may not be misled, it may be said the request is not likely to be granted. The matter was debated in the Legislative Assembly on the 7th October, 1896. Mr C. J. Moran, member for Yilgarn, then moved:—"(1.) That in the opinion of this House, it is desirable that a railway line should be constructed from Esperance Bay to Norseman forthwith. (2.) That if the Government do not choose to undertake the work they should be empowered to grant permission to private persons to build the line." He urged that there was more foreign capital available for the development of Norseman and Dundas goldfields by very many hundreds of thousands of pounds than was set apart for the Southern Cross fields at the time the House decided to build the railway to Southern Cross. The Norseman goldfield, he submitted, had every prospect of being rapidly developed, provided the mines there were given the same facilities of transit that were given to the other goldfields. Private persons had offered to construct the line, and one or them had undertaken to hand over the line to the Government in ten years. Another offer conceded to the Government the right to fix the maximum rate per ton freight to be charged on the proposed railway. The Hon. Sir John Forrest, in reply, said there was no doubt that at the present time the House was not prepared to agree to the construction of a line to the Norseman. It seemed to him that the motion before the House was a mischievous one, because it raised the hopes of the people, which would not be fulfilled, and it therefore did more harm than good. Although the line might pay, yet political reasons ought not to be quite ignored in dealing with questions of that sort. If by building the railway in question they would injure the port of Fremantle and the trade of Perth, they had to consider that question, and, no doubt, it would be dealt with at the proper time. He had to say that they had not to deal with that question at the present time.

The following extracts from the report of Surveyor E. S. Brockman, dated June 26, 1896, have been courteously furnished by the Under-Secretary, Crown Lands department (Mr. R. C. Clifton) :—" The country for 50 miles on each side of Esperance may be generally described as—First, an irregular belt of sand and limestone hills joining the coast line on the south and extending inland, with an average width of about five miles. This belt of country is fairly grassed with a coarse coast grass, and contains numberless little hollows (with good soil and water at shallow depths), suitable for growing vegetables, lucerne, and root crops. Adjoining the coast hills on the north comes a very irregular strip of ordinary sand-plain country, consisting of loose sand and gravel, with poor vegetation and very little water, having an average width of 25 miles, practically extending to the edge of the ' certain rainfall.' This is succeeded by mallee scrub of stunted growth for the first few miles, growing on poor sand, clay, and gravel, but increasing in size, with a marked improvement in the soil as it extends inland. From a line about 60 miles north from the coast inland to Norseman the soil is generally good ; it is covered with mallee scrub and occasional salmon gum and black-heart forest, and is well grassed in patches, after good rains, which are apparently rare. Generally speaking, the country is poor where the rainfall is good, and the soil good where the rain is uncertain. The exceptions to this rule occur principally along the valleys of the small rivers rising in the mallee country, and running through the sand plains and coast hills to the sea. The most noticeable of these exceptions is on the Dalyup ; but there are good little strips on the Sart, Oldfield, Munglinup, and Young rivers, and also, I am informed, on the Thomas, principally within pastoral leases, and not of sufficient extent to set apart as special areas. There are also patches on the edge of the mallee country. The only patch of considerable extent not subdivided, is on the Munglinup, about 4000 acres. Of the special areas already subdivided the Myrup creek area contains about 300 acres of good land. The subdivided portion of the Dalyup special area is very good land, consisting of clays and strong loams ; it is well grassed and the clearing very light ; it is within the good rainfall, and inland from the belt of sandy coast country, and is therefore well situated for hay growing for the Norseman market. I consider that this from its situation is the most valuable piece of agricultural land now held by the Crown in the colony. It would be advisable to prevent the whole of this area being selected by one or two selectors, and I would suggest limiting one applicant to two blocks as subdivided. As evidenced by the number of applications there is a strong desire to acquire garden blocks under clause 55, on the coast line in the neighborhood of Esperance. In this case I think the regulations exactly fit the country, as there is much good garden land, though in small patches."

The Bremer Bay and Esperance districts extend 520 miles east from Esperance. The Hon. G. Throssell, Commissioner of Crown lands, has asked the Surveyor-General to report as to the cost of sending a party to examine and report on the agricultural lands available in the Bremer Bay and Esperance districts. This step has been deemed necessary by the Commissioner on account of the large number of enquiries for land which have been coming from that quarter. At present there is very little detailed information in existence with regard to the agricultural prospects of these localities. The Minister is satisfied that the department should be in possession of the fullest and most accurate data at the earliest possible moment.

Although the Government is not prepared to grant a railway at present to Esperance, lest it should ultimately become a rival to the Fremantle-Yilgarn line, they are able to show that the means of transit for produce or mining machinery are not nearly so unfavorable as those existing in other parts of the colony which are without steam haulage. "Norseman," says Mr. A. R. Richardson, late Commissioner of Crown lands, "is specially favored in being near the coast. It is also favored with a beautiful climate, where all kinds of draught stock are able to haul more than is possible in a tropical climate such as that of the north-west. I say the people of Norseman are favorably situated. The people in other parts of the colony such as I have mentioned, may well envy them in living under conditions that are so favorable as compared with the conditions existing in many other places." As for producers, a line would leave them more exposed to the competition of the eastern colonies; it would chiefly benefit South Australia. Mr. Loton stated when the subject was discussed in the Assembly:—"The people of Norseman are doing very well with their present facilities, and they may continue to do well. Some of them can earn very good money by carting supplies to the fields, the same as was done at Ballarat in the old days of goldfields' development in Victoria."

Mr. John Rushton, secretary of the Esperance agricultural, horticultural and fruitgrowers' society, sends replies from the society to the questions asked by the Bureau. He says—"The replies are as reliable as it is possible to make them, taking into consideration the very recent general settlement of this district. There can be but little doubt that, given proper facilities, the district as a whole is capable of much in the way of settlement, and, though the soil near the coast is not striking to a casual visitor, yet what has been done proves it to be better than it looks. We have no reason to doubt that when the time arrives for the construction of the railway from here to the goldfields, settlement will be rapid and profitable. There are no good roads to Government land that is open for selection. The roads board is, however, bringing the matter under the notice of the Government with a view of obtaining assistance for the purpose of making roads. We consider the capital essential for a successful start on a homestead farm of 160 acres, would be £250. This sum would be required for clearing, fencing, working plant, and first order of seed. If a man takes up 500 acres he should have £500. There are two surveyed agricultural areas in our district, namely, Myrup and Dalyup. These areas were only thrown open for selection on the first of April last, consequently too late to allow them to be placed under crop this year. On Dalyup, 14 selections have been made, and five on Myrup. Myrup was made available some time before Dalyup was proclaimed. The only school in the cultivable country is one at Esperance. We should recommend a man, having not more that from £100 to £200, to take up a garden block of 20 acres. The produce of the district is eagerly competed for by the buyers' travellers; the demand greatly exceeds the supply. Just now there is no market anywhere else as good as that which is at the command of the Western Australian producer. The Esperance district grows to the best advantage lucerne, barley, rye, wheat, root-crops, such as mangolds, beets, etc., pumpkins, melons, tomatoes, and all classes of vegetables. There has not been sufficient time since settlement began at Esperance, to test accurately what crops should be avoided here. Our society would rather defer for a while giving a definite answer to your question—'What crops should be avoided?' As far as we are able to judge, the land, being of a sandy nature near the coast, quickly exhausts itself; but, a little way back from the sea, there is a large amount of first-class mallee country, which would be capable of growing good crops without manure for some years. There is a very large orchard and vineyard area throughout the district, that is of land suitable for planting with vines and fruit trees. It would be almost impossible, even approximately, to give the quantity in figures. Some of the local cultivators are also sheep farmers. The district is not much troubled by native pests, such as dingoes, boodie-rats, opossums, eagle-hawks, etc. There is box poison all over the district, principally on the gravel banks of the creeks. It is singular that the poison is in all cases found on the right hand of these creeks, as seen when travelling inland. There is heartleaf poison on the granite outcrops; candiup grass, which is noxious vegetation, is found in the swampy country in fairly large quantities. The larger portion of the country hereabouts is, generally speaking, more or less affected by poison plants. Nevertheless, with care and reasonable attention, the Esperance is a good district for stock. The herbage is of excellent character. There is bushfeed on the sand plains, alternating with grass. The chief grasses and stock-feeding plants are speargrass, barley grass, dandelion and native couch. The extent of arable land that can be found in one piece is, we should think, from about 100 to 1000 acres. This estimate includes the mallee country. The country is well watered within 15 miles of the coast. Within this limit of the sea there is an abundant supply, but outside that range the supply is indifferent. The cost of conserving water on the coast is very small, there being no scarcity. The quality of the water is excellent. It can be obtained in wells at a depth of from 3 feet to 10 feet. Beyond 20 miles from the coast very little has been done in the conservation of water. In a dry season there has never been a water difficulty on the coast. Such a difficulty has occurred in the mallee country. In the mallee the only way of obtaining water known at present would be by condensing. Possibly artesian water might be struck if bores were put down. There are facilities for irrigation almost anywhere within 10 miles from the coast. The general character of the soil and configuration of Esperance territory is :—(1.) Sandy near the coast ; (2.) in the mallee country, rich loam with clay subsoil ; (3.) the general configuration of this division of the colony is undulating. The country here is sparsely timbered on the coast with paper-barks and yates ; there are also peppermint and eucalypti. Outside the coast is the mallee country ; the land is well timbered. Cost per acre to clear ready for the plough may be estimated as follows :—(1.) £1 per acre near the coast ; £2 10s. per acre in the mallee country. The crops usually grown are wheat, barley, and oats. These are cut for hay, the general yield of which is one ton per acre. The facilities for transport of produce to market are very bad at the present time. Fruit is only grown in a comparatively few places. It has been tried at Fanny's cove. Here grapes, peaches, and figs have been planted. At Esperance figs are grown. Very few other fruits have been cultivated. So far as the experiments in fruit growing have gone fair success has been achieved. Settlement has been progressing fairly well. The co-operation of the Land bank has not yet been sought. The local annual rainfall calculated for the last 20 years is 25 inches at Esperance. The general character of the seasons is good. The average sizes of the selections on Crown lands are (1.) garden areas, 10 acres ; (2.) for farming purposes 150 acres. The land has been taken up by old settlers. So far we have no recent immigration. The chief advantages of the Esperance district are the splendid harbor and close proximity to several of the goldfields, which provide us with an ample market for produce. Esperance is the port of the goldfields. The country between Esperance and the goldfields is of a level character, and presents no engineering difficulties for the construction of a railway ; there is also fair pastoral country between the port and the goldfields. The class of implements in general use are single, double, and treble furrowed ploughs, stump-jump ploughs, and harrows. The Osborne side delivery, and the Massey-Harris reaper and binder are employed and give satisfaction. In



Pumpkins and Melons grown by Mr. W. J. White at Esperance Bay, without irrigation.

the direction of stock raising a fair number of sheep, horses, and pigs are bred. Given a railway, the opportunities for a larger scope of work are good. Dairying is being neglected, and it cannot be said that we do any dairying for market purposes. Vegetables are not grown to any extent at present. Large plots are now, however, being brought under cultivation, and it is hoped that vegetables will be very largely grown. Potatoes do well and are planted. Several of the potato crops at the present time (July 1897) are looking very well. There is Government land suitable for potato cropping available. This land is not nearer than 250 miles to a railway, Coolgardie being the nearest point where the locomotive runs. There are also private lands available for potato growing, but we are unable to give the price and terms which would be offered to purchasers. Frosts are not prevalent and destructive on the coast. Heavy frosts are experienced further inland. The approximate dates of the earliest and latest frosts are May and August, respectively. The Esperance district is adapted for close settlement, *i.e.*, for 10 and 20 acre men, supposing that the market of the goldfields is opened up by the laying of a railway so as to enable garden and dairy produce to be quickly and economically transported there in good order. Farmers are not keeping fowls or bees. From our observation, the chief requisites for a new settler are railway and good roads. The lessons of local experience in the clearing and treatment of the land show that the best results are obtained from fallowing and early sowing. The soil has not yet been sufficiently tested to answer authoritatively the question, 'What fertilisers are best adapted to it?' We can, however, say that liberal manuring from the outset is profitable. There are no eligible large estates open for subdivisional sale, or available for occupation under improvement leases. The only suggestions that we can make for the guidance of new settlers are that they must have some capital and previous experience in agricultural pursuits."

CHAPETR IX.

THE SWAN DISTRICT.

The Swan district, geographically considered, is a large one, extending from the mouth of the Swan river, the York road, or the Eastern railway, on the south, to the westerly course of the Moore river on the north ; on the east to Bindoon and Bailup (or half way from Fremantle to Northam), and to the shores of the Indian ocean on the west. From a producer's point of view the Swan district may, roughly gauged, be said to comprise only the rich alluvial flats of the Swan river in the neighborhood of Guildford, a strip of country that is not more than three miles wide and eight long. These alluvial flats are bounded on the east by the Darling range, and on the west by sandy stretches of coast lands, which up to the present have only been improved by the removal of banksia timber for the supply of firewood for Perth. The flats, with the river frontage to the Swan, were much coveted in the early days of the settlement of the colony ; there were many eager claimants for this fecund spot. Governor Stirling, the arbiter, solved his invidious task with wise impartiality on the partition principle, and gave to each applicant only one acre in twenty-five fronting the stream. The long narrow parallel lines of the first grants made near Guildford are still known as Governor Stirling's "ribbon blocks." *En passant* it may be remarked that the present system of the Lands department, in dealing with water frontages, is to make that frontage one-third as wide as the depth of a block, with the reservation, however, of the water for public purposes. For years no survey has approached nearer than one chain to the edge of a river ; along that chain the public and stock are free to travel. If fences are erected across that reserve they may be lawfully cut down. The "ribbon blocks" on the Swan did not reserve water rights for public use.

The pioneers of Western Australia who set such store by the goodly territory of the Swan did not over-estimate its value and productiveness. More than half a century's experience has fully approved the judgment of those who first trod the forests of flooded gum that had thickly crowded on the kindly soil along the course of the river. The Swan was for years the granary of Perth ; it is now the great orchard ground of the metropolis, and it is equally luxuriant in the heavy crops of cereals and fruit it abundantly produces. The pioneers who sought to dwell in this Arcadia, forecasted its fertility from ordinary observation ; the artesian bore has in later years furnished the geologist with the materials for confirming their conclusions from scientific knowledge. The flats resemble the prolific valleys of the Nile; they are the product of floods that washed from the interior earthy deposits, which, settling layer upon layer in the course of ages, made fat seed-beds that in their transition from their original place had become sweetened by exposure to air and water. In those deposits there was the humus of decaying vegetation, swept from the surface of the tracts over which the floods had raged, and the black loam, with which the flats have alternately been built up. At a depth of 200 feet there have been found boulders of considerable size, showing that, at one time, the flats must have been the bed of a very rapid stream, as the stones had been carried for miles from the ranges, while the presence of the alluvial, to a depth, in places, of 40 or 50 feet, mark the places where, owing to depressions, the stream had coursed more slowly, carrying and liberating as it flowed nothing but mud, which, when dried, became the richest garden mould. It is on the "made" land—made in the manner that has been briefly sketched—that the cultivators of the Swan are able to achieve their greatest success. As soon as you get beyond the somewhat narrow line of the alluvial, there are the gravelly sides of the Darling ranges on the east, and on the west, cold, sandy country, timbered with banksia, which is of no agrarian account. About here the ranges carry the distinctive sign of poor country in the growth of the kingya blackboys, which may easily be identified by a stranger from their single stem, surmounted with a bunch of heads, that are very similar in appearance to a cluster of drumsticks. Where these are seen the place is one that the intending selector should avoid.

"The banks of the Swan," says Mr. Charles Harper, M. L. A. (President of the Bureau of Agriculture), "are highly adapted to the growth of wheat; the river bottoms are remarkable for some of the yields of corn that have been taken off them. I have been told that 400 bushels of wheat were obtained from ten acres, which have been pointed out to me. Of course that land had been, to some extent, manured. Wheat is seldom grown now on the flats; the crops are nearly all cut for hay. The general yield is about a ton and a half to the acre. The upland is not so rich. The flats vary from 20 yards to half-a-mile wide. I should say there are 2000 or 3000 acres of them in the Swan district proper, that is, close to Guildford. All this land is in private hands. It is many years since there were any Crown areas here. The original grantees got the land in consideration of their colonisation efforts in Sir James Stirling's time. Not many of the grants belong to the families of the original beneficiaries. At first, the Swan was almost exclusively a farming district, as it was the nearest place to Perth where suitable land could be got to provide flour for the people. There is still in the neighbourhood an interesting relic of that time. I mean Cruise's mill, which was driven by the water-power of Ellen's brook, a tributary of the Swan. When York was opened as a farming centre, wheat for a time ceased to be grown, because competition came from the eastern districts. It was easier for the York growers to cart wheat (for they had no railway) to the city, than to cart hay. So the Swan growers, still having the hay market to themselves, cut their crops for fodder instead of for corn, and Cruise's mill fell into desuetude. Ellen's brook is only a small stream, and a dam had to be made above the mill to increase its driving power. Cruise's mill did good work in its day, and it was a good investment for its owners, besides being a landmark that must have been very remindful to the English immigrants, of a rural scene at home."

The old grants have not been much subdivided ; there are now new men, but old acres, on the Swan. An exception is the property of Mr. W. D. Moore, which was originally selected by Mr. George Moore. Neither have the grants been extensively improved, except close to the river. There are thousands of acres which have not even been ringbarked. It is expensive to clear them of their forests of red gum, white gum, and swamp gum, and many of the owners are living abroad. "Absenteeism," says Mr. Harper, "is the reason that more has not been done in the Swan district. In other directions, notably fruit-growing, very satisfactory progress has been made. The Swan is a great orchard place now, one of the principal in the colony. Cereal crops are grown, but fruit production takes the pride of place. Latterly," Mr. Harper states, "a great improvement has been made here in methods of orchard cultivation ; old errors are being corrected and knowledge is being enlarged ; new and superior varieties of stocks are being introduced. At one time trees and vines were overcrowded, so that horse power and labor-saving plant could not take the place of the spade ; now the plantations are being laid out accurately on the square, quincunx, or septuple systems, and proper work is done upon them at all seasons of the year. The best soil is allotted to fruit and vineyards, with the result that better fruit is being sent to market. You may hear people say that they used to see finer peaches than they get nowadays, but they forget that they are speaking of the fruit of a special tree, of a superior variety perhaps, or one which had the good fortune to be planted in an excellent situation, and to have been attended to. The bulk sample of the yield of the Swan orchards and vineyards is of a higher grade than that which was formerly sold. Moreover, study has been given to having a rotation of crops in the orchards. I can remember when there was a glut at one time of the year, and none at all for many months afterwards. In the vineyard stocks there has been a marked improvement both in the table and wine varieties. Among the choice sorts that have been introduced, speaking of table kinds, are Knight's centennial, Waltham cross, black St. Peter. Before we got these stocks the standard dessert varieties were white Nice, chasselas, crystal, and Whortley hall and sweetwater.

There were not many wine grapes grown of the better kinds. Now there are many acres planted with carbinet, mataro malbec, besides doradilla, which is an excellent grape, both for the table and the wine vat. It makes superior white wine. All vines thrive on the Swan ; I cannot say that the dessert stocks do better than the wine kinds, but the table crop is certainly very fine. I have never seen choicer grapes, either larger or of better flavour. If anything, the ground is too rich for the wine grape. The crop is a very heavy one, but an earthy flavour in the wine has sometimes been suspected. Perhaps a more gravelly country, with an admixture of lime and ironstone, would grow a more perfect grape for the wine maker. A great deal of wine is made in the district. The largest vignerons are Mr. C. Ferguson, of Houghton, whose cellars are about five miles from Guildford, Mr. George Lennard, also an extensive grower, and Messrs. Nanson & Co."

The Swan district is one of those which are looking forward to the establishment of co-operative wineries in order to prevent a glut of grapes, and to ensure the making of wine of a high and uniform grade on a large scale, under the most skilful treatment and supervision. The scheme has engaged the attention of the Bureau of Agriculture. It is the desire of the Bureau to establish co-operative wineries on a purely mutual basis, so that the producers will reap all the profits of their labor above actual working expenses. The plan that has been outlined by the Bureau is that the capital required to equip a central winery shall be advanced by the State at 5 per cent. per annum, the loan to be repayable in ten years, on the security of the first mortgage over the land, buildings, and plant of the factory, and the joint and several guarantee of all the members in the group. It is also proposed that the Government shall have power to levy a tax upon the vineyards which supply grapes to the State-aided winery in case the interest and sinking fund are not paid within three years. An alternative plan is that advances shall be made by the State at the rate of 5 per cent. per annum for a period of ten years, amounting to ten shillings in every pound of fully paid up capital subscribed by the groups ; the land, buildings, plant, and machinery to be given as security for the subsidy. The proposals of the Bureau received the assent of the Producers' conference, 1896, and at the conference of the following year another resolution was agreed to affirming the desirableness of co-operation among producers. It was urged that in order to prevent the grape market being over supplied, which would result in a serious fall in prices, it was necessary that the growers who do not possess plant and cellars should take steps to provide their own output on terms, which, while being helpful to themselves, would impose no risk of loss upon the State. In the other colonies overstocking had occurred, with the result that some of the smaller vineyards had become unremunerative, and the large vignerons were given the power to rule the market, buying at quotations which they took care to fix low enough to serve their own interests. As a great deal of capital was needed to carry on the making of wine in a manner that would ensure a high class quality of wine, it was not to be expected that every man who planted a few acres of vines could successfully embark in the business of fermentation, blending, and keeping his wine until it had properly matured ; nor was every vigneron skilful enough to make really good wine even under the most favorable conditions. The result was that Western Australian wine had not, like that of France, a distinctive quality and character appertaining to certain districts, and which would enable foreign buyers to give orders with confidence that they would get what they wanted. So far co-operative wineries have not been established. The price of grapes is so good that there is not at present much incentive to see the plan earnestly achieved. There is a demand for all the grapes that are grown, and the growers are, for the time being, content to let well alone, but Mr. Harper utters a warning that there is danger ahead. He says Western Australian vignerons are only repeating the policy of inaction, in not looking ahead to provide a certain market for their grapes, that has proved to be mischievous in California, Victoria, and South Australia. In these countries there was a time similar to that which is being enjoyed on the Swan, when it was only necessary to produce grapes in order to net large profits. But as enlarged and new vineyard areas came into bearing a disastrous competition set in to get the owners of large cellars to take the crop. The capitalists saw their opportunity and took advantage to press rates down as low as 30s. per ton for grapes which, when converted into wine, realised a very handsome profit, after allowing a very liberal margin for working expenses and all charges. The growers, in fact, had to come to the position of working for the benefit of those who were enabled to become monopolists, because those who had grapes to sell were without the means of turning them into wine. Those means could be as fairly supplied to vignerons on adequate security as loans from the Land bank are advanced to the farmer ; but the State is not likely to offer money from the public coffers to assist any of the producing industries unless the need for such is pressed upon the attention of the Government. By and by, when the menace to the vineyards which is looming up assumes a more tangible shape, Mr. Harper says the small grape-growers, meaning those who do not make their own wine, may find that the capitalist is too strong for them. That has been the experience of other places ; the wine-makers who have established a reputation have been able to bring so much influence to bear, owing to their vested interests, that the numerical superiority of the vignerons who have desired State aid have been unable to obtain it.

To illustrate the scope of the scheme formulated by the Bureau, and to show the scope of work that a central winery would have in the Guildford district, His Excellency the Governor, Sir Gerard

Smith; the Premier, the Rt. Hon. Sir John Forrest, other members of the Ministry and of the Legislature, besides a distinguished party of private guests, were on April 3, 1896, conducted on a tour of inspection through portion of the Swan district. The object of the Bureau in arranging the tour was to enable the merits of the proposal to establish state-aided wineries to be better understood by Parliament and by the public. The party were conveyed to Woodbridge, where the large and well-appointed orchard was seen in full bearing. It was much admired as an example of the method with which it had been laid out, its scrupulous neatness and the thoroughness of its cultivation. From the broad verandah of Woodbridge the visitors had a view of the verdant fruit trees, the Swan river, and the sparkling cascade of the artesian bore, which in summer refreshes the thirsty ground. The orchard is planted upon deep rich flats of heavy black loam, and that it can grow all kinds of English fruits to perfection was shown by the splendid samples which the visitors were invited to partake of. The nursery stocks, which occupy several acres, were in a very forward and healthy condition. The party drove to Carlisle, on the west Swan road, the property of Messrs. Nanson, Lindley-Cowen and Despeissis. The site of the vineyard, which is 110 acres in extent, was purchased in 1893 from Mr. Harper, and since that time a wonderful transformation has been made. From a piece of lightly timbered forest land, light reddish and slate-coloured in different parts, it had become a vineyard that might have been transplanted from a sunny slope of France. There were then in course of being broken up, additional acres for new plantations of vines, it being the intention of the proprietors to bring the whole of it under cultivation. The guests were entertained at Carlisle, and the postprandial speeches bore many references to the subject of establishing central wineries. In proposing the toast of "The Ministry," Mr. Harper said that the Bureau had become convinced that, in the interests of the wine industry, which was destined to become one of the great resources of Western Australia, a new departure should be made. It was well known that every man who grew grapes ought not to make wine, and it was desired to give the small grower the benefit of co-operative enterprise in turning out wine of a high class. To make wine properly required a plant which was beyond the ordinary private resources of the small growers to purchase, especially as it was evident that the vigneron should use every pound of his capital and his available labour in bringing additional land under cultivation. Under these circumstances, and in order to prevent a surplus production, which had been the bane of the viticulturist in the other colonies, the Bureau had drawn up a scheme by which it was proposed to ask for a State loan for the establishment of wineries in such districts of the colony as had a large area of vines under cultivation. It was with the object of showing the members of the Government, and as many

FOR DESCRIPTION SEE BACK.

Karri Country, Karridale.

THESE trees grow to gigantic sizes, and share with Jarrah the pride of being the principal trees of Western Australia. The tree on the centre of the plate, "King Karri," measures 160 feet to the first branch, and it is reckoned that the bole of the tree weighs over 40 tons. The area is confined to the more humid coastal region extending from the Hamelin to near Albany. It delights in soil varying from a red sandy loam intermixed with limestone reefs, somewhat similar to that met with in the Tuart country, to deep, dark mould, moist, but well drained.

members of the Legislature as it had been possible to invite, what these so-called second-class lands of Western Australia were capable of in the growth of the vine, that the excursion of that day had been arranged. Those present were sitting in sight of land that he knew well, as it had formerly been his property. While he owned it he had not set a high value upon it for grazing purposes. It was, in fact, land of a character of which the colony possessed hundreds of thousands of acres, and they saw what the owners of Carlisle had made of it. They had shown that the colony possessed a most valuable asset in such land—that, in fact, it grew vines to perfection, if it were properly and carefully cultivated. This fact was of immense importance at a time when special encouragement was needed to induce men to put their money and their efforts into cultivation—a time when people were much more prone to try to get rich at a bound by a lucky investment in mining. The time might come when it would not be necessary to offer such special inducements to reclaim and develop the soil as it was now, but at the present time the Bureau had felt impelled to take some steps towards endeavoring to add to the producing resources of the colony and to turn the public lands to the best account. Especially was this desirable at a time when it was necessary to introduce co-operative effort, instead of leaving the production of grapes and wine to be carried out in the vineyards and the cellars of large capitalists. The question was exercising the minds of vignerons in Victoria as to how they could obtain a proper return for their grapes, without sacrificing too much of the profits by selling to the wine merchants. The question having presented itself to the members of the Bureau, of which he had the honor to be chairman, they had thought it would be well to take the initiative before a glut in the harvest of the vineyards occurred. Having regard to the enormous expense of laying down a wine-making plant, the Bureau was in favor of asking the Government to find the money for district wineries, the loan to be advanced on proper security. When it was remembered that in addition to making the wine there had to be accommodation for storing it, it would be perceived that a large amount of money would be required, more than could be expected to be found by the vigneron. Moreover, the district wineries would, under the management of an expert, produce wine of a first-class quality, which would find its place in the markets of the world. If this scheme was carried out Western Australia would be acting upon the methods pursued in the best wine-making countries, and one that would be calculated to give a stimulus to vineyard cultivation. The great expense of clearing land, tending vines, and waiting for the yield, should be borne in mind, and should strengthen the appeal that it was proposed to make to the Government. There were, of course, some little difficulties to be overcome, but he did not see why co-operative wine-making could not be carried out by this colony in the same way that the butter export trade of Victoria had been built up. He was sure that the turning to account of the large area of second-class land in Western Australia for vineyard purposes would be a great national asset for the colony. Sir John Forrest, in acknowledging the cordiality with which the toast of "The Ministry" had been honored, said that during the time they had been in office the members of the Government had exerted themselves on behalf of the agricultural interests; they had made railways through the cultivable districts of the colony, in order to get the land settled. At one time railways were considered to be all that was necessary to achieve this object, but now that nearly everyone, himself included, was anxious to take some part in mining, it seemed that something more was necessary, albeit the agricultural Land bank had been established and liberal land laws passed. If the Bureau of Agriculture would lay their scheme fully before the Government, he could promise them the sympathy of the Cabinet, even if the Government could not grant all the requests that were made. What Mr. Harper had said about making a valuable national asset of the Crown lands of the colony appealed to him very strongly. What was the use of the 640,000,000 acres of land in Western Australia if they were not turned to profitable account, it they were not made to yield an income. The visitors then drove to St. Leonards, the estate of Mr. G. B. Lennard, about five miles distant, and were shown over an excellent and well-developed property. Forty-five acres of vines were seen in superb condition. St. Leonards, which is replete with all the modern appliances for carrying on farming on a large and successful scale, is most picturesquely situated. The energy and competent direction of the owner are apparent in every feature of the place, which is one that Western Australia may be glad to exhibit to visitors. An olive-shaded avenue leads to the commodious homestead.

A very enjoyable and instructive day may be spent in a tour around the Swan district, and in the inspection of the various valuable properties which nature and art have combined to render delightful places of residence, and notable examples of the productive capabilities of Western Australia. Almost adjoining the Guildford station on the north is the Caversham estate, which belonged to the late Mr. R. de Burgh, and which in response to the demand for country homes within easy distance of the city, and possessing great natural advantages, is being made the site of what will soon become a fashionable suburb of the capital. The design is that here shall be laid out orchards and vineyards, and small but highly improved pasture lands, as the adjuncts of the homes of prosperous professional and mercantile men, where rural sights and sounds shall exhilarate the spirits and restore the tone of languid nature. The lead has been taken in this direction by Mr. Robinson, whose bijou villa will occupy a very picturesque situation. On its western boundary is an important heritage of the Hamersley family, and which is entailed upon the elder son of Mr. Edward Hamersley senior. On his death Pyrton, as the place is called, passed to his son Hugh, who has been engaged in farming on the Greenough flats of late years; hence the property has not been kept in the perfect order which used to distinguish it. In Mr. Edward Hamersley's time Pyrton was known as the most carefully managed property, and the most highly improved of any to be found on the banks of the Swan. It contains orchard, vineyard, and arable lands, all of which were models of what skill, supervision, and money could do in creating a domain that was fair to look upon and profitable to own. Above Pyrton is Mr. James B. Roe's location; here we see a young and flourishing orchard, but hardly yet in bearing, the trees having only been planted within the last year or two. An old vineyard marks the site of the effort of one of the pioneers to replace the flooded gums with luscious fruit. Another vineyard that has fallen into decay is that of the adjacent estate of Mr. W. Harris. Still following the west side of the river a glance is had at Mr. Lennard's; Messrs. Nanson & Co's (which has already been referred to); West Oakover, Mr. W.D. Moore's and Mr. Chester's freeholds. Henley Park, belonging to the Hon. H. J. Saunders, to which the visitor now comes, is a very fine property. A considerable sum has been, and is being, expended in its development, especially in clearing operations. Mr. Saunders so recently acquired Henley Park that he has not yet had time to bring all his schemes for its improvement to fruition. In time, when his designs are perfected, there will be a large orchard and vineyard stocked with the best and rarest varieties of trees and vines. The soil is a sandy loam on a clay bottom. The merit of the land is that it remains friable when it is broken up. On the east side of the river, at the head of the Swan river flats, and the foot of the Darling range is Belvoir, owned by Mr. W. T. Loton, who for many years represented the electorate of the Swan in the Legislative Assembly. He retired when Parliament was prorouged at the beginning of 1897, in consequence of the passing of the Redistribution of Seats Bill, having rendered an appeal to the country necessary two years before the life of the Assembly would have expired by effluxion of time. Belvoir is at the head of the Swan, that is to say, a few miles below the point where the stream emerges from the hills. The estate is not one of the most fertile to be found in the district, a good deal of its area being of a light sandy character. Close to the river good crops are obtained, but most of the estate is devoted to grazing. Some dairying is done there, but only during the winter and spring months; the milch herd is not artificially fed, nor is ensilage prepared for the summer. The stock comprises choice Ayrshires, to the importing and breeding of which Mr. Loton has devoted much attention. A great deal of clearing has been done at a liberal outlay. On the face of the range, to which the property extends, there are excellent natural grasses. Where the land has been cultivated the indigenous grasses disappear, and their place is taken by dandelion and other imported weeds, on which stock thrive. The trefoil, commonly known as clover, is the best of these plants. The adjoining property is Mr. Padbury's, which has been extensively cleared. For many years money has been freely laid out upon it, and a great deal of hay has been grown upon it. An orchard has been planted. Another estate, which is associated with the name of one of the earliest colonists of the west, is the one on the boundary of Mr. Padbury's, going south. This is the estate of the late Mr. William Brockman, who bequeathed it to his daughter, Mrs. De Courcy Lefroy, and it is now under the management of her son. The lands are chiefly used for hay-growing and grazing. The property almost entirely consists of rich flats, and a considerable area has been cleared ; the uplands are also of good quality. Nearly opposite them on the river are the broad acres, intersected by Lion's brook and Ellen's brook, that belonged to his Honor Mr. Justice George Leake. On the death of his honor, the place was purchased, with the old Cruise's mill, that is so full of associations of the first colonising experiences in Western Australia, by Mr. George Lennard, who is actively engaged in further reclaiming and cultivating the ground. In this neighbourhood is Oakover (Mr. W. D. Moore's), and the Protestant orphanage, the grounds of which are one of the earliest grants of land which the Crown made for public purposes. The institution, which was long under the admirable charge of the late Canon Brown, has some acres in an advanced state of tillage. The orphanage, which has a subsidy from the Treasury, observes the best systems in laying out and tending its vegetable and fruit gardens. Above the orphanage is the vineyard of Mr. C. W. Ferguson, one of the largest and best kept in the colony. Nearer Guildford, a large area of excellent land, on the river frontage, represents the freeholds of Mr. S. H. Viveash, and adjoining Woodbridge there is an estate that belongs to Mr. North, brother-in-law to Lady Forrest.

The Swan district is thus described by one who, as a large cultivator and an old resident, speaks with authority upon the subject :—" The richest lands, that is those on the flats, were in their virgin state equal to any in the colony. No larger crops have been produced anywhere than those which came, for example, from the land of Colonel Irwin, which is now Henley park, in the hands of the Hon. H. J. Saunders. The park was one of the greatest hay producing farms in the west, but it is not all of the quality of the fringe of the river banks. There is a part of it sand, which grows jarrah, a fact which is worth mentioning as one of the characteristics of the district. The theory which some people hold that the jarrah finds its habitat only on the ironstone, is not tenable. It is true that jarrah prefers ironstone, and never grows so large where this formation is not found ; but the tree grows more or less thickly on some sandy stretches within fifteen miles of the sea, not only near the Swan, but also in many other places further south towards Bunbury. The sandy land about the Swan has one advantage over the heavy loams of the river bottom, which are liable to bake in the height of summer and allow the moisture to rapidly evaporate unless continually cultivated. The lighter soil where the jarrah is found, on the other hand, is always loose when it is worked, and it makes up in this respect for some of its inferior fertility and strength as compared with the flats. These flats have great stamina ; although there has been very little interval in almost continuous cropping for many years, the ground is to-day very productive. It is only now that fertilisers are being used. The flats grew flooded gums ; on the east side of the river there is no jarrah, red gum takes its place on the lighter loams. There are also some white gums on patches of stiff red soil. In this district the white gum country is very good for wheat. The flooded gum is much more difficult to kill by ring-barking than the red gum, owing to its tenacity in throwing out suckers. The ironstone on the ranges hereabout is not of the rich quality that is found about Pinjarrah and Drakesbrook ; it is poor and hungry, and not good for anything. There is no estate on which all the land is of the best kind ; the division of the river frontages was too equally made to allow of that, but some of the freeholds have more of the best country than others. There has been a gradual dimunition in the rainfall of the Swan during the last 30 years, but still we cannot complain of not having enough. Up to ten years ago floods were of occasional occurrence ; they were caused by heavy rains in the interior ; the local rainfall was never sufficient to cause the Swan to inundate the country. There was a danger of total loss of crop through floods in those days. The crops then, with a larger rainfall, were not as good as those which are reaped now that the rainfall has become less. More moisture is not required for the growing of cereals, but some of the orchards would do much better with irrigation. The citrus family would especially be greatly benefitted, but ordinary English fruits can be well matured without an artificial supply of water. The apple does very well on the flats, when it is left to depend on the rainfall, and it does fairly well on the uplands without irrigation, as the uplands hold the water for a long time—longer than the heavy loams on the margin of the stream."

In the neighborhood of the Swan river five artesian bores have been put down with most successful results at varying depths. The discovery that artesian water was obtainable was first made by the Railway department on the site for the new locomotive work-shops, at the Midland Junction, two miles from Guildford. The water was struck at 490 feet, and a daily supply of 256,000 gallons is obtained from it. Mr. Charles Harper, M.L.A., of Woodbridge, was the next to essay the task of obtaining the benefit of an artesian supply for the irrigation of his extensive vineyard and orchard grounds. He had the satisfaction of getting 170,000 gallons per day at a depth of only 170 feet. The supply is used all through the summer, and in the rainy season it is shut down by means of a tap and plugs. The third bore was put down by Mr. H. E. B. Gull, close to the Guildford station ; the fourth by Mr. James Morrison, to a depth of 690 feet, on the bank of the Helena river, which flows into the Swan at Guildford ; and the fifth by Mr. H. Hamersley, who had to go the deepest of all, namely, 760 feet. The bores were all started with a diameter of 10 inches at the surface. The water from Mr. Gull's has already been used for irrigating his fruit trees and vines, but so far arrangements have not been perfected for conserving the supply during winter ; it now runs to waste when it is not wanted in the vineyard and orchard. The bores on Mr. Hamersley's and Mr. Morrison's properties are expected to be applied to fruit growing during the summer of 1897. The artesian water is impregnated with iron, but it is not unpleasant to the taste, and so far as observation has shown during the comparatively short time it has been used for irrigation purposes, its chemical composition is not disadvantageous to the vineyards and orchards. The Government are assisting the municipality of Guildford to put down an artesian bore for the service of the inhabitants of that town.

In reviewing the questions tabulated by the Secretary to the Bureau of Agriculture for the collating of information of value for the purposes of the GUIDE, Mr. Charles Harper, M.L.A., President of the Bureau, courteously furnished the following notes in the course of an interview accorded to the reporter :—"The roads throughout the Swan district have been cut up by the hay teams, and are not as a rule in good order. The main road through Guildford is of course an exception to this criticism, as it is attended to by the town council of the municipality. The country highways running, as they do over a soil that is not good for the carriage of traffic, are much in need of forming. The only forming that has been done is along the sandy patches, which would have been impassable had they not been metalled. The loam or clay tracks having been left to a state of nature, are in a bad way, the Government grants being inadequate to enable the roads board to keep them in order. It is difficult to get road-making material in the neighbourhood of the Swan, which accentuates the trouble. A bridge is wanted between the upper Swan and what is called Barker's bridge. As to how much capital a man should have in taking up land, I am convinced that the same should be not less than £1 per acre, if he is going in for general farming. The case would be different if he were about to lay out an orchard, for when he had planted his trees he could, while waiting for the fruit, work for wages or on piece-work jobs to pay expenses. But if he is to make a success of farming he must keep on clearing ; he cannot leave that work to earn money, without neglecting his own place. If he has need to work for wages, he is better off the land than on it, for he will not get a fair chance to make his holding profitable. A piece of land when first selected requires, at least, all the work of one man to make anything of it. With every desire to see the land settled, I think people would be ill-advised to select if they have not some means which will pay expenses and support them while they are getting their ground in going order, and enable them meanwhile to give all their energy to that work. They should at least have enough to buy implements and horses, and tide them over a year. In the southern district, where a tolerably large piece of land would be needed, in order that a little grazing might be combined with cultivation, I think £500 is little enough for an applicant to have in the bank. For working a garden block for fruit and vegetables, for which the south-west is so well adapted, a much smaller sum would suffice, because intense culture would allow of a small block being handled with profit. I know of one instance in which a man working on an orchard of his own in his spare time and doing outside labor, has prospered very well, because he is able to bring his place up to a state in which it can have a rest and be improving all the time he is engaged elsewhere. But there is no resting time on a farm, every year, a farmer, if he is to do any good, wants more land to cultivate.

"Speaking of the market for produce, fruit and vegetables are sought for by buyers' travellers. Hay and chaff have of late readily found a buyer at remunerative prices ; but I have known the market to be fully supplied, or even more coming to hand than was immediately required. The farmer has to seek for his buyer ; the orchardist and the vegetable grower find the purchasers come to them. Just now (July, 1897) there is a scarcity of fodder in consequence of growers being engaged in farming operations, and not having time to cut their hay into chaff, and also of the dry season that has been experienced in the eastern colonies. I believe chaff has lately been sold at £9 per ton. A few years ago it brought £10 per ton. The time is coming, through the large areas of land that are being cleared, when fodder will decline in price. I would counsel growers who are not close to a railway, to cut their wheat crops for wheat during this year's harvest, for it is probable that wheat will pay as well, if not better than hay. At any rate, the wise course to follow would be for some of each crop to be cut for wheat and some for hay. It should not be forgotten that before the goldfields were discovered prices for fodder were low, and that the demand, at the present yearly rate of the increase of production, will sooner or later be again overtaken. On the other hand, the market of the colony is the best one I know of for farmers, and they now enjoy what the early settlers did not, an enormous advantage in the extension of the railway service. I do not, however, regard the tariff of freights as an indulgent one for farmers.

"It is hard to say what the Swan district will grow to the best advantage, but you may take it that the two things that pay best are those which are mostly grown, namely, fruit and hay. These grow excellently. I would not put one before the other in estimating the fertility or productiveness of the district, because we have a great variety of soils which produce both fruit and cereals to perfection. I would answer to your question that orchards and crops, whether cut for wheat or hay, never fail, and are very profitable on our rich alluvial flats. Of the crops that should be avoided, lucerne is one. It does not succeed here, probably because there is not enough lime on the made lands. The soil is also rather too stiff to suit that plant. Moreover, the climate is too dry in summer, when, of course, maize should be grown, to allow us to grow it to advantage. Nor, speaking generally, do potatoes thrive. The strong land is too stiff for them, and the sandy land too poor to yield a heavy crop. There are spots where potatoes do very well, but these are the exception. It is evident that the district is not well suited for potatoes, or potatoes would be largely grown so near to the metropolitan market, and they are not largely grown. Farmers find out very quickly what they can make the most money out of—that is, what will grow best. The experience of the Swan is against potatoes, for the price they realise affords every encouragement to grow them. I do not think they are ever sold at less than £10 per ton. But I should add that when potatoes are grown on the Swan they are of remarkably good quality and first-class keepers—that is the spring crop. The early rose variety is the kind which thrives best.

"The land does not quickly exhaust itself—not the good land, and the inferior is hardly touched. The rich paddocks have been cropped for many years without the aid of manuring, but they have to some extent been fertilised by the grazing of sheep. Bone dust is now being largely used; it is obtainable at a reasonable rate. A few years before so many large Queensland preserving factories were established, bone dust was very scarce and cost £7 per ton; it is now £5 per ton, and of better quality than that which used to be in the market. This fertiliser is creating a revolution in the agricultural industry of the district. When artificial manures were not obtainable there was necessarily less production. You could not get guano, and it does not suit the Swan as well as bone dust. At the time of which I speak the concession under which the Messrs. Broadhurst and Neil remove guano from the Abrolhos islands had not been granted. The 'live guano,' which was excellent, could only be obtained from Sharks Bay in small quantities, where the deposits are limited. Bone dust, so far as I know, is suitable for a larger variety of soils than guano; it is quicker in its action. Thomas' phosphates are being largely tried this year, more largely than ever before.

"Many of the local cultivators are also sheep farmers. They buy store sheep from the north, but the supply of this stock is not equal to the demand. The reasons for this are that during the last ten years people in the south have given up the breeding of sheep and cattle, while drought in the north has reduced the number there.

The result is that store stock is very hard to get. If store sheep can be purchased at a reasonable rate, it is very profitable to fatten them on the Swan. Mr. Lefroy gets them from his own stations in the north. Sheep do very well on the stubble, and also on the scrub country when it has been burned and the first rains fall. The scrub will, however, only burn every second year.

" The only native pests here are parrots in the orchard ; parrots do so much mischief that if a man can afford it the netting in of vines and fruit trees, to protect them from the birds, will return its cost pretty nearly in the extra returns from the crop the first season after the precaution is taken. I have some ground netted. It is the right thing to do while muscatels for table grapes bring fourpence per lb. We have to contend with poison plants also on the eastern side of the Swan. The western side is free of this danger. At some distance back from the river, at the foot of the range, there is a considerable amount of poison, of the kind known as black adder poison. It is similar to the York road poison, and is the only variety of noxious vegetation known in the Swan district. The plant gets its name through growing along the banks of the Black Adder creek. The infested places are fenced off, and stock cannot be depastured there at any time of the year. The creek forms one of the boundaries of Woodbridge, but only for a few chains, when it empties itself into the Swan. The land where the poison grows is private property ; it is poor country, and not of much use even for grazing, supposing it were clean. The locality is hilly. The stock is more likely to eat the poison when it shoots green after a fire has been over it ; but it would be fatal if eaten at any time. Miles of country along the foot of the range is infested. The range rises to a maximum height of 1100 or 1200 feet. On the whole the Swan is a very healthy district for stock ; they do not require a 'coast change' when they are kept there any length of time. They do not get at the poison, as they are all kept in clean paddocks ; nothing is being done to eradicate the poison, as the country where it grows is so inferior that it would hardly pay for the work of grubbing.

" The extent of arable land in one stretch to be found in the Swan district would measure 500 or 600 acres, if the boundary fences of different owners did not intervene. Henley park has 120 or 130 acres of first-class arable land in one block. Mr. Lennard also has some fields of about 100 acres, and so has Mr. Padbury. The country round about the Swan has plenty of water if it is tapped, but not much on the surface. There are springs along the banks of the rivers. As you go back on the west side you get ti-tree swamps. In parenthesis I may say that these swamps, even if they were drained, would not be very good for garden cultivation. The springs are sweet water, fit for human consumption. There is an excellent spring at Henley park from which the household water is drawn. The Swan is a well-watered district with its artesian supply, which no bore that has been put down has ever failed to tap. There is no water difficulty in a dry season. Well water can be struck at a depth of from 6 to 40 feet, but sometimes it is slightly brackish. There are no facilities for irrigation, except from the artesian bores. The Swan is not serviceable for summer watering, because at that season its level is so low that the sea water enters its channel, and impregnates the stream as far up its course as Guildford. We have no timber that is of any commercial value. Along the river flooded gums used to grow, and behind their fringe, red and white gum. The cost of clearing land ready for the plough is from £2 to £10 per acre.

"The fruits grown on the Swan are all the English fruits, with the exception of plums and most of the berries, which do not thrive. The Japanese plum does very well, and strawberries also in places. The latter need a very rich soil; they want irrigation; left to the rainfall, the district is too dry for them. The citrus tribes decidedly do better on the hillsides than on the flats, which are eminently suited to the pear, and the apple, better than to the apricot or the peach. The stiff black soil of the flats is liable to crack in the summer and let the moisture escape, which militates against some kinds of fruit. The sandy areas back from the river are, through being more friable, better in this respect, but are hardly rich enough to do justice to orchards.. There is no inferior sandy land on the Woodbridge estate. Tropical fruits, such as mangoes, are not produced on the Swan.

"The Swan district is capable of producing 25 bushels of wheat to the acre; I have grown 28 bushels per acre on small fertilised fields. When manured, two tons of hay per acre is harvested on the river flats. The Government railway gives us excellent facilities for transporting produce either to the Perth market or to the Yilgarn goldfields. The Midland railway is useful for carrying stores, implements, and other goods to the farming places along its route, but it is not much used for conveying crops to market.

"The rainfall of the Swan is about 26 inches per annum. This quantity would do far more good if it were more evenly distributed. We get a very heavy fall during July, August, and September, and hardly enough before and after those dates. It would be better if we could get the autumn rains in March or April instead of in May, and sometimes in June. A few more thunderstorms in summer would also be very beneficial. So far this season —1897—has been an excellent one, rain and sunshine alternating, so as to enable the crops to get very forward and promising.

"The chief advantages of the district are proximity to the capital, a good climate, fairly sufficient rainfall, railway communication, and fertile soil. The best modern farming implements are in use. There is not much done in stock raising—only in stock fattening. It does not pay to breed stock so near market, the feed is too valuable, and so is the land ; enough stock cannot be kept tó make it profitable to wait while young stock are coming on. The ground will keep nearly the same number of full-grown sheep and cattle, which only need a few months to top up for the butcher and bring in a return. There is more profit in the turnover represented in successive drafts of store stock fattened than in rearing one lot of calves or lambs in the same time. This will be better understood when it is stated that the frontages to the Swan are worth from £15 to £25 per acre. There are none for sale, but that is what the choicest parts of the various estates on the river may be fairly appraised at. For the same reason there is no room for settlement, as the word is ordinarily understood, on the Swan. The district is becoming a place where city people are providing themselves with country residences, and garden and orchard blocks. Near Guildford there will be a fashionable suburb of Perth. At the same time, as one of the oldest and most productive centres of the colony, it stands out as a place where the experience of cultivators and graziers is valuable as a guide for those who are going to newer divisions to do what has been accomplished on the Swan. Even here there is opportunity for a larger scope of work, for all the best land is not under cultivation. A great deal of clearing and other improvements are being done, although some of the estates are at a standstill. The Land bank is not being applied to for means, because the properties, having long been improved, are profitable to work, and, moreover, they are in the hands of men of means.

" Dairying is being neglected. If there had been no factory system in the eastern colonies, more dairying would have been done in the west. The factory system and the export trade of Victoria, New South Wales, and South Australia are too well organised, supported as they are by natural advantages, to permit of profitable competition. The butter made by the process of refrigeration on a wholesale scale, and of the best quality shipped to Western Australia in cool chambers and carefully packed, hardly admits of profitable local competition. The land that is well enough grassed to keep cows as they should be kept, is too valuable to use for that purpose. It is more lucrative to fatten stock upon it to keep up the meat supply. Even if land were largely laid down with English grasses meat would pay better than butter. There is very little cleared land of good quality that can be spared from the raising of cereal crops. I do not see any prospect of a change in this respect ; first class pasturage will always be wanted to maintain the meat supply of the people. It is better to import butter than meat, because live stock deteriorates on shipboard, and butter, if it is properly carried, does not. Vegetables are grown on the Swan to a considerable extent. The gardens are not very large, but some of the crops are marketed. Most of what is sold goes along the Midland line to Champion Bay, very little to Perth. Fruit is also grown for sale. The Swan flats are not altogether suitable for growing vegetables; it is not wet enough when the winter rains are over. When we get more artesian bores for irrigation purposes there will be a good time for market gardeners, if any of the land owners desire to go into that enterprise in a big way. There is no Government land available for this purpose, and no one that I know of desires to sell blocks to introduced settlers who are looking for a site where they can carry on intense culture.

"Frosts are not prevalent and destructive. They occur mostly at the end of June and beginning of July, and harm potatoes and tomatoes. Frosts are only of occasional occurrence. I have known frosts to come in May, and to be as late as August, but this is exceptional. Fowls and bees are not attended to as a source of income. Some poultry and a few hives are to be seen on many of the farms. From my experience as to the chief requisites for a new settler I should say that he should have plenty of energy and industry, and of tough moral fibre, so as not to be easily disheartened by difficulties. He should be thrifty, and have a thrifty wife—a good manager of household affairs. Of course sobriety is understood to be an essential on the part of a selector without naming it. A man well-furnished with the advantages enumerated should be cautious in choosing his holding. If he gets a fairly good piece of country he should have nothing to fear as to making ends meet at first, and adding something to his income in every subsequent year. As to the crops which he should grow, that would depend upon the characteristics of the soil and climate, and distance from a railway station, and from his market, wherever he may be settled. It would be a safe general principle to lay down on this head that he should be guided by the practice of his neighbours and imitate the most successful of them.

"The lessons of local experience in the Swan district are that it is cheaper and better to ringbark the land and allow the trees to decay before the grubbing is done. When the trees are as dry as tinder they can be burned off, and the fire will follow the roots underground and remove them more cleanly than if they have been grubbed. If the clearing is deferred for five years after the ringbarking is carried out, fully thirty per cent. can be saved in getting the land fit for cultivation. It is necessary to apply manure with judgment, as it would be easy to so enrich some naturally good land that the crop would fall of its weight before it was ripe enough to cut. Hence, although the use of fertilisers is to be recommended, they require to be applied with judgment. I have used Thomas' phosphates on a crop this year that is growing and looking very well. When it is harvested it will add something to the data that is being collected by the Bureau of Agriculture to show which is the cheapest and best fertilisers to use on certain soils, and the quantities which suffice to obtain a satisfactory result on different kind of soils in the various divisions of the colony."

CHAPTER X.

THE MIDLAND DISTRICT.

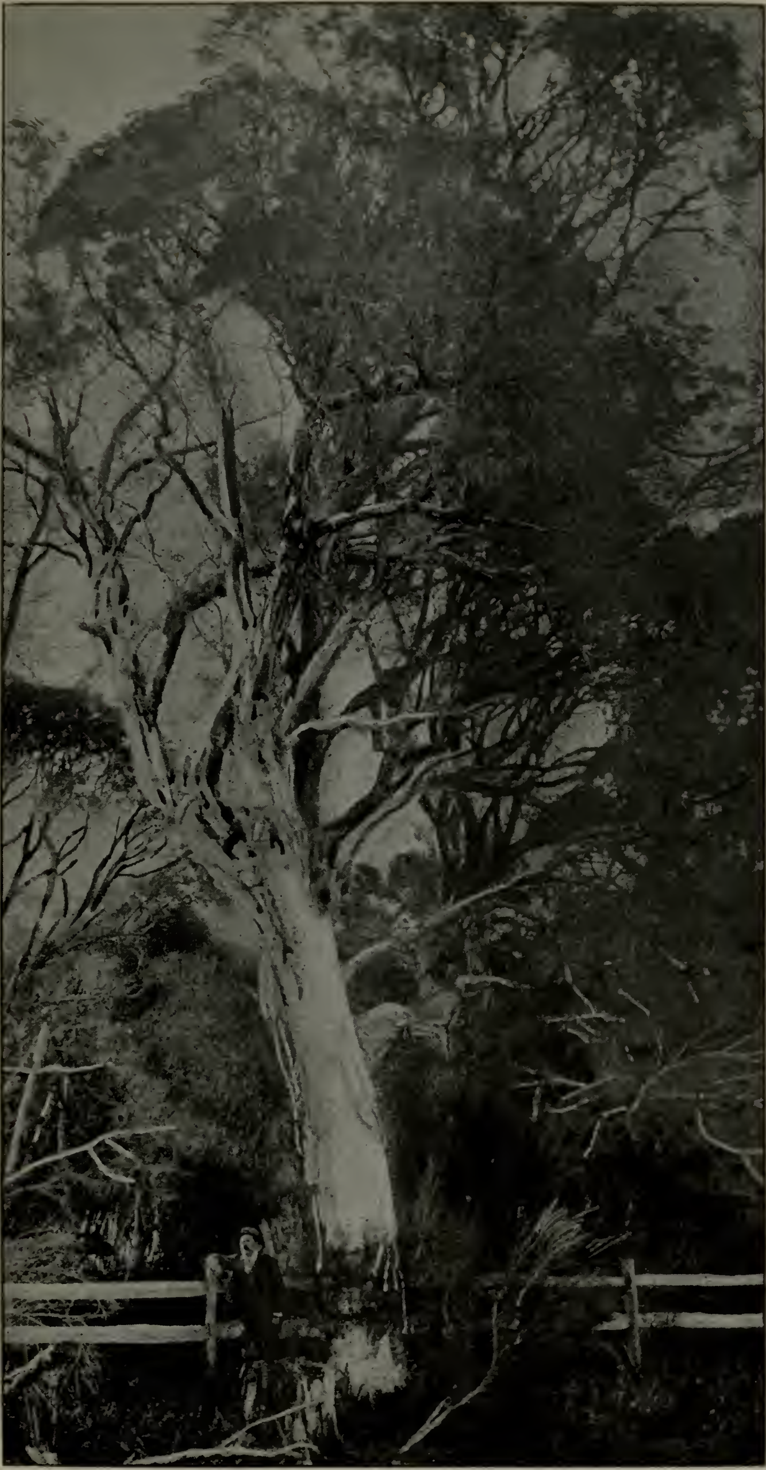
In our notes of agricultural areas in the Midland district we shall glance at the country traversed by the Midland railway from Gingin to Walkaway, and the remainder of the northerly portion of the South-west Land division, which includes Mullewa, Greenough and Thompson's Flats. On the map the part of the colony which for convenience of reference is being termed in this hand-book the Midland district, includes part of the Swan country, and the whole of the Melbourne and Victoria territory that is deemed to be fit for cultivation purposes. To the eastward of the northern portion of the South-west Land division lie nearly half of the geographical boundaries of the Victoria district, but this eastern half need not be considered in a SETTLER'S GUIDE, because the land is not suitable for settlement, and is the site of the Yalgoo goldfield. The Yalgoo country would be remarkably fertile if it had a certain rainfall, but it is a dry area where a crop could not be counted upon. The land is lightly timbered ; the soil is of the richest chocolate loam ; if it could be watered it would be a magnificent tract for the production of cereals or fruit ; it is undulating enough to secure perfect drainage without being hilly and difficult to work ; in a word, it has every gift of Nature except that of rainfall, which renders all the other gifts useless to the yoeman, and therefore it is outside the pale of further description for our present purpose. To the south of the Midland district, between Gingin and the river flats of the Swan, which formed the subject of the previous chapter, there are about 30 miles of country which may be passed over with the remark that much of it is inferior, and that the good spots are already occupied. By beginning our journey of inspection at Gingin we get fairly into the country for which the Midland railway company furnishes us with a distinctive title and a text for a few necessary words of explanation as to the history of that company, which has had an important bearing upon what those who are most familiar with the locality describe as a retarding influence upon settlement between Gingin and the Irwin river.

The Midland railway, which is 277 miles long, was constructed on the land grant system by an English company, which in 1886 was granted 12,000 acres of land for each mile of the railway, or about 15,000,000 acres in all. The conditions were that the grants should be selected within 40 miles on either side of the line, the frontage to which was to be equally divided with the Government. Before the line was completed the company found it necessary to borrow

£500,000 from the Government upon the security of the property and of a mortgage embracing 2,400,000 acres. The mortgage provides that the Government shall have power to foreclose in event of the company falling in arrears in the payment of interest to the extent of £20,000. There has been some dissatisfaction on the part of the colony, owing to the lands granted to the company not having been settled. Since the company executed its mortgage to the Government there has been no disposition to sell the grants, and it has become a matter of complaint that farmers cannot enlarge their holdings, nor pastoralists obtain any security of tenure for their leaseholds under the jurisdiction of the company. The reason the company is not anxious to dispose of the estate is explained by one of its representatives as follows :—" If we sell the land we shall have to pay the proceeds into the Treasury ; people only want to buy the best spots, and, while our affairs are pending re-construction, we do not want to be left with only the inferior residue of our lands." The matter was brought before the Legislative Assembly by Mr. H. B. Lefroy, member for the Moore, who has since accepted the portfolio of Minister of the Post office department and of Education. Mr. Lefroy moved that the Government should foreclose as soon as they were in aposition to do so, and that fair consideration should be paid for the interests of the company. He said :—" My reason for bringing forward the motion is that a large quantity of land between Perth and Geraldton is locked up from settlement through being in the hands of the Midland railway company. I have no other reason for the motion than to see the land thrown open for selection. . . . In the year 1886, when this concession was granted, it was understood that it was granted for opening up the lands of the Midland district. It was granted for no other purpose but that of encouraging settlement to improve the national estate ; but, up to the present time, the company has done nothing whatever in the direction of settling those lands. The whole belt of 80 miles, stretching from Perth to Geraldton, has been virtually locked up for 11 years. . . . Here we have a company having in its possession 2,400,000 acres of what is undoubtedly the best land between Perth and Geraldton, and the company will not do anything with it. . . . It was generally understood when the scheme for this railway was approved by Parliament, that the building of the railway was going to open the country for settlement. . . . We are needing people to settle on our lands, in order that the agricultural population shall, as nearly as possible, keep pace with the mining population. . . . It will not pay to purchase land from the company at from £2 to £3 per acre for the growing of cereals, when similar land can be obtained from the Government on the other side of the line for nothing. . . . It is in the interests of the people, not only in the district I represent, but of the whole colony, that something should be done to open up the land between Perth and Geraldton.

The company has not sold any land, because it will not sell except at exorbitant prices, at which it will not pay people to buy the land and settle on it afterwards. . . . When this concession was granted the company led people to suppose that it was going to encourage settlement, and, in fact, there was a clause in the contract by which the company bound itself to introduce five thousand immigrants. That immigration clause was erased, in some way or other, but still the principle sticking out from every part of the arrangement from the very outset, was that this railway was to be built for the benefit of Western Australia, and not alone for the benefit of the people who built it. We were to get people on the land who were to become producers. There are plenty of young men anxious to settle on the land. A small area of country has been marked out as an agricultural area by the Government, and to show that people will acquire land there I desire to state that nearly the whole of that area has been taken up. That area lies along the Midland line, south of the Moore river. This is a proof that if the Midland railway company was trying to dispose of its land they would soon get a great deal of it settled ; but in that case the company would have to part with it on terms very much lower than it is asking at present. The position of the settlers along the Midland railway is different from that occupied by the other people of the colony ; people who hold leases under the company have to relinquish three months' notice to quit." Mr. Phillips, the member for the Irwin electorate, which is included in the Midland district, said :—" We have now waited some ten years for the settlement of the company's lands and, speaking for the people of the Irwin district, which I represent, it has been a terrible blow to that district through the land being locked up so long. We have lost the bone and sinew of the place, as the farmers' sons have had to go elsewhere and find a living because they could not obtain land in their own district. I can see that the Government cannot do anything until the agreement expires, and I should like to know when it does expire." Mr. H. W. Venn (Wellington) said :—" The action of Parliament in reducing the price of all Crown lands has mitigated against the company selling its land, because if the Government land was equally as good as the company's land, those seeking settlement would go on the Government land preferentially, on account of the terms. I do not say the legislature did wrong in lowering the price of land for the purpose of obtaining settlement, as that was a just thing to do ; but we must remember the company based its calculation on the then price of Government land, and they could not reasonably have expected that as the country became more settled the land would get cheaper. The country is progressing. The company will have a better opportunity of dealing with its land than it has had in the past." The motion was withdrawn after the Premier had informed the House that on the date on which the question of foreclosure was discussed the company was not in default to the full extent of £20,000, which would allow the penal clauses of the mortgage to be brought into operation. On enquiry the reporter of the Bureau learned in July, 1897, from a leading official of the company, that the company was likely to be unable to keep their account with the Government square, unless they were able to make some fresh arrangements in London, and that negotiations with that object were then in progress. The following figures showing dealings with lands of the company have been supplied from their Perth office :—Total land subsidy to the contractor who laid the line, and others for services rendered in connection with the affairs of the company, 3,324,000 acres; mortgaged to the Government, 2,400,000 acres; lands disposed of, 821,077 acres ; free unencumbered lands, 102,943 acres. After the mortgage to the Government was executed, the company had 924,000 acres outside the operation of that lien. The references which have been made serve to show why the Midland is not a great producing district supporting a large population, and also throw light upon the opportunities that are still open in that quarter for immigrants to obtain suitable farming areas on the Crown lands adjoining the railway and grants. It has been the experience of all the colonies, as well as of Western Australia, that population attracts population to a certain district, and that where there are large closed areas the tide of settlement is borne to some other destination. The shutting up of 15,000,000 acres between Perth and Geraldton, owing to the Midland railway belonging to a private corporation, has diverted attention from the adjacent Crown territory that is open for settlement. The railway, which was opened for traffic during November, 1894, runs in a northerly direction from the Midland junction, on the Eastern railway near Guildford, to Mingenew, a distance of 217 miles. From Mingenew the course of the railway is due west for 36 miles to Dongarra, the commercial centre and seaport of the Irwin river district, thence north along the coast for 24 miles to Walkaway, where it joins the Government line laid between Walkaway and Geraldton, the port of the Yalgoo and Murchison goldfields.

Arriving at Gingin, the visitor will see, within a few miles of the station, not only one of the choice garden spots of Western Australia, but the place where oranges grow larger and of better flavor than anywhere else south of the equator. The estate is known as Cheriton, and is the property of Messrs. Edgar Wedge and Co., one of the proprietors being Mr. Charles Harper, of Woodbridge, the orchards and nurseries of which have been briefly described in the chapter dealing with the Swan district. The Cheriton orangery was planted about 40 years ago by the late Mr. W. L. Brockman, and some of the trees are now 40 feet high, and of a diameter in the trunk of 4 feet 6 inches, the fruit having to be gathered by the aid of long bamboo ladders ; the yield is annually between three and four hundred dozen per tree. Mr. Brockman found, indeed, on the banks of the Gingin creek, what



FOR DESCRIPTION SEE BACK.

Paper Bark Swamp.

A GOOD representation of a Paper Bark (*Melaleuca Leucadendron*) thicket. These swamps, when cleared and drained, are extremely fertile. They are found all along the coast line from Geraldton to the Leeuwin, and are not always so thickly timbered. Much sought after for vegetable gardens whenever they are within easy reach of a railway line.

has been described by a professional orchardist as an ideal spot for oranges and lemons; but it is superflous to quote the testimony of experts in the face of the results which the ground has achieved. It is worth while, for the tutelage of new men, to examine into the natural conditions which have contributed to the achievement of such conspicuous success at Cheriton. In the first place the soil on the margin of the creek is of the richest alluvial loam, 14 feet or 15 feet deep; the water of the creek is used to irrigate the trees in summer, and they are excellently sheltered by the surrounding forest, which has been saved from ringbarking in order that it may act as a breakwind. The soil, which is rich and warm, is over a limestone formation, which is more noticeable on the caps of the surrounding hills, where limestone appears on the surface. The orangery is irrigated from a dam or reservoir communicating with channels leading down the slopes between the trees, which have grown so large and were planted so closely together that the branches overlap each other. A larger area has been planted with apricots, oranges and lemons, by Messrs. Edgar Wedge and Co., and one also by Mr. Henry Brockman, the son of the original owner of Cheriton. Both the new plantations are looking very promising; vegetables are also grown under the management of Mr. George Buchanan, for the Murchison and Yilgarn goldfields, with the greatest success. The work is done on a proper scale, with horsepower-implements, instead of the spade, that is too often seen in the market gardens around Perth. The ten additional acres which have been planted with citrus trees, are on higher ground than the original orangery; here the ground cannot be irrigated by gravitation, but a pump is to be set to work to remedy this drawback. Of the 10,000 acres in the Cheriton estate, 200 have been retained by Mr. Henry Brockman, and are being devoted to fruit trees, among which apricots, which find a congenial situation at Gingin, have a prominent place. Mr. Brockman's orchard was planted between three and four years ago, and it bore an excellent crop of fruit last season. The superbly good land at Cheriton does not run back more than ten chains from the creek. The bulk of the estate is red gum country, carrying a great deal of limestone. Its chief pasture plants are silver grass, dandelion, couch and trefoil. It is an exceptionally good grazing property, especially the limestone hills. Cattle fatten rapidly at Cheriton, where a great deal of ringbarking is now being done. The effect of ringbarking in the Midland district is to propagate such an enormous quantity of eucalyptus suckers that some owners of land, who are not prepared to carefully keep down this growth for two or three years after the large trees are dead, prefer to leave the forests untouched. They admit that the opening up of the country to the sun and the free action of the air by ringbarking, is very beneficial, as is proved by the large crop of young trees which almost immediately make their appearance; but all of them are not prepared to keep on spending money to thoroughly win the ground from the encroachment of the indigenous trees. Their argument is that unless the work of eradicating the eucalypti is done thoroughly it is better left alone.

To see the Midland district it would be necessary to traverse it, first, along the old road between Perth and the Irwin river, and then make a tour along the railway line, and break the journey in order to diverge to the east and west from the principal stations. The road runs near the coast, and is a very heavy sandy track, while the railway is laid very much to the eastward of what may be considered the arable tract of the Midland district, for the greater part of its length. Looking at the course of the road and the railway on the map, an outline is formed by them that somewhat resembles that of an elongated egg ; that is to say, they are close together at the commencing and terminal points, after making a tolerably wide circuit outwards, the widest portion of the detour being in each case in the middle of the course. The reason why this divergence is emphasised is that there is a marked difference in the characteristics of the country passed through near the sea and more inland, that the traveller who had been over the road, or the railway only, would give entirely different descriptions of their observations. Taking the road route first, we follow the course of the Gingin creek in a westerly direction, through a number of small but flourishing holdings devoted to mixed farming, to the junction of the creek with the Moore river. Along the banks of the creek the land is excellent ; it is red gum country, and has a chocolate soil varied with patches of limestone that carries a thick swath of grass, or when tilled produces heavy crops of cereals, but this kind of land is very limited in extent. Along the creek every farmer has some orange trees planted ; the water of the stream is so fresh and beneficial to vegetation—being free from the slightest mineral ingredient—that it is very stimulating to the growth of the trees. A very slight appearance of black scale is the only approach to disease that the citrus tribe has ever been known to suffer from in the neighbourhood of Gingin. "But take them all round," says an informant, who has lived from boyhood in the district, "and they are as clean oranges, and as choice in every respect, as any that are grown in the world." The Gingin brook has its source in the Cheriton estate, and oranges and lemons are grown the whole way down to the Moore river, which in the summer loses itself before it meets the creek which flows into the Indian ocean. So long as the oranges are planted close enough to the brook to get the advantage of the narrow fringe of alluvial that margins the water, they "grow without any trouble at all." Outside the limestone formation, red gum patches, interspersing the sandy banksia country that is not much good for anything, and which it is very fatiguing for the horses to pull even a light vehicle over this apology for a road, are passed through. If the scrub is burned regularly the banksia country will sustain, but will not fatten stock. All the good land near the creek is in the hands of small farmers, who keep a few stock and grow cereals and vegetables. The Hon. H. B. Lefroy says :—" There are lots of good patches where small holders could settle down between Gingin and Dandaragan and make a living if they went in for growing fruits and garden stuff, but there are no valuable large blocks available." The sandy roads have been a drawback to this class of industry, but the railway, which is not far off at this point of our journey, now affords facilities for transporting crops either to the Perth market, or to the goldfields of Yilgarn or the Murchison, which consignments can reach without leaving the rails once they are delivered to the Midland company, for Government lines touch their railway at its commencement and its terminus. After passing the Moore river it is necessary to strike in a north-easterly direction to avoid the waste of sand timbered with banksia—which extends westward of the road to the sea—in order to see a change in the landscape, and then the famous Yatheroo estate, the property of Mr. Edward Roberts (who was a station hand as a boy upon the place), breaks upon the view in all the beauty of its almost unrivalled pasture lands, its luxurious homestead, its orchards, its irrigation resources, and the large herds of beeves, that are in the primest condition. Yatheroo is a place upon which many thousands of pounds have been spent on strictly commercial principles ; it earns thousands annually. The property was originally taken up by a pioneer named Connolly, who sold it before it had been much improved to Mr. Padbury, in whose hands it assumed something of its present value and importance. He held it for 39 years and then sold it for £20,000 to Mr. Edward Roberts, who had managed the estate for Mr. Padbury for a long time. It comprises 16,000 acres in fee simple, nearly all first class land. The best of it is limestone ridges, which were never heavily timbered ; they grew nothing but wattle, prickly bush, and wooly bush, which grows about a foot high on the banks of watercourses. A great deal of Yatheroo is, or rather was, red gum forest country interspersed with banksias, these areas being of a light, inclining to sandy, loam. Mr. Roberts is a most successful grazier. His experience shows what the best portions of Western Australia are capable of when care is taken to make the pastures good. He buys store cattle and in a short time they are prime fat for the butcher. "I have sold £17,000 worth of cattle from Yatheroo during the last 12 months," he states, "and during the five years I have been the owner of the place it has returned me more than £10,000, clear of working expenses." This result has been achieved by the natural goodness of the station, which, together with Dandaraga, is an oasis in a wide region of sand plain. The feed is encouraged by the ringbarking of the timber, the removal of the shrubs and small trees from the limestone, and the burning of the paddocks in rotation every year. The chief herbage plants are trefoil, clover and dandelion. All the best indigenous grass grow luxuriantly. Cattle do better than either sheep or horses at Yatheroo and Dandaraga ;

owing to the limestone they need no coast change. A good deal of neat kine are bred at Yatheroo. Mr. Roberts imports bulls of the best shorthorn strains from South Australia and New South Wales to raise the grade of his herds, the representatives of which are always large prize takers at the annual show of the Royal agricultural and pastoral society, which is held in November at Guildford. He also milks 80 or 90 cows for winter dairying, but at the expiration of the cool months the cows are turned out and allowed to rear their calves. From May to the end of July the milking herd are given a liberal ration of hay, which is grown in Mr. Roberts' paddocks. The butter he makes is sold in Perth at 1s. 4d. per lb.; his cows are milked only once a day. He finds that as his stock improve in beef-carrying properties, they steadily deteriorate in the profit they yield in the dairy. The general utility cow, which some would-be farmers' guides recommend, may be a fair animal all round, but either meat, or milk and cream, must be made a specialty if the breeder is to achieve distinct success in supplying the beef or the butter market; so says Mr. Roberts, and he thinks few who put their theories to the test of practice will find reason to differ with his conclusions. Another point upon which he gives a definite opinion is that if a cow is to milk well she must be fed well. He compares a cow that is working for a dairy to a draught horse that is daily in harness. Neither of them can stand the drain on their strength and vitality unless they are well nourished, any more than an engine can be kept going without the furnace being replenished with fuel. In addition to the freehold land at Yatheroo, Mr. Roberts leases 60,000 acres from the Midland railway company. He shares Mr. Lefroy's conviction that it would be greatly to the interests of the colony if the line and the landed interests of the company were acquired by the Government; but he does not consider the company to be an unmixed evil, on account of the carrying facilities it affords. But as compared with the position of the settlers in other districts, who have been given the boon of a state railway, the security of tenure, and the liberal land regulations of the Government, he thinks the people of the Midland are badly off. His view was aptly expressed by Sir John Forrest in replying to Mr. Lefroy, when that gentleman's motion regarding the proposed acquisition of the Midland railway (to which reference has been made) was before the Legislative Assembly. On that occasion the Premier said:—"I fully sympathise with the hon. member and his constituents in the position in which they have been placed during so many years, through not been able to acquire any of the company's land on the easy terms on which the lands of the Government can be acquired; but it should not be altogether forgotten that the people in that district have some advantages at any rate from the operations of the company, for they have means of transit provided by the railway for carrying stock, and also to some extent for other produce, which were not available before the railway was constructed." Mr. Roberts formerly held his pastoral leases from the Government. When the country he was occupying was selected by the Midland company he lost his security of tenure, which, although not legally expressed, is felt by those who have the state for their landlord. The position of the pastoralists in the Midland district, in being liable to be turned off their leaseholds at a quarter's notice, was voiced by Mr. Lefroy in the Legislative Assembly in terms which are instructive, as showing one of the reasons why the contemplated, or rather advocated, taking over of the line by the Government is so strongly supported. Speaking of the graziers in the electorate of the Moore, the hon. member said :—" They may lease land from the company, and may stock it with 10,000 or 20,000 head, and then receive notice to quit, and have to sell their stock at a great loss at a forced sale. In conditions like these a leaseholder might be ruined. It is, I am sure, not the desire of Parliament that any of our people should be subject to conditions of this sort. It is all very well to say that similar conditions apply under the land regulations administered by a Government responsible to the country and to Parliament. A Government could not do anything harsh or arbitrary, and yet private companies might do those very things and be within their rights. I am not saying that anything of this sort is likely to take place in the case of any leaseholder under the company, but the fact remains that this is the position in which the leaseholder stands."

Yatheroo is always kept understocked, it being the rule of the owner that two well fed beasts are much better than three that are out of condition. He is a great believer in the subdivision of paddocks in order to conserve and properly stock the pastures. There are 150 miles of fencing. The water supply has also received liberal consideration. There are forty wells and tanks on the estate. As well water can be struck at a depth of eight or ten feet the cost of these works is comparatively small. The losses of stock do not exceed one per cent. per annum. After the true grasses have been burned at the end of the summer, the cattle are turned out on the scrub feed until the autumn rains come, when the vegetation on the burned places springs rapidly and the herbage is very succulent and wholesome. Every three years the scrub country is also fired in order to prevent the scrubs becoming coarse and debilitating. The further north the paddocks are, the quicker the feed grows, owing to the greater heat of the climate. About 1000 acres have been cleared at Yatheroo, which is the exemplar of what a grazing and farming property should be, but it is somewhat singular that cereals will not grow on the richest limestone areas. These crops have to be put in what, for the sake of distinction, we must call the second class land, although this second class country would be termed first class almost anywhere else. On the limestone the wheat springs well, but before it ripens it wilts away. Mr. Roberts does not attempt any explaination of the fact, but it certainly is not due to the poverty of the soil. The homestead is replete with every appointment of a luxurious and well ordered place of residence. There is an orangery and an orchard, which are irrigated whenever water is needed, and by an ingenious and costly arrangement of storage and reticulation, the water can be turned on at will and regulated as to the quantity that is to be allowed to flow. Even the drinking troughs for the cattle are fitted with ball taps, so that the intake from the dams is governed automatically. The catchment area of the water is aided in filling the dams by the undulating character of the country, which is not mountainous, but would be described in America as rolling prairie. There is no other piece of country in the Midland like that which is found around Gingin and at Yatheroo and Dandaraga. Outside the confines of their territory there is either sand plain, until the Irwin river is reached, or the heavier, and, in some places, more gravelly soils of Victoria plains. There are some very good flats at Yatheroo, but the general characteristics of the property are its low hills and broad shallow valleys. The clearing was not costly, owing to what may be called large shrubs taking the place of the forests that are generally found on the fertile parts of Western Australia. The wooly bush has a peculiarity which is worthy of note ; it carries a fibre which would make good rope. Mr. Roberts sent some of the fibre to England and had it spun into lines, which were very strong, but rather heavier than those made of hemp. Another feature of the portion of the Midland district under notice is that it has a monopoly of the bare, or almost naked, limestone patches or crowns of the ridges which have made Yatheroo so favorably known among stock masters. The limestone is found exhibiting the same features at Dandaraga, but Yatheroo and Dandaraga are naturally one belt of country which only a different ownership has divided by fences and nomenclature. Dandaraga has some land that is as good as the best of Yatheroo, but less has been heard in its praise. because it has not been so highly improved as Mr. Roberts' estate, and it has not quite so large a proportion as the latter station of the superbly high class pasturages. Dandaraga was at one time another property which belonged to Mr. Padbury, but it is now in the possession of Mr. D. Drummond, a member by marriage of Mr. Padbury's family. The strip of land which includes Yatheroo and Dandaraga is about six miles wide and thirty long ; it has been described to the reporter for the Bureau as "an oasis in the desert." About 100 acres of Yatheroo are used for growing cereals, mostly for home consumption. The rainfall of the district is not deemed to be very favorable for general farming. The annual average at Yatheroo and Dandaraga is 24 inches, which would be sufficient if it were more evenly distributed. July and August are very wet months ; they get a plethora of rain, and there is a shortage which is more or less acutely felt during the remainder of the year. The summer especially is protracted and very dry, but with plenty of water the cattle do not lose condition appreciably on the dry feed. "It is astonishing," remarks Mr. Roberts, "how well they do stand the long hot season, when the scrub is the only bite that is at all green." The herds are in their primest condition in December, when there is plenty of pasture and the sun has put it in good heart. A great recommendation of Yatheroo and Dandaraga is that there are no "poison lands" there. Poison plants flourish near their boundaries, but the stock have been prevented from straying on to the places of danger by being kept enclosed. "That is one reason why we fenced—to fence the poison out," Mr. Roberts exclaims. The varieties of the noxious vegetation are rock poison and sand plain poison. Rock poison grows in the hills and the sand plain species near the coast. Before the fencing was completed, Yatheroo lost a lot of stock through poison. Now Yatheroo and Dandaraga supply the metropolitan butchers with a thousand head of cattle annually, nearly all of which are trucked to the city. Sheep would be kept to a larger extent if the price of wool were higher. In the present state of the market, cattle pay better than sheep, and therefore the ground is almost wholly reserved for the great stock.

"We commenced twenty years ago," said Mr. Roberts, "to make Yatheroo what it is to-day. We preferred to grub the trees instead of ringing them; not much ringbarking has been done. The cost of clearing the land has ranged from 5s. to £5 per acre. The inferior country is not ringed, as the second growth of saplings that would be induced by the killing of the trees would, unless it were checked, take greater possession of the ground than the trees do now. It is not worth while spending so much on the poor places as would be needed to get them clear. Then, again, the suckers are very troublesome; they can be killed by burning if there is sufficient grass to raise a good fire, but that is not always the case on the second or third-rate areas. You can ring too much, unless you intend to look after the ringbarked land; it does not do to use the axe and let the ground alone for ten years. To get the benefit of ringbarking it is necessary to complete the work by destroying the young growth as fast as it appears. One way to deal with the second growth of York gum is to get sheep to eat down the young sprouts; cattle will not touch them. The red gums were the only large trees we had to deal with at Yatheroo, and they burn well when they are dry, or if they are grubbed green in the summer time. With reference to the questions tabulated by the Bureau of Agriculture, which you put to me, I may say that as a rule the roads of the Midland district are very bad; most of them are very sandy, and as severe upon the horses as they are trying to the patience of travellers. An exception to this indictment is the road from Moora to Dandaraga, which is being made by the roads board for a distance of twenty miles, at a cost—with the aid of the Government grants—of 50s. per chain. We have been seventeen years at that job. There is no room for settlers who want to get holdings from the Government in the neighborhood of Yatheroo.

the good land is all alienated from the Crown ; the Midland company have some of it, especially about Victoria plains. The people there did not make hay while the sun shone, as we did on this side of the line ; I mean, they did not purchase the land while it was in the hands of the Lands department, while we bought largely. A number of farmers selected inside our leaseholds ; the smallest holding is 130 acres ; others have as much as 2,000 acres ; they are mostly graziers. Of the wheat that is grown very little goes out of the district. Each man grows to supply his own family with flour. We have no local surveyed agricultural areas. There has been no new settlement for fifteen years. Twenty-five years ago people were taking up land very rapidly in the Midland division. The educational wants of the district are only attended to by one school at Dandaraga, as far as public tuition is concerned. I have a school for my younger children at the Yatheroo homestead, and the families of the people employed on the place are free to attend and receive instruction. The invitation is generally availed of. I do not think any child is growing up in ignorance in the Midland district, although some of them may have to travel several miles to school. The query as to what capital may be considered essential for a successful start on 500 acres or less, is not one to which a comprehensive answer embracing every case can be given. A great deal depends upon the man and upon circumstances—whether he knows his business, is frugal and industrious, and is able to get near a railway station, and not too far from his market ; also, whether he proposes to keep stock. The only point on which I can speak definitely in this relation, is that a man should have at least enough to start him with horses and implements, and pay for wire, fodder, and stores, etc., for at least twelve months, and that will amount to some hundreds of pounds. Of course, I am supposing that a man is expecting to make a reasonably good start, such as will result in his place returning sufficient, during the second year, to maintain a wife and children in tolerable comfort. If a man merely takes up a block of land near where he is employed, in order to have a home of his own and to save rent and the cost of vegetables, my estimate would be considerably modified. I am speaking of the selector who is looking to mixed farming for a living, and is not open to work for an employer. In that case he will want to buy some stock, and that is another item of outlay that would have to be taken into account, especially as store stock is very scarce, and the price of them is on the rise, because the supply is not equal to the demand. Most of the stores come from the north-west, and the competition for them is getting very keen, because the unfavourable seasons there are keeping down the number of consignments of the station owners. The railway freights are very reasonable, and the farmer, thanks to the goldfields, can get a good sale for his crops, at better prices than do any of our neighbours in eastern Australia. The

Midland is not, however, a great farming country as a whole ; it is very good for agriculture in patches ; it is a great grazing country, if the sand plains are excepted. If the paddock is picked for the different crops there is nothing I know of that the Midland will not grow ; it is very good for fruit, cereals and vegetables, if the spots for growing them are well selected. When I mention fruits, I refer to oranges, lemons, apples, grapes and pears ; we have not been able to do much with plums or cherries. We do not enrich the land except by resting it ; we have enough land to crop our paddocks only in alternate years. We find it cheaper to do that than to buy fertilisers. Although the best of the arable land is very good, I believe that continuous cropping for four years would exhaust, or, at any rate, seriously deteriorate it. There are no large local orchards ; most of the settlers grow a little fruit for themselves. When we were without a railway it cost about five pounds per ton to cart stuff to Perth, and, therefore, we did not expect to be able to produce fruit at a profit, hence only comparatively few trees were planted. Since the railway has been opened some encouragement has been given to enlarging the productiveness of the district, but orchards require time to come to maturity. Many of the settlers combine the keeping of sheep with cultivation. The largest flockmaster is Mr. Drummond, at Dandaragan. I find pigs more profitable than sheep. I kill about fifty pigs every year. They are allowed the run of certain securely fenced paddocks until they are wanted for fattening ; then they are fed on wheat meal in the sty, and make prime bacon, for which I have obtained many prizes at the Guildford show, or are sold to the butcher. I keep Berkshire pigs, and always use imported boars. Dingoes are very troublesome ; they occasionally kill pigs and calves. Another pest is the domestic cat, that has gone wild in the bush ; they are destructive among the chickens in the poultry yard. An enormous number of eaglehawks are shot and poisoned. The bonus of 2s. per head has been paid on about five thousand eaglehawks in the Midland district within the last seven years. I cannot give a complete list of the local grasses, but I would like to say a word against couch, which I think is held in undeserved esteem in this colony, although it may prove to be a valuable pasture plant in New South Wales, where it grows splendidly. My experience is that we should be much better without couch in Western Australia, and I will give my reasons for this unfavorable verdict. It always grows on the very best land—paddocks that have been cultivated, for preference—and wherever it takes root it drives every other grass out. The stock get on to the green couch in the summer time, when it is the only green thing on the ground, and eat it bare. When the couch has been fed down close the cattle still hang on it, and fill themselves with earth or sand trying to get another mouthful. In a word, they not only go hungry and lose condition by sticking to the couch, but many a beast has been lost through impaction of sand in the intestines, the result of burrowing down into the roots of the couch. There are four varieties of poison which grow in the Midland district, namely, the sand plain variety, whose habitat is the Victoria plains, box, York road and white gum poison. But, nevertheless, if the stock are kept in paddocks which are free of poison, the Midland is a good grazing country. What is known as the 'Yatheroo oat' is one of the best pasture plants we have; it is finer in the texture of the stalk than the ordinary wild oat. There is also plenty of Dutch clover and trefoil and Cape weed, and numbers of other useful and fattening varieties of herbage. I have planted rye-grass; it is growing fairly well. I sent to Melbourne for the seed. As a whole the country is better for winter, and worse for summer feed than before so much clearing was done. The reason is that the coarser growths which used to stand the heat have been supplanted by the more succulent herbage, such as trefoil and dandelion, which come on in the spring, and dying out about Christmas time leaves the pasture very short for the remainder of the dry months. The shrubs once killed by burning do not grow again, while the grass seed falling every year renews the life of that vegetation. Of course we take care to burn only after seeding time. We can keep far more stock in the winter than we could forty years ago. Owing to extensive clearing operations, from 200 to 500 acres of arable land can be found in one piece, although so much is never cultivated; nor would it be so suitable for cereals around Yatheroo as the land at the Victoria plains. We keep on breaking up fresh land, because land that has been cultivated is better for stock and carries more stock than any other. The proper management of stock is an important factor in securing success on the land. It is not every one who goes on the land who is fit for a settler's life, and the blame of individual unfitness is often thrown upon the land. The parts of the Midland district I know most about are well watered, if the water is only taken care of instead of being allowed to run to waste. It is easy to conserve water; there is good holding ground for dams and drainage from the rises into them. The cost of an artificial water supply, which is necessary, is not heavy. Wells are usually sunk for £1 per foot; tanks and dams are excavated for a shilling per cubic yard. There has never been any serious want of water in a dry season; if there had been, we should only have had to blame ourselves. In sinking a well, if we do not get water at a shallow depth, we try another place. The well water is, if anything, too fresh; a little more salt would be preferable. There are facilities for irrigation on the banks of the Gingin creek, as the orangeries and orchards of Messrs. Edgar Wedge and Co. and Mr. Henry Brockman most successfully attest. The general character of the soil and configuration of the district is land of a deep dark and rich chocolate; limestone patches, or a lighter and less fertile loam of a light color and sandy texture; low ridges and vales are the predominating features of the landscape. The chocolate country is very friable, and works up splendidly beneath the plough and harrow. I grow oranges and lemons upon it admirably. There are springs at the Yatheroo homestead which are used for irrigating the fruit trees. The spring water is collected in a dam, from which it is reticulated through channels cut in the garden. The limestone and ironstone country commences about 15 miles from the coast line. The timber in the Midland territory consists of red gum, white gum, York gum, salmon gum, raspberry jam, wattle and manna trees; there are also amongst what may be termed the undergrowth, blackboys, wooly and prickly bushes. We have done most of our clearing by contract. This year (1897) there has been less labor available than I ever remember before, in spite of good wages being offered. The rate of pay has increased fivefold, as compared with what men used to get in the early days of the colony. The rate now is £1 to £1 5s. per week and rations found. The cost of clearing is never more than £5 an acre, and sometimes only as many shillings, but in the latter case only shrubs have been dealt with. At Koojan Mr. Padbury has been employing Chinamen to clear land which Europeans would not undertake at the price he offered, namely, 50s. per acre. The Chinamen found the job pay well at the price, and one of them went back to his own country with £90 in his pocket. It is surprising how much hard work Chinese can do, considering their inferior physique; they keep at it longer hours than the whites, if they get a piecework job. The country which Mr. Padbury had grubbed was ringbarked two or three years ago; every year as the trees decay the land is less trouble to grub, and the price is reduced in consequence. The crops usually grown in our neighborhood are oats, wheat, hay and potatoes, and almost every kind of vegetable. The growers mostly use their produce, or fatten stock with it, as we are so far from the railway the cartage to the line would swallow up most of the profit. The local wheat is grown at Yatheroo; I have a mill there; it is the only mill in the district. As to the yield per acre, I have never had less than 15 bushels per acre and as much as 40 bushels; my average yield is about 20 bushels, and a ton of hay to the acre. If I manured the land I should expect two tons of hay to the acre. Self-sown hay crops yield very heavily; but there are too many burrs in the crop to allow it to be sent in to market. If we send produce away by rail, we have to cart it from 15 to 30 miles; we are fairly well satisfied with the facilities for transport. I have omitted from the lists of fruits that grow well with us, the Cape gooseberry, which thrives luxuriantly on all our soils, except the limestone. The squash family are also well suited here; figs do not flourish anywhere more abundantly than they do in the Midland district. Fruit is grown on the lighter, not the best lands, and melons, pumpkins, etc., on the moist spots near the watercourses; they go ahead like weeds. The deep red, almost purple, land on the limestone is reserved for grass. I have about 150 fig trees in bearing ; I planted 50 more the other day. I would sooner be overdone with fig trees than with oranges and lemons, because you can fatten pigs, fowls, in fact, all kinds of stock, on figs, and they are no trouble to grow. I do not use at home one-hundredth part of the fig crop. I shake the fruit down from the trees, and let the pigs in to fatten upon them ; this saves labour in picking and carrying the figs to the pens. Our orchards are fairly successful, that is to say, figs, grapes, oranges and lemons are all that we could wish, but apricots are not of more than second-class quality ; nectarines are superior, and the peaches something great. Apples come to a fair size, but the flavour is not equal to that of the apples that are grown further south. There is a strip of Crown land open for selection, 16 miles wide, between Yatheroo and the railway. The company tried to get all the best land, but they were under the restriction that they had to share the railway frontage equally with the Government. There will be a great deal of selection on Victoria plains. I can recommend a man to go there who is looking for a selection ; there has not lately been any land taken up. The co-operation of the Land bank has been availed of by some farmers on the Victoria plains. Personally, I would rather borrow privately if I wanted money, but I am willing to admit that my reason may not be a good one. I hold that if a man should be unable, through some special misfortune or sickness, to meet his obligations to his creditors, he may prevail upon an individual lender to be lenient with him ; but the bank is governed by statute, and if a man does not punctually pay up he must be sold up. The local rainfall is 24 inches per annum, and the general character of the seasons is a long, dry summer, and a short winter. Six or seven months in the year, or from the beginning of November to the end of April, there is seldom a single shower. During the past few years we have not had rain until the end of May. The rainy season has been getting shorter than it used to be ; the wet weather has been late in commencing and has gone off early. The maturing of the crops has been a very critical time owing to the scarcity of rain. A shower or two that would have been very beneficial to fill the wheat ears has often been withheld. We harvest in November and December ; hay is cut in October. July and October are considered our wettest months. The rain commences about the end of May as a rule. I have occasionally known good rains to fall in April, and they have been very welcome ; we cannot get too much rain in April. The land around here is mostly freehold ; it was taken up long enough ago for the improvements to have been made, the purchase money to be paid by deferred payment instalments, and the titles to issue. Some owners have only small blocks of about 150 acres ; others as much as 16,000 acres. The settlers are all British subjects. The chief advantages of the district are good soil, fair rainfall, and a railway, although its route is not very close to some of the best parts of the district. The stock fattening capabilities of the Midland are very much in its favor. The implements in general use for farming are single, double, and treble furrow ploughs, mowers, reapers and binders, and chaff-cutting plant. Mr. Drummond has at Dandaraga a six furrow plough, but it is most suitable for stirring up fallow. I use a steam driven chaff-cutter; most of my neighbors cut their hay by horse power. In stock raising attention is mostly given to the breeding of cattle, about 2,000 head of which are kept around Yatheroo. Sheep are somewhat neglected. There is not much opportunity for a larger scope of work at present, as the best of the land is taken up. If ever the large estates are subdivided and sold, farming could be carried on upon a much larger scale than it is at present. Dairying is done during the winter and spring by Mr. Drummond and Mr. Cook, as well as at Yatheroo. Most of the butter that is made is sold locally, except the output of Mr. Cook's place and mine, which goes to Perth. The topping up of cattle for the meat supply is our staple resource. Potato and other root crops do fairly well, but they are only grown in a small way for home use, the same as other vegetables. There is no Government land suitable for potato crops awaiting selection, nor have I any knowledge that private owners are willing to make sales for this purpose. We get frosts in June and July which prevent a winter crop of potatoes being grown. I have known sharp frosts to occur in September; but as a rule July is the latest month when they are experienced. The Midland district is not the place for 'blockers' *i.e.*, 10 and 20 acre men; they would be too far from a centre of population to be able to make a living by intense cultivation, nor would they be likely to get enough water for summer irrigation which would help them to work with success. Poultry and bees are kept. Nearly everyone has hives and fowls. Bees thrive well. Fowls are sent to Perth, where they bring 6s., and ducks, 7s. per couple, and turkeys, about 10s. each. It is a healthy country for turkeys, being so dry, but fowls pay better than any other sort of poultry. The chief requisites for a new settler are, in my opinion, that he should get from 500 acres to 1500 acres of eligible land, and should be thrifty, sober, and industrious. He should know the value of money, and take care to get a pound's worth for a sovereign. Some men by careful management make a given amount of money go twice as far as others. The selector in order to prosper in the Midland must go in for stock to some extent, and engage in mixed farming. A few sheep should be bought, if only to keep the weeds down; they are splendid scavengers, and their manure is not to be despised as a dressing when they are run on the stubble. The lessons of local experience are in favor of ring-barking as a first step after going on a piece of new country, as it makes the clearing of land after the first year so much easier than it would be if the timber were left in the green state. Ringbarking reduces the cost of clearing by at least one-third, if clearing is delayed for seven or ten years. After the trees are dead the heaviest forest lands in the Midland district can be cleared for 30s. per acre, provided the wood is thoroughly dry. As artificial manures have not been used generally locally, I cannot say from observation what fertilisers are best adapted to our soils, but I believe there is nothing better than bonedust. Some bonedust has been experimented with and excellent results obtained. The day will come when it will pay to manure all round to increase the productiveness of the arable lands, and thus prevent the soil becoming exhausted. Liberal manuring from the outset is profitable if the produce is marketed to make a livelihood for the grower. As far as I know there are no eligible private estates open for sub-divisional sale, or available for occupation under improvement leases. I have nothing to add to the suggestions I have already made for the guidance of new settlers."

There are two agricultural areas along the Midland railway which are described as follows in the directions issued by the Lands department :— The Koojan area, which is situate about 100 miles north of Perth, was opened for selection in November, 1894 ; it contains 14,000 acres, of which 9209 acres have been surveyed into sixty-two blocks. At present (January, 1897) there are eight settlers on the area, who hold between them 3156 acres. The Midland railway runs along the eastern boundary of this area. A large number of selections took place in this vicinity just previous to the area being gazetted. It is therefore probable that much land here will be taken up by persons desirous of increasing their holdings, as well as other new selectors. This land is suitable for corn growing and fruit culture. The cost of clearing would be about £4 per acre.

The Dalaroo agricultural area is north of and adjoining the Koojan area ; it was opened for selection in November, 1894. It contains 9000 acres, of which 3685 acres are surveyed into 23 blocks. There are at present no selectors on this area. It adjoins the western side of the Midland railway line. A townsite (Moora) has been laid out on this area, consisting of 89 town and 62 suburban lots. The land here is somewhat similar to that in the Koojan area. The average rainfall is about 20 inches. A branch of the Moore river runs through the area ; there are also small swamps suitable for gardening purposes.

The Hon. H. B. Lefroy, Minister of the Postal and Education departments, who is very conversant with the Midland district, says sandy country lies along the road from Gingin to Dandaraga to the Moore river ; banksia and scrub occupy this sand plain, which has a most uninviting appearance ; there are patches of blackbutt and red gum, but they are small and far isolated from each other. Approaching Yatheroo homestead there is a surprising revelation that is as pleasing as it is unexpected by a stranger. Yatheroo is described by Mr. Lefroy, who is a large pastoralist, and therefore competent to give a practical opinion, as being equal to any fattening place he has seen in his travels. Adjoining Yatheroo is the Kianabbey estate, which has been purchased by Mr. Roberts from the executors of the late Mr. McIntosh. Kianabbey has the same characteristics as Yatheroo and Dandaraga, but it has not been made to the same extent as the Yatheroo run. Yere is another notable grazing property. It belongs to Mr. Drummond, after having passed through the hands of Mr. Padbury, who was the first to discover its true worth. Besides the large estates there are a number of well-kept farms to be seen. These holdings comprise from 200 to 500 acres, a fair proportion of which is under cereal cultivation. Taking now a survey of the Midland district along the course of the railway line, in lieu of the road, soon after Gingin is left behind, low hills of ironstone, gravel, and growing jarrah and banksia are sighted. The hills extend as far as the Moore river. The Mogumber railway station is on the banks of the river. Crossing the river, 18 miles further on, Mr. Padbury's flourishing homestead, Koojan, is reached. A large sum has been spent in converting the property from rough bush land to one of a very desirable character, viewed either from the standpoint of the stock raiser or the yeoman. A salmon gum forest has been annihilated, in order to make room for rich pasture grounds and cornfields. A similar area along the railway and a branch of the Moore river is being rapidly taken up by farmers, and therefore the ease with which salmon gum may be cleared ready for the plough cannot be too widely known by settlers.

The facility with which some forest lands may be cleared is graphically described by a correspondent of the *Western Mail* in discussing the proposed Italian colony, which was a scheme of Signor Vanzetti's. The extract states :—" There are several salmon gum forests of from three to five thousand acres area, separated by sand plain and thicket. Some of the sand plain will grow vines luxuriantly, while much of the tamma thicket is suited for both cereal and orchard purposes. The salmon gum country would be of value in about three years after settlement. It would need to be first ring-barked, then, when the trees were thoroughly dead, a box of matches would render the land fit for the plough. The inflammable nature of the dead salmon gum forests is incredible. The trees will burn from the uttermost twig at the top of the tree to the deepest root in the soil. Holes large enough to bury a horse in are created by the action of the fire following the roots down in search of more wood. The explanation of this peculiar fact is possibly found in the statement that all these trees are hollow, so that a vent is left for the flame to travel by. It is absolutely astounding what a single lucifer will do. The whole dead tree when once ignited will burn for days, and a burned forest looks like a miniature volcano field, with smoke pouring from holes which were formerly the butts of trees. Such a mode of clearing is cheapness itself. Ringing will probably cost half a crown per acre, for the trees are thick, and in three years' time after the application of fire ten shillings an acre will cover the cost of clearing what was missed. A reliable settler on forest land was telling me of his experience in this class of land. When the timber was dead he let a contract to clear it at twenty shillings per acre for the plough. Accidentally a fire broke through thirty acres of it, and from his description, after the fire the thirty-acre paddock must have resembled a skittle alley when nearly all the pins are knocked down."

Mr. Lefroy says :—"The Koojan agricultural area embraces much good land ; this is a stiff red soil that will grow cereals well. The site of the area would doubtless have been taken up by the Midland railway company, only they had to leave half the railway frontage in the possession of the state. The area promises to become the scene of many smiling fields of ripening corn. Twelve miles further on from Koojan the traveller arrives at Moora railway station and town site. Between Koojan and Moora, salmon gum predominates. Moora has a telegraph station. A post and telegraph office and a police station are about to be built; also, a new public school. The children of the district are now being taught in a rented building. It may be predicted that Moora will become one of the most thriving townships between Perth and Geraldton as soon as the district obtains a larger farming population. This settlement is retarded by the ownership of the Midland company of so much of the land in the neighborhood ; the company will not part with any of their grants except at high prices. They have been approached by would-be buyers, but no one has ever been able to buy any land from them ; at the same time they have never attempted any settlement of their estates on their own account, and in the face of the generous character of the land legislation of Western Australia, it is no wonder that settlers have not been attracted in larger numbers to the Moora district. Moora is the railway station of the people of Dandaraga, which designation includes the residents of Yatheroo and the surrounding territory. It also serves the northern part of the Victoria plains, the southern portion of which does business with Mogumber. The name Victoria plains is a misnomer, as the land is not level but hilly. The Victoria plains cover the Darling ranges at their northerly commencing point, but the ranges do not in this locality rise to any considerable altitude. The timber seen hereabouts is very similar to that seen in the Newcastle and Northam districts, namely, York, white salmon gums and manna trees. There are farms on the plains, but the greater portion of the country is leased for grazing purposes. The Victoria plains have always been looked upon as being of a superior character to the average of the pasturage areas of the central district, especially for sheep. The wool grown here always holds a very good position in the London market. A good many fat

Darling Range Country.

Dense Jarrah Country, with a fine Red Gum tree in the centre. Both kinds are the most widely distributed over the agricultural portion of the South-West division of the Colony. They both grow within the moister coastal zone, embracing the ironstone ranges which extend from the Moore River to the Leeuwin. Wherever Blackboys *(Xanthorrhæa)* and Tamia Palms or Bracken grow amongst them, there the soil is most fertile. Costly to clear.

sheep are also sent from the plains to Perth every year. Strictly speaking, this section of the colony cannot be considered first-class agricultural country owing to the presence of granite, but between the stony places there is some arable land that in course of time will be cultivated. Many of the sheep runs have been greatly improved ; most of the sheep are kept in fenced blocks ; some of them are shepherded in the open. There are poison plants in spots throughout the district, but most of the country thus affected is unoccupied. The poisons are of the York road and white gum varieties."

One of the principal stations on the Victoria plains is Walebing, which was taken up about 40 years ago by the father of the Hon. H. B. Lefroy and his uncle, who came out from Ireland to engage in pastoral pursuits. They went in search of suitable country beyond the coast line, which was all that had then been explored, and found a large stretch of good feeding ground at what was afterwards named Victoria plains, and formed Walebing station there. The Hon. Anthony O'Grady Lefroy, who, with his brother, established Walebing, became secretary to the Governor of the colony, and subsequently filled for more than 30 years the office of Colonial Treasurer. During the latter portion of this time Walebing was managed by the Hon. H. B. Lefroy. Walebing carries a large number of sheep, and it has been well improved as far as the freehold land extends, but Mr. Lefroy states that the regime of the Midland company has proved a serious discouragement to enterprise and expenditure in respect of the leaseholds for which no tenure can be obtained.

South of Walebing is the New Norcia mission station, which was founded by Bishop Salvado, of the Roman Catholic church, for the reclaimation of the aborigines, who, besides being trained in agriculture and other useful kinds of work, are brought up in the faith of the church. The mission furnishes excellent illustrations of the great variety of crops which the Midland district will produce. The features of the station have been vividly sketched by " L.L.C." in the columns of the *West Australian*, who drove there from Newcastle, a distance of 50 miles. He writes :—" The road traverses country that seems to be given over entirely to its native denizens and a few wandering flocks of sheep. It is chiefly ironstone country, with here and there patches of good clay land, moderately heavily timbered, chiefly with white gum. Almost every acre of this most inhospitable looking country is good for cultivation of the vine, and the day will come, many years hence though, I fear, when smiling vineyards will greet the traveller on every side. Nearing the mission there are more evidences of settlement, and the well tilled farm and neat homestead of Mr. Clune are particularly noticeable from the main road. The term ' mission ' is altogether too insignificant to express New Norcia, which is really a township, and a more pretentious one, in some respects, than many that boast of a mayor, town council and tax gatherer. The mission building looms up on the right hand side of the road, and on the opposite side is the chapel, all the farm buildings and a number of cottages. . . . The good bishop's hospitality is proverbial. . . . The olives, mission grown and mission pickled, were a treat. . . . The wine, mission grown and mission made, sound as the bell that summons the faithful to prayer, clean and bright, and pure juice of the grape. . . . And the olive oil—no cotton seed here—but coming up to the standard of the real Simon Pure. No taste, no smell, no colour. . . . And the bishop's snuff—his only luxury! Mission grown and mission made. . . . And those candied almonds, and figs, and raisins, and grapes, and apples, and a host of other things. . . . The whole time we were there we lived like the proverbial fighting cock, and the only two things set before us which were not grown on the place were the coffee and sugar. Farmers, please note. On Sunday afternoon we had a good look round the flour mill, stables, implement sheds, and all the other outbuildings and adjuncts and accessories of the mission farm. The wheat is grown and ground into flour, which is converted into bread and macaroni, and the meat is all grown on stations belonging to the mission. The bishop is a great horsebreeder. The mission horses are deservedly popular in the market. Many used to find their way to India at one time, but this trade has declined altogether. All the stock about the place is good, and the bishop is a great believer in the truism that a good animal eats no more than a scrubber. It will be well when this is more generally recognised. There are nearly 1000 acres cleared, and it takes, as the yield is not very large, a greater part of this to supply the wheat for the mission wants from year to year. The land is rich, judging by what I saw. It is the scanty rainfall and short season that makes wheat growing somewhat precarious. The bishop has a thresher with a straw-cutter attached, of which he is very proud, and he also has imported several other machines of recent invention. The mission shows what can be done in the face of the greatest obstacles, and what the ground can be made to produce even with a very limited rainfall. It is a glorious monument to indomitable courage, unwavering perseverance, and ceaseless industry. Under the guidance of Brother Ramiro we visited Glentromie, the home of Mr. and Mrs. Davidson. This fine estate is well known in Western Australia as having been at one time the property of the late Mr. McPherson, a popular squatter, and one who dearly loved a horse. The improvements put up in his time show this. The stables, built of brick, contain over 20 stalls and loose boxes, and everything about the place shows that no expense was spared to make it a model institution."

Beyond the Victoria plains the valleys of the upper and lower Irwin river form one of the best agricultural districts in the colony. The land is extremely fertile and very valuable, but as none of it is open for selection space need not be devoted in the pages of the

Guide to enlarge upon its advantages. The produce of the Irwin is sent to the Murchison goldfields, or shipped from Dongara (the port at the mouth of the lower Irwin) to Perth. On the upper Irwin the Midland company had large grants of country, many of which have been acquired by some of the promoters of the company. Walkaway, the terminus of the Midland line, is another agricultural centre. The Greenough river runs westerly into the Indian ocean, a little to the north of Walkaway. The Greenough flats were thirty years ago rapidly settled. They have had a somewhat chequered history. Until rust made its appearance in the crops, the farmers made liberal profits out of wheat growing. Then a disastrous flood accentuated their difficulties. The flood waters came from the interior and washed away crops, fences, and stock. There are what are known as front and back flats, divided by ironstone and limestone. The fertile area consists of about forty square miles. It is still largely cultivated. On the flats the land has all been alienated from the Crown. White gums, York gums, and wattles were the chief woods which the first settlers had to clear. Their holdings average about 300 acres per man. The chief drawback of the district is the uncertainty and insufficiency of the rainfall. The soil is of two kinds, it is of a heavy loam, almost of a clayey character on the front flats ; behind the lime and ironstone the ground is of a lighter quality. Water can be obtained from springs, but it has a strong taste of lime and magnesia. Fruit grows well if the trees are sheltered from the violent south-west winds that prevail during summer. The back country in the hills is occupied by graziers ; sheep are their principal stock ; they rely on breeding, not on the fattening of stores. Nearer to Geraldton cattle thrive when drought does not make feed scarce. Mr. John Morrell, whose place is between Walkaway and Geraldton, makes a good deal of butter during the cool season. There is an eager market in Geraldton for fresh butter. For the greater part of the year new milk is not to be had there. Unless the making of ensilage is resorted to, the district is too far north for dairying, except during the three winter months of the year. For the same reason the farmers get better returns from their crops when the seed is sown in dry furrows to await the first rains in autumn. The wheat is ground at a roller flour mill at central Greenough. Among the chief fodder plants of this part of the colony is the wild oat, which is encouraged to grow on the pasture grounds. The sheep farmers in the hills sow the seeds of the wild oat. The plant is cut, threshed, and the seed bagged until the winter rains are falling, when the sowing is roughly done on burnt ground or other likely seed bed places ; the ground is not ploughed to receive the wild oats.

Geraldton is connected by rail with Northampton. There are three agricultural areas adjacent to the Geraldton-Northampton railway. These are officially described as follows:—" The Appertarra area was thrown open for selection in April, 1894, and comprises

6560 acres, the whole of which has been surveyed into forty-three lots. There is at present one settler here, who holds 144 acres. The area is situate close to Northampton townsite, adjoining the west boundary of same, and extending north therefrom. The land here is of a light loamy nature, and should prove suitable for the growth of cereals and fruit. The cost of clearing would be about £3 per acre, as the land is not heavily timbered. As there is a prospect of a revival of the mining industry at Northampton, selection in this area is anticipated at an early date. The Northampton-Geraldton railway passes through the southern portion of this area."

The Nonga agricultural area contains 11,311 acres; it was thrown open for selection in September, 1893. It has been entirely subdivided into seventy-four blocks, but as yet no land has been applied for. There is a fair amount of good soil in this area, which has a frontage on the Bowes river and Nokanena brook. The proximity of this area to the Northampton-Geraldton railway line should lead to its early settlement. The dry seasons we have lately experienced have placed a great check on agricultural development. The cost of clearing here would be about £4 per acre.

The Weeranooka area, which contains 14,500 acres, and forms a portion of the original Northampton area, has not been laid out in blocks, as at present there appears to be little demand for agricultural land in this locality.

Mullewa, which is the first township on the line from Geraldton to Cue, the capital of the Murchison goldfields, is in the neighborhood of an agricultural area that was proclaimed, in order that farmers desiring to produce crops for the requirements of the mining population might have an opportunity of settling on Crown lands close to the railway. The Mullewa area contains 12,000 acres, and was thrown open for selection in August, 1894. Of the total area gazetted 6104 acres have been surveyed into fifty-four lots. There is one settler on this area, who holds 138 acres. A townsite has been laid out here comprising ninety-three town and suburban lots. This area is situate at the termination of the Geraldton-Mullewa railway, about 65 miles from Geraldton. Since the area was gazetted the railway has been completed to Cue. As there is a large population on the Murchison goldfields the land on the Mullewa area should soon be in more demand, and though the rainfall in some seasons is somewhat uncertain and scanty the blocks are considered suitable for the growth of cereals. The cost of clearing would be about £3 per acre.

The following statement has been supplied, respecting the conditions which a settler would meet with in the Midland and Geraldton districts:—Some eligible large private estates are open for subdivisional sale, or for occupation under improvement leases. In local farming operations, liberal manuring from the outset is profitable; but so few fertilisers are used that it is not easy to say which kind is the best to use. In order to succeed, a selector should be a hard worker, have any amount of pluck, and be very economical. Fowls are commonly kept by our farmers, but not nearly so largely as they ought to be. Bees are neglected. The districts are not adapted for close settlement, *i.e.*, for ten or 20-acre men. No data has been kept to show the times at which the earliest and latest frosts occur. Frosts are, however, not prevalent and destructive. There are private lands available that would grow excellent crops of potatoes and other root crops ; but the terms upon which the blocks could be obtained would be a matter for private treaty. No terms of sale are advertised, or are public property. None of the paddocks referred to are far from the railway. There is very little "potato land" belonging to the Crown ; nearly all the best of it has been taken up. On suitable spots, potatoes and other root crops do well in the districts. Vegetables are not grown to any extent—not nearly as largely as they could be. Dairying is being neglected ; there is very little of this form of industry in the Midland division. It cannot be said there is an opportunity for a larger scope of work. The breeds of horses, cattle and sheep are being improved. The chief advantages of our territory are that it is good agricultural and pastoral country. The average size of selections of Crown lands is 100 acres. The general character of the seasons is dryness, which prejudicially affects the returns. For 14 years, prior to 1896, the average rainfall was 18·55 inches. The Land bank has not been applied to by local borrowers, as far as is known here. Settlement has been progressing. The fruits grown are oranges, apples, peaches, grapes and figs, and these mature with very great success, the only drawback being the high winds that are experienced during a portion of the year. The facilities for the transport of crops to market are fairly good, now that railway carriage is accessible from the Greenough, Northampton, Irwin and Mullewa stations. The crops usually grown are hay and grain. It costs about £3 per acre to clear land ready for the plough. The kinds of timber are York gum, flooded gum, white gum, morrell, gimlet, and raspberry jam. The forests are rather sparse. No spot can be named where there are facilities for irrigation. In the vicinity of Geraldton water can be struck inside 100 feet, and at a much shallower depth on the Murchison. In a dry season there is a great scarcity of water, as the storage capacity is nowhere large. In general, however, the country is fairly watered. On the whole, this division of the colony can be said to be a good one for stock. There are poison plants in our neighbourhood, chiefly of the York road and box varieties, distributed in patches throughout, and amounting in the aggregate to very many thousands of acres. The district is not much troubled by native pests, such as dingoes, boodie rats, opossums, eaglehawks, etc. Dingoes and eaglehawks have been largely destroyed in the last few years. Of the other pests mentioned there are none. A great many of the local cultivators are also sheep farmers. The orchard and vineyard area is steadily increasing. The land does not quickly exhaust itself if it is properly manured and cultivated. The district grows hay and grain crops to the best advantage. We know of no market for produce that is as good as that of Western Australia. In our opinion from £100 to £200 would not be sufficient capital for a start on a piece of land large enough, under the conditions that prevail in this district, for the maintenance of a family. The amount of money that is required to sustain preliminary expenses, and to keep things going until returns begin to come in, depends upon the part of the colony in which the selection is made. In the southern part of the colony more capital is required than in the Victoria district. In the latter district £500 and £1500 respectively would be needed by the applicant for a homestead farm of 160 acres, and a conditional purchase of 500 acres, respectively. The surveyed agricultural areas in the district are Nonga and Appertarra, near Northampton, and at Mullewa.

CHAPTER XI.

THE DEEP RIVER DISTRICT.

The following report has been furnished to the Lands department by Surveyor W. H. Goodwin, and we have to acknowledge our indebtedne-s to the Surveyor-General for placing the data of what is looked to as a new field for settlement at our disposal :— "The Deep river has its source at lake Muir, which has been almost dry for the last four or five years ; it takes a southerly course through paper bark swamps for about one mile, thence westerly for four and a half miles, thence southerly without any definite channel for seven miles over wide and more or less scrubby plains, which are joined by other plains from the north-west. After this there is a well defined channel, and the river takes a south-easterly course for twelve miles, when it turns south-westerly for about 27 miles ; thence south-easterly for 18 miles, thence easterly for about six miles to the Nornalup inlet. The river is spread from source to mouth by innumerable creeks and gullies, but the only tributary of any importance is the Weld river, which joins the Deep river at a place 22½ miles S S.W. from lake Muir. Permanent water is found all along the course of the river from a point about 13 miles south from its source, but continuous running water is not met with until about 26 miles south. It would only be possible to take a small boat up the river for three miles from its mouth, where the river varies from two to three chains in width. Above this point the channel is from 100 to 150 links wide as far as the Weld river, and full of logs, and the water very shallow, except where there is a water hole, of which there are several. Above the Weld river, excepting occasional pools, the channel gradually narrows until it ceases to exist on the plains six miles south from lake Muir. Karri is met with almost the whole way down the river, from about nine miles south from its source, but seems to be confined to the immediate neighborhood of the river in belts varying from 20 to 80 chains in width, or running in belts along some hill or gully. Red gum is found on all karri belts, generally on the margin of the jarrah country, and along the river banks. Many of the karri trees are of immense size, the trunks measuring six to ten feet in diameter four feet from the ground, and gradually tapering for 100 to 150 feet without a branch. The red gum varies very much in size, but as a rule, where it grows with karri the trunks are from four to six feet in diameter, and 60 to 80 feet in length. The jarrah is, as a rule, small, but there is an immense area where very fair jarrah, two to three feet in diameter, suitable for any purpose where large timber is not required, can be obtained. The country to the east of the Deep river consists of moderately high ranges, timbered with jarrah and scrub, broken by patches of karri and gum ; that to the west of the river is more gently undulating country, carrying similar timber. Around Brooks' inlet there are large, fairly open plains, timbered with stunted jarrah and scrub. Karri country is generally a chocolate loam of good depth, and should be very suitable for agricultural purposes. Where the red gum grows with the karri, the soil is red loam and ironstone. There are also outcrops of granite and ironstone. Jarrah country is generally poor looking sandy loam, or a light loam and ironstone, with granite and ironstone outcrops. Some of the former cover several acres. The country south of lake Muir is essentially timber country, and generally unfit for agricultural purposes, except where karri grows, and here the cost of clearing prohibits settlement until better means of communication with the market is provided, as it would never pay to spend at least £20 per acre clearing the land and have to cart the produce 100 miles or more. As a rule, the country is very scrubby and difficult to travel over, especially in the karri country, some of which is almost impassable owing to dense growths of hazel, acacia and other shrubs. A great deal of the timber has fully reached its prime and is only deteriorating as the years roll by, so that milling should be encouraged and all young timber strictly preserved. I was unable to examine the country away from the river as much as I would have liked, owing to the difficulty in getting about, but trust that the information I have collected will be of value to the department."

CHAPTER XII.

REPORT ON THE EUCLA DISTRICT OF WESTERN AUSTRALIA.

The following report on the Eucla district of this colony was furnished by request to the Commissioner of Crown Lands some months ago, and prior to the expedition being sent out under Mr. Surveyor Mason to define the country infested by rabbits. The writer of the report (Mr. Alex. Crawford) spent some time exploring the Eucla country a few years ago :—

The area described in this report consists of the land lying between longitude 124° and the boundary of South Australia, and the coast line and latitude 30°.

This area may be roughly divided into four distinct districts :—

1st. That extending from the coast to the foot of a low chain of hills or cliffs that run into the sea about two miles east of Eucla township, and generally increase in distance from the coast as they travel westward, until in some places they are 20 miles distant, and then gradually come into the coast a little beyond Eyre.

Immediately along the coast the country consists of low white sand hills covered with stunted mallee ; but as you go further back the land changes first to grey sand and then to good red soil of considerable depth, timbered with peach, sandalwood, and in places mulga, all with a limestone foundation. Some places are heavily grassed, and there is an abundance of salt bush, both the small variety and the "old man" salt bush, blue bush, cotton bush, and, in the season after rain, a great variety of herbage that sheep and horses eat. Hitherto, so far as I am aware, no actual fresh water has been obtained by sinking, although a good many wells and bores have been put down ; but at some places water has been found slightly brackish, but good enough for domestic use, while at other places water has been obtained good enough for stock purposes. At the same time it cannot be relied upon being obtained, except at considerable expense, as probably five or six bores will have to be put down from 70 to 100 feet before stock water is obtained—some of the water being much salter than the sea, and going three ounces of salt to the gallon. Good fresh water may be obtained, as a rule, in the sand hills along the coast, at no great distance from high water mark, by sinking just a little below the level of the sea. At the foot of the hills a plentiful supply of water may be conserved by making tanks or dams, as the bare limestone rocks in many places afford a first-rate natural catchment. There would be some expense attached to this method, as the ground is very porous, as is also the rock, and the tanks would have to be cemented. All this country, with the exception of the white sand hills and the samphire flats, is admirably adapted for wheat and barley growing. I had some cleared, and, although planted very late in the season, wheat and English barley yielded very heavy returns, but the straw was short.

In dealing with the rabbit pest, this will be the most difficult portion of the whole country to keep clear, as there is a good depth of soil for them to burrow and breed in, while the cliffs are in many places rotten and cavernous, and will afford great protection, and immediately on top of the cliff the scrub is very dense. In time this area ought to become a very valuable wheat producing country, and, as along the coast there are several breaks in the coral reef that runs parallel with it, good sized vessels can come to within a very short distance of the land, so that the expense of getting provisions there, and getting produce away, will be low.

The settlers in South Australia are getting good crops on far poorer land than is to be found all along here.

The second division consists of what—immediately on the top of the cliffs, and extending to about latitude 31·30°—may be described as fairly good stock country, but not fit for cultivation, except in a very few places, as the limestone rock comes very near the surface, and the average depth of soil is not more than eight or nine inches, while in many parts the rock is quite exposed. To the eye the country appears quite level, but I found that the land rose gradually as I went northward, as nearly as I could judge from the barometers about one and a half feet per mile from the top of the cliffs, the cliffs being about 200 feet above sea level.

This area consists of open plains and belts of timber, and belts of scrub, principally broom bush, which is found wherever there is the slighest approach to a sandhill.

There are a few narrow belts of dense mallee, that were so thick that we had to cut a track through with our axes, otherwise being quite impenetrable for either horses or camels. Some of the belts were not more than half a mile through, and the largest about two miles. Here the plains were fairly well grassed, where the depth of soil allowed it, and where the soil was too shallow, salt, blue and cotton bush abounded. The timber consisted of peach, sandalwood, mallee, bull oaks, and other varieties of the Casuonua ; also mulga and myall, the two latter being found in the northern part of the area.

There will always be a difficulty in conserving water here, as tanks or dams would have to be excavated out of the limestone rock, and that is almost as porous as a sponge. On one occasion there was an inch of rain in 15 hours, and in the hollows of the rock not a drop was to be found half an hour after the rain ceased ; in fact, the only water we saw here was in one or two large clay pans, and, although full, they were not more than an inch deep.

In this part we found many curious blow-holes, varying in size from two inches across to over two feet. From some of these a very strong current of air was issuing, while in others there was a strong suction. Some of them made a curious roaring noise, much louder at some times than at others, and on a still night could be heard a long way off. I went down one of the largest, being lowered about 16 feet by a rope before I reached the rock below. I found then I was in a large egg-shaped cave with a passage at one side, up which came a great rush of perfectly fresh air. I went about 20 feet down the passage or tunnel, and got into another cave, and while here I could distinctly hear the murmuring of water, apparently a great way off.

At a number of the blow holes we could distincly hear water running. In this district we found no tracks of natives at all. Saw plenty of kangaroos and emus, but very little bird life. Wedge-tailed eagles were visible every day all over this country.

The third division is a narrow strip of country extending, rougly speaking, from latitude 30·31° to latitude 31°.

It is in places almost desert, the rock being so near the surface that very little vegetation can grow, and in many places there is none at all. What there is consists principally of small stunted salt and blue bush, and where the soil is a little deeper, stunted sandalwood and narrow belts of mallee. The limestone here is more flinty in character and does not seem so porous and is extremely hard. Only one or two blow holes were found, and no others were seen further north. Except just after the rains this country would be almost useless for grazing purposes.

The fourth division extends from latitude 31° to a little south of latitude 30° and is far and away the best country in the whole area. Here I found in many places a good depth of soil and the country undulating, and in many places limestone hills and rocks standing up abruptly from the plain. It is a well grassed country, grass being often up to the camels' knees, while the timber is much larger than any found in the south. There is evidently a good rainfall, and water courses were found in many places, not the slightest trace of any such having been seen further south. Although no blow holes were found here, several large depressions were found that looked like half filled up wells, and in one of these most of the watercourses ended, thus showing that they led to underground channels. Native tracks and smoke were frequently seen, but notwithstanding all our efforts, we could not come across any natives, although several times we came on their fires, and once some kangaroo cooking, but the blacks had seen us and disappeared in the timber before we got near enough to them. We found no water in this district, and the natives seem to depend principally upon the mallee roots for water. In places where the natives had evidently camped for some time great heaps of these roots were found. The roots were nearly all about the thickness of a man's little finger, and about three feet long. The method of obtaining the water is to place the roots in hot ashes for a minute or two, and then turn them upright, with one end in a vessel to catch the water which gradually oozes out. On two occasions I believe the lives of our party were saved by thus obtaining water. The water is pure and fresh, without taste or flavour of any kind, much resembling distilled water. I might also say here that water is also to be obtained from the roots of the casuarinas, but the roots have to be broken in short pieces about three or four inches in length.

At the northern part of this district the limestone seems to run out, and a sandstone formation takes its place. Just at the end of the limestone country there is a vast chain of yellow sand hills covered with scrub of great variety and many beautiful wild flowers, also pine trees, but these do not grow high ; then comes a dense spinifex country that I did not go through, the camels refusing to go more than a few yards into it. In all probability good water soaks will be found in the sandhills, as native tracks were very plentiful, also dingo, kangaroo, emu, parrots and various other kinds of birds were in great numbers.

At the north-west portion we came to a small forest of what appeared to be red gums, none of the trees very great in girth, and about 30 to 40 feet in height, and here we also saw several good well developed water courses, and also some quartz gravel and reefs. A great deal of this district is good wheat producing land, and could be put under the plough at a very small cost. When I left this district I made for Queen Victoria Spring, as the water supply was almost done in our casks. When we got to the spring it was quite dry, but we found a soak about eight or ten miles south by following up the native tracks, and here we got our casks filled up.

In conclusion, I may say it would be useless for any person to go over this country looking for gold, as, with the exception of the north-west corner that I have already mentioned, all the rest is part of a great limestone formation, that also extends for about 200 miles east of the Western Australian border, and is known as Nullabar plains. If water could be obtained in the fourth division, I am certain, as a wheat and barley growing district, it could not be surpassed. I also consider it an ideal place for horse breeding, as there is an abundance of good pasture, and, with the limestone formation, could not be surpassed for producing bone and substance. The climate is magnificent—in winter, frosty nights ; in summer, heat, but dry, and never oppressive.

It may take time to open up this country, but I am certain, sooner or later, it will be one of the best districts in the colony for wheat growing.

I may just say here that I think there must be some large inland lakes to the north of it somewhere, as at night ducks and swans used often to fly overhead in a northernly direction. On several moonlight nights I have shot both ducks and swans as they have been passing over.

I may also say that on several occasions we came across a number of white kangaroos ; the only place in Australia I have seen them.

The timber called sandalwood throughout this report, is not the sandalwood of commerce, but what is known as sandalwood in the Eucla district.

PART II.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

INTRODUCTION.

By the EDITOR.

"I have a baylife as skilful as may be; yet, remembering the old saying that the best doung for the field is the master's foot, and the best provender for the horse, the master's eye, I play the overseer myself."—GERVASE MARKHAM, 1620.

THE numerous inquiries received almost daily by the Bureau of Agriculture, by whose direction the SETTLER'S GUIDE is issued, show that there are a number of people who have either already taken up land in the colony, or intend doing so, with the object of cultivating it, who have had little or no previous experience in agriculture. The majority of our more recent settlers are the "bone and sinew" of the eastern provinces; men well versed in colonial agricultural practice. For these any elementary lessons conveyed in the following pages will have little interest. They are intended for the guidance of the new settler who has not had the same experience. but whose welfare is nevertheless a matter of supreme importance, It is impossible to learn farming from a book; and no pretence is made in the following pages of imparting the whole theory and practice of agriculture. It is merely intended to convey, in the plainest language, a few useful and practical hints on the preliminary preparation of land after it has been taken up in its virgin state, and to give the new settler, lacking knowledge in cultural methods, the results of the experiences of others who have been farming for a lifetime in the colonies. Speaking generally, colonial farming cannot be called high-class farming. It is capable of great improvement, and it is pleasing to record that improvement is now gradually taking place, thanks to the dissemination of knowledge by the various departments of agriculture of the colonies and by the Australian press, to the noble example set by men of superior intelligence, and, in some cases, of superior means also, who voluntarily divorced themselves from the vast army of single croppers, and launched out in entirely new directions, in an endeavor to show how the land could be made to produce to its fullest extent. The depression which has existed for the past few years in all the colonies, except Western Australia, has perforce, caused the farmers of the eastern provinces to pay greater attention to varying the products of the soil, and unite in developing new features of rural industry that had hitherto been either totally neglected, or carried on by individuals in a more or less tentative and perfunctory manner. Prior to the granting of responsible government to this colony, and the shortly subsequent discovery of our phenomenal auriferous wealth, there was little or no inducement to the Western Australian farmer to produce much more than would supply his actual needs. He was in an isolated position. There was no demand for the produce of his broad acres across the seas, if we except wool and an indigenous product—sandalwood. The population of the colony was small—something under 40,000 souls—and the wants of these were easily supplied from the few fertile acres under cultivation. During the decade immediately preceding the advent of self-government, the area under cultivation decreased rather than increased. The long period of stagnation—its monotony, if broken at all, being only so by an active period of retrogression—which enveloped the Western

Australian farmers in their isolation like a mantle of fog, had the effect of making them, paradoxical as it may appear, the most sturdy, independent, self-contained, and, in a manner, prosperous farmers of the Australian group. The Western Australian farmer of the old school is scoffed at freely by newcomers who do not know him, and who do not realise all he has had to go through. There are ample evidences that farming in this colony was, twenty or thirty years ago, and is at the present time, by the same old school, conducted on sounder agronomic principles than it ever has been in the eastern colonies by the average free selector. Land, that in the halcyon days of the east would have been scorned by the selector, has been under crop here for forty years and is still in good heart, thanks to the judicious treatment it has received. The Western Australian farmer is a farmer of the very best type ; his adversities have made him so. In the eastern districts, in the south-west, and in other parts, one can find farms on which the first sod was turned by the plough nearly half a century ago, that are models of all that a well-conducted farm should be. This defence of the Western Australian farmer is made by one who knows them well ; by one who has never hesitated to tell them their shortcomings, and it is made in the interests as well of the new settler for whom this GUIDE is published. The new-comer who wishes to settle on the land will be one of the two classes into which new arrivals may be generally divided. The one class comes spilling over with theory and energy. The man belonging to this class wants to give advice ; not to receive it. He wants to write a book at once and tell everyone in the country how things should be done. His end is premature. To this class the Bureau of Agriculture has nothing to say. The other class, in which we find the man of intelligence, of quiet energy, of perseverance, the man who knows much, and knowing much, realises how little he knows, how much that he has learnt in one country will have to be unlearnt in another, how knowledge is the same all the world over, and yet how variously it has to be applied before it can become power, the man who seeks advice, not scorns it ; this is the man, whose success is almost assured, whom the Bureau of Agriculture welcomes to the shores of Western

Australia, and will cater for in every reasonable manner, and it is this man, if he contemplates settling on the soil, that I ask not to hold in too light esteem any advice that may be given him by the Western Australian farmer. Like, yet unlike, the farmer from the east will find that there are many lessons, taught by previous experience, that he will have to unlearn before he can be said to be truly successful here. That he may be successful is the earnest desire of the Government and people of this great colony.

CHAPTER I.

PRELIMINARY PREPARATIONS.

RINGBARKING, CLEARING, FENCING, CULTIVATION.

The Selector's Outfit.

I am now presuming that the land has been selected, and the settler and farmer of the future is about to leave Perth and take up his holding to commence the preparations preliminary to ringbarking, clearing, fencing, and cultivating. I am not presuming, however, that the selector is a man of capital, and can afford to while away his time in the city while all the rough work is being done, but that he has only sufficient capital, aided by his own labor and the strictest economy, to establish himself on the land.

The new settler in Western Australia has one advantage in his favor—the absence of great variations of climate. With the exception, perhaps, of the extreme south-west, where the rainfall is very heavy and continuous for some months, one might live in the open from year's end to year's end, satisfied, dry, and warm, covered only by a blanket and a sheet of bark. There are still in this and the eastern colonies many bark huts to be seen, still inhabited and very cosy, that were put up in the early fifties. Canvas now takes the place of bark as a temporary dwelling, and the new settler will have to equip himself with a tent and fly if he is going to settle on his block at once and commence to fulfil the residence clause of the Land regulations. It is surprising how comfortable tents can be made with a little trouble and ingenuity. They are made in the following sizes, and can be purchased in Perth for about the prices set opposite to each respective size :—8 feet × 5 feet, 10s. 6d., fly, 6s. ; 10 feet × 8 feet, 12s. 6d., fly, 8s. ; 12 feet × 10 feet, 16s. 9d., fly, 10s. 3d.

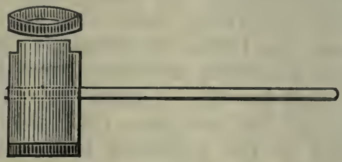
A fly, which may be described as a second and upper roof to the tent, is essential. It keeps the rain out in the winter, and adds greatly to the coolness of the tent in the summer.

In pitching the tent there will be no difficulty experienced in finding suitable saplings for uprights and ridge pole, etc. The highest ground should be selected as a site and the shade of trees will be welcome.

As the settler has come to stay, unless the price of it is of the most vital importance, a few sheets of corrugated roofing iron, a few feet of guttering and a 200 gallon tank may most advantageously be added to his equipment. Four uprights of stout saplings, with forks left at the upper ends, well sunk in the ground, two cross pieces for wall plates, with half a dozen sheets of ten foot iron laid on top, with bark, bag or brush sides, will make a temporary cook-house that will add greatly to the comfort of the good wife. Two lengths of guttering tacked at the back will always ensure a supply of fresh rain water. Half a ton (a case) of ten foot iron may be purchased for about £10, and if the selector can afford this outlay the tent may be dispensed with and a rough slab hut put up at once. The case in which the iron is packed is not to be despised, turned upside down on four stakes driven into the ground we have not half a bad table. When the selector is thoroughly settled down he will be free to provide himself with a brick oven, but he need not wait until then for a serviceable oven that can be made for little or nothing. Procure an iron nail can or an oil drum, clean it thoroughly and set it lengthways on stones or bricks, sufficiently high to get fire under it. Close it round with sheet iron, or anything that will resist fire. Leave about an inch clear space between the drum and the iron that surrounds the oven, and cover the latter with a layer of clay, working it well to make it secure and reduce cracking. The thicker the clay the longer it will hold heat, and the more it is worked the less it cracks. Leave an outlet at the top or back of the oven for the smoke to escape. Fit a door of wood or iron to close the mouth, and put in shelf to form sole for the bread or whatever has to be cooked, to stand on. If there are large white ant hills near the house the inside may be scooped out of one, and this will make an oven. Or one may be made entirely of pug, and if covered will last for many years. The selection of cooking utensils must be left to the wife. In case the selector is so unfortunate as to be single, the outfit will probably begin and end with a frying-pan, a billy, a pannikin, and a camp oven ; though this latter comparatively inexpensive article is considered by many as a useless accessory, and evidence of gross extravagance on the part of the owner. There are many men who have lived for years under the genial sun of Australia who have never owned anything more than a "bluey," a "billy," and a thirst. In the event of a chimney being required, ready made iron ones, which may be affixed with a few nails, may be had from about £2 5s. to £2 15s. each, according to size, and colonial ovens cost, 24 inches, 16s.; 30 inches, 22s.; 36 inches, 30s., each. A few bricks will be required for the hearth, and the chimney will last much longer if it is bricked up inside the back and sides for a couple of feet or so, to keep the fire from the iron. If bricks are not available, pug made from white ant hills or stiffish clay will do for the time being.

Tools.

The tools required by the selector on taking up his holding, will comprise axes, wedges, maul, grub hoes, picks, spades, fork, shovels, crosscut saws, files for sharpening same, tomahawk, steel bar, grindstone, and a set of carpenter's tools. Collins's or Sharpe's axes are the best, and are sold at 6s. each. Wedges, of which three or four will be required, are also sold at 5d. per lb. If the maul rings are bought, the head and handle of the maul, which is used in driving the wedges in splitting logs, can be made by the selector from any tough wood, a 1½-inch augur for boring the hole in the head for the handle being the only accessory tool required. The augur may well be added to the outfit, as if dynamite is used in clearing it will be found necessary. Maul rings may be bought in Perth for 2s. 3d. per pair. The maul is a large two-handled mallet, and the accompanying illustration shows how the rings, which are to prevent the head splitting, are put on.



Mattocks and grub hoes are used in clearing, for getting out the earth from between the roots. Grub hoes are made without the chopping arm, but mattocks, as shown in the illustration, are most generally in use. Grub hoes cost in Perth about 4s. each, mattocks 4s. 6d. each, and the handles 1s. each. A strip of leather inserted between the eye of the hoe and the handle will keep the head tight, as the handle is not wedged in like that of the axe. Grub hoes, mattocks, and picks, when they have become blunt, and perhaps jagged, if the ground is stoney, from continued use, are not ground, but "laid"; that is, they are put into the forge and given a new edge and re-tempered. The cutting attachment may with advantage be given a turn on the grindstone.

One long-handled pick, costing 4s. 6d., handles 1s. each, will be sufficient in the settler's outfit of tools. This is chiefly useful in particularly stiff ground, where the surface roots are so thick as to necessitate its use in preference to the grub hoe.

It will be found that if the handles of all the tools, so far enumerated, are dipped for a few minutes in kerosene before they are used, they will last much longer and be less liable to fracture. This treatment toughens the wood considerably. It will have been noticed, perhaps, that a strip of wood off a kerosene case that has been saturated by the oil, will, if broken across the knee, not come away in two clean parts, but will splinter longitudinally, and will require much twisting and pulling before the parts are finally separated. The application of kerosene to the wooden parts of all farm machinery that is much exposed to the weather has a most beneficial effect in preserving it, and will repay the slight cost of material and labour.

The spades and shovels required by the settler require no description, though care should be taken in selecting them. A spade costs from 4s. to 5s. 6d., and shovels, long or short-handled, round-mouthed or square, 3s. 6d. each. A digging fork may well be added to the outfit at a cost of 4s., as it will be found useful in clearing up and putting together the small scrub and under-ground blackboys preparatory to burning them.

The cross-cut saw had better be of the old-fashioned peg-tooth type, unless the settler has some knowledge of the lightning-tooth saws, which are not easy for the amateur to sharpen. Anyone of ordinary intelligence can put an edge on the old type of saw with a flat file. Saws of this or the lightning kind may be had as follows :—$4\frac{1}{2}$ ft., 11s. 6d.; 5 ft., 12s.; $5\frac{1}{2}$ ft., 13s.; 6 ft., 14s. 6d.; $6\frac{1}{2}$ ft., 16s. each. Flat files cost 9d. each.

The tomahawk, with hammer-head attached, is the handiest of tools, and no outfit is complete without it. Price, 3s. The grindstone is an absolute necessity. Prices vary according to the size, and may be quoted approximately as follows :—12 inch, 3s. 9d.; 14 inch, 4s.; 16 inch, 4s. 9d.; 18 inch, 6s.; 20 inch, 7s.; 23 inch, 8s.; 24 inch, 11s. each. Fittings, 4s. per set.

There is no necessity to go in for an elaborate standard treadle arrangement. A good strong spindle and handle or crank is all that is required, and two stakes well set in the ground, or a stake and a friendly tree or stump, will do for the stand. It is always advisable to keep the grindstone covered. This little attention adds years to its life and always makes it more satisfactory to use. Care should be taken in grinding tools, particularly heavy ones like axes, to keep an even surface on the stone, not to wear it away unduly either on the one side or the other, or, as is more commonly done, in the centre. Should this occur, the stone can be set right again by using a piece of square steel rod, pressing it firmly and squarely against the grinding face of the stone, which is turned meanwhile until the stone is ground true again. In mounting the stone an almost everlasting lubricant can be secured if a piece of bacon rind is laid fat side up in the sockets and under the spindle. It is surprising how long this simple and effective device will last, even under heavy pressure, as in the case of windlasses used for drawing water from wells.

A six foot octagonal steel crow-bar, which may be purchased for 8s. 6d., and a few carpenter's tools, will complete the settler's initial outfit. A claw hammer, three chisels, $\frac{1}{2}$, $\frac{3}{4}$, and $1\frac{1}{4}$ inch, a cold chisel, two saws, files for same, saw set, a brace and an assortment of bits, an adze, a jack and a smoothing plane, if the slab hut or more pretentious building is going up at once, may be had in Perth for the following prices, and may be regarded as a sound investment :—Claw hammer, 2s. 6d.; handled chisels, $\frac{1}{2}$ inch, 10d., $\frac{3}{4}$ inch, 11d., $1\frac{1}{4}$ inch, 1s. 6d. each ; cast steel cold chisels, 1s. 6d. each ; Sorby's hand saws, 26 inches, 5s. each ; Disston's hand saws, 26 inches, 7s. each ; hand saw files, 6d. each ; saw sets, 9d. each ; improved brace, 4s. 6d. each ; $\frac{1}{2}$ dozen bits, assorted, to 1 inch, 8s. lot ; adze, complete, with handle, 5s. 6d.; jack plane, 5s. 6d.; smoothing plane, 4s. 6d.; Mathieson's screw augers, $\frac{1}{2}$ inch, 1s. 8d., $\frac{3}{4}$ inch, 2s. 3d., 2 inch, 5s. 6d.; nails, any size from $1\frac{1}{2}$ inch to 6 inch, $2\frac{1}{2}$d. per lb.; bolts and nuts, $\frac{3}{8}$ inch, 4d., $\frac{1}{2}$ inch, $3\frac{1}{2}$d., $\frac{5}{8}$ inch, $3\frac{1}{2}$d. per lb.

Should the settler desire to add a blacksmith's and farrier's outfit to his initial working plant, he can do so at the following cost :—Blacksmith's tools—sledge hammer, 5s. 6d.; hand hammer, 2s. ; tongs, 2s. pair ; flat file, 12 inches, 1s. 4d. each; half-round file, 12 inches, 1s. 4d. each; vice, any size, 36s. per cwt.; anvils, any size, 29s. per cwt.; bar iron, 10s. per cwt. Farrier's tools—shoeing hammer, 3s. 6d. each; shoeing pincers, 2s. each ; shoeing knife, 1s. 2d. each ; shoeing rasp, 1s. 9d. each ; buffer, 1s. 6d. ; pritchel, 1s. 9d. Portable forges, similar to the one illustrated, the "Buffalo," may be had for £4 4s. each, and blacksmith's bellows at from 45s. to 80s., according to size.

All the foregoing quotations for implements and tools have been kindly supplied by W. Sandover & Co., of Perth and Fremantle, and are subject to slight modifications governed by market fluctuations.

CHAPTER II.

RING-BARKING AND ITS EFFECTS.

Compiled from Information Received from Societies in Various Districts.

The object of ring-barking or sap-ringing is to kill the trees in order that the pasture and water supply may be improved, and to facilitate clearing in the future. The surface roots of trees absorb nearly all the nutritive value from the soil, and grasses and other herbage cannot possibly grow, while the leaves of some trees, the salmon gum and sheoak, for instance, completely destroy the herbage upon which they fall, and grasses cannot be got to grow until the trees are dead. There are two methods of destroying the trees, one by ring-barking, that is taking off a belt of bark about a foot in width, and the other sap-ringing, that is cutting into the sap or outer wood of the tree as well as taking off the bark. The illustration herewith shows the different methods, and on perusal of the following pages it will be found which varieties of trees, in the opinion of old colonists in various districts, should be ring-barked and which sap-rung. The season for ring-barking or sap-ringing varies according to locality; but in all cases the trees should be rung when the sap is up. To ring too early in the spring when the sap is rising, means that but the top of the tree will be killed, but the roots will retain their vigor and continue to throw up shoots and suckers, which will be a continual annoyance to the selector, and prove a greater evil than the tree itself. When the trees are in bloom, it may be said, speaking generally, is quite time enough to begin ring-barking, and at this season the work is expeditiously carried out, as the bark strips most easily. In large paddocks, or in paddocks of any kind where stock are to run, a few of the best trees should always be spared to give shade. After the ring-barking has been done, the fallen timber and logs should be cleared up so as to give the grass every possible show, and it will be found economical to keep the paddocks clear of suckers as fast as they grow, and timber, as it falls when the trees are dead.

The following are the common and botanical names, as supplied by the Conservator of Forests, of the trees found growing in the South-west Land division of the colony:—

Jarrah (*Eucalyptus marginata*, Smith).
Red gum (*E. calophylla*, R. Brown).
Flooded or "blue" gum (*E. megacarpe*, Mueller).
White gum (*E. redunca*, Schauer).

Peppermint (*Agonis flexuosa*, de Candolle).
Yate (*E. coenuta*, la Billardiere).
Sheoak (*Casuarina Fraseriana*, Miguel).
Paperbark (*Melaleuca* sp.)
York gum (*E. loxophleba*, Bentham).
Jam (*Acacia acuminata*, Bentham).
Salmon gum (*E. salmonophloia*, F. von Mueller).
Morell, or Parker's gum, or mallee of Victoria (*E. oleosa*, F. von Mueller).
Mallet, or fluted gum, or gimlet wood (*E. salubris*, F. von Mueller).
Blackboy (*Xanthorrhoea*).
Wattle (*Acacia leiophylla*, Bentham).
Wattle Badjong (*A. microbotyra*, Bentham).
Karri (*E. diversicolor*, F. von Mueller).
Spearwood (*E. doratoxylon*, F. von Mueller).
Tuart (*E. gomphocephala*, de Candolle).
Black-butt (*E. patens*, Bentham).
Zamia (*Cycas* sp.)
Flooded gum (*Eucalyptus rudii*, Endlicher).
Flooded gum (*Eucalyptus decipens*, Endlicher).
Morrell (*Eucalyptus longicornis*, Mueller).
Sandalwood (*Santalum cygnorum*).

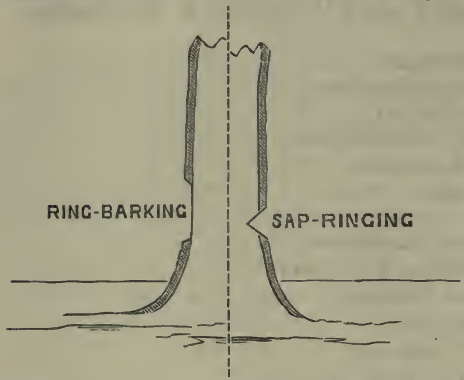
South-Western District.

Varieties of trees.—Jarrah, red gum, flooded gum, banksia, white gum, blue gum, peppermint, yate, black-butt.

Method and time of destruction.—Great diversity of opinion exists, apparently, both as to the method of killing the trees, whether by ring-barking or sap-ringing, and also as to the period of the year during which the work should be done. There is, however, an unanimous opinion that jarrah, red gum, banksia, and black-butt, should be destroyed by ring-barking, and yate, peppermint, and flooded gum by sap ringing. In the case of blue gums, the advocates of sapping and ring-barking are equally divided, while in the case of white gums the advocates of ring-barking are in a large majority. One correspondent does not enumerate the trees in his locality (Bridgetown), but advises "all to sap when the trees are in flower;" while another correspondent would "advise all newcomers to adopt ring-barking."

In regard to the time of the year when the ring-barking or sapping should be done, there is a wide range of opinion. All the months in the year are recommended, except April, May and June. There is a slight preponderance of opinion in favor of ring-barking the trees from October to February. One correspondent at Jayes reports having killed jarrah and white gum in three days by ring-barking in February. July to October appears to be the best period for destroying the red gum. January, February, and March for the blue gum, white gum, flooded gum, peppermint, yate, and black-butt. All, with one exception, agree that the banksia may be killed by ring-barking at any period of the year, the dissentient being in favor of the months of January, February and March.

Referring to jarrah, red gum, and black-butt, Mr. J. Forster Johnston, of Leschenault, writes :—"I have had over 1,000 acres ring-barked on my Preston property in different months, varying from March to November, and found it all effective." Referring to the "Leschenault blue gums" the same writer says :—"These trees I find very difficult to kill. Some few will die right out and others live for years." The late Mr. Andrew Muir, of Lake Muir, writes :—"I find the best time to ring-bark in our district is in the months of September, October, and the early part of November, for jarrah, red gum and black-butt. Yate requires ringing in January, as, if rung at that time, it will die in a few days, and will not throw up suckers, which it will do if rung in the winter months. . . . White gum you can ring at any time when the bark strips freely ; in fact, it is no use ringing any tree if it will not bark freely."



Mr. J. P. O. Wellard, of Mornington, writes :—"In ring-barking I have found the months named (January, February and March) the best for my land. The trees take longer to die, but they do not throw out any suckers. I think it will be found very hard to lay down any hard and fast rules about ringing, as it will be found not only to vary in different districts, but also in the same districts, as to the best time of the year."

Blackboys.—Mr. Wellard continues :—"What is almost as necessary as ringing the timber here in the hills, is having the blackboys cut down. I have had some land chopped and find the stock much prefer the cleared land to that where the blackboys are still growing in the same paddock. Price for chopping the blackboys, about 2s. per acre." On this subject Mr. J. Forster Johnston writes :—"I have 100 acres at the Preston . . . so thick with blackboys that I have known a stockman to ride three times round the block before he could find a beast in it, so I determined to have the blackboys chopped off. I let 50 acres to an old man at 2s. 6d. per acre . . . and on settling up he was so satisfied that he walked back 40 miles to do the other 50 acres and had a nice cheque to take. My neighbors laughed at me for doing this, saying it was money thrown away, but I see now a good many of them are following my example. You can now see nearly all over the paddock and there is a good swath of English grasses growing in a large portion of it." The Preston progress association reports that "chopping down blackboys greatly improves the carrying capabilities of the land."

Effect of the destruction of trees upon the water supply and growth of grasses.—There is a decided unanimity of opinion that the killing of the timber increases the water supply in all the localities from which correspondents have replied, but apparently more so in some localities than others. The increase in the water supply is probably governed by the diversity of the timber and the geological formation of the ground, and thus the slight difference in opinion may be accounted for. With one exception, that of the Ferguson farmer's association, who report that "the natural grasses die out" after ring-barking, there is a decided unanimity of opinion that the destruction of the timber is followed by a marked increase in the stock carrying capacity of the land. So unanimous is this opinion that one is led to believe that the exception referred to above has been caused, perhaps not by ring-barking, but by the young and finer grasses which the destruction of the timber had induced to grow, being fed out by overstocking. In fern (bracken) country ring-barking appears to be of doubtful benefit. Mr. Andrew Muir, Lake Muir, writes :—" From my own experience I should say that ring-barking improves all lands where there are no ferns ; but in fern country the killing of the timber stimulates the growth of the ferns to such an extent that they completely choke out the grasses in a few years."

Cost per acre of ring-barking or sapping.—The highest price paid for ring-barking is, according to the returns, 2s. 6d. per acre, the lowest, 1s. ; the average price per acre being 1s. 9¾d. The highest price for sap-ringing is given at 4s. 6d. per acre, the lowest at 1s. 6d., the average per acre being 2s. 9¾d.

Cost per acre of clearing before and after the destruction of the trees.—In nearly all cases the returns show that the cost of clearing the land ready for the plough is reduced to one-half after the timber has been killed by ring-barking or sapping. The highest price for clearing is returned by the Ferguson farmer's association at £20 to £25 per acre before ring-barking, and £10 to £12 per acre after the timber is dead. Mr. Andrew Muir returns the cost of clearing at £15 per acre before and £12 per acre after ring-barking in his district. Nearly all the other returns give the cost at £10 to £12 per acre before ring-barking, and £5 to £7 after. Omitting the two returns mentioned above, those of the Ferguson farmers' association and Mr. Muir, the average cost of clearing over the whole area covered by the returns is, before ring-barking, £9 14s. per acre, after ring-barking, £5 10s. 6d. per acre.

Murray District.

Varieties of timber.—Jarrah, red gum, blue gum, banksia, sheoak, paper bark, wild pear tree.

Method and time of destruction.—Jarrah, ringbarking. Red gum, Mr. Richardson recommends ringbarking, while the Murray horticultural society recommends sapping. Blue gum, sheoak, paper bark, wild pear, sapping. Banksia, ring-barking.

August to December for all trees except banksia, which may be rung at any time, and paper bark and wild pear, the best period for ringing these being returned as doubtful. "The blue gum can be killed at any time of the year within 24 hours, if it is properly sapped," according to the Murray horticultural society's return. The honorary secretary of this society in returning the form writes :—"It is the general opinion here that ring-barking and sapping tend to toughen the roots of the trees, making the trees harder to pull up for some time after, so if you cannot afford to wait for two or three years to allow the roots to rot, it is a better plan to pull up the trees green, as the heavy tops help to bring them down. But having waited the time mentioned, the clearing of the land is made all the easier, as the trees come down willingly."

Effect of the destruction of the trees upon the water supply and growth of native grasses.—There is a very decided opinion expressed in both returns that the destruction of timber largely increases both the water supply and feed.

Cost per acre of ring-barking and sapping.—From 1s. to 2s. for ring-barking, according to the quantity of timber. From 2s. to 3s. for sapping.

Cost per acre for clearing before and after the destruction of the trees.—The returns show the cost of clearing to be reduced to one-half after the timber is dead. Before ring-barking the cost is set down by the Murray society at from £3 to £5 per acre, and by Mr. Richardson at from £4 to £15 per acre. After ring-barking, from £2 10s. to £8 per acre.

Great Southern Railway District.

Varieties of trees.—White gum, York gum, jarrah, jam, sheoak, stinkwood, manna gum, flooded gum, red gum, yate, salmon gum, Parker's gum or morrell, mallet or fluted gum.

Method and time of destruction.—In three of the returns sapping is recommended for all the trees mentioned above, with the exception of the salmon gum, which one correspondent advises should be ring-barked. York gum and flooded gum are liable to throw up suckers, it is said in another return. "Sap-ringing is desirable in each case for immediate results, but ring-barking is preferable if one can afford to wait the results for, say, four years."—*Wagin-Arthur farmers' alliance.* The Katanning farmers' association advocates destroying the white gum and jarrah, either by ring-barking or burning around the butts ; and ring-barking jam, sheoak, and manna gum, and sapping York and flooded gums. Stinkwood if cut down, dies out. York gum and jam should be rung when the sap is well up. The bark will then fall off every limb, and the roots can be burnt right out. Flooded gum is very difficult to kill. Firing round the trunk in the month of March very often has the desired effect. Two correspondents state their experience has shown that ring-barking and sapping may be carried on all the year round with successful results if the work is properly performed. The Wagin-Arthur farmers' alliance advises that the work should be done during December, January and February, while the Katanning farmer's association advocates ring-barking, or sapping, as the case may be, in September and October, for all trees except manna gum, the period for this variety being extended from September to March. Sheoak may be treated at any time.

Effect of the destruction of timber on the water supply and growth of grasses.—All the correspondents are of the unanimous opinion that the destruction of the timber improves very materially both the water supply and the stock carrying capacity of the land. The Katanning farmers' association, however, makes a reservation in favour of the retention of jam trees—"Jam is the only tree which does not injure the grass to any extent. When all the trees are destroyed, the sun has more power over the grasses, which quickly dry up. In the middle of the summer the grass is often found to be green and succulent under the shade of the jam trees when it is dried up elsewhere. . . . Stock eat the leaves of the stinkwood and young sheoaks."

Cost per acre of ring-barking or sapping.—In two returns from the Wagin district the cost of sapping is put down at 1s. less per acre than that of ring-barking, the prices being 2s. to 3s. per acre respectively. In the other returns the cost of ring-barking is from 9d. to 1s. 6d. per acre, and of sapping from 1s. 9d. to 2s. per acre. The average cost per acre, taking all the returns into consideration, for ring-barking is 2s. 1d., and sapping 1s. 11½d.

Cost per acre of clearing before and after destruction of the trees.—The Wagin-Arthur farmers' alliance return puts the cost of clearing, both before and after the destruction of the timber, at £3 10s. per acre. The other returns show that the cost of clearing after the timber has been killed by ring-barking or sapping is reduced fully one-half. The Broomehill agricultural society's return puts the cost of clearing prior to ring-barking at £3 per acre, and after the timber is dead, at £1 10s. per acre. In the Katanning return the figures are £3 and £2 per acre respectively.

York District.

Varieties of trees.—York gum, white gum, salmon gum, jam blue bush, native cassia, manna gum, morrell gum, flooded gum, sheoak.

Method and time of destruction.—The Beverley branch advises ring-barking all the eucalypti, while the York branch advocates sapping, without any reservation. The Greenhills progress association advises that old York gum trees should be sap-ringed and that the young ones should be ring-barked; that white gum, salmon gum, cassia and jam, should be sap-ringed, and that the blue bush should be cut down. It will thus be seen there is a preponderance of opinion in favor of sap-ringing.

From January to April is the opinion of the York and Beverley branches for ring-barking or sapping all trees, while the Greenhills association advises November to April for ring-barking York gum, and May to October for sapping this tree. November to May is the period advised for destroying white gum and cassia, and "any month" for the remaining trees.

Mr. W. Padbury filled in a return embracing his experience in the Eastern districts, the Victoria Plains, and at Yatheroo. His remarks may be inserted here. He says:—"I would not cut through the sap of trees on land I wanted to cultivate; as when the tree is dead and the tree-puller is put on to it, if it has been cut through the sap, it is liable to break off and leave the stump in the ground. I prefer using the tree-puller in clearing, to the ordinary grubbing, as it pulls more roots clean out, and in ploughing afterwards you do not find so many obstructions. For red gums, white gums, salmon gums, and York gums, I find sapping the best, and the time I do it is as soon as the bark will run after the first winter rains, until the sap goes down again. With flooded gums I find you must cut through the sap, as they will not die otherwise. My experience is that trees that have been sap-ringed do not generally throw out so many suckers. Some trees take two or three years to die, according to the nature of the tree and the land on which it grows. I think when the sap is well up, say September, October, and November, is the best time for ring-barking, as the tree dies more quickly if the work is done at this time."

Effect of the destruction of the trees upon the water supply and growth of native grasses.—There is an unanimous opinion expressed that a most marked increase takes place in both the water supply and the number and vitality of the native grasses that spring up after the trees have been destroyed.

Cost per acre of ring-barking or sapping.—From 1s. 3d. to 2s. 6d. per acre are the prices given for ring-barking, and 1s. 7d. to 2s. 6d. for sapping. The York branch puts down the first cost of sapping at 1s. 3d. to 1s. 9d. per acre, and second cost 4d. to 6d. per acre for killing suckers.

Cost per acre of clearing before and after the destruction of the trees.—The cost of clearing for the plough after the country has been ring-barked for two to three years, is in all cases estimated at half that of clearing prior to ring-barking. The average cost o clearing when the trees are green is, for the district, £2 15s. per acre, and half this sum per acre when the trees are dead.

Northam District.

Varieties of trees.—York gum, jam, morrell, white gum, gimlet wood, salmon gum, manna gum, wattles, sheoaks, flooded gum.

Method and time of destruction.—Mr. Gregory advises ringing salmon and flooded gums, sheoak and jam, and sapping white and York gums. This, in the main, is also the advice of the Irishtown branch, while Mr. Throssell advises sapping all the trees except the jam, which should be rung. Mr. Dempster furnishes an interesting note on the destruction of the York gum. He writes :—"All trees or scrub can be killed at once by sap-ringing, but the York gum throws out shoots for years after the top of the tree has been killed, and the cost of keeping under the suckers is more than that of ringing in the first instance. I have not yet met any one who can speak positively as to the best time of the year for ringing these trees. Occasionally, some die and give no further trouble, but as a rule they will not under the present system. Killing the tree slowly by barking I think is the most effectual. I have an idea, supported by facts, that goes to prove that by killing the tree slowly the strength returns to the soil, for the best results I have ever seen from ringing have been by the slow process."

Mr. Dempster and Mr. Throssell have apparently succeeded in killing the other trees by either ring-barking or sapping all the year round, but they both evidently incline to doing the work in the summer. The former says : "I rather think that the summer ring-barking is best for York gums and large trees of the same class." Mr. Throssell writes : "I have not arrived at any conclusion, as I have succeeded in the matter of effectually killing the gums by ring-barking during all the months of the year. I prefer summer for either sapping or ring-barking. In the latter the process is slower, but more effective." The Irishtown branch advise that the work should be done between November and March, while Mr. Gregory favors January and February for York and white gums, and September and October for the others.

Effect of destruction of trees upon the water supply and growth of native grasses.—There is a decided consensus of opinion that the destruction of timber improves both the water supply and the growth of the native grasses. Mr. Throssell writes in reference to the latter :—"Especially is this noticeable on the salmon gum country, which prior to killing the timber is devoid of herbage. The effect is marvellous, as different species of grasses put in an appearance the first winter after the timber has been ring-barked, and grow luxuriantly. Owing to this 'discovery' the salmon gum country is coming into great favor."

Cost per acre of ring-barking and sapping.—From 1s. 3d. to 1s. 9d. for ring-barking, and 1s. 6d. to 2s. for sapping.

Cost per acre of clearing before and after the destruction of the trees.—The highest price quoted for clearing before the timber has been destroyed is £3, and the lowest £2 per acre. The highest quotations given for clearing after the timber is dead is £2 10s., and the lowest £1 10s. per acre. The average per acre of the returns is : before ring-barking, £2 14s. ; after the timber is dead, £1 17s. 6d. Mr. Throssell writes :—"Referring to the value of killing timber as a preparatory measure to clearing for agriculture, it requires to be explained that in setting down the saving at only 10s. per acre, I refer to landowners who let out their clearing by contract at so much per acre. But for the farmer who thoroughly ring-barks or kills off the timber some years before clearing, and then clears his land with his own or monthly hired-labor under his own supervision, the saving, I am confident, would be fully one-half."

Toodyay District.

Varieties of trees.—White gum, jam, York gum, red gum.

Method and time of destruction.—White gum, ring-barking ; York gum, ring-barking or sapping ; jam, sapping ; red gum, not stated.

White gum should be destroyed from September to October ; York gum, February to March ; jam, at any time ; red gum, not stated. The secretary adds in a note :—"The branch is of an opinion that the red gum should never be interfered with on the pastoral lands, as these trees do not do any harm to the feed, and are invaluable as shade."

Effect of the destruction of trees upon the water supply and the growth of native grasses.—The destruction of the timber has a most beneficial effect in increasing the water supply and the growth of the native grasses.

Cost per acre of ring-barking or sapping.—1s. to 1s. 6d. per acre for either operation.

Cost per acre of clearing before and after the destruction of the timber.—Before, £3 ; after, £2 10s. to £2 15s. The secretary writes as follows :—"For agricultural purposes the branch is of the opinion that grubbing when the timber is green is preferable to killing the timber by ring-barking, or sapping before clearing. The cost per acre of clearing after ring-barking is from 5s. to 10s. less, but this is from two to three years after the ring-barking has been done."

Geraldton District.

Varieties of trees.—Wattles, York gum, jam, flooded gum.

Method and time of destruction.—Wattles, York gum, and jam, by ring-barking ; flooded gum, by sapping.

November or December, when the sap is down, is returned as the best time for destroying the trees.

Effect of the destruction of trees upon the water supply and growth of native grasses.—The effect is very great upon the water supply. Even within six months after ringing the supply gets stronger. The grass grows thicker and is appreciated more by stock.

Cost per acre of ring-barking or sapping.—Ring-barking, about 5s. per acre ; price for sapping not stated.

Cost per acre of clearing before and after the destruction of the trees.—Before ring-barking, £5 per acre (wheat lands) ; after the timber has been killed, £3 per acre.

Note.—Mr. M'Kenzie Grant writes :—" Ring-barking, I find, is only the beginning of clearing the land, as the saplings and young shoots keep springing up and have to be grubbed out year after year."

CHAPTER III.

CLEARING; HOW TO DO IT, AND HOW NOT TO DO IT.

The removal of timber from virgin land preparatory to ploughing, is known in Australia as "grubbing and clearing." The cost of doing this work, of course, varies very greatly, as will have been gathered from the earlier chapters which give the average price of clearing in the various localities described. The chief factor in the cost of clearing is the quantity of timber that has to be removed, and there are also subsidiary causes which regulate the price at which the work can be done, as, for instance, the nature of the soil, the time of the year at which the work is carried on, the variety of timber, the proximity to the labor market, and the mechanical aids that may be employed. Taking all these things into consideration, and speaking generally, the spring and early summer are the best periods of the year in which to do this work. If the land is clay or at all inclined to be stiff it will have been well soaked by the winter rains, and be easier to remove from around the roots of the trees. Land cleared in the spring and ploughed the same season, is less prone to throw up suckers from the fragments of roots that are bound to be left on the ground, no matter how carefully the work is done, than land cleared or ploughed in the autumn or winter. Another advantage of clearing in spring and early summer is that the rains are less frequent and the timber has a better chance of burning. Light sandy soil covered with banksia and other woods that burn readily, may be cleared at any time of the year. The new settler may think that anyone who has sufficient strength can do grubbing and clearing as well as the next one. This is a great mistake. One cannot exalt clearing into an art or a science, but there is a knack in doing the work that, simple as it looks, requires a good deal of practice before one can become master of it. So much is this the case that if the inexperienced settler has the money at his command, my advice to him is to get this most laborious work done by contract.

If he has not, and is compelled to do the work himself, the hints conveyed in the following notes may be of use to him. If I now give in skeleton form the outline of a specification for clearing, it will, I think, with a little explanation, convey to the mind of the new settler the chief features of the work that has to be done, and the proper way in which it should be performed.

I. All trees to be grubbed completely round and out to a depth of not less than 18 inches, and all roots to be run to the same depth or until they can be broken by the hand.

2. All underground blackboys to be grubbed out below the crown.

3. All zamia palms to be grubbed and completely removed from the ground.

4. All scrub large enough to impede the progress of the plough, or that cannot be completely turned in in ploughing, to be grubbed out.

5. The timber and scrub, after having been grubbed, to be burnt and the ashes spread as far as they can be cast.

6. All wood not absolutely required for burning the butts and stumps of trees, to be left on the ground.

7. No holes to be filled in until they have been examined by ………………………………or his agent ; when passed, to be filled in three inches above the level of the surrounding ground.

8. The whole of the ground to be left ready for the plough, and the contract to be completed in a workmanlike manner on or before………………………………

9. If the contract is not completed on or before the date above-mentioned a penalty of………………shillings per day for every day over the specified time, to be paid by the contractors, and deducted from any money that may be due to them.

Such is the rough framework of a specification for a grubbing and clearing contract. The first clause is self-explanatory. The second and third clauses refer only to that part of the country where zamia palms and underground blackboys are to be found. The latter, if not grubbed well below the crown, that is, where the leaves shoot from the bole, will continue to spring up perennially.

Clauses 4 and 5 need no explanation, unless it is to say that the reason for having the ashes spread is that they are a most valuable potash manure and should be made as much use of, and spread over as large a surface of ground, as possible. Clause 6 is inserted at discretion. If work is very plentiful and the settler has a large area, it may be omitted ; but if the area is 100 acres or less, the economy of firewood cannot begin too soon. It may appear to the settler that there is plenty of wood for all the world, and for ever ; but even if there was, there is no sense in wasting it. There is no sense in wasting anything, so far as my experience goes. But, as a matter of fact, it does not take very long, if clearing is vigorously pursued, to exhaust the wood supplies on a 100-acre farm ; for it must be borne in mind that even with the most careful management about 80 per cent. of what would otherwise be available for firewood has to be used in burning the trunks and butts of trees that cannot be utilised.

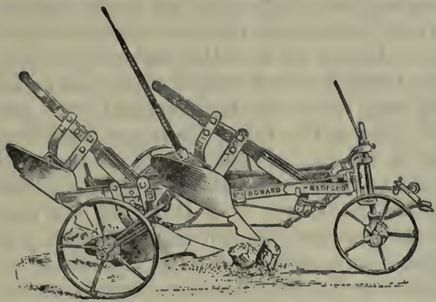
It is important that no holes should be filled in until they have been examined for roots, and when they are filled in they should be heaped up a little in order to allow for the settling down of the loose soil that must eventually take place. It is for the person letting the contract to say whether he will supply tree pullers, tools, explosives, and rations. As a rule, the contractors supply themselves with all these things, and it is better, as it saves possible complications, that they should.

Before going any further, I should like to impress upon the minds of not only new settlers, but old settlers also, the desirableness of having all contracts made in writing. Verbal agreements frequently give rise to misunderstandings that might have been avoided if ink and paper had been resorted to. The best of intentions may exist on both sides at the time the verbal contract is made, but it is a very difficult matter, in the first place, to get two minds to completely grasp the same situation from exactly the same aspect; and it is, in the second place, an infinitely more difficult matter to get these same two minds two months afterwards to look back upon the situation as it then appeared, and again view it from the same aspect. Memory is so apt to play us false; black and white, never. The risks to both sides of acting upon a verbal agreement are infinitely greater than committing oneself to any serious error in signing a written contract that has been mutually agreed upon.

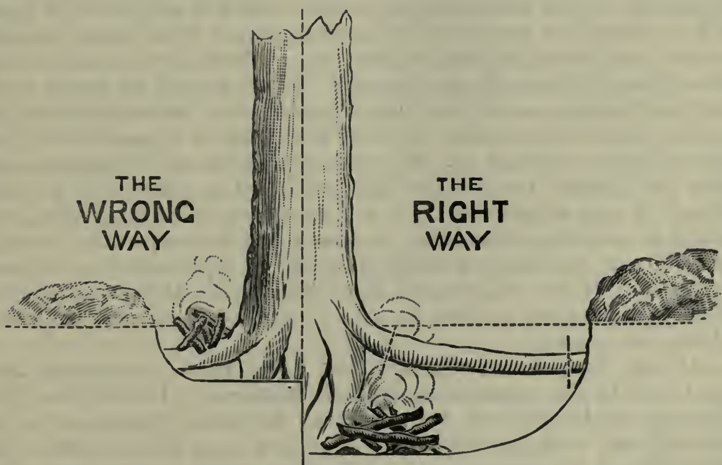
There is another matter I should like to mention here, and that is, the advisableness of the settler, particularly the new comer, keeping a daily record of his work. A diary may be had for a shilling that will last for a year. It may be used as a day book, in which the outgoings and incomings in cash and produce may be put down until such time as they can be entered up in the proper books. Every event of any importance should be noted, the taking-on of a new hand, paying him off, ploughing, sowing, harvesting, burning off, increase in live stock, and the hundred and one operations and events that make up the routine of twelve months of farm life. It is surprising the many little mental worries and anxieties, occasioned by the vagaries of memory, that this simple record relieves. Between tea time and bed time there is always a spare half hour, and a portion of it cannot be more profitably expended than in recording, in black and white, the more important events of the day.

To return to clearing, and the new and inexperienced settler who has, perforce, to undertake the work himself.

On clearing the lighter soils, which generally in this colony mean lighter and easily removed timber, there is very little to be said. Common sense in this, as in everything else, must be the settler's best guide. It may be that it will be considered desirable the first year to leave all the large timber standing—in which case it should be ring-barked at once, no matter what time of the year—and grub out only the small stuff, say 12 inches in diameter and under. If the large trees are not too thick this can be done with advantage, and the ground can be ploughed—"scruffed up"



is the better expression, as it is hardly ploughing, under the circumstances—with a stump-jump plough. This plough, as the illustration shows, and as its name implies, is constructed in such a manner as to permit ground of the very roughest kind being worked. If an obstacle which cannot be cut through is encountered by the share the movable beam is raised by the tractive force, and, after the obstacle is passed, the share falls into the land again and recommences work. The stump-jump plough is, however, an expensive item—a double-furrow costing about £17, and a treble-furrow £23—the small settler will be hardly able to afford, and unless he can get the work done by contract, an ordinary single-furrow plough will have to be called into requisition. Ploughing only partially cleared land with a single-furrow rigid plough is a most exhilarating, but not altogether satisfactory, operation, but still it can be done with a little care and without damaging the implement. If the land is to be cleared outright at once, which is by far the best way, if time and means permit, the settler must gird up his loins and make up his mind to tackle the job bravely. If a big tree has to be got out it is no use playing round the roots. Dig the



soil away well round the tree, so that you have plenty of room to work. There is nothing gained by chopping off the roots close by the trunk, for you must remember that every root has to be traced until it is well out of the way of the plough that is to follow clearing. Again, the tap root has to be got at, and this cannot be done unless you give yourself ample room to work round and under the tree. If the tree has plenty of top, when the main lateral roots are cut in all probability it will fall; but if there is little or no top, then either the tap root will have to be cut, or the agency of fire will have to be invoked. Don't be too ready with the fire stick. Grub well round the tree to the full depth before you think of starting the fire. Once you have started your fire, do not think of letting it go out. Clearing is not eight-hours-a-day work. Last thing at night and first thing in the morning the fires have to be gone round and put together. A sapling from six to seven feet long is used as a lever for putting the logs together whilst burning.

A second and more expeditious method of clearing is by means of a tree-puller or "forest devil." Several of these machines, both for horse and man power, have been invented and perfected in this colony, and will be found satisfactory in every way. Where clearing has to be done quickly and on a large scale, the tree-puller is almost indispensable; but on a small piece of land, and especially when it is intended for vines or fruit frees, I am inclined to think that the slight extra cost of clearing entirely by hand is money saved in the long run.

A third method is by the use of explosives, and this I have found both expeditious and profitable, especially on ring-barked country where the timber is dead. I have always used dynamite in preference to either powder or rackarock, the only other explosives I have tried. It is not necessary to use sufficient explosive to blow the tree down, but merely to loosen the ground about the roots and create a vent under the butt of the tree. When the timber is dead a fire-stick will generally do the rest. A hole should be bored with a two-inch auger, not in the butt of the tree, but immediately under it, in the fork of the roots. From ¼ lb to ½ lb. of dynamite will be quite sufficient to shake up the roots and create a vent for the fire under the largest tree. Last summer I had to have some ground cleared. It was stiffish clay land, and the ground was very hard, and I found a considerable saving in time, and consequently money, was effected by using a small quantity of dynamite, as I have described, to loosen the ground round the trees. Dynamite may be had in 5-lb. packets, costing 8s. 9d.; detonators cost 9d. per doz., and fuse 1s. per coil.

At one time it was thought the royal road to clearing had been found in the use of saltpetre and kerosene. I have tried the following method myself, but must say have only found it to be advantageous with timbers that will in any case burn readily. A hole, eighteen inches deep, is bored with a 1¼ inch auger down the centre of the stump after the tree has been felled. Into this hole two or more ounces of saltpetre are put, or it is filled up with kerosene and plugged up. In fine weather, in the spring, the plug is removed and about a quarter of a pint of kerosene is put in if the saltpetre has been used, or the hole is again filled up with the oil if oil has been previously applied. This being set on fire, it is said the stump will continue to burn away quietly until both stump and roots are consumed. Personally, I am of opinion that a little dynamite properly applied, or one of the other methods of clearing mentioned in this chapter, are cheaper and more satisfactory in the end.

There is a fourth method, which is certainly the most expeditious, but it requires a large amount of capital and would only pay where a large area of country had to be cleared. I refer to the use of traction engines fitted with long wire ropes by means of which the trees can be pulled down as they stand, without any preliminary preparation, and then "snigged" up into rows eight or ten chains apart, and there left for all time or to be burnt off at leisure. If this process is followed there is nothing to do but to fill up the holes and set the stump-jump plough to work.

Mr. James Biram, a Victorian farmer recently arrived in this colony, writes as follows to the Secretary of the Bureau of Agriculture :—"I send you herewith particulars of a plan that has been adopted in South Gippsland, Victoria, for the last seven or eight years, of burning out or stoving trees or stumps, instead of grubbing. The Gippsland timber required to be killed by ring-barking for two or three years first, but I believe that in the north-eastern and Goulburn Valley districts of Victoria, among the box timber, they will burn out at any time, and this method has been in use for many years there. Some of the timber in this colony might be like the box and burn out at any time, while others might want to be killed ; but I am sure it is worth trying. The method is as follows :—

"Clear away all the earth from the stump and the surface roots to a depth of about six inches. Pack small billets of wood alongside and over the surface roots, and also pack billets all round the stump for a height of about one foot or eighteen inches. Cover all the billets with earth exactly in the same manner as for burning charcoal, leaving a small vent-hole for the purpose of lighting a fire. When the fire is fairly alight close the vent-hole. Go round the fires once or twice a day with a light wooden rammer, and where-ever the ground is loose or has burned hollow, press the earth close again and keep it covered up. The success of the operation lies in not allowing the fire to burn hollow, but in keeping the earth close to the burning roots and stumps. In this manner the largest sized timber may be burned out in from one to three weeks, and the roots will be burned down quite clear of any plough or other farm implement. After the burning, spread the ashes and earth again. The top part of the stump that is above the banked up earth will burn through before the stump is burned. It must be rolled aside and the earth closed over the place again. If standing trees are burned in this way, care will have to be taken to keep stock away ; and also in going about it, as the trees may fall unexpectedly, but it is found cheaper and better to chop down the trees and burn out the stump than to grub the trees, besides the sour earth is not turned up as in grubbing. The work is light. It takes very little time or trouble to go round the fires to keep them burning, and one man can attend to a great number as well as keep on lighting others. Before leaving Victoria last March I was at the farm of Messrs. Murdie Bros., well-known farmers near Warragul, who have some very heavy timber on their land. They told me this was the best way they had tried. An old man had taken a contract from them last year to clear 50 acres of stumps. He had been working by himself all the winter and had nearly finished, and it had cost them from £3 to £4 per acre less than the old way. Other farmers about there told me it was only half the cost of grubbing to stove the stumps. I had some stumps cleared on my own selection about three years ago for £2 per acre that would have cost over £4 per acre to grub."

Burning Off.

With some varieties of trees it is much easier to get them down than to get rid of them after they are down. This is particularly the case when the timber has not been previously killed by ring-barking. The usual method of getting rid of the timber is by burning it, first cutting the smaller limbs up into convenient lengths for handling with an axe or cross-cut saw. The larger limbs and butts of the smaller trees should also be cut up and pulled up to the largest trunks by horse power. The mistake is sometimes made by those who have not done this work before, of stacking up all the small timber on the trunks and setting fire to the whole lot at once. This should not be done except in the case of trees that are dead, and consequently dry, and that are known to burn freely. Burning off is, at best, under the most favorable circumstances, a tedious process, and though it may seem very slow work, it is quicker in the long run to economise the smaller stuff and add a little to the fires as needed. It occasionally happens, in spite of the greatest economy, there are still butts unburnt, and which are too large to be moved whole and which cannot be split by the wedge and maul. When this occurs it has to be decided whether it is cheaper to haul more timber to the spot or break up the butts by means of explosives. A plug or two of dynamite judiciously applied will do more in the few minutes the operation requires, than a man and a team will do in a day.

Another way, which has been recommended to me, but which I have not tried, of getting rid of the huge butts of red gums and other trees that are full of sap and refuse to burn except under the most intense heat, is to throw earth up to them and treat them in the same manner as if burning charcoal. In burning off, in fact, in the whole operation of clearing for the plough, it should not be forgotten that it is one hundred per cent. labor, and in order to cheapen the process as much as possible, not cheap labor, which is very often dear labor in the long run, but mechanical appliances and every other available means should be employed to assist the capable laborer in his work. In the rudimentary, but necessary, work of clearing, brains should come into play as well as hands. The foregoing remarks are not intended as a complete discourse on the whole art of clearing, but merely to indicate to the newcomer the several methods which may be followed with advantage. In this, as in everything else, a little practical experience is of more value than a whole library of theory.

CHAPTER IV.

BURNING OFF.

THE BUSH FIRES ACT AND REGULATIONS.

It is very desirable to burn off scrub country occasionally in order to sweeten and promote a more vigorous growth of succulent feed. Fire is the great revivifying agent of the Australian bush. It may seem very strange to those living in the colder latitudes of the northern hemisphere, but a large number of seeds of indigenous plants of Australia will not germinate until they have been subjected to an intense heat. Nature has protected them with an outer covering that is so hard that only fire will break it sufficiently to permit the requisite moisture to gain admission to the seed and induce germination. The end of summer or beginning of autumn, before the rains set in, is the best time for burning, and it should be done at night if possible, as it is so much easier to see where the sparks fly. Every precaution should be taken to prevent the fire getting away, and it is better to burn a strip round the fences first in order to obviate this as far as possible. By the following extracts from the "Bush Fires Act" it will be seen that regulations can be made from time to time by the Governor in Executive Council, as to what time burning off is permissible in certain districts. It will also be noticed that burning off may be done, under certain conditions, at any time, provided adequate notice is given to neighbours.

INTERPRETATION.

4. In this Act the following words shall have the meanings respectively assigned to them, if not inconsistent with the context :—

"Bush" shall mean and include grass, stubble, scrub, bushes, trees, and all other vegetation.

"Prohibited times" shall mean the times of the year during which it shall have been declared by the Governor in Council to be unlawful to set fire to the bush within any district or part of the colony as hereinafter mentioned.

"Occupier of land" shall include any person residing on the land and having charge or control thereof, whether such person shall be the owner or tenant, or a bailiff, servant, caretaker, or other person residing and having charge or control as aforesaid.

5. The Governor, with the advice of the Executive Council, may from time to time, by notice published in the *Government Gazette*, declare the times of the year during which it shall be unlawful within any district or part of the colony mentioned in the said notice, to set fire to the bush within that district or part, and may from time to time revoke, vary, or amend such declarations by notice as aforesaid.

PENALTY FOR SETTING FIRE TO THE BUSH DURING PROHIBITED TIMES.

7. Every person who shall wilfully or negligently set fire to the bush within any district or part of the colony during the prohibited time for that district or part, shall be liable, on conviction thereof before any two or more justices of the peace, to a penalty not exceeding £50. Provided that any lawful occupier of land may set fire to the bush on the land in his occupation, if he shall have previously given to all occupiers of the lands next adjacent to his said land, not less than seven days before he shall set fire to the bush as aforesaid, a notice in writing that he intends to set fire to the bush on the land in his occupation on some day or days between the seventh day and the fourteenth day after giving the said notice as aforesaid, and if he shall also take all such precautions as shall prevent the fire from extending to any of the lands adjacent, or from damaging the crops, grass, trees, houses, or buildings on any of the lands adjacent.

SERVICE OF NOTICE.

8. The said notice may be in the form in the schedule to this Act, or in any other form which shall clearly convey the information required by this Act, to be given to the adjoining occupiers. Provided that notice shall be deemed to have been duly given under this Act, if it shall have been either given or shown to the occupier of the adjacent land, or if it shall have been left at his usual place of abode; and provided, further, that no notice as aforesaid shall be necessary in the case of lands which are unoccupied.

PENALTY FOR SETTING FIRE TO BUSH WITHOUT NOTICE TO ADJACENT OCCUPIERS.

9. If any occupier of land shall wilfully set fire to the bush on the lands in his occupation during any prohibited times, without having given notice to all the occupiers of adjacent land as aforesaid, he shall be liable, on conviction thereof before any two or more justices of the peace, to a penalty not exceeding £50, although such fire shall not have extended to any of the adjacent lands and shall not have done any damage as aforesaid.

SCHEDULE.

Take notice that I intend to set fire to the bush on my land situate at
on some day or days between the   day of   and the
day of   189 .

Signed

To Mr.
of   Date.

Following are the dates, supplied by the resident magistrates of the respective districts, between which it is permissible to burn off without giving notice:—

York, Toodyay, Bunbury, Murray, Vasse, Albany	From March 2nd to September 30th
Geraldton	From February 16th to October 31st
Gascoyne, Katanning	From April 1st to August 30th.

Between 19 degrees 30 minutes N. latitude and Tropic of Capricorn, firing the bush is prohibited the whole year.

CHAPTER V.

FENCING.

VARIOUS KINDS OF FENCES, AND HOW TO ERECT THEM.

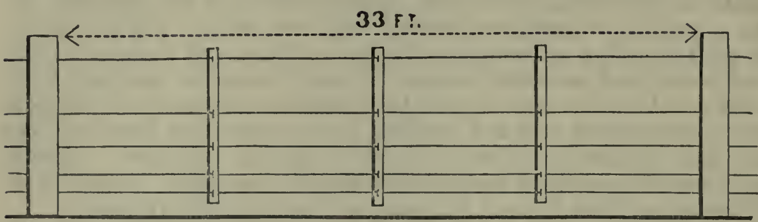
The new settler will find it is necessary to do a certain amount of fencing as soon as his clearing is done. Whenever possible the ploughing should be done before the fence is erected. There are two reasons for this—appearances, and protection of the fence from fire. If the fence is put up before ploughing it will not be possible to plough much closer to the fence than 18 inches, and if cultivation is followed subsequently on the other side of the fence this will mean that there is an unsightly strip of unbroken scrub ground three feet wide, and the length of the fence, dividing two otherwise neat and refreshing-looking cultivation paddocks. When the ground along the fence line has not been broken it is much more difficult to keep it free from undergrowth, and consequently danger of the destruction of the fence by fire is greatly increased. In boundary fencing, or in dividing off large paddocks intended for grazing only, the line should be cleared to a width of six feet of all scrub, and trees or limbs overhanging the line should be felled and removed by burning, or be pulled off before the fence is put up. It is a great comfort to feel, in the hot summer months, when bush fires are of daily occurrence, that the fences are clear of scrub and combustible matter generally, and if a plough furrow, no matter how rough or crooked, has been run in the spring on each side of the fence, and as near to it as possible, so much greater is the sense of security.

There are many styles of fencing in use in Australia, and as many or more are the varieties of timber used for posts. The choice of timber is not by any means restricted to two or three varieties in this colony, but most of the fencing is either put up with jarrah or jam posts, except in the nor'-west, where iron standards are used, timber not being available. The wood of the raspberry jam is practically indestructible, and its strength is as surprising as its durability. Where this timber is found growing nothing better can be used, but the settler must make the best use of the timber readiest to his hand. The jarrah tree is widely distributed over the south-west division, and split posts of this timber are very desirable. There is, however, jarrah and jarrah, and some discrimination is necessary; for instance, jarrah is found in some cases to rot off at the surface of the ground, and black-butt is preferred instead. White gum in some localities is white ant-resistant, and is a most admirable timber for fencing, while in other localities it is not worth putting in the ground. In the selection of timber for fencing, the new settler will do well to be guided by the experience of older settlers, and to have a good look round and see what timber is chiefly used for fencing in the locality. With the exception of jam, which is universally admitted to be irreproachable, it is not possible to lay down any hard and fast rule as to the use of various timbers in different localities. Exactly why the one variety of timber should differ so much in quality in different localities has not yet been satisfactorily determined.

The style of fence that is to be put up must be governed by the passive work it is intended to perform. Before commencing the erection of the fence the settler should decide whether it is to be a permanent or only a temporary structure, and what class of stock it is intended to keep in or keep out. If the fence is to be a permanent one, only the very best of material should be used, and the greatest pains should be taken to make the work a lasting one. If the fence is only a temporary one it does not matter much what the material is or how it is put up, so long as it performs the functions it is intended to; but in my experience it is a most difficult matter to put up a temporary fence anyhow and make it do its duty. It is easier, and cheaper in the end, to put it up well, though it is only intended to be there for a year or two.

Boundary fencing to keep large stock in or out may be of two wires only, the top wire and third wire from the top. If it is intended to use barbed wire this may as well be run at once stapled to the top of the posts. In this case the top plain wire may be dispensed with. Time is saved in the long run if boring for all the wires that are to be run in the future, five, six, or seven, as the case may be, is done at once. The extra wires are then very quickly run in case of emergency, or if sheep are suddenly introduced by a neighbour. Black steel wire, it may be as well to say here, should never be used in the coastal districts, as the sea air has a damaging effect upon it. Galvanised wire is the best in all localities, and No. 8 is the size most generally used, though No. 10 is quite heavy enough for short sub-divisional fences where only quiet stock are kept.

There is a very excellent, light, cheap, and yet serviceable fence that is very largely used in the north-west, where timber is scarce, for subdividing sheep runs. It is made with five or six wires, with posts set half-a-chain apart, between the posts three or four droppers are fastened to the wires with wedges. Its elasticity is its strength. It is perfectly sheep-proof, and big stock seldom break through it. It is a capital fence to use where a farm is in a state of transition. It can be readily understood how quickly the fence can be erected when it is said that there are only 160 holes to dig and the same number of posts required for a mile. Any kind of timber can be used for posts, and the stouter they are the better. The wire of course can be used again in the permanent fence. The droppers

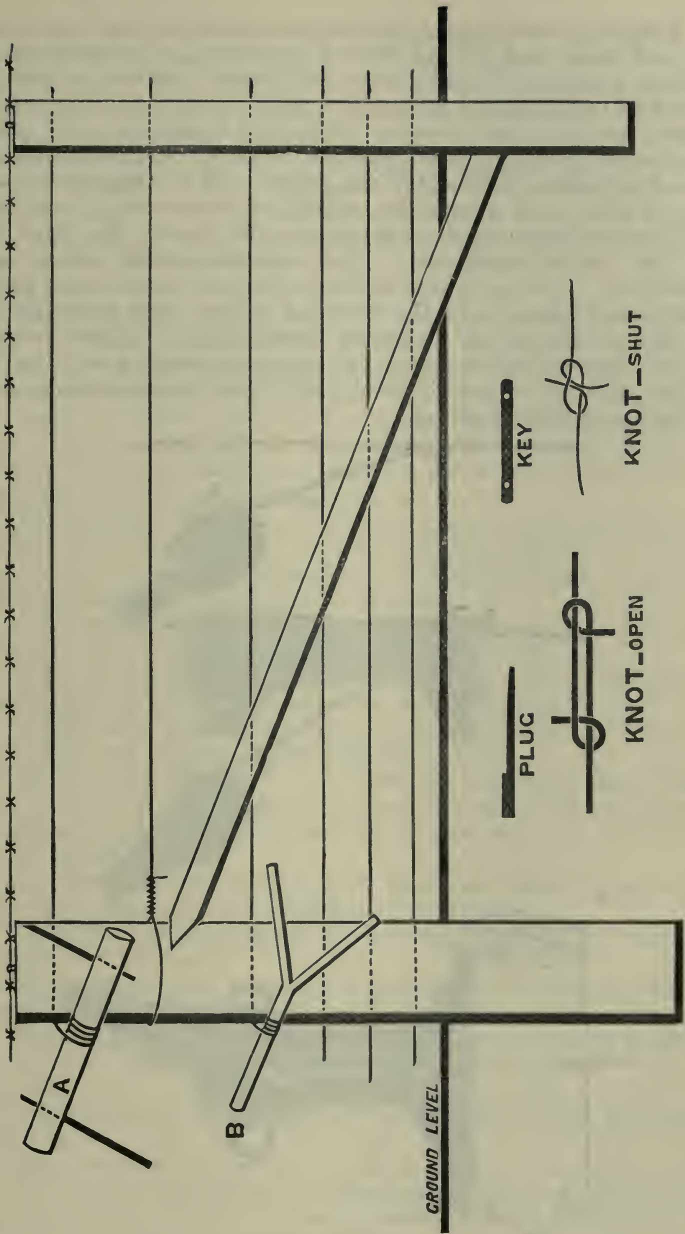


DROPPER FENCE.

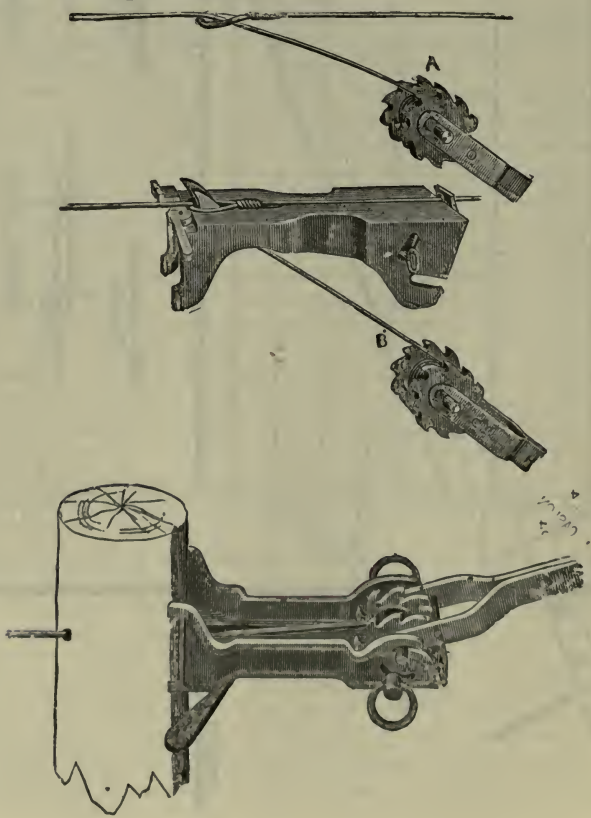
for six wires can be obtained in the colony from W. D. Moore & Co., Fremantle, for 6s. per doz. and the wedges to fasten them to the wires for 3d. per lb.

Having considered purely temporary fences, it may now be as well to enumerate the different kinds of permanent fences that are to be recommended and the methods of their erection.

They may be named as follows :—Post and rails, post and top rail and wire, posts and wire, posts and wire and wire netting. Picket and other fancy fences do not call for any description here. Slab and stake, chock and log, zig-zag, and other purely timber fences, used to be common in the colony in the old days, prior to the introduction of wire netting, and when labor was cheap and timber plentiful, and though there are many surviving, they are never put up now, unless under exceptional circumstances. This may be generally said to be the age of metal, and post and all rail fences are seldom used now except for stock yards and small enclosures where a large number of horned stock are congregated. These fences are costly in both labor and material, though most satisfactory and enduring if properly put up with the right kind of timber. The post and rail and wire fence is a fence, as the name implies, with one top rail and all below that of wire. This is an excellent fence, but more expensive than the fence now in most general use, the post and all wire. The wires may be five, six, seven, or eight in number, but six wires are enough to keep in any kind of stock that is at all domesticated, and if the cattle are wild I do not see that one or two extra wires would keep them from breaking through. The accompanying illustration shows the end panel of a six wire fence, with a barbed wire run on top of the post. This I consider to be a maximum fence, in that it has all that is required to keep in stock. The stock this fence would not keep in, a brick wall would not. This fence would be almost equally serviceable and less expensive if the second and third wires were raised about three inches and the top plain wire dispensed with, Barbed wire must in all cases be put either on the top of the posts or inside one's own paddock.


A
B
GROUND LEVEL
PLUG
KEY
KNOT_OPEN
KNOT_SHUT

The illustration (page 237) is drawn to scale, half an inch to the foot, and shows how a fence should be erected, if properly put up. The stay running diagonally from the corner post to the first post is notched in the former at a point exactly two-thirds of the height of the post from the ground. This post is shown to be 4 feet 6 inches out of the ground, and the notch to receive the stay is cut at 3 feet above the level of the ground. If it is higher or lower the post will, in soft ground, be pulled out more easily in straining. Two kinds of handy bush strainers are also shown, the drum (A), and the forked stick (B). The drawing makes these self-explanatory. There are various kinds of patent strainers for straining against the posts, and for attaching to the wires in the panels. We give an illustration of one of these—Reid's "Titan"—which may be applied either way, but quite as much power can be exerted with either the drum or the forked stick, and they have the merit of costing nothing.



In straining wire expansion in the hot weather and contraction in the cold must not be forgotten. Wire, if the "Titan" is used, is more expeditiously tightened if the strainer is used on the wires between the straining posts, and not up against the posts, as is usual. Straining this way is less trying to the end posts, which have to bear all the strain, and double the distance can be strained at one operation. The illustration referred to above shows the iron plug used for driving into the hole to hold the wire after it has been strained by the ordinary bush strainers, and the key, for twisting the loose end round the standing part of the wire, and giving a secure and neat finish, is also illustrated.

The woodcut shows how to make a proper fencing-knot. This—the figure-of-eight knot—will stand any amount of straining (in fact, the greater the tension applied the tighter the knot), and looks much neater than the double loop and twist one often sees.

I may conclude these brief notes on fencing with a specification in blank, which may be of use to those who are able to get the work done by contract, as well as a guide to the less fortunate, who have to do the work themselves :—

Specification for a post and wire fence to be erected on the (direction, N., S., E., or W.) lines at length about chains.

Line to be cleared throughout the entire length of all scrub and over-hanging trees to a width of 6 feet.

Posts to be of split, and no post to be less than 6 feet 6 inches long, and 6 inches by 3 at the smaller end.

Posts to be 9 feet apart, and to be sunk 2 feet in the ground, leaving 4 feet 6 inches out, and to be well rammed.

When rocks prevent sinking, posts to be strutted and stayed on both sides, and weighed down with loose rocks.

Straining posts of to be not less than 7 feet 6 inches long, and 1 foot in diameter at the smaller end, and set 3 feet in the ground, and to be stayed to foot of next post, and wires to be run through the stays.

Straining posts to be not more than ten chains apart, and at the tops of rises and in the bottoms of depressions.

Gate posts to be same size as straining posts and to be set feet apart in the clear.

Water gaps over creeks and gullies to be separate from and independent of the fence, with a straining post on each side.

Posts to be bored with a half-inch bit to the following gauge :— first wire, inches from the ground ; second wire, ; third wire, ; fourth, ; fifth, ; sixth, .

A barbed wire to be strained and stapled along the tops of the posts.

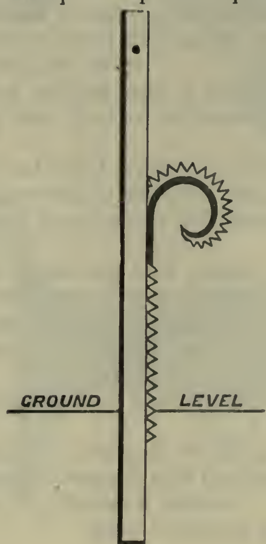
The contractor to provide all posts, wire and material.

The work to be finished in a proper manner and completed on or before , under a penalty of 10s. per day for every day over and above the specified time.

Such is the specification of a fence, as shown in the drawing. The terms can be altered at will to suit any class of fence. In post and rail fencing the mortices should be six inches by two, and are made by boring holes with a two-inch auger and taking out what is left with a chisel. The rails should be split, and not less than six inches by three, and any length that may be considered desirable. Where wire-netting is used as a protection against dogs or ground vermin, it should be trenched into the ground at least six inches, being well stapled to the foot of the posts and drawn tight by a plain wire woven through the meshes at the top. The life of wire-netting is lengthened, especially where there is salt in the ground, if that part of it which is under ground is coated with gas tar. This can be easily done by dipping the end of the coil before it is unrolled in a drum of hot tar. Charring the ends of the posts which will be in the ground adds to their durability and protects them from the attacks of white ants.

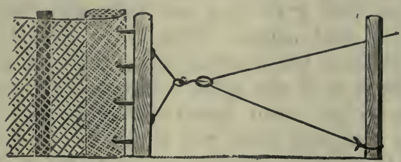
When ground vermin only exist, wire netting trenched into the ground six inches, with two top wires, will make an excellent fence. But, where the festive opossum disports himself, fruit-growers will have to take more elaborate measures to prevent the intrusion of this most pestiferous and importunate rodent. In the first place, all overhanging trees should be cleared from around the boundaries. It is advisable to do this in any case, and a little more money spent at the first in thoroughly clearing the line is invariably a judicious investment.

The accompanying diagram will indicate a fence which it has been suggested to me will prove 'possum proof.

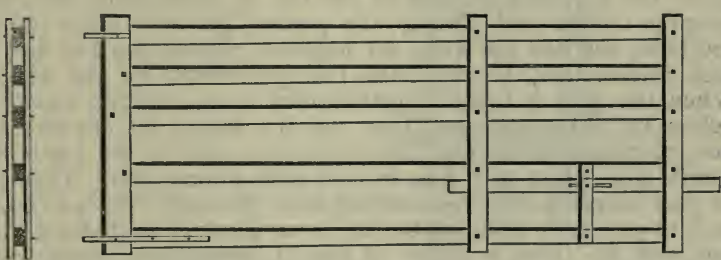


Wire netting, trenched in the ground to a depth of six inches, is carried up the posts and curved over an iron bracket. One or two top wires complete the fence. When the 'possum runs up the post, he finds himself confronted by the curved wire netting. So far as I know, this kind of fence has not been tested, and there are several objections to it, though it has in theory much to recommend it. It is expensive and would be easily damaged by stock, and I am inclined to think its possible effectiveness might be improved by substituting barbed wire on the curve for wire netting and offering inducements at intervals for the 'possum to climb. The 'possum will always run up a stick set at an angle in preference to a perpendicular post, and at intervals of a chain or so apart I would place sloping sticks against the fencing posts leading nearly to the top, and over the top of the post make with wire netting an alley leading down on the other side into a trap into which the 'possum must go or stay out of the orchard altogether. Perhaps some enterprising orchardist who suffers from the depredations of opossums may be induced to try this kind of fence, and put these suggestions to a practical test.

It is a difficult matter in putting on wire netting to stretch it so as to take out the bagginess. Ordinarily this fencing is slack and very untidy. It needs to be thoroughly stretched. To do this the plan shown in the sketch may be used to advantage. A strip of board has four or more hooks



arranged on one side to hold the roll firmly and to stretch each section as it is unrolled. A pulley attached to the following post draws the netting tightly past the preceding post, where it is secured firmly with staples and the work advanced to the next post.



Gates are a most important feature in a fence, and where paddocks have to be protected they are absolutely necessary. The foregoing is an illustration of a cheap and very satisfactory gate which I have had in use now for some years :—

The largest piece of timber in the gate is 6in. x 1in., and there are no mortices to work loose. The timber for a gate—jarrah, karri or any hard wood—can be purchased at the mills for 8s., the bolts for 3s., and the strap hinges top 18in. x 2in., $\frac{3}{8}$ iron, bottom 6in., and hooks cost 6s. the set ; total, 17s. Any one who can use a saw and a brace and bit can put a gate together and hang it in two hours and a half. Putting the labor down at 1s. per hour, this brings the total cost of the gate up to £1, if you have to pay for labor. Here are the quantities for a gate 12ft. x 4ft. 6in. high.

Two pieces, 7in. x 1in. x 4ft. 6in., for hanging stile ; four pieces, 3in. x 1in. x 4ft. 6in., two each for closing and middle stile ; two pieces, 3in. x 1in. x 9ft., for diagonal brace ; three pieces, 7ft. x 1in. x 12ft., for rails ; one piece, 3in. x 1in. x 5ft., for latch ; two pieces, 3in. x 1in. x 1ft., for packing top hinges.

Bolts.—Two, $4\frac{1}{2}$in. x $\frac{1}{2}$in., one each top and bottom hinges ; two, $4\frac{1}{2}$in. x $\frac{3}{8}$in., for top hinges ; eighteen, $3\frac{1}{2}$in. x $\frac{3}{8}$in., for fastening stiles and braces.

Rails.—Take the three boards 7in. x 1in. x 12ft. and mark off 4in. at one end and 3in. at the other. Run a line and rip down diagonally. This will give you six rails 4in. wide at one end, tapering to 3in. at the other. Five rails will be wanted for the gate. The mill will do the ripping for you if you like. This is the only real work there is in the gate. Lay on the ground on chocks sufficiently high to get your hand under so as to get the bolts in one side of the hanging stile 7in. x 1in. x 4ft. 6in., and 8ft. from this and parallel to it the middle stile 3in. x 1in. x 4ft. 6in., and 4ft. further on again the closing stile 3in. x 1in. x 4ft. 6in. Whatever the length of your gate, the middle stile should be two-thirds of the whole length from the hanging stile. Lay on these pieces the five rails any distance apart you like, only be sure and have the 4in. ends all at the hanging stile and the *saw cuts turned alternately*. This is most important, as herein lies all the strength of the gate. When you have laid the rails on the top of them, place the other hanging, middle and closing stile pieces ; get your brace and bit and bolts, and bolt the whole lot together, putting in a $\frac{3}{8}$-in. bolt at each intersection, reserving the two $\frac{1}{2}$-in. bolts for the hinges. When the gate is bolted together, turn it up on edge, square it, tighten up all the bolts, and then put the braces on, one on each side, running from the foot of the hanging stile to the top of the middle stile. Bolt with $\frac{3}{8}$-in. bolts at each intersection. Then put on your hinges and latch—a sliding piece 5ft. long, with two chocks on it to prevent it shooting too far, is as good as any—hang your gate, and the thing is done. A coat of Washington white-wash, which is about a tenth the cost of paint, and very durable, and you have in your gate " a thing of beauty and a joy for ever."

Washington white-wash is so named from the fact that the White House at Washington, the official residence of the President of the United States, is coated with it. It is made as follows, and if properly made will neither wash off nor rub off, and has all the appearance of paint :—Slake a bushel of quick-lime in a barrel, covering with a bag while the lime is working ; melt 1lb. common glue to a thin size ; make 1½lb. ground rice into a thin paste with boiling water ; mix up 1lb. of whiting as you would mustard. When the lime is quite slaked, add the glue, whiting, and rice-paste and a half-peck of common salt. Mix well and let stand for 48 hours, keeping covered. Thin down to consistency of ordinary white-wash and apply hot.

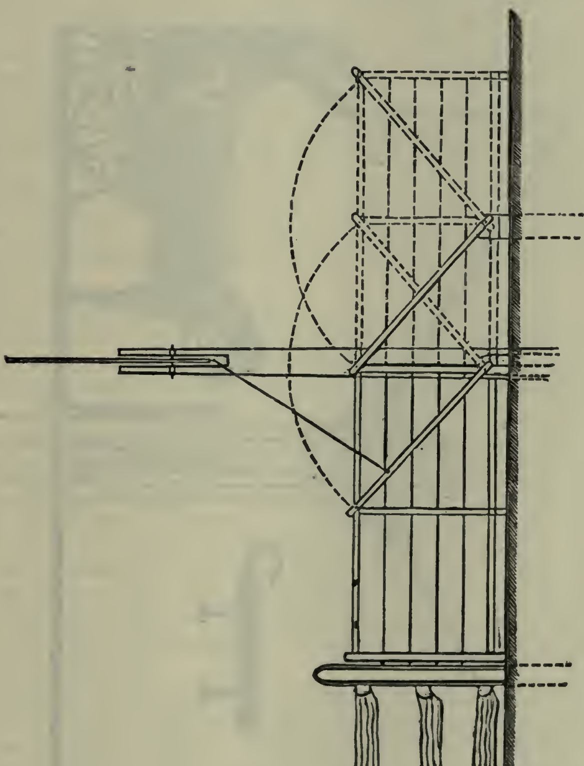


DIAGRAM No. 1.

A GOOD "SWING" GATE.

Mr. W. H. Graham, J.P., of Fairfield, one of the oldest and most enterprising squatters of the Eticup district, kindly forwarded to the *Journal* in November last, plans and description of a gate that he put up on his run some three years ago, and which has been found of the greatest convenience and to work well. To those who drive often alone, and, perhaps, young and active horses, a gate of this kind—which can be opened without leaving the vehicle—is a great boon, and may be the means of saving a runaway, and consequently many pounds' worth of damage and deterioration of horse flesh. The description given by Mr. Graham, and the plan, make the construction of the gate very clear, he has several of these gates in use on his property, and confidently recommends them. Mr. Graham writes :—

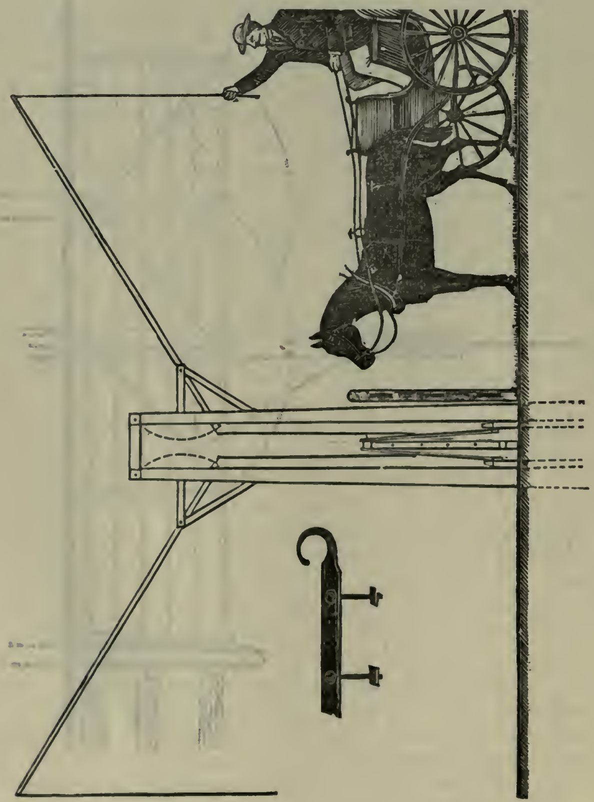


DIAGRAM NO. 2.

In reply to your letter of the 27th ultimo, I beg to forward you a description of the timber measurements, and mode of erecting the "swing gate" as nearly as I can give it you from memory.

The original plan, sent you herewith, is drawn on a scale of a ½ inch to 1 foot. The two posts are of white gum, 18ft. 6in. long, about 9in. in diameter at the smallest end, 3ft. 6in. of this is in the ground, leaving 15ft. out. Cut down into the top end of each post a slot 3in. wide and 4ft. long. At 2ft. from the top fix the arms that are to carry the levers. These arms are 4in. x 2in. karri, supported by struts of the same size, and are best dove-tailed into the posts, driven in lightly, and nailed on the outside, so as to have a clear surface, free of bolt-heads inside the slot. The struts can also be notched into the posts and bolted through, the upper ends checked into the arms on the outside, with a small ⅜ or 5-16th bolt, with the head counter-sunk inside. Fit a cross-piece in between the heads of the posts and bolt it through, leaving 18 inches between the posts clear on the inside. Adze or hew down any inequalities on the insides of the posts. Do all the fitting on the ground, even to the levers mentioned later on. Number the pieces and the places they belong to, then take them apart before erecting. Sink the hole 3ft. 6in. deep, and level the bottom with a spirit level, and if the posts are exactly the same length this will save trouble afterwards. Erect the posts and put in the top cross-piece, on which put a mark in the middle, that is, 9 inches from each post, and drop a plumb line from this mark between the posts, and see that they are 9 inches from the plumb line, then fill in and ram well.

The levers should be saplings, white gum, or marlack, 21 feet long, adzed down to 2½ inches one way only, unless they require making lighter, but don't allow any spring in them if possible—that is, don't make them too light so that they will bend. It requires pretty heavy levers to balance a large gate. Fit on the end of each lever an iron plate with a hook—see the design in diagram No. 1—to carry the lifting bars. Adjust the levers so that they work clear of each other, and about 3 feet from the ends bore the holes through them and the arms to carry a ⅝ or ¾-bolt. The lifting bars are of ⅝ round iron, 7 feet long, with an eye at each end. These bars should be short enough to keep the inner ends of the levers well down when the gate is shut or at rest ; and when the gate is half-way over, or at its highest point, the outer ends of the levers should be high enough so as not to strike a person on horseback or in a carriage.

The gates are made of 3 x 1 karri, five rails, and 10ft. 6in. in length, and 4ft. 6in. high, the heads or stiles and centre bar being double and bolted together. The four parallel bars that guide the gate should be 5in. wide, more especially the pair to which the lifting bar is bolted. These guide bars are loosely bolted to four stump posts 2 feet in the ground, as shown in the diagram (No. 1). The position of the bolts carrying the lifting bars is a matter of adjustment. About one-third of the whole length from the top gives a good result ; if the gate is too heavy, move the bolt nearer the top.

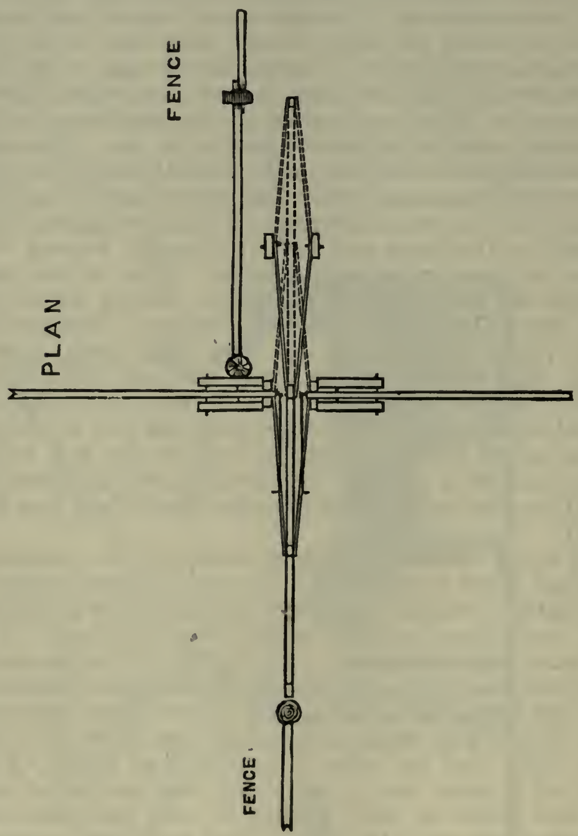


Diagram No. 3.

The bolts carrying the lifting bars should be $\frac{3}{4}$in., with square necks or heads, and as short as can be made so as not to turn or bend in the holes, or chafe in passing between the posts. All bolts should have a safety pin or key to prevent the nuts from working off.

To open the gate pull steadily on the rope at the end of the lever, and when the gate is a little more than half-way up give it a jerk to pass it over the centre, or balancing point, when its own weight will carry it down (No. 2). Shut the gate in the same way. To prevent the end of the gate being pushed in or strained by horses or cattle pushing against it, put in two round posts for it to fall between, say 9 inches apart.

The cost of this gate would be about £3 10s. if the large posts were handy.

FENCING MATERIALS.

BLACK AND GALVANIZED STEEL FENCING WIRE.

Per ton				Gauge	Length per cwt.	Weight Required per Mile.														
Black		Galv.				1 Wire			2 Wire			3 Wire			4 Wire			5 Wire		
£	s.	£	s.	No.	Yds.	c.	q.	lbs	c.	q.	lbs.	c.	q.	lbs.	c.	q.	lbs	c.	q.	lbs.
10	10	12	0	6	469	3	3	0	7	2	0	11	1	0	15	0	0	18	3	0
10	10	12	0	8	586	3	0	0	6	0	0	9	0	0	12	0	0	15	0	0
10	15	12	10	9	727	2	1	19	4	3	10	7	1	0	9	2	20	12	0	11
10	15	12	10	10	880	2	0	0	4	0	0	6	0	0	8	0	0	10	0	0

4-point thick set barbed fencing wire (448 yards per cwt.) £16 per ton.

WIRE NETTING, in rolls of 50 yards.

Mesh.	Width	24in.	30in.	36in.	48in.	60in.	72in.	
1½in.	Price per yard ...	2½d.	3d.	3½d.	4½d.			per yard
2in.	,, ,, ...	2d.	2½d.	3d.	4d.	4½d.	5d.	,,
3in.	,, ,, ...	1½d.	1¾d.	2d.	3d.	3½d.	4d.	,,

Galvanised fencing staples ... ... 35s. cwt.
Reid's wire strainers ... ... 20s. each.

Boring machines (post hole) complete with, Six bits each (½in., ⅝in., ¾in. 1in., 1½in., 2in.) 35s.

Prices supplied by W. Sandover and Co.

CHAPTER VI.

DRAINING.

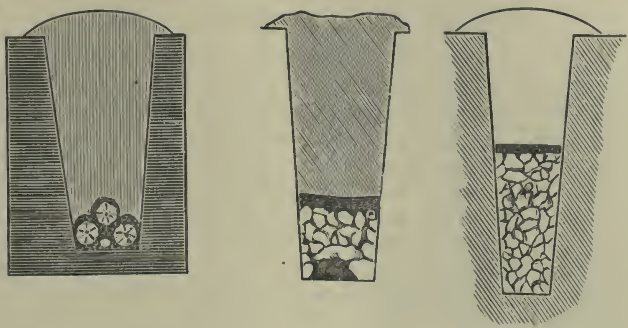
The Necessity of it, and the Results.

In the coastal districts, where the rainfall is copious, it will be found advisable to drain the clays and loams, and loams overlying clays. The new settler should carefully note, during the first winter, where the water lodges on his land, and mark these spots for future draining. In districts where the rainfall is scanty, surface drains, made in the winter with a plough, are generally sufficient to carry off the surplus water, but even here deep drainage could be advantageously undertaken. Where the rainfall is heavy and continuous a more elaborate scheme of under drainage will have to be undertaken if the best results are to be secured. In laying our drains the first thing to be decided upon is the outfall. This, I need hardly say, should be at the lowest point ; from this a series of main and subsidiary drains should radiate, their depth and proximity to each other being governed by the nature of the soil. The following table from M'Connell's *Agricultural Note Book* (a cheap and useful little book that every farmer should possess) gives the width and depth of drainage according to the soil :—

Soil.	Depth in feet.	Distance apart in feet.
	ft. in.	ft.
Stiff clay	2 6	15
Friable clay	2 6	18
Soft clay	2 9	21
Loamy clay	3 0	21
Loam with gravel	3 3	27
Light loam	3 6	33
Sandy loam	3 9	40
Light sand with gravel	4 0	50
Coarse gravelly sand	4 6	60

The figures in the above table mean, for instance, that a drain of 2 feet 6 inches deep in stiff clay will only take the surplus water away from the soil for a distance of 7½ feet on each side of it ; whereas in coarse gravelly sand the drain should, at a depth of 4 feet 6 inches, make itself apparent on the ground 30 feet away from it.

Drains may be made in various ways, but it must be borne in mind that no drain should be of less depth than will allow the deepest culture without injury to itself. Where "blackboys" (*Xanthoreas*) are plentiful, these may be used, and will last for a



great number of years. A trench is dug to the required depth, sufficiently wide to allow of two blackboy trunks being laid side by side, the scales facing the way the water runs, with a few inches of space between them, a third trunk is then placed on the top, as shown in the illustration, and the trench filled in, and the earth well trodden down by walking a heavy horse up and down it until well solidified.

A box drain may be made of slabs, split or sawn, or any waste timber of any kind, the two sides and top only being required, unless the fall is very great, when it is advisable to have the bottom in as well. Rubble drains, where stone is available, are cheaply made, and very effective, the rubble being laid in the trench, as shown in the illustration.

Tile drains are really the best, and though expensive, and not within the reach of everyone, are cheaper in the end, as, if carefully laid, their life should be at least half a century.

The best shape for tiles is an oval, or elliptical bore, with one or two flat outside bottoms. They should be made of well-ground clay, well burnt, with not too much sand in their composition, straight, smooth, and free from ragged ends.

In making surface drains attention should be paid to the character of the soil, in order to prevent scouring or the washing away of the sides, as much as possible. The fall can be made greater in stiff soils without this occurring, than in light soils.

The advantages to be derived from draining may be summed up as follows :—Soils sweeten much more rapidly, and are consequently sooner ready to throw a good crop ; they are more easily and sooner worked ; lime and manures act better ; seed time and harvest are earlier, and larger and better crops result ; good natural grasses spring up, and the herbage is more nutritous ; noxious weeds and insects are kept in subjection, and the health of live stock is improved.

CHAPTER VII.

THE FARM WATER SUPPLY.

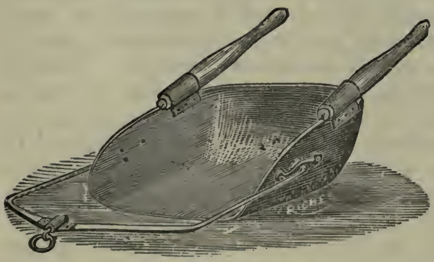
Tanks, Dams, and Wells.

If the new settler has not been sufficiently fortunate to locate himself where there is a permanent supply of pure fresh water, one of his first duties will be to provide this, both for himself and his stock. Soaks are not infrequently found, and, if opened out, may provide sufficient for moderate needs, and, in the south-west, springs capable of affording a domestic supply are not uncommon. Though these may do for the time being, there is nothing like having a permanent and plenteous supply of water, and this must either be obtained from wells, tanks, or dams, or from all three combined. If it is decided to put down a well, unless the settler has some practical knowledge of what he is about to undertake, he had much better have the work done by contract by an experienced well-sinker, either by the day or by the foot. It is not an easy matter for an amateur to put down, and brick up and finish off a well properly, especially where quicksand or a liberal supply of water is struck and rushes into the well freely. In the sandy country along the coast, water is invariably struck at very shallow depths, and these wells require no skill to put down. They may be slabbed up to prevent the sides washing in, and the work is quickly and effectively done by anyone with a little common sense. When the roofs of the house and outbuildings are of iron, either galvanised iron tanks, or underground or overground brick tanks should be provided to conserve the rain water. Even with an adequate supply of well water it is always advisable to have a tank or two of rainwater in reserve. It is not unusual for wells to become contaminated, either by the subterraneous springs that feed them washing out an alkali pocket in their course into the well, or by drainage of impurities from the surface. One cannot be too careful about the water one drinks, and every precaution should be taken to ensure a plenteous supply of pure water for this purpose.

Overground brick tanks are in every way preferable to underground ones. They are as cheap, or cheaper, to construct, they are less liable to contamination, they are more easily cleaned, and the water is more readily drawn from them, and if a leak should occur it is more easily detected, and more quickly stopped.

Water for stock may be conserved either by dams built across the bed of a stream, or in tanks excavated in the ground. Wells mean lifting the water, and this is a laborious and costly process which should be avoided if possible, if many head of stock are kept.

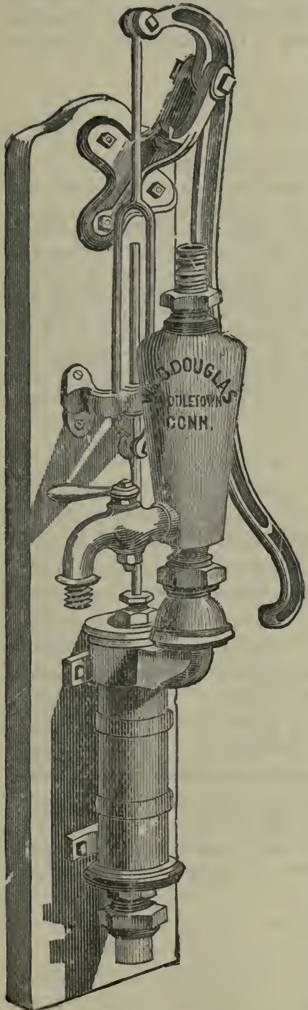
Dams of sufficient strength to impound a considerable quantity of water may be made of the rudest material, provided there is sufficient of it to withstand the lateral pressure. Two walls of rock, with clay well rammed down, or two rows of piles with clay in between, may be made to serve. In this kind of work horse labor should be used as much as possible, and if the stuff on the sides of the creek is suitable, the plough and scoop may be brought into requisition. If the packing between the walls has to be carted, the walls should be far enough apart to allow a cart to be driven right through, so that the load may be dumped into its place at once, without any shovelling. The passing of subsequent loads over this all helps to solidify the whole mass, and when it is completed with a little topping up and some gravel, if available, the top of the dam makes an excellent and dry crossing-place over the creek. The illustration shows a handy little scoop, costing about £4, that will be found very useful, not only for dam making and tank sinking, but for other purposes on the farm.



Before excavating for a tank, unless the farmer is well up in the business, it is desirable to put down one or two trial holes to the depth the tank is to be sunk, in order to see whether the soil is good holding ground or not, or whether there is any indication of a rise of salt water. I have known one or two instances where, at a depth of about eight or nine feet, saline springs have been struck, and completely ruined the tank. This, of course, is of rare occurrence, and I only mention it to put it on record.

From surface indications the experienced eye can easily locate good holding ground, but the new comer will be wise to put down a trial hole or two first. The excavation of a tank is a very simple matter, and in ordinary ground may be done very quickly with a plough and scoop. The tank is first marked off and the timber cleared away, the surface is then ploughed; this is scooped away, and then another layer is ploughed up and scooped away, and so on until the required depth has been reached. The sides are finished off with a pick and shovel when the excavation is completed. If there is any doubt about the holding capacity of the ground, it is a very good plan to puddle the bottom by driving a flock of sheep into it after the first shower. The pressure of sheep's feet has the effect of ramming down and completely solidifying the soil at the bottom of tank and rendering it impervious to moisture.

When more than one paddock has to be watered, the tank should be placed in the centre, where the fences intersect each other, so that the stock in all the paddocks can have access to it. It is not a good plan to leave the whole of the tank open to stock. In the hot weather they are liable to get into the water to escape the flies and the heat, and spoil the water. With a little ingenuity approaches, which will permit drinking, but not bathing, can be fenced off. It is needless to say that the tank should be excavated in the lowest place in the paddock, so that the catchment area should be as large as possible where the rainfall is light. In the autumn, before the rains are expected, the area for some distance round the dam should be thoroughly cleaned up, the dung and other things, likely to wash into the dam and pollute the water, being carefully removed. Plough furrows should then be run leading into the dam, so that every drop of rain that falls has a fair chance of finding its way into the reservoir provided for it.



There are various mechanical appliances for lifting water, and when something better than hand power is required, a wind-mill will be found, perhaps, as satisfactory as anything. The names of the various kinds of wind-mills is legion, and all have something to recommend them. They are not expensive, and one with an angle iron stand and pump complete can be bought for somewhere about £40, or, perhaps less. Two pumps are illustrated in this chapter. The small one is made in several sizes, from $2\frac{1}{2}$in. bore up to $3\frac{1}{2}$in., the lesser bore discharging 1 3-5ths gallons of water per minute, and the larger one $4\frac{3}{4}$ gallons. They cost from 14s. to £1 5s., according to size. The large illustration shows a "Douglas Force Pump," suitable for drawing water from wells or cisterns and forcing it up to any height required. These pumps may be worked either by hand, wind, horse, water, steam, or any other power, and are bored from $2\frac{3}{4}$in. to $5\frac{1}{2}$in., and cost complete from £3 to £5. When there is the slightest suspicion of alkali in the water, care should be taken to have a brass-lined pump, brass not being subject to corrosion. Where running water is available as a motive power, rams may be used for elevating the water to a moderate height. These are comparatively inexpensive appliances, and are always at work so long as the water runs, but only a fraction of the water that passes through them is elevated.

Capacities of Windmills and Reservoirs.

Size of mill, in feet ...	Diameter of pump cylinder, in inches ...	Depth of well, in feet.	Length of mill stroke, in inches ...	Number gallons water at each stroke ...	Amount of water per hour, in gallons ...	Amount of water in 24 hours, in gallons ...	Amount of land that can be covered one foot deep by mills working for 300 days in the year at the rate of fifteen hours per day. Acres covered	Size of reservoir capable of holding water for twenty-four hours continuous pumping on estimate given. Reservoir 4 feet deep; banks 16 feet; base 5 feet high; interior size.
10	8	30	10	$1\frac{1}{2}$	3,660	87,840	—	—
10	6	50	10	$1\frac{1}{4}$	2,580	61,920	—	—
10	4	75	10	$\frac{5}{8}$	1,320	31,680	—	—
12	10	30	12	$4\frac{1}{2}$	7,500	180,000	103 acres.	90 by 75 feet.
12	8	50	12	$3\frac{1}{2}$	6,300	151,200	86 acres.	90 by 60 feet.
12	6	75	12	$1\frac{1}{2}$	2,700	64,800	37 acres.	60 by 40 feet.
12	4	125	12	$\frac{3}{4}$	1,320	31,680	18 acres.	50 by 30 feet.
14	12	30	14	$6\frac{1}{3}$	10,620	254,880	146 acres.	125 by 80 feet.
14	10	50	14	$4\frac{1}{3}$	7,260	174,240	100 acres.	90 by 75 feet.
14	8	75	14	$2\frac{3}{4}$	4,620	100,880	63 acres.	75 by 50 feet.
14	6	125	14	$1\frac{3}{4}$	2,940	71,560	40 acres.	65 by 40 feet.
14	4	175	14	1	1,680	40,320	23 acres.	50 by 30 feet.
16	5	200	16	$1\frac{1}{2}$	1,700	47,680	25 acres.	50 by 35 feet.

Extra reservoir required to reserve overflow after 24 hours pumping should be of one and two-acre sizes, holding from 8 to 16-acre feet of water.

Large reservoirs of one and two-acre sizes, 8 feet deep, banks 9 feet high, base, 45 feet. A square acre is 209 feet on each side. A two-acre reservoir would be 209 x 418 feet.

CHAPTER VIII.

THE FARM LABORER.

Hiring, Wages, Rations, and the Masters and Servant's Act.

The really capable farm laborer is not easy to procure in this colony. The attractions offered by the goldfields are greater than those of the farm, and the consequence is that most of the labor that by right of training belongs to the rural districts, finds its way to the fields. The wages paid on the fields are higher than those the farmer can afford to offer, though when the extra cost of living is taken into consideration, the increase is more apparent than real. The majority of men who are now working on the farms is made up chiefly of those who have been to the goldfields and have come back sadder and wiser, or of those who have not been through this experience, and are working in the rural districts until they can save enough money to take them eastward. The average colonial farm laborer is undoubtedly below the average of his English compeer; and there is an opening for a good class of farm hand. The farm laborer of the present day is not the Hodge of a century ago. Agronomic science has developed, and in a lesser ratio he has developed with it. The man with brains in the colonies finds so many avenues of more congenial employment open to him, that he is seldom found drudging on a farm as a laborer. If he is, it is from causes which need not be mentioned. Again, the land laws of the colony are so liberal that anyone who has an inclination to follow rural pursuits may become the owner of his own farm.

Farm hands are usually hired by the month, and the rate of pay varies from £3 to £5, with board and lodging, the lower rate being for the laborer pure and simple, and the higher for the teamsters and ploughmen. It costs about 10s. per week to keep a man. The usual bare ration is 10 lbs. flour, 12 lbs. meat, 2 lbs. sugar, and ¼ lb. tea per man per week. Butter or jam are frequently added.

There is a labor branch in connection with the Bureau of Agriculture, and farmers requiring hands, or men requiring work in the country, can register their names at the offices of the Bureau.

The following extracts from the "Masters and Servant's Act, 1892," are of interest to both the employers of labor and the employed:—

(4.) Whenever the employer or employed shall neglect or refuse to fulfil any contract of service, or the employed shall neglect or refuse to enter upon or commence his service according to the contract, or shall absent himself from his service, or whenever any dispute, question, or difference shall arise as to the rights or liabilities of either of the parties, or touching any misusage, misconduct, ill-treatment, or injury to the person or property of either of the parties under any contract or service, or touching the loss or destruction of such property, the party feeling aggrieved may lay an information or complaint in writing before a justice of the peace, setting forth the ground of complaint, and the amount of wages, compensation, damage, or other remedy claimed for the breach or non-performance of such contract, or for any misusage, misconduct, illtreatment, or injury to the person or property of the person complaining, or for the loss or destruction of such property, and upon such information or complaint being laid, the justice taking the same shall issue, or cause to be issued, a summons to the party so complained against, setting forth the grounds of complaint, and the amount claimed for wages, compensation, damage, or other remedy as set forth in the said information or complaint, and requiring such party to appear at the time and place appointed in such summons, before any two or more justices of the peace, to answer the matter of the information or complaint, so that the same may be then and there heard and determined.

(7.) Upon the hearing of any information or complaint under the provisions of this act, the justices hearing the same, after due examination, and upon proof of the matter of such information or complaint, by an order in writing under their hands, in their discretion, as the justice of the case may require, shall either make an abatement of the whole or any part of the wages or other remuneration then already due to the employed, or shall direct the fulfiment of the contract of service with a direction to the party complained against to find forthwith good and sufficient security by recognisance or bond, with or without sureties, to the satisfaction of a justice for the fulfilment of such contract, or shall annul the contract, discharging the parties from the same and apportioning the amount of wages or remuneration due up to completed period of such contract ; or where no amount of compensation or damage can be assessed, or where pecuniary compensation will not, in the opinion of the justices, meet the circumstances of the case, shall impose a fine upon the party complained against, not exceeding in amount the sum of twenty pounds, or shall assess and determine the amount of compensation or damage together with the costs to be made to the party complaining, inclusive of the amount of any wages or remuneration abated, and shall direct the same to be paid accordingly.

(8.) If the order shall direct the fulfilment of the contract and shall direct the party complained against to find good and sufficient security as aforesaid, and the party complained against shall neglect or refuse to comply with such order, a justice may, if he shall think fit, by warrant under his hand, commit such party to any gaol, there to be confined and kept until he shall so find security ; but nevertheless so that the term of imprisonment, whether under one or several successive committals, shall not exceed in the whole three months, provided, always, that the justices hearing the information or complaint as aforesaid may, if they think fit, assess and determine the amount of wages, compensation, or damage to be paid to the party complaining, and direct the same to be paid, whether the contract is ordered by them to be annulled or not ; or, in addition to the annulling of the contract of service and discharge of the parties from the same, may, if they think fit, impose a fine as hereinbefore authorised, provided always, that no apprenticeship indenture or agreement shall be annulled except upon proof of illtreatment of the apprentice by the master, or incompetency on the part of the master to teach such apprentice, or wilful neglect so to teach such apprentice, or incorrigible misconduct on the part of the apprentice, provided, also, that the justices if they rescind or annul any agreement or indenture of apprenticeship may, if they think fit, order the whole or any part of the premium paid on the binding of the apprentice to be repaid to the person or persons paying the same provided, also, that nothing herein contained shall authorise the justices to adjudicate where the amount claimed exceeds fifty pounds, or to make an order for the payment of any sum exceeding fifty pounds (exclusive of the costs incurred in the case), or to require security to an amount exceeding fifty pounds from any defendant or his surety or sureties.

(13.) Where on the hearing of an information or complaint under this act it appears to the justices that an injury inflicted on the person or property of the party complaining, or the misconduct or illtreatment complained of has been of an aggravated character, and that such injury, misconduct, or illtreatment has not arisen or been committed in the *bona-fide* exercise of a legal right existing, or *bona-fide* and reasonably supposed to exist, and further that any pecuniary compensation or other remedy by this act provided will not meet the circumstances of the case, then the justices may, by warrant, commit the party complained against to gaol, there to be (in the discretion of the justices) imprisoned, with or without hard labor, for any term not exceeding three months.

(14.) When any wages or money due for work shall be paid to an employee by any cheque, draft, order, or note in writing upon any bank or any person, and shall be dishonored, no employee shall thereby be deprived of any remedy given to him by this act for the recovery of his wages, but every such person shall be entitled to recover such reasonable damages as he may have sustained in consequence of the dishonor of such cheque, draft, order, or note, and such damages shall be recoverable as wages.

(15.) When any contract of service shall have been made by, or any work shall be entrusted to, the management or superintendence of the steward, agent, bailiff, foreman, or manager of any employer, and also where two or more persons shall carry on business as partners, in every such case respectively the like proceedings shall be had by or against such steward, agent, bailiff, foreman, manager, or any one or more of such parties, and shall be as effectual, for all the purposes of this act, as if the same had been had by or against the principals or all the parties, provided that when any such proceedings shall be had against a steward, agent, bailiff, foreman, or manager, in respect of any cause of complaint not being for personal misconduct, all sums of money paid or satisfied by such steward, agent, bailiff, foreman, or manager, by virtue of any order of the justices made in pursuance hereof, shall be recoverable by him against the employer from whom the same is adjudged to be due, or shall be allowed to him out of any money at the time of payment or afterwards in his hands belonging to such employer.

(16.) When any married woman or infant under the age of twenty-one years shall have cause of complaint in any of the cases provided for by this act, such complaint may be lodged and all further proceedings thereupon had by and in the name of such married woman or infant, or of the sureties of the infant, in any agreement or indenture of apprenticeship, or of any person nominated by such infant, and all such proceedings shall be as effectual, valid, and binding as if such married woman were sole or such infant were of full age.

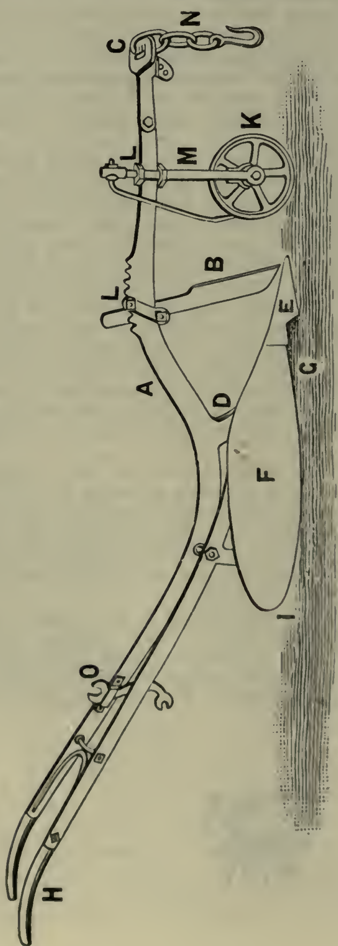
(17.) The provisions of this act shall apply to all contracts of service by indenture or other written agreement made by any employer in the United Kingdom or in any of the dependencies or colonies thereof, or in foreign countries, with persons about to proceed to or actually resident within the colony of Western Australia, for service in this colony, provided such contracts be not contrary to any law of the colony relating thereto.

CHAPTER IX.

CULTIVATION.

Breaking up new Land—the use of the Scoop—Ploughing—Harrowing and Seeding.

Having cleared part of his newly-acquired property of timber and scrub, the next thing for the settler to do is to prepare it for the



A—Beam
B—Coulter
C—Bridle
D—Body
E—Share
F—Mould-board
O—Wrench

G—Sole plate
H—Handles
I—Side plate (opposite side of body to mould-board)
K—Wheel
L L—Clips
M—Standard
N—Drag chain and hook

reception of whatever seed is to be sown. The land will have to be broken up, and the plough is the implement that must be used for this purpose. It is presumed that the settler knows little or nothing about agricultural practice and farm implements, and an illustration of a plough is given with all the parts numbered and named, so that if there is occasion later on to refer to any particular part, the reader will, after having studied the illustration, know at once what is meant.

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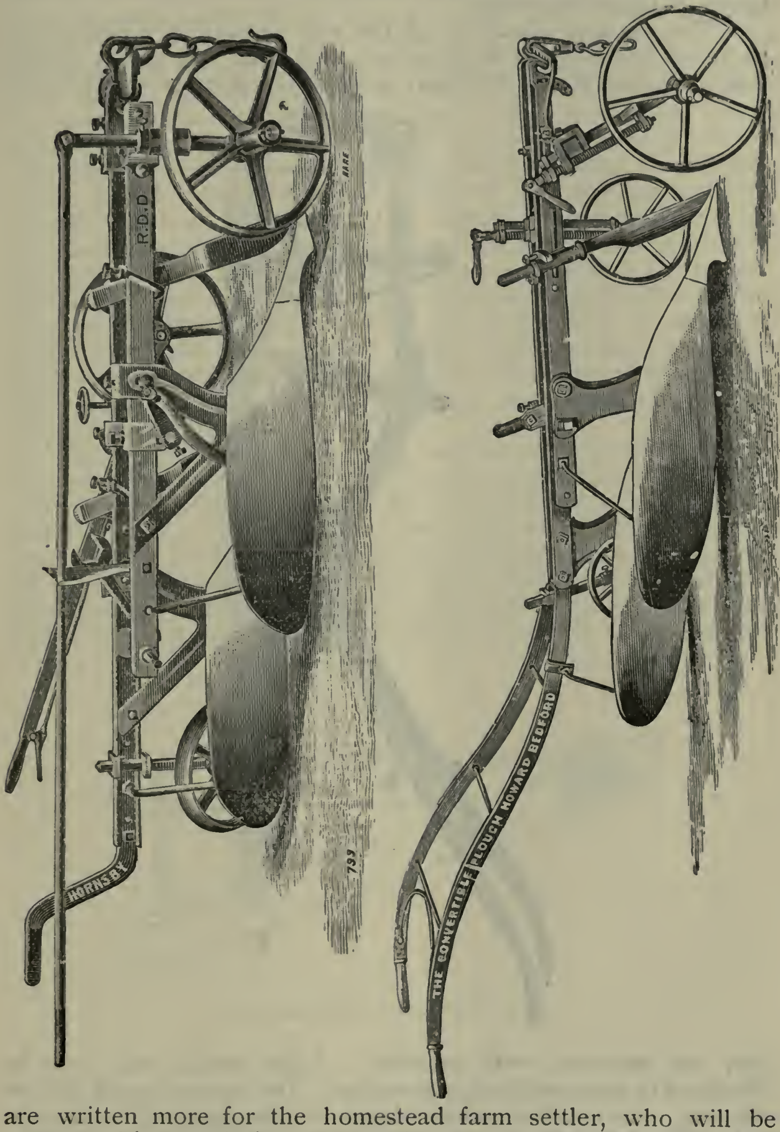
The objects of tillage are to so divide and mellow the soil as to render it permeable to air, to water, and to the roots of cultivated plants, and to so mingle all the parts of the soil that the constituents required by plants for their nourishment may be equally diffused and readily available. Tillage can be performed to perfection with the spade and the fork, but, of course, these rudimentary implements cannot be used where large areas have to be cultivated. It must not be forgotten that the two chief objects of tillage are to aerate the soil and diffuse the plant food that it may contain as much as possible. The implement that will do this next best to the spade is undoubtedly the digging-breasted plough. The first illustration represents a single furrow, long mould-board plough, as commonly used in the colonies. The second illustration shows a digging-breasted plough of the type most used in the United States, and now rapidly coming into use in Australia.

A glance at the two illustrations will suffice to show that each of these ploughs must turn a very different furrow. The long mould-board turns an unbroken rectangular slice and leaves the ground in a series of parallel well-defined ridges. The digging plough completely pulverises the soil, turning it right over, and leaves the ground, especially if it is light soil, with a comparatively even surface. Every particle of soil is turned by this plough, while the long mould-board plough partially turns the furrow slice bodily. The accompanying woodcut will explain the difference.

As regards the method of ploughing, English agriculturists, as a general rule, maintain that ploughing should be done on such a system as to turn over the furrow slice with a uniform surface and with a mass of soil unbroken and compressed. If, however, the best condition in which to leave the soil is that in which atmospheric influences will be best able to act upon it, then the continuous packed slice of the long mould-board cannot obviously be superior to the disintegrated mass of stuff thrown from the short breast of the digger. The digging plough has another advantage, it will do as much work again in a day as a long mould-board plough, and with less fatigue to both horses and men. It will stand any amount of rough work, and is as well adapted to breaking up new land as any iron plough. Its lightness is its great strength. The plough shown above is known as the "Oliver Chilled, No. 40," and costs about £4 complete. It may be used with two or three horses. It will turn a turn a furrow 9 inches deep and 16 inches in width, and only weighs 130 lbs. as against 175 lbs. of the wrought iron colonial plough cutting a furrow 6 inches deep and only 9 inches in width.

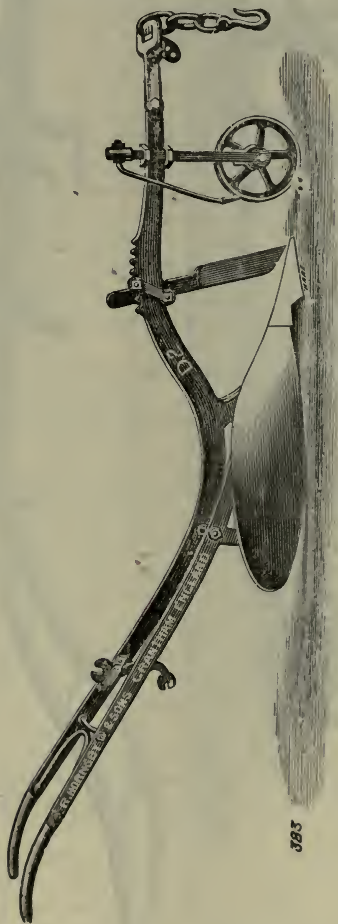
I have used this style of digging plough in all classes of soils for some years and have not been able to find fault with it yet. I have broken up stiff, imperfectly cleared land, full of roots, and never had a mishap, and ploughed up to twelve inches in depth with two horses in loam. The other illustrations show two makes of double furrow ploughs as generally used in the colonies, where ploughs of all sorts, shapes and sizes, from one furrow up to twenty furrows, may be found, drawn by horse, bullock, and steam traction. These chapters



are written more for the homestead farm settler, who will be content with a single furrow plough and a couple of good horses.

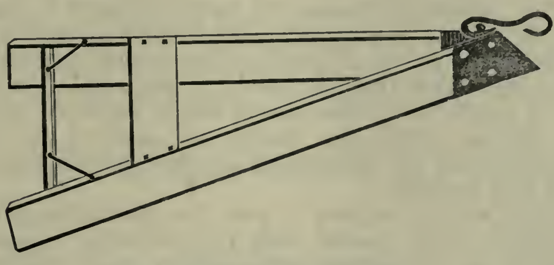
When he gets to that happy state when he requires double and treble furrow ploughs and several teams of horses, he will have gained sufficient experience to get along without reference to handbooks on tillage operations.

The physical condition of the soil when it is ploughed is a matter of considerable importance. The drier the soil is when it is broken, the better. Stiff clay soils should never be worked when



they are saturated with moisture. Light sandy soils may be ploughed in any condition, wet or dry. The reasons for all this are obvious. To repeat, the chief object of ploughing is to aerate the soil. The atmosphere has no chance of penetrating a slice of saturated clay akin in consistency to an unbaked brick. It merely dries the surface and leaves a stiff unworkable clod. Except in favored localities, the growing season here is so short that ploughing once commenced has to be continued, rain or fine, until the crops are in. The crops must be in early, or not at all. Hence, in the drier districts, the advantage of having a .sufficient area of arable land, to have half of it in fallow. There is no doubt in my mind that where crops fail on new unexhausted land, it is chiefly owing to imperfect tillage. The scarcity of rainfall is blamed, when it is not culpable ; as the same ground, ploughed when it was in a proper condition for ploughing, would have, it is safe to say, thrown a much better crop with half the rainfall. When stiff soils are ploughed, harrowed, and sometimes rolled wet, a solid impervious face is presented to the rain, which does not sink into the ground, but either lodges and drowns the young plants, or runs off the surface, or is speedily evaporated, instead of being stored up underground for the future use of the plants. As soon as the warm weather sets in, the surface cracks in all directions, and the little moisture there was in the soil is soon dissipated into the atmosphere, without passing through the plant.

Before commencing ploughing, the land to be broken up should be carefully looked over. If there are any.slight rises they may be "scruffed" up with the plough and scooped into any depressions that may exist ; or the leveller, shown in the accompanying illustrations, may be used. The leveller may be made on the farm, all the aid it will be necessary to invoke being that of the blacksmith to make the iron nose and even this is not an absolute necessity, as our hardwoods will stand a good deal of friction before wearing away.



SERVICEABLE LAND LEVELLER.

To make the leveller take two hardwood planks about 12 feet in length, two inches thick and eight inches wide. Cut down one edge with a drawing knife, plane or adze, so that it will be about half an inch on the edge. Put the boards together in V shape with the flaring edges at the bottom inside and resting on the ground. Take an eight-foot board, trimmed down the same, but two inches narrower. Mortise and bolt the ends into the side boards about two feet from the ends. Put two bolts through where the side pieces are joined to make the front of the leveller. Bolt a hook on top so that the whipple trees may be attached. Nail an eight-inch board across near the centre. When you want to cut down a ridge, ride upon the board, drive the horses on one side and swing your weight so as to cut into the soil. If you wish to fill up dead furrows or ditches, drive along one side and throw the weight of the body where the soil is to be moved from, and thereby guage the filling of the hole.

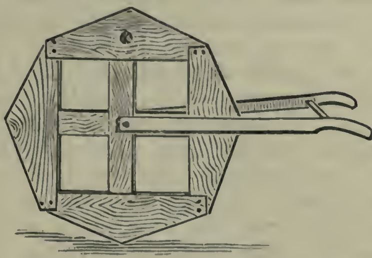
The land may have crab-holes or hog-wallows in it, and if so, the best treatment for these, before filling them up, is a charge or two of dynamite. These crab-holes indicate an impervious substratum, which must be broken up if proper drainage is to be secured. If they are merely picked in and filled up with the scoop they will be nothing better than quagmires when the heavy rains fall. The most satisfactory way of treating them is by blasting. I have a paddock, a portion of which, when cleared, showed a considerable depression honeycombed with crab-holes. With a steel crow bar I drilled holes all round the depression, about 4 feet deep and from 10 to 12 feet apart, and in each hole put a couple of plugs of dynamite. The result is most satisfactory.

What was a minature lake in the winter is now under crop, not a drop of water is lying on the surface, and the crop there, if anything, looks better than that in any other part of the paddock, in all probability owing to the deep tillage or shaking up the ground got. The cost of doing all this, and reclaiming about half an acre of ground, was not more than 25s. Dynamite is preferable to powder, or any other explosive, because the force expended is chiefly in a downward direction. It is perfectly safe to use and easily obtainable. The charge must be put in deep—at least four feet—as it is the impervious stuff below that one wants to break up. If it is not put down to this depth the surface merely will be shattered, and little or no good effected. After the blasting the sides of the crab-holes should be picked in, the holes filled up with earth by means of the scoop, and well rammed.

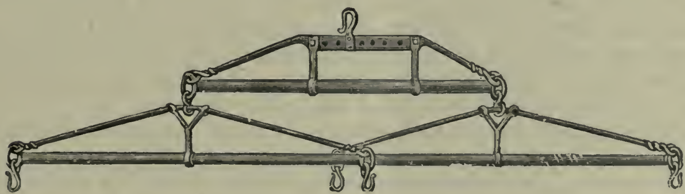
Before or after ploughing it may be considered desirable to measure up the land exactly, and the measurer shown in the accompanying cut can be made without very much trouble, and will be found useful in laying off lands and measuring ground before planting any particular crop.

The implement is made in the following manner :—Four boards, cut in the form shown, are "halved" together at the ends and braced by crosspieces, so as to form an octagonal wheel, the circumerence being just one rod, and each side one-eighth of a rod, or

$24\frac{3}{4}$ in. Two handles are put on, plough-handle fashion, and attached to the wheel by a pin at the centre. It can then be wheeled in any direction, and the revolutions counted for the rods passed over. A plainly visible mark is put on one segment, in order that the revolutions may be more easily counted as this mark passes the handles. Such a measurer is more easily made than a circular wheel, on which it is quite difficult for the ordinary worker to strike such a circle the circumference of which will be exactly one rod. This frame is also made and put together more readily than a circular wheel.

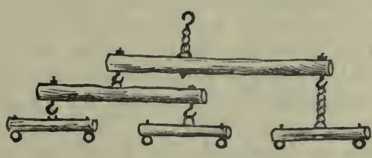


In the accompanying illustrations two sets of whipple trees are shown, one for two horses yoked abreast, made of all iron, and costing about £1 5s. the set; the other, a home-made set for three horses. There is no reason why these essentials should not be made from any round hardwood, and be equally as good and serviceable as the more expensive iron ones.



A blacksmith will make the eyelets for six or seven shillings, and the rest can be done with the saw and brace and bit. The arrangement of the bars for three horses, as illustrated, compels each horse to do his full share of the work, or show at once that he is shirking.

The point of attachment to the plough or load must be made exactly one-third of the distance from the point of attachment of the double and single whipple trees, to give each horse an equal share of the work. To make a four-horse set, attach a double whipple tree to the point where the single one (seen in the sketch) is attached, and make the attachment for the load exactly in the middle of the rear bar.



A set of plough harness for two horses consists of two winkers, two collars, two sets hames, two backbands, and four trace chains. A complete set of harness, including saddle for dray work, leading traces and plough harness, can be bought for about £15; and a new farm tip dray, with wide-tired wheels (which have the greatest advantage in point of draught over narrow tires) may be purchased for from £20 to £25. It should be borne in mind that time spent in the care of harness is never time wasted. A thorough washing and oiling while the leather is damp at frequent intervals adds years to the life of harness. It also should not be forgotten that the floor of the stable is not the best place to hang up harness, neither is it pleasant for the horse to have the winkers left in the manger with his feed.

Before actually commencing ploughing, the width of the lands into which the ground is to be ploughed must be decided upon, and then they must be laid off. A chain (22 yards) wide is a most convenient width. A line is marked with tall sticks (that are easily seen between the horses) down the centre of the land, and when this line is ploughed, the distance of the furrow to the centre of the next land can be stepped off, and the second land laid out. The ground should be first opened out, that is, a shallow furrow should be thrown on each side away from the centre, and then up, the same two furrows being turned back again a little deeper towards the centre. By doing this the whole of the ground is moved, and there will not be any unsightly scrub left to grow up through the crown, as would be the case if the opening out were not done first. The following hints on ploughing, from M'Kay's *Australian Agriculturist*, will be of use to the beginner :—

Ploughs with one or two wheels are the easiest for the inexperienced. The plough should always be upright in the furrow while at work. The wheels are for regulating the width and depth, and for turning the plough round at each end of the field. The small, or land wheel, runs on the surface of the ground, and the higher it is drawn up the deeper the plough will work. The large or furrow wheel runs in the furrow, level with the bottom of the plough, and regulates the width of the furrow slice. The plough will come out of its work easily at the end by a little pressure on the handles while the horses are moving forwards. The plough must not be lifted or carried round at the end of the work, but must follow the horses or draught power, and must be turned on the large, not on the small wheel. A little practice soon enables this to be done easily. The draught chain at the head of the plough should be set so that the plough will run straight forward in work, and the best place will soon be found by trying it in the different positions from the centre, either to the right or left. It can also be raised or lowered for hard or soft land. Two horses are found sufficient for ordinary work. Yoke them two abreast. In dry soil, the animals should be further from the plough than in loose or soft soil. Steel breasts or mould-boards are better than iron ones for stiff soil. The share should have more or less inclination downwards at the point in proportion to the hardness or softness of the soil. Stiff soils require sharp, keen shares; half-worn shares should be kept for soft soil. Strong, sharp coulters are necessary to cut through the strong, matted grasses of warm climates. In strong grass land, the coulter should have a decided slope forwards at the end point; in clean land it may be almost straight down from the beam. The point of the coulter should just clear the share, and always cut in a straight line with the sole of the plough. When a plough is fitted with two wheels, the small, or land wheel, should be drawn up to the depth required to be ploughed; and the large, or furrow-wheel, should be placed level with the bottom of the plough, and set to the width of the plouhing, measuring from the land slide or slade of the plough. When a plough is fitted with a land-wheel only, it must be drawn up to the required depth, the width being now regulated by the judgment of the ploughman. When a swing-plough (without wheels) is used, the depth and width has to be entirely regulated by the skill of the ploughman.

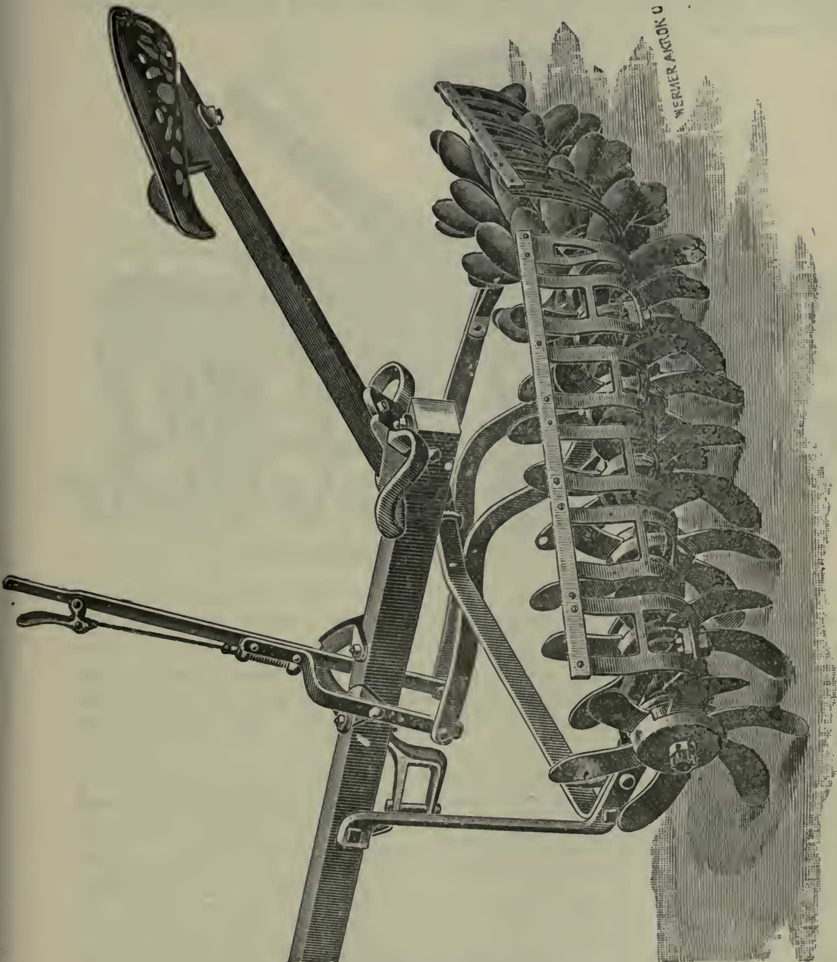
In comparison with similar tests made in England, dynamometer trials at colonial matches say much for the skill brought to bear by local makers upon the plough. In vol. 1 of "Transactions of the Agricultural Society of England," we have the following figures:—

The draught in ploughing has been recently experimented upon in America with the following interesting results:—1. A deflection of the traces when under draught, from a straight line from shoulder to whipple-tree, results in a decided loss of power, and such loss is applied to the galling and worrying of the horses. 2. The use of a six-inch land-wheel under the end of the plough-beam, showed a saving of 14.1 per cent. of the draught at the average of the trials made, and, in addition, gave a more uniform furrow and relieved the ploughman. This saving can be made only when line of draught is light. 3. The use of the coulter is not common in America, and this report says its use was, without exception, attended with a decided loss of force or increased draught by whatever form of coulter used. The average gain of draught by dispensing with the coulter was 15·6 per cent. The coulter invariably disturbed the line of draught, resulting in a furrow of different dimensions from those formed without it. 4. The draught of a plough decreases in proportion as width of furrow increases, until the normal capacity of the plough is reached, after which it increases again under the same limitations as in previous case of depth; yet it does not increase in as rapid a ratio as is seen in depth. The absolute draught in a 15-inch furrow was less than for a 10-inch furrow. On stony and sandy soils the share of the plough wears away very quickly, and time is lost in taking it off for re-laying, sharpening, etc. The chilled share is an advantage, so far as the iron being chilled, or made harder on the under side than it is on the upper side, the share wears sharp until it is worn out. These shares are coming into very general use.

The value of subsoiling by means of the plough—of giving as great a depth as possible to land under cultivation without bringing the poorer raw soil to the surface—cannot be overrated in a warm climate. The work is effectively done with the subsoil ploughs, many forms of which are made, for one, two, three, and four horses. We prefer the single horse implement. It is light, handy, and breaks the soil from four to seven inches deep. When run in the furrow after a plough turning out a slice six inches deep, a total depth of from ten to twelve inches is obtained at the lowest cost of labor. Subsoiling should follow the draining. It is absolutely valueless unless the water that flows into the soil moved by the subsoiler is carried off at once. Water allowed to lodge under such circumstances converts the subsoil into a sour mud that is destructive to every root that comes into contact with it. Beneficial, then, as subsoiling is, drainage (either natural or artificial) should be seen to before it is attempted. But with combined drainage and subsoiling, we have the means of growing crops at all seasons, whether they be very dry or very wet, or the happy medium between the two.

The depth to which the ground is to be ploughed must be governed by previous tillage operations, the nature of the soil, the manure to be used, and the length of time ground can be allowed to lie fallow before the crop is put in. It may be said at once that it is not desirable to plough previously unbroken land too deeply, unless it is to lie fallow for some considerable time. Three or four inches is quite deep enough for the first ploughing of the average West Australian soil, only recently denuded of its forest growth of timber, and where seeding immediately follows the plough. The reason for this is that more sour soil would be turned up than could be possibly sweetened by atmospheric action, and any nutriment it contained be made available to the young plant. If a liberal dressing of fertilisers is applied, especially if lime or salt are included, deeper ploughing may be done with advantage. But it is advisable to plough a little deeper every year, and gradually turn up a "new farm" over the surface of the old one and so have "a heap of land to the acre."

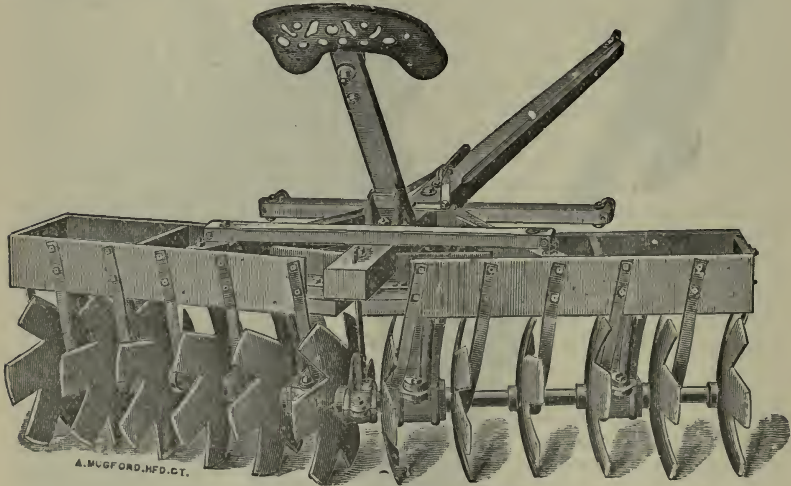
Sandy soils may be ploughed deeper at once, as the air penetrates them more readily than stiff soils. If the ploughing is done in the spring, and the ground can be allowed to lie fallow until seed time in the autumn, then the deeper it is ploughed the better, especially if it is worked two or three times during the summer with the scarifier. The object of ploughing is to secure a good seed-bed for the young plants, and this can only be done by thoroughly pulverising the soil that is turned up, and adding the nutriment that may be deficient. It frequently happens in the stiffer soils, after a succession of shallow ploughings, that an impenetrable hard-pan is formed, and this is one of the reasons why deeper ploughing every year is advocated; and when the maximum depth has been reached, then the ploughing should be shallower and deeper each alternate year, so as to prevent the possibility of a hard-pan forming. Hard-



MORGAN SPADING HARROW.

pans prevent the proper penetration of the roots of the plants and the absorbtion of water by the soil, and nothing is so inimical to plant life as either stagnant water near the surface, or an insufficiency of water.

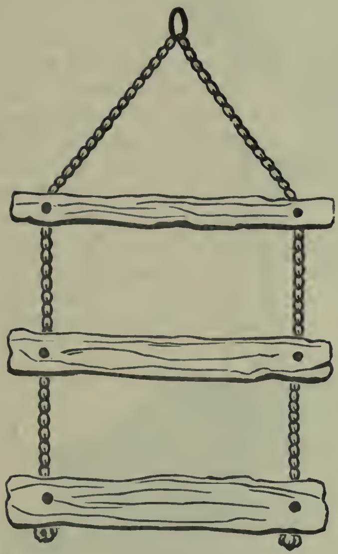
When the newly-ploughed land turns up rough and cloddy it will be advisable, in order to secure a good seed bed, to break down these clods. This may be done by using either a disc, a cutaway, or a Morgan spading harrow, which are here illustrated, or one of the homely but effective clod crushers also portrayed in the accompanying woodcuts.

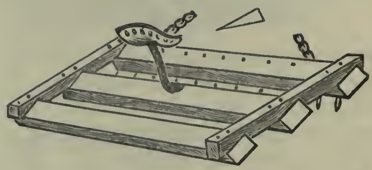


THE CUTAWAY HARROW.

The spading harrow, six feet wide, for two horses, costs £9, and is really a most excellent implement, and more effective than either the disc or the cutaway. I have had one in use now for three years, and have no fault to find with it. If the new settler cannot, however, afford one of these, then there is no excuse for his not having one of the other simple appliances here shown for breaking down rough land.

Three logs, the last one being the heaviest, six auger holes, two chains, and six pins driven through to keep the chains in place, and the clod crusher is made and ready for use. It is dragged over the ground like a harrow, and literally tumbles the clod to pieces. The second one is a little more elaborate, and, if possible, more effective on the stiffer soils. The one here shown can be made in half a day. Three railway sleepers, or similarly squared logs, placed parallel eight inches apart, with two crosspieces and a dozen old harrow teeth, are all the raw material required. Fit on the two crosspieces by first sawing into the upper and front edge of each sleeper, and split off a triangular-shaped piece, so that when the crosspieces are bolted on, the front edge of the bottom of each sleeper will be about three inches from the ground. The crosspieces should be bolted on with two bolts through each sleeper. Some old drag or harrow teeth are put through the front sleeper four inches apart, the holes being bored so the teeth will slant back, which prevents clogging. An old mowing-machine seat is fastened to the centre of the middle plank.





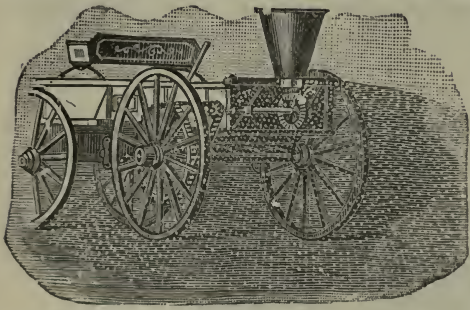
The drag can be drawn by a tongue fastened similar to a wagon, or by a short chain in such a manner that the draft is from the centre. This implement works well on any kind of ground when first ploughed, and will fit it in good shape for the harrow or cultivator. It will leave the surface more level and finer than a roller.

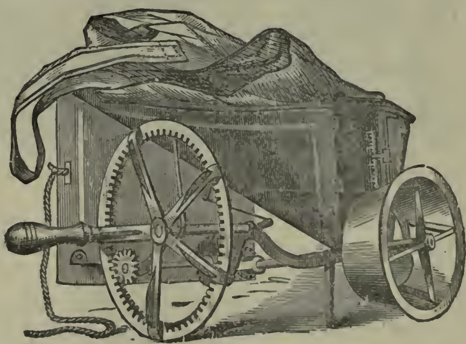
The land is now in order for the sowing of artificial manures, or, if none are to be used, for the reception of seed. When stable manure is used it is ploughed in, artificial manures are broadcasted or drilled in with the seed.

Sowing, Harrowing, Rolling, and Fallowing.

The Agricultural Chemist of the Bureau deals most exhaustively in another part of the Guide with artificial manures and their application to the various kinds of soils and crops, so it will not be necessary for me to say anything more about them here.

Seed may be sown either broadcast, by hand, or by use of the machines made for the purpose, or drilled in. It requires some little practice to cast seed evenly by hand so as to avoid sowing it thick and thin in patches. If sowing is done by hand, a box that will hold about half a bushel should be suspended round the neck about level with the waist by means of a saddle girth, or other broad band. Bags are placed at convenient intervals along the field to be sown and the box is filled from these as required. Both hands are used in casting, the left hand throwing the seed to the right across the body, and the right hand to the left. The accompanying illustration shows a handy little seed sower, the "Cahoon," costing about £1 5s., and made so that any size seed can be sown. It is especially designed for the use of farmers who only cultivate a comparatively small area and do not need one of the larger seed sowers, also illustrated herewith. The breadth of cast of the "Cahoon" is chiefly governed by the weight of the seed sown. The heavier the seed the greater the distance to which it is thrown. At an ordinary walking pace from four to eight acres may be sown in an hour.

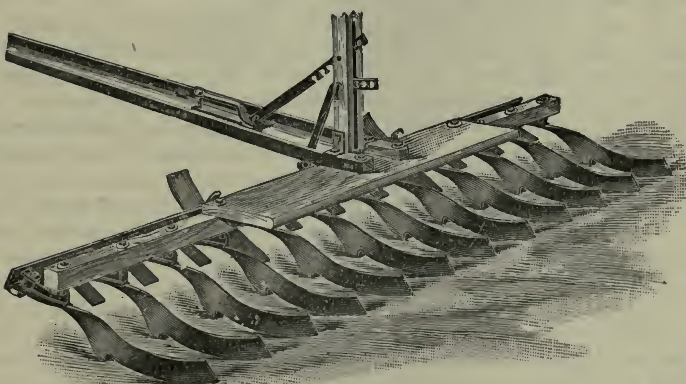




The larger seed sowers, which are worked by an endless chain from the wheel of a dray, cost about £8 15s., and will sow from 10 acres to 12 acres per hour.

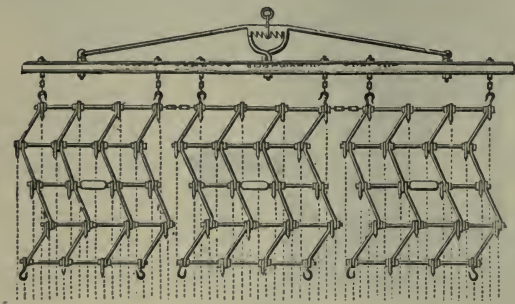
There is another method of sowing, and that is by means of the drill. If the tillage conditions are right, this has many advantages over broadcasting, the chief of which are that less seed per acre is required, every seed is buried at the same depth, the seed germinates better and is less subject to climatic extremes, and is better protected from the attacks of birds, rodents, and insects. Before the drill can be used satisfactorily, it is essential that the ground should be free from roots and stones, and that a thorough tilth has been secured. Seed boxes are sometimes made to attach to the disc and cut-away harrows, and these implements are then called seed drills ; but they are not altogether satisfactory, although they will work on rougher land than the proper seed drill, and are, perhaps, more economical in the matter of seed than the hand-casters. Three-quarters of a bushel of seed sown by a

drill is better than a bushel and a half broadcasted, and where a large area has to be sown, the quantity of seed thus saved is an



important item. There is no doubt that where the rainfall is scanty larger yields will be obtained if the drill is used than if the seed is broadcasted. The drill has another advantage, that as the seed is sown by it in regular parallelled rows equi-distant, subsequent cultivation is easily accomplished, and weeds can be better kept in check. A good seed drill, that will sow both seed and artificial manure simultaneously, costs from £40 to £60, and this is a large amount for the new settler to lay out, and it is for him to decide whether such expenditure is warranted. If, however, 100 acres or over have to be sown, and the land is in good order, a drill soon pays for itself in the seed saved.

After the seed has been sown, the land will have to be harrowed until a fine tilth is secured, fully and evenly covering the seed.



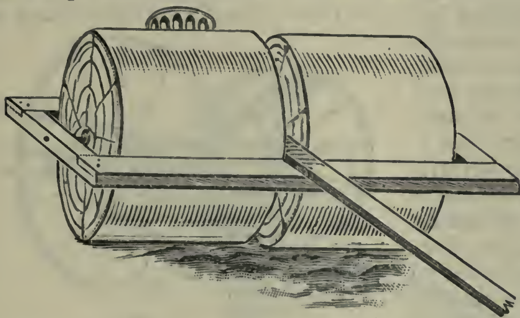
The "Acme" harrow illustrated here, is really a most excellent implement (cost, two-horse, £6), for pulverising the surface, but the harrows most commonly in use are the "zig-zag," which are dragged either down or across the furrows, or diagonally, or all three if necessary. The best way of covering the seed, especially in rough ground, is to harrow down the furrows first, and then diagonally, starting at one corner and going straight across to the opposite corner, and round and round this diagonal line until the whole field is harrowed. A great deal more work (probably one-third), and better work, is done this way.

A set of these harrows, three leaves, costs £4 10s., but if this outlay cannot be afforded, the farmer can make a set for himself for much less. A limb of a tree, with the branches left on, may be used as a makeshift, or a forked branch, with wooden tines driven in it, will last a season or two. A really serviceable set may be made by making the frame work of sawn timber bolted together, and purchasing the iron tines. When grass or other small seeds are sown a brush harrow is quite sufficient to cover them with.

After harrowing, the roller, which can be made on the farm, is the next implement required. Illustrations of two simple and effective rollers are shown herewith.

The following description of the way this farm roller is made is given in the *Rural New Yorker*:—"A frame of 4 x 4 hardwood was made and the tongue placed as shown in the sketch, which also shows the braces and the gudgeons or pins which held the rollers in place. The logs were solid, $3\frac{1}{2}$ feet long and 18 inches in diameter. Gudgeons about 16 inches long were driven into the ends of the logs. These were $1\frac{1}{4}$ inches iron squared for

12 inches of their length and driven into 1 inch holes, leaving the four inches round part to project. One log was set four inches ahead of the other in the frame. To keep the frame from tipping back quite so much, the tongue was placed over the front 4 x 4, and under the hind one. An old mower seat was fastened on the back part of the frame. No trouble with this roller bearing down on the horses' necks! Also, it was cheap, easy to turn, was just the right width to go between the rows of corn, and last, but not least, it would do better work than a large roller, because, instead of riding over the big clods, as a large roller would, it would push them ahead of it, grind away at them, and, probably, break them in several pieces before it mounted them. A large roller of the same weight would run easier, but a small one will break up more clods, and that is what a roller is for. " A large roller strikes a clod nearly on top, and simply pushes it down, while a small one strikes it on the side and gets several whacks at it before it is done.

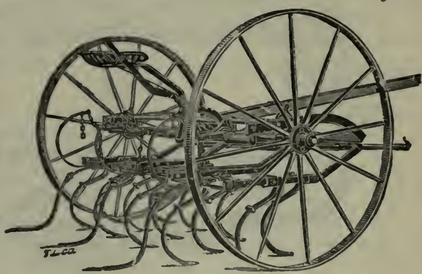


This pattern is more easily made than the previous roller, and is quite as good for all purposes. It must never be forgotten, however, that on no account should ground be rolled when it is wet and sticky. If the ground is not sufficiently dry to roll when the seed is sown it is much better to wait until after the crop is up. After the rolling has been done water furrows should be opened up with the plough to carry off the surplus surface water, and any short surface drains may be dug that cannot be opened with the plough.

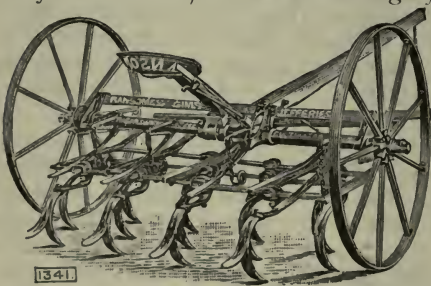
After the main crop is in, if there is any more land ready, it should be ploughed up at once and allowed to lie fallow, or else utilised for a summer crop until next seed time. The benefits of fallowing newly-cleared land in Western Australia are very great. Speaking generally, the land is sour when first broken up, and needs a thorough sweetening before the best results are obtained from it. There is no sweetener like the sun's heat, and land deeply broken up and left to lie open to the sun's rays for some months is as good as if a liberal dressing of manure had been given to it. The fallow should be scarified two or three times as opportunity offers during the summer, and if this is done it will be in splendid condition for the reception of the seed in the autumn.

Whether the land has been newly cleared, or has been under crop before, there should be always a fair proportion of fallow on every farm.

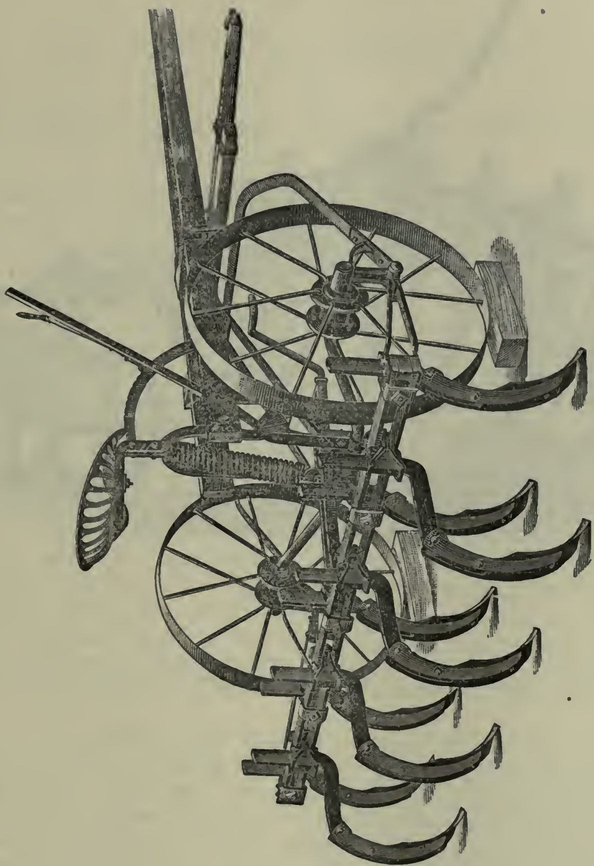
Four illustrations are given here of cultivators or scarifiers. Coleman's is the original type, and has strength and durability to recommend it. Bamford's steel cultivator, it is claimed, will prepare land equally well for seed bed or for autumn fallowing. A similar one is made by the Massey-Harris company, and has been used in this colony and well spoken of. The Planet Jr. horsehoe does good work, but is more suited to light lands. There is also the Giant sectional cultivator, a Canadian make (Richard Purser, local agent), to which a seed-box may be attached, and which is highly recommended for all classes of land. It is said to be used in the United States for breaking up macadamised roads previous to re-metalling and rolling, so it must be of immense strength.



THE GIANT.

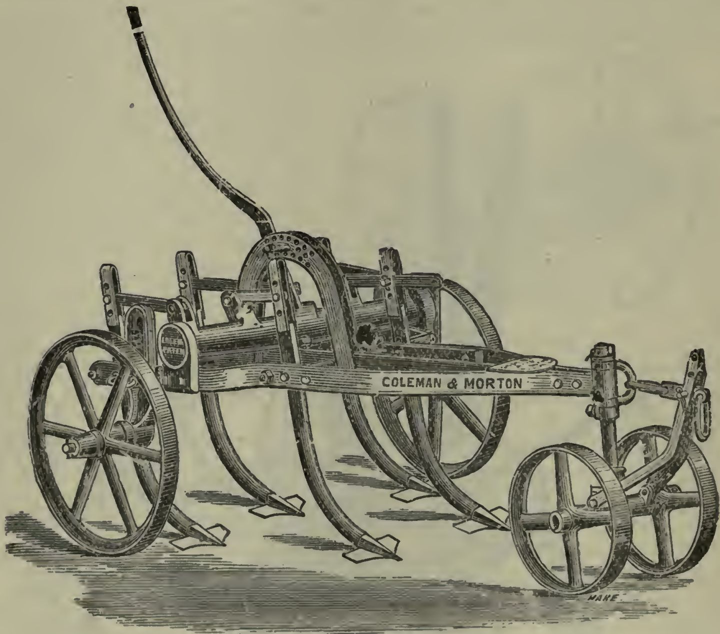


In the drier districts of the colony I cannot urge too strongly upon farmers the advisableness of running the harrows over the growing crops in the spring as soon as the rains begin to slack off. Lawes and Gilbert found that 36 per cent. of the rain percolated to the depth of 20 inches into the soil. With a 25-inch rainfall every acre receives 567,168 gallons per annum, of which 200,000 sink deeply into the soil. *Two-thirds of the whole are evaporated.* This means that when there is only a 15 inch rainfall, 10 inches, or 1000 tons of water per acre, are evaporated and practically lost to the plant. It must be borne in mind that the plant is dependent upon the moisture in the soil for its nourishment. A plant cannot eat, it can only drink, that is, it cannot take up food in solid form, but only in a liquid state. The plant drinks up its liquid nourishment, retains the solids in its composition, and the liquid is evaporated through its leaves. This shows the absolute necessity for retaining as much moisture in the soil as may be requisite for the full development of the plant. Harrowing in the spring, when the rains have practically ceased, breaks up the surface of the ground, destroying the minute channels or capillaries, by means of which the water finds its way down below, and in doing so arrests the escape of moisture direct from the soil, compelling it to evaporate through the leaves of the plant. It also destroys weed growth—weeds mean extra evaporation. The farmer need not be afraid of



Planet Jr. Horsehoe.

doing any serious damage to the crop. It is very difficult to kill a wheat plant once it is firmly established. I have harrowed wheat when it was two feet high without hurting it but, on the contrary, doing it a lot of good. I am, by experience, thoroughly convinced of the benefits of spring harrowing, and would urge it upon all farmers settled in the drier districts.



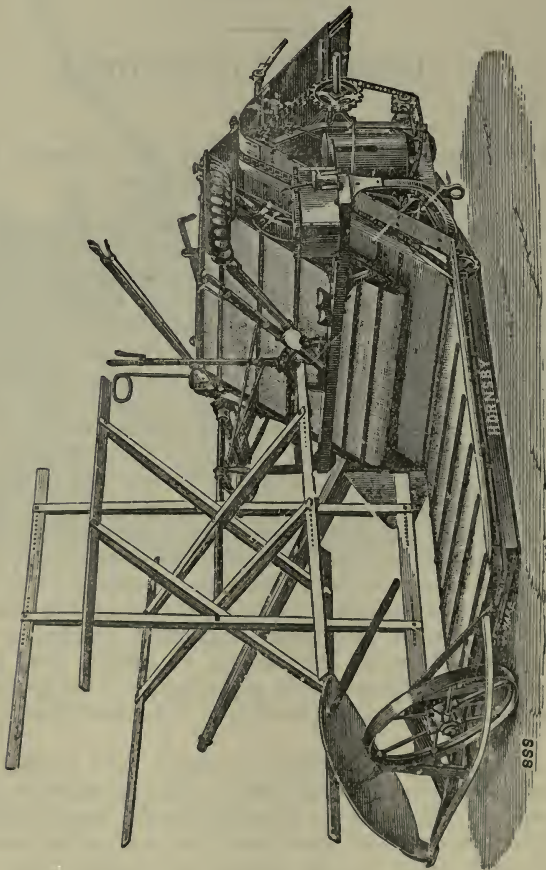
CHAPTER X.

HARVESTING OPERATIONS.

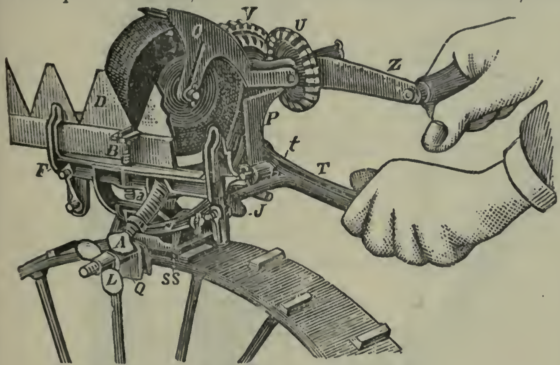
Various Methods of Harvesting Hay and Grain, Stacking, Thrashing, Chaff-Cutting.

If the crop is to be cut for hay it should be harvested well on the green side. Buyers for the goldfields' markets insist upon having a green sample, and as they are the largest purchasers, their wishes must be considered. The crop can be cut in many ways ; by the antiquated hand-hook or sickle ; by the scythe ; by the mower ; or by the reaper and binder. If the area under crop is sufficiently great it will pay the selector to purchase a reaper and binder at once. It is quite possible that he may be able to get his first crop harvested by contract, but there is always the possibility of the contractor having his own crop to harvest first, and thus delaying and depreciating the value of the settler's crop he has agreed to cut. The reaper and binder, of which there are many makes in the market, and all more or less excellent, is cheaper in the end than the mower and rake. Every season sees these machines improved, simplified, and made more in accordance with the necessities of Australian agricultural practice, and better able to withstand the wear and tear of roughly cultivated paddocks, unskilled workmen, and the extremes of our climate. Soft wood, so largely used in the construction of these machines a few years ago, is now giving place to iron and steel, wherever it is possible to substitute these metals for wood.

If it is decided to purchase a reaper and binder, and the selector has had no previous experience of these machines, it will pay him to spend a little time in ascertaining the merits and demerits of the different makes that have been worked in the district. The very gentlemanly agent for this make will probably wait upon the farmer with a bland smile and persuasive eloquence sufficient to stop a chaffcutter, and while nursing the youngest child with one hand, will produce with the other enough documentary evidence to conclusively prove, to any ostensibly sane person, that his particular brand of reaper and binder is absolutely the acme of perfection, and the people who use any other are either suffering from a temporary hallucination, which must be dispelled when they see his machine at work, or else are wilfully blind. Hardly will the new settler have had time to recover from the rhapsodies of the departed agent than another will come along, who, in less time than it takes to say "Jack Robinson" will prove by facts,

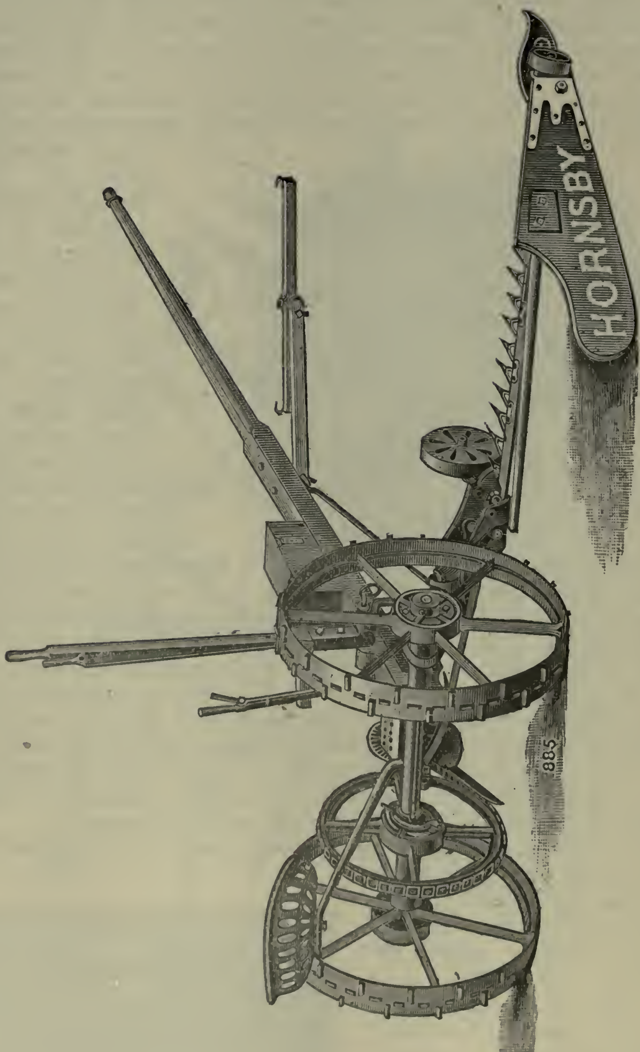


figures and other things, all capable of conversion and various constructions and mis-constructions, that the other fellow's machine is only made of scrap iron and tin tacks and dungaree overalls and cheap paint and unclarified mutton fat. Between these two stools the ingenuous agriculturist may come to the ground, but it is to be hoped not. Never buy anything from or through a travelling agent, is a safe rule to follow; and a rider may be added to the effect that it is not advisable to tamper with new brands. The only thing, in my experience, that it is safe and best to purchase on the strength of a new name in the colonies is bottled spirits; the first consignment of a new brand never contains the same generous percentage of sulphuric acid, fusil oil and other cheerful, short-range poisons, that subsequent lots do. But though whisky, as supplied to the colonies, is occasionally, and by accident, made from corn, and frequently from potatoes and other farm produce excepting corn, it is manufactured mostly from petroleum oil and other deadly sins, and, it is to be hoped, will not enter into the agronomic economy of the new settler. To return to the reaper and binder—In purchasing this, and all other expensive machinery, the farmer should deal direct with an established agent, who has a reputation to lose as well as a living to make. There is no excuse for not doing so, for all the best makers of agricultural machinery have their established agents in the metropolis, and these in turn have reputable sub-agents in all the towns of the colony. These agents, when they sell a machine, fit it up and start it working, and guarantee it, and if any accident occurs it is always possible to obtain duplicate parts without unnecessary and annoying delay.

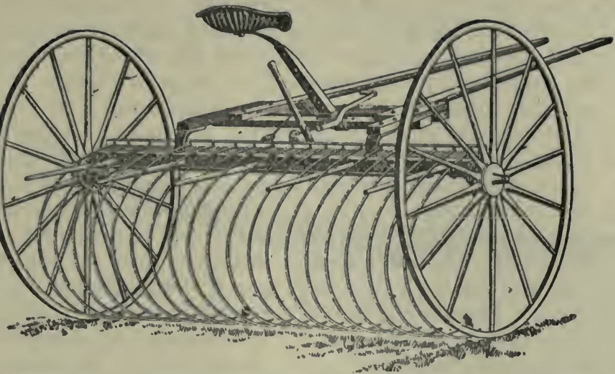


THE "DUTTON" MOWER KNIFE GRINDER.
R. PURSER, W.A. Agent.

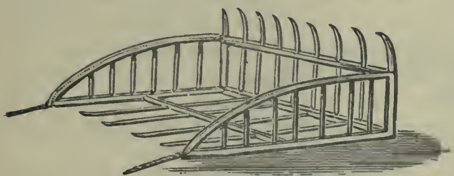
If it is decided to purchase a mower, there are many patterns in the market, and the selector should have no difficulty in getting a good machine. The illustrations herewith show the ordinary mower for two horses (with a 4ft. 6in. cut) and the self-raking reaper. This latter machine delivers the crop, as shown in the illustration, ready for hand-binding; the former merely cutting the crop, which has to be raked up afterwards into wind rows.



When the mower is used, a horse-rake will be found a necessity if the area of crop is more than a very few acres. Such a rake is shown in the accompanying illustration.



Another one, used in the United States on level ground for raking up windrows and carrying the hay to the stack, is shown, and this can be made on the farm, the block fully illustrating the construction of the implement, to which two horses are hitched. A horse on each of the windrows attached to the ropes will gather up an enormous mass of hay, which can be pulled right up to the stack or hay shed. If desired the side uprights can be carried above the rails like those at the rear.

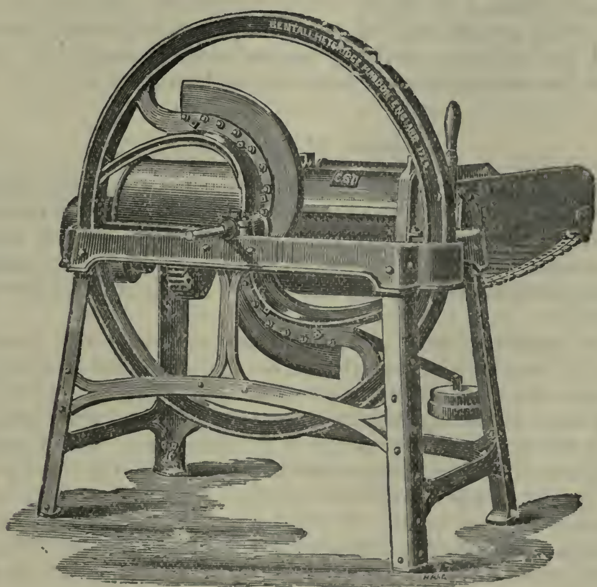


If the crop is to be used for hay it must, as I have said, in order to meet the taste of the market, be cut well on the green side, after flowering and before the stalk begins to harden. If it is cut very green there will of course be little grain in the chaff, but the nutritive value of the straw will be higher. If a reaper and binder is used the sheaves are stooked, that is, any numbers of pairs of sheaves are set against each other, the usual number being six pairs. Stooks are generally set in rows with the ends of the stooks pointing east and west, so that the hay dries more gradually and retains its colour better than if the broadsides of the stooks are presented to our almost tropical sun. In the northern hemisphere where the heat of the sun is not so intense, the reverse order is followed, the stooks being placed north and south. If the crop is being harvested in broken weather the stooks may be bonded, that is, sheaves are placed along the top of the stooks, heads interlaced, to shed the rain, but it is seldom necessary to do this in Australia. When the sheaves are sufficiently dry, so that there is no possibility of heating in the stack, they are carted from the field to the stack. The cart is brought up alongside a row of stooks, one man forks the sheaves to the carter on the cart, who places them with their stubble ends outwards, tier upon tier, until a load is made. A rope is then thrown across the cart from each corner behind and secured in front to the shafts, unless the distance is so short from the stook to the stack to render this unnecessary. If the stack is likely to remain for some time, it is better to lay down a stool or bed of straw or rushes or brush for the sheaves to stand on, when permanent stools are not erected. The stack may be of any shape, cylindrical, square, or oblong. The chief thing in stacking is to see that the centre is kept well up, that is, that the sheaves, placed stubble ends out, all point downwards and outwards from the centre. If a heavy fall of rain should occur before thatching, the moisture runs off much more readily if the stack is built this way, than if it is hollow in the centre. If the stack is to remain for any great length of time it is better to thatch with straw or rushes, but if it is intended to convert it into chaff without much delay this is not necessary. A layer or two of coarse salt between the sheaves will assist greatly in conserving the attractive green colour so fancied by the buyer, and adds also to the flavour of the chaff. When hay is a regular annual crop, the farmer will find it pay best to go in for a hay shed as soon as he can possibly afford it. A hay shed in Australia is simply a light galvanised iron roof thrown over a series of high uprights, and of any size that may be desired. With a hay shed the farmer is comparatively safe against the accidents of weather and the vagaries of the market. They are not expensive to erect, and their original cost is returned many times over in the course of a few years.

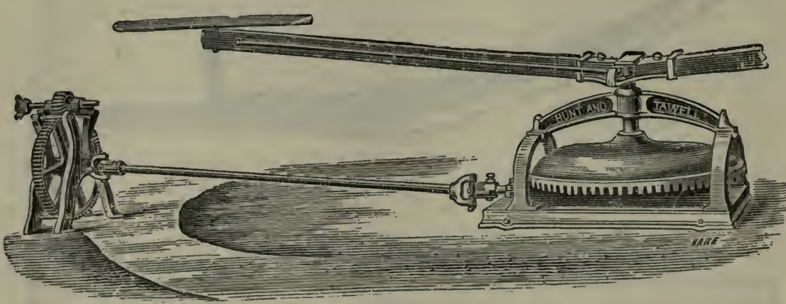
If the crop is cut with the scythe or the mower it must be raked up into rows and then put together with forks into cocks. When dry enough these are carted away and made into a stack. As good a looking sample of chaff cannot be made from loose hay as when it is bound in sheaves, but if the crop is cut at the right time and properly cared for, all other things being equal, the nutritive value of the feed is just as high, though the market value will be a few shillings lower. The rake gathers up a good deal of rubbish, especially on newly cleared ground, that is, of course, left on the ground when the reaper and binder is used. In the moister districts of the colony, where rain sometimes occurs during harvest, if it is thought there is any danger of hay heating in the stack, it can be obviated by placing a boss or trestle in the middle of the stack and building round it, laying down a good bed or stool of logs or brush first so that the air can get under the stack and have access to the centre. The boss may be either in the shape of a triangular tree-guard, or conical, or like a saddler's horse for oblong stacks, and made out of rough logs and any kind of scrap boards that will hold it together.

Chaff cutting is a very simple operation when the hay is in sheaves, and with anything like ordinary care a good sample of chaff can be turned out. When, however, the stack is of loose hay it requires some little skill to feed the machine properly. A hay knife will be required with loose hay to cut down the stack, and if the straw is very dry and dusty it may be sprinkled with water before being fed into the machine.

There are numerous makes of chaff-cutters, from the majestic portable or stationary cutter and bagger, driven by steam, and putting through a ton or more an hour, down to the humble hand



power machine, which turns out less than this quantity in a day. There are, in the chief hay-growing districts, travelling chaff-cutters, and if the farmer can get one of these to cut up his crop by contract he will in all probability find it more satisfactory than if he has to do it himself with one of the primitive machines driven by hand or horse power. Illustrations of a chaff-cutter and horse works are given herewith.



The modern and highly improved steam chaff-cutter will cut hay to $\frac{1}{4}$ inch guage, but I do not think that this very fine chaff is as good for ordinary working horses as the longer cut. It looks nice, but the animals have a tendency to bolt it.

Grain Harvesting.

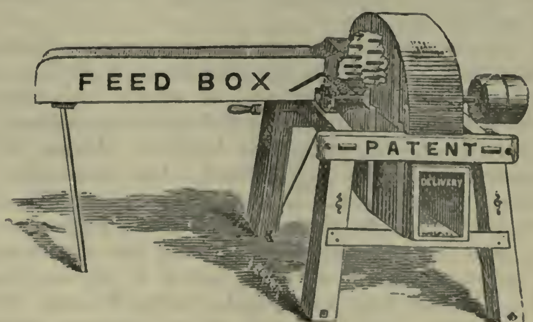
The harvesting of the grain crop, that is, of wheat, can be done either by the stripper or the reaper and binder, the latter machine or a mower being generally only employed in the harvesting of other cereals. M'Kay, in his *Australian Agriculture*, makes the following observations on the use of the reaper and binder and the stripper :—

The rapidity with which harvesting machines have come into use in Australia proves that, when suitable, our farmers are not slow to see the advantages of good things. The change which has taken place in the system of harvesting in the principal wheat-growing districts is very marked in its character. For a long series of years the Adelaide stripper has been steadily but surely gaining ground. The reapers and wire binders were introduced suddenly, and owing to the action of Australians, who saw them at the Philadelphia Exhibition, and afterwards string binders replaced the wire machines. Then, by a system of sowing only clean seed, it was seen that the land could be kept comparatively free from wild oats for many years, and in clean crops both machines did excellent work. Straw was of little value when grass was abundant, and markets distant and difficult of access ; while in regard to the effect on the system on the fertility of the soil, burning the straw upon the wheat fields proved to be better than cutting it off by the reaper and failing to return it in the shape of manure, so that, wasteful as it is to burn the stubble, it is better than taking all that is grown off from the land ; so, where the straw is usually short, no interference seems likely with the supremacy of the stripper as a harvesting machine ; and it has also been made clear that the reapers and binders are capable of doing really good work. At first, the machines were somewhat complicated, and farmers were afraid to risk the danger of stoppages through something going wrong ; but most of these machines that are now made inspire more confidence. There are situations, to, where both kinds of harvesters are used with advantage. With the aid of a reaper and binder, harvesting can be commenced a week or a fortnight earlier than stripping, and stripping can be carried on long after reaping would be impossible, because of the grain being shaken out. It is probable, therefore, that the harvest in the future may begin by reaping, until stripping time arrives. This will give a quantity of straw for the farm, and when the crop is ripe enough, the stripping machines may be put in to finish the work. By this means hurry and bustle will be done away with, and, at the same time, the farm stock will not be left without a supply of straw. The stripped wheat can also, if necessary, be sent to an early market, while that which has been reaped will the more easily be allowed to wait for the thresher. Recent dry seasons, and correspondent scarcity of horse and cattle feed, raised the value of straw in the estimation of fhe farmer.

The losses of stock, too, and the difficulty of carrying on the ploughing through want of horse feed, have brought the importance of the straw-stack forcibly before the minds of those who keep an eye upon the ways and means. Markets have also been made available through the extension of railways, so that we have an explanation of the tendency to adopt a means of harvesting by which the straw is saved. When it is returned to the land, in the form of manure, we are in a fair way of making another advance in our system of cultivation.

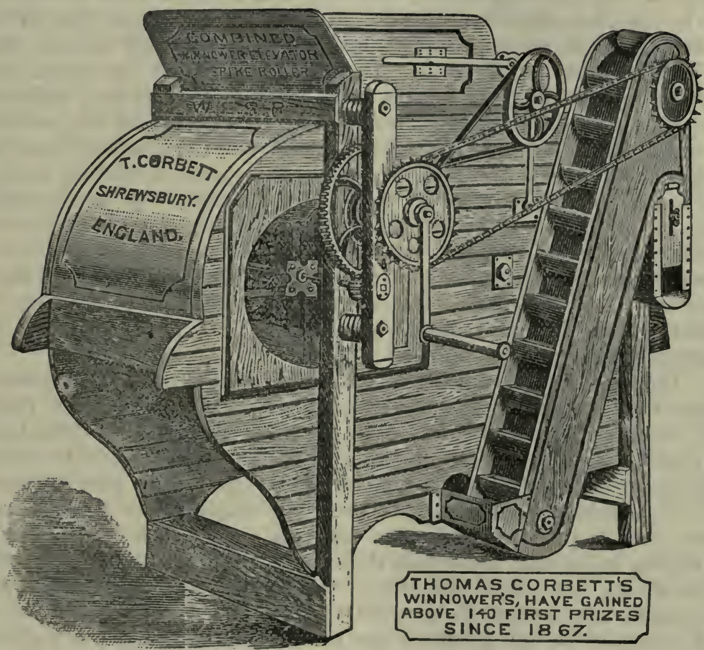
If the stripper only is used, the crop must, of course, be left till it is dead ripe ; but when the reaper is used it is now a well-established fact that a larger and in every way better yield is obtained by the grain being harvested before it is dead ripe. The straw also is of greater value as fodder. When the grain has become glazed and before it gets hard is the time when it is in the best condition for reaping. When harvested at this stage, "it is kept from shrivelling by drawing nutriment from the straw after being cut, and both weight and quality are benefited." Grain stripped on the green side shrivels, but it is not so when the crop is reaped. "Wheat that is stripped or reaped after it is dead ripe possesses dryness, flouriness and other excellent qualities, but is inferior in strength to that which has been reaped slightly on the green side."

On the subject of stripping, in the *Australasian Farmer:* Cheapness is the principal recommendation of the stripping system. Amongst the first settlers in the Wimmera district were a considerable number of Germans from South Australia, who came to the colony with their stripping machines, and an intimate knowledge of the South Australian system of making wheat-growing pay. The other selectors, who came from the southern parts of Victoria, soon learned to appreciate the stripper, and the result was that cheap production, and an almost complete independence of the labor market, were established from the first in the Wimmera district. Thus, having been able from the outset to harvest the crops at a very low cost, and having been saved from the extortionate wages which had to be paid in other districts, the Wimmera farmers had an advantage which has contributed in no small degree to what measure of success they have attained. Some idea of the cheapness of stripping may be formed from the fact that the work is done by contract for from four shillings to six shillings per acre. Taking six shillings per acre as the contract price for stripping an average crop, and remembering that a farmer will be able to harvest his own crop at something below the contract rate, it is not difficult to see that no other machine has any chance of competing in price with the stripper. The farmer engages to supply food to the men and horses working the stripper, and this, with the charge per acre, brings his crop, in the shape of wheat and chaff, to the winnower. By supplying a winnowing machine, and finding food for the men, he gets his wheat cleaned and put into bags at sixpence per sack, so that the whole harvesting process, up to carting the bags to the station, is done cheaply and quickly. When it is considered that, even with the reaper and binder, after supplying string and going through the processes of reaping, stooking, and stacking, the item of threshing has still to be paid, it will be admitted, that for cheapness, the stripper is unrivalled.



Hitherto the demand for chaff has been so great in Western Australia that since the discovery of the goldfields little or no wheat-growing has been done, but before very long the supply of locally grown chaff will in all probability be up to the demand, and then the grain grower will have the market to supply. There are also combined harvesters made, which strip, clean, and bag the grain, the bags being filled and sewn up ready for market. But these implements are best suited to very large paddocks, and are only within the reach of the farmer on a very large scale. An illustration is given herewith ot a header which may be used conveniently by the small-area man for separating the grain from the straw after it has been reaped.

After the grain has been stripped it is winnowed and bagged and is ready for market. An illustration of a winnower is given.



Wide winnowers with plenty of middle space, should be used, and large machines are generally to be recommended. There is much saving of labor in using large portable winnowers capable of cleaning after several strippers. Horse power should be used wherever possible.

When the crop is cut with a reaper and binder it is stacked in the same way as described in the chapter on the hay harvest, and when ready is carted in and stacked to await the arrival of the threshing machine. The following remarks on thatching stacks are taken from the *Australasian Farmer* :—

Covering the grain stacks is a course too often neglected, and the loss resulting is considerable. All that has been said in regard to the mistakes in producing grain and failing to save it, through careless stacking, applies with equal force to neglecting to provide suitable covering from the weather. The mildness of the climate, which encourages a careless system of stacking, results also in insufficient attention being paid to covering the grain ricks. When stacks are intended to stand only for a short time, they should be well covered with rick cloths of tarpaulin, or other waterproof material, as providing covers will be found cheaper than thatching; but in the case of stacks intended to stand throughout the winter, thatching is the more profitable course. Rushes and tussock grass are sometimes available for thatching, and can be used with advantage, but straw, of which there should always be a sufficient supply, answers the purpose well. The straw should be carefully sorted out into bundles, and then put on by an experienced thatcher. Begin at the eaves, and add tier after tier upon a section four or five feet wide, until the top of the stack is reached. A quick method is to lay on bundles, spread them out until the layer is about nine inches thick, rake and pat down firmly, secure with straw rope or hemp lashings to pegs, and proceed with the next tier, continuing until the top is reached. But in the more complete system, the thatcher takes small bundles, amounting to a good handful, and places each in position singly.

The top of the bundle is gathered into a point and inserted under the straw or hay of the roof, the bottom spread out, raked, and beaten down, and each section secured by ties as completed. In putting in the pegs which secure the ties, they should be driven slightly upward into the roof, so as not to lead water into the stack.

The farmer who keeps a threshing machine of his own can have this important operation carried out to his mind, but as threshing is for the most part done by travelling machines worked by contract, it is often difficult to prevent waste and loss. It is frequently the contractor's main object to get through the work, and it should be the farmer's aim to see that the work is properly carried out. Frequent inspection of the straw will be necessary to see that all the grain is being taken out, and the sprouts will also have to be watched to see that the grain is not being cracked. Equal supervision will be advantageous to ensure that the grain is properly cleaned, and that it is not being blown away over the riddles. The farmer will earn more money in attending to these things than in trying to fill a man's place in pitching sheaves or hauling away chaff. The system of threshing by contract adopted in the colonies might be improved upon. At present a certain sum per bag is paid for the threshing, the thresher being relieved from all trouble as to finding men and supplying food. The farmer has to collect a large staff of men for a few days and make arrangements for supplying them with food. The American system seems much more convenient. A certain charge is made for threshing, and the owner of the machine carries out the whole work, paying men's wages, catering for his workmen, and relieving the farmer of a great deal of anxiety. A gang of men travel with the machine, carrying a cook, a portable kitchen, and all requisites with them. The worry of gathering up men and providing them with food is one of the farmer's greatest troubles in the colonies, and the American system might be adopted with advantage.

If grain has to be stored on the farm, it may be done in bulk if there is a suitable building to hold it, or, if not, in sacks. The chief thing is to protect the grain against the ravages of mice. Two methods of stacking sacks (from the *Australasian Farmer*) are given herewith :—In stacking sacks the most important consideration is to protect the grain from mice. There are two ways of securing this end. The first one is to leave space for the cats to run all through the stack, and the other is to leave no spaces through which the mice can penetrate. According to the first plan, the first tier of bags is laid about a foot apart, and the next tier, which is laid transversely on top, is also made up of bags about a foot apart. By thus leaving a space between all the bags the cats can creep about in every direction, keeping the mice from the grain. The other system is quite as effective, and equally practicable. A layer of sacks is placed in position close together, and chaff from the thresher or winnower is spread over, being pressed tightly into all the spaces. After laying the next tier, more chaff is put on, being rammed into every space, and the process is continued until the stack is built. The whole is then covered with chaff and straw, and the mice are unable to make their way into the sacks. In the dry districts sacks can be stacked in this way in the field with safety for a considerable time. When stored in the field, sacks should be kept well off the ground and covered with a thick layer of chaff or straw.

If the farmer is a man of capital, he can with the greatest advantage build himself a mice and rat-proof barn. Such a building must be on piles, the floor about two feet above the surface of the ground. On the top of each pile is placed a good-sized square of flat iron, say two feet by two feet, and if nothing is allowed to lean up against the walls, and there are no steps leading into the structure, it will be found to be vermin proof, for the simple reason that rats and mice cannot walk upside down like flies, and they would have to do this to get in.

The reaper and binder is the best machine for harvesting the oat crop. The stripper is sometimes used in the dry districts, but it is very wasteful. The same remarks apply to barley and rye.

CHAPTER XI.

FEEDING DOWN GROWING CROPS.

Given early sowing and a favorable season, there is a decided gain in feeding down the growing crops with sheep or light horned stock. Sheep have golden feet on a farm, especially on light loams, and to use the patent medicine vendor's jargon, "no farm is complete without them." If the growing crops are well forward the sheep may be put in early, with great advantage to the sheep and the crop. A large flock that will get over the ground and the crop quickly is to be preferred, but better a small flock than none at all. Feeding down in a forward season prevents fungus diseases attacking sickly straws, the lodging of the crop, and induces the plants to stool out well, and give an increased yield. The sheep should be put on in dry weather, and early enough in the season to give the crop time to recover. With clean land, deep and thorough cultivation, clean seed, early sowing, feeding down, spring harrowing, and anything like a favorable season, the farmer is safe, and may count himself happy.

Pickling Seed to Prevent Smut.

Seed grain before sowing is pickled, in a manner which will be described, in order to prevent the plant when fruiting being attacked by parasitic fungi, commonly known as bunt and smut. Bunt is produced by a species of fungus called *Tilletia foetens*, which occupies the whole farinaceous portions of the grain of wheat, and gives the ear a burnt appearance. Smut is caused by the attack of a fungus belonging to the section *Ustilagineæ* of the *Hypodermiæ* group. Smut shows itself first in the organs of fructifaction, the epidermis of which is ruptured in a great number of places, a black soot like dust then appearing through the slits. In color and shape the smut fungus resembles the bunt, but its spores are not so long, and it possesses none of the disgusting odor that characterises the latter.

Dr. Cobb, the vegetable pathologist of the Department of Agriculture, New South Wales, says:—"Loose smut first appears at a time when the wheat comes into flower, and this fact is in itself almost a guarantee that this is the period at which it infests the next crop. Bunt, on the other hand, does not break loose from its ball-like enclosures until harvested and threshed. That is the period at which it infests the crop, either through immediate contact with healthy seed, or by being disseminated on the land so as to infest the seed when sown."

There are numerous chemical substances that may be used to pickle seed, and prevent smut and bunt, but the one in most general use is sulphate of copper, commonly known as bluestone. This is cheap, easily procurable, and effective. When mixing the pickle a copper or a wooden vessel should be used, as the vitrol soon attacks and destroys other metals. The seed should not be allowed to remain long in pickle, as it might absorb sufficient to destroy the germ, or enough moisture to cause it to malt if sown in dry ground.

The usual method of pickling is to dissolve bluestone in hot water at the rate of a quarter of a pound to the gallon. This is sufficient for half a bag of wheat. A quantity of the solution is made and put into a half-barrel or wooden tub. The butt of seed is submerged in this until the liquid has thoroughly penetrated it. It is then lifted out and placed on a cross piece over the tub to drain. If large quantities of wheat have to be handled, I think the most expeditious and economical way is to dump the contents of several bags out on the floor of the barn and sprinkle the grain with the liquid from a garden watering-can, turning the grain over with a shovel as the sprinkling goes on. A dusting with dry lime renders the seed at once fit for sowing either by hand or drill. If the salt pickle is used, the brine must be sufficiently strong to float an egg, and the seed must be immersed for fully five minutes in the solution and, when taken out, mixed with one-twelfth its own weight of dry lime.

Another plan is to dip the seed in a strong solution of lime, the lime forming a thin coating upon the grain. If only a comparatively few bushels of seed have to be pickled, it will pay to empty the contents of the bag into the pickling tub and stir them well up. By this means all weed seeds, and light and defective seeds that would not germinate, will come to the surface and may be skimmed off. Every grain left in the tub will be sound and whole. In whatever way the pickling is done, it must be borne in mind that the seed must not be steeped or allowed to become saturated with the solution.

The device, as shown in the accompanying diagram, will be found useful and handy, not only for pickling seed wheat and other grains, but for potatoes, as a precaution against disease.

The above is thus described by a writer in the *Rural New Yorker* :—" I procure a good barrel, an oil barrel, and put a faucet or plug in close to the bottom. Then I make a box 19 inches wide outside (or three inches narrower than the chines of the barrel) by three feet long, put cleats in the inside corners to strengthen it ; it is open top and bottom, and as high as the tub I draw the liquid into. I hollow out one end a little so the barrel will not roll when turned down on its side ; the swell in the barrel just hits the end, making it just about balance. I place the barrel on one end of the box, with the faucet over the tub, fill with the solution and potatoes, let stand one hour, and open faucet. When the solution has all run off, with one hand the barrel can be turned in the opposite direction and the potatoes run into crates. Without any lifting, lugging, or getting wet, a person who can lift a half-bushel of potatoes can do all the work. I am using the same barrels and

tubs I commenced with four or five years ago, and I see no reason why they are not good for several years yet. A platform will not do, as the barrel is hard to tip, rolls around, and when it passes the centre, comes down too hard, and all the potatoes want to get out at the same time. I am using the box for the first time this season, and think now that I want nothing better."

If it is desired to pickle maize, peas, beans, or other large, hard grains, the coal tar pickle is really the best. The tar is poured upon the maize slowly and the grain stirred until every grain is lightly but completely coated. It is then dusted with dry lime. Seed so pickled will retain its vitality for any number of years, and will not only be free from attacks by, but prove objectionable to, the voracious crow and ground vermin. The all-devouring crow may sample a few of the grains so treated, but he will not be found making a practice of dining off them to any great extent afterwards, unless all creation has dried up and left him absolutely starving. The same remarks, founded on observation, apply to rats, opossums, and other vermin.

Quantity of Seed Per Acre.

The following table will be found useful for reference :—

NAME.	QUANTITY PER ACRE.	WEIGHT PER BUSHEL.
Artichokes, Jerusalem, in rows 3 ft. x 18 in., according to size	...	(tubers) 45 lbs.
Barley, broadcast, for green fodder	2 bushels to 3 bushels	40 lbs.
Barley, in drills	1¾ bushels to 1½ bushels	40 lbs.
Beans, field, in drills 20 in. to 30 in. apart.	2 bushels to 4 bushels	64 lbs.
Beets, or mangels	6 lbs. to 10 lbs.	21 lbs.
Buckwheat, in drills	1 bushel to 1½ bushels	50 lbs.
Cabbages, to be transplanted	½ lb. to 1 lb.	50 lbs.
Cabbages, in drills	3 lbs. to 4 lbs.	...
Carrots	4 lbs. to 6 lbs.	(roots) 40 lbs.
Chicory, in drills	4 lbs. to 7 lbs.	(roots) 40 lbs.
Clovers	15 lbs. to 20 lbs.	60 lbs.
Cocksfoot grass	3 lbs. to 5 lbs.	2c lbs.
Couch grass	7 lbs. to 10 lbs.	40 lbs.
Cucumbers, melons, pumpkins	1 lb. to 2 lbs.	20 lbs.
Flax (linseed)	1½ lbs. to 2 lbs.	56 lbs.
Grass	2 bushels to 3 bushels	20 lbs.
Hemp, in drills	1 lb. to 1½ lbs.	40 lbs.
Kohl-rabi, in drills	3 lbs. to 4 lbs.	50 lbs.
Lucerne, broadcast	20 lbs.	62 lbs.
Lucerne, in drills	8 lbs.	...
Lupins	1 bushel to 2 bushels	62 lbs.
Maize, for grain	1 bushel	60 lbs.
Maize, for green fodder or ensilage	2 bushels to 3 bushels	...
Mustard, broadcast	15 lbs. to 20 lbs.	50 lbs. to 56 lbs.
Oats	2 bushels to 3 bushels	50 lbs.
Onions	5 lbs.	40 lbs.
Parsnips	6 lbs. to 8 lbs.	(roots) 40 lbs.
Peas, in drills	1½ bushels to 2 bushels	60 lbs.
Peas, broadcast	3 bushels to 5 bushels	60 lbs.
Potatoes, in drills, or hills, cut,	10 cwt. to 12 cwt.	45 lbs.
Potatoes, (cut to single eyes),	3 cwt. to 5 cwt.	...
Radish, broadcast,	4 lbs.	35 lbs.
Rape, broadcast,	8 lbs. to 10 lbs.	50 lbs.
Rape, in drills,	3 lbs. to 5 lbs.	50 lbs.
Rye	1½ bushels to 2 bushels	60 lbs.
Sanfoin	1 bushel	28 lbs.
Sorghum, broadcast,	½ bushel to ¾ bushel	40 lbs.
Sorghum, in drills,	⅛ bushel to ½ bushel	...
Turnips, in drills,	2 lbs. to 4 lbs.	50 lbs.
Turnips, broadcast,	4 lbs. to 6 lbs.	...
Vetches or Tares	2 bushels to 3 bushels	64 lbs.
Wheat, broadcast,	1½ bushels to 2 bushels	60 lbs.
Wheat, in drills,	½ bushel to ¾ bushel	...

Plants Per Acre.

Feet apart	No. of Plants.	Feet apart	No. of Plants.	Feet apart	No. of Plants.
2	10890	9	537	20	108
3	4840	10	435	21	98
4	2722	12	302	25	69
5	1742	15	193	30	48
8	680	18	134	35	35

Rule.—Multiply the distances into each other, and with the product divide 43,560 (the number of square feet in an acre), and the quotient is the number of plants.

CHAPTER XII.

FARM BUILDINGS.

How to put up a Cheap, Substantial, and Comfortable House.

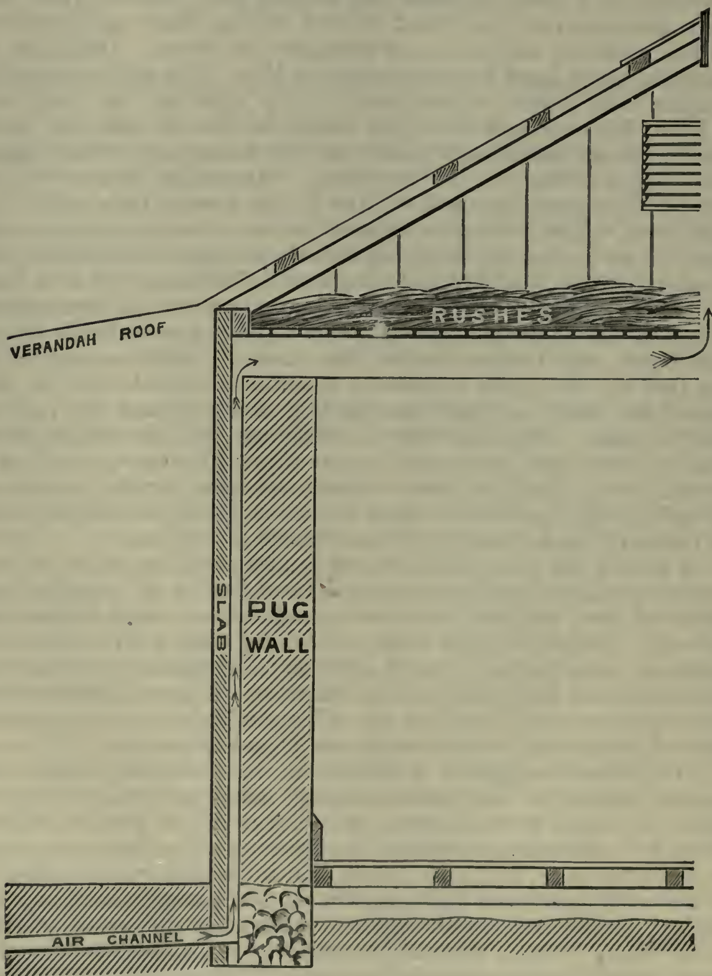
The selector, in the matter of buildings, will necessarily be governed by the capital at his command. Possibly a tent, a slab-and-dab or log hut, or a tin shanty will be the first home of the new settler, but let us hope that whichever of these is chosen will soon give place to a more substantial and comfortable residence. To the settler who can run to bricks and mortar or stone from the very start I have nothing to say about house construction, as he will be well able to secure the services of an architect, and be very foolish if he does not. In this chapter I merely presume to offer to the selector with a limited amount of capital a few suggestions that will enable him to put up a house, costing little, and yet substantial and comfortable. While the climate of Australia is tropical and sub-tropical, the style of architecture chiefly in vogue is essentially that of the temperate zone. Why this should be I do not know, but it has always appeared to me to be wrong. In building a house, or rather, I should say, a home—for the former frequently means a place in which we intend other people to live, the latter always an abode for oneself—the chief things to be aimed at are that it should be cool in summer and warm in winter. In order to obtain this most desirable end, certain natural laws must be strictly observed. These laws, as far as my experience goes, are more honored in the breach than in the observance, in the construction of dwelling-houses in Australia. Galvanised iron is very largely used in the construction of houses in the colonies, and a more unsuitable and really dangerous material for the purpose it would be hard to discover. A "tin" house is cheap, and like so many other cheap things, it is nasty. It is intensely hot in summer, and equally as cold in winter, and death lurks in every joint of it. From an hygenic point of view a tent is infinitely preferable, and a slab-and-dab hut a palace by comparison.

Milk is a peculiarly sensitive, complex fluid, and at once affected by any marked variation in temperature. How very few houses there are in Australia in which a pan of milk could be set in any living room during the summer months, without its turning in a few hours. There is always a place specially constructed, called the dairy, in which the milk is kept. My argument is that what is good for milk is good for man, the most sensitive and complex of solids, and that our houses in the tropical and sub-tropical portions of Australia should be constructed on the same principle as dairies, in which an equable temperature is secured all the year round. It is curious, but I have noticed it frequently in my Australian travels, that while a good dairyman will take all sorts of precautions to ensure his milk being kept sweet and cool in summer and warm in winter, he himself lives, year in, year out, in a construction of iron, wood or brick, stifling, stuffy and smelly in the hot weather, and cold and draughty in winter. Obliquity of economic vision must be responsible for this. The milk represents so much cash, thinks the dairyman, totally ignoring the fact that his brain, his bone and sinew, his flesh and blood, and his good sound physical and mental health, all rolled into one, is the biggest cash asset that there is on the farm. Australian farmers are a healthy lot because they live so little in the houses they build for themselves, while Australian farmers' wives, so far as my experience goes, are, as a class, anything but robust, because chiefly they live so much in these fearfully and wonderfully ill-constructed houses.

Some years ago, before the age of butter factories and creameries, I lived in the northern part of Victoria, near a very large home-built dairy, and I often visited the place. I made up my mind then that if I ever built a house in Australia it should be on the plan of this dairy—on the principle that what is good for milk is good for man. The time for the fulfilment of the self-imposed promise came some four years ago, and it is this house, in which I am still living, that I propose to briefly describe for the benefit of the settler who has not too much money to spend on buildings and yet desires to make himself as comfortable as possible.

I should like to say that I never built a dwelling house before, and that I had no assistance but that furnished by an unskilled but handy laborer, and that I was not a millionaire when I started the contract. I mention these facts, not for my own glorification, but merely to show that any one of ordinary intelligence who can use a hammer, saw and chisel, can do likewise. We are all very wise after the event, and I can see lots of little mistakes in construction that will be avoided in the next house I have to put up.

The house originally consisted of four rooms (it has now twelve); is built of two native materials, wood and mud, or pug, or adobe, or whatever one likes to call it; and this is how it is constructed: I bought a couple of truckloads of slabs (face cuts), some round jarrah poles for corner posts, and the necessary sawn timbers for the roof, floor joists and uprights. I first put up a shed 40 x 20, that is, I put the necessary uprights in the ground and put the roof on top of them. Then I covered the sides with slabs, leaving spaces for doors and windows, trenching the slabs into the ground at the bottom and nailing them to the wall plate at the top. The openings between the slabs I closed with the thin ones, nailing them well on each side. The next work was to put down the floor joists and lay the floors, leaving a space of 18 inches all round each room between the slab wall and the ends of the joists. The windows and doors were hung and the family moved in. Then commenced the real business of house building. Inside the slab walls I proceeded to put up 18 inches of pug. I first laid down foundations of broken stone to a level with the floors, and built the pug up on the top of these to the



height of the ceiling, when this was done the ceilings were put in, the walls plastered with mud and made smooth, and the paper-hanging and plastering gone on with until the intra-mural decorations were completed. The clay of which the walls are made is of the common or garden variety, worked up with water into stiff pug, carted in a barrow, and slapped up against the walls tier upon tier, right round the house, until the required height is reached. The finishing-off was done with lighter soil from the surface, and the surface of the walls made as smooth as if they had been built of brick and lime plastered. The construction of a place of this kind is as simple as can be, and the only things I am particularly desirous of impressing upon my readers are the precautions taken for keeping the building cool. In order to explain these fully and clearly a diagram is necessary.

The diagram shows the outer wall of slab, the inner wall of pug, and between the two an air space. If the clay is thrown up against the wood it will shrink away from it in drying and leave a space of an inch or more. Leading into the house from as many directions as possible are air channels formed beneath the ground. These can be made of galvanised iron down pipe, drain pipes, wood, or any handy material that will secure the uninterrupted circulation of the air. They should fall away from the house, and this can easily be done, presuming the house has been built up on a rise and not down in a hollow. The longer these channels are, the cooler will be the air flowing through them. The arrows in the diagram show the direction in which the air circulates. The hot air from outside passing through these channels is cooled in transmission and passes between the outer wall of wood (a non-conductor of heat) and the inner wall of clay and along the channel under the ceiling (as shown) and out through the roof. The ceilings are covered under the roof a foot or eighteen inches thick with rushes, and a louvre window is placed at each gable end. It is easily seen that the hotter the roof gets the greater the circulation of cool air, and the cooler the house is, provided doors and windows are kept shut and the hot air excluded. In a house ventilated as this is there is no occasion for gaping doors and windows always ajar. So long as the outer air is hotter than that inside the house there is nothing to be gained in opening the windows if the house is properly ventilated. The sides of the channel running under the ceiling are perforated, and the hot air in the rooms escapes through this, and is replaced by cool air from below. The proof of the pudding is in the eating, and I have lived for years, and am still living in such a house as I describe, and it is without exception the coolest house in summer and the warmest in winter that I know.

In putting up stables, cow byres, pig styes, and other farm buildings, it must not be forgotten that the climate of this colony does not necessitate elaborate buildings. It is very nice to have substantial stables and out-buildings, but, at the same time, stock, &c., will do here without them. At the same time it must be remembered that the stock appreciate cool and shade in summer, and warmth and shelter from the rain in winter, as much as we do, and will repay in condition any extra trouble of this kind spent upon them. The cost of well-arranged tool and harness rooms will not seem great when we consider their convenience and the saving which may be effected by them. " A place for everything and everything in its place," is a maxim nowhere more important than on the farm. On many farms much time that should be saved is wasted in searching for tools left out of place and ill cared for.

The following dimensions of farm buildings of a most suitable kind may be found useful, and are taken from *McConnell's Notebook*:—

Dimensions of Details.

(M'Connell's Note Book.)

Stable.

Length of stable travis, 9ft.
Height of travis at end near wall, 7ft. ; at heel-post end, 5ft. 6in.
Thickness of division boards, $1\frac{1}{2}$in. ; width, 9in.
Heel-post, 6in. drum, or 6in. x 4in.
Head-post, 6in. drum, or two pieces each 4in. x $2\frac{1}{2}$in.
Width of hay-rack, 18in. ; height above floor, 9in.
Width of manger, 18in. ; length, 2ft.
Height of top of manger and rack, 3ft.
Size of top and bottom rails of rack, 4in. x 3in.
Size of spars, 2in. x $1\frac{1}{2}$in., or 2in. square.
Depth of manger, 9in. or 10in.
Width of windows for stables and cowhouses, 3ft. 6in. x 4ft. 6in. in height. Glass, 21-oz.
Width of stable doors, 4ft. x 7ft. 6in. in height.
Width of gutter in stable, 12in.
Fall of ditto, $1\frac{1}{2}$in. to 10in.
Fall of floor of stall, 1in. in 3ft.
Loose-box in stable to be twice the width of single stalls.
Louvre-board ventilator for every four animals, to be 6ft. long x 3ft. wide and 2ft. 6in. above ridging—to be divided longitudinally by boarding so as to have an up-going and a down-going current of air irrespective of the direction of the wind.

Cow-house.

Length of stall from front partition to gutter behind, 7ft. for average cows and 7ft. wide ; 8ft. square for largest only.
Length of travis, 4ft. ; height of travis, 4ft. to 5ft.
Thickness of travis, if of stone slab, 4in. ; if of wood-head, heel-posts, and top rail, 4in. x 3in. ; boards, $1\frac{1}{2}$in. thick and 9in. wide.
Length of feeding-trough, 3ft. ; width, 15in. ; depth, 1ft.
Width of gutter, 2ft. ; height of cow's bed above bottom of gutter, 8in. ; height of gangway above bottom of gutter, 6in. Gutter to have a fall of 1ft. sideways (towards the gangway), besides the fall lengthways. Gangway to be inclined towards gutter. Cows' beds are thus 3in. above level of passages.

Width of dunging passage, 6ft.
Width of feeding passage, 4ft.
Hammells for feeding cattle, 10ft. x 15ft. for each animal in shed.
Cattle-boxes, 10ft. square, with feeding passage 6ft. wide ; each box provided with a door 4ft. wide and a turnip trough.
Cattle courts and sheds : 75ft. superficial allowed for each animal in sheds, 150ft. in the court.
Shed for 300 sheep : 100ft. long x 15ft. wide ; court, 100ft. x 80ft., or 100ft. square.

Roofs.

A roof of two of span to one of height is suitable for the smaller offices.
A roof of three feet of span to one of height is suitable up to 30ft. span.
Roofs under 15ft. span will do with simple tie-beam ; up to 25ft. require king-post ; up to 30ft. require struts in addition.

The following recipes from Mackay's *Australian Agriculture* will be found useful in making paint for rough outside work :—

1. Unslackened lime, 20 lbs., slake it with water, covering during the process to keep in the steam ; strain the liquid through a fine sieve or strainer, and add to it 15 lbs. or more salt, previously dissolved in water ; rice, 3 lbs., boiled to a thin paste, and stirred in boiling hot ; Spanish whiting, ½ lb. ; clean glue, 1 lb., which has been previously dissolved in water, soaking it well, and then hanging it over a slow fire in a small vessel immersed in a larger one filled with water ; next add hot water to the mixture, enough to make a nice thick paint, stir it well, and let it stand a few days covered from dust ; then put it on hot if possible. This will last on wood, stone, or brick for years.

2. "Machine," or skimmed milk, 2 quarts ; fresh slackened lime, 6½ ozs. ; linseed oil, 4 ozs. ; common whiting, 3 lbs. Put the lime into a stoneware vessel ; pour upon it sufficient milk to make it like thick cream ; add the oil a little at a time ; mix thoroughly ; add remainder of milk, then the whiting made fine ; keep the whole well stirred while using.

3. Cement wash (cement, or water-lime, as some call it). Mix the cement with water, and apply three or four coats. Any color may be added. This will last for years, and by renewing once in two or three years a building may continue looking well at small expense.

4. Use common stone lime ; slake or reduce it to powder in a tub, by pouring on sufficient water. During the process cover the tub with a bag to keep in the steam, then pass the powder through a fine sieve, and to every 6 quarts add a quart of salt and a gallon of water ; then boil and skim clear ; to every 5 gallons of the liquid add pulverised alum 1 lb., pulverised bluestone ½ lb., and add, very slowly, about 6 lbs. of fresh burnt wood-ashes from mangrove or

oak-wood, if possible, and any coloring matter desired. Apply the paint with a brush. It looks well, and is very durable ; will stop small leaks in roofs, prevent moss from growing thereon, make it incombustible, and render bricks impervious to water.

A good base for rough paint is Spanish white, or, as it is more commonly called, whiting, mixed in pure, raw linseed oil ; stir until it is thoroughly mixed ; then reduce with oil to the consistency of paint, and add a little turpentine or other drier, sufficient to dry it. Apply with an ordinary brush. It must be thoroughly beaten up together, so as to work out all the lumps of the whiting. Another : For weather-worn weather-boading take about one half common whiting, one half white lead, and a small portion of red lead or chrome yellow to overcome the blackness of the wood, or add umber for a drab color. Flax seed oil may be used ; a little turpentine or kerosene makes the paint flow more freely from the brush. Small portions of Venetian red and lampblack do for dark colors. A good green paint for outdoor work may be made by rubbing two parts of white lead and one or more of verdigris with linseed oil varnish, mixed with oil of turpentine and diluted with ordinary drying oil.

Wall Papering.

When ordering wall paper for internal decorations it is worth knowing that a piece of paper is 12 yards long by 21 inches wide (reckoned at 20 inches). To find the number of pieces required, divide the surface of wall in feet by 60. One-eighth to one-ninth should be allowed for waste in hanging.

Many, especially those situated some distance from cities, undertake to do their own paper hanging, and for the benefit of these, the following suggestions, as published in the *Rural New Yorker*, are given. Wall paper is cheap, it livens up the house and adds to its æsthetic comfort, and any moderate expenditure in making the home attractive is, in my opinion, amply justified. Individual taste must be relied upon in the selection of colours or designs suited to the various rooms to be papered, and so much has already been written upon this subject that I shall only say in regard to selection, choose for the first attempt a good quality of paper, one that will not tear easily ; though the expense may be a trifle greater, the saving of time and dissapointment will more than offset it, at least until you have gained a little experience in handling the paper. Sanitary papers will wash.

The first matter for consideration is a proper outfit for the work. Purchase a "smoothing brush," a wide, thin-backed bristle brush which may be had for 75 cents. An ordinary whitewash brush of good quality, a rather soft one, is a good paste brush. Then one needs a large pair of scissors, and a pocket or pouch large enough to hold the smoothing brush and shears. This pocket is suspended from the waist while working. This is the entire outfit of necessary tools, with the exception of an old table or, better, a couple of broad, smooth boards supported on light trestles, making a table about two feet wide and nearly as long as the room.

Do not cut the paper, piece by piece, as needed. Cut several at a time, but before doing this, the paper should be trimmed. Lay a bolt across the feet in an ordinary sitting posture, draw the end up over the knees, and with the right hand, shear off the margin with a clean, even cut, and roll up the ready trimmed portion with the left hand, proceeding in this way until the whole bolt is trimmed.

Always begin with the ceiling, and as there are 12 yards in a bolt, a little head-work will quickly determine which way the paper should run to cause the least waste, though the shorter width is the easier to handle.

In cutting wall paper, never cut odd lengths, but always a certain number of repeats. The repeat is usually from 13 to 17 inches long, and marked by a dot or print on the margin. The ceiling pieces must be cut to the nearest repeat longer than the width of the room. After the first cut, there need be no measurement, as one lays the second piece over the first and cuts to the same repeat mark, and so on until a whole bolt is cut, before beginning to paste and hang.

This done, the worker will have a number of pieces lying upon each other. Do not separate them. Simply turn the whole bunch face downward on the long table. Have a pot of smooth flour paste at hand, and with the brush quickly and thoroughly wash over the first or uppermost sheet, and when done, fold each end in towards the centre, leaving 10 to 12 inches of the pasted side exposed at the middle of the piece. The first attempt at folding in the ends will, doubtless, be a failure, as it requires quickness and decision. Smooth these folds flat, and do not fear that the sharp break in the paper will do any harm.

The sheet is now ready for hanging, the most difficult part of all. Along one side of the ceiling draw a cord parallel to the side wall, and about 16 inches from it, marking its position at intervals with a pencil. Take up the pasted paper, paste side up, and holding it over your head on upturned palms, carefully fit the untrimmed margin to the line marked, at a point equidistant from either end, and with a stroke or two of the smoothing brush paste it fast. For one person alone to hang the ceiling requires great dexterity, and an assistant to hold one end while you brush on the other will be indispensable at first, and at all times helpful. The weight of the paper, if not supported, would immediately tear itself away from the wall, so while the assistant holds one end, and with the left hand retaining the central part already placed, loosen the corner of the fold with the right thumb and finger, and pull it down part of its length, after which its own weight will gradually unfold it, while with bold strokes of the smoothing brush it is pressed firmly and smoothly to the ceiling. Striking the edge of the brush into angles will push the paper entirely into them without tearing. Treat the other end in the same way, and if the paper should extend down the side walls more than three or four inches, cut it off to that length after it is on the wall. The operation is repeated for each successive sheet, carefully matching the paper at the middle. Never begin at one end, but always at the middle, and then if the paper does not perfectly match, the ends may be allowed to loosen by their own weight till near the middle, and then be corrected and brushed smooth again.

The walls are not so difficult as the ceiling, though, in cutting the paper for them, the lengths are cut in the same way. Find the height of the room, beginning five or six inches from the ceiling, and measuring down to the baseboard, including the chairboard if there is one, and cut to the nearest repeat longer than this measurement. This will always result in the least waste of paper. Paste and fold in the ends as before, and mark with a plumb line for the edge of the first piece. The object in folding the paper paste inward is that it may be handled then like dry paper, and while at work the printed side will be against the wall, thus allowing it to swing clear without adhering until you have it properly placed.

Loosen a few inches of the upper end, and beginning near enough the ceiling so that the border will cover it, fasten and let the sheet drop, smoothing it to the wall as it unfolds. Reaching behind, start the lower fold, and with the brush work the paper into the angle at the top of the chair-board, and draw the point of the shears along the angle, not so as to scratch, however, but merely to make a mark. With the left hand, draw the paper away a few inches again and cut along this line, and smooth down a second time. This makes a perfect fit every time, if properly cut. The piece thus cut off is not laid aside, but is placed beneath the chair-board, extending several inches above its lower edge as well as down over the edge of the base-board. Mark these angles as above, cutting to the line, and again smoothing into place with the brush. All angles, horizontal or perpendicular, are treated in this same way, and one should never undertake to cut a piece of paper beforehand to fit a certain space, for it cannot be done. Spaces over doors and windows will, of course, require the cutting of short pieces, which often results in considerable waste, but it cannot be avoided if you would do nice work. Last of all, the border is hung, but this requires no new method of handling. It may take a beginner a trifle longer to paper a room than it would a professional, but even the first attempt, if carried out in this way, will be far superior to the lower grade of professional work.

The following approximate quotations for building necessaries are kindly supplied by W. Sandover and Co., of Perth and Fremantle :—

Square painted iron tanks.

50	100	200	400 gallons
35s.	45s.	57s. 6d.	75s. each.

Round galvanized iron tanks, with brass tap.

100	200	300	400	500	600	700	800	1000 gallons
32s. 6d.	35s.	45s.	52s. 6d.	60s.	72s.	82s.	90s.	110s. each.

Galvanized gutter O.G. or half-round, in lengths of 6 feet.

4	5	6 inch
2¼d.	2½d.	3d. per foot.

Galvanized ridge capping, in lengths of 6 feet.

12	14	15	16	18 inch.
2¾d.	3¼d.	3½d.	3¾d.	4d. per foot.

Galvanized down pipe, in lengths of 6 feet.

2	2½	3 inch
2d.	2½d.	2¾d. per foot.

Galvanized corrugated iron.

26 gauge.	5	6	7	8	9	10 feet.
Sheets per ton.	226	186	162	140	120	112
	£17 15s. per ton,				£18 15s.	£19 15s. per ton.

Doors, American, four-panel.

6 ft. 6 in. x 2 ft. 6 in. x 1¼ in.	6 ft. 6in. x 2 ft. 6 in. x 1½ in.
13s. 3d.	14s. 6d.
6 ft. 8 in. x 2 ft. 8 in. x 1½ in.	6 ft. 10 in. x 2 ft. 10 in. x 1¾ in.
16s.	19s. each.

Sashes, six-light.

8 x 10	10 x 12	10 x 14	12 x 14
5s.	6s. 9d.	7s 9d.	8s. 9d. per pair.

T Hinges,	6 in.	8 in.	10 in.	12 in.	14 in.	16 in.	18 in.
	4d.	6d.	6d.	7d.	8d.	1s.	1s. 3d. pr.
Butt Hinges,	1½ in.	2 in.	2¼ in.	2½ in.	3 in.	3½ in.	4 in.
	3d.	4d.	4d.	4d.	5d.	6d.	7d. pair.

Rim Locks,	6 in.	7 in.	8 in.
	2s. 9d.	3s. 6d.	6s. each.

Genuine White Lead, 30s. per cwt.
Raw Linseed Oil, 3s. 6d. per gallon.
Turpentine, 3s. 6d. per gallon.

Wood Screws,								
⅝ x	5	6	7	8				
	5½d.	6d.	6½d.	7½d.				
¾ x	6	7	8	9	10	11	12	
	6½d.	7½d.	7½d.	8d.	8½d.	9d.	10d.	
1 x	6	7	8	9	10	11	12	14
	7½d.	8d.	8½d.	9d.	9d.	10d.	11d.	1s.
1¼ x	8	9	10	11	12	14	16	
	10d.	10½d.	11d.	1s.	1s. 1d.	1s. 4d.	1s. 8d.	
1½ x	8	9	10	11	12	14	16	
	11d.	1s.	1s.	1s. 1d.	1s. 2d.	1s. 6d.	1s. 10d.	
1¾ x	8	9	10	11	12	14	16	
	1s. 1d.	1s. 1d.	1d. 2d.	1s. 3d.	1s. 4d.	1s. 8d.	2s.	
2 x	10	11	12	14	16	18		
	1s. 3d.	1s. 4d.	1s. 6d.	1s. 10d.	2s. 3d.	2s. 8d.		
2½ x	10	11	12	14	16	18		
	1s. 6d.	1s. 8d.	1s. 10d.	2s. 3d.	2s. 8d.	3s.		

CHAPTER XIII.

METEOROLOGY.

Written Especially for West Australian Farmers.

By W. Ernest Cooke, *Government Astronomer*.

Farmers and sailors are proverbially weatherwise. Being accustomed to an outdoor life in which the vicissitudes of climate play such an important part, they naturally acquire the habit of observing closely the sequences in the formation of cloud, direction of wind, and rainfall ; yet notwithstanding this general proficiency their knowledge may be supplemented by an intelligent use of instruments designed to estimate the density, temperature, and humidity of the atmosphere, and a carefully compiled record of the rain will inform them as to the quantity which they may reasonably expect to fall within a season. It is the purpose of this article to give a brief description of the meteorological instruments generally employed, with simple directions for reading them :—

The Barometer.

I am sorry I cannot recommend an aneroid, as it is in many respects convenient. But its indications are not as a general rule to be depended on, unless compared at intervals of a few months with some reliable standard. For those who intend to take systematic observations a mercurial barometer is almost indespensable. The particular form I should recommend is the "Board of Trade Standard," sold in England for £4 4s. Fairly reliable mercurial barometers can be obtained from £1 1s. upwards.

In making observations pay no attention whatever to the legend inscribed on the face, such as "rain," "change," etc. These may possibly be of use to the people of London, but are only misleading to dwellers in West Australia. Read the barometer (as described below) together with the attached thermometer at a certain hour or hours every day, 9 a.m. and 3 p.m. if convenient, and keep a record of these readings.

Prognostications are to be obtained by observing first, the actual reading, reduced to sea level ; second, the rate of rise or fall. In order to reduce to sea level a set of Scott's tables are useful, but failing these the reductions can approximately be affected in the following manner. First subtract a quantity, depending upon the reading of the attached thermometer, which can be obtained by interpolation from the following :—

Reading of thermometer		40 deg.,	subtract	·031.
"	"	50 deg.,	"	·058.
"	"	60 deg.,	"	·085.
"	"	70 deg.,	"	·111.
"	"	80 deg.,	"	·138.
"	"	90 deg.,	"	·164.
"	"	100 deg.,	"	·191.
"	"	110 deg.,	"	·217.

Next add the correction for the height of the station above sea level. This can be obtained exactly from Scott's tables, or roughly, by taking ·100 inch for every 100 feet in height. If readings are carefully taken and reduced, and the means computed every month, it will probably be found that they oscillate on each side of 30 inches. In fact it may be taken as a first generalization that a reading over 30 accompanies fine weather, and under 30 bad. But it will be further noticed that the barometer is on the whole lower in summer than in winter. Hence we may expect unsettled weather with a reading of 30·1 or 30·2 in winter, whereas it may be fine when the barometer indicates 29·8 or 29·9 in summer. But we must also pay attention to the rise and fall. The usual sequence is as follows :—The barometer commences to fall with fine, bright weather, becoming warmer until the lowest point is nearly reached. As this point approaches, the sky becomes overcast, and rain is probable. After the minimum, as the barometer commences to rise, the weather generally becomes squally, especially in winter, with driving showers from the N.W. and W. These gradually diminish in intensity, but may be expected occasionally as long as the barometer commences to rise, or the wind remains in the west. It not infrequently happens that the weather clears rapidly after the minimum has been reached, but the barometer remains stationary, or commences to fall a second time, and the wind backs from W. or N.W. to N. or N.E. In this case prepare for even heavier squalls within 24 hours, or probably less. The indications in summer are not as a rule so well marked as in winter, but generally when the barometer falls below 29·8 unsettled weather may be looked for, and if in addition the mercury be very unsteady thunderstorms may be expected. Do not mistake the diurnal change for a falling barometer, the reading at 3 p.m. being almost always slightly below that at 9 a.m.

Thermometer and Hygrometer.

The best form of hygrometer consists of two ordinary thermometers mounted vertically side by side, one of which has a strip of muslin attached to the bulb at one end and dipping into a cup of water at the other. These thermometers are known as dry bulb and wet bulb. Suitably exposed the dry bulb indicates the "temperature in the shade," and the two conjointly with the aid of Symons' hygrometrical tables, give the amount of humidity in the atmosphere. Considerable care should be bestowed upon the wet bulb in order to obtain accurate indications. A strip of fine mull muslin about four inches long and just wide enough to go once round the bulb, with a quarter-inch overlap, should be provided. Obtain the services of an assistant to hold the thermometer, and after wetting the muslin wrap one end round the bulb, leaving the other end to hang down. Now tie a piece of cotton round the stem (and muslin) above the bulb, and moderately tightly round the muslin underneath the bulb. The muslin should fit tightly and not be "baggy." The loose end which hangs vertically should be placed in a cup of water. The surface of the water should be $1\frac{1}{2}$ inches below the bulb, and the cup should be frequently refilled as the liquid evaporates. The muslin must be kept clean and renewed frequently (at least once a week in summer). This hygrometer will be found a valuable auxiliary to the barometer, but notwithstanding this the "farmer's barometer," where the three instruments are combined, cannot be recommended, as the dry and wet bulb require to be exposed outside, whereas a barometer is usually mounted inside the house. It will be noticed that on a dry summer day when the dry bulb reads 100 deg. the difference between the dry and wet amounts to as much as 30 deg. This, of course, indicates that the atmosphere is very dry, and as a matter of fact, under these conditions it is capable of holding nearly five times as much aqueous vapour before condensation occurs. As a general rule the less the difference between the dry and wet bulbs the more humid is the atmosphere, but the actual amount of humidity can be obtained from Symon's hygrometrical tables.

In addition to the hygrometer it is well to have a pair of self-registering thermometers, maximum and minimum, and I should recommend Negretti and Zambra's form of maximum (in fact I can confidently recommend these makers for all thermometers), and strongly advise that they be graduated on the stem, not on the mount. In this instrument there is a slight contraction of the tube just above the bulb. The thermometer is mounted almost horizontally, but with the bulb end slightly lower (about $\frac{1}{4}$ inch) than the other, and acts as an ordinary dry bulb as long as the temperature is increasing, but the moment it starts to decrease a small break is noticeable in the mercury column at the point of contraction. The force of cohesion being insufficient to overcome this extra friction, the mercury behind the break flows gradually down toward the bulb, whilst that in front remains in position, thus indicating the highest point reached. The minimum thermometer has a spirit column in the place of a mercurial, and a black glass index moves freely in the spirit, but cannot, without violence, enter the vacuum at the top of the tube. As the temperature decreases, the index is carried down by the spirit until the lowest point is reached, and as the atmosphere then gets warmer the spirit flows past, leaving the index to record the lowest temperature attained. The question of thermometer exposure is a very difficult one. What do we mean by "temperature in shade?" Is it the shade of a tree, a verandah, or an iron shed? A form of exposure known as the "Stevenson's screen" has been adopted by the Royal Meteorological Society, and is in extensive use elsewhere. Nearly, if not quite all, the Government observing stations throughout Australia mount their thermometers in this manner, and it is to be highly recommended. If thermometers are not thus exposed a comparison cannot be made with the statistics published by any of the recognised observatories. The Stevenson screen is a wooden box 1 foot 6 inches high, 1 foot 8 inches wide, and 1 foot 1 inch deep, internal measurement. The top and bottom are of double boards, having an air space of at least an inch between, and plenty of ventilation, and the sides, including the door, are of double louvres, so that the wind passes through, but the direct radiation from the sun or ground is excluded. This is mounted on four stout posts, with four others extending diagonally from the top corners to act as supports in case of high winds. All four thermometers, viz., dry bulb, wet bulb, maximum and minimum, should be mounted in this screen, the two latter nearly horizontally, and the two former vertically, but behind the others. If readings can be taken only once a day, say at 9 a.m. the dry and wet should be recorded first, so that the heat of the body will not vitiate their reading. Then read the maximum and minimum without touching them, but enter the reading of the former to the previous day. After this has been done and checked, both of these may be set, and the muslin of the wet bulb be attended to if necessary. If observations are also taken at 3 p.m. it is better to read the minimum and set the maximum at 9 a.m., and read the maximum and set the minimum at 3 p.m. In this case, of course, the reading of the maximum must be entered opposite the day on which it was taken. The self-registering thermometers immediately after setting should read the same, or nearly, as the dry bulb.

Rain Guage.—This very useful instrument is so well known that a description and instructions as to its use are hardly necessary. It may be as well to state that the top scratch, or mark, on the measuring glass registers 50 points, or half an inch, and that rainfall observers in Western Australia are now instructed to record the amount in "points." It may also be mentioned that the Perth Observatory is prepared to issue rain guages to persons residing in approved localities, and likely to settle permanently, upon the condition that a record be faithfully kept and a monthly return be sent to head-quarters on forms supplied for the purpose.

Wind.—The direction from which the wind blows should always be noted, and it is desirable to have a vane erected in a well exposed situation. A few hints as to the connection between the wind and weather have already been given under the heading "The barometer." It may also be added that the usual direction in which the wind changes in the south-western and southern portions of this colony is from south round by E., N., and W. This is called "veering," as the reverse, viz., S., W., N., and E., is called "backing." In the winter it will be found that the wind almost always "veers," and steady rain sometimes sets in with the wind at N.E., changing to squalls as it reaches the N.W. By the time it reaches S.W., an early cessation may usually be expected, but the rain sometimes continues, especially on the south coast, right round to S.E. Do not confuse the direction of the wind with the direction from which the storm is travelling. When the wind is at N.E., the storm is generally well to the westward and approaching so as to pass the south of the observer. In fact, nearly all the winter storms travel from west to east or thereabouts. In summer the wind occasionally "backs," as thunderstorms seem to come from all quarters. With the wind "backing," the storm is probably to the north, and passing round to the eastward.

Clouds.—It is probably by the feel of the wind and the appearance of the cloud that most farmers prophesy, but even if this be so it will be found that organised knowledge is preferable to that obtained at haphazard. The subject cannot be properly treated on account of its importance, in such an article as this, but I can recommend the careful perusal of "Cloudland" by Clement Ley. Clouds are divisible under three different headings—cirrus, cumulus, and stratus. The first-named are popularly known as "wind clouds" or "mare's tails." They are high whisps, very common in summer. When they appear in winter time they are of considerable significance, for they usually presage rain. This prognostic is strengthened if they develop into cirro-stratus, a sheet of high thin cloud which forms those large dark rings round sun or moon known as haloes. When a storm clears quickly, and cirrus is seen above the lower clouds, it generally portends another fall of the barometer with more rain before long. In summer they occur so frequently that their significance is lost, and even the name of "wind cloud" has no justification. The name "cumulus" is given to any heavy woolly mass of cloud. It is seen in perfection on a warm quiet summer day about noon, or later. In its pure form it generally accompanies fine weather, but does not necessarily forecast it. When the edges harden, and the cloud appears like a huge cauliflower head, with a dark base, thunder and lightning may be expected. When, on the contrary, it appears with soft and very ragged edges moving rapidly, squalls are likely. Cumulo-nimbus is the name given to the ordinary squall cloud. It is a species of cumulus, but surcharged with moisture, and altogether darker and softer than the pure specimen. Sometimes the cumulus, instead of appearing in detached masses, forms into the long heavy rolls (strato-cumulus) and covers the sky in this shape. With this appearance fine dry weather may be expected, but frequently accompanied by keen winds between S. and E. The third great cloud division is "stratus." Originally this term was applied to lifting fog, but now it signifies any thin layer of vapour clouds. There are really two distinct types of stratus. When cirro-stratus drops and becomes denser it forms into a dense sheet, through which the sun appears as a misty blue. This is called alto-stratus, and is considered an intermediate type. It generally continues to fall and becomes still denser. It is now regarded as a stratus, but perhaps the term strato-nimbus would better describe it. From this cloud steady rain often falls. The other type is met with on a fine day. It is a thin layer of vapour cloud, but broken up, showing patches of blue sky, and at night often forming beautiful coloured "coronæ" round the moon. This is regarded as distinctly associated with fine weather. I should suggest that the former kind be designated strato-nimbus, and the latter broken stratus. Nimbus is scarcely a seperate division, but is a general term for clouds from which rain falls. I have now briefly described all the principal kinds of clouds except two, viz., cirro-cumulus and alto-cumulus. The former consists of high, small lumps, sometimes called mackerel clouds. They are not infrequently arranged in parallel lines and associated with cirrus. When these are lower and coarser, but still finer and higher than ordinary cumulus, they are called alto-cumulus. We have then the following classification, where the clouds are arranged roughly in order of height :—

Cirrus,
Cirro-stratus (alto-stratus),
{ Cirro-cumulus,
{ Alto-cumulus,
Cumulus,
Strato-cumulus,
Cumulo-nimbus,
Nimbus,
Stratus.

Having now given a brief sketch of the principal instruments employed by meteorologists, and indicated a few of the rules by which they endeavour to forecast the weather, I will now repeat for the benefit of those who may wish to take systematic observations, some of the instructions which are issued to the meterological observers connected with the Perth Observatory. Private observers cannot do better than conform to the same system, and I shall always be happy to give any explanations or afford any assistance in my power.

Instructions to Meteorological Observers.

The Stevenson screen must be erected in an exposed situation, with the door facing south. The bottom of the louvred box must be level, and about four feet from above the ground.

The barometer must be mounted either in the office or the observer's private quarters. A spot should be selected free from draughts and other disturbing influences (such as fires, etc.), and with a good side light if possible. In mounting it, first fix the detached bracket on the wall at a height of four feet above the floor, and then, taking the barometer very carefully out of the box, drop the end of the "arm" into the bracket. If the wall be constructed of stone or brick, a wooden plug should be inserted, and the bracket affixed thereto. Paste a piece of white paper on the wall immediately behind the top part of the tube.

The thermometers are :—Dry bulb, wet bulb, maximum, and minimum. These are all placed in the Stevenson screen. The two former are to be hung vertically in the brass clips attached to the moveable wooden arms at the back of the screen. The maximum and minimum are to be laid horizontally in the wooden brackets attached to the uprights in the front part of the screen, the bulb ends being to the left and slightly lower than the other ends.

The rain guage must be in a well exposed situation. Its rim must be level and about a foot above the ground.

Reading the barometer.—There are two scales, one fixed and one movable. The latter is called the "vernier." First turn the "vernier" up until the light can be seen between the top of the mercury and the bottom of the vernier. Then turn the vernier down slowly until its bottom edge just touches the rounded top of the mercury. In doing this it is absolutely necessary that the eye should be in a line with the front and back edges of the vernier, and the observer must move his head up and down so as to be quite sure of this. The barometer, being now set, is read as follows:—First write down the reading of the fixed scale next below the point where it is cut by the bottom of the vernier. The divisions of the fixed scale are as follows :—

....
30.200
30.150
30.100
30.050
30.000
29.950
29.900
29.850
29.800
and so on.

Secondly find a line on the vernier which agrees exactly with a line on the fixed scale (there will generally be one and only one such line). Take its reading on the vernier, remembering that the divisions run from below upwards 2, 4, 6, 8, 10 (marked 1), 12, 14, 16, 18, 20 (marked 2), etc., and add this vernier reading to the fixed scale reading. The sum will be the "barometer reading."

Example.—Thus, suppose the bottom of the vernier cuts the fixed scale between 30.050 and 30.100, the first quantity would be 30.050. Then suppose the vernier reading is 28. Add 28 to 30.050, and the sum 30.078, will be the barometer reading.

Reading the Thermometers.—These must always be read in degrees and tenths. Thus, suppose the mercury is just half-way between 72 and 73, the temperature must be entered at 72.5. If not quite quarter way call it 72.2. If nearly 73 call it 72.8, etc. A little practice will soon make this easy. If the mercury is just opposite a whole degree always enter .0 ; thus 72.0, 73.0, not 72, 73.

The minimum or spirit thermometer has a small black "index." The end of this index farthest from the bulb is to be read and recorded as the minimum.

Setting the Thermometers.—The dry bulb need never be touched. The wet bulb need be taken down only when the muslin is changed ; but the maximum and minimum must be set once a day. At 9 a.m. the observer will notice that there is generally a break in the mercury column of the maximum thermometer just above the bulb. He must now lift the thermometer carefully out of the bracket and holding it vertically with the bulb end downwards, gently shake it until the mercury quite, or very nearly, unites ; then carefully replace it. This is called setting the maximum.

Caution.—Never let the bulb end of a maximum thermometer be raised higher than the other end, even by half an inch.

In setting the minimum thermometer at 3 p.m., take the instrument off the bracket and gently raise the bulb end until the black index has run down to the end of the spirit ; then replace it carefully.

N.B.—In setting the maximum or minimum do not remove the thermometer into the sunlight. There is plenty of room inside the box.

Accidents to Instruments.—The minimum thermometer is liable to have its column of spirit broken, but this can generally be immediately rectified. (A new minimum sent by rail or boat will almost always have this fault, and it must be attended to before mounting). Grasp the thermometer firmly at the end (not the bulb end) and extend the arm horizontally in front of the body. Then, taking care that there is nothing in the way, swing the arm rapidly downwards past the hips. Keep repeating this operation until the column re-unites. The "index" will now be found in the bulb, and perhaps stuck fast, but if the thermometer be held bulb upwards a slight tap will release the index. Always make a note of any such occurrence in the field book and on the monthly return.

Unusual Meteorological Phenomena.—Whenever an unusual phenomenon occurs, such as a violent storm or a rapid fall of the barometer, take frequent readings of the barometer and direction and force of the wind, and note the lowest reading with the time of its occurrence, and the way in which the wind veered.

Observations must be taken at proper times. If the observer is absent he must employ a substitute.

CHAPTER XIV.

THE KITCHEN GARDEN.

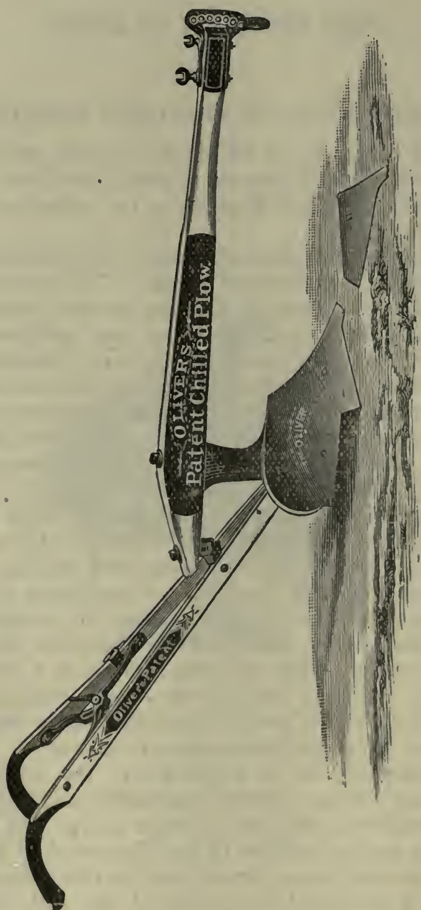
A Few Hints on Vegetable Growing.

The culture of fruits of all kinds is dealt with in a separate volume, the *Handbook of Horticulture and Viticulture*, edited by Mr. Despeissis, the expert of the Bureau, so no reference will be made to this subject here.

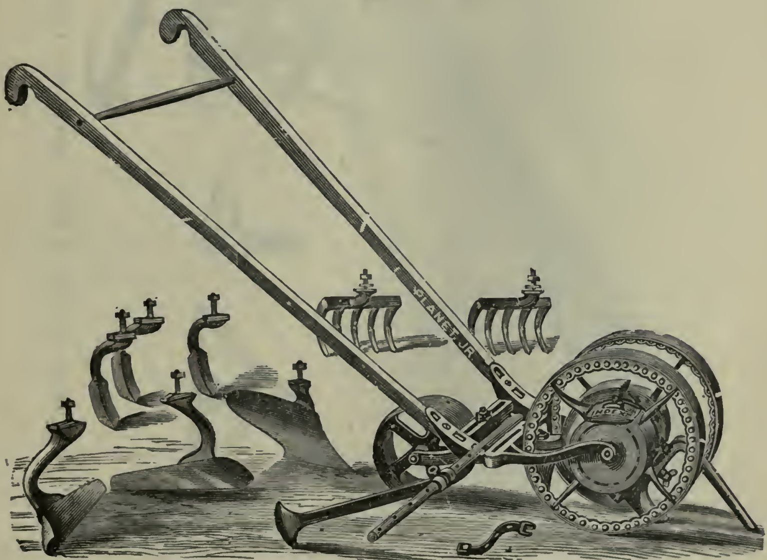
It is to be hoped that the new settler will find time to establish a flower garden in front of the house, if it is only a small plot. Western Australia is universally famous for the variety and beauty of its indigenous flora, and many of our prettiest flowers are improved by cultivation in gardens. There is nothing that adds so much attractiveness to the surroundings and the beauty of the homestead as a flower garden, and if only for the pleasure of the good wife and the silent education of the younger members of the family in the most beautiful and entrancing art of floriculture, every effort should be made to have a few beds of flowers and some ornamental trees and shrubs around the house. A trellis of vines of some table variety is a delight as well as distinct commercial gain, and the same may be said of the passion fruit (*passiflora edulis*), which thrives luxuriantly in moist ground, and gives a handsome return in a short time. Creepers should be planted to cover up rough and unsightly buildings, and they serve the double purpose of keeping the outbuildings much cooler. The *dolichus lignosus* is a favourite creeper in the warmer districts and grows very readily. The native *kennedias* and the *bourgainvillia* have the same recommendation, and make a most gorgeous show when in flower.

"Truck" farming, as it is known in the southern states of America, that is, growing culinary vegetables and ground fruits, such as melons, pumpkins, etc., on a large scale, will be dealt with separately in the second edition of the *Handbook of Horticulture and Viticulture.* There are large areas of land in this colony, in the south-west, that are, by reason of the nature of the soil, the mildness of the climate, and the plenteous rainfall, admirably adapted to truck farming, and it is surprising that this industry has not developed more than it has. Vegetables are now being grown on more than a small scale with irrigation as far north as Cue, and on the Eastern Goldfields; and in Part 1 of the Guide a good deal was said about the possibilities of this culture in the south-west Land Division.

The swamp lands of the south are particularly suited to the growth of culinary vegetables, and it cannot be very long before the value of these lands is appreciated, and the monopoly of vegetable growing is wrested from the hands of the patient but somewhat objectionable Mongolian. I have never been able to understand why the Chinese in Australia should be allowed to retain the



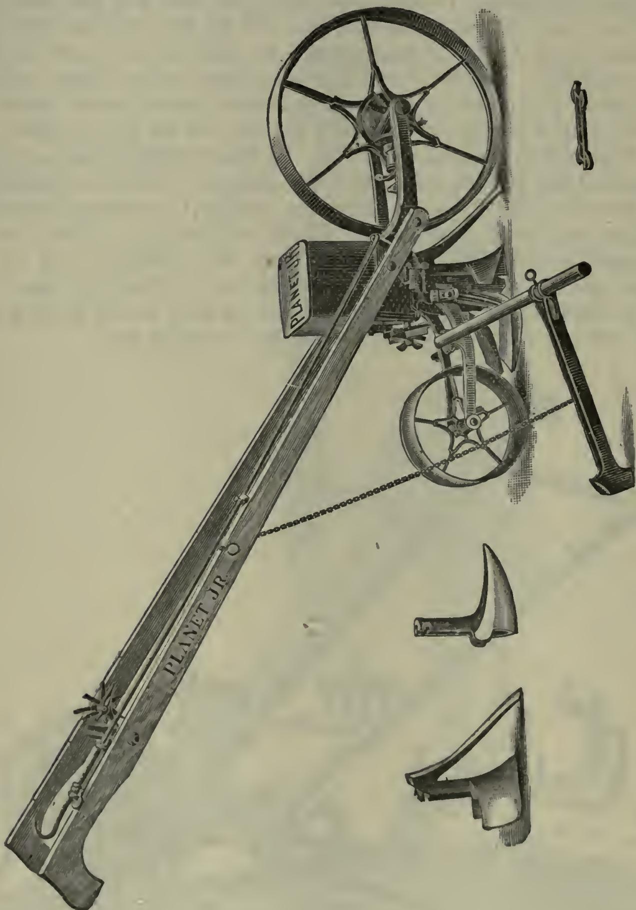
practical monopoly of vegetable growing. Their intelligence is not so great as that of the Caucasian ; their methods are pre-adamite ; and their labor, though apparently cheap, is more costly in the end than that of the white man. The truck farmers of the south-eastern states of America are all white men and have driven the Chinese completely out of the market. Why cannot the same be done here? I have no doubt it will in time, as our vast area of swamp and other gardening land becomes appreciated at its true value. There is at the present time, and will be for many years to come, more than a competence for the intelligent vegetable grower, and when I say intelligent, I mean the man who will not be content to fiddle about with a spade and hoe, but will go into the business on a large scale, using horse power as much as possible and hand labor as little as possible. As this chapter is intended to deal chiefly with the house garden of the settler it is not necessary to say more about soil than that a light fertile loam should be selected for the garden. No matter how rich it may be naturally, the more manure that is applied the better, if the best of vegetables are wanted. Liberal applications of well-rotted stable manure aided by artificial manures should be made after each crop is removed. If the soil is of a stiffish nature the ground should be ploughed or dug very deeply, and in the vegetable garden sub-soiling or trenching will be found to pay. In matter of implements illustrations are given of a handy little garden plough, turning a furrow 5 x 10 inches and costing £3.



THE PLANET JR. COMBINED DRILL, WHEEL HOE, CULTIVATOR, RAKE AND PLOUGH; COST £2 15s.

The Planet Jr. implements are great favourites with gardeners and the various kinds are also illustrated.

In order to prevent or mitigate the attacks of insect pests and fungus diseases the gardener should provide himself with a spray



PLANET JR. NO. 3 HILL DROPPING GARDEN DRILL; COST £3 5s.

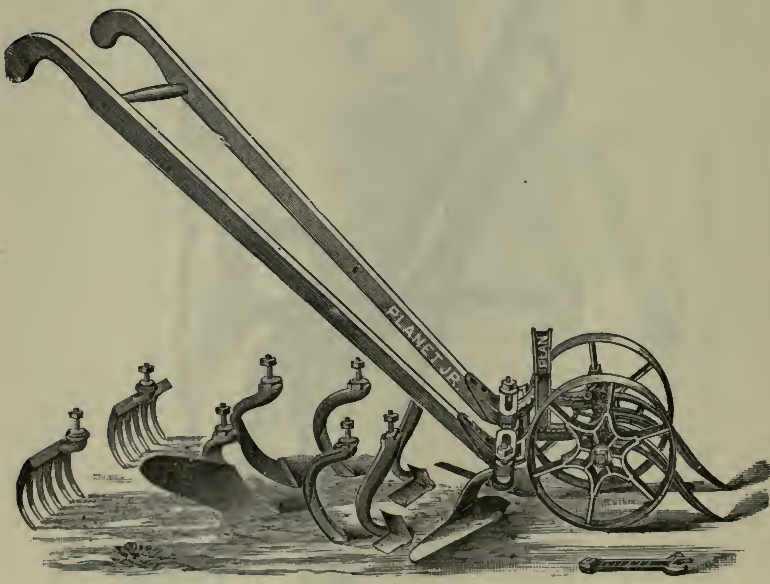
pump. If the garden is only a small one a knapsack pump such as shown in the illustration, costing £3 5s., will do all the work. If a cheaper and smaller one is desired a handy little pump costing £1 15s. is also shown.

The application of flowers of sulphur is often rendered necessary to destroy the spores of fungus diseases, and though this can generally be applied, like lime, by means of a dredger or a piece

PLANET JR. HORSE HOE AND CULTIVATOR; COST £3 10s.

of gunny sack shaken over the plant, if a large area has to be gone over it will be found more economical to buy a sulphuring machine, such as is shown herewith, costing £3.

When a large area has to be sprayed it will be found better to get, at once, a Nixon spray pump, such as is shown below, and have it fixed to a barrel. The barrel is placed on a sled or low wheeled waggon and drawn by a horse wherever wanted. Cost, £5 10s.



PLANET JR. PLAIN DOUBLE WHEEL HOE; COST £1 10S.

It is impossible with a range of climate so great as that of Western Australia to formulate a gardener's calendar that will be suitable to the whole of the south-west Land Division. The new settler must be guided by local experience in the first place, and by the results of his own experience as it accumulates.

The following notes on the cultivation of culinary vegetables, compiled by Mr. W. Adamson, the well-known gardener of Victoria, will be found useful by the amateur.

ASPARAGUS (*Asparagus officinalis.*)—Cultivation.—Sow in September in rich, light soil, in rows eighteen inches apart, and when large enough thin out to nine inches. Care should be taken to keep down all weeds for the first year, else they will choke and destroy the young seedlings. To have the young plants strong for transplanting, plenty of water or liquid manure should be given

during dry weather. The most economical width for an asparagus bed is five feet, which will take three rows, one down the centre and one on each side, about a foot from the edge. When planting is finished, the ground should be mulched with a thick coating of good stable dung, and when the weather becomes dry water must be given, and that in abundance, if complete success is desired. The after cultivation consists simply in keeping the ground clean, and in dressing with salt during the spring.

Artichoke (*Oifnora scolifmus.*)—Cultivation.—Sow in spring in a row where they are to remain ; thin to a foot or eighteen inches apart, and transplant the following season, allowing each plant four feet on all sides.

Beet (*Beta vulgaris.*)—Cultivation.—Red beet is not so much grown as its merits deserve. It requires a deep, open soil. The ground should be dug at least two spits deep ; and if manure is necessary, it may be turned in with the bottom spit, so as to bury it ten or twelve inches below the surface. This will cause the top roots to descend, and prevent forking. Seed may be sown in August and September for summer crops, and in November and January for early autumn and winter crops. Sow the seeds thinly in drills

drawn eighteen inches apart, making the drills two inches deep in the light soils, and one inch on the heavy soils. When the plants are fit to handle, thin out to six inches apart. Keep the surface stirred from time to time in dry weather to promote growth.

Swiss Chard, Silver, or Sea Kale.—Habit erect and vigorous. The midribs are silvery white and very large. They should be served as asparagus, and the remainder of the leaf makes a valuable dish, dressed as a spinach. This beet is reproductive, and will bear frequent cutting, but the roots are not edible.

BEANS, BROAD (*Faba vulgaris.*)—Cultivation.—Sow in April for the earliest crops, and again in July and August; and for the latest crop, in September. Sow the seed in drills three to three and a half feet apart, and twelve inches in the rows. Cover the seed to the depth of about two inches. As soon as the crops come into bloom, the top of each stem should be pinched off to increase the advancement of the pods.

BEANS, SNAKE OR YARD LONG.—This variety, which is a climber, produces long, narrow, stringless pods about twelve to eighteen inches long, of very delicate flavour. It is an immense cropper, and bears in bunches. It succeeds best in warm districts. Sow at the same time and in the same manner as recommended for the French bean.

BEANS, WAX POD OR BUTTER (*Phaseolus vulgaris.*)—Dwarf varieties.—The wax pod or butter beans are perfectly hardy. The pods are stringless, and can be cooked whole; the flavour is excellent. When they become better known, they will take the place of the ordinary French beans. Sow at the same time and in the same manner as recommended for the French bean.

Beans, French (*Phaseolus vulgaris.*)—Cultivation.—For the earliest crop sow in September, in the warmest and most sheltered part of the garden ; later crops may be sown in damper and more exposed situations. Successional crops may be sown once a month until January. Sow the seed in drills two feet apart, and two inches in depth, or less in heavy soils, and four inches between the seeds. If the weather becomes dry the ground may be mulched, and soakings of water should be frequently given. The climbing varieties should be sown in drills four feet apart, and six inches between the seeds. They may be sown near a fence or building, and trained on strings or trellises ; otherwise sticks five or six feet in length should be stuck in the rows, one to each plant.

Beans, Lima—Cultivation.—Lima beans should not be planted until warm weather has fairly set in (say October). The tall variety requires stakes or poles about five feet high. They are dressed and cooked like broad beans, which they somewhat resemble in flavour, but far more nutritious, and served with butter. In America they are very largely grown, and highly esteemed.

Borecole, Kale or Curled Greens (*Brassica oleracea acephala.*)—Cultivation.—Sow the seed from December to February for the main crop, and again in July, and plant out as soon as ready in rows two feet apart, and eighteen inches to two feet between the plants.

Brussels Sprouts (*Brassica oleracae bullata minor.*)—Cultivation.—Esteemed as the best of the cabbage genus. Sow the seed in June or August, for use in midsummer, and again November, January, and February for early and late winter use, and plant out in rows two feet apart.

Brocoli (*Brassica oleracea botrytis asparagoides.*)—Cultivation.—Brocoli does well on soil that has been manured for a previous crop, and if the soil be light it need not even be dug for the young plants. For a winter crop the seed must be sown in October, and the plants put out about the end of the year. For the chance of a crop to succeed cauliflowers in summer, seed may be sown in January or February, and planted out in April. When the plants are sufficiently large, transplant into rows about two to two and a half feet apart.

Cabbage (*Brassica oleracea capitata.*)—Cultivation.—This is one of the most important of vegetables, as it may be had in use every day in the year. A little seed may be sown once in every month, except in May and June. When the plants are large enough to handle, transplant into rows from two to two and a half feet apart.

Savoy Cabbage (*Brassica oleraceo bullata.*)—Cultivation.—The general cultivation of savoys is very similar to that of the cabbage. The best time to sow the seed is from December to March. Savoys are generally preferred for winter use, being of better flavor, and not so rank when grown large.

Portugal Cabbage (*Brassica oleracea costata.*)—Cultivation.—Sow from October to January, and plant out under the same conditions as cauliflowers. It likes a rich soil. A very tender and sweet variety of the cabbage tribe. The heart of the plant can be used in the same manner as the cabbage, and the ribs of the largest leaves will be found an excellent substitute for sea-kale, if served up in a similar way.

Chinese Cabbage (*Pe-tsai.*)—Cultivation.—Similar to that of the cabbage.

Cardoon (*Cynara cardunculus.*)—Cultivation.—This vegetable is little known, and less cultivated, in the colony, though it is extensively grown and much esteemed on the continent of Europe, where it is used in soups and for stewing. The leaf-stalks are the parts used, and the mode of culture is almost exactly the same as for celery.

Caper of Commerce (*Capparis spinosa.*)—Cultivation.—The caper is a trailing shrub, which grows freely on dry, rocky soil, and might become an article of commerce, as it succeeds well in this climate. The flower buds are the parts used, forming the caper of commerce. Plants may be raised from seed in heat in spring, and planted out when strong. They may also be raised from cuttings. The roots of the plant are particularly strong and vivacious, and if they can get deep enough, even among rocks or stones, they will continue to grow for an indefinite period. It is considered advisable to cut the plants over every third or fourth year.

Cape Gooseberry (*Physalis edulis.*)—This, though used as a fruit, is generally cultivated as a kitchen-garden plant. Sow the seed in September, October, and November, in a pot or seed pan, and when large enough they should be planted in a warm, sheltered situation, and should stand three or four feet apart. The plants will last several years, and should have the old wood cut out annually. The fruit, when used in a raw state, should be thoroughly ripe, as previous to ripening they contain a deleterious principle.

Capsicum or Pepper (*Capsicum annuum*, *Capsicum frutescens.*)—Cultivation.—The varities of capsicum or chili require light, rich soil and a warm situation. For the earliest crop sow in the beginning of September in heat. When the plants are large enough to handle, prick into pots or boxes, and after they have become well-established and hardened-off, plant out in October, when the weather is fine. Seed may be sown in the open ground in the beginning of October. They may stand two and a half to three feet apart. The plants must be duly watered while young, and shaded from the hot suns until established. The best situation is at the foot of a wall or fence, on the sunny side.

Carrot (*Daucus hortensis.*)—Cultivation.—The most suitable soil for the carrot is a deep, rich, light, loamy or sandy soil, which has been enriched at the previous cropping; but should the soil be poor, a dressing of well-decomposed manure shall be given, and thoroughly mixed with the soil. The seed should be sown in shallow drills, which may be a foot apart for the early horn, and fifteen inches for James' intermediate and similar varieties, and from eighteen inches to two feet for field carrots. The soil should be made very fine, and if in a dry state, or very loose, should be pressed very hard after the seeds are sown. The ground should be kept loose on the surface by frequent stirrings with a hoe. When the seed is sown in cold weather, and not likely to vegetate before hoeing becomes necessary, it is useful to drop a few seeds of radish or turnip to mark the position of the rows. The horn varieties may be left three to four inches apart; other varieties at greater distances, up to eight inches for field carrots. Make large sowings from August till February.

Cauliflower (*Brassica oleracea botrytis cauliflora*)—Cultivation.—Cauliflowers may be obtained in this climate during at least half the year under ordinary treatment, and in cool situations, or where water is plentiful, nearly the whole year around. The soil for them should be equally rich as for cabbage, and where that for winter crops happens to be damp it may be formed into ridges, and the cauliflowers planted on the top. The distance between the plants must be regulated by the size of the heads required; heads of the largest size may be obtained from plants thirty to thirty-six inches apart, but for private use small or middle-sized heads are the most suitable. Of course the summer crops must have the greatest amount of space, but plants put out in autumn need not be more than two feet or eighteen inches apart. For the first, or autumn crop, the seed must be sown from December to February, and for later crops a little may be sown every month until August ; but heads can rarely be obtained during the hottest months, except in cold districts, or by abundant watering.

CORN SALAD OR LAMBS' LETTUCE *(Valerianella olitoria.)*—Cultivation.—The first sowing of this useful small salad, which is chiefly grown by the French, ought to be made at the commencement of the autumnal rains, and a successional crop put in at intervals of two months thereafter. Seed may be sown in any waste soil of a light nature, in beds four feet wide, and in shallow drills six inches apart. The seedlings must be thinned to four inches apart, and the outside leaves picked for use as they expand. In summer, seed should be sown every month in a moist, sheltered spot ; the seedlings thinned as soon as fit for handling, and when large enough for use, the heads cut as wanted, close to the surface of the ground.

CRESS (*Lapidium sativum.*)—Curled cress may be grown in winter on a patch of ground at the foot of a fence, or other warm spot, by drawing shallow drills as close as possible with the finger or a small stick ; the seed sown quite thick, and the surface beaten with the back of a spade, barely covering the seeds. A shady spot should be chosen for summer ; or where there is not a garden the seed may be sown in boxes, or between the single folds of a wet flannel. American cress may be sown monthly in drills nine inches apart, slightly covered with earth ; when the plants are bushy, the heads may be cut close to the surface of the ground. Water cress is an excellent salad. Young runners are most commonly used for planting out, but seed may be sown during the autumn and winter months in a moist, shady place.

CELERY (*Apium graveolens.*)—Cultivation.—Celery requires a very rich deep soil, and a moist situation is the best to select, but not where the soil is saturated with water. Seeds may be sown in August for the earliest crop, and at that season require artificial heat to cause them to vegetate. They may be sown in a seed pan or shallow box in light rich soil, and placed in a hot-bed frame, or some other warm place. As soon as the plants are large enough to handle, they should be pricked into other boxes, and continued in heat until well established, then hardened off, and planted out to six inches apart in a bed of rich soil six inches deep, on a bottom of boards or some other hard substance, which the roots cannot penetrate, to facilitate transplanting, where they must be well watered and shaded ; and when of sufficient size, the soil cut into squares with a plant in the centre of each ; then lifted with the balls entire, and conveyed to the trenches, where they must be shaded with boughs, boards, bags, or anything at hand until re-established. During the season of growth water must be applied in unlimited quantities. The second and later sowings may be made in the open ground, and the young plants treated in a similar manner. October will be early enough for sowing in the open air, and two more sowings may be made in November and December. Manure to the depth of five or six inches should be dug into the bottom of the trench, and as much liquid manure as can be spared may be given while the plants are growing. A trench should be sixteen to eighteen inches in width, and the plants set at six to twelve inches apart. Earth up the plants as they advance in growth, but it is not advisable to place much soil around them, with a view to blanching until about a month before they are wanted for use. The final earthing up requires to be done carefully ; in order that the soil may not fall into the heart of the plant, the leaves should be tied together, then the soil thrown in, in layers, and packed closely around the plants by hand.

SWEET CORN, OR TABLE MAIZE (*Zea mays.*)—Cultivation.—Few are aware of the excellence of the sugar maize as a vegetable ; it will bear favorable comparison with asparagus and peas when boiled in a green state, and eaten with white sauce or gravy. The cobs should be taken as soon as the grains are fully formed, and before they have begun to harden. Seed may be sown in September and three following months for succession, in drills three feet apart, and the plants a foot apart. It requires rich soil, and is improved by top-dressing during growth.

CUCUMBER (*Cucumis sativus.*)—Cultivation.—For the earliest crop out of doors, plants may be raised on a hot-bed, well hardened off, and planted out in September, as soon as the weather has become warm. The plants must be protected with hand-glasses, or some other covering, and shaded when necessary until established. For a late crop, plants may be raised in a cool frame, and planted out in October, always providing duplicates to replace failures. Seeds may be sown at the same time, and again in the course of a month, where they are to remain. The soil must be kept loose by frequent hoeings, and before the weather becomes dry, should be mulched with a good layer of stable dung. Abundant water is necessary in dry weather.

EGG PLANT (*Solanum esculentum.*)—Cultivation.—The egg plant may be treated in exactly the same manner as the capsicum —the earliest raised in heat and transplanted, and the later crops sown in a warm situation, where they have to remain ; the plants may stand eighteen inches to two feet apart. The fruit must be thinned if a fine sample is required. They may be easily grown in pots, and trained to stakes like tomatoes.

ENDIVE (*Chicorium endivia.*)—Cultivation.—This is a good useful salad for winter use, becoming now of more repute than hitherto. To grow it well the culture recommended for lettuce is exactly suitable. The heads require to be blanched, which may be effected either by tying the leaves close together, or covering each plant with a flower pot, saucer, or piece of slate, a few at a time. The seeds should be sown in January, February, and March, and the plants transplanted with the first autumn rains.

Sweet, Pot, and Medicinal Herbs.—Cultivation.—The best way of growing these with little trouble and expense is to procure a few plants of the required sorts, such as marjorum, sage, thyme, hyssop, etc., and plant them together in a portion of a shady border, in lines fifteen or eighteen inches apart each way. If plants cannot be conveniently had, seed may be sown in a warm border, in lines one foot apart, merely deep enough to cover the seed. When up, thin out to a foot apart, water and mulch the first summer in dry weather, and keep the surface loose. Next autumn, or early in spring, take up and divide the roots, and plant again fifteen or eighteen inches apart, and continue making new plantings every winter, as a means of saving them during the summer drought.

Kohl Rabi, or Turnip-Rooted Cabbage (*Brassica oleracea caulo-rapa.*)—Cultivation.—This is a delicious vegetable, and highly esteemed by those acquainted with it ; but its merits are not sufficiently known or appreciated. It is greatly superior as a table vegetable to any kind of turnip, but must be tested in good condition, and while young and tender. The seed may be sown from January to April, in beds as for cabbage, and transplanted into good soil. The bulb-like stems will be fit for using during the winter and spring, and should be taken when not more than three or four inches in diameter, or they will become coarse and inferior.

Leek (*Allium porrum.*)—Cultivation.—The leek likes a deep, friable, and rich soil. The first sowing may be made in June or July, and subsequent sowings once a month till December. When the young plants are about the thickness of a goose-quill, they may be transplanted into deep holes made with a dibble or stake, nine to twelve inches apart, in the bottom of a drill drawn with a hoe, into which the plants are dropped and a few crumbs of soil put in to cover the roots, unless the soil is dry, when the holes may be filled with water. In the process of hoeing, the holes become filled up with soil, and, as they grow, soil from each side may be drawn to them to cause the stems to lengthen. The drills should be fifteen inches apart. Large leeks for exhibition may be grown in trenches prepared as for celery.

Lettuce (*Lactuca.*)—Cultivation.—This popular salad plant may be had all the year round by frequent sowings and plantings. A warm and dry situation should be chosen for the winter crops, and one that is low and damp for those of summer. The soil should be loose and extremely rich, for lettuces are crisp only when grown rapidly. For summer culture, sowings may be made where the plants are to remain—as they cannot be safely transplanted in dry weather—once a month from August onwards, in rows eighteen inches apart, and thinned to twelve inches. For a winter crop, sowings may be made in March or April, and the plants transplanted in rows.

ROCK, OR MUSK MELON (*Cucumis melo*).—Cultivation.—Rock melons for the earliest crop may be raised on a hot-bed in July and August, well hardened off, and planted out in September, or as soon as the weather has become warm enough ; the plants should be protected until well established. The soil for the rock melon should be a good, rather strong loam, without manure, except a little to give the plants a start. For the later crop, sow in September and October in the open ground. The seeds should be sown in hills, which ought to be from five to six feet apart, placing ten or twelve seeds in each, and when the plants have two or three rough leaves thin out to three or four inches.

WATER MELON (*Cucumis citrillus.*)—Cultivation.—The water melon requires a richer soil than the rock melon, and if well grown will afford abundance of fruit without stopping the shoots or any other manipulation being required. Every effort should be made to get the fruit ripened early, for it is little valued except in hot weather. A warm situation should therefore be chosen, and the plants raised in heat in July and August, and grown strong before being planted out, two or three on a hill, about eight feet apart.

MANGO MELON, OR EGYPTIAN PROLIFIC VEGETABLE PEACH.—Cultivation.—Cultivate in a similar manner as that recommended for rock melon. Grows like a rock melon, branching out in dozens of vines in every direction full of fruit and blossoms, commencing early and lasting on till frost if watered in dry weather ; suitable for all climates. Fried in batter, green, a substitute for egg plant. It is also said to be superior to vegetable marrows, cooked in a similar style if used before being too ripe. When ripe and yellow makes beautiful, white, transparent preserves and sweetmeats, equalling the celebrated California fruits and Japanese pie melon ; they are just like an orange when ripe. The late fruit makes excellent pickles. Young green ginger makes the best flavouring, and it does not colour the preserves.

MANGO MELON, OR VEGETABLE PEACH JAM.—To every pound of vegetable peaches allow three-quarters of a pound of the best white sugar, and one pound of good, young, green ginger to every 8 lbs. of fruit. Mode : Cut up the fruit, taking care to scoop out all the pips (using a spoon is best); weigh, and put into a china basin with the quantity of sugar sprinkled on, and allow it to stand twenty-four hours ; choose young ginger, wash carefully, and scrape off all the outside skin ; then boil in an enamel pan for several hours in clean water ; boil till you can stick a fork in ; then take out and cut up as finely as possible ; this is imperative or it will spoil your jam ; mix all together, and boil gently. It takes a long time to cook, as the melon must be quite clear, and a thin skin must come over the jam. This is ascertained by occasionally taking out a small spoonful and putting on a saucer to cool. Always cover the jars with strong paper while hot. About six ounces of preserved ginger, cut very small, improves it, but darkens it.

MUSHROOM (*Agaricus campestris.*)—Cultivation.—The mushroom can be successfully cultivated in pots, boxes, or beds, either out of doors, or in a shed or cellar, during the autumn and winter months. The beds are made of fresh horse-dung, which must be dried and fermented until the violent heat is gone, before being used. When ready, the material should be made into a bed four feet wide and a foot deep, beaten extremely hard with a rammer or mallet, and left until the heat is steady at sixty or seventy degrees, when pieces of spawn, about the size of walnuts, should be inserted about an inch deep, and eight or nine inches apart, all over the bed, which must then be covered to a depth of three inches with soil, such as the mushroom naturally grows in, well beaten with the back of the spade, and, if out of doors, should be covered with a good thickness of hay. The soil should not be allowed to become dry, nor ever very wet ; therefore something should be at hand to ward off heavy rains if out of doors. Mushrooms may be expected in six or seven weeks from the time of spawning, and a good bed will last for two or three months. In gathering the crop, the stalks should be pulled completely out, otherwise they rot and destroy the young brood. Before the month of April, while the weather is warm, the bed may be made in a trench, dug six inches deep, in dry and well-drained ground.

MUSTARD (*Sinapis alba.*)—Cultivation.—Mustard for salad may be grown under a variety of circumstances both indoors and outside. During the hot weather it should be sown in a shady place. It may be grown in pots or boxes in the dwelling-house, or on the windowsill, or even on a piece of woollen cloth kept moist. Any kind of light soil will suffice, as water alone will enable it to grow large enough for use. The treatment recommended for cress will equally apply to mustard. The seed should be sown about a week later than cress.

ONION (*Alluim cepa.*)—Cultivation.—To produce good crops of onions, ground of a deep loamy nature should be selected ; it requires to be well worked and manured. Onions may be transplanted, or the seed may be sown where the plants have to remain. When required early, the seed may be sown in April, though June is considered the best month to sow for transplanting. For that purpose the seed should be sown in wide drills or beds, and kept free from weeds until fit to transplant. For bulbing on the ground where sown, the month of August is a suitable time. Sow the seeds in drills a foot apart, and thin to six inches. As some of those transplanted are likely to start for seed, the flower-heads must be pinched off as soon as they appear. For pickling onions, seed of the silver-skinned varieties should be sown in August, rather thickly in drills, and left unthinned. For salad the seed may be sown whenever required, providing the soil is watered and shaded should the weather be dry.

OKRA, OR GOMBO (*Hibiscus esculentus.*)—Cultivation.—This plant is not so much grown in this country as its merits deserve. The pods, which are used while green and tender, form an excellent ingredient in soups, stews, and pickles, and are believed to be very nutritious. They can also be cut in slices, and dried for winter use. For an early crop the plants may be raised in heat in July, like tomatoes, and planted out ; the ordinary crop may be sown in September and October for succession, in drills two feet apart, and the plants thinned to the same distance. The soil should be rich and well cultivated.

PARSLEY (*Petroselinum sativum.*)—Cultivation.—Though parsley repays for good soil as well as any other crop, it does not always obtain the best kind of treatment, being generally used as an edging to the walks in the kitchen garden, or sown in some out-of-the-way place in poor soil, and insufficiently thinned. The seeds should be sown in drills fifteen inches apart, and the plants thinned to twelve inches. Sowings should be made in August in a low, shady border, for summer and autumn supply, and again in March or April for winter use.

PARSNIP (*Pastinaca sativa.*)—Cultivation.—Treat in the same manner as recommended for the carrot. On dry, early soils, a sowing may be made in autumn, on the occurrence of the first rains, to furnish roots for use in spring, and again in September, though the produce of these sowings must be used early, otherwise the plants would run to seed. October is the best month in which to sow the main crop, and for winter use a sowing may be made about the beginning of December. The rows should be eighteen inches apart, and the plants thinned to six or eight inches, according to the size of the roots required, thin roots being the most suitable for private families.

PEAS (*Pisum sativum.*)—Cultivation.—Soil that has been manured for a previous crop will suffice for winter-sown crops, but for summer an additional dressing should be given, and the ground well worked. For dwarf varieties the rows should be two and a half to three feet apart, for taller sorts four to six feet, and the seed of the former should be placed about one inch apart, and the latter three to four inches apart. The sowing of peas may commence in April, and be continued till February. The autumn sowings should consist of the earliest varieties, including rising sun, on account of its hardiness ; the same, or other early kinds, may be sown in June ; second earlies and marrows in July and August ; marrows again in September and October, and the latest varieties in November and December ; afterwards early varieties again. To maintain a continuous succession, it is a good rule to sow whenever the previous crop is fairly above ground.

POTATOES (*Solanum tuberosum.*)—Cultivation.—The soil should be in good condition, and if requiring manure, stable dung, superphosphate of lime or bone dust should be used. The first crop, for which a dry soil and warm situation should be chosen, may be planted in July in favourable localities, using the earliest varieties; a successional crop of the same, and also of the second earlies, and late varieties in August, and the latest up to November. Then in January, early varieties may be again planted for an autumn crop. The early and dwarf-topped sorts may be planted two feet by ten inches apart, larger-topped sorts should have thirty inches by twelve. With regard to sets, large kinds with few eyes, if cut into pieces of good size, will yield as much produce as whole tubers of equal weight, though, in general, whole tubers of 4 to 6 ozs. in weight are preferable; but if the eyes are numerous, all but the crown should be rubbed off, otherwise numerous stems will rise, and a large proportion of the produce will be of small size. The after culture consists in drawing soil to the stems, and frequent digging or hoeing of the spaces between the rows.

PUMPKIN (*Cucurbita melopepo.*)—Cultivation.—Sow from September to December in hills, well manured, from eight to twelve feet apart, placing from ten to twelve seeds in each hill, but not allowing more than two of the best to run.

RADISH (*Raphanus sativus.*)—Cultivation.—The soil for the radish, if not naturally sandy and loose, must be very finely pulverised before the seed is sown; it should also be moderately rich to encourage rapid growth, but not recently manured, unless with dung rotted to mould. The seed may be sown in drills in the cool months, when the plants take longer to grow, to enable weeds to be kept down easily; but in summer time it may be sown thinly broadcast, or very thinly in the rows with carrots or other root crops, or with lettuces to be drawn out as required. It may be sown every third or fourth week throughout the year. In winter a dry situation, and in summer a moist one, should be chosen.

RHUBARB (*Rheum hybridum.*)—Rhubarb delights in a rich, loose, deep, and well-drained soil; it does not succeed in stiff soil, preferring that which is sandy. The seed may be sown, in the beginning of September, where the plants have to remain, or in drills for transplanting. The drills may be made in light, rich soil, two feet apart and an inch deep; the seeds should be sown very thinly. In the permanent plantation, the plants must stand three feet and a half or four feet apart, according to the size of the variety, and the crowns covered not more than two inches. A good plan is to sow a row on the permanent plot, in patches fourteen or sixteen inches apart, and transplant two-thirds of the plants the following winter, leaving the remaining third where sown. The beginning of August is the best time to transplant, just before the plants commence to grow; but if the ground is not wanted, transplanting may be effected in April or May. No stalks should be gathered from the seedlings the first year after being planted, but all left to strengthen the roots. Rhubarb may be forced for winter use in the same manner as sea kale.

Salsify, or Oyster Plant (*Tragopogon porrifolius.*)—Salsify succeeds well under the same treatment required for carrots and other root crops. Seed for an early crop may be sown in August, and for the general crop in October. Sow the seed in drills about fifteen inches apart, and thin the plants to six inches. The young leaves, when blanched, may be used as a vegetable. The roots are boiled or stewed like carrots and parsnips, or half boiled and grated fine, made into small flat balls, and dipped into batter and fried like oysters, which they strongly resemble.

Scorzonera, or Black Oyster Plant (*Scorzonera hispanica.*)—Culture the same as recommended for salsify. Similar in many respects to salsify, and is called by some the black oyster plant. It is cultivated exclusively for the roots, which may be boiled and served plain like parsnips. Before cooking, the outer coarse rind should be scraped off, and the roots soaked in cold water for a few hours to extract their bitter flavor.

Sea Kale (*Crambe maritima.*)—Sea kale will succeed well in any ordinary garden soil. Sow the seed in August and September in drills two feet apart, and thin the plants to a foot apart. For blanching, the plants should be covered with pots, boxes, or casks, or the like, and covered with fresh dung in such quantities as will produce a gentle and prolonged heat. They are ready for use when they have grown the length of a few inches.

Spinach (*Spinacea oleracea.*)—The soil for spinach requires to be made very rich, so as to grow it quickly, and obtain the largest weight of leaves. The round spinach is grown for summer use, and the prickly or Flanders varieties for winter. The first sowing may be made as soon as the first autumn rains have fallen, and successional sowings once a month until the weather becomes too dry, unless water is plentiful, when sowing may be continued throughout the year. The seed should be sown thinly in drills, which, in winter, should be eighteen inches or more apart, and the plants thinned to twelve inches ; the spring and summer crops need not stand further apart than half that distance. In gathering the leaves for use, they are taken singly from the winter crops as they attain full size, but in summer the whole plant may be cut off by the ground.

Squash (*Cucurbita melopepo.*)—Cultivation.—The squash is closely related to the pumpkin and vegetable marrow, except the bush varieties, which do not run, and require so much room.

Stachys Tuberifera (*Chinese Artichoke.*)—Cultivation.—This plant grows to a height of fifteen inches, being free and branching ; from the axis spring a number of fine roots on which the tubers are produced, about two inches in length, and make a nice salad, resembling the taste of the radish, and when cooked and served with melted butter in much the same manner as the globe artichoke, they are delicious in flavour. The roots should be planted in rcws two feet apart, and nine to twelve inches from each root.

Tomato (*Lycopersicum esculentum.*)—To have tomatoes early, seed must be sown in July in heat, and the young plants grown in pots until ready to plant out when the weather has become warm in September. For later crops, the seeds may be sown in a warm border out of doors towards the end of August. The tomato requires rich soil, and succeeds best in that which is sandy. The earliest plants should be planted and trained against a north wall or fence ; later crops may be planted against other fences, or in the open quarters, allowing a space of three feet to each plant, but in all situations they ought to be supported off the ground by stakes or trellises. The plants, as they grow, should be kept thinned of shoots, weak laterals being pinched off, and those that are to remain stopped at the flower. To ensure a full crop during dry weather an abundance of water is required.

Perennial Tree Tomato (*Cyphomandra betacea.*)—This fast-growing perennial, which is perfectly distinct from the ordinary tomato, reaches a height of ten or twelve feet, with leaves over eighteen inches long and by more than twelve inches broad, and, independently of its fruit, is a beautiful foliage plant. It comes into bearing in about eighteen months, and its fruit, which is orange-coloured and about the size of a hen's egg, is very delicious.

Turnip (*Brassica rapa.*)—To have turnips tender and mild they must be grown rapidly and without check ; therefore the soil must be in good condition. The seed may be sown broadcast on a bed, or in drills, the latter being the preferable mode. The drills for early sorts should be at least fifteen inches apart, and the plants thinned to six or nine inches ; but for swedes the drills should be eighteen inches, and the plants twelve inches apart. The first sowing should be made in the beginning of February, or earlier, if a good rainfall happens to occur. Successional sowings may be made of white sorts in autumn and early spring, choosing the yellow-fleshed varieties for summer growth, as they withstand the heat better than the others. The seed should be sown extremely thin, the plants thinned early, and the surface of the soil around them kept in a loose state.

Vegetable Marrow (*Cucurbita pepo ovifera.*)—The instructions given for the cucumber are applicable to the growth of the vegetable marrow, with the difference of only having one plant instead of two in every space, and the distance eight feet apart instead of six, and little or no stopping, further than thinning where the vines are too thick.

Flower Seeds and Their Cultivation.

Soil.—One of the first considerations in the culture of annuals is the condition of the soil, to which sufficient attention is rarely paid. It is seldom either properly worked or sufficiently fertile. With the exception of a few gross-growing kinds, annuals, to attain perfection, should be sown in soil that is both rich and well worked. Great pains are generally taken with the soil of the vegetable garden, but that of the flower garden is left very much to itself, with the exception of a light digging once a year, and occasionally a little manure applied, whereas it should be well and deeply dug and highly manured.

Sowing.—All the hardiest kind of annuals attain the greatest perfection when sown in autumn, because they have a longer season to grow. They attain greater development, and consequently flower the stronger ; but tender sorts must not be sown till spring. Like all other seeds, they succeed best in a firm soil ; therefore, if the soil has been recently dug, it should be pressed more or less before sowing. If the seeds are very fine—but large seeds are better to be sown first, and trodden or otherwise pressed into the soil—the less covering will then be required. For the finest seeds it is advisable to sift a little fine compost on the spot, and press it smooth before the seeds are sown. The covering must be in proportion to the size of the seeds. The largest of the lupin seeds may have an inch in depth of covering, while the twentieth of an inch or less will be sufficient for the smallest. Indeed, fine silver sand, just sufficient to cover the soil, may be sifted on them, and to prevent the soil from drying before the seeds have had time to germinate, it should be closely covered by a flower pot, a bell or hand glass, or even a flat pane of glass ; but that, or any covering impervious to light, should be gradually removed as soon as the seeds germinate. It is a common and injurious fault either to sow too thickly, or to thin the plants insufficiently, as when overcrowded they can neither develop to perfection nor flower finely. Thinning should commence as soon as the plants can be fairly laid hold of, and continued until each plant has sufficient space for full development. Seeds of biennial or perennial plants, being sown in rows or beds for transplanting, need be only thinned to such an extent as to prevent overcrowding before being transplanted. An old-fashioned plan is to sow the seeds of annuals in rings, and it answers well enough for large-growing plants ; but smaller ones are better sown in patches, which in both cases may correspond in extent with the size the plants attain.

Arrangement.—When annuals are sown in mixed beds or borders, they must, of course, correspond in height with the other plants, the dwarfest being nearest the eye. The same rule must be followed when beds are filled solely with annuals. The colors should contrast with each other, and also with those of other plants that are near. When annuals are grown alone in beds or borders, various modes of arrangement may be followed. A peculiar effect may be produced by mixing seeds of different kinds and sowing them together. In large beds they may be arranged in bands, according to size, sloping from back to front, or in groups, each sort forming a group.

Management.—The soil should not be allowed to become quite dry after the seeds are sown; therefore, if rain does not fall, watering must be practised. The larger kinds may be afterwards fed with liquid manure, if perfection in size and flowering is desired. Of course, the soil should be kept free from weeds; it should also be loosened around the plants, but so as not to disturb the roots. Tall-growing plants will generally require to be supported by some means. Tall plants may have a stake to each, while cylinders of wire netting, or rings of wire affixed to stakes, are suitable for those of spreading habit. Where seed is not required, the period of flowering may be lengthened by picking off the seed vessels as soon as the flowers fall.

Monthly Calendar for the Vegetable Garden.

January.—Brussels sprouts—Sow largely, to use in June; broad beans—sow a few, to ripen about May and June; borecole, or kale—sow largely, to use from June; French or kidney beans—plant medium crops, for use in April and May; brocoli—sow a few early sorts, to use in May and June, finish planting out late sorts early this month; cauliflower—sow largely towards the end of this month; carrot—sow a few early sorts, to use in June and July; celery—sow a few seeds of an early variety, to use from the end of July, plant out former sowing, as they advance; chou de burghley—sow early in the month; cress and mustard—sow fortnightly; lettuce—sow a few to remain until fit for use in six or eight weeks; onion—sow a few for salads, to use from April; peas—sow a medium crop of early varieties, to use in April and May; potatoes—plant out kidneys or other early varieties, to use in April and May; raddish—sow a few of the long sort, to use in four or six weeks; savoy cabbage—sow a medium crop; turnips—sow largely, for use from March to May.

February.—Brussels sprouts—sow a few, to use from July to September; cabbage—continue sowing early sorts, to use in June and July; cauliflower—sow largely, to use in June and July; celery—plant out largely, as the plants advance, for winter supply; cress and mustard—sow fortnightly; endive—sow for use in autumn; French beans—sow for a succession; leek—transplant largely into drills for a winter supply; lettuce—continue to sow, for using in six or eight weeks; peas—sow a few early varieties, to succeed the former sowing; potatoes—plant out largely of early varieties, to use in May and June; radish—continue to sow, for use in four or six weeks; spinach—sow a medium crop for autumn use; savoy cabbage—sow a few early in the month, if not done last month; turnip—continue sowing a few for winter use.

March.—Brocoli—Sow a few of early varieties, to use in spring; cabbage—sow a few of early varieties, to use in July and August, transplant largely; cauliflower—sow a few to succeed former crops, transplant largely about the end of the month;

celery—finish planting out in shallow trenches for the last crop; cress and mustard—continue sowing fortnightly; endive—sow a few for winter use; lettuce—continue sowing, to succeed former crops; onion—sow for spring green onions; peas—sow a few of the earliest sorts early in the month, in a warm situation, to use in May; radish—continue sowing, to keep up a regular supply; spinach—continue sowing winter varieties, to succeed the others; turnip—sow a few for winter use, also seeds for winter and spring.

April.—Asparagus—Cut the stems down to the surface as they decay, top-dress and manure with horse-droppings; borecole or kale—sow a good supply for spring use; cabbage—sow early sorts for spring supply; celery—remove the side shoots from the crowns of advanced crops, earthing up only a few for immediate use; cress and mustard—sow fortnightly; corn salad or lamb's lettuce—sow for use in spring; carrot—sow early horn, for use in the end of winter; endive—sow largely; garlic and shallots—plant; lettuce—sow largely and transplant, when ready, to use in June and July; onions, potato and tree—plant out largely for the first spring onions; onion—sow largely, to use green in spring, and to transplant in June for early summer bulbing; peas—sow a few of early sorts towards the end of the month, for the first supply in spring; radish—sow again; spinach—sow largely of winter varieties for spring supply; turnip—sow a few on trial if not done last month.

May.—Asparagus—Clear away and top-dress as recommended last month; borecole or kale—sow a few early, if not done last month; cabbage—finish planting out early, to head before the spring growth, or else they go to seed; cauliflower—sow a few towards the end of the month, to use in September; cress and mustard—sow fortnightly; endive—sow largely; garlic and shallots—plant out a few; herbs—divide and re-plant; horse radish—divide the roots and re-plant, storing for use all the fine, clean sticks; lettuce—sow for succession; onion—continue sowing; peas—sow largely of early sorts for spring use; parsnip—sow a few for spring use; radish—sow for a succession; rhubarb and sea kale—make young plantations towards the end of the month; spinach—sow a little to use in spring.

June.—Broad beans—sow for a successional crop; carrot—sow the early horn variety for September use; celery—earth up advanced crops finally in dry weather, remove all side shoots from the young ones; cucumber—sow for forcing in a hot-bed frame; garlic and shallots—finish planting; horse radish—continue planting out, keeping in store the long straight pieces; leek—sow for summer use; lettuce—sow for a successional crop; onion—sow largely for summer bulbing, transplant early from thinnings of former crops; parsnip—sow a few for spring use; peas—sow largely all commendable sorts for spring use; radish—sow for a succession; rhubarb and sea kale—plant as recommended last month; spinach—sow a few winter varieties for a late crop.

July.—Broad beans—sow largely for use in October and November; Brussels sprouts—sow a few to use in December; borecole or kale—sow a few to use in the summer months; carrot—sow largely of early and late sorts to use in October and November; cabbage—sow early and medium sorts to use about the end of the year; cauliflower—sow a few, or, if not done last month, sow largely early; garlic and shallots—finish planting early; herbs—if not yet done, divide the old roots and re-plant; horse radish—if not yet done finish planting out early; kohl-rabi—sow in pans for transplanting; lettuce—sow for a succession; leek—sow largely late this month for autumn and winter supply; onion—continue sowing largely; parsnip—sow a few to use in November; peas—sow largely all good sorts to use in October and November; potatoes—plant out a few early kidneys in a dry, warm situation; radish—sow for a succession; rhubarb and sea kale—finish planting out; savoy cabbage—sow a few to use in November; spinach—sow of winter sorts for the last time this season.

August.—Asparagus—sow largely, plant seedlings as soon as the buds begin to swell, and top dress established plants; beet—sow largely to use in January; brocoli—sow largely early and late varieties for autumn and early winter use; broad beans—sow largely all good sorts to use in November; Brussels sprouts—sow largely for mid-summer use; cabbage—make a good sowing of early sorts for summer, and late sorts, including the red, for autumn, transplant former sowings; cape gooseberry—sow in hot-bed frame; carrot—sow largely of early sorts for end of summer; cauliflower—sow largely to use from end of November, plant out the former sowings as the plants are ready; celery—sow in a hot-bed frame for early use; cucumber—sow a few in a warm frame for planting out in October; garlic and shallots—finish planting; herbs—sow largely all pot herbs such as sage, thyme, marjoram, savory, etc.; leek—sow largely for winter use, transplant June sowing; lettuce—sow largely; melons (rock and water)—sow a few along with the cucumber seeds; onion—sow largely for winter keeping, transplant early from former sowings; parsley—sow largely for summer supply; parsnip—sow largely for autumn use; peas—sow largely as directed last month; potatoes—plant out largely early and late sorts in high ground; radish—sow every third week; rhubarb—sow largely, gently force a few established roots; salsify and scorzonera—sow largely early varieties for autumn use; sea kale—sow largely and blanch; spinach—sow largely of the round variety to use in October; tomato—sow in a hot-bed frame.

September.—Asparagus—sow early and transplant, if not done, top-dress established plants; basil—sow in a hot-bed frame; broad beans—sow for successional crop; French beans—sow a few in warm situation; beet—sow largely if not done last month; brocoli—sow largely if not done last month; Brussels sprouts—sow towards the end of the month for succession, transplant former sowings ; cabbage—sow twice in the month, plant out former sowings ; caper of commerce—sow in hot-bed for transplanting in October ; cauliflower—plant out largely in a low situation ; capsicum—sow a few in the cucumber frame ; carrot—sow largely of late sorts for autumn and winter use, and a few of early sorts for summer, if not done last month ; cardoon—sow largely ; celery—sow a few towards the end of the month in the open ground and under protection for the autumn crops ; cress and mustard—sow fortnightly ; cucumber—sow a few again in the frame to plant out in October ; egg plant—sow on hot-bed for transplanting ; garlic—plant out early if not done ; herbs—plant early if not done last month ; kohl-rabi—sow in drills to remain ; leek—sow early if not done last month ; lettuce—sow largely to use early in December ; melons (rock and water)—sow early along with the cucumber seeds ; okra—sow on hot-bed for transplanting ; onion—sow thickly for pickling, bulbs to ripen in January ; parsnip—sow largely for autumn and winter use ; peas—sow largely, chiefly late sorts, to use from December ; potatoes—finish planting early on high grounds, commence for a full crop on low grounds ; radish—sow every third week ; rhubarb—sow early if not done previously ; salsify and scorzonera—sow early if not done previously ; savoy cabbage—sow early and late sorts for autumn and winter supply ; sea kale—sow early if not done, continue blanching established plants ; spinach—sow largely if not done in August ; turnips—make a good sowing towards the end of the month to use from November ; tomato—sow with capsicum ; vegetable marrow, pumpkin, and squash—sow in the open ground at the end of the month, and transplant from the frame if the weather is mild.

October.—Asparagus—cut the shoots six inches long for use ; broad beans—continue sowing for succession ; French beans—sow largely of late sort, to use in December ; beet—sow largely for autumn and winter use ; borecole or kale—sow largely to use in winter, transplant former sowings ; brocoli—sow largely for successional winter use, transplant stout young plants ; Brussels sprouts—sow largely for successional winter use, transplant stout young plants ; cabbage—make a good sowing for autumn supply, transplant stout young plants ; capsicum—sow for full crop in a warm border, transplant those raised in heat ; cardoon—sow for a full crop in trenches, to remain so ; carrot—make a good sowing of late varieties ; celery—sow largely in the open ground, prick out young seedlings ; cress and mustard—sow fortnightly ; cucumber—sow largely in the open ground, plant out seedlings from under cover ; herbs—sow a few still if not already done ; leek—sow a few to plant out in January for late crop, transplant ; lettuce—sow a few to remain until fit for use in November ; melon—*see* cucumber ; maize—sow sweet corn in the beginning and end of this month ; peas—make a good sowing of large podding varieties for successional crop ; radish—sow a few long and turnip radish ; rhubarb—

remove the forcing materials, gently tear away for use the outer stalks from the other plants ; spinach—sow a few of the round variety ; savoy cabbage—make a good sowing, to plant early in autumn for winter use ; sea kale—continue blanching ; turnip—sow largely, to use from December ; vegetable marrow, pumpkin, and squash—*see* cucumber.

NOVEMBER.—Broad beans—plant out a few for autumn use ; French beans—sow largely ; borecole or kale—sow a few early, to plant in autumn for autumn and winter use ; brocoli—sow a few early, to plant in autumn for autumn and winter use ; Brussels sprouts—sow a few early, to plant in autumn for autumn and winter use ; cabbage—sow a few early, to plant in autumn for autumn and winter use ; celery—sow largely, to plant in autumn for late crop ; couve tronchuda or Portugal cabbage—sow for winter use ; cress and mustard—sow fortnightly ; cucumber—sow largely early in the month, and plant out from under cover ; lettuce—sow largely where to remain if the situation is low and moist ; melon—*see* cucumber ; peas—sow largely of large sorts ; radish—sow a few ; turnip—sow largely twice in the month ; vegetable marrow, pumpkin, and squash. *See* cucumber.

DECEMBER.—Cabbage—sow a few, to plant in autumn for winter use ; cauliflower—sow a few ; couve tronchuda—sow for winter and spring use ; celery—sow for winter use ; remove side shoots from, and earth up advanced crops if required for immediate use ; cress and mustard—sow fortnightly ; kohl-rabi—sow in drills for winter use ; lettuce—sow largely if in a low situation ; peas—sow early and late sorts ; spinach—sow a few of the round variety ; turnip—sow a few.

CHAPTER XV.

BOOK-KEEPING FOR FARMERS.

THE NECESSITY OF KEEPING ACCOUNTS CORRECTLY.

(BY J. BUCKLEY, Accountant to the Bureau of Agriculture.)

(*Introduction by the Editor.*)

Farming is as much a business as selling tea and sugar or dry goods, or banking, or any other commercial pursuit, and it is quite as necessary that the farmer should keep proper books of accounts as the dry goods merchant, the storekeeper, the banker, or any other commercial man. The farmer buys, sells, and makes profits and losses during the year, and it is absolutely necessary for the proper conduct of his business that he should know what profit or loss he has made at the end of the twelve months, and, more particularly on what lines he is losing money, and on what he is gaining. The average farmer is not fond of the pen, and is not a ready reckoner, as a rule. This is all the more reason why he should keep books of account so as to be a check upon his memory, in which storehouse farmers are too apt to insecurely lock away the ill-calculated results of their monetary transactions. I do not suppose that more than 15 per cent. of the farmers of Australia keep any kind of account books at all, and perhaps not more than five per cent. keep them properly and can tell, after a glance at their books, how they stand, how much profit they made last year, and the chief lines on which these profits were made. On frequent occasions I have been selected as a judge of farms in competitions for the best managed farms in certain localities. I have, in the scale, always allotted a certain number of points to book-keeping, but my experience has shown that the full measure of these points has never yet been awarded, and frequently that the farmer who owned the best managed farm kept no books at all, or anything worthy of calling books of account. I remember asking one of the best and most practical farmers of an eastern colony why he did not keep a proper set of books, and he replied, "Oh, the bank does that for me. When I've got money in the bank I'm all right, and when I haven't I'm all right too, because they lend me some." Asked how he kept a check upon the bank, he said the bank was honest enough. But while the bank may be honest enough the want of system in not keeping books is all wrong. It would never do for the merchant to go on in this haphazard way, and it is not right for the farmer to do so.

The first book the farmer should possess himself of is a scribbling diary. This may also be used as a day-book and journal if the transactions of the farm are not very elaborate or frequent. "Great events from little causes spring," and it is of the utmost importance that every event that takes place on the farm should be recorded at the time of its occurence. Memory is so apt to play us false. If the ledger referred to later on is to be kept properly it is absolutely necessary that a short but complete record should be kept of the day's doings. What the farmer himself is doing, and what each man in his employ is doing, must be carefully set down for posting in the ledger at the end of the month. A note should also be made at the time of receipt or sale of goods, not in detail, but just the mention of the mere fact. For instance, "Received from W. Sandover and Co., one single furrow plough," or "Sold to J. Smith, half ton of chaff at £ per ton." Invoices and sale notes should be carefully filed away, as they will be wanted again when the books are made up, the entries in the diary serving as a check, so that nothing is omitted.

The books necessary for the system of book-keeping as shown herein are a day book, journal, and ledger. The day book and journal can be combined by using the left hand page for the journal. In the day book all transactions must be first entered, with full particulars of each item; sales of stock or produce, receipts and payments of money, with the dates of such transactions, and the names of the parties concerned.

The journal on the right hand page is ruled in two money columns, the left one headed "Dr.," and the right one "Cr." The entries are to be kept on the left hand side of these columns in a classified form; when this is done they are ready for posting in the ledger. All figures under the "Dr." column in the journal are entered in the "Dr." column of the ledger, and all under the "Cr." column of the journal are entered in "Cr." column of the ledger.

Having shown how the day book entries are recorded and entered in the journal in a classified form (journalised), it may be necessary to observe that the entries in the day book need not be confined solely to monetary transactions. The times when crops are sown or reaped, work in vineyard and orchard, variations in the weather, storms, floods, or droughts, might be recorded in the day book as they occur, making it a diary of events, or a separate diary may be kept, as the farmer thinks fit. This record may be of great use to the farmer as a work of reference in the future.

Let us suppose that Jas. Thompson is the owner of 200 acres of land and possessor of certain working plant for farming purposes, also live stock and cash on the 1st of January, 1895. His first step is to ascertain the nett value of his land, working plant, live stock, and cash in hand, and make an entry in the manner shown in the day book, after which follow the various transactions supposed to occur in a farmer's business during the year, examples of which are given in the day book and journal as follows :—

DAY BOOK.

Page I.

January 1 The property I possess is as follows:—
200 acres of land, value £200.

Live stock, £122.

Working plant, £27.

Cash in bank, £100.

The above items constitute the entire capital; it is sub-divided and classified in the Journal (journalised) under the head of property, live stock, working plans and cash accounts.

" 5 Bought from Sandover and Co., one single furrow plough, £6 10s.

As this purchase is an addition to working plant, that account is charged with it and credit given to Sandover and Co. for supplying it.

" 5 Paid for stores for house, £7.

This being an expense, expenses account is charged (debited) with the amount and cash account credited for money paid out.

12 Bought from M'Bean and Co., five sacks bonedust, £2 10s.

The bonedust being for cropping purposes, crop account is charged (debited) with amount, and M'Bean and Co., receive credit (credited) for supplying the bonedust.

" 30 Paid M'Bean and Co. my cheque, £2 10s.

M'Bean and Co.'s account is charged (debited) with this amount, and cash account credited for so much money paid out.

" 30 Sent my cheque per post to Sandover and Co., £6 10s.

This is similar to the foregoing transaction, and the same explanation applies to it

February 4 Sold to Jas. Ferguson four tons of hay at £2 15s. per ton, £11.

Ferguson is indebted for the amount of hay, his account is charged (debited) with the amount, and crop account receives credit (credited), the hay being a portion of crop.

" 17 Sold to Jas. Murphy two calves at 15s. each, £1 10s.

The foregoing explanation applies to this transaction, except in this matter, live stock account receives credit for the calves sold to Murphy.

JOURNAL.

Page 1.

1895			Ledger Page.	Dr. £	s.	d.	Cr. £	s.	d.
January	1	Dr. property account ...	95	200	0	0			
,,	1	Cr. capital ,, ...	85				200	0	0
,,	1	Dr. live stock ,, ...	110	122	0	0			
,,	1	Cr. capital ,, ...	85				122	0	0
,,	1	Dr. working plant account ...	105	27	0	0			
,,	1	Cr. capital account	85				27	0	0
,,	1	Dr. cash ,, ...		100	0	0			
,,	1	Cr. capital ,, ...	85				100	0	0
,,	5	Dr. working plant account ...	105	6	10	0			
,,	5	Cr. Sandover & Co. ac., 1 s.f. plough	1				6	10	0
,,		Dr. expenses account, stores ...	75	7	0	0			
,,	5	Cr. cash	65					0	0
,,	12	Dr. crop account, bonedust ...	115	2	10	0			
,,	12	Cr. M'Bean & Co. account, bonedust	2				2	10	0
,,	30	Dr. M'Bean & Co. account, cheque	2	2	10	0			
,,	30	Cr. cash account, cheque ...	65				2	10	0
,,	30	Dr. Sandover & Co. account, cheque	1	6	10	0			
,,	30	Cr. cash account, cheque ...	65				6	10	0
February	4	Dr. Jas. Ferguson account, 4 tons hay at £2 15s.	3	11	0	0			
,,	4	Cr. crop account, hay	115				11	0	0
,,	17	Dr. Jas. Murphy ac., 2 calves at 15s.	4	1	10	0			
,,	17	Cr. live stock account, calves ...	110				1	10	0
		Carried Forward		£486	10	0	486	10	0

DAY BOOK.

Page 2.

Feb. 24 Received cash from Jas. Ferguson, £11.

Ferguson having paid this money his account is credited with the amount, and being a receipt in favour of cash, cash account is debited.

" 28 Received cheque from Jas. Murphy, price of calves, £1 10s.

Cash account in this transaction is also debited, and Murphy's account receives credit (credited).

March 6 Bought from Sandover and Co. one set of iron harrows, £4.

This is also an addition to working plant; the account is charged (debited) and Sandover and Co.'s account receives credit (credited).

" 6 Paid my cheque for stores for house, £4 10s.

This is an expense for which payment is made. Expenses account is charged (debited) and cash account is credited for the money paid out.

April 9 Paid my cheque to Sandover and Co. for harrows, £4.

Having paid for the harrows, Sandover and Co.'s account is debited with the amount and cash account credited for money paid out.

May 6 Sold for cash twelve young pigs for 10s. each, £6.

This is a cash transaction. Cash account is debited for money received, and live stock account receives credit (credited), pigs being a portion of live stock.

June 2 Sold to R. Jenkins 150 bushels of wheat at 6s. per bushel, £45.

Jenkins' account is charged (debited) with amount of wheat, and crop account receives credit (credited).

" 5 Bought from Barrett and Sons seeds to the amount of £2 10s.

The seeds being intended for crop purposes, crop account is charged (debited) and Barrett and Sons receive credit for supplying the seeds.

" 6 Drew from the bank the sum of £5 for petty cash.

This being intended for payment of sundry current items for use of the house must be looked upon as an expense. Expenses account is charged (debited) and cash account credited for amount drawn from bank.

July 10 Received from R. Jenkins £44 for wheat, allowing him £1 discount.

Cash account is debited for money received, and Jenkins' account credited for £44 and also for £1 discount allowed. Profit and loss account is debited with discount, being a loss; this transaction requires four entries in Journal and Ledger.

JOURNAL.

Page 2.

				£	s.	d	£	s.	d.
		Brought Forward ...	...	486	10	0	486	10	0
Feb.	24	Dr. cash ac., cheque Jas. Ferguson...	65	11	0	0			
,,	24	Cr. Jas. Ferguson account, cheque...	3				11	0	0
,,	28	Dr. cash ac., cheque from J. Murphy	65	1	10	0			
,,	28	Cr. J. Murphy account ...	4				1	10	0
March	6	Dr. working plant ac., 1 set harrows	105	4	0	0			
,,	6	Cr. Sandover & Co. ac., harrows ...	1				4	0	0
,,	6	Dr. expenses account, stores ...	75	4	10	0			
,,	6	Cr. cash account, stores ...	65				4	10	0
April	9	Dr. Sandover & Co. ac., cheque ...	1	4	0	0			
,,	9	Cr. cash account, cheque ...	65				4	0	0
May	6	Dr. cash account pigs, ...	65	6	0	0			
,,	6	Cr. live stock account, pigs ...	110				6	0	0
June	2	Dr. R. Jenkins ac., 150 bus. wheat at 6s.	5	45	0	0			
,,	2	Cr. crop account, wheat ...	115				45	0	0
,,	5	Dr. crop account, seeds ...	115	2	10	0			
,,	5	Cr. Barrett & Sons account, seeds ...	6				2	10	0
,,	6	Dr. expenses account, petty cash ...	75	5	0	0			
,,	6	Cr. cash account, petty cash ...	65				5	0	0
July	10	Dr. cash account, cheq. from Jenkins	65	44	0	0			
,,	10	Cr. R. Jenkins account, cheque ...	5				44	0	0
,,	10	Dr. profit and loss ac., disc'nt Jenkins	125	1	0	0			
,,	10	Cr. R. Jenkins account, discount ...	5				1	0	0
		Carried Forward ...	...	£615	0	0	615	0	0

DAY BOOK.

Page 3.

July 30 Sold to Wm. Jones, fruiterer, 20 cases oranges at 10s. each, £10, for cash.

A cash transaction ; no account is required for Wm. Jones, as he paid cash at the time. Cash account is debited for money received, and crop account receives credit (credited), for oranges sold.

August 1 Paid Jas. O'Neil 15 weeks wages at £1 per week, for work on farm, £15.

Crop account is charged with O'Neill's wages. His labor being used in putting in and taking out the crop. Cash account is credited for money paid from cash.

" 5 Paid Barrett and Sons my cheque, £2 10s., for seeds.

Barrett and Sons are debited with this amount, and cash account credited for the money paid out.

" 15 Paid Wm. Robinson 10 weeks' wages at £1 per week, for work in orchard, £10.

This is charged to crop account (debited), and cash account credited for money paid out.

" 30 Paid John Brown 12 weeks' wages at £1 per week, for work in vineyard, £12.

Crop account is also charged with this expense (debited), and cash account credited for amount paid.

" 30 Paid Thos. Smith for fencing £25, contract work.

Fencing being an improvement effected, improvement account is charged with the amount, and cash account credited for money paid out.

September 1 Provided food for 3 labourers for 6 weeks, at 10s. per week each, £9.

The food consumed by labourers having come from the house, which was previously purchased and paid for, crop account is charged (debited) with the amount, and expenses account receives credit (credited).

" 5 Bought from White and Co. one spring dray for £15.

The spring dray is an addition to working plant ; that account is debited and White and Co. credited for the cost of dray.

" 10 *Given White and Co. my promissory note at three months for £15, cost of spring dray.

White and Co. are debited with promissory note £15, and bills payable credited.

" 15 Received for butter and eggs sold during the last six months, £10 5s.

Cash account is debited, being so much money received, and live stock gets credit for amount of produce of stock.

" 25 Sold to Jas. Morrissey one draught horse for £20 and received his promissory note for same at three months.

Morrissey is charged with the price of the horse, and live stock receives credit, and having accepted a promissory note for the animal at three months from Morrissey his account is credited with the amount, and bills receivable debited.

JOURNAL.

Page 3.

				£ s. d.	£ s. d.
		Brought Forward ...		615 0 0	615 0 0
July	30	Dr. cash account, oranges ...	65	10 0 0	
"	30	Cr. crop account, oranges ...	115		10 0 0
August	1	Dr. crop account, wages Jas. O'Neill	115	15 0 0	
"	1	Cr. cash account, wages Jas. O'Neill	65		15 0 0
"	5	Dr. Barrett & Sons account, cheque	6	2 10 0	
"	5	Cr. cash account, cheque ...	65		2 10 0
"	15	Dr. crop ac., wages Wm. Robinson	115	10 0 0	
"	15	Cr. Cash ac., wages Wm. Robinson	65		10 0 0
"	30	Dr. crop account, wages John Brown	115	12 0 0	
"	30	Cr. cash account, wages John Brown	65		12 0 0
"	30	Dr. improvements account, fencing	120	25 0 0	
"	30	Cr. cash account, fencing ...	65		25 0 0
September	1	Dr. crop account, food for laborers...	115	9 0 0	
"	1	Cr. expenses ac., food for laborers ...	75		9 0 0
"	5	Dr. working plant ac., 1 spring dray	105	15 0 0	
"	5	Cr. White & Co. ac., 1 spring dray	7		15 0 0
"	10	Dr. White & Co., ac., pro. note at 3 mo.	7	15 0 0	
"	10	Cr. bills payable ac., pro. note at 3 mo.	135		15 0 0
"	15	Dr. cash account, butter and eggs...	65	10 5 0	
"	15	Cr. live stock account, butter and eggs	110		10 5 0
"	25	Dr. Jas. Morrissey ac., 1 draught horse	8	20 0 0	
"	25	Cr. live stock ac., 1 draught horse	110		20 0 0
"	25	Cr. J. Morrissey ac., pro. note at 3 mo.	8		20 0 0
"	25	Dr. bills receivable at., pro. note ...	135	20 0 0	
		Carried Forward ...		£778 15 0	778 15 0

DAY BOOK.

Page 4.

October 1 Paid for stores for the use of the house, £9.

Expenses account is debited and cash account credited.

" 10 Paid blacksmith's account, £5 10s.

This is an expense incurred in repairing implements, and must come under the head of working plant, that account is charged with the amount (debited), and cash account credited for money paid.

" 20 Paid for draining £6, contract work.

This being an improvement it is charged (debited) to improvement account, and cash account credited.

December 13 Paid this day my promissory note to White and Co. for £15.

Bills payable account is debited and cash account credited for cash paid out.

" 29 Jas. Morrissey paid his promissory note for £20 due 28th December.

Cash account is debited for money received, and bills receivable account is credited.

" 31 Used in the house, garden and orchard produce during 12 months, to the value of £10.

This must be looked upon as an expense as if the cash were paid for the produce; expenses account is charged (debited), and crop receives credit (credited).

" 31 Used in the house butter, eggs, bacon, poultry, during 12 months, value £15.

This is also an expense. Expenses account is charged (debited), and live stock receives credit (credited).

" 31 Crop consumed by stock during 12 months value £25.

A certain quantity of produce having been consumed by stock, live stock account is charged (debited), and crop receives credit for what was used by stock.

" 31 Paid for clearing, £20, contract work.

This being also another improvement, the account is charged (debited), and cash account credited for money paid.

---

*Bills given and received are deferred payments; the amounts represented by them do not appear in the cash book until the bills are met, that is, paid. Three days grace are given in addition to the time specified in bill. For instance, the bill given to White and Co dated 10th September does not become due until the 13th December. If the date of payment (due date) falls on a Sunday it must be met (paid) the previous Saturday.

JOURNAL.

			£ s. d.	£ s. d.
	Brought Forward ...		778 15 0	778 15 0
October 1	Dr. expenses account, stores ...	75	9 0 0	
,, 1	Cr. cash account, stores ...	65		9 0 0
,, 10	Dr. working plant account ...	105	5 10 0	
,, 10	Cr. cash account	65		5 10 0
,, 20	Dr. improvement account, draining	120	6 0 0	
,, 20	Cr. cash account, draining ...	65		6 0 0
December 13	Dr. bills payable account ...	135	15 0 0	
,, 13	Cr. cash account	65		15 0 0
,, 29	Dr. cash account	65	20 0 0	
,, 29	Cr. bills receivable account ...	135		20 0 0
,, 31	Dr. expenses ac., crop used in house	75	10 0 0	
,, 31	Cr. crop account, crop used in house	115		10 0 0
,, 31	Dr. expenses ac., stock used in house	75	15 0 0	
,, 31	Cr. live stock ac., stock used in house	110		15 0 0
,, 31	Dr. live stock ac., crop consumed ...	110	25 0 0	
,, 31	Cr. crop ac., crop consumed by stock	115		25 0 0
,, 31	Dr. improvement account, clearing	120	20 0 0	
,, 31	Cr. cash account, clearing ...	65		20 0 0
	Total		£904 5 0	904 5 0

In property accounts the "Dr." items mean expenses incurred, and "Cr." items mean receipts or returns in favor of the account. In cash account Dr. items mean actual cash received from time to time, and the Cr. items mean money paid out. Every purchase or sale necessitates four entries for each transaction. The first two are made in personal and property accounts. The last two, when the money changes hands, in personal and cash accounts, but when ready money is received and paid there is no necessity for a personal account, the transaction is confined in the journal and ledger to property and cash accounts.

When entering items in the ledger accounts from the journal, the journal page should be written in the ledger column under the heading of "journal folio," and the ledger page should be written in the journal under the heading of "ledger page," in order to show that such accounts are duly posted in the ledger.

INDEX TO LEDGER.

	Page.
Sandover and Co.	1
McBean and Co.	2
Ferguson, Jas.	3
Murphy, Jas.	4
Jenkins, R.	5
Barrett and Sons	6
White and Co.	7
Morrisey, Jas.	8
Cash	65
Expenses	75
Capital	85
Property	95
Working Plant	105
Stock	110
Crop	115
Improvements	120
Bills Account	135
Profit and Loss	125
Balance	130
Valuation Book	200
Labour Book	210

LEDGER.

SANDOVER AND CO.

Dr. Page 1.	J. Fol.			Cr.	J. Fol.	
1895. Jan. 30.				1895. Jan. 5.		
To Cheque	1	6 10 0		By one D.F. Plough...	1	6 10 0
May 9.				March 6.		
To Cheque	2	4 0 0		By one set Harrows...	2	4 0 0
		10 10 0				10 10 0

MCBEAN AND CO.

Page 2.						
Jan. 30.				Jan. 12.		
To Cheque	1	2 10 0		By five bags Bonedust	1	2 10 0

LEDGER.

Jas. Ferguson.

Page 3.

Feb. 4.	To Hay	1	11	0	0		Feb. 24.	By Cash	2	11	0	0

Jas. Murphy.

Page 4.

Feb. 17.	To Calves	1	1	10	0	Feb. 28.	By Cash	2	1	10	0

R. Jenkins.

Page 5.

June 2.	To Wheat	2	45	0	0	July 10.	By Cheque	2	44	0	0
							By Discount	2	1	0	0
			45	0	0				45	0	0

Barrett and Sons.

Page 6.

Aug. 5.	To Cheque	3	2	10	0	June 5.	By Seeds	2	2	10	0

White and Co.

Page 7.

Sept. 10.	To Pro. Note at 3 months	3	15	0	0	Sept. 5.	By Spring Dray ...	3	15	0	0

James Morrissey.

Page 8.

Sept. 25.	To 1 Draught Horse	3	20	0	0	Sept. 25.	By Pro. Note at 3 months	3	20	0	0

Page 65.

LEDGER.

Cash Account.

Dr.

1895.	Journal Page.	£	s.	d.
Jan. 1. To Cash in Bank ...	1	100	0	0
Feb. 24. To Cheque, J. Ferguson	2	11	0	0
Feb. 28. To Cheque, J. Murphy	2	1	10	0
May 6. To Cheque, Pigs ...	2	6	0	0
July 10. To Cheque, Jenkins ...	2	44	0	0
July 30. To Cheque, Oranges ...	3	10	0	0
Sept. 15. To Cheque, Butter, Eggs	3	10	5	0
Dec. 29. To Cheque, Morrissey...	4	20	0	0
		£202	15	0

Cr.

1895.	Journal Page.	£	s.	d.
Jan. 5. By Cash for Stores...	1	7	0	0
Jan. 30. By McBean & Co. ...	1	2	10	0
Jan. 30. By Sandover & Co....	1	6	10	0
March 6. By Stores	2	4	10	0
April 9. By Sandover & Co....	2	4	0	0
June 6. By Petty Cash ...	2	5	0	0
Aug. 1. By Wages	3	15	0	0
Aug. 5. By Barrett, seeds ...	3	2	10	0
Aug. 15. By Wages	3	10	0	0
Aug. 30. By Wages	3	12	0	0
,, T. Smith, fencing	3	25	0	0
Oct. 1. By Stores	4	9	0	0
Oct. 10. By Blacksmith ...	4	5	10	0
Oct. 20. By Draining ...	4	6	0	0
Dec. 13. By White & Co. ...	4	15	0	0
Dec. 31. By Clearing	4	20	0	0
,, Balance		53	5	0
		£202	15	0

Page 75.

Expenses Account.

	Journal Page.	£	s.	d.
Jan. 5. To Stores	1	7	0	0
March 6. To Stores	2	4	10	0
June 6. To Petty Cash	2	5	0	0
Oct. 1. To Stores	4	9	0	0
Dec. 31. To Crop	4	10	0	0
,, Stock	4	15	0	0
		£50	10	0

	Journal Page.	£	s.	d.
Sept. 1. By Crop	3	9	0	0
Dec. 31. By Profit and Loss ...		41	10	0
		£50	10	0

Page 85.

Capital Account.

Dr.	Journal Page.	£	s.	d.	Cr.	Journal Page.	£	s.	d.
1895.					1895.				
Dec. 31.					Jan. 1.				
To Balance		449	0	0	By Land	1	200	0	0
					„ Stock	1	122	0	0
					„ Working Plant ...	1	27	0	0
					„ Cash	1	100	0	0
		£449	0	0			£449	0	0

Page 95.

Property Account.

Jan. 1.					Dec. 31.				
To Lands	1	200	0	0	By Balance		200	0	0

Page 105.

Working Plant Account.

Jan. 1.					Dec. 31.				
To Plant	1	27	0	0	By Valuations ... See Valuation book.		52	4	0
Jan. 5.									
To 1 Single-fur. Plough	1	6	10	0	By Profit and loss (loss)		5	16	0
March 6									
To 1 set of Harrows ...	2	4	0	0					
Sept. 5.									
To 1 Spring Dray ...	3	15	0	0					
Oct. 10.									
To Blacksmith's Acct....	4	5	10	0					
		£58	0	0			£58	0	0

Live Stock Account.

Page 110.

Jan. 1.					Feb. 17.				
To Stock	1	122	0	0	By 2 Calves	1	1	10	0
Dec. 31.					May 6.				
To Crop	4	25	0	0	By Pigs	2	6	0	0
Dec. 31.					Sept. 1.				
To Profit and Loss (Gain)		6	11	0	By Butter and Eggs	3	10	5	0
					Sept. 23.				
					By 1 Draught Horse	3	20	0	0
					Dec. 31.				
					By Stock for House	4	15	0	0
					„ Valuations ... See Valuation book.		100	0	0
		£153	11	0			£153	11	0

Crop Account.

Dr. Page 115. | Cr.

1895.	Journal Page.	£	s.	d.	1895.	Journal Page.	£	s.	d.
January 12. To Bonedust	1	2	10	0	Feb. 4. By Hay	1	11	0	0
June 5. To Seeds	2	2	10	0	June 2. By Wheat	2	45	0	0
August 1. To Wages	3	15	0	0	July 30. By Oranges	3	10	0	0
August 15. To Wages	3	10	0	0	December 31. By Expenses, House	4	10	0	0
August 30. To Wages	3	12	0	0	December 31. By Expenses, Stock	4	25	0	0
September 1. To Expenses	3	9	0	0	By Value of Crop on hand ... ... See Valuation book.		23	5	0
December 31. To Profit and Loss (Gain)		73	5	0					
		£124	5	0			£124	5	0

Improvement Account.

Page 120.

		£	s.	d.			£	s.	d.
August 30. To Fencing	3	25	0	0	December 31. By Valuations ... See Valuation book.		45	18	0
October 20. To Draining	4	6	0	0	By Profit and Loss ...		5	2	0
December 31. To Clearing	4	20	0	0					
		£51	0	0			£51	0	0

Profit and Loss Account.

Page 125.

Loss.		£	s.	d.	Gain.		£	s.	d.
July 10. To Discount	2	1	0	0	December 31. By Stock ... ... See Stock account.		6	11	0
December 31. To Working Plant ... See Working Plant account.		5	16	0	December 31. By Crop ... ... See Crop account		73	5	0
,, Improvements ... See Improvements account.		5	2	0					
,, Expenses ... ... See Expenses account.		41	10	0					
,, Net Gain		26	8	0					
		£79	16	0			£79	16	0

LEDGER.

Balance Account.

Page 130.

December 3.			December 31.	
To Land	200 0 0		By Capital	449 0 0
See Property account.			See Capital account.	
„ Valuations	222 3 0		„ Balance (Gain) ...	26 8 0
See Valuation book.				
„ Cash	53 5 0			
See Cash account.				
	£475 8 0			£475 8 0

Bills Account.

Page 135.

Bills Receivable.

Date.	From whom received.	To whom payable.	Amount.	When due.	When paid.
1895 Sep. 25.	Jas. Morrissey.	Jas. Thomson.	20 0 0	Dec. 28, 1895.	Dec. 28, 1895.

Bills Payable.

Date.	To whom payable.	By whom.	Amount.	When due.	When paid.
1895 Sep. 10.	White & Co.	Jas. Thomson.	15 0 0	Dec. 13, 1895.	Dec. 13, 1895.

Having finished the posting of the journal accounts into the ledger up to the end of the year, we must turn our attention to the valuation book, in which is entered a list of farm property, viz.,—live stock, crop, working plant, improvements and their respective values. Care should be taken to give a proper valuation in order to ascertain the exact state of affairs. In the valuation of implements, full allowance should be made for wear and tear; the amount representing the depreciation in value should be in proportion to the time they have been in use. In the value of improvements, the money expended on such represents their value, but in the course of time this will diminish, consequently a certain percentage should be taken off the original cost. In these matters the farmer must use his own judgment to ascertain what is fair to allow for depreciation. For the purpose of an example I have taken off 10 per cent. from the value of the live stock, working plant, and improvements. The valuation book might be kept as follows :—

Page 200. VALUATION BOOK.

Valuations taken on 31st December, 1895.

LIVE STOCK.		
1 bay draught horse, branded B2 off neck	25 0 0	
1 dark brown draught horse, brand HL near shoulder ...	15 0 0	
1 grey draught horse, branded JT off shoulder	20 0 0	
5 cows, average £8 each	40 0 0	
3 calves „ 15/ „	2 5 0	
4 pigs „ 25/- „	5 0 0	
8 young pigs, average 5/- each	2 0 0	
Poultry	2 15 0	
	112 0 0	
Allow 10 per cent. depreciation in value	11 4 0	
		100 16 0
CROP.		
3 tons of straw at £2 per ton	6 0 0	
3 tons hay, at £5 per ton	15 0 0	
Manure	2 5 0	
		23 5 0
WORKING PLANT.		
1 double-furrow plough	15 0 0	
1 single-furrow plough	6 10 0	
2 harrows	9 10 0	
1 spring cart	15 0 0	
2 sets cart harness	10 0 0	
Tools for working	2 0 0	
	58 0 0	
Allow 10 per cent. for depreciation in value	5 16 0	
		52 4 0
IMPROVEMENTS.		
Draining	6 0 0	
Fencing	25 0 0	
Clearing	20 0 0	
	51 0 0	
Allow 10 per cent. for depreciation in value	5 2 0	
		45 18 0
Total		£222 3 0

Having completed the entries in the valuation book, let us give our attention again to the ledger for the purpose of closing the accounts and drawing up a balance-sheet, a matter of importance, as it enables the farmer to ascertain his exact position, which can be arrived at in the following manner: Add up the Dr. and Cr. money columns of each account, and if they are found to agree, rule a line at the foot of each column and enter the totals in figures under it. If the Dr. and Cr. money columns are not equal, subtract the lesser from the greater, the difference is what is called the balance, this is added to the lesser money column; when done, the two will be found equal. As no debts were incurred by the farmer, and no money owing to him, the personal accounts in the ledger do not show a balance on either side: the money columns agree. When the Dr. side of an account is greater than the Cr. side, deduct one amount from the other, and enter the difference in the Cr. money column, prefixed by the words "By Balance." In like manner when the greater amount exists on the Cr. side of an account, the difference between it and the amount on the Dr. side is entered to it prefixed by the words "To Balance," which, when added up, the columns of figures will be found equal. This will be understood on reference to the cash account where a balance of £53 5s. 6d. appears, showing the difference between the Dr. and Cr. sides; that is, the expenditure, or Cr. side, is less than the receipts, or Dr. side. In working plant account the entries on the Dr. side amount to £58, the cost of the implements and expenses in repairing; on the Cr. side appears the entry "by valuation £52 4s. od." which represents the value of the working plant on the 31st December; on the same side also appears "by profit and loss, £5 16s. od." this means the depreciation in value of working plant. It is a loss. Stock account—the Dr. side entry "to stock" is the value of stock on the 1st January, £122, added to which is £25, an expense incurred in maintenance, the two amounts added will be found to amount to £147. The Cr. items represent the product of stock sold, and the value of stock in possession—total amount, £153 11s. od., leaving a balance of £6 11s. od. in favor of the Dr. side, which means so much gained in stock, the entry for which, on the Dr. side, will be "to profit and loss, £6 11s." Crop account—the Dr. side represents the expenses, and the Cr. side the sales and the value of crop unsold. It will be perceived that the Cr. side is greater than the Dr. side, the difference between them being £73 5s. od., which is so much gained. The balancing entry is "to profit and loss, £73 5s. od." The improvement account—the Dr. side shows the amount expended in fencing, draining, and clearing; total, £51. The Cr. entry "valuations, £45 18s." represents the value of such at the end of the year. There is a depreciation in the value amounting to £5 2s. od. The second entry is "by profit and loss, £5 2s. od." Profit and loss account—the Dr. entries in this account show the losses in cash (discount), £1; working plant, £5 16s. od.; improvements, £5 2s. od.; and amount of household expenses, £41 10s. od. The Cr. entries show what has been gained in stock and crop, and it will be perceived that the Dr. side (loss) is less than the Cr. side (gain) by £26 8s. od., this amount is added to the Dr. side for balancing purposes "to nett gain, £26 8s." Balance account—the Dr. side shows on December 31st, 1895, land £200; the value of live stock, crop, working plant, and improvements (see valuation book) equal to £223 3s. od.; and cash in hand (see cash account), £53 5s. od; total on Dr. side, £475 8s. od. On the Cr. side is the entry "by capital," that is, the amount of capital possessed on the 1st January, 1895. The difference between the two sums is £26 8s. od., in favor of capital. The entry on Cr. side is "by balance, £26 8s. od."

A labor book is necessary for a farmer to enter the names of the men in his employment and the nature of their work, such as ploughing, harvesting, vineyard, or orchard work, the time they entered upon their employment, and the rate of wages agreed upon.

Date.	Name.	How engaged.	Rate of wages.	Weeks.	Days.	£ s. d.	Remarks.
April 12.	James O'Neill.	Farm Labor.	£1 per week.	15	—	15 0 0	Up to 1st August.
June 6.	Wm. Robinson.	Work in Orchards.	£1 per week.	10	—	10 0 0	Up to 15th Aug.
June 7.	John Brown.	Work in Vineyard.	£1 per week.	12	—	12 0 0	Up to 30th Aug.

Having balanced the ledger accounts, our next proceeding is to open accounts for the following year. To do this we must refer to the balance account in ledger, and enter the items on Dr. side of balance account book as follows :—

In balancing my accounts on 31st December, 1895 I am possessed of the following :—

DAY BOOK.

1896. Jan. 1	£	s.	d.
Land value	200	0	0
Live stock, per valuation book	100	16	0
Crop, per valuation book ...	23	5	0
Working plant, per valuat'n bk.	52	4	0
Improvement, per valuation bk.	45	18	0
Cash on hand per cash book	53	5	0
	475	8	0

JOURNAL.

1896. Jan. 1	Dr. £	s.	d.	Cr. £	s.	d.
Dr. property a/c ...	200	0	0			
,, live stock a/c ...	100	16	0			
,, crop a/c ...	23	5	0			
,, working plant a/c	52	4	0			
,, improvement a/c	45	18	0			
,, cash a/c ...	53	5	0			
	475	8	0			
Cr. capital a/c ...				475	8	0

The system of book-keeping on the double entry principle as set forth herein is the basis of good book-keeping. In order to avoid tediousness, and make it easy of comprehension, the explanations given are in as concise a form as possible. More could be said on the subject, but what is here detailed is applicable to farmers and orchardists. Book-keeping is not easily understood when first looked into, but when the initial difficulties are overcome a knowledge is easily acquired, when it becomes not a labour, but a pleasure. A good method to adopt to attain this object—and one that I recommend—is to write out a copy of the accounts given herein as examples, beginning with the day book and journal, after which the ledger in the manner prescribed. A few sheets of foolscap ruled in journal and ledger form would answer the purpose. This exercise might be repeated two or three times, and by this means the farmer will acquire sufficient knowledge to put theory into practice.

CHAPTER XVI.

MEDICAL AND SURGICAL HINTS.

WHAT TO DO IN EMERGENCIES.

POISONS AND THEIR ANTIDOTES—FIRST AID IN ACCIDENTS.

THE MORE COMMON COMPLAINTS AND SIMPLE REMEDIES.

The following chapter has been kindly prepared, at the request of the Editor of the GUIDE, by Dr. O'Connor, of Perth. The GUIDE does not profess to teach the whole theory and practice of agromony, neither does this chapter pretend to cover the whole range of surgery and medicine. In a country so widely settled as this, there is necessarily a large number of people living at long distances from medical help. Whenever possible, skilled medical aid should be summoned immediately; but where this is not possible, or where some time must elapse before the doctor can arrive, what to do, and how to do it, in the preliminary stages of accidents, or other physical emergencies, can be gathered from the following pages :—

POISONS AND THEIR ANTIDOTES.

POISONS.	ANTIDOTES.
Acids— (*a*) Sulphuric, (*b*) Hydrochloric, (*c*) Nitric	Bicarbonate of soda, magnesia, chalk, or whitewash in water. Soapy water, milk, eggs, olive, or almond oil.
Alkalies— Caustic Potash, Lime, Ammonia	(*a*) Vinegar, lemon juice, milk, and oil. (*b*) Warm water and stimulants.
Arsenic	(*a*) Emetics. (*b*) Magnesia, oils, iron rust. (*c*) Sal volatile, 30 drops, repeated in 5 minutes.
Carbolic Acid	(*a*) Epsom salts, ½ oz. in water. (*b*) Eggs and milk, strong coffee.
Chloral	(*a*) Emetics. (*b*) Strong coffee. Rouse the patient. Keep patient warm.

Corrosive Sublimate	White of egg, flour and water freely, emetics.
Prussic Acid (*a*) Bitter Almonds (*b*) Cherry, apricot & peach stone. (*c*) Cyanide of potash.	(*a*) Sal volatile, one teaspoonful. (*b*) Artificial respiration, with cold and warm affusions in the head and spine. (*c*) Mustard to stomach, black coffee.
Nux Vomica Strychnine	(*a*) Emetics. (*b*) Strong tea.
Mushrooms	Emetics. Stimulants and castor oil.
Opium— (*a*) Laudanum (*b*) Morphia (*c*) Chlorodyne	(*a*) Emetics. (*b*) Strong coffee, keep patient awake, smelling salts with care. (*c*) Artificial respiration, warmth, sour red wine.
Phosphorous Rat paste	Use magnesia in water. Avoid oil or fat.
Verdigris	Use sugar and eggs. Avoid oil, fat, or vinegar.
Coal Gas Carbonic Acid Gas Chloroform Ether Strangulation	(*a*) Remove patient to fresh air, and keep him warm. (*b*) Douche or sprinkle the head ; rubbing. (*c*) Mustard poultices to calves and heart. (*d*) Smelling salts. (*e*) Artificial respiration ; pull forward the tongue occasionally. In all cases keep the patient warm.

Emetics, to Produce Vomiting.—(*a*) Warm water, salt and water, mustard, alum, or bluestone in water ; (*b*) tickling the back of the throat with the finger or a feather.

Artificial Respiration (*Sylvester's*).—Put patient on the back, with pad under the shoulders, so that the head hangs over the end of the table. Then, standing at the head, grasp the arms below the elbows, and draw them upwards until they lie on each side of the head, then carry them again downwards on the chest and press on the lower part of the chest, so as to force the air out. This should be repeated at regular intervals about 20 times a minute.

In Case of Drowning.—The body should be placed on the side, and the legs carefully lifted to allow the water to run out of the lungs, &c. (greatest care should be exercised, as any roughness may stop the heart). If respiration has stopped, the body is turned fifteen times per minute from side to face ; when on the face pressure is made on the back ; by this method the tongue can fall forward and water in lung, or vomited, can run out of the mouth instead of being sucked down into the lungs, if on the back, and one lung is kept patent.

SNAKE BITE.—(*a*) Suck the wound, if there is no abrasion in the mouth ; (*b*) tie a tight strap at once around the limb between the wound and the body ; (*c*) if liquid ammonia or Condy's fluid be at hand, drop it in the wound ; (*d*) cut the bitten piece out, or cut into the wound and allow to bleed ; (*e*) wash with vinegar ; (*f*) stimulants, with care.

HEMORRHAGE, OR BLEEDING.—(*a*) Pressure of finger or pad with bandage ; (*b*) elevate the part ; (*c*) no stimulants.

HEMORRHAGE FROM THE LUNGS.—(*a*) Put the patient to bed, with head and chest raised ; (*b*) keep perfectly quiet, remove friends from room : (*c*) no speaking, or deep breathing ; (*d*) suck ice, swallow two tea-spoonfuls of salt in a little water.

HEMORRHAGE FROM THE NOSE.—(*a*) Lie down on the back ; (*b*) cold applications to the nose ; (*c*) breathe through the mouth ; (*d*) inject solution of alum, or vinegar and water ; (*e*) press together the nostrils ; (*f*) take one packet of epsom salts ; (*g*) no stimulants.

HEMORRHAGE FROM THE STOMACH.—(*a*) Rest in bed and keep perfectly quiet ; (*b*) suck ice ; (*c*) light milk food in small doses ; (*d*) no stimulants.

WOUNDS.—(*a*) Stop the bleeding (see hemorrhage) ; (*b*) keep wound clean ; (*c*) dress with cold water compresses ; (*d*) rest.

BURNS.—Douche with cold water ; apply cold applications or cover at once with flour ; dress afterwards with olive or salad oil.

BRUISES.—Cold applications, with lead lotion.

In all serious accidents, do not move the person, as movement robs him of his only chance. Send for the doctor.

FRACTURES.—Physical signs and symptoms, in general :—(*a*) Loss of power in the limb ; (*b*) pain and swelling at injured part ; (*c*) some distortion and irregularity ; (*d*) if the limb is pulled, it resumes its natural shape ; (*e*) if gently moved, a grating sensation (crepitis) may be felt ; (*f*) limb is movable. Note.—Some of these signs may be absent.

DISLOCATION.—(*a*) Occurs at joints ; (*b*) limb is fixed, not movable ; (*c*) no crepitis.

FRACTURE OF SKULL.—Unconciousness ; bleeding from the ears. *Treatment*—Rest in bed.

FRACTURE OF JAW.—(*a*) Irregularity ; (b) bleeding from the gums. *Treatment.*—Bandage around the jaw and head.

FRACTURE OF COLLAR-BONE.—(*a*) Pain ; irregularity ; (*b*) elbow supported by the other hand ; (*c*) head inclined to side of fracture. *Treatment.*—(*a*) Place patient on hard bed on his back, without a pillow ; (*b*) Put pad in the arm-pit, put on triangular bandage with elbow brought forward and close to the side.

FRACTURE OF ARM.—Several symptoms. *Treatment.*—Put padded splints back, front and each side with a bandage, and put hand in a sling, leaving the elbow free.

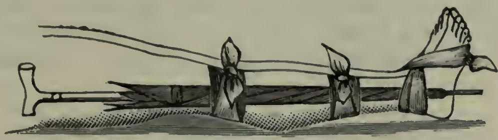
FRACTURE OF FORE-ARM.—Loss of power, pain, depression. *Treatment.*—Bend the fore-arm and keep the thumb upwards. Padded splint back and front with bandage, and put fore-arm in a sling.

FRACTURE OF HAND OR FINGERS.—Put hand on a well padded broad splint, and carry it in a sling.

FRACTURE OF RIBS.—Pain in breathing or coughing. Pressure of hand to prevent movement relieves pain ; short breathing ; crepitis. *Treatment.*—Envelope with a broad bandage or towel.

FRACTURE OF THIGH.—Usual signs. *Treatment.*—Long splint on the outside.

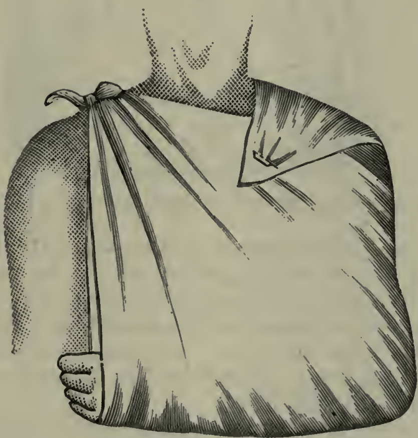
Fracture of Leg.—Any stiff material will do for temporary splints, as board, wood, wire netting, umbrella, card-board, tin, straw.



The fractured part should, before being put in splints, be placed in as natural a position as possible.

Sprains.—Rest ; cold applications.

Handkerchief Bandages.



Four-Cornered Bandage for the Arm.

Foreign Bodies in the Ear.—Syringe gently along the roof of the opening ; do not try to remove by probes.

Foreign Bodies in the Throat.—(*a*) Remove by forceps if in sight ; (*b*) emetics if moveable.

Foreign Bodies in the Nostrils.—Remove with wire loop or forceps.

Whitlow.—(*a*) Poultices of linseed or bran ; (*b*) keep arm raised ; (*c*) put in a sling.

Retention of Urine.—Hot bath.

Sore Nipples.—(*a*) Cleanliness ; (*b*) alum wash.

INSENSIBILITY CAUSED BY FAINTING, APOPLEXY, EPILEPSY, ALCOHOL, CONCUSSION OF THE BRAIN, OPIUM, POISONOUS GASES.—Fainting and epilepsy—*Treatment.*—(*a*) Lay the patient with head low ; (*b*) loosen the clothing ; (*c*) smelling salts ; (*d*) prevent the tongue from being bitten (epilepsy) ; (*e*) stimulants in fainting, excepting in case of hemorrhage ; (*f*) rest. Opium, poisonous

THREE-CORNERED BANDAGE FOR THE ARM

gases : (*see poisons*). Concussion of the brain : (*a*) keep patient quiet in bed ; (*b*) ice or cold applications to the head. Alcohol : (*a*) Give an emetic ; (*b*) castor oil ; (*c*) strong coffee ; (*d*) warmth. Apoplexy : The face becomes purple, breathing deep and blowing, eyes staring, pulse slow and full. *Treatment.*—(*a*) Raise the head ; (*b*) cold or ice to the head ; (*c*) mustard or linseed poultices to the calves of the legs ; (*d*) light food.

SORE EYES.—(*a*) Cold or ice application ; (*b*) solution of alum in water ; (*c*) if getting worse, see a doctor at once.

PILES.—(*a*) Apply hot poultice and alternate this with cold or ice applications ; (*b*) smart purge of epsom salts.

TYPHOID FEVER.—This is the commonest disease in Western Australia, and though it occurs most frequently in the crowded centres of population it also happens in the most remote. The principal causes are unhealthy and dirty surroundings, with overcrowding. It is spread most usually by means of the air, drinking water and milk. It commences with a feeling of lassitude and want of energy. This is followed by frontal headaches, pains in the back and limbs, loss of appetite, thirst, dry skin, sometimes diarrhœa or constipation, rigors and a few pinkest spots on the chest and abdomen, which come out in crops and last for a few days. In a favourable case, and under proper and early treatment, nearly every patient will get well in a few weeks. In the severe cases, vomiting and diarrhœa, become severe, the tongue becomes dry and brown, sleeplessness (with great restlessness), delirium, acute or stupid condition, delirium or delusions of a quiet kind, sometimes hemorrhage from the bowels, inflammation of the lungs, swollen leg with pain in the groin. High temperature; a thermometer should always be in use. *Treatment.*—(*a*) Put patient in bed in large cool room, with two beds if possible; (*b*) give three pints of milk, with water, during the 24 hours, and one pint of clear soup, ice or cold water to suck; sponge the body twice a day; (*c*) keep food and medicines in another room; (*d*) do not taste food before the patient. (1) Headache may be relieved by ice or cold applications to the head, with mustard poultice to nape of neck. (2) Vomiting: Give ice to suck, and small doses of food; mustard or poultices to stomach. (3) Diarrhœa: Peptonised milk, with lime water; alum whey, instead of milk; add one tea spoonful of alum to pint of boiling milk and skim off the whey. (4) Tongue when dry and brown should be cleaned with lemon juice, and ice to suck. (5) Sleeplessness: (*a*) Ice to head, mustard leaf to nape of neck; (*b*) cold sponging. (6) Delirium: See sleeplessness. (7) Hemorrhage: (*a*) Binder round the abdomen; (*b*) small doses of alum whey or peptonised milk; (*c*) stop stimulants, for a time, at least; (*d*) 30 drops of laudanum at once. (8) Swollen legs: (*a*) Keep the leg warm with hot bottles, and envelope in wool; (*b*) Rest in bed until quiet well. (9) High temperature: (*a*) Sponge the body with warm water, and then use ice or ice water. When convalescent the patient should remain in bed 10 days after the temperature is normal in the evening, and should, after that time, get a little custard. If the temperature keeps normal the food may be increased very slowly. The temperature should be taken every night, as relapses are very common.

TO AVOID TYPHOID FEVER.—(*a*) Boil all drinking water, or use a Chamberland-Pasteur filter; (*b*) avoid drinks of any sort (ice-creams, milk) unless satisfied that they are pure; (*c*) take milk only from persons who study cleanliness and have healthy cows; (*d*) wash thoroughly all vegetables and fruits; (*e*) keep your house and premises clean, and study personal cleanliness; (*f*) apply equal parts in saw-dust and lime to the closet pan; (*g*) see directions on disinfectants for those suffering from typhoid fever.

ASTHMA.—Loosen the clothing; apply mustard to the chest; foot baths; give a purge.

CROUP.—(*a*) Generally occurs in children; (*b*) usually at night time the child wakes up gasping for breath. *Treatment.*—(*a*) Emetics, as one teaspoonful wine of ipecacuanha in warm water every quarter of an hour until vomiting comes on; tickle back of throat; (*b*) apply sponge wrung out of *boiling water* to the throat; (*c*) smart purge; (*d*) keep the room warm; (*e*) steam the room.

SORE THROAT.—All cases of sore throat should be considered suspicious, on account of diphtheria. Diphtheria commences with whitish grey spots on back of throat. *Treatment.*—For ordinary sore throat: (*a*) Use a gargle of alum; (*b*) poultices to throat.

CONVULSIONS.—Occurs in children; (*a*) put in warm bath; (*b*) give a smart purge of castor oil; (*c*) if due to food, give an emetic.

COLIC, OR GRIPES.—(*a*) Linseed poultices to abdomen: (*b*) chlorodyne, 30 drops, and repeat in two hours, if necessary; (*c*) capsicum, ginger, eucalyptus, 15 drops; (*d*) castor oil.

DIARRHŒA.—(*a*) See treatment for colic; (*b*) milk diet. This does not apply to diarrhœa in children, which requires a doctor.

PAIN.—(*a*) Heat, as poultices; (*b*) rest; elevation.

VOMITING—(*a*) Small doses of milk; (*b*) ice to suck; (*c*) mustard, bran, or linseed poultices to the stomach; (*d*) fresh air.

CONSTIPATION AND INDIGESTION.—(*a*) Active exercise, especially riding; (*b*) green vegetables, and fruit; (*c*) oat-meal; brown bread; (*d*) Hot water before breakfast; (*e*) small doses of epsom salts in hot water before breakfast; (*f*) regularity in meals; (*g*) regularity in going to stool; (*h*) well made coffee or tea; (*i*) olive or olive oil fat.

DISINFECTANTS.—(*a*) Sulphur fumes for rooms; (*b*) boiling or steam for clothes; (*c*) rags should be burnt; (*d*) chloride of lime about the rooms; (*e*) excreta should be burnt or put in solutions of carbolic acid, sulphate of iron, condy's fluid, corrosive sublimate.

S. W. Kilgore

CHAPTER XVII.

USEFUL FACTS AND FIGURES AND RECIPES.

CULLED FROM VARIOUS SOURCES BY THE EDITOR.

HOW TO MAKE AXLE GREASE.—The recipe given here for this purpose is that of "Booth's axle grease." The following are the directions given in the original patent: Dissolve $\frac{1}{2}$ lb. soda in 1 gallon of water; add 3 lbs. of tallow and 6 lbs. palm oil, (or 10 lbs. palm oil only); heat them together to 200 or 210 deg. F.; mix, and keep the mixture constantly stirred till the composition is cooled down to 60 or 70 deg. F. A thinner composition is made with $\frac{1}{2}$ lb. soda, 1 gallon of water, 1 gallon of rape oil, and $\frac{1}{4}$ lb. of tallow or palm oil.—*Trade "Secrets."*

BALLS FOR REMOVING GREASE AND PAINT SPOTS FROM CLOTH, ETC.—Fuller's earth, 30 parts; French chalk, 1 part; yellow soap, 20 parts; pearlash, 15 parts. Make into a paste with spirits of turpentine, give a slight color with a little yellow ochre, and then cut it into cakes. This form, omitting the French chalk, is that which is so very generally sold about the streets.—*Trade "Secrets."*

BOOT BLACKING.—The following is a formula for a blacking without sulphuric acid: Bone black, 4 oz.; molasses, 2 oz.; vinegar, $\frac{3}{4}$ pint; spermaceti oil, a teaspoonful. The bone black must be very finely ground, and the oil is first mixed with it. The molasses are then added, and lastly the vinegar. If the ingredients are of the best quality, this blacking will be found exceedingly good. The addition of oil to the blacking tends to soften and preserve the leather, but if too much be added, it increases the difficulty of getting a good "shine." The oil chosen should be some cheap, non-drying fat oil. Coarse neatsfoot oil is often used, and would be preferred if it could always be had cheaply.—*Trade "Secrets."*

BEESWAX, PREPARING.—Separate the better part of the comb from the brood portion as much as possible when you are draining the honey. When drained, boil the comb in water, stirring frequently to prevent its burning. When completely melted, strain through bags (hair bags are the best) into a tub of cold water. Repeat this operation twice, or even thrice, and through bags increasing in fineness. Finally, melt the wax by itself, and pour into moulds of desired shape, first wetting them. Cool in a warm room until the cakes solidify. This will prevent their cracking in the middle. Another plan, and more simple, is to place the combs in a conical earthenware vessel filled with a mixture of one ounce of nitric acid to a quart of water. Set this upon an open fire and stir until the wax be completely melted, then remove it and allow it to cool gradually. The product will be in three almost distinct layers ; the upper one will be pure wax, in the middle will be sufficiently good wax to be added to the next melting, or for many household purposes, and the lowest layer will be chiefly impurities.—*Australasian Farmers' Guide.*

Device for Leading a Cow.—Mr. J. W. Gilman, Kearney Co., Neb., gives an arrangement of the halter for the easy leading of cattle that are inclined to hang back. He writes : " I learned the method from a young Dane in my employ. I had two cows, neither of which would lead with any degree of comfort ; to lead them both at once was out of the question. One day I noticed the Dane

leading them with as little trouble as if they were well broken horses. This ease in leading was due to his taking a half-hitch in the halter around an ear of each cow in such a way that it would not slip off. This idea has been worth a great deal to me." To those who have tugged and worried over a cow that would not lead at the halter this hint will be welcome. The engraving shows the manner of making the half-hitch of the halter about the animal's ear.—*Australasian.*

Capacity of Carts and Barrows.—An ordinary cart 6 ft. long, by 3¼ ft. wide, and 2½ ft. deep will hold 45 cubic ft., or about 2½ tons of clay ; a dobbin-cart will hold ¾ yds., cubic ; an earth-waggon, small, 2 yds., cubic ; ditto, large, 3 yds., cubic ; wheel-barrow, heavy, one-tenth yd., cubic ; ditto, ordinary, one-fourteenth yd., cubic.

Concrete.—Materials to 1 cubic yd. of concrete. (1.) Proportions—Lime or cement 1 ; sand, 2 ; clean shingle, 6. Require—Shingle, etc., 27 cubic ft.; sand, 9 cubic ft.; cement, etc., 3.51 bus.; water, 25 gals.

(2.) Proportions—Lime or cement, 1 ; gravel or ballast containing $\frac{1}{3}$ part sand, 7 ; ballast, etc., 33 cubic ft. Require—Lime or cement, 3.67 bus.; water 30 gals.

(3.) Proportions—Portland cement, 1 ; gravel or ballast, 10. Require—Ballast, etc., 33 cubic ft.; lime or cement, 2.49 bus.; water, 30 gals.

The proportions marked (1.) and (2.) are those usually adopted in the best foundations.

The concrete in Portland cement, marked (3.) is generally used in filling, and may be also used as foundations for light buildings.

Tar Concrete requires, per cubic yard, about 12 gals. of coal-tar, and from 10 to 20 lbs. of pitch, according to the thinness of the tar.

The size of the stone may vary from $\frac{1}{4}$ to $2\frac{1}{2}$ inches in diameter according to the thickness or purpose for which the concrete is intended.

Portland cement varies in weight from 108 to 120 lbs. per bushel. Fineness and weight indicate good quality.

A bushel of lime weighs 70 lbs.

Change of Seed.—It is found that, if the farmer continually uses seed of his own growing, his crops deteriorate in a few years, while fresh seed, if judiciously selected, will yield good crops. A change should always be made, if possible, from an earlier district or a better soil. At the same time, much improvement may be made by a more rigid selection of home seed. Major Hallet developed his well-known varieties by careful selection of the best grains year after year, without changing, and the same principle might be applied by farmers to their ordinary crops. Select the best part of the field when growing, let it ripen well, harvest carefully, and afterwards dress the grain over two or three times with the most suitable dressing machine, so only the very best grain be retained. If this system is persevered in, a better crop will result than from a perpetual change of seed.—*McConnell's Agricultural Note Book.*

Cross Fertilization.—In order to produce a variety of plant which shall combine the good characteristics of two separate kinds, the system of cross breeding has been largely practised, especially with wheat. On one of the selected parent plants the glumes are opened and the anthers removed some time before the latter are ripe. When the pollen is ripe for shedding in the other parent plant, it is dusted over the feathery stigmas of the young germ in the plant first operated on, the glumes closed, and the heads tied up in muslin, to protect from birds, etc. The operation requires much careful manipulation, and the delicate organs must not be exposed to the weather, while it requires to be done early, as self-fertilization naturally takes place inside the glumes some time before the empty anthers are pushed outside. Cross-bred varieties are now common. —*McConnell's Note Book.*

COMPARATIVE EVAPORATIVE POWER OF SOILS.—Grains of water evaporated in four days :—

Calcareous sand	146 grs.	Heavy black turf soil	128 grs.
Light garden mould	143 ,,	Fine white clay	123 ,,
Very light turf soil	132 ,,	Fine grey clay	123 ,,
Arable soil	131 ,,		

McConnell's Note Book.

CEMENT FOR MENDING.—A very good cement consists of plaster of Paris, mixed with a solution of gum arabic to a thinnish paste. The cement is beautifully white, and will join two pieces of china or crockery very firmly, but as it sets in a few minutes, it would form a solid, useless mass as soon as bottled.—*Trade "Secrets."*

DIAMOND CEMENT.—Soak ½ oz. of isinglass in 4 ozs. of water for 24 hours; evaporate in a water bath to 2 ozs., add 2 ozs. rectified spirit (alcohol of 85 per cent.), and strain through linen. Mix this solution while warm with a solution of the best gum mastic in 2 ozs. alcohol; add 1 drachm powdered gum ammoniac, and triturate together until perfectly incorporated, avoiding loss of the alcohol by evaporation as much as possible.—*Trade "Secrets."*

WATERPROOF CEMENT.—The following is an old and tried recipe :—Take ale, 1 pint; best Russian isinglass, 2 ozs.; soak in a close vessel for 12 hours, and then put them into a common glue kettle and boil until the isinglass is disolved; then add 4 ozs. of the best common glue, and disolve it with the other; then slowly add 1½ ozs. of boiled linseed oil, stirring all the time while adding, and until well mixed. When cold it will resemble india rubber. When you wish to use this, dissolve what you need in a sufficient quantity of ale to have the consistence of thick glue. It may be used for earthenware, china, glass, or leather for harness, bands for machinery, cloth belts for cracker machines for bakers, etc. If for leather, shave off as if for sewing, apply the cement with a brush while hot, laying a weight to keep each joint firmly for 6 to 10 hours, or overnight.—*Trade "Secrets."*

CURING BIRD SKINS.—One general observation applies to the preservation of all skins, which is, they must be made perfectly dry, so the sooner they are exposed to a free current of air the better; and unless they are speedily and thoroughly dried the skin will become putrid and rotten, and the hair or feathers will consequently fall off. If a skin be properly dried soon after it is killed, it will keep a considerable time without any preservation whatever, only it will be more liable to be attacked by insects afterwards. If a large bird like the swan be skinned, as much as possible of the fat should be scraped off with a blunt table-knife or palate-knife, and a quantity of chalk applied, which, when saturated with the oily matter, should be scraped off and a fresh supply used, after which a much larger proportion of the preserving soap should be applied than in other birds which are not fat. If, however, the oil should get on the feathers, dilute a little ox gall with water, and apply it with a sponge, washing with pure water immediately afterwards. The following is a recipe for making arsenical soap. We have kept skins free from insect attacks in an open box for nearly twenty-four months by its means :—Take arsenic, $\frac{1}{2}$ lb. ; camphor, $1\frac{1}{4}$ ozs. ; white soap, $\frac{1}{2}$ lb. ; salt of tartar, 3 ozs. ; and powdered lime, 1 oz. ; cut the soap in small thin slices, put into a crucible with a small quantity of water, hold over a gentle fire, and stir frequently with a wooden spatula. When properly melted the powdered lime and salt of tartar may be added, and thoroughly mixed. Now take it off the fire and add the arsenic, gently stirring all the time. Reduce the camphor into a powder in a mortar, with the addition of a little spirits of wine. The camphor may now be added, and well mixed with the composition whilst off the fire, to assist in incorporating the ingredients, but do not heat it too much, as the camphor will escape rapidly. It may now be poured into small earthenware pots, and allowed to cool. This composition, if well made, will be about the thickness of ordinary flour paste. When you use it, put as much as you imagine you will require into a small shallow pot, adding an equal proportion of water. Apply the lather. with a bristle brush, using first of all some solution of corrosive sublimate to the rump, inside wings and legs, head, &c. Keep the composition as close as possible, as it is a deadly poison.—*Australasian Farmer.*

Digging.—To dig with a spade an acre of land, from 9 to 12 inches deep, a man will take from 14 to 21 days in recently moved soil. If old lea, will take, in some cases, double the time.—*McConnell's Note Book.*

Dumoulin's Liquid and Unalterable Glue.—This is one of the oldest forms, and one of the best. It is prepared as follows : —Soak 8 ozs. of best glue in half-pint of water in a wide-mouthed bottle, and melt by heating the bottle in a water bath. Then add slowly $2\frac{1}{2}$ ozs. of nitric acid, spec. gr. 1·330, stirring constantly. Effervescence takes place under escape of nitrous acid gas. When all the acid has been added the liquid is allowed to cool. Keep it well corked, and it will be ready for use at any moment. It does not geletanise, or putrify, or ferment. It is applicable to many domestic uses, such as mending china, wood, &c. An iron pot cannot be used in making this liquid glue, as the acid would act on the metal. Glass or earthenware must be used.—*Trade "Secrets."*

Excavation—Ten Hours Work of a Laborer.—Hacking ground with a pick, and thinning out ready for removal—Compact vegetable earth, 22 cubic yds. ; loamy clay, 16 cubic yds. ; stiff clay, 10 cubic yds.; hard gravelly soil, 7 cubic yds.; chalk, 5 cubic yds.

Note.—In narrow trenches, as for drains, &c., deduct one-third. Digging soft ground for agricultural purposes, from 8 to 10 inches deep, 220 sup. yds. One ton of—Sand, river, 20 cubic ft.; sand, pit, 21 cubic ft.; gravel, coarse, 19 cubic ft.; clay, stiff, 19 cubic ft.; coal, 45 cubic ft.; earth mould, 32 cubic ft.—*Spons' Engineers' Tables.*

ESTIMATED PERCENTAGE OF ELEMENTARY SUBSTANCES IN THE EARTH'S CRUST.

1.	Silica	53·0	7.	Carbonic anhydride	7·5
2.	Alumina	19·0	8.	Iron oxides ...	
3.	Lime	6·3	9.	Sulphuric anhydride	
4.	Magnesia	5·8	10.	Chlorides	
5.	Soda	2·5	11.	Other bodies ...	3·5
6.	Potash	2·4			

—*McConnell's Note Book.*

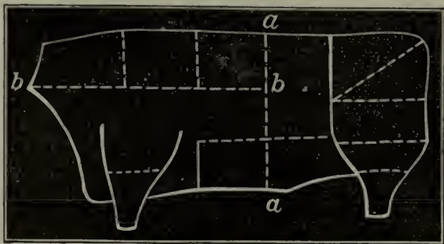
FLY PAPERS.—Of the sticky papers, the best are coated with artificial bird lime, prepared by boiling any vegetable oil with a little resin. Rapeseed oil, linseed oil, or any of the cheap oils answer well. After the resin and oil have been compounded, they may be made into a sort of emulsion with a little honey or molasses. The following formula gives good results: resin, 1 lb.; raw linseed oil, 1 lb.; molasses, 4 oz. Melt the resin, add the oil little by little, and while still warm beat up with the molasses. The poisonous fly papers are not open to the objection of being sticky, and if well dried will keep indefinitely. Cooley gives the following formula: Treacle (molasses), honey, or moist sugar, mixed with about 1-12th of their weight of orpiment (yellow tersulphide of arsenic). Paper to be soaked in the mixture, dried and cut into suitable pieces, which are to be laid on a plate containing a little water. The water dissolves the mixture, bringing it back to the former condition of a syrup, which the flies drink with great eagerness. Fortunately there are other substances which have a very disagreeable taste to human beings, and are not poisonous to them, and yet are quite attractive and fatally poisonous to flies. Redwood's formula for such a liquid is: Small quassia chips, ¼ oz.; water, 1 pint; boil 10 minutes, strain, and add 4 oz. of molasses. Flies will drink this with avidity, and are soon destroyed by it. It may also be employed to saturate paper, which may be used as previously directed. —*Trade "Secrets."*

FURNITURE CREAM.—(1) Soft water, 1 gall.; soap, 4 oz.; beeswax in shavings, 1 lb.; boil together and add 2 oz. of pearl-ash. To be diluted with water, laid on with a paint brush and polished off with a hard brush or cloth. (2) Wax, 3 oz.; pearl-ash, 2 oz.; warm water, 6 oz.; heat them together and add 4 oz. of boiled oil and 5 oz. of spirits of turpentine. (3) The name is sometimes given to a mixture of 1 oz. of white or yellow wax, with 4 oz. of oil of turpentine.—*Trade "Secrets."*

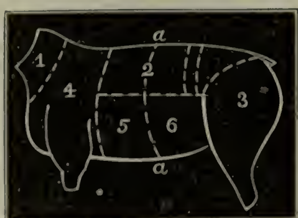
Good Paste for Paper-hanging is made of old flour, mixed to a milk-like consistency with water. When put in the saucepan to boil, a little size or glue may be added, which will increase its tenacity. A little alum may also be added to paste in order to cause it to spread more freely. This ingredient has the property of keeping paste sweet and wholesome, and it is generally used in the thicker kinds of paste (such as shoemakers' paste) partly for this purpose. The paste when boiled should be of the thickness of ordinary gruel, and must be laid on the paper smoothly and equally with backward and forward strokes of the brush.—*General Building Art and Practice.*

Harness Dressing.—The English Government harness dressing is said to be prepared as follows ; 1 gall. of neatsfoot oil, 2 lbs. of bayberry tallow, 2 lbs. of beeswax, 2 lbs. of beef tallow. Put the above in a pan over a moderate fire. When thoroughly dissolved, add 2 quarts of castor oil ; then, while on the fire, stir in 1 oz. of lamp black. Mix well, and strain through a fine cloth to remove sediment ; let cool. A composition which not only softens the harness but blackens it at the same time, is made as follows ; Put into a glazed pipkin 2 oz. of black resin, place it on a gentle fire ; when melted, add 3 oz. of beeswax ; when this is melted, take it off the fire, add ½ oz. fine lampblack, and ½ dr. of Prussian blue in a fine powder ; stir them so as to be perfectly mixed, and add sufficient spirits of turpentine to form a thin paste ; let it cool. To use it, apply a coat with a piece of linen rag pretty evenly all over the harness, then take a soft polishing brush and brush it over, so as to obtain a bright surface. Blacking for harness : Molasses, ½ lb. ; lampblack, 1 oz. ; yeast, a spoonful ; sugar candy, olive oil, gum tragacanth, and isinglass, of each 1 oz., and the gall of an ox. Mix with 2 pints of stale beer, and let it stand before the fire for an hour.—*Trade "Secrets."*

Killing Quiet Cattle.—A rope being passed over the horns or head of the animal, it is drawn tight to a ring in the floor of the slaughter-pen, or to other strong fixture that may be available. A sack or something else is thrown over the eyes, and a broad, sharp chisel, held in the hand by means of a rope or withe, as a blacksmith holds a swedge, is driven into the vertebræ just behind the skull, and a sudden blow with a maul drives it between the bones and into the spinal cord. This blow instantly paralyses the victim. The throat is then cut clean across, to divide both the vein and artery, and the animal bleeds very quickly. Taking off the Hide and Cutting up.—After it has bled the beef is turned upon its back, and the skin is ripped from the throat over the brisket down to the thighs, and then up the thighs to the hock-joints ; it is also ripped up the fore-legs to the knee. These joints are then severed and separated, taking care not to cut the sinew at the back of the hock, by which the carcase is to be hung up. The skin is stripped down as far on the sides as need be. The carcase is then opened, the brisket is sawn through, and a stick put in to hold it apart. The internals are then taken out, received in a large tub, and set aside. The carcase is then hoisted up, the skin wholly stripped off, and the head cut off. The skin is laid on one side for the present. The carcase is then drenched with a few pails of cold water, and is divided down the backbone with a saw, and possibly an axe; unless the axe is very sharp a cleaver is the best thing to use. The



sides are then left to cool and set. This is a point which is often neglected, and the meat consequently may not keep, and is tough and hard. When the meat is firm and quite cooled it is cut up, being first divided, as on the line from *a* to *a*, figure 1. The fore-quarter is laid on a strong bench, and is divided across on the line *b* to *b*. The upper parts may be cut for roasts and the shoulder into steaks, or, with the brisket, into salting pieces. The flanks and belly are suitable for salting, and the loins for roasts and steaks. The three-cornered pieces in the rump make steaks, the thigh is called the round, and makes steaks and a very fine salting piece, and the knuckles are fine for soup pieces. When thus divided, the meat is saleable, and what is not sold can be salted down for corned beef. For domestic use the larger pieces can be divided again, and the most of the pieces can be corned and barrelled. If dried beef is desired, it is taken from the lower part of the leg of the beef, which is a wedge-shaped piece, and is lightly salted, with some sugar and spice added, and then smoked.



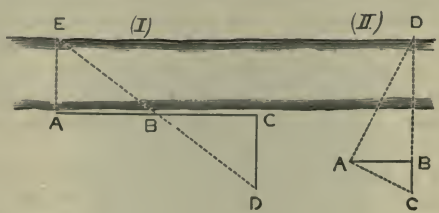
A sheep is killed by laying it upon a bench, with the head projecting over the edge, and cutting the throat quite through. When it has bled it is hung up, and the skin removed. As soon as the belly is clear, the carcase is opened, and the offal is taken out at once. If this is not done quickly the meat will have what is called a "wool taste," from the absorbtion of the gasses from the intestines. The carcase is divided into quarters by cutting or sawing down the back, and by dividing the halves of line *a* to *a*, as in figure. If the saddle is cut out, it is taken before the carcase is divided into halves down the back, this piece being the two loins marked 2, and not separated. This is the choice roast of the mutton. Otherwise the leg is cut off, as marked by the dotted lines 3, the neck is cut off at 1, and the shoulder at 4; at 5 and 6 are the flanks used for stewing. The neck is regarded as the best piece of the mutton for soup. The mutton ham (3 in the illustration), trimmed nicely, salted and smoked, is good enough for anybody, and they ought to be plentiful in Australia. The English mode of cutting up a carcase of mutton is by many preferable to the Scotch or American. The leg is cut short like a ham, and the shoulder-blade—the scapular region of the anatomist—is removed entire. This piece makes an excellent roast; of the neck piece, the fore-part is fitted for boiling and soup, and the hind-part for roasting and chops. The breast is left bare on removing the shoulder, and the ribs, called spare ribs, are roasted, broiled, or corned along with the brisket. The back end of the breast makes a good roast; but for this purpose the loin is the favorite cut; when removed double, forming the chine or saddle, it may grace the table of a public dinner. The leg is roasted or broiled, but when cut long, taking in the hock-bone, it resembles a haunch of venison, and is roasted accordingly.—*McKay's Australian Agriculture.*

Live and Dressed Weight of Cattle.—Messrs. Swan, of Edinburgh, the well-known cattle dealers, write as follows regarding the proportion of beef netted to the live weight of cattle:—"We should say that well-finished two-year-old cattle will yield 60 lbs. to 62 lbs. of beef per 100 lbs. live weight. The primer the quality and the younger the animal the more beef is given. For a finished three-year-old bullock we should say 58 lbs. to 61 lbs. of beef per 100 lbs. live weight. We calculate that fat cattle generally yield 55 lbs. to 58 lbs., according to quality. In weighing them alive, in order to get at the dead weight, they should be fasted twelve hours, or, if weighed full, or after being fed and watered, a reduction of 5 per cent. on this account should be taken from the gross live weight."—*Australasian Farmer.*

Measuring a Hay Stack.—To the height in feet from the ground to the eaves add one-half of the height of the top above the eaves for the mean height. Then multiply the mean height by the breadth, and multiply their product by the length. Divide the gross product by 27, and the dividend will give the number of cubic yards in the stack. The difference between old and new hay is not the only point to be considered. The size of the stack, especially its height, the nature of the crop, and its condition when put together, are important points. The only satisfactory plan is to cut a truss representing an average half or quarter of a cubic yard, weigh it, and from that calculate the total weight.—*Australasian Farmer.*

Making Hop Beer.—The following is a recipe for 10 gallons hop beer: 10 lbs. sugar, 10 gallons water, 4 ozs. hops, a pinch of isinglass, a few rasins, two large bottles of porter, or a pint of yeast! take four gallons of water and boil it with the sugar and hops for one hour, then strain into a tub and put the hops on again in a little more water, and boil for half an hour; then strain into the tub, and then into a cask with a piece of muslin over the funnel to prevent the seeds going through; then fill up with cold water, which will make the 10 gallons. It must be filled up every morning for four days with cold water; and the day before bottling a pinch of isinglass dissolved in a little of the beer warmed is a great improvement to clear it. Of course you put the yeast or porter in after you fill the cask; then, also, add the rasins. If bottled on the fifth day it is nearly ready for drinking.—*Australasian Farmer.*

Mensuration and Levelling.—Computation of acreage.—Divide the enclosure into convenient triangles; multiply the base (in links) of each triangle by its perpendicular height, and divide by two: this gives area in square links; point off five figures to the right (= dividing by 100,000, the number of square links in an acre), which gives acres and decimal fraction. Repeat the process for each triangle, and add together. Multiply decimal fraction by four, point off five figures, leaves roods; multiply fraction left by 40, point off five figures, leaves poles with decimal fraction. To set off a right angle with a chain only.—Measure off 40 links on the ground along the base-line; then take 30 for the perpendicular, and 50 for the hypothenuse; by fastening the extremities of these last 80 links at the ends of the base, and pulling the chain tight, we have a right-angle triangle.



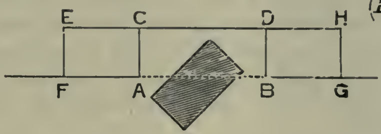
Inaccessible Points.—(1). Start from A (exactly opposite to E) and go to B; continue to C, making B C = A B; erect C D perpendicular to A C, and find D in a line with B and E: C D = A E.

(2). Take B A at right angles to C D; draw A C perpendicular to A D; then A B : B D :: C D : B A.

Obstacles in Chaining Lines.—(1). If the obstacle can be seen over :—Erect two perpendiculars (A C and B D) of equal length at A and B ; then C D = A B.

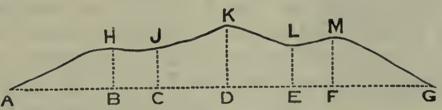
(I)

(2). If the obstacle cannot be seen over :—Lay off A C and E F, equal to one another, and at right angles to A F ; range the points D and H in line with E C, and set off B D and H G at right angles to E H, and each = E F or C A ; then C D = A B, and B and G are points for ranging the continuation of F A.



(II)

To Measure the Area, where Boundary Irregular.—Lay off a base line, A G, and measure offsets to the various bends and angles of the boundary line, and at right angles to the base : this divides the enclosed space into approximate triangles and trapezoids. The area of the triangles is calculated in the usual way ; for the trapezoids the average of the two sides is taken and



multiplied by the base : thus, area B C J H = $\frac{BH + CJ}{2}$ × B C ; and similarly for the rest : the sum of the whole= area A G M K H.—*McConnell's Note Book.*

Miscellaneous.

Weight of Plough Harness.

Collar	15 lbs.
Haims, iron-plated and straps ...	7 ,,
Bridle	$4\frac{1}{2}$,,
Backband	$3\frac{1}{2}$,,
Chains	8 ,,
Total	38 lbs.

A bricklayer's hod carries 16 bricks, or $\frac{1}{2}$ bushel of mortar, or $\frac{2}{3}$ cub. feet.

A bricklayer should lay from 100 to 150 bricks per hour, according to the nature of the work.

Mortar : 100 of lime contains 25 striked bushels = 100 pecks. One ton = 32 bushels.

Eighteen heaped = 22 striked bushels = 1 cub. yard = one load of sand.

Two and a half to five parts of sharp, clean sand to one of lime for mortar, according to quality of lime.

Or, 1 of lime to 2 of sand and 1 of blacksmith's ashes.

Coarse mortar = 1 of lime to 4 of coarse gravelly sand.

Concrete = 1 of lime to 4 of gravel and 2 of sand.

One load of mortar = 1 cub. yard.

One load of sand = 1 cub. yard.

A road of brickwork requires from $1\frac{1}{2}$ to 3 loads of mortar.

Portland cement : A bushel of cement weighs 67 lbs., and a barrel is 5 bushels ; a bag is 3 bushels, and a sack is 5 bushels.

Equal parts of cement and sand are used for building purposes.

Portland cement concrete for floors or walls : 1 of cement to 6 or 7 of broken stone, mill cinders, burnt ballast, shingle, gravel, or slag ; must be from loam, mud, fine sand or dirt of any kind ; moulds to be soaped.

Roman cement, only one-third the strength of the above.

Mastic cement is 1 of red lead to 5 of whiting and 10 of sharp sand, mixed with boiled linseed oil.

One yard of reduced brickwork requires about $2\frac{1}{4}$ bushels of equal parts of Portland cement and sand.

One square yard of plastering with cement requires three-fourths of a bushel.

Concrete walls should be raised only 18 in. per day.

Plastering : 1 cub. yard of lime, 2 yards of sand, and 3 bushels of hair will cover 75 sup. yards on brick, or 70 yards on lath.

One bundle laths and 500 nails will cover $4\frac{1}{2}$ yards sup.

—*McConnell's Note Book.*

Mortar—Lime, as used for building purposes, is obtained from several of the varieties of stone, marble, and chalk, termed limestones. It is prepared by burning or calcining the stone, thus drawing off the carbonic acid in which it abounds. After calcination it is reduced to a white powdery material, which greedily takes up the water ; it is then known as quick-lime. In making mortar, fresh burned lime is taken from the kiln, and laid in a heap in a convenient place, and, sprinkling a quantity of water on it, the lime begins immediately to crack and fall down, steam issuing from the heap in considerable quantities, a high degree of heat being at the same time induced. On the completion of the process of decomposition, the lime is reduced to an impalpable powder, which goes by the name of 'slacked' or 'slaked' lime. The slacked lime thus obtained is next to be well mixed with water, forming a paste, and, afterwards, have the proper proportion of sand added—two-thirds sand to one-third of lime. The sand used in mortar-making is of three kinds—pit sand, river, and sea. The first is obtained in pits; the latter from rivers and sea-shore. River water is the best to use for mortar, but all waters known as mineral are to be avoided, The sea sand should never be used, if it can be at all avoided, as walls built with mortar prepared from it are very likely to be damp. Mortar thus prepared sets very soon on being exposed to the atmosphere, but it is by no means calculated to stand under water, or in very moist and damp situations. Where mortar is required for such work, hydraulic mortar or hydraulic cement must be used. Clay, burned and mixed with lime, will enable the lime to withstand, to a certain extent, the action of the water. Where a rich lime is obtainable, a hydraulic lime may be made by mixing twenty parts of dried clay to eighty of the lime. Coal cinders ground to a powder and mixed with lime make a mortar which will be useful in wet or damp situations.—*Handbook of the Mechanical Arts.*

Pickling Eggs.—Take a bushel of lime, 2 lb. of salt, ½ lb. of cream of tartar, and water sufficient to form a solution strong enough to float an egg. It is claimed that eggs may be preserved in this liquid for two years. The following has had strong claims made for it: The fresh eggs are carefully placed in a mixture of 5 kilogrammes of alum, dissolved in 5 litres of water, heated to from 45 to 50 deg. C., and left in that liquid for from 30 to 40 minutes; the eggs are next drained, and in the meantime the solution of alum is heated to a boiling point. The eggs are again immersed in the liquid, and kept therein for from 10 to 15 seconds; after having been drained and cooled, they are packed in either dry bran, sawdust, corkdust, sifted ashes, or cotton wool. We give the following as one that will satisfy the most exacting stickler for a complicated formula: Dissolve in 1 gall. of water 12 oz. of quicklime, 6 oz. common salt, 1 dr. soda, ½ dr. saltpetre, ½ dr. tarter, and 1½ dr. borax. The fluid is brought into a barrel, and a sufficient quantity of quicklime to cover the bottom is then poured in. Upon this is placed a layer of eggs; quicklime is again thrown in, and so on until the barrel is filled, so that the liquor stands about ten inches deep over the last layer of eggs. The barrel is then covered with a cloth, upon which is also scattered some lime.—*Trade "Secrets."*

Paints.—If it is of importance that the paint should dry quickly, and still have a bright appearance, it should be mixed with turpentine, and some gold size added when mixed. If it is wished to make a paint to dry in twenty minutes or half an hour, it must be mixed with turpentine, and without oil. When dry this paint will have a very dead, lustreless appearance, and requires a coat of varnish afterwards to make it look as it ought. This is a method very often adopted for iron-work. When about to re-paint old work, all dirt and projecting pieces must be carefully removed, and if the paint appears greasy it should be washed with turpentine.

Sometimes a good washing with weak tea water, made by pouring boiling water on tea leaves that have been already used for making tea, will prove effectual. Whenever pieces of paint have come away through sun blisters, or other causes, the patches must be painted over with a coat of priming. All the effects must be stopped and made good with putty, when the new coat may be applied. Table of compound colors produced by mixing simple colors.—Straw color: Chrome yellow and white lead. Lemon color: Chrome yellow and white lead; more of the first than in straw color. Orange: Chrome yellow and vermilion (bright), yellow ochre and red lead (duller). Buff: White lead and yellow ochre. Cream color: Same as for buff, but with more white. Gold color: Chrome yellow, with a little vermilion and white lead; or Naples yellow and realgar. Stone color: White lead and yellow ochre, with a little burnt or raw umber. Stone color (grey): White lead and a small quantity of black. Drab: White lead, burnt umber, and a little yellow ochre (warm); white lead, raw umber, and a little black (cool). Flesh color: Lake, white lead, and a little vermilion. Fawn color: Same as for flesh color, with stone ochre instead of lake. Peach color: White lead, with vermilion, Indian red, or purple brown. White lead: Prussian blue, and a little lake. Olive: Black, yellow, and a little blue; or yellow, pink, lamp black, and a little verdigris. Chestnut: Light red, and black. Salmon color: Venetian red, and white lead. Chocolate: Black, with Spanish brown, or Venetian red. Sage green: Prussian blue, raw umber, and a little ochre, with a little white. Olive green: Raw umber, and Prussian blue. Pea green: White lead, and Brunswick green; or white lead, Prussian blue, and some chrome yellow. Pearl grey: White lead, with a little black, and a little Prussian blue, or indigo. Silver grey: Same as for pearl grey. Grey (common): White lead, and a little black. Lead color: White lead, with black or indigo. Violet: Vermilion. white lead, and indigo, or black. Purple: Violet, as above, with the addition of a rich, dark red, or colors for French grey. French grey: White lead, with Prussian blue and a little lake. Lilac: Same as for French grey, but with less white. Oak color: White lead, with yellow ochre and burnt umber. Mahogany color: A little black, with purple brown or Venetian red.

Operations in Process of Staining Wood.—The process consists of three distinct operations: first, staining; second, sizing; third, varnishing. The wood should be rendered as smooth and even as possible with the plane, and all knots covered, and nail holes filled, by mixing a little of the stain with plaster of Paris till it assumes the consistency of paste; sappy portions of the wood should be damped with water. The stain may then be laid on plentifully with a brush along the grain of the wood. When the wood is thoroughly dry, it must be twice sized, using each time a very strong solution of size. The size must be dissolved in hot water, in the proportion of 1 lb. to a gallon of water. The amateur is cautioned against using size stronger than this, and he must remember not to work his brush up and down when charged with size, for this, when the size is too strong, often produces a lather on the wood. The best way to apply size is to use it warm, and work the brush in one direction only, namely, from top to bottom or from one side to the other, as may be necessary. If an interval of twenty-four hours be left after staining, before sizing, the color is softer and richer. As the beauty of the result depends mainly upon the grain of the wood, well-seasoned wood of beautiful figure and variety in the grain should be selected for choice work. When the second coat of size is thoroughly dry, the work must be varnished. When the wood is to be French polished, it should be only sized once before applying the polish. Exterior work should be sized once, and varnished twice ; and for rough work, boiled oil may be used instead of varnish.—*General Building Art and Practice.*

POINTS IN JUDGING AN ENGINE.

(High. Soc.)	Points.
Price	20
Simplicity of construction, and fewness of working parts	25
Economy of fuel	20
Rapidity of raising steam	5
Facility of erection and cheapness of foundations ...	5
Economy of water	5
Steadiness and regularity in running	15
Economy of lubricant	5
McConnell's Note Book.] Total :	100

POISONING WILD DOGS OR DINGOES.—A bonus of 10s. per tail is paid by the Western Australian Government for the destruction of wild dogs. The tails must be produced before a justice of the peace, who will certify to the number. The usual method of destroying the dogs is by laying poisoned baits. Strychnine is the poison generally used, and the dogs always prefer freshly killed meat. The bait should be handled as little as possible, and where ground vermin are not troublesome, the bait should be dropped from a buggy or horseback without dismounting. Where boodies and kangaroo rats are plentiful the bait should be stuck in a forked stick eighteen inches or two feet from the ground. A drop or so of oil of aniseed or oil of rhodium on the bait serves to attract the dogs. Wherever poison is laid notices should be put up on the gates to this effect.

PHOSPHORISED GRAIN.—Fifty lb. grain, 5 gallons water, $\frac{1}{2}$ lb. phosphorus, and 7 lb. dark brown sugar. Bring water to a boil in a copper ; take out a bucketful of the hot water with which to mix the phosphorus, and throw the sugar into the copper ; stir contents of bucket well for about ten minutes, keeping water as near boiling point as possible, then pour into the copper and keep stirring for a quarter of an hour; let the contents of copper gradually cool, but keep well agitated, and then add the grain gradually. The complete soaking of the grain with the liquor is of the utmost importance and takes a considerable time. While the mass is cooling keep it covered with bags to retain the steam. Stir well after it has cooled off. Cyanide of potassium, strychnine, and arsenic may be mixed in this way with grain, or the former may be dissolved in vinegar and then mixed.

PHOSPHORISED POLLARD.—Dark sugar, 3 lbs.; phosphorus, half to 1 stick; bi-sulphide of carbon, 1 tablespoonful; pollard, half bushel. Take two vessels, one containing half pint, and the other about 2 quarts of cold water. Mix the phosphorus and bi-sulphide of carbon in the smaller quantity, and the 3 lbs. sugar in the other. When ingredients in both vessels are dissolved mix contents together, and gradually pour upon the pollard, stirring well all the time with a wooden stick. After mixing well spread the mass out flat on a board, making a cake about $\frac{1}{2}$ in. thick, subdivide into inch squares with a wooden straight-edge, and cover with a damp sack, so that it may dry slowly. When handling phosphorus do so with wooden tongs; if with the fingers, keep them well wet with cold water. Phosphorus sticks must be always kept in bottles filled with water.

TO FIND THE NUMBER OF GALLONS OF WATER RAISED BY A PUMP.—To find the number of gallons or fraction of gallons that will be raised at each stroke of a pump, first ascertain the diameter of the pump cylinder; secondly, the length of stroke. Square the diameter and multiply by the length of stroke, and divide by 353. Thus, if the diameter is three inches: $3 \times 3 = 9$; and the length of the stroke 12 inches, $9 \times 12 = 108$. $108 \div 353 = \cdot 3005$, or roughly, $\frac{1}{3}$ of a gallon at each stroke.

PUMPS.—Ordinary dimensions, wells under 30 ft.—Diameter of barrel, 4 ins.; length of stroke, 10 ins.; quantity of water per minute, 20 ft. well, 24 gallons. This is the size best suited for one man, and for general use. Wells from 30 to 70 ft.—Diameter of barrel, $3\frac{1}{2}$ ins.; stroke, 9 ins.; quantity of water per minute, 50 ft. well, length of 16 gals. To be worked by fly-wheel and crank.

SOAP FOR REMOVING CORNS AND WARTS.—For removing corns and warts this salve never fails. Caustic potash, 1 lb.; extract belladona, $\frac{1}{2}$ oz.; peroxide maganese, 2 oz. Mix, and make into a salve with a little lard. Apply to the corn or wart, and in three minutes it will come off.—*Trade "Secrets."*

HOME-MADE SOAP.—The following, being of general interest to country readers, are quoted from a pamphlet on making soap without boiling, by Mr. W. J. Menzies, Liverpool:—Potash wool-scouring soap.—A pure potash wool-scouring soap can best be produced in the following manner: Take a 20 lb. can of pure caustic potash

(Greenbank), cut open the lid and put the whole can into an iron or earthenware vessel, with two gallons of water. The potash will soon dissolve out, itself heating the water ; the empty can then being removed, allow the liquid potash (or lye) thus obtained to cool until warm to the hand (say 90 deg. F.). In a large iron pan or boiler melt 80 lbs. of tallow, free from salt, until dissolved, and of a heat feeling fairly hot to the hand (say 120 deg. F.) Into the melted tallow now pour the potash lye in a small stream, with constant stirring with a flat wooden stirrer about three inches broad, and continue to stir until the mixture is smooth and appears well-combined—a few minutes is all that is necessary. This mixing operation may be done in the melting-pan itself, or often, what is more convenient, an old watertight barrel can be used. Now pour off the mixture into any convenient square box for a mould, damping the sides with whitewash, or better still, lining it with a calico cloth, to prevent the soap from sticking. Wrap up the box well with sheepskins (to keep in the heat by the mixture itself turning into soap), put in a warm place, and leave it for four or five days. The box will then be found to contain 120 lbs. of hard potash soap, which if cut up into bars, and kept for a week or two, will be further improved in quality. If the soap has been mixed in a barrel, and required only for sheep-washing or dipping, it can remain in the barrel instead of being poured off. But it must be well wrapped up, and left standing in a warm place for a week or two.—*Australasian Farmer*.

Hard Soda Soap.—Put the contents of a 10 ℔. can of Greenbank double refined 89 per cent caustic soda into an iron or earthenware vessel, with four gallons (40 ℔s.) of soft water. The pure powdered 98 per cent. caustic soda dissolves instantly, heating the water. Let it stand a few minutes until just warm to the hand (say 80 deg. F.). Melt about 75 ℔s. of clean grease or tallow, free from salt. Skim and let it settle out any impurities. Weigh off, and put in any convenient vessel for mixing exactly 70 ℔s. of the liquid tallow or grease, allowing it to cool until fairly warm to the hand (say 120 deg. F.) ; a wooden tub, old barrel, or a copper will do for this purpose. Now pour the caustic soda lye in a small continuous stream into the liquid tallow, at the same time stirring with a flat wooden stirrer about 3in. broad. Continue stirring for a few minutes, until lye and liquid tallow are thoroughly mixed and smooth in appearance. Take any convenient square-sided box, line it with damp calico, to prevent the soap from sticking, and pour in the mixture, wrapping it well up, and putting into a warm place, to keep in the heat caused by the mixture slowly combining and turning into soap. After three days turn out the block of hard soap from the box used for a mould, and which will weigh 120 ℔s.; cut the soap up with a wire or string into bars, and put them away for a month in a warm room. The soap is much improved by keeping, lathers more freely, becomes quite hard, and is altogether better. It, therefore, never should be used immediately after cutting up. The chief points in the foregoing directions are—the quantities given must be taken exactly. Lye poured into the grease, not grease into the lye. The lye and liquid grease must be well stirred until the mixture is complete and uniform, but not longer. The mould containing the soap must be well wrapped up. The soap, after cutting up, must be kept for a time. The grease used must not contain any salt, which would completely prevent the soap from forming.—*Australasian Farmer.*

Soldering.—Soldering is very useful for joining copper and copper, copper and brass, copper and iron, brass and brass, brass and iron, tin and tin, and tin and any other metal. If the joint has to stand a rather high degree of heat, such, for instance, as the seams of a small copper steam boiler, a hard solder must be used. By hard solder is meant one that only fuses at a high temperature ; a soft solder, on the contrary, fuses at a low degree of heat. The following are the compositions of some of the most useful of solders and alloys, with the degrees of heat required to melt each :—

Tin.	Lead.	Bismuth.	Mercury.	Melts at
1 part	25 parts	—	—	558° Fahr.
2 parts	1 part	—	—	340° ,,
3 ,,	2 parts	1 part	—	292° ,,
5 ,,	3 ,,	3 parts	—	202° ,,
5 ,,	3 ,,	3 ,,	3 parts	122° ,,

We must see with what tools and appliances soldering is effected, and the way in which this operation is performed. First, the surfaces to be united must be thoroughly cleaned and brightened ; without this the mètal will not adhere. The soldering iron must be warmed sufficiently to melt the solder ; it must not be made red-hot, because the solder will not "hold to it." Whilst the iron is warming, tin the surfaces by brushing them over with muriatic acid, dipping them into the melted solder, and quickly rubbing off the adherent metal. This, if done well, will leave a thin coat of solder. When it cannot be done thus, the surfaces must be tinned by means of the soldering iron. In this case they must be coated or washed with the acid as before, but the solder must be melted on the places required with the hot iron. When tinned, the surfaces must be brought close together, a little acid rubbed along the joints, and the iron dipped in the acid and put against some solder, so that the melted solder will stick to the iron The iron must now be applied to the joints, and drawn slowly along in such a manner that the metal between the joints is melted, and the joints filled up. A little practice will soon make the amateur tolerably skilful in doing this. The muriatic acid, or spirit of salt, as it is sometimes called, must be killed, or rendered neutral, before it is used, and this is done by putting one or two small pieces of zinc into it, and allowing it to expend all its energy on this. Killed acid is much more effective than the raw pure acid. Sometimes resin is used instead of the acid ; but the neutralised acid is preferable, because it does not leave the work in such a mess as resin. The soldering-iron, or copper-bit, as it is sometimes called, it is a forked piece of iron put into a handle and having between the prongs of the fork a piece of copper, pointed. It can be made wholly of iron, but copper is generally used because it does not oxidise or waste away so quickly when heated, as iron does, and it also retains its heat longer than iron. The copper tongue should be rubbed against a piece of brick, or something of the sort, immediately it comes from the fire and before it is used. This is done to remove any dirt that may happen to have got about it, and which, if allowed to remain, would prevent the solder from sticking to the copper—thus, in all probability, spoiling the operation. Besides the soldering iron, or copper bit, which may be bought for about 1s. 6d. or 2s., but little else is wanting for soldering, and that little comprises an old knife for scraping clean the metal that is to be soldered, and a bottle containing a little muriatic, or spirits of salt, killed in the manner described. In brazing, the pieces to be united are cleansed from grease, etc., in the same manner as for soldering. The pieces are bound firmly together with fine wire, or held together with a pair of tongs, and put into a clear fire. When just red hot, they must be taken out of the fire and a few bits of soft brass and a little powdered borax put on the joint, which is then returned to the fire and kept there until the brass is thoroughly melted. One can hardly imagine it so, but however close the joint, if the operation is performed with a little care, the brass will penetrate quite through the seam, and, indeed, through the pores of the iron itself. The brass used for brazing should be tolerably soft, and in small pieces. Braziers generally use what is called granulated brass, which is nothing more than melted brass dropped whilst liquid into water. When granulated brass is not obtainable, or not at hand, brass filings will answer almost as well. In addition to the solders already given, it may be useful for the amateur to know that the lining of tea-chests makes a good solder for tin-plate goods, being made of tin and lead in the proper proportions, that is to say, two parts of tin to one part of lead. For soldering pewter, from one to three parts of bismuth should be added to solder for tin. Plumber's solder is made of equal parts of lead and tin. Equal parts of copper and zinc melted together make a good solder for brass. Glazier's solder, for joining strips of lead to form lead casements, is made of three parts of lead to one part of tin.—*General Building Art and Practice.*

Soft Putty.—The following recipes for making soft putty, and for softening hard putty, are taken from Spon's *Workshop Recipes*, a very useful book, for which a place should be found on the shelves of all amateur artisans. Recipe (soft putty): Mix 10 lbs. of whiting and 1 lb. of white lead with the necessary quantity of boiled linseed oil, adding it to half a gill of the best salad oil. The salad oil prevents the white lead from hardening, and preserves the putty in a state sufficiently soft to adhere at all times, not suffering the wet to enter by getting hard and cracking off, as is often the case with ordinary hard putty. The best way to preserve ordinary putty from cracking is to paint it as soon after it is put on as possible; and when putty has dried and cracked to such an extent that it allows the wet to enter, it is best to remove it and substitute fresh putty, or to run a brush charged with priming over the putty, working the bristles well into the cracks, and then to rub soft putty into the cracks to fill them up, after which the work should receive at least two coats of paint. The following is an excellent way to soften putty:—"Take 1 lb. of American pearlash and 3 lbs. of quick-stone lime, slake the lime in water, then add the pearlash and make the whole about the consistence of paint. Apply it to both sides of the glass, and let it remain for twelve hours, when the putty will be so softened that the glass may be taken out of the frame with the greatest facility."—*General Building Art and Practice.*

STOVE POLISH.—Mix two parts of copperas (evidently sulphate of copper or blue copperas), one of bone black, one of black lead, with sufficient water to form a creamy paste. This will produce a very enduring polish on a stove or other iron article, and after two applications it will not require polishing again for a long time, as the copperas will produce jet black enamel, and cause the black lead to permanently adhere to the iron.—*Trade "Secrets."*

TANNING KANGAROO SKINS.—Collect some wattle bark and make a strong decoction, either by boiling or steeping. If you have a tannery near you it will be easier to buy a bushel of crushed bark. Before you steep the skins, scrape off all the fleshy parts. A large square watertight case is preferable to a hogshead, for it is best not to double the skins up more than can be helped. Look at the skins once a week, and not only scrape them over again, but change the liquor. The same liquor will do if you boil and skin it. It will take six weeks to tan large skins. For 'possum skins a month will be long enough.—*Australasian Farmers' Guide.*

TAR PAVEMENT.—Although making it is a very dirty and unpleasant piece of work, and best left to practical hands, it may be easily laid by the amateur. The surface of the walk should be removed to the depth of three or four inches, and well beaten. Some thick coal tar should then be poured over a heap of shingle or coarse gravel, and the whole worked together with a spade, or crooked fork, until the gravel is thoroughly impregnated with the tar. This composition must be spread over the surface of the walk, and rolled down with a heavy roller. Another mixture must now be made of tar and finer gravel, or sifted ashes from the dust-bin, and a thin layer spread over the layer of rougher stuff first put on. Fine sand or gravel must then be sprinkled freely over the top of this, and the whole once more rolled, or beaten flat with the back of the blade of a spade, if no roller be available.—*General Building Art and Practice.*

CONCRETE PAVEMENT—This is far cleaner to work than tar pavement, and is put down in the following manner: The earth is first taken off the surface of the path to a depth of 8 in. or 9 in., and the shallow trench thus made is filled up to about two-thirds or three-fourths of its whole depth with stones, broken brickbats, and coarse gravel, well rammed together so as to present a level surface. The Portland cement must now be mixed in a tub with water until it is of the consistence of thick cream or custard, and poured over the gravel. This must be spread about with a bast-broom to level the surface and send it into the interstices of the first rough coat of stones and gravel. On this a coating of Portland cement and gravel, mixed with water, must be spread, bringing the service very nearly up to the height of the path; and when this has hardened, a finishing coat must be put on of clean, sharp sand and Portland cement in equal parts, and brought, when mixed with water, to the consistence of mortar. The surface must be rounded and brought to smoothness by the aid of a float, a piece of wood with a handle at the back, something like a laundress's iron, but longer, with which plasterers finish the surface of walls and ceilings. No one should be allowed to tread on the surfaces thus made until it is perfectly dry and hard.—*General Building Art and Practice.*

TRACTIVE FORCE OF HORSES.

Rate in miles per hour	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
Tractive force exerted in lbs. ...	166	150	125	104	83	62	41

Force of traction required for carriages of one ton on a level road:

	Description of road.	Force of traction per ton.
1	On rails	8 lbs.
2	Well made pavement	33 ,,
3	Macadamised road	44 to 67 ,,
4	Turnpike, hard and dry	68 ,,
5	,, dirty...	88 ,,
6	Hard compact loam	119 ,,
7	Gravel	150 ,,
8	Sandy and gravelly	210 ,,
9	Ordinary bye-road	237 ,,
10	Turnpike, newly gravelled	320 ,,
11	Loose sandy road	457 ,,

A horse produces his greatest mechanical effect in drawing a load at $2\frac{1}{2}$ miles per hour with a tractive force of 150 lbs.

Draught of Horses.

At 8 hours per day, $2\frac{1}{2}$ miles per hour, and tractive force of 150 lbs.:

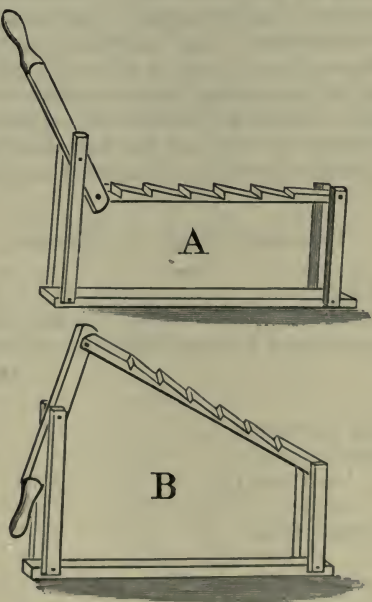
On level hard road	3	tons.
On inferior or hilly road	1	,,
On rails	16	,,
On a canal	60 to 90	,,
Carrying on his back	300	lbs.
Lifting over a pulley	110	,,

Length of furrow: 250 yards long is the best average suited to the strength of horses.

Speed of horses: From $1\frac{1}{2}$ to 2 miles per hour while in the plough.

Distance travelled per acre: At a width of 8 in., 12·3 miles; at a width of 9 in., 11 miles; at a width of 10 in., 9·9 miles; at a width of 12 in., 8·2 miles.

Average time to turn: Three quarters of a minute.



Time lost in turning: For 250 yards length of furrow, the loss is 1 hour 30 minutes every 10 hours.

If a field has 50 turns to the acre, the loss will be $37\frac{1}{2}$ minutes; if 100 turns per acre, 1 hour 15 minutes; if 200 turns per acre, 2 hours 30 minutes; and to these must be added time taken up in resting.

Limit of draught: 7 cwt. per furrow. Ordinary ploughing varies from 3 to 5 cwt., or 170 to 280 lbs. per horse, depending on nature of soil, etc. Steam plough equals $6\frac{1}{4}$ cwt. per furrow (25 cwt. in all) at 100 yards per minute; depth, 6 inches.

—*McConnell's Note Book.*

VINEGAR.—Ordinary vinegar is made by the fermentation and acetification of cider, wine, molasses, etc., and the management requires no great skill. All that is wanted is a temperature above 50 deg. F. and plenty of air, and the process will proceed of its own accord. Vinegar from sugar.—Put 9 lbs. of brown sugar to every six gallons of water; boil it for a quarter of an hour, and then pour it in a tub in a lukewarm state; put to it a pint of good yeast, let it work four or five days, stir it up three or four times a day, then turn it into a clean barrel, iron-hooped, and set full in the sun.—*Trade "Secrets."*

WAGGON JACK FOR LIGHT WAGGONS.—The illustration depicts a very convenient and easily constructed waggon jack. The base or main piece is a 2 by 4 in. scantling 4 ft. long. The top or notched stick is 2 ins. by 3 ins. of about the same length. At each end of the base and on each side, bolt pieces 2ins. by $1\frac{1}{2}$ ins. Let one set be about 18 ins. or 20 ins. high and the other 26 ins. or 30. ins. Fasten the short pair so it will be stationary, but the other pair must be so it will move backward and forward. Arrange the lever so that when in the position shown at A, the notched stick will be nearly horizontal. Then place the jack under the axle of the waggon. Bring the lever to the position shown in B. This will lift the wheel off the ground, and if the jack has been properly constructed the lever will remain in position while the wheel is being taken off and the axle greased. Make the top and upright pieces of some kind of hard, strong wood—the lighter the better. The bottom can be of pine.

WEIGHT OF CATTLE BY MEASUREMENT.—A correspondent of the *Agricultural Gazette* gives his plan, which he was taught by a gentleman who had had great experience with the tape, and had, moreover, the great advantage of being able to see his bullocks weighed afterwards in a butcher's shop (a relative's). For the girth find the smallest place just behind the shoulder, and for the length measure from the point of the shoulder where the neck appears to be set on to a point square with the hind quarters. Multiply the square of the girth by the length, and the result by 42, and divide the product by 100, the result of which division will be the weight of the animal in 8-lb. stones. Example: Girth, 6 ft. 4 in.; length, 4 ft. 7 in.:—

```
      6.4
       6.4
    ---------
    38.
     2.1.4.
    ---------
    40.1.4.
         4.7
    ---------
   160.5.4
    23.4.9.4
    ---------
   183.10.1.4
            6
    ---------
  1103.-8.-
            7
    ---------
  77.21.4.8-        Answer : 77 stone.
```

With any sort of measurement it is necessary to know, if possible, how long the beast has been "up," and how he has got on, and to add to or deduct from the result of the measurement accordingly. —*Australasian Farmer*.

Yeast Cakes.—Put into three pints of water a handful of hops and nearly a quart of pared potatoes, cut into small pieces. Boil for half an hour, and strain, while scalding hot, into sufficient flour to make a stiff batter. Stir it well, adding one teaspoonful of fresh yeast, and set it in a warm place to rise. When light, mix it stiff with Indian meal, roll out thin, and cut into round cakes or square pieces, about 2½ inches in diameter. Dry these thoroughly, and they will remain good for months if kept in a moderately dry place.—*Trade* "*Secrets*."

Yeast.—This is another important ingredient in bread making. A simple and thoroughly good way of making it is to put one ounce of hops into two quarts of water, boil until the water is reduced by one-third ; strain this, and add to the water two tablespoonfuls of sugar ; when the mixture is cool add two tablespoonfuls of flour, and bottle it. This gives about three pints of yeast, and what is wanted first for use should be put into a bottle that contained yeast before. If no such bottle is handy, a few drops of vinegar or a bit of dough will cause it to ferment. It is ready for use as soon as fermentation sets in, or, in moderately warm weather, about 24 hours after the fresh yeast is made. It keeps for weeks when corked tight and put away in a cool place. One pint of this yeast is sufficient for 12 lb. of bread.

WEIGHTS AND MEASURES.

Area in Acres for One Statute Chain in Length of a Given Breadth in Feet.

Breadth in feet.	Acres per chain in length.	Breadth in feet.	Acres per chain in length.
1	·001515	6	·00909
2	·00303	7	·010606
3	·004545	8	·012121
4	·00606	9	·013636
5	·007575	18	·015151

Tables for Converting Feet into Links and Links into Feet.

Links.		Feet.	Feet.		Links.
1	=	·66	1	=	1·5151
2	=	1·32	2	=	3·0303
3	=	1·98	3	=	4·5454
4	=	2·64	4	=	6·0606
5	=	3·30	5	=	7·5757
6	=	3·96	6	=	9·0909
7	=	4·62	7	=	10·6060
8	=	5·28	8	=	12·1212
9	=	5·94	9	=	13·6363
10	=	6·60	10	=	15·1515

Timber Measurement.

Take the average girth in inches, divide by 4, deduct 1 inch for bark for each foot of circumference, and square the result: this gives mean sectional area. Multiply this by length of tree in feet and divide by 144: the quotient = contents in cubic feet. Timber less than 26 inches round the bark is not included in the length.

Imperial Troy Weight.

·003961 cub. inch of water		1 grain (gr.)	20 pennyweights		1 ounce (oz.)
3·17 grains	-	1 carat	12 ounces	-	1 pound (lb.)
24 grains	-	1 pennyweight (dwt.)	1 ounce	-	480 grains
			1 pound	-	5,760 grains

The weight of a grain of wheat taken from the middle of the ear, well dried, is "1 grain."

Imperial Avoirdupois Weight.

27·34	grains (grs.)	1 drachm (dr.)
16	drachms	1 ounce (oz.)
16	ounces	1 pound (lb.)
14	pounds	1 stone (st.)
28	pounds	1 quarter (qr.)
4	quarters	1 hundredweight (cwt.)
112	pounds	1 cwt.
20	huudredweight	1 ton
1	ounce	473½ grains
1	pound	7,000 grains.

Imperial Measure of Capacity.

5 ounces of water	1 gill
4 gills	1 pint (pt.)
2 pints	1 quart (qt.)
4 quarts	1 gallon (gal.)
2 gallons	1 peck (pk.)
4 pecks	1 bushel (bus.)
8 bushels	1 quarter (qr.)

These measures are used up to the gallon for liquids, and from the peck upwards for dry goods.

Imperial Wine Measure.

(For all Wines and Liquids.)

4 gills	1 pint (pt.)
2 pints	1 quart (qt.)
4 quarts	1 gallon (gal.)
10 gallons	1 anker (ank.)
18 gallons	1 runlet (run.)
31½ gallons	1 barrel (bar.)
42 gallons	1 tierce (tier.)
2 tierces	1 puncheon (pun.)
63 gallons	1 hogshead (hhd.)
2 hogsheads	1 pipe (pipe)
2 pipes	1 tun (tun).

Imperial Ale and Beer Measure.

(For Malt Liquors and Water.)

2 pints	1 quart (qt.)
4 quarts	1 gallon (gal.)
8 gallons	1 firkin (fir.) (ale)
9 gallons	1 firkin (fir.) (beer)
18 gallons	1 kilderkin (kil.)
36 gallons	1 barrel (bar.)
1½ barrels (54 gals)	1 hogshead (hhd.)
72 gallons	1 puncheon (pun.)
2 hogsheads	1 butt (butt)
2 butts	1 tun (tun).

Imperial Corn Measure.

2 quarts	1 pottle (pot.)
2 pottles	1 gallon (gal.)
2 gallons	1 peck (pk.)
4 pecks	1 bushel (bus.)
2 bushels	1 strike (str.)
4 bushels	1 coomb (coomb)
4 bushels	1 sack
2 coombs or 8 bushels	1 quarter (qr.)
4 quarters	1 chaldron
5 quarters	1 load (load)
2 loads or 10 qrs.	1 last (last).

The gallon has the same capacity in all Imperial measures, i.e., 277¼ cubic inches, or = 10 lbs. of distilled water at 62° F., and barometer at 30 inches. The bushel is 1·28 cubic feet: 19 inches diameter, and 8¼ inches deep.

Foreign Liquid Measures.

		Name of measure.		Contents in gallons.
Britain	-	Gallon	-	1·0
America	-	Gallon	-	0·833
Austria	-	Eimer	-	12·449
Denmark	-	Anker	-	8·493
France	-	Litre	-	0·22
Holland	-	Anker	-	8·406
Portugal	-	Almude	-	3·750
Prussia	-	Eimer	-	15·147
Russia	-	Veddras	-	2·712
Spain	-	Arroba	-	3·527
Sweden	-	Eimer	-	17·289

Imperial Lineal Measure.

72 points	1 inch (in.)
3 barleycorns (in length)	1 inch (in.)
12 lines	1 inch (in.)
12 inches	1 foot (ft.)
3 feet	1 yard (yd.)
6 feet	1 fathom (fth.)
5½ yards	1 rod, perch, or pole (po.)
40 poles	1 furlong (fur.)
8 furlongs	1 mile
3 miles	1 league
69 and one-ninth miles	1 degree (deg. or °)

The chain used for measuring land is 4 poles, or 22 yds., long, and consists of 100 links, each link being $\frac{22}{100}$ yd., or 7·92 in., long. 10,000 sq. lks. = a sq. chain; 25,000 sq. lks. = sq. rood; 100,000 sq. lks. or 10 sq. chains = 1 acre.

Foreign Lineal Measures.

Country.	Name.	Number equal to 100 feet English.	Length in inches English.
Britain	Foot	100·0	12·0
America	,,	100·0	12·0
Austria	,,	96·4	12·45
Denmark	,,	97·2	12·35
France	Metre	39·47	39·37
Holland	Foot	107·7	11·14
Portugal	,,	92·7	12·96
Prussia	,,	97·1	12·36
Russia	,,	87·2	13·75
Spain	,,	108·0	11·03
Sweden	,,	102·7	11·69

Imperial Square Measure.

144 sq. inches	...	...	1 sq. foot (sq. ft.)
9 sq. feet	...	...	1 sq. vard (sq. yd.)
30¼ sq. yards	...	...	1 sq. pole (sq. po.)
40 sq. poles	...	...	1 rood (rd.)
4 roods ...	...	...	1 acre (ac.)
640 acres ...	...	...	1 sq. mile (sq. m.)
43,560 sq. feet	...	...	1 acre
4,840 sq. yards	...	...	1 acre
160 sq. rods	...	...	1 acre
10 sq. chains	...	...	1 acre.

Solid Measure.

1,728 cubic in.	...	...	1 cubic foot (cub. ft.)
27 cubic ft.	...	...	1 cubic yard (cub. yd.)
A barrel bulk ...	...	...	5 cubic feet
A load of rough timber	...	...	40 cubic feet
A load of squared timber...		...	50 ,, ,,
A ton of timber, shipping		...	42 ,, ,,
A ton of freight, shipping...		...	40 ,, ,,
A stack of wood	...	...	108 ,, ,,
A cord ...	...	...	128 ,, ,,

Fluid Measure.

60 minims (m.)	...	...	1 fluid drachm
8 drachms ...	...	...	1 ounce
20 ounces ...	...	...	1 pint
8 pints ...	...	...	1 gallon.

Old Apothecaries' Weight.

20 grains ...	...	...	1 scruple
3 scruples ...	...	...	1 drachm
8 drachms ...	...	...	1 ounce
12 ounces ...	...	...	1 pound (lb. Troy).

Superseded in 1864.

New Apothecaries' Weight

Ounce ...	...	...	437½ grains
Pound (16 oz.)	...	...	7,000 ,,

Same as avoirdupois.

Symbols used in Prescriptions.

j	one	a.a.	of each
ij	two	F. ft.	mix
iij, etc.	three, etc.	ft.	make
s.s.	one-half	R.	take of
gtt	drop	Q.S.	sufficient quantity.

Bread and Flour Weight.

4 lbs. 5½ oz. Imp.	...	...	1 quarter loaf
8 lbs. 11 oz. Imp.	...	...	1 half-peck loaf
17 lbs. 6 oz. Imp.	...	...	1 peck.

A peck or stone of flour is 14 lbs.; a bushel of flour is 56 lbs.; a boll is 140 lbs.; and a sack of 5 bushels is 280 lbs., or 2½ cwt.

Wool Weight.

7 lbs. avordupois	...	...	1 clove
14 „ or 2 cloves	...	...	1 stone
28 „ or 2 stones	...	...	1 tod
182 „ or 6½ tods	...	...	1 wey
364 „ or 2 weys	...	...	1 sack
4,368 „ or 12 sacks	...	...	1 last.

20 lbs. = 1 score, and 240 lbs. or 12 scores = 1 pack. Wool is frequently sold in Scotland by the stone of 24 lbs. Imp. In practice, wool buyers frequently reckon 30 lbs. to the tod.

Various Moneys.

Country.		Name of Coin.		Value in £1 English.
Britain ...	...	Shilling	...	20
America	...	Dollar	...	4·84
Austria ...	...	Florin	...	9·83
Buenos Ayres	...	Patacon	...	4·8
Denmark	...	Dollar	...	4·897
Egypt ...	...	Pound	...	0·979
France ...	...	Franc...	...	25·57
Holland...	...	Florin	...	11·97
India ...	...	Rupee	...	10·78
Italy ...	...	Lira ...	...	25·263
Portugal	...	Milreis	...	4·285
Prussia ...	...	Dollar	...	6·9
Russia ...	...	Rouble	...	6·4
Spain ...	...	Dollar	...	4·8
Sweden ..	...	Ducat	...	2·182

A halfpenny is 1 inch diameter, and 1½d. = 1 oz. in weight.

Metrical System.

Long Measure.

	Metres.	Inches.	Feet.	Yards.	Miles.
Millimetre	·001	·03937	·00328	·00109	—
Centimetre	·01	·3937	·0328	·0109	—
Decimetre	·1	3·937	·328	·1093	·00006
Metre -	1	39·37079	3·2809	1·0936	·00062
Decametre1	10	—	32·809	10·9363	·0062
Hectometre	100	—	328·09	109·363	·06213
Kilometre	1,000	—	3,280·9	1,093·63	·62138
Myriametre	10,000	—	—	—	6·21382

Square Measure.

	Square Metres.	Square Inches.	Square Feet.	Square Yards.	Acres
Milliare -	·1	155	1·076	·119	—
Centiare - -	1	1,550	10·764	1·19	·00025
Deciare - -	10	15,501	107·64	11·96	·0025
Are - -	100	—	1,076·4	119·6	·0247
Decare - -	1,000	—	—	1,196	·2471
Hectare - -	1,0000	—	—	11,960	2·4711

Solid Measure.

	Cubic Metres.	Cubic Inches.	Cubic Feet.	Cubic Yards.
Millistere	·001	61·028	...	...
Centistere	·01	610·28	·353	...
Decistere	·1	6,102·8	3·531	·13
Stere, or cubic metre	1	61,028	35·317	1·308
Decastere	10	...	...	13·08
Hectostere	100	...	...	130·802

Weights.

	Grammes.	Avoir. oz.	Avoir. lb.	Cwts.	Tons.	Grains Troy.
Milligramme	·001	...	...	...	...	·015
Centigramme	·01	...	...	...	...	·154
Decigramme	·1	...	...	...	...	1·543
Gramme	1	·035	·0022	...	...	15·432
Decagramme	10	·352	·022	...	...	...
Hectogramme	100	3·527	·2204	...	...	...
Kilogramme	1,000	35·274	2·2046	·019	·00098	...
Myriagramme	10,000	...	22·046	·196	·00984	...
Quintal	100,000	...	220·462	1·968	·0984	. .
Millier or bar	1,000,000	...	2,204·62	19·684	·9842	...

Dry and Fluid Measure.

	Litres.	Inches.	Feet.	Gallons.	Bushels.
Millilitre	·001	·061	...	·00022	...
Centilitre	·01	·61	...	·0022	...
Decilitre	·1	6·1	...	·022	·0027
Litre	1	61·02	·0353	·22	·0275
Decalitre	10	610·28	·353	2·2	·275
Hectolitre	100	...	3·53	22	2·751
Kilolitre	1,000	...	35·317	220·09	27·512
Myrialitre	10,000	...	353·17	2,200·9	275·121

The metrical system is based on the metre (39·3709 inches), which is the ten-millionth part of the quadrant of a terrestrial meridian. The litre is the cube of the tenth part of a metre ; the weight of a litre of distilled water at its greatest density is a kilogramme, and one-thousandth of this is a gramme, the are is 100 square metres, and the stere one cubic metre.

Specific Gravities of a few common and useful things.

Distilled water -	1·000	Garden Mould - -	2·332
Rain water - -	1·0013	Humus - - -	1·370
Sea water - -	1·027	Flint, dark - - -	2·542
Common earth - -	1·48	Flint, white - - -	2·741
Rough sand - -	1·92	Lime, unslaked - -	1·842
Earth and gravel -	2·02	Chalk - - -	2·62
Moist sand - -	2.05	Granite - -	2.5 to 2·66
Gravelly sand - -	2·07	Limestone - -	2·64 „ 2.72
Clay - -	2·15	Quartz - -	2·56 „ 2·75
Clay and gravel - -	2·48	Stones for building, various	1·66 „ 2·62
Silicious sand - -	2·653	Brick - -	1·41 „ 1·86
Sandy clay - -	2·601	Iron, cast - - -	7·23
Loamy clay - -	2·581	Iron, wrought - -	7·888
Brick clay - -	2·560	Lead, flattened - -	11·388
Pure grey clay - -	2·533	Zinc, rolled - - -	7·191
Pipe clay - -	2·540	Rock salt - - -	2·257
Arable soil - -	2·401		

PART III.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

INTRODUCTION.

BY THE EDITOR.

THE third part of the SETTLER'S GUIDE, as will be seen on perusal, deals with fodder and forage plants; with what may be termed special products of the farm; the native poison plants, and noxious weeds. The information conveyed in the following pages, though written primarily for the new settler who contemplates pursuing mixed farming, should not be without interest to the pastoralist. Mr. F. Turner, F.L.S., author of "Australian Grasses" and other works, who, since the death of the much lamented Baron von Mueller, has done a great deal of valuable botanical work for the Bureau of Agriculture, contributes articles on the West Australian grasses and salt bushes, and it is to be hoped his remarks on the conservation of natural grasses will be read with attention, and acted upon. The chapter on fodder and forage plants, exclusive of grasses, is compiled principally from a bulletin by Mr. Jared G. Smith, assistant agrostologist to the United States Department of Agriculture, and issued by the department last year. Mr. Samson-Scrivner, chief of division of agrostology, in introducing the work of his assistant, says :—

"The work is popular in its character, and is as free from technicalities as possible. The descriptions are brief, and the remarks under each species, while brief, include what has been regarded as most important, and afford such iuformation as the farmer and others interested would be most likely to wish to know. Besides the cultivated forage plants which are already more or less widely known, native species which have never yet been cultivated are included in the enumeration. There are in the United States over 200 native or wild species of this class which are recognised locally as excellent forage plants. More attention should be given these natives, for there is every reason to believe that among them are many kinds fully equal in productiveness and feeding value to any of those now under cultivation, and possibly many superior to anything we have now in their adaptibility to certain soils or climates or in their value for special uses." The concluding observation applies quite as forcibly to Australia as to the United States, and on pastoral holdings there is infinitely more profit to be derived from conserving the best of our natural grasses than in attempting to introduce new species. On small holdings where cultivation is carried on it is different. The object should be to secure the greatest quantity of fodder from the smallest area, and introduced plants under intense cultivation will be found to pay handsomely, especially in the southern districts.

The native poison plants have been catalogued and described with a view to making them known to the new settler. When there is any doubt specimens should at once be forwarded to the Bureau of Agriculture for identification. There is no doubt that the wide dispersion of poison plants in Western Australia is a decided detriment to rapid settlement, but, as indicated in the descriptive chapters of Part I of the GUIDE, it will be seen that experience has shewn the difficulty of overcoming the poison plants is not insuperable, and the danger is easily and cheaply removed.

The concluding notes of this part are on noxious weeds. Mr. Helms, in introducing the subject, gives ample reasons for the suppression of objectionable weeds; and the Bureau regrets that at present there is no legislative power which enables one to deal with any of the weeds except the Spanish radish and Scotch thistle, by no means two of the worst weeds which have invaded the colony. It is hoped, however, that during the present session of Parliament a Bill will be introduced which will remedy this defect in our statute book, and enable those settlers who are anxious to prevent the spread of noxious weeds to invoke the authority of Government in doing so.

CHAPTER I.

WEST AUSTRALIAN GRASSES.

BY FRED. TURNER, F.L.S., F.R.H.S., ETC.

There are about three hundred and sixty species of grass indigenous to Australia, and they are fairly well distributed over the continent. Of the total recorded, one hundred and nineteen species, arranged under forty-nine genera, are found in Western Australia. All these, of course, are not good forage plants, but amongst the most valuable and nutritious, from a pastoral point of view, the following may be taken as examples. Six species of *Andropogon*, including the famous "blue," and other excellent grasses. Three of *Anthistiria*, which are commonly known as the "kangaroo," "tall oat" (this yields a good sized grain), and "landsborough" grasses respectively. Three of *Chloris*, including the "star" or "windmill," and "spider" grasses. Five of *Danthonia*, including the widely and favourably known "wallaby" grass. All the species of this genus have a high reputation as forage for stock. Two of *Diplachne*, one of which is a very good grass for moist situations. Eight of *Eragrostis*, some of which are very good forage grasses, and others are remarkable for their drought-enduring qualities. Eight of *Panicum*, all of which are excellent forage grasses, and include the widely and favourably known "Australian millet," the seeds of which at one time formed an important article of food for the aborigines. Six of *Poa*, which include some good pasture grasses. There are also several species of the following genera. *Amphibromus* ("marsh brome" grass), *Astrebla* (the famous "Mitchell" grass), *Chrysopogon*, *Cynodon* ("couch" grass), *Deyeuxia* ("bent" grass), *Dichelachne* ("plume" grass), *Elensine* ("finger" grass), *Eriochloa* ("early spring" grass), *Microlæna* ("meadow rice" grass), *Pappophorum* ("black heads"), *Paspalum* ("water couch"), *Pollinia* ("sugar" grass), Setaria ("millet"), *Sporobolus*, and *Sorghum*.

The most undesirable grasses found in Western Australia belong to the genera *Aristida* ("three-awned spear" grass), *Heteropogon* ("spear" grass), *Stipa* ("spear," "corkscrew," or "wire" grass), and *Triodia* ("porcupine" or "spinifex" grass), the latter term, however, is a generic one given to a quite distinct grass, therefore, must not be confounded with it.) Whilst young, some of these grasses are really good pasture plants, but when the seeds of *Aristida*, *Heteropogon*, and *Stipa* are ripe, they are irritating and dangerous to the eyes of sheep, often causing blindness. Moreover, the seeds, with their adherent awns, not only become entangled in the wool, which somewhat depreciates its value, but they sometimes enter the vital parts and cause death. Unfortunately, when the grasses that bear these long seed-awns become old, cattle and sheep seldom or never eat them, consequently they grow and produce seed almost undisturbed. The two species of *Triodia* are dreaded on account of their sharp-pointed leaves. Although the total number of undesirable grasses does not amount to more than a dozen, still they are of sufficient importance to make their position felt and somewhat disliked by pastoralists. It would increase the grazing capabilities of those parts of the country where these undesirable grasses very largely predominate in the pastures, if they were occasionally burned off. The operation should be performed when the grasses are in seed, for at this period of their growth both the harsh stems and the objectionable seed awns would be destroyed. In favorable weather new growth is soon made after burning, but it is not advisable to allow animals to graze on this succulent herbage until considerable growth has been made, otherwise it might give them what is commonly termed the scours, or diarrhœa, which sometimes becomes chronic, and, of course, has a weakening effect upon them.

The burning-off of the more valuable pasture grasses is not to be recommended unless they become diseased, or grow into objectionable tussocks of harsh, dry herbage. When good pasture is burned, millions of valuable grass seeds are destroyed, which are, of course, their only natural means of reproduction. Should the more valuable pasture be accidentally set on fire, sheep should never be turned into the paddocks until the herbage has made considerable growth, though cattle may be turned in without any serious damage being done, for they never eat grasses so close as do sheep. I may here mention the fact that sheep destroy the natural grasses and other herbage in much less time than horses, and the latter much sooner than cattle.

From the above synoptical review of the indigenous grasses of Western Australia, it will be gathered that there is some good material to conserve and cultivate. As a preliminary undertaking towards the conservation of the indigenous grasses and other herbage, reserves should be established in various part of the country for the purpose of raising seeds to be disseminated in places where the herbage may have been eaten out. Such reserves need not occupy large areas. It is astonishing the quantity of seed that can be harvested from a few acres. It would be a wise thing for the Governments of the Australian colonies to make grass reserves a compulsory undertaking when granting new leases for Crown lands. That such reserves would have a most beneficial effect upon the pastoral areas in this country cannot be gainsaid by thinking persons. In fact, there are already valuable data to work upon. All the railway enclosures throughout the continent are excellent reserves for the preservation of the indigenous grasses and other herbage, and the most superficial observer cannot fail to have seen the amount of seed that is matured and distributed on the adjacent land by winds and other agencies. When this seed germinates it cannot fail to enhance the grazing capabilities of the pastures for miles around.

The small paddock system is the best to adopt for grazing large areas in country that is suitable for pasturing sheep, and where the herbage is plentiful. For those areas that have deteriorated so much that animals have a difficulty to eke out an existence on them, it would be a wise thing to rest them for a period, until the better kinds of herbage recuperate. It may not be generally known, but it is an almost invariable fact, that where horses are constantly allowed to graze in pastures where the undesirable "spear" and "three-awned spear" grasses grow, these plants are not nearly so plentiful as they are on those areas from which these animals are excluded ; sheep, on the contrary, that are allowed to roam over large areas, eat out the very best grasses and other herbage, and it is not until they become pressed with hunger that they will eat the coarser vegetation.

It would depend upon the size of the pastoral holding and the number of sheep that is grazed upon it, as to the size of the paddocks to be adopted, but any larger than 2,000 acres are not to be recommended, smaller areas being preferable. The paddocks should be so arranged that each one should have at least from three to four months' rest in a year. This would give the herbage an opportunity to produce seed, which in time would germinate, and new plants would spring up and cover the ground. Unless the paddocks were in a very bad state before the system was adopted, it is astonishing how quickly some of the herbage would recuperate, drought time, of course, excepted. Another very great advantage to be taken into consideration by adopting the close paddocking system, is that sheep could be kept, if not near shearing time, a little longer than usual in any paddock which might have a number of noxious plants growing in it, during which time they would trample most of them down. This would give a better chance for the superior grasses and other herbage to grow when that particular paddock was resting. By adopting the close-paddocking system, it would also be found that fine crops of grass could be cut in some of the paddocks in propitious seasons, which could be made either into hay or ensilage to provide feed for stock during drought time. With the appliances in the shape of labor-saving machinery that are now obtainable at a moderate cost, thousands of tons of fodder could be saved in times of plenty. Whether the grass or other herbage is turned into hay or ensilage it would be advisable to make the stores of fodder some distance apart, so that when it became necessary to artificially feed stock the animals would not be congregated in very large numbers at any particular point. It is easy to imagine, if such a thing did take place, that scores of the weaker ones would be trampled to death. The stacks should, of course, be protected with fencing, in order to keep the animals off during the time that herbage was plentiful in the pastures. Following are the descriptions of those illustrations which accompany this chapter :—

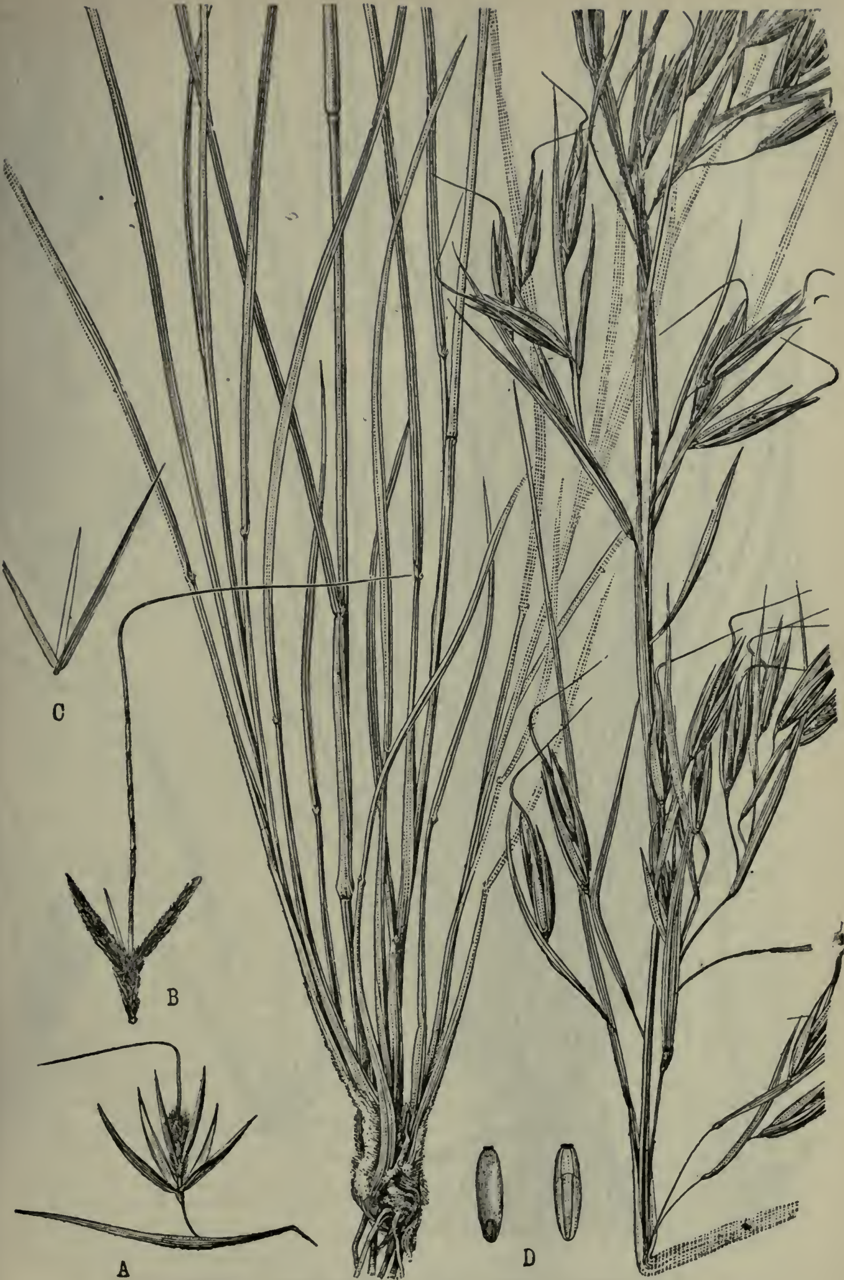
Andropogon bombycinus (R. Br. "Silky heads.")—This erect-growing perennial grass, which attains a height of from one and a half to three feet, is found all over Australia, but principally on the plains in the far interior. It generally grows on the richest of soils, though the writer has occasionally seen it growing on stony ridges. It will withstand a phenomenal amount of dry weather in any situation where its strong, wiry roots can penetrate easily into the earth. Like many other species of the genus *Andropogon*, the base of the stems on being bruised emit a strong aromatic perfume. During the early summer, and sometimes in the autumn months, this grass makes a quantity of succulent, leafy herbage which stock are fond of. When the grass becomes old, however, the herbage is somewhat harsh, and then it is seldom, or never eaten unless other feed is scarce. The writer has had this species under experimental cultivation, where it proved a very prolific grass, and the herbage lost that harshness, even when it was old, that characterises it when grown on uncultivated land. The seeds usually ripen during November, December, and January, though occasionally in the autumn months.

Anthistiria avenacea (F.V.M." Tall oat grass ").—This perennial grass is found all over Australia, from the coastal districts to the far interior, but principally in the latter portion of the continent. It is only found on the richest of soils, and often in a good season may be seen growing five feet high. It generally grows in tussocks, and produces a quantity of leafy herbage at the base, which, when young, cattle are remarkably fond of and fatten on. After the flower stems have developed, however, they become hard and cane-like, and when in this state cattle will leave the plant for more tender herbage. Under ordinary conditions it produces a great amount of seed, which usually ripens during October, November, December, and January, though occasionally in the autumn months. The seeds are large, and in appearance somewhat resemble oats (*Avena satira*, Linn.).

Anthistiria ciliata (Linn. " Kangaroo " grass).—This is one of the most widely-distributed grasses on the Australian continent, and at one time was supposed to be exclusively Australian. It is, however, found in many countries, including New Guinea. In the tropical parts of Australia it grows more or less all the year round. In the southern portion of the continent it is essentially a summer-growing grass, for it seldom starts into growth before October or November. On good soils it is an excellent pasture grass, which

Andropogon combycinus (R. Br. "Silky heads.")

Reference to Plate.—A, showing the arrangement of the two spikes and sheathing bract; B, showing the arrangement of the sessile and pedicellate spikelets on the rhachis (opened out); C, the sessile and pedicellate spikelets; D, the sessile fertile spikelet, showing the four glumes and terminal awn (opened out); E, grain, back and front views. All variously magnified.



Anthistiria avenacea (F.V.M. "Tall oat" grass.)

REFERENCE TO PLATE.—A, cluster of male or barren spikelets, and the fertile one, opened out to show how they are arranged ; B, fertile spikelet opened out, showing the three glumes and terminal awn ; C, male spikelet ; D, grain, back and front views. All the details natural size, with the exception of the cluster of spikelets, which is reduced.

Anthistiria ciliata (Linn. "Kangaroo" grass.)

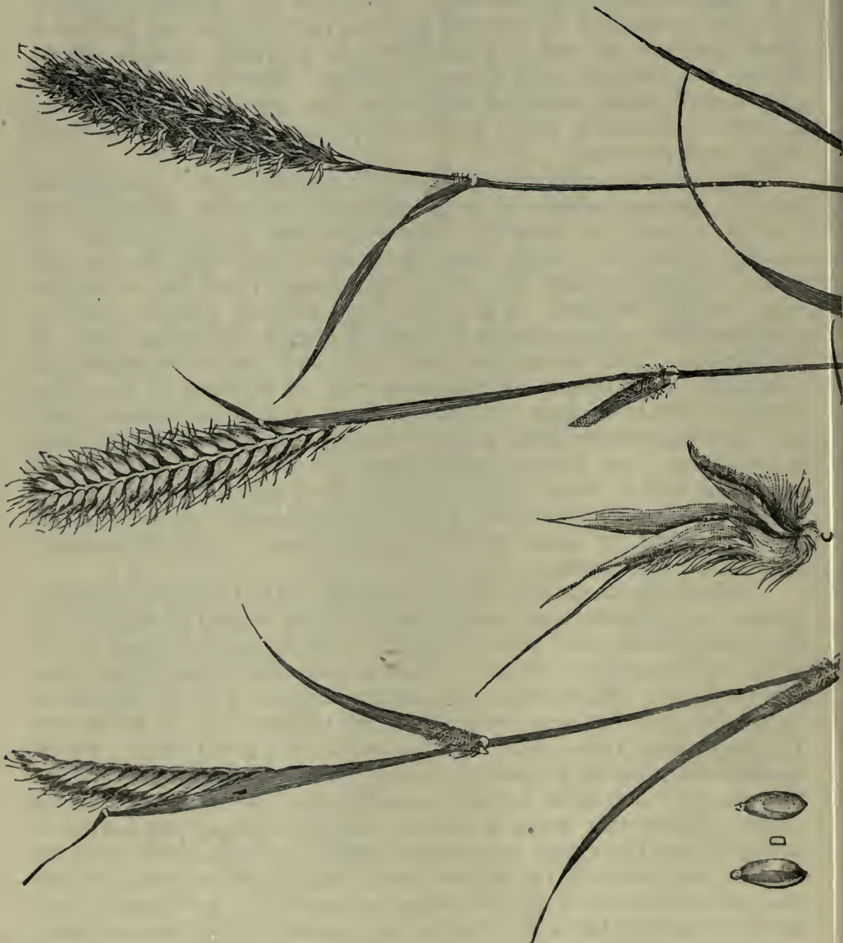
REFERENCE TO PLATE.—A, compound cluster of spikelets; B, cluster of male or barren spikelets, and the fertile one, opened out to show how they are arranged; C, fertile spikelet, opened out to show the three glumes and awn. All variously magnified.

herbivora of all descriptions are remarkably fond of and fatten on. Horses may frequently be seen browsing upon the young flower panicles, which they eat with great relish. In the coastal districts it is often cut and made into hay. Although the "kangaroo" grass develops a number of flowering stems, yet it does not perfect a great amount of seed. What there is, however, usually ripens during the summer and autumn months. Mueller and Rummel give the following chemical analysis of this grass during its spring growth :—Albumen, 2·05 ; gluten, 4·67 ; starch, 0·69 ; gum, 1·67 ; sugar, 3·06 per cent.

Anthistiria membranacea (Lindl. "Landsborough" grass).—An annual species, which is fairly plentiful in many parts of the continent, and is generally found growing on rich soils. It usually grows in small tufts, but in a favorable season the weak stems lengthen out very much, and form an entangled mass over a foot deep. It is essentially a summer growing species, and generally makes most of its growth during the hottest part of the season. The writer has had this grass under experimental cultivation, and raised an excellent crop of herbage in less than three months from seed. It is considered a most nutritious grass, and towards autumn often gets so exceedingly dry and brittle that it breaks up into innumerable pieces, but even then stock of all kinds are said to be so fond of it that they lick the broken stems and leaves from the ground. The "landsborough" grass produces an abundance of seed, which usually ripens during November, December, and January.

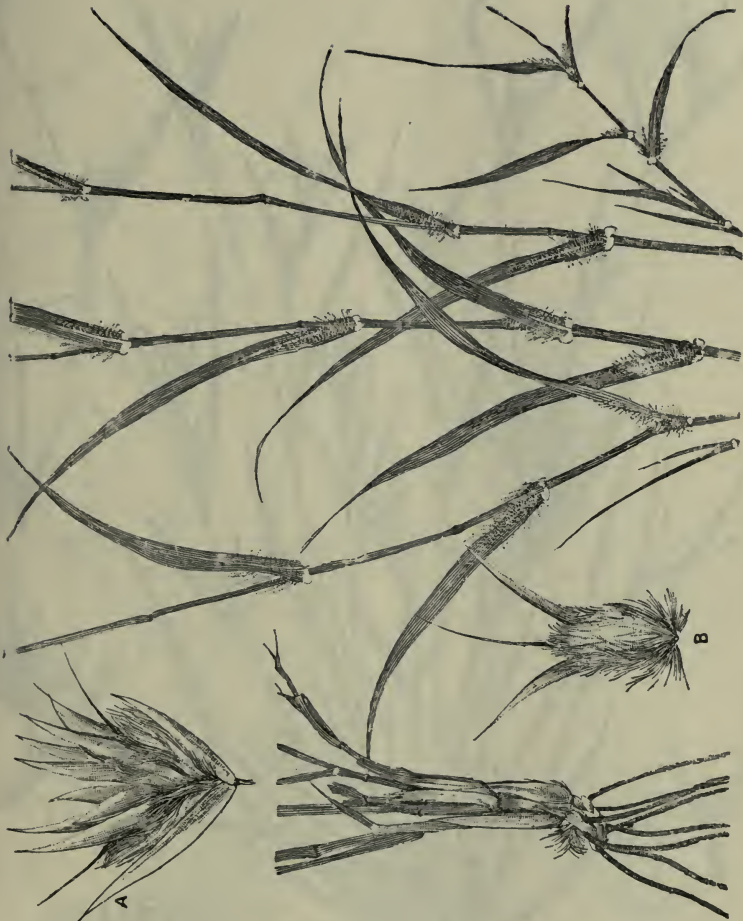
Astrebla pectinata (F.V.M.)—This is one of the famous "Mitchell" grasses which some pastoralists and stockmen regard as the best of all native grasses, both for its drought-enduring qualities and for its fattening properties. On rich soils this perennial grass grows into large tussocks, and in ordinary seasons will yield a great amount of rich, succulent herbage, which is much relished by all herbivora. Its thick, wiry roots penetrate the earth to a great depth, which enables the plant to withstand the most protracted drought, and for this reason it is a most valuable stand-by for stock during adverse times. When this grass becomes so dry during a long period of drought that the stems and leaves break to pieces, stock may be seen licking them off the ground, and they seem to fatten on this feed, notwithstanding its uninviting appearance. An experienced drover once told the writer that stock would travel further and keep in better condition when fed on this than on any other grass in Australia. The seeds of this grass when ripe are like small grains of wheat, and at one time they formed an article of food for the aborigines. The seeds usually ripen during November and December, but sometimes in the autumn months.

Danthonia semiannularis, (R. Br. "Wallaby" grass).—A perennial species found over nearly the whole of Australia, and in some situations it is fairly plentiful. It is very variable as regards stature ;



Astrebla pectinata (F.V.M. "Mitchell" grass.)

Reference to Plate.—C, floret, open ; D, grain, back and front views All variously magnified.



Astrebla pectinata (F.V.M. "Mitchell" grass.)

Reference to Plate.—A, spikelet ; B, floret, closed.

Anthistiria membranacea (Lindl. "Landsborough" grass.)

Reference to Plate.—A, compound cluster of spikelets; B, cluster of male or barren spikelets, and the fertile one, opened out to show how they are arranged; C, fertile spikelet, opened out to show the three glumes and terminal awn; D, male spikelet, opened out to show the three glumes; E, grain, back and front views. All variously magnified.

Danthonia semiannularis (R. Br.) "Wallaby" grass.

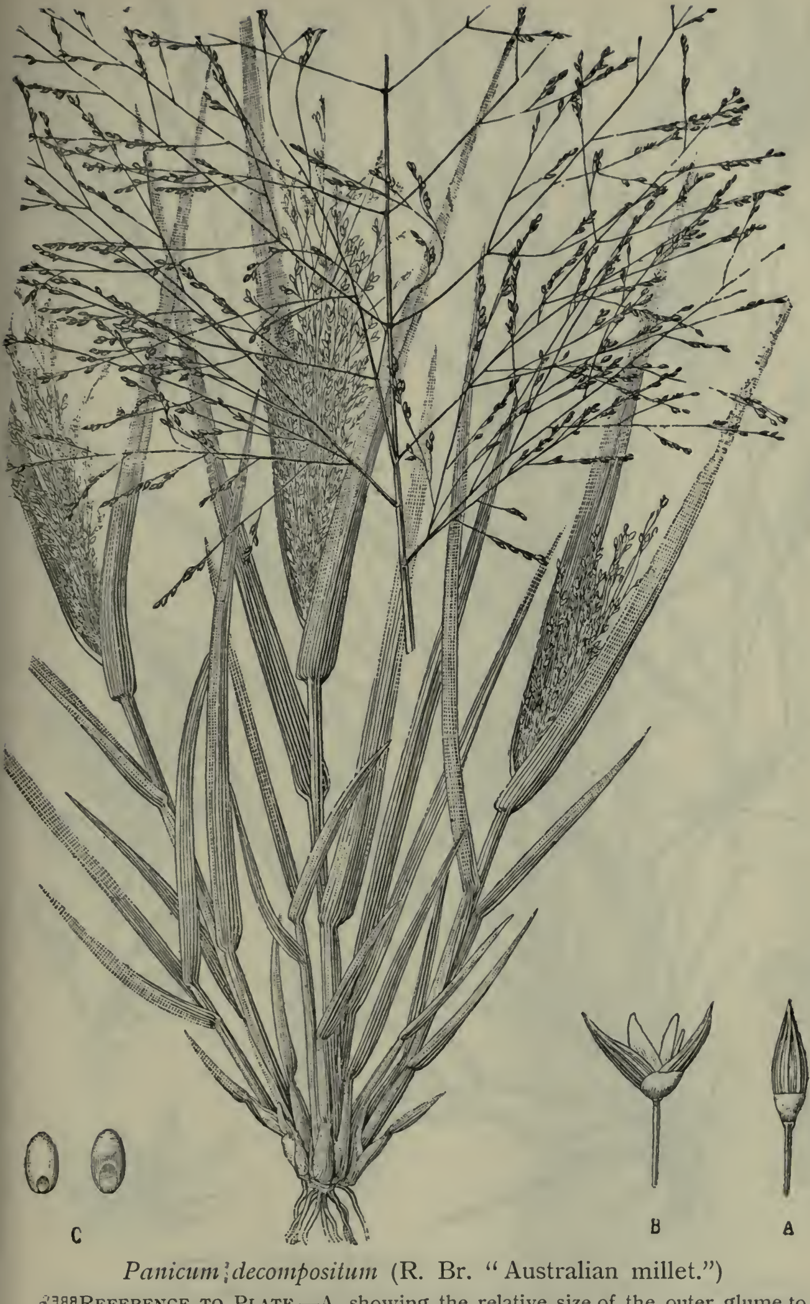
REFERENCE TO PLATE.—A, spikelet; B, floret, closed, showing the three semiannular rings of hairs on the back of glume; C, floret, open; D, grain, back and front views. All variously magnified.

on rich soils and in a fairly good season it grows three feet high, on those of a poorer description it rarely exceeds a foot in height. In all its varied forms, however, it is one of the most nutritious grasses in Australia, and, unlike most other species of the genus, will grow more or less all the year round. Stock of all descriptions are remarkably fond of the plant and fatten on it. The writer has had this grass under experimental cultivation, and the rich, succulent herbage it produced was much superior to that generally seen in pastures. If cut immediately the flower stems appear it makes capital hay. The seeds usually ripen during October, November, and December, but sometimes in the autumn months.

Panicum decompositum (R. Br. "Australian millet").—This valuable grass is found all over Australia, from the coastal districts to the far interior. In moist places and by the side of water-courses, it sometimes attains a height of four feet ; on the plains, however, it rarely exceeds two feet in height. In all its varied forms it yields most valuable herbage, which stock of all kinds are remarkably fond of and fatten on. The writer has had the "Australian millet" under experimental cultivation for several years, and the amount of herbage it yielded in a few months was really astonishing. The hay that was made from it was equal to three tons per acre. The seeds usually ripen during the summer and autumn months. At one time the aborigines used to collect the seeds in large quantities, grind them between stones, make the flour into cakes, bake them, and use them as an article of food.

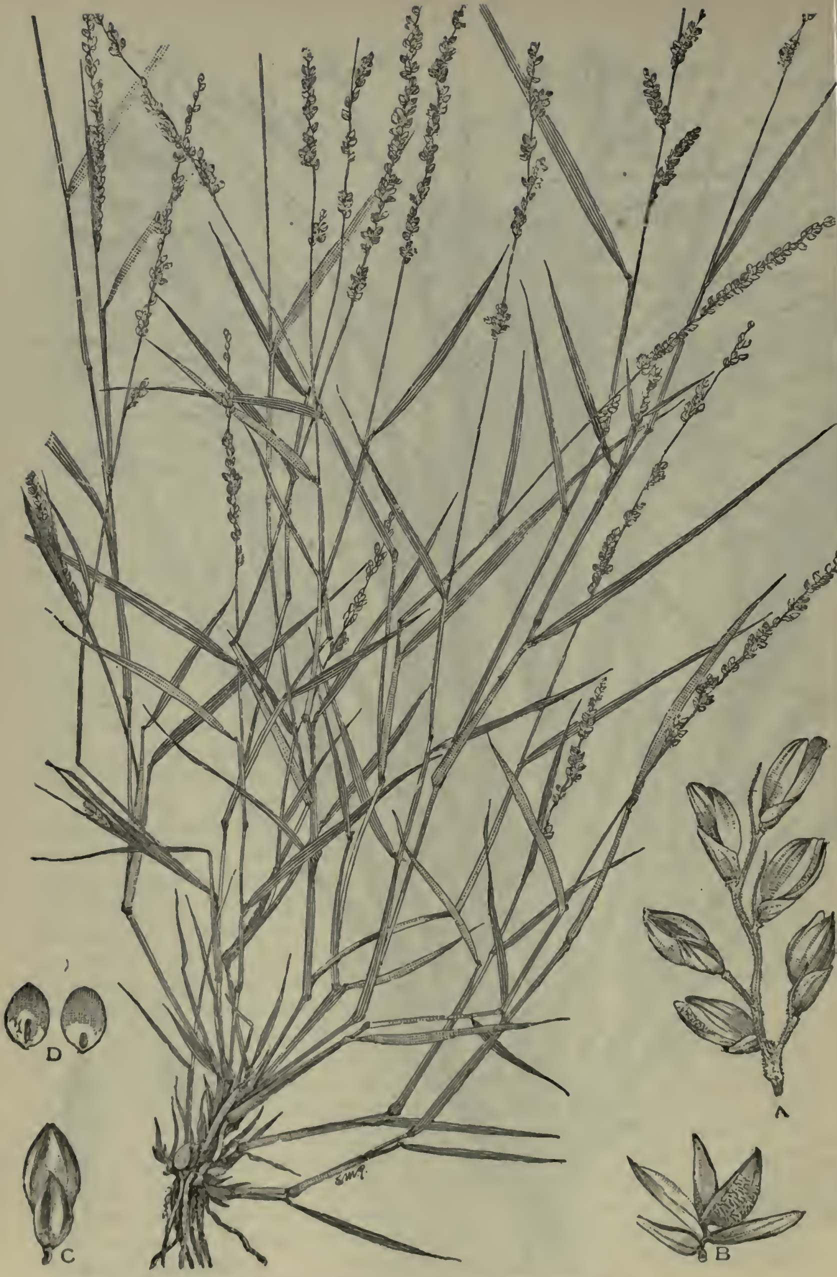
Panicum gracile (R. Br. "Slender panick grass").—This perennial species is fairly well distributed over the continent. It is rather variable in habit, but in all its varied forms it is an excellent pasture-grass which stock of all descriptions are remarkably fond of and fatten on. In rich pastures it yields a very superior herbage. On poor soils and in very dry situations its leaves are narrow, and in dry seasons its stems are somewhat harsh ; still when in this condition cattle seem fond of it. The seeds usually ripen during October, November, and December.

Pollinia fulva (Benth. "Sugar grass").—This perennial species is easily recognised when in flower amongst other grasses by its rich brown, silky spikes. It is generally found growing on the richest of soils, and often on deep alluvial flats, bordering rivers and creeks. It is a superior pasture grass, and is much praised by stockowners, who have given it the name of "sugar grass," on account of the sweetness of its stems and foliage. During the summer months, in an ordinary season, it produces a great bulk of rich, succulent herbage, which is much relished by all herbivora. It makes capital hay. The seeds usually ripen in November and December.



Panicum decompositum (R. Br. "Australian millet.")

REFERENCE TO PLATE.—A, showing the relative size of the outer glume to the spikelet ; B, spikelet opened out, showing the position of the four glumes and two paleas ; C, grain, back and front views. All variously magnified.



Panicum gracile (R. Br. "Slender panick" grass.)

Reference to Plate.—A, showing the arrangement of the spikelets on the rhachis ; B, spikelet opened out, showing the four glumes and palea ; C, showing the relative size of the outer glume on the spikelet ; D, grain, back and front views. All variously magnified.

Pollinia fulva (Benth. "Sugar" grass.)

Reference to Plate.—A, showing the arrangement of the spikelets on the rhachis; B, sessile and pedicellate spikelet; C, sessile spikelet, showing the arrangement of the glumes and terminal awn; D, grain. All variously magnified.

CHAPTER II.

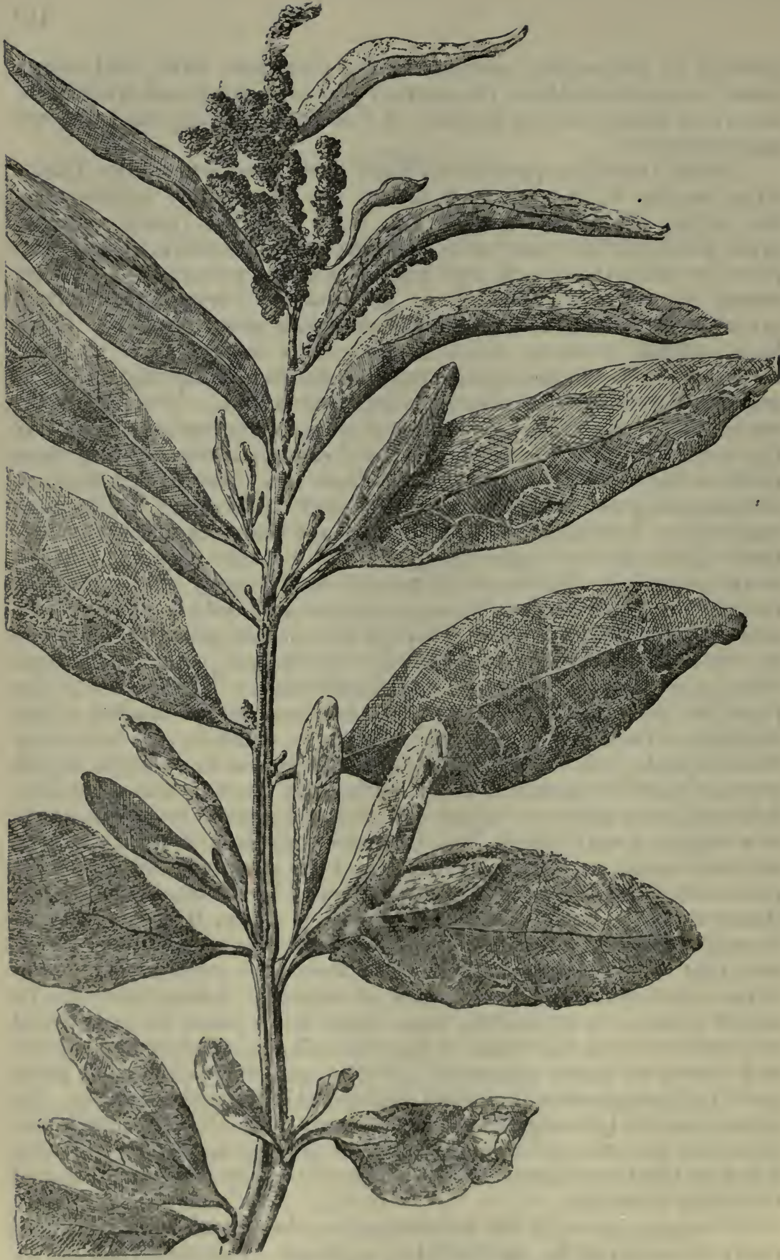
WEST AUSTRALIAN SALT-BUSHES.

By Fred. Turner, F.L.S., F.R.H.S., etc.

Amongst the native forage plants of Australia (non grasses) the most numerous and valuable belong to the natural order *Chenopodiaceæ* (*Salsolaceæ*) numbering as they do for all Australia about one hundred and twelve species, arranged under fifteen genera, eight of which are endemic. Some are found on the littoral sands, whilst others extend to the arid plains of the interior and are remarkable for their drought-enduring properties. Of this total sixty-three species, arranged under fourteen genera, are found in Western Australia. Amongst the best are fifteen species of *Atriplex*, some of which attain the dimensions of good-sized shrubs, whilst others are dwarf, herbaceous perennials. They are fairly well distributed over the colony, grow on a great variety of soils, will live through the driest season, and most of them are good forage plants. Nine species of *Rhagodia* have been recorded from different parts of the colony, most of these growing into good-sized shrubs, but a few being of prostrate habit. They withstand a phenomenal amount of dry weather and have a good reputation as forage for stock. The next large genus is that of *Kochia*, which includes ten species, all of which are remarkable for their drought enduring properties, but on the whole are not considered such valuable forage plants as the species arranged under the two preceding genera. Many of the remaining species are good forage plants whilst young, though exception might sometimes be taken to certain of the following. During protracted droughts balls of cotton-like substance form on *Kochia villosa*, Lindl., *Enchylæna tomentosa*, R. Br., and a few other species of the order. It is generally supposed that this adventitious growth is caused by some insect. Speaking generally, however, only one bush in a thousand is subject to this cottony " gall," except during very protracted droughts, when the " galls " are more plentiful. The fulvous tomentum on some species of *Sclerolæna*, and the woolly covering of the fruits of some species of *Chenolea*, have been known to kill sheep when they have partaken too freely of this indigestible stuff along with other parts of the plants. Only two or three species of *Anisacantha* are found in Western Australia, and these have not nearly such long spines on their fruits as those that are peculiar to the eastern portion of the continent have, and which cause so much trouble to the salivary glands of sheep and other small herbivora if they eat too greedily of these plants when the fruits are near maturity.

Most Australian pastoralists know from long experience that a large number of the salt-bush family are exceedingly tenacious of life, in fact, the drier the season the more luxuriant many of them grow, provided that they are not persistently eaten down. Moreover, there are abundant proofs that when sheep are pastured on country where plenty of salinous plants are growing amongst the natural grasses, distoma and other allied diseases are almost unknown. It has been said that if horses, which are subject to swamp cancer when on the low coast lands, are turned into dry pasture where salinous plants are growing plentifully, they soon lose this disease. Where the salt-bush grows plentifully on pastoral areas in the eastern division of the continent stock thrive during the driest of seasons. But in those parts of the country where the salt-bush has disappeared through over-stocking and other causes, sheep and cattle often die in large numbers of starvation when the grasses and the more tender herbage have died out through drought. To provide against such a contingency in the future it would well repay pastoralists to redisseminate salt-bush on those areas from which it has disappeared, and systematically conserve it where it is already growing. Fenced in salt-bush reserves should also be established on every pastoral holding in the country where the conditions for the growth of the plant are favourable. Most kinds of salt-bush will withstand a few degrees of frost with impunity. Reserves could be made at very little expense, and the best way to lay them out so as to be of the greatest possible benefit to stock during dry times, when other feed is scarce, is as follows :—Each one should be made from half a mile to a mile in length, about two chains in width, and from three to six miles apart, according to the size of the pastoral holding. This plan is recommended for obvious reasons. It is easy to imagine if these reserves were laid out near each other, that the hungry animals would congregate in large numbers at some particular point, and that scores of the weaker ones would be trampled to death. It is really astonishing the amount of excellent forage that can be cut, if done in a systematic way, from a few acres of established salt-bush, even in the driest of seasons. The young succulent shoots and leaves of many species of *Atriplex* and *Rhagodia* make fairly good table vegetables if cooked and served in the ordinary way. On those pastoral holdings where it is difficult and often impossible to grow the common garden vegetables during the hot summer months a few of the best kinds of salt-bush could easily be cultivated and used as a substitute.

Propagation.—All the salt-bushes can be raised from seed, and many of them can be multiplied by cuttings. The latter should be made of the half-ripened wood, cut into lengths of about one



Atriplex cinerea (Poir. "Grey Salt-bush.")

foot or fifteen inches, and put into the ground in the ordinary way. The best time to do this is during the early spring or early autumn months, when the soil is sufficiently moist to keep the cuttings from wilting until root action begins. As soon as the cuttings have taken root they will withstand any amount of dry weather. Speaking generally, most species of the genera *Rhagodia* and *Atriplex*, also several species of *Chenopodium* and *Kochia*, can be readily multiplied by cuttings. The seeds of the different species of *Atriplex*, when mature and dry, are very light, and it will take about twenty thousand of them to a pound. The best time to sow salt-bush seed is in early spring or early autumn, when the ground is moist, but not wet. Under such conditions the seed will germinate quickly, and the plants grow rapidly. The seeds should be sown in patches (about half a dozen seeds together) at distances of about ten yards for the tall-growing kinds, and three yards for the dwarf-growing sorts, and from half an inch to an inch deep. If the soil is of a strong, tenacious character, the seeds should be covered with some light, decayed vegetable matter, which will offer no impediment to the young plants coming out of the soil. The seed can be put in with the aid of a light hoe. It is not necessary to plough the land preparatory to sowing the seed, as salt-bush spreads rapidly on most kinds of soil, once the plants become established thereon, if protected against cattle and sheep for a time. It should be mentioned that to sow the seed broadcast on the land is both an unsatisfactory and expensive way of propagating salt-bush. Most of the seeds being very light, it is a difficult matter to cover them when sown in this way, and if left on the surface they would be blown away by the wind. Following are the descriptions of those illustrations which accompany this chapter :—

Atriplex cinerea (Poir. " Grey salt-bush.")—A branching shrub, which often attains a height of several feet, and is covered all over with a white or grey scaly tomentum. Its leaves are oblong, or lanceolate, and from one inch to two or more inches in length. The plant is peculiar to the saline sands on the eastern, southern, and western seaboards of the continent, and in some places is fairly plentiful. The succulent stems and leaves make excellent forage for cattle, which eat it with great avidity, and they seem to thrive well on this herbage. This salt-bush is easily propagated both by seeds and cuttings. The latter should be made of the half ripened wood and inserted in the soil in the ordinary way. The seeds can be sown where the plants are intended to grow permanently, or in prepared beds, and when the seedlings are large enough to handle they can be transplanted to their permanent positions.

Atriplex halimoides (Lindl. "Salt-bush").—This is a procumbent or diffuse undershrub, often attaining a height of one foot or more. The whole plant has a glaucous or whitish appearance. Its leaves are variable, but mostly ovate-lanceolate or rhomboidal, and from

Atriplex halimoides (Lindl. " Halimus-like Salt-bush.")

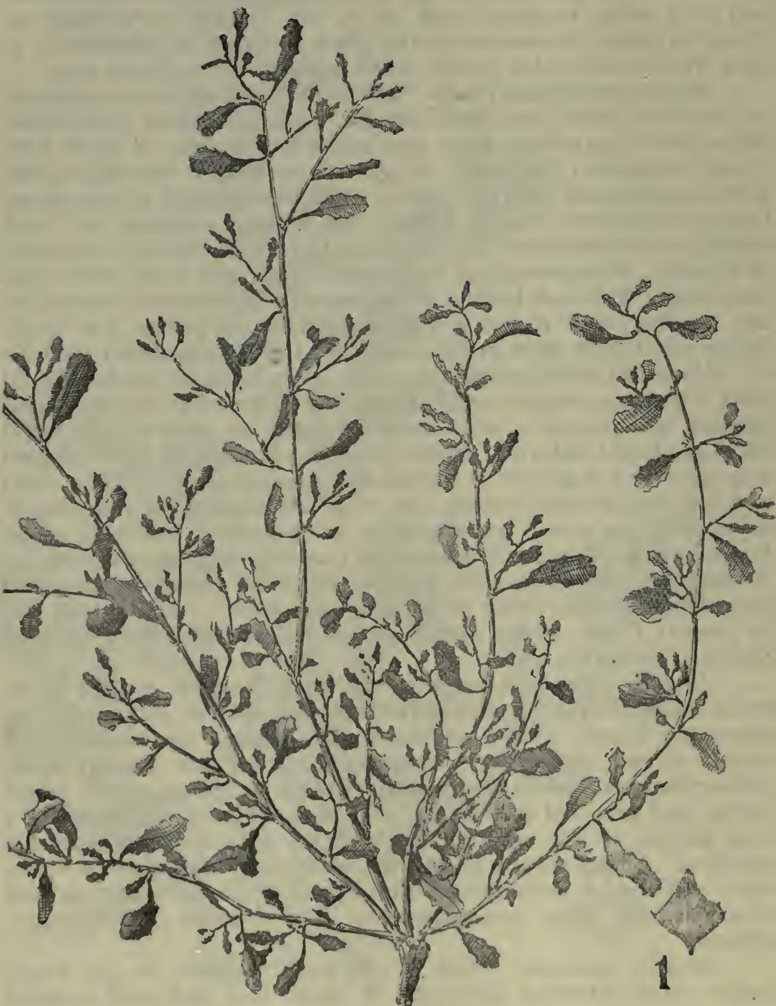
FIGURE 1.—Enlarged drawing of the fruit.

one and a quarter to two inches long. This salt bush is peculiar to the inland plains, and will withstand a phenomenal amount of dry weather. It is a capital forage plant, both for sheep and cattle, and they seem to thrive well on it, the former particularly so. Under ordinary circumstances the plant produces an abundance of seed which germinates readily when sown in the ordinary way.

Artiplex semibaccata (R. Br. "Salt-bush").—This is a procumbent, or prostrate, many branched, slender, perennial plant, with herbaceous stems spreading from one and a half to two or more feet. Under cultivation, however, its growth is simply marvellous, the stems lengthening out very much. The whole plant is pale green, though sometimes nearly white. Its leaves, arranged on short stalks, are somewhat variable in shape, but mostly oblong-lanceolate, or cuneate, sinuate-toothed, and rather thin, and from half to one inch long. This salt bush will withstand a phenomenal amount of dry weather, and it has a high reputation as forage for stock. Sheep eat it with great avidity, and they thrive remarkably well on it. When left unmolested for a time it produces an abundance of seed, which germinates readily under ordinary circumstances. This atriplex has proved a most valuable plant on some of the worst alkali lands of California, single specimens are said to have covered a space with a diameter of sixteen feet in one season. "The yield of a full crop is about twenty tons of green material, or five tons of dry matter, per acre. Some seasons will permit of two such crops. It seems to be already demonstrated that this Australian species of *atriplex* will constitute itself a most important industrial factor in this state, and will render productive vast tracts of land which are at present a blot on the landscape."—Report Agricultural Expert Stations, California.

Atriplex stipitata (Benth. "Salt-bush.")—This species is an erect, bushy, rather slender shrub, covered all over with a white or somewhat brown scaly tomentum. The leaves are variable, but mostly narrow, oblong, very obtuse, contracted into a short stalk, rather thick, and about three quarters of an inch long. It is found on the arid plains of the interior and is capable of withstanding a long period of dry weather without its growth being seriously checked. Sheep eat the plant with avidity and they seem to thrive on it. When left undisturbed for a time it produces a fair amount of seed which, when ripe, germinates readily under ordinary conditions.

Atriplex vesicaria (Hew. "Salt-bush.")—This is an erect, bushy shrub attaining an height of about two feet, and covered with a scaly tomentum. The leaves are variable but generally oblong-lanceolate, contracted into a short stalk, and about three-quarters of an inch long. It is peculiar to the inland plains, and in some districts is fairly plentiful. This, however, may be attributed to the fact that the plant produces an abundance of seed when left unmolested for a time. This salt-bush is regarded as an excellent



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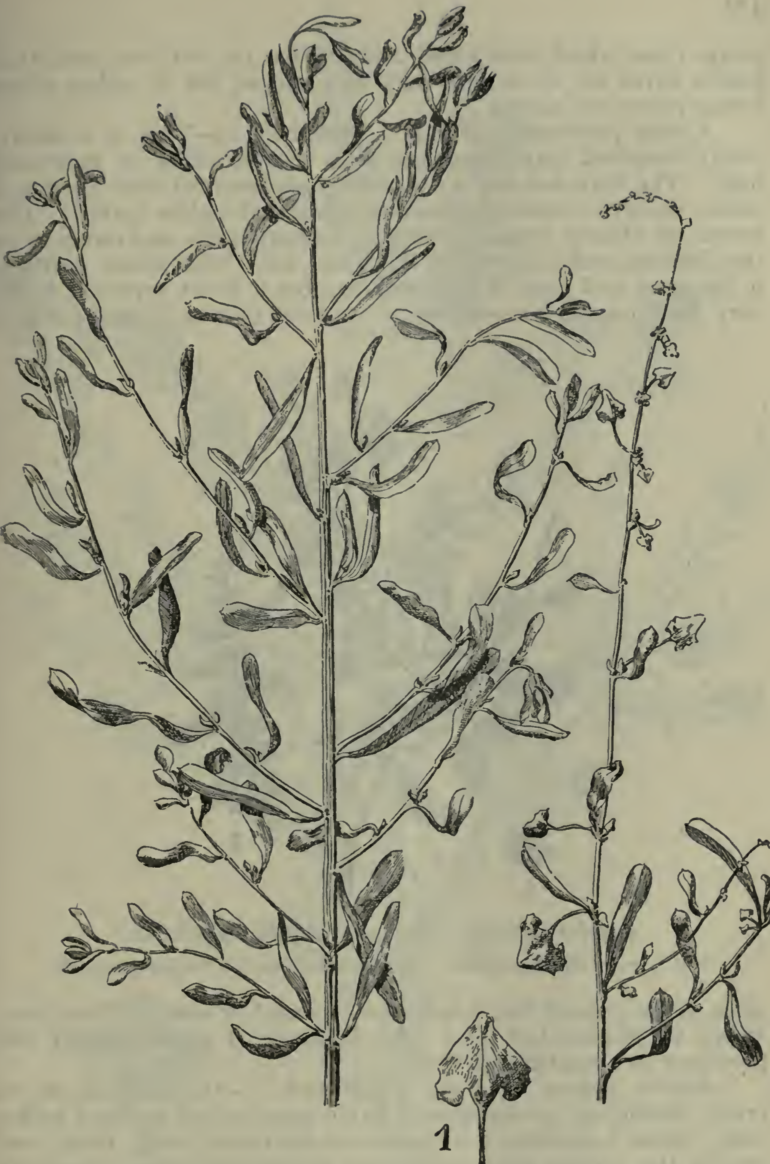
Atriplex semibaccata (R. Br. "Half-berried Salt-bush.")

FIGURE 1.—Enlarged drawing of the fruit.



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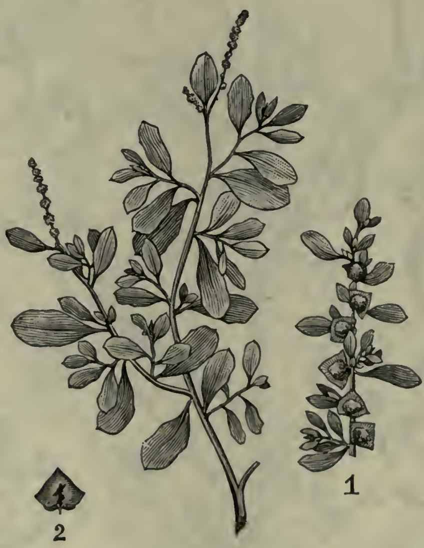
Antriplex stipitata (Benth. "Kidney-fruited Salt-bush.")

FIGURE I.—Enlarged drawing of the fruit.

forage plant which sheep and cattle thrive on, but it is said that horses never do so, in fact they will seldom eat it unless other forage plants are scarce.

Kochia planifolia. (F.V.M. "Salt-bush.")—This is a divaricately-branched shrub, growing from two to three or more feet high. The branches and young foliage are covered with a soft and dense woolly tomentum which wears off the older leaves. The leaves are oblong, obtuse, arranged on short stalks, and rarely more than half-an-inch long, rather thick, but flat. This shrub is found in the most arid parts of the continent, but it is not reported to be very plentiful anywhere. Stock are fond of it, and often eat it so



Atriplex vesicaria, HEW.—" Bladder salt-bush."

FIG. 1.—A fruiting branch. FIG. 2.—Section of a fruiting perianth.

close to the ground that it is generally found in a stunted condition. When left undisturbed for a time, however, it grows rapidly and produces an abundance of seed.

Kochia villosa. (Lindl. "Salt-bush.")—An under-shrub of erect, spreading, or decumbent habit, more or less covered with a silky, villous tomentum. Its leaves are alternate, linear, thick, and soft in the typical form, and about half-an-inch long. There are about half-a-dozen varieties differing more or less from the typical form, though not of sufficient distinction to warrant their being classed as distinct species, notwithstanding their geographical distribution over the continent being considerable. This salt-bush is

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Kochia planifolia (F.V.M. " Broad-winged Salt-bush.")

FIGURE 1.—Enlarged drawing of the fruit.

peculiar to the inland plains and is capable of withstanding a long period of dry weather. Cattle and sheep greedily eat the plant when it is young, and often crop it down close to the ground so that it gets little chance to produce seed for its perpetuation. When left unmolested for a time, however, the plant produces an abundance of seed which, when ripe, germinates readily under ordinary conditions.

Kochia villosa, Lindl.—" Silky salt-bush."

FIG. 1.—Enlarged drawing of the fruit.

Rhagodia billardieri. (R. Br. " Salt-bush.")—A branching, straggling, or erect shrub, sometimes attaining a height of six or more feet. The leaves are about an inch long, usually green above when full grown, and pale or whitish underneath, somewhat variable in shape, but usually oblong-lanceolate. This shrub is found only in the coastal districts, and sometimes on the brink of the ocean ; it is neither affected by the severest gales nor by the spray from the sea. At one time it was growing abundantly along the coast, but where cattle have had free access it is gradually disappearing. Most animals are so fond of its succulent stems and leaves that it is often cropped down close to the ground, and has

Rhagodia billardieri (R. Br. "Coastal Salt-bush.")

FIGURE 1.—Fruiting branch.

little chance to recuperate or produce seed for its natural reproduction. This salt-bush is easily raised from seed and it can be readily propagated by cuttings made of the half-ripened wood and put in the ground in the ordinary way. It is well worth encouraging on the littoral sands, which it would help to bind and prevent being carried inland by the fury of the winds that blow from the ocean.

Rhagodia nutans, R. Br.—" Nodding salt-bush."

FIG. 1.—Enlarged drawing of the fruit.

Rhagodia nutans (R. Br. " Salt-bush").—This is a herbaceous, prostrate or procumbent plant, with slender stems usually spreading from one foot to three or more feet long. The leaves are opposite, or here and there alternate, arranged on slender stalks, and somewhat variable in shape, but generally broadly hastate, with prominent basal lobes, the lower ones about one inch long, but the upper ones get gradually smaller towards the inflorescence. Whilst young the foliage is more or less mealy white. Where this plant is not too closely fed down its prostrate stems often carpet the ground for a considerable distance, which prevents the evaporation of moisture from the soil near its roots. This, of course, enables the plant to withstand a long period of dry weather with impunity. It is an excellent forage plant for all herbivora, sheep being particularly fond of it. Under ordinary conditions it bears an abundance of seed which germinates readily either in spring or autumn.

To Messrs. F. and C. Bennett, the proprietors of the *Town and Country Journal*, the writer's thanks are due for these excellent engravings of grasses and salt-bushes, which have been prepared at their establishment.

CHAPTER III.

FODDER AND FORAGE PLANTS.

(Exclusive of Grasses.)

The bulk of the information given in the following pages is taken from Bulletin No. 2, issued by the United States Department of Agriculture, division of agrostology. Numerous other plants are mentioned in the bulletin, but only those have been selected which it is considered might be successfully introduced into this colony. Some of the varieties are already here, and are deserving of further propagation. The scientific names, as well as the common names of the plants, are given, and also a short botanical description.

Allionia incarnata (Gunaninpil).—A slender prostrate plant belonging to the Four o'Clock family, which comes up from the seed after the summer rains in the grazing region of Arizona and New Mexico, and furnishes a palatable and nutritious food for sheep and cattle. It stands pasturing well, and usually ripens an abundance of seed.

Amaranthus (Bigweed; pigweed; tumbleweed).—On the western ranges there are several species of *Amaranthus* which contribute to the forage. One of these, *A. blitoides*, comes up on new breaking, and with other weedy species is readily eaten by cattle before it has become woody. Because of their tumbling habit, they are rapidly scattered by the winds.

Anthyllis vulneraria (Kidney vetch; common kidney vetch; wound wort; wound clover; sand clover; yellow sand trefoil; lady's fingers. Fig. 1.)—A low perennial legume, which is found wild over a large part of Europe. It grows naturally in very dry and sterile soils along the roadsides wherever the soil is thin and the subsoil calcareous. It is recommended as furnishing a palatable though scant forage on dry, calcareous soils in places that are too poor to support even white clover. The product of the first year is small, so that it is only a profitable crop when sown with grain. The second year the plants throw up tall stems, often three or four feet high. It is not recommended to sow this crop in the United States, except experimentally upon such barren soils as have been described, and then only after the better species have been tried and found to be failures.

Apios tuberosa (Ground nut).—A wild-climbing bean, with milky juice, and straight or slightly curved many-seeded pods, growing in low grounds as far west as the Missouri river. It is eaten by all kinds of stock. The edible tubers, which furnish food for swine, are borne on underground shoots.

Arachis hypogæa (Spanish peanut; peanut; goober; earth nut. Fig. 2).—An annual herb, a native of Peru and Brazil, introduced very widely in cultivation throughout the Southern States. The peanut is hardy as far north as Maryland. This is one of the most valuable fodder plants for the Southern States. There are two varieties—the one which furnishes the peanut of commerce, which requires a long season; and the Spanish peanut, which matures in about three months. The pods of the latter are smaller, and the seeds fewer and smaller than those of the edible

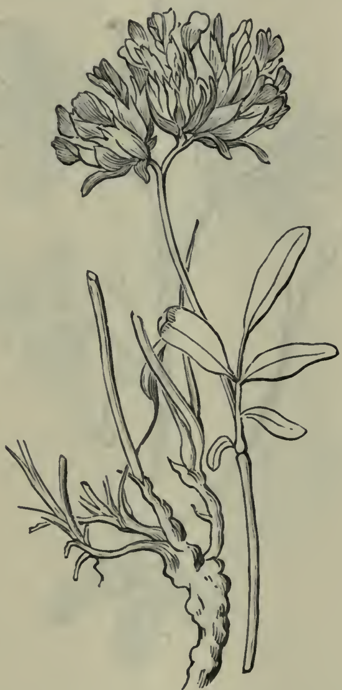


FIG. 1.—Kidney vetch (*Anthyllis vulneraria*).

variety. Peanut-vine hay is more nutritious than that of red clover. The yield of nuts ranges from 50 to 75 bushels to the acre. The Spanish peanut is the one usually grown for forage. The vines are pulled when the pods are about half-formed, and are converted into hay by a method similar to that used in the treatment of cowpeas. The nuts or beans are rich in oil and albuminoids. Peanut meal makes a richer stock food than cotton-seed meal. A valuable oil can be expressed from the seeds.

Astragalus (Buffalo pea ; rattle pod. Fig. 3).—Herbaceous perennials, with pinnate leaves and usually conspicuous bean-like flowers, the pods becoming inflated when ripe. The genus is one of which there are about 100 American species distributed throughout the United States, the greatest number occurring in the prairie

FIG. 2.—Peanut (*Arachis hypogæa*).

and Rocky Mountain regions. Some of the species are, from their wide distribution and number of individuals, of great value on the native pastures of the west. Perhaps the most important of these are :—*A. hypoglottis*, rattle pod ; *A. caryocarpus*, the buffalo pea and buffalo clover of the plainsman ; *A. canadensis*, Canada milk vetch ; and *A. adsurgens*. The buffalo pea has fleshy pods, which are produced in enormous quantities in the early spring. They are eaten by cattle and horses, and are nutritious. The pods have also been used as a vegetable. Besides these innocuous species, the genus contains a number which have attained wide notoriety as loco weeds, poisonous to stock, the worst and most widely distributed one being *A. mollissimus*. Many of the species are worthy of cultivation.

FIG. 3.—Buffalo pea (*Astragalus adsurgens*).

Antriplex canescens (Shad scale. Fig. 4).—A perennial shrub of the pigweed or saltbush family, often attaining a height of ten feet, native in the higher valleys and mesas or table-lands of New Mexico and Arizona. The leaves and small twigs are eaten by cattle, which grow fat upon them, but are said to give a bad taste to milk. It is the principal forage plant of a wide range of territory in the south-west, and deserves to be more widely distributed and brought into cultivation, especially on saline or alkaline soils.

Atriplex confertifolium (White sage; shad scale).—A native saltbush, growing on the high plains of Nevada and Utah, where it furnishes a considerable part of the winter forage. It grows on alkali spots, and is worthy of cultivation in attempts to reclaim lands which are too strongly alkaline to produce better forage plants.

FIG. 4.—Shad scale (*Atriplex canescens*).

Bœhmeria nivea (Ramie; cloth plant; China grass plant; ramie grass).—This well-known fibre plant, which has been introduced rather widely throughout the United States in the last twenty years, furnishes a large amount of forage of fair quality. It is eaten well by all kinds of stock; so that wherever this plant is grown for its fibre it is well to remember that it will also furnish valuable feed.

Brassica napus (Winter rape; rape; dwarf Essex rape).—A succulent and nutritious forage plant, closely related to the Swede turnips. It is adapted to deep, rich, and warm loams and sandy soils. It has been widely cultivated in the northern United States and Canada, and succeeds on any rich and well-drained soil, provided the summers are not too hot and dry. If the ground is in good condition and free from weeds, it may be sown broadcast at the rate of three to five pounds of seed per acre. If the land is wet, however, rape should be sown in raised drills, when one or two pounds will be sufficient. The time for sowing the seed will vary with the object sought, and the climate. For soiling purposes it may be sown in May in the states bordering on Canada, and cut or eaten off when it is sufficiently advanced. It will grow up again and may be used a second time in the same manner, but ordinarily the best results are obtained when it is sown during the latter part of June or the first half of July. When put in earlier, the hot suns

FIG. 5.—Sedge *(Carex retrorsa).*

of August seem to hasten its maturity, and the yield is not satisfactory. If sown in drills, it should be cultivated as long as a horse can be driven between the rows. Sheep may be pastured upon a field of rape by cutting it up into small pens by means of movable hurdles, so that different parts of the field may be depastured in rotation. Cattle should not be turned into a field, because they will trample and destroy much more than they eat. Rape fed to cows increases the flow of milk, and there is less danger of the milk being tainted than when turnips or turnip tops are fed. There is considerable danger in turning hungry sheep or cattle into a field, because of a liability to bloat. It is also a good rule never to turn animals into a field in the early morning.

Brassica oleracea (Cabbage).—An annual or biennial plant, indigenous to various parts of Europe, and widely cultivated as a vegetable throughout the world. Cabbage is largely grown in some parts of Europe as a crop for soiling either sheep or cattle, and as a stable food in late autumn it is far superior to turnips. It has been estimated that the crude protein of an acre of cabbage amounts to about 1 500 pounds—an enormous yield compared with that of alfalfa or red clover.

FIG. 6.—Pigweed (*Chenopodium leptophyllum.*)

Carex retrorsa (Late-fruited sedge. Fig. 5).—A stout, erect, tufted, leafy sedge, 1½ to 3 feet high, growing in wet, boggy places in the lake region of Minnesota and the Dakotas. It is very tender and juicy, and is readily eaten by stock. It is seldom cut for hay, because of its growing in places too wet to be mowed, but it is an important factor in the natural forage of the region. Analyses show that it contains nearly 16 per cent. crude protein. This is one of the species which is deserving of cultivation.

Centrosema virginianum. (Spurred butterfly pea)—A twining perennial bean, with trifoliate leaves and large, showy violet flowers an inch long. The pods are 4 to 5 inches long, many-seeded, linear, flat, thickened at the edges, and marked with a raised line on each side next the margin. Common in sandy woods in the Southern States, extending into tropical America. It furnishes a large amount of valuable forage in woodland pastures, and is worthy of cultivation.

Ceratonia siliqua. (Carob tree ; St. John's bread ; carob bean.)—A leguminous tree, often attaining a height of 50 feet, indigenous to the eastern Mediterranean region, but introduced somewhat widely through the Southern States and in California. Its saccharine pods are very valuable as a food for stock, and are sometimes used as human food. The fruit is abundantly produced, even in arid regions and in seasons of drought. The pods contain about 66 per cent. of sugar and gum, and are fed in rations of about 6 pounds per day, crushed or ground.

Chenopodium. (Pigweed ; goosefoot ; lamb's-quarters. Fig. 6.)—There are a large number of native and introduced species in the United States, all of which are eaten by cattle and sheep, contributing much valuable forage when young. They are adapted to arid and barren lands, as well as to cultivated fields, and should be included in the list of forage plants adapted to the grazing regions of the west.

Cicer arietinum. (Chick pea ; ram's horn ; gram ; coffee pea. Fig 7.)—An annual legume, native of Armenia, which has been cultivated as cattle food and as an article of human diet for over three thousand years. Next to the cereals, it forms the largest part of the food used in Spain, India, and portions of Africa. The seeds are ground into meal, and used in the same manner as cotton-seed meal for fattening animals. The leaves are covered with a clammy exudation, consisting largely of oxalic acid, so that the plant itself is unsuited for forage, but it is often used as a soil renovator. The yield of seed is sometimes very large—upward of 100 bushels to the acre. The crop ripens in about four months.

Cichorium endivium. (Endive.)—This culinary vegetable is particularly adapted as a pasture plant for extremely arid regions, as it matures seed which will germinate in the hottest deserts of central Australia. (Von Mueller.)

Cichorium intybus. (Chicory.)—A well-known perennial, indigenous to Europe and northern Asia, where it is found growing wild along roadsides and in old fields. It is a good fodder plant, especially for sheep, and can be kept growing for several years if it is cut before flowering. The roots are much used as a substitute for coffee.

Convolvulus edulis (Sweet potato).—The tubers are used in many parts of the southern States as food for cattle, and the vines are cured on racks like cowpeas, and used for hay.

Crotalaria juncea (Sunn; sunn hemp).—A fibre plant, indigenous to southern Asia. It is cultivated in India to feed milch cows, and is suited for cultivation in the warmest portions of the United States. In rich, friable soil, under favorable circumstances, it often grows to a height of ten feet.

FIG. 7.—Gram (*Cicer arietinum.*)

Cyperus esculentus (Chufas; hognut; ground almond. Fig. 8). —A perennial sedge, spreading extensively by underground stolons, which produce enormous numbers of edible tubers. In rich, sandy loams it is often cultivated as a food for hogs, which are turned into the field in autumn to root up the nuts. The tubers contain from 17 to 28 per cent. of oil, 27 to 29 per cent. of starch, and 12 to 21 per cent. of gum and sugar. This sedge is important for cultivation in desert regions. The oil extracted from the nuts is said to surpass in excellence all other oils used for culinary purposes.

Fig. 8. Chufas (*Cyperus esculentus.*)

Cyperus strigosus (Tule; tula grass).—A tall sedge with the stems four to six feet high, growing in marshy places in California and Arizona. It is much relished when young by all kinds of stock.

Cytisus proliferus albus (Tagasaste).—A shrubby perennial legume with silvery grey leaves, native of the Canary Islands, which has been recommended for cultivation as a forage plant in hot and dry regions. It will, perhaps, prove of some value in the arid southwest. The seeds, which are slow in germination, should be boiled four or five minutes, or soaked in water for twenty-four hours before planting. The plants should be kept one year in the seed bed and then transplanted to rows six to eight apart in the field where they are to remain, and cultivated until they are two or three feet high. At the end of about the third year cattle or sheep may be turned into the field, and the crop will require no further attention except to occasionally cut back the shrubs to prevent their growing too high. The leaves and twigs are very nutritious, both cattle and sheep fattening rapidly upon them. This plant should be given a thorough trial in the south-western portions of the United States, for, when once firmly established, the tagasaste plants will withstand any amount of drought.

Dasylirion texanum (Sotol).—A fodder plant of the lily family, which occurs throughout western Texas and north-western Mexico. It grows abundantly in the great bend of the Rio Grande, and is there highly esteemed, producing fodder for sheep in the winter season and during periods of extreme drought. The appearance of the plant is something like that of a large pineapple growing on a trunk two to five feet high. The narrow leaves, three to four feet long, and one-third to one-half inch wide, radiate in every direction, forming a rosette at the top of the trunk. The portion eaten is the inner cabbage-like heart, which remains after the spiny leaves have been cut off. An analysis of this, made by the chemist of the Department of Agriculture, shows that it contains about 12 per cent. of sugar and gum, and about 3 per cent. of crude protein, besides 65 per cent. of water. No attempt has been made to cultivate sotol, and it is becoming exterminated in many portions of its range. Sheep can exist upon it four or five months in the winter without access to water, so that it would be an excellent forage plant for dissemination and cultivation in arid regions where the winters are not too severe.

Desmodium tortuosum—D. molle (Beggar weed ; Florida beggar weed ; cockshead ; Florida clover ; tick trefoil ; West Indian honeysuckle. Fig. 9). An annual leguminous plant, indigenous to Florida and the Gulf States, extending into the West Indies and tropical America. This is undoubtedly one of the very best forage plants for those portions of the United States where it grows. The stems are tall, and, if grown at considerable intervals, are woody, but where seed is scattered thickly over the ground the entire plant can be converted into hay or ensilage. Florida beggar weed springs up naturally in fields wherever the ground has been disturbed, about the middle of June, and matures a crop in seventy-two to eighty days. On sterile clay soils in the vicinity of Washington, D.C., beggar weed grows three to four feet high. In the rich, moist, sandy fields along the Gulf of Mexico it grows from six to ten feet high. Horses, cattle, and mules are very fond of it. Beggar-weed hay contains about twenty-one per cent. of crude protein. At a yield of ten tons, the amount of fertilizers contained in a crop yielded by one acre has been estimated at : Potash, 80 pounds ; phosphoric acid, 160 pounds ; and ammonia, 400 pounds. It will be seen from this that as a renovator of worn soils, or as a green manure, no better or cheaper fertilizer can be added to a field than to turn under a rank growth of beggar weed. The tap root descends deeply into the soil, bringing up mineral fertilizers from the subsoil, which can be utilized by other crops. Beggar weed can be sown after a crop of oats has been harvested, or it can be scattered between corn rows after the crop has been laid by. Six to ten pounds of clean seed are enough for an acre. If beggar weed is tried as a crop

FIG. 9.—Beggar weed (*Desmodium tortuosum*).

in the north, it should not be planted until midsummer. If planted early, the seed will lie in the ground and will fail to germinate until the ground has become warm. Clean seed can be procured in the markets at about fifteen dollars per bushel of sixty pounds. Beggar weed makes an excellent quality of ensilage, either alone or mixed with corn fodder.

Desmodium triflorum.—A densely matted perennial herb, occurring in tropical regions of Asia, Africa, and America. Roxburgh states that it helps to form the most beautiful turf in India, and that cattle are very fond of it. It springs up in all soils and situations, furnishing an excellent fodder in places too hot for ordinary clover. It deserves trial in the warmest portions of the Southern States. There are many other species of *Desmodium* in the eastern and southern United States, some occurring in woodlands, and others found only in open prairies. All are eaten with avidity by stock, and all are worthy of an extended trial in cultivation, although on account of their jointed pods covered with minute hooked hairs they are perhaps liable to become weeds. The foliage produced by them is exceedingly nutritious, and because they are strong growers they would have some value in reclaiming worn lands.

Dioscorea batatas (Chinese yam; yam).—A rank-growing vine cultivated in all tropical countries for its edible roots. It is propagated by means of aerial tubers which form in the axils of the leaves. This has been introduced into tropical Florida. The fleshy, mucilaginous roots serve as food for man, and are readily eaten by all kinds of stock.

Dolichos multiflorus (Velvet bean; banana field pea; banana stock pea).—A rank growing vine with plump, velvety pods, each containing three or four large oval beans. An ornamental, which promises to become a valuable forage plant on sterile, sandy soils in the South. In Florida it has yielded at the rate of 16,680 pounds of green forage per acre. It is there esteemed as a winter mulch, as, when killed by frost, the leaves remain on the vines over winter.

Erigeron canadensis (Horseweed; butterweed; fireweed).—A bristly, hairy, erect, wand-like, annual composite, with numerous linear, mostly entire, leaves, and very numerous heads of small dirty white flowers. A cosmopolitan weed growing in waste lands, fence corners, and along roadsides. This species has been reported valuable as sheep fodder in the arid regions of New Mexico and Arizona.

Erodium cicutarium (Alfilaria; storksbill; pin clover; pin grass; pinweed; filaria; filaree; alfilarilla).—This weedy annual has nearly as large a distribution as the following species, but is of less value. This species has been regarded by agricultural writers as the true *Alfilaria*, but according to Professor Greene its occurrence is rare compared with that of *E. moschatum*, and its foliage is more fragrant and less readily eaten by stock.

Erodium moschatum (Cranesbill; alfilaria; storksbill; pin clover; pin grass; pinweed; Filaria; pilaree; alfilarilla).—An annual of the geranium family, which occurs abundantly and is of much value in pastures over a large extent of territory on the Pacific slope. Elsewhere in the United States it is sparingly introduced, and usually regarded only as a weed, though not troublesome. It springs up during the wet season from January to June, and grows on all kinds of soils from the coast up to the snow line. It is an excellent pasture plant, but seldom reaches a sufficient height to be mowed for hay. It is eaten by all kinds of stock as long as it is green, but when dry is of little value, because the stems are brittle and break up into small fragments. It is cultivated to some extent, and has been recommended for sowing in pasture lands in the Southern States. A related species, *E. cygnorum*, native of Australia, is considered one of the best forage plants of the drier regions of that continent.

Ervum lens (Lentil ; Winter lentil).—An annual legume, native to and widely cultivated in Europe. The leafy stalks make good forage. Its seeds are palatable and nutritious as food for man and domestic animals. It is suited for cultivation in cold climates and in the mountains at high elevations. The seeds retain their vitality for about four years. The variety called the "winter lentil" is more prolific than the "summer lentil." In common with most other leguminous plants, a calcareous soil is essential for its prolific growth.

FIG. 10.—Winter fat, or sweet sage *(Eurotia lanata).*

Eurotia lanata (Winter fat ; white sage ; sweet sage. Fig. 10).—A perennial half-shrubby plant growing a foot or two high, abundant throughout the Rocky Mountain region from British Columbia to Mexico. Its slender woolly twigs bear narrow leaves an inch and a half long, with velvety grayish surfaces, and with the margins rolled back. The flowers are minute, in small clusters in the axils of the leaves, chiefly on the upper parts of the stem. In western Texas and in the more arid regions of Arizona, Nevada, and Utah this plant is very highly valued for winter forage. An important fact in regard to the plant is its ability to thrive in alkali soils. It contains a bitter principle, which is sometimes employed as a remedy for intermittent fevers. Sheep and cattle grazed on lands where winter fat grows, increase in weight rapidly, and are said to be remarkably free from disease. It is worthy of trial, and should be introduced into the pastures of all arid and semi-arid or alkaline grazing regions.

Fava vulgaris (Horse bean; broad bean; common field bean; straight bean).—A coarse, erect, rank-growing annual of considerable value as a forage plant, grown in the eastern United States, and more extensively in Europe. The beans, which contain about 33 per cent. of starch, are used for fattening cattle, but their use, if long continued without change or without proper admixture of other foods, often results in paralysis, on account of the bitter poisonous alkaloids which the seeds contain.

Fagopyrum esculentum (Buckwheat; common buckwheat; Japanese buckwheat; silver-hull buckwheat).—Buckwheat, the well-known annual cultivated for its seeds, is a native of northern Asia, and has been under cultivation about 1,000 years. It succeeds in cold climates on the poorest land. For fodder, or as green manure, clayey soils produce the largest crops. On account of the short season in which it matures, it is adapted to cultivation in high latitudes and alpine regions. It is an excellent soiling crop, either fed alone or with oats or green corn, and is recommended for soiling milch cows.

Franseria dumosa.—A shrubby plant related to the cocklebur, which is one of the most characteristic plants of the Colorado desert and the dry sandy plains of southern California. It is valuable food for stock, either dry or green. It produces an abundance of burs, which are eaten by cattle and horses, and are as fattening as grain. It also makes a very fine feed for sheep. It dries up after the winter rains, but becomes green after every shower.

Galactia glabella (Smooth milk pea).—A low, prostrate or twining, perennial bean with nearly smooth stems, trifoliate leaves, and purple flowers in interrupted or nodding racemes. Common in sandy woods from New York to Florida and Mississippi. It makes an excellent summer forage for milch cows, and adds value to woodland pastures.

Galactia pilosa (Milk pea).—Like the last species, but with stems and leaves soft and downy. It is of some value as a summer forage in the eastern United States.

Galega officinalis (Goat's rue; goat's clover).—A perennial legume, with erect, branching, leafy stems 1½ to 2 feet high, pinnate leaves, and purple flowers born on a long-stalked spike. A forage plant of value on account of its resistance to drought, which has been recommended for the northern prairies and central Rocky Mountain districts. It is usually fed green, as it makes a poor quality of hay, and is not readily eaten by stock until they have become accustomed to its taste. The air-dried hay contains 17 per cent of crude protein.

Genista scoparia (Scotch broom).—A shrubby, perennial legume, native of Scotland. The young growth is chiefly valued as a food for sheep and other animals in winter.

Gleditschia triacanthos (Honey locust).—A leguminous tree 30 to 60 feet high, native of the eastern United States. The pods are eaten by stock, and the young growth is browsed down by cattle.

FIG. 11.—Soja bean (*Glycin hispida*).

Glycine hispida (Soja bean; soy bean; coffee bean. Fig. 11) —An erect annual legume, with hairy stems and leaves, which has been cultivated in China and Japan from remote antiquity. It was long grown in botanic gardens, but when the facts concerning its use as a human food by oriental nations came to light about twenty years ago, it was largely introduced into this country and Europe, where thorough trials of its forage and food value have been made. There are a large number of named varieties, which vary in the color of their seeds and the length of time which the plants require to come to maturity. The seed is planted at the rate of half a bushel to the acre, in drills $2\frac{1}{2}$ to 3 feet apart, and cultivated about the same as Indian corn. In Virginia, soja beans are planted between the hills of corn, so that two crops are produced on the same field at the same time. The yields of seed are often enormous. Soja beans are fed to stock green, as silage, or as hay. The haulms are rather woody, and do not make the best quality of

FIG. 12.—Sulla (*Hedysarum coronarium*).

hay, but as either ensilage or green forage they are unsurpassed. The hay contains from 14 to 15 per cent. crude protein and 3 to 6 per cent. of fat. The beans contain from 32 to 42 per cent. protein, and from 12 to 21 per cent. of fat in fresh material. When fed to milch cows, a ration of soja beans increases the yield of milk, improves the quantity of the butter, and causes the animal to gain rapidly in weight. It is an excellent addition to a ration for fattening cattle. In China and Japan, where the soja bean is an article of diet, substances similar to butter, oil, and cheese, as well as a variety of dishes, are prepared from it. The yield of green forage amounts to from 6 to 8 tons per acre, and of the beans from 40 to 100 bushels. The feeding value of the bean has been found to be greater than that of any other known forage plant except the peanut.

Hedysarum coronarium (Sulla; Spanish sanfoin; French honeysuckle; Soola clover; Maltese clover; honeysuckle. Fig. 12).—This perennial legume is a native of southern Italy, and was first introduced into cultivation in 1766. It grows best on sandy or clayey soils which are well drained, or which have the ground water from six to ten feet below the surface. It will withstand slight frosts, but is killed if the roots are frozen. It is a perennial in southern Italy, Sicily, and Algeria, but must be resown each year in northern Italy, where the winters are more severe. It has not as yet been largely introduced into this country, but deserves to be given a trial in Florida and the Gulf States. The practice is to sow the seeds in September or October, on land that has been deeply ploughed and thoroughly pulverised, either alone or with winter oats or wheat. After the latter has been taken off the field, a crop of sulla four to six feet high springs up, and is ready to cut from the latter part of May to July. In feeding value it compares very favorably with either red clover or alfalfa, and is better adapted to tropical or sub-tropical climates, provided seed is sown on well-drained and well-prepared land. If the seed bed is only given a shallow cultivation in preparation for sowing, it will require a full year before one crop can be taken from the land. The same precautions are necessary in using sulla as a soiling crop as with clover and alfalfa, to prevent loss of cattle through bloating.

Helianthus annuus (Sunflower).—The sunflower is a well-known annual weed, a native of Peru, which has become widely spread throughout the United States. Its leaves and heads make good green fodder for cattle and horses, and its oily seeds, which are produced at the rate of from 40 to 50 bushels to the acre, furnish an oil cake which is a valuable stable food. Six pounds are required to seed an acre. It is said to endure the excessive summer heat of central Australia better than any other cultivated herb that has been tried there, and deserves to be regarded as other than a useless weed in our own arid and semi-arid grazing and pastoral districts.

Helianthus tuberosus (Artichoke).—The artichoke is a native of North and South America, and has been cultivated in this country for fifty years or more for its edible tubers. Fed to milch cows, these tubers, which contain large amounts of sugar and gum, increase the flow of milk enormously. The leaves are also eaten by all kinds of stock. Artichokes are planted like potatoes, but greater distances apart, and the yield is from 200 to 500 bushels per acre. On rich and friable soils it yields spontaneously and uninterruptedly for several years without replanting. The tubers should be dug in autumn after the upper part of the plant has been killed by frosts, as at that time they contain the most sugar. It grows best in loams containing a high percentage of potash.

Hippocrepis comosa (Horse-shoe vetch).—This perennial fodder plant is quite widely cultivated in middle and southern Europe and northern Africa. It grows best on stony ground, especially on soils containing lime. It furnishes an early and very nutritious, though scant, forage, and is worthy of a trial on stony soils in the warmer portions of the United States.

Fig. 13.—Wild vetch (*Hosackia purshiana*).

Hoffmanseggia.—Leguminous shrubs or herbaceous perennials native of Texas and New Mexico, especially along the Rio Grande and its tributaries. The foliage is eaten by stock. Small, sweet tubers are produced by certain species, which in years of famine are eaten by the Mexicans and Indians.

Hosackia glabra (Deerweed).—This low bush of weedy herb grows on the mesas, and in the mountains and desert regions of southern California. It grows two or three feet high on the driest and most sterile soils, and is an excellent forage plant. It sometimes occurs in such abundance that it is cut for hay. As it ripens a large amount of seed each year, this is a promising species for trial under cultivation.

Hosackia purshiana (*Lotus americanus*; wild vetch. Fig. 13).—An annual vetch widely distributed from Minnesota to Arkansas and west to the Pacific, in fields and open prairies. The erect branching stems are 6 to 18 inches high, the trifoliate leaves nearly sessile, smooth to silky haired, the flowers small, solitary, and inconspicuous, the pods narrow, flattened, six-seeded, and about an inch long. It is very common in the prairie region, especially along the Upper Missouri, and in some parts of California. It blooms all summer, and being readily eaten by all kinds of stock is on this account a valuable plant on the ranges, withstanding close pasturing and trampling, and reseeding itself freely, no matter how closely it may

Fig. 14.—Winter flat pea (*Lathyrus cicer*).

be eaten down. Cattle and sheep become "rolling fat" on pastures where this vetch abounds. It is one of the most promising native forage plants, and should be given an extended trial in cultivation, being particularly adapted to the drier soils.

Lathyrus cicer (Winter flat pea. Fig. 14).—A forage plant cultivated to some extent in Germany and Switzerland, and particularly valued because it becomes green earlier in spring than almost any other forage crop. The seeds are sown at the rate of two bushels to the acre. Its appearance is much like the more common flat pea. It reaches a height of one or two feet.

Lathyrus hirsutus (Winter vetch).—This vetch is one of the best that has been grown in the Southern States for winter forage. It is sown in September or October, so that it may germinate with the fall rains and become established before cold weather. It grows slowly until the ground freezes. By the first of January the roots are sufficiently developed so that the tops begin to grow rapidly, and by February the plants form a dense mat and continue to grow until hot weather. The plants bear grazing well, and stock of all kinds eat the dry hay. For the Gulf States this is one of the most valuable species of vetch for winter and early spring fodder. It reseeds itself freely. (Tracy).

Lathyrus macrorhizos.—A native of Western Asia which would be valuable for introduction into this country. It makes a good growth on the most barren woodlands, especially in mountain regions.

Lathyrus polymorphus (Everlasting pea).—A low pea, 6 to 12 inches high, with very large purple flowers, common on the prairies from Missouri and Nebraska westward. This furnishes considerable pasturage, and ought to be given a trial in cultivation.

Lathyrus sativus (Bitter vetch).—A native of middle and southern Europe, which is adapted to cultivation in cold climates and alpine regions. The fodder is superior to that of vetches, but the yield is scant. In India it is grown as a winter crop, often on heavy, clayey soils which will grow no other legume. Great caution must be used in feeding the seeds of this plant, as they contain an alkaloid which is highly poisonous to domestic animals and to man. It has not been cultivated much in this country.

Lathyrus splendens (Pride of California).—This vine has been introduced into gardens because of its beautiful flowers. It grows wild in the mountains of Southern California, and is said to be an excellent forage plant.

Lespedeza striata (Japan clover. Fig. 15.)—An annual herb naturalized in this country, especially in the South. Cattle and sheep are fond of it, and because of its deep roots it withstands drought, so that it is excellent clover to sow in mixtures with taller growing-species in dry pastures. It is particularly valuable in such places because the herbage has a salty taste and is welcome in hay.

Lotus tetragonolobus (Square pod pea. Fig. 16.)—A much-branched ascending annual, closely related to the birdsfoot clover. It is a native of southern Europe, and is there grown for salads and as an ornamental plant. It has been recommended by the California Experiment Station as the best winter crop for ploughing under in spring as green manure. It yields from 20 to 25 tons of green fodder, equivalent to four or five tons of air-dried hay, and the roots are described as being fairly incrusted with tubercles, whose office it is to extract nitrogen from the air ; and though the plant does not contain as high a percentage of crude protein as alfalfa or the clovers, it is worth as a green manure two or three times as much as either, because of the enormous amount of herbage produced. Sown in January, it will be ready to be ploughed under in May. The seed should be sown broadcast thinly on freshly ploughed land and harrowed in.

Fig. 15.—Japan clover. (*Lespedeza striata*).

Fig. 16.—Square pod pea. (*Lotus tetragonolobus*).

Lotus uliginosus (Swamp horn clover).—This is a slender branching clover, with heads of rather large, yellow flowers, and slender elongated pods. It is a native of northern Europe, where it is esteemed for swampy meadow lands.

Lupinus albus (White lupine. Fig. 17.)—An annual, native to the Mediterranean region, which is widely grown in Europe, and to a less extent in this country, for soiling and green manure. On rich soil it grows from two to three feet high, and is recommended as a crop to plant for purposes of enriching the ground, and at the same time freeing it from weeds. It has a deep tap-root well supplied with tubercles, which gather large amounts of nitrogen from the air. It yields good forage while young, but should not be fed after the flowers appear. The seeds contain a bitter alkaloid. After this has been removed by soaking or boiling, the seeds are sometimes used as food.

Lupinus hirsutus (Blue lupine).—The blue lupine is an annual, much resembling *L. albus* in value and habit of growth. Its only use is for turning under as a green manure.

Lupinus luteus (Yellow lupine; scented yellow lupine).—This annual species is the one most generally used in middle Europe to improve sandy soil, as the best of all yet tested. It is satisfactory

Fig. 17.—Lupine (*Lupinus albus*).

even on sand dunes along the coast. Like the other lupines, it can be fed green, or as hay. The seeds of this species are very fattening when used as an addition to hay, and are in this respect quite equal to oil cake, while the foliage is said to be not inferior to that of clover, and more bulky. Ninety pounds of seed are required per acre. It should be sown in spring as soon as the ground is warm. It attains maturity very rapidly. Lupines, unlike most other leguminous plants, do not do well on calcareous soil nor on ground which is at all wet, but for improving sandy fields they have few equals. There are about ninety species of lupines native of the United States, principally in the Rocky Mountains and Pacific coast regions, and many of them have acquired local reputation as being good pasture plants, particularly those that grow in the arid south-west. One of our species, *L. perennis*, which is common to this country and the old world, is often cultivated as an ornamental plant in gardens, and has been recommended by German agriculturists as equal to white lupine in certain dry soils.

Fig. 18.—Tarweed (*Madia sativa*).

Madia sativa. (Tarweed. Fig. 18.)—A rank-growing annual, native to both Chili and California, which has been recommended as furnishing an excellent summer sheep forage. The leaves are clammy, with a viscid exudation, and the plant has a rank odor. Its chief merit is its rapid growth. It is cultivated in the arid southwest and California, and makes a palatable and nutritious food for sheep. An excellent lubricating oil is extracted from the seeds.

Manihot aipi. (Sweet cassava ; cassava. Fig. 19.)—A spurge, native of the tropics, largely cultivated in the West Indies, Central and South America, and to a less extent in Florida and California. It is a rapid grower, with rank, branching, erect stems four or five feet high, large, seven-parted, long-stalked leaves, and horizontal fleshy roots or tubers three to five feet long and from one to two-and-a-half inches in diameter. It thrives in loose, dry, sandy loams, and produces from 6,000 to 8,000 pounds of roots per acre on soils of average fertility, to 10,000 or 20,000 pounds on fields that have received a large amount of fertilizers. The roots are fed

FIG. 19.—Cassava (*Manihot aipi.*)

whole or sliced to all kinds of stock. They contain 72 per cent. of starch, 17 per cent. sugar and gum, and over three per cent. of albuminoids. On account of the small amount of flesh-formers contained in the roots, they should be fed with some nitrogenous food to make up the deficiency. Cassava is propagated by means of cuttings of the stems, each piece having two or three eyes or buds. These are planted in hills four feet apart each way, and the rows rolled, to pack the earth around the cuttings and prevent their drying out. The roots should be dug only as fast as they can be used, as they rot very quickly when exposed to the air.

Medicago denticulata (Bur clover ; medic clover ; medick bur ; toothed medick. Fig. 20).—An annual clover, native of the Mediterranean region, which has become naturalized in most warm countries. It was early introduced into California, and has become widely distributed in that State and in the grazing regions of the south-west. It is not as nutritious nor as palatable as either alfalfa or clover, but fills in the season when other more important forage plants have become dried up by the summer heat. Stock of all kinds fatten upon the burs, which they pick from the plant while it is growing, and search for on the ground after the foliage has

Fig. 20.—Bur clover (*Medicago denticulata*).

become completely dry and dead. It flourishes best in moist valleys and along the coast where there is abundant rain, from January to June. It also occurs on the drier uplands back from the coast, but does not do so well in such localities. One of its disadvantages is that its prickly burs become entangled in the wool of sheep. It has become widely disseminated over the ranges, and adds much to the value of the summer pasturage. To establish a crop of this clover, the burs may be scattered broadcast in autumn. They will root as soon as the winter rains come. They may be harrowed or cultivated in the early spring.

Medicago falcata (Yellow lucerne; yellow moon trefoil).—A close relative of alfalfa, much resembling it, but smaller, and with yellow flowers. It grows wild in northern Europe, along roadsides and fence corners, and in light or sterile soils. It has been cultivated to some extent, but it is without value, except that it furnishes a scanty pasturage on soils too barren for better and ranker growing species. It is even more susceptible than alfalfa to excess of water in the soil.

Fig. 21.—Alfalfa, or Lucerne.

Medicago lupulina (Black medick; hop clover, in part; yellow clover, in part; nonesuch; black grass; shamrock, in part; lupuline).—An annual or biennial clover, widely grown as a pasture plant in wet meadows and on stiff, clayey soils which are too poor to grow alfalfa or clover. On rich, moist soil it sometimes makes an enormous growth, but ordinarily its only use is in pastures. It is sometimes recommended to be sown mixed with white clover for lawns, as it remains green through the driest summers.

Medicago maculata (Spotted medick; bur clover; California clover; black medick; heart clover; St. Mawe's clover; Arabian snail clover).—An old world pasture plant, which has become widely introduced in the eastern and southern States, as far west as Texas. It is very similar to *M. denticulata* in appearance and in its feeding qualities, and is often mistaken for the latter.

Medicago sativa (Alfalfa; lucerne; lucerne clover; lucerne medicago; lucerne clover; Spanish trefoil; purple medick. Fig. 21).—Alfalfa, or lucerne, is one of the best known and most widely distributed of fodder plants. It is an upright, branching, smooth perennial, one to three feet high, with three-parted leaves, each leaflet being broadest above the middle. The purple pea-like flowers, instead of being in a head, as in red clover, are in long, loose clusters or racemes, scattered over the entire plant. The ripe pods are spirally twisted, and each contains several seeds. Alfalfa is a deep feeder. The taproot descends to a great depth wherever the soil is loose and permeable, often averaging ten to fifteen feet, while extraordinary depths of 50 or 60 feet have been recorded. It will grow in favorable soil anywhere from sea level up to 7,000 feet elevation, and the success or failure of the crop depends as much upon the character of the subsoil as upon the surface layers. Good drainage is necessary, as the plants are killed by excess of water in the soil or on the surface.

A contributor to the *Sydney Mail* writing *re* lucerne on the farm, makes the following remarks, and gives some good advice as to the sowing and subsequent cultivation and use of this crop:—There ought to be more ground under lucerne by a hundredfold in this colony than there is. Beyond a shadow of doubt lucerne is the most useful and the most enduring in usefulness of all the fodder crops that have been tried in Australia. It will flourish in almost every part of New South Wales, and there is no conceivable reason why farmers have not sown it more extensively, unless it be that the returns from it are not immediately under their noses. Once a farmer has used lucerne for cutting for hay, for feeding to stock, or for pasture, he will never be without some of it, unless the bank or some other mortgage closes and the unfortunate man is left without anything. Some experts say that lucerne should be sown in April or May, if possible, but September is the best of the other months. For my part I believe September to be the best for the ordinary farmer at all times. It is not desirable to sow on new land, because the soil is almost always too cold for such a small seed, and poor progress is made by the plants at the most critical stage of their existence. Land that has been well broken up to a good depth and cropped once or twice is best, but when a farmer has been at the expense of clearing that land he wants three crops off it as fast as he can get them. If you turn over these old paddocks in April or May and sow your lucerne on a bed prepared to the necessary fine tilth, the seed droppings from the last crop, the grass, and the weeds all begin to grow together, and in the struggle for existence the lucerne will get a great deal the worst of it. By waiting to September the weeds and other growth can be turned in with a light furrow, and the lucerne, if properly sown, comes away by itself. It is objected that September is sometimes a dry month, but so are April and May occasionally, and no man should sow lucerne unless the conditions are favourable to germination. Another very important consideration is the fact that farmers are seldom able to put in lucerne in April and May, when they are busy with their crops. In August there is not much doing, and any old cultivation paddock may be broken up then and sown to lucerne in September. I am aware that there are often difficulties in the way of putting in forage crops in the off season. The horses are in low condition, and the farmer and his family, who are unable to pay wages, are jaded and weary. But as Tennyson's new style said, "Wurrk mun agone to the gettin'. Whinever money wur got." By working the horses in spells it is always possible to put in 20, 40, or 100 acres, according to the strength on the farm. The outlay is small, and even 20 acres of good lucerne is a magnificent property when compared with 20 acres of old stubble on which the native grasses that are returning to it are light and tender, and easily swept off by a dry spell. In very rare cases subsoiling is necessary for lucerne. The plant once properly started is very hardy and will soon force its roots through all but the most stubborn of subsoils. Generally speaking, an ordinary ploughing will be sufficient, but the land must be cultivated by harrowing and rolling till the surface is fit for ordinary vegetable seeds. The seed should be carefully tested. Send for four or five samples, and the seedsman will forward them with the prices marked. Place some of each sample between two pieces of moist flannel and put them in plates on your mantelpiece. Keep the flannel moist for 36 hours, and then you will find the seed germinated, and can easily ascertain the percentage of good seed in each. I once obtained the best results from a sample that was 2d. per lb. cheaper than that which the seedsman esteemed his best. When it was sown the seed was true to the test, and a splendid 40-acre paddock of lucerne sown on the 15th September was the result. Some experts favour sowing by drills ; others like broadcasting. Those that believe that harrowing will injure the growing lucerne prefer drilling, because cultivation can be accomplished between the rows. I cannot see that this is necessary. The plants, if sown in a clean seedbed, will soon cover the ground, and when cultivation is required, a light scarifier will do no harm. The object should be to keep the plants from thinning out and losing vigour as long as possible, and this is the chief use of after cultivation. There has been much dispute as to the quantity of seed that should be sown, from 4lb. to 25lb. to the acre being advocated. If the ground is well tilled 10lb. to 12lb. will cover it nicely. It is always well to remember that a patchy lucerne paddock can never be properly made up. The long broadcast sower on a barrow is the best for farmers. If two or three neighbours purchase one of these the cost is light, and the machine can be used turn-about. When a man is delighted with a bright, green, young crop of lucerne that has jumped out of the ground in response to late spring or summer rains, he should not rush a lot of stock on just to see what it will carry. Spell a good deal and feed a little, or cut once the first year ; after that any fair and honest treatment will not hurt your lucerne. I saw a remarkable result obtained on 40 acres of lucerne one season in Victoria. The crop was sown in September, in a dry district, and came away in fine style. Late rains favoured it, and in the summer it was like a great green eye in a burnt-up, brown, and grey country. The owners, pushed for feed, fed it to the ground—almost into the ground. Retribution arrived, when, after a dry autumn, the paddock was still red and bare. Then the owners decided to spell the paddock all through the winter. But they could not see so much land wasted for a season, so they actually disc-harrowed it with weights on the harrow, and sowed it in wheat. Twenty acres of wheat was cut for hay, 20 allowed to ripen, "just to see how it would turn out." In the generous shelter of the green and yellow corn the lucerne made a surprising body of stuff. The old binder couldn't take the bulk, and continually choked. When it was threshed the leaves were knocked off the four-foot lucerne stalks and some five tons of the most wonderful chaff in the world came out of the chaff hole. Once a horse or a cow tasted that fodder it only wanted one item on its bill of fare for ever afterwards. Strange to say, the lucerne, despite the heavy disc-harrowing, flourished that year, formed a great sole on the land, and the 40 acres was a fine pasture paddock four years later.

Melilotus officinalis (Yellow sweet clover ; King's clover ; Hart's clover ; plaster clover ; melilot clover ; common melilot ; wild laburnum).—This European species has become quite widely naturalized in this country. It possesses little value—not enough to warrant its cultivation. It grows in swamps and in wet meadows, while *M. altissimus* grows only on the driest soils.

Modiola decumbens (Modiola).—A prostrate, creeping, weedy, annual mallow, native of Chili, which has been introduced into portions of California, and is recommended by the California Experiment Station as an alkali plant. Analysis made of it show that it contains almost as much crude protein as alfalfa. Sheep and cattle are fond of it, and eat it down closely. Because it roots freely at the joints, it is, like purslane, difficult to eradicate, and should be introduced with some caution. A closely related species of very similar habit, *M. multifida* is a native of low grounds from Virginia southward. This is also valuable as a pasture plant.

Onobrychis sativa (Sainfoin ; esparcette ; asparset ; Bourgoyne Fig. 22).—A deep-rooting perennial legume, extensively cultivated in the temperate portions of Europe on dry, calcareous soils which are too barren for clover or alfalfa. The stems are erect or ascending, one to two feet high, ribbed and downy, the leaves unequally pinnate, composed of six to twelve pairs of opposite leaflets, with an odd terminal one. The bright pink flowers are numerous in spike-like racemes, borne on a long stalk. A permeable, well-drained sub-soil is essential for its growth. Like alfalfa, it is quickly killed whenever the ground becomes saturated with water, and is therefore not suited for growth in wet meadows or in marshy

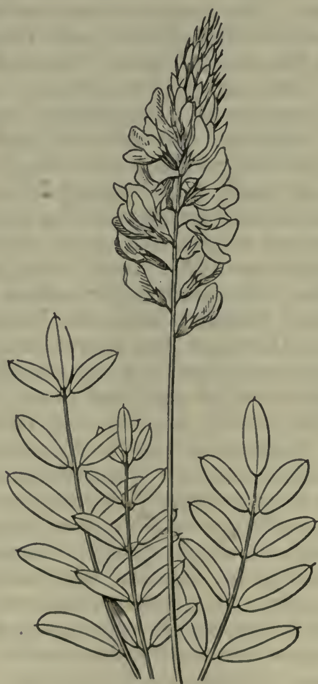


FIG. 22.—Sainfoin *(Onobrychis sativa).*

lands. There is no better plant for growing on barren hills, but it does better on the sunny slopes than on those facing north. It is rather difficult to establish, as the plants are easily killed when young, but when once well rooted, sainfoin will live from twenty to twenty-five or sometimes a hundred years, provided the soil is rich enough. One crop of hay can be cut each year. It should be cut at the time of full bloom, which in the latitude of Washington, D.C., is about the 1st of May. In England the average yield ranges from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre, and the hay is better and more nutritious than that of red clover. Eighty pounds of seed should be sown per acre, any time from the middle of May to the end of June, and, unlike alfalfa, it should be covered quite deeply to insure germination. If shelled seed is to be had, half as much will suffice. Fresh

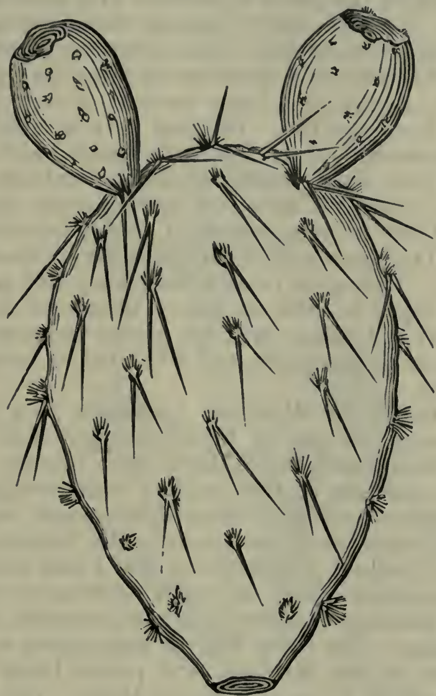


FIG. 23.—Prickly pear (*Opuntia engelmanni*),

seed must always be used, as it loses its vitality if kept a year. It can be grown in any part of the United States, and should be more extensively cultivated, especially in localities where the ground is too dry or too barren for red clover. The yield of seed ranges from 10 to 25 bushels of 40 pounds. Sainfoin should not be pastured closely, as it does not have the same recuperative ability as the clovers.

Opuntia engelmanni (Nopal; prickly pear. Fig. 23).—A species of cactus which grows wild from western Texas through the arid regions of the south-west to California. Its so-called leaves, or flat oints of the stem, are sometimes, in large specimens, a foot long and nine or ten inches broad. They are covered with groups of stout spines from one-half inch to one and a half inches long, which point backward on the stem. Throughout the grazing regions of Texas, where this prickly pear grows, it forms one of the most highly valued fodder plants. It is sometimes fed on the range, but the more common, most economical, and safest method of feeding is to prepare the stems by the removal of the spines. They are singed off by holding the joints a moment in a blaze, or the stems are chopped up in a feed cutter without removing the spines, or they are boiled to soften them. This cactus is chiefly utilised in dry seasons, when there is a shortage of grass on the ranges, the succulent stems containing a large amount of water, and enough starch and gum to sustain life. The best way is, however, to feed with hay or cotton-seed meal. Many thousand head of cattle are marketed every year which have been fattened entirely upon prickly pear and cotton seed. A ration of five to seven pounds of the cotton seed, and fifty to sixty pounds of prickly pear per head is one usually given. The stems vary from one to six, or sometimes ten to twelve feet high. They grow in such abundance, and are propagated so easily, that there is little danger of their ever being entirely exterminated. If fed alone, without proper admixture of other foods, prickly pear causes laxity, and when fed to working stock a tendency to bloat.

Mr. W. L. Boyce, of Warraba, Lochinvar, New South Wales, sends the following account of his experiment with prickly-pear ensilage to the New South Wales *Agricultural Gazette*. It might be mentioned that a sample of this product was brought under the notice of the Agricultural and Dairy Conferences, and was favorably commented upon :—In my article in the *Gazette* of April last, under the above heading, I mentioned that I had included twenty loads of prickly pears in a stack of ensilage with maize and sorghum. I now have the pleasure of forwarding you a sample, and reporting unqualified success. The cattle like the pears quite as much as the other constituents of the ensilage, and prefer these pears to the steamed pears, which I am still giving them. The ensilage was made in a stack in the open and pressed with home-made appliances and covered with iron. Owing to the drought, the stack is only a small one, which makes my present triumph the greater. The base of the stack is 19 ft. by 16 ft. 6 in. and only 3 ft. high in its compressed state. I estimate that the pears amount to one-third of the whole stack. In building the stack I put alternate layers of pears and maize or sorghum, four loads of pears in one layer, but never allowed the pears to be nearer than a foot to the edge. At present I am feeding the cows on this ensilage, steamed pears and barley, all on the same day ; there is also a good picking of green herbage, yet everything is eaten up clean. The milk test is at present four per cent. of butter fat, which is amongst the highest at my creamery. Now, as this ration has a good proportion of prickly pears, the facts stated prove that there is considerable virtue in the much despised prickly pear. It only remains for me to add that the pears were placed in the stack whole, including thorns and roots, the largest bunches being afterwards chopped to flatten them. The heat and ferment of the silo has softened the thorns and rendered them harmless. I always add a bag or more of coarse salt to a stack to make the fodder more palatable.

The Rev. Herbert Heath, who lately left Queensland, in writing to the Queensland *Agricultural Journal*, states that he resided for many years in Mexico, and had had many opportunities of observing the uses to which the prickly pear was put to by the

FIG. 24.—Serradella (*Ornithopus sativus*).

rancheros. In dry seasons, and even during good seasons, the vaqueros and peons go out on the runs and cut down quantities of mesquite bushes, and make piles of them at intervals over a large extent of country. Labor being plentiful and very cheap, the work is performed in quicker time than might be supposed. Quantities of prickly pear are now cut and thrown on to the heaps, which are then fired. The heat and evolved steam disarm the leaves and fruit of their thorns and prickly hairs, and the cattle assemble and eat the juicy leaves and succulent fruit with greater zest than they ate the grass. In reply to a question asked about the possibility of destroying and exterminating the plant in Queensland, Mr. Heath said : "You don't know the valuable-fodder plant you have here. I can tell you this : Take away the prickly pear from Mexico, and rancher, rancheros, vaqueros, and all who have to deal with cattle may leave the country, for there will be no further employment for them. Cattle will be a thing of the past."

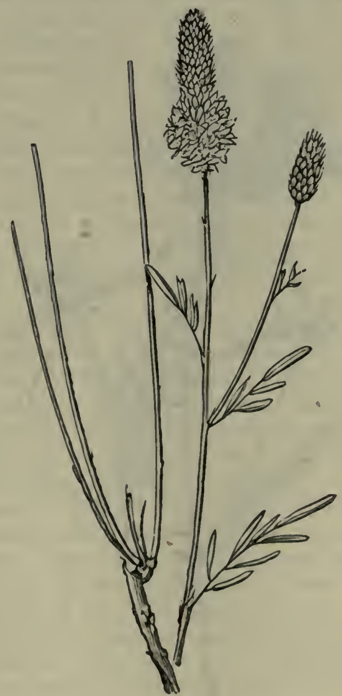


FIG. 25.—Prairie clover (*Petalostemon candidus*).

Ornithopus sativus (Serradella. Fig. 24).—An annual legume, native of southern Europe and northern Africa, which is valuable as a fodder plant on moist and sandy sterile soils. At the Pennsylvania station the yield from two cuttings was 11½ tons of green forage. It does not require lime, and is often used as a green manure to bring up the value of sterile fields. The forage, which is much relished by cattle and sheep, has about the same feeding value as red clover.

Petalostemon (Prairie clover; white prairie clover; purple prairie clover; leafy prairie clover. Fig. 25).—A number of species of prairie clover are common throughout the prairie region, and westward into the Rocky Mountains. They are erect perennial legumes, with heads of white or purple flowers and finely divided compound leaves. They contribute a considerable amount of forage on the prairie pastures, and should be given a trial in cultivation.

Phaseolus helvolus (Long-stalked kidney bean).—A perennial bean with slender diffuse stems. A single plant makes a large quantity of herbage. Common in the Southern States, where, in certain localities, it produces a large amount of forage.

Phaseolus perennis (Wild kidney bean).—A species closely related to the garden bean, widely distributed over the eastern and southern United States, and as far west as the Mississippi river. It grows in woodland copses and along the banks of streams, and wherever found is eaten greedily by stock. It should be given a trial in cultivation.

Pisum arvense (Gray winter pea; Canada field pea; field pea).—The common field pea is a native of Italy, and has been in cultivation for a good many hundred years. It is grown chiefly for its seeds, which are used both as an article of diet and for fattening cattle. It is one of the best soiling crops for milch cows, and is largely used in the Northern States and Canada, and as far west as the Dakotas for this purpose, and for green manure. The seed is sown broadcast and harrowed in. It is planted in early spring, and is ready to cut in May or June. For soiling, the fodder is sweet, palatable, and very nutritious. It also makes an excellent quality of ensilage. It grows best on light calcareous loams, and produces heavy crops on rich land.

Plantago lanceolata (Rib grass; plantain; ripple grass; plantain herb; rib herb).—A weed extensively naturalised in this country in lawns and meadows, and truly considered a vile pest, but in Europe frequently recommended for sowing in pasture mixtures. It possesses the advantage of growing on the most sterile soils. Cattle and sheep are fond of it when young. There are a number of American species, widely distributed in all parts of the country, many of which add value to the scanty spring forage in barren pastures. Some species of the prairie region grow on salt marshes and alkali spots, and would, perhaps, be of value for cultivation on such soils.

Polygonum aviculare (Knotweed; duckweed; dooryard grass. Fig. 26).—A weedy annual of the knotweed or smartweed family, common everywhere in dooryards, waste places, and fields. The stems are slender, prostrate or ascending, branching 6 to 14 inches high, and leafy; the leaves oblong to lanceolate, from one-fourth of an inch to an inch long, pointed at each end, and bluish green. It is very hardy, growing readily on the poorest of ordinary soils, even in times of drought, and is greedily eaten by all kinds of stock. Stockmen in the north-west esteem it highly, as it furnishes a palatable and nutritious forage, which continues green all summer under all kinds of hard treatment. The dry forage contains nearly 19 per cent. of crude protein, so that its value as a flesh former is high, ranking above that of the clovers.

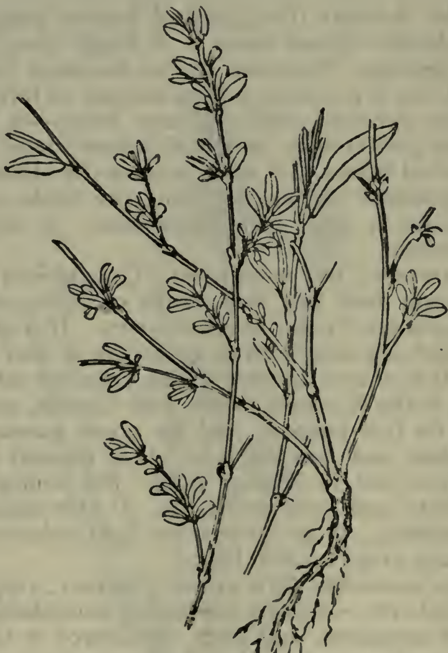


FIG. 26.—Knotweed (*Polygonum aviculare*).

Polygonum erectum (Upright knotweed).—A hardy annual knotweed, widely distributed through the northern States. In the upper prairie region it is highly valued as a forage plant for milch cows. It grows from 10 to 15 inches high, and in rich, moist soils may be cut for hay. The hay is nutritious, containing 11 per cent. of crude protein.

Polygonum sachalinense (Giant knotweed ; sachaline ; saghalin polygonum).—Giant knotweed or sachaline is a hardy herbaceous perennial, 6 to 12 feet high, with strong creeping rootstocks, broad, somewhat heart-shaped, shining leaves nearly a foot long, and small greenish-white flowers appearing late in the season. It has been cultivated for a good many years as an ornamental. Recently attempts have been made to introduce it into this country as a forage plant, and extravagant claims have been made concerning it. Considering that it is a native of northern Asia, growing along moist river banks upon an island with a cold and very moist climate, and from the recommendations as to its culture by horticulturists who have had experience in growing the plant, it is very doubtful if it will prove a success except in swampy waste lands. The leaves are eaten by cattle, but the small quantity of forage produced and the time which one must wait until production commences, preclude its ever being of great value in this country.

FIG. 27.—Mesquite (*Prosopis juliflora*).

Portulaca oleracea (Pusley ; purslane).—This well-known weed is of considerable value as an autumn forage plant in the south and south-west. The fleshy leaves and stems are put forth in great abundance during the hottest and driest weather, and it is hard to kill. The same qualities which make it a vile pest in our gardens and cultivated fields cause it to be highly esteemed by sheep herders and cattlemen in years of drought. Fed to cows, it increases the flow of milk, but causes laxity if too much is given at once.

Prosopis juliflora (Mesquite tree; screw bean. Fig. 27).—A thorny, leguminous shrub, growing in favored localities to a tree 20 to 40 feet high, with a trunk 2½ feet in diameter. It is widely distributed from Texas to southern California, through tropical

FIG. 28.—Mexican clover (*Richardsonia scabra*).

America to Argentina. The leaves are very good browsing for horses and cattle. It bears two crops of beans a year, which are next to barley for fattening horses, cattle, sheep, and hogs. The leaves, pods, and bark are rich in tannin, and a gum, similar to gum arabic, exudes copiously from the trunk and branches. The wood is hard, strong, and durable, and takes a hard polish. It is the most common woody plant of the mesas of the south-west, and because of its many uses is an exceedingly valuable species.

Richardsonia scabra (Mexican clover ; Spanish clover ; Ipecac weed ; Florida clover ; water parsley ; bellfountain ; poor toe ; pigeon weed. Fig. 28).—An annual weed, native of Central America and Mexico, which has been introduced into the Southern States and has now spread along the gulf westward into Texas. It is a succulent, creeping, prostrate plant, chiefly valued as a renovator of sandy fields on the coast. It is not a true clover, but belongs to the Rubiacæ, the family in which coffee is included. Reports concerning it are conflicting. According to some it is a valuable pasture plant, while others affirm that neither cattle nor horses will eat it. On rich lands it can be cut, making a nutritious and palatable hay, which is readily eaten by all kinds of stock. Chemical analysis shows that the hay contains nearly as much nutriment as red clover. It is never cultivated, but appears as a weed after corn and cotton have been laid by. In Florida it is considered an excellent plant to grow in orange groves as a mulch, and to turn under for green manure.

FIG. 29.—Greasewood (*Sarcobatus vermicularis*).

Rubia tinctoria (Madder).—The foliage of this prickly dye plant makes forage of fair quality if cut the second season before the plants have commenced to blossom.

Salicornia herbacea (Saleratus weed ; samphire ; glasswort).—A low, fleshy, leafless herbaceous plant, growing in the borders of salt marshes from Arizona to the Saskatchewan and along the Atlantic coast. It grows on soils too salty or too alkaline to support any other plant. In portions of Arizona and in Utah it is valued highly for winter feed. After frost, stock live almost entirely upon it and "winter fat."

FIG. 30.—*Sida elliottii.*

Sarcobatus vermicularis (Greasewood. Fig. 29).—An erect, scraggy shrub 2 to 8 feet high, with the leafy branches covered by smooth, white bark. It is one of the most common of the shrubs called "greasewood," in the region from Montana to New Mexico and Arizona, and where it is abundant, supplies a considerable part of the winter forage on the ranges. This and the saleratus weed belong to the pigweed family, of which the Australian salt-bush, so widely recommended for culture on alkaline soils, is a member.

Sida elliottii (Elliott's sida. Fig. 30).—A low, shrubby or bushy plant of the mallow family, native of the south, which grows 1½ to 2 feet high on hard, clayey soils and rocky land. It is an excellent pasture plant which readily catches from seed, provided the surface soil is scratched with a rake when the seed is scattered. Cattle, sheep, and hogs are fond of it, but horses and mules do not relish it. The sida has been quite widely introduced in the grazing regions of California. It apparently thrives better without than with irrigation, and is therefore of much value on waste lands designed for permanent pastures. It is not a good soiling crop, and should not be cut for hay.

FIG. 31.—Giant spurrey (*Spergula maxima*).

Spergula arvensis (Spurrey ; sand spurrey).—An annual, producing a low, tangled mass of succulent stems, with numerous whorled linear leaves. It produces a crop in eight or ten weeks, and is valuable as a catch crop in short seasons, and for soiling sheep and milch cows. It has been especially recommended as a first crop on the pine barrens of Michigan, to turn under for green manure. The air-dried hay contains about 12 per cent. of crude protein.

Spergula maxima (Giant spurrey. Fig. 31).—Similar to common spurrey, but making a ranker growth. It is also slightly richer in flesh-forming ingredients, and is the more valuable species of the two.

Symphytum asperrimum (Prickly comfrey; comfrey).—A coarse, rank-growing perennial herb, with purple flowers in nodding one-sided clusters, and large, rough leaves. A native of the Caucasus, which has been widely introduced and recommended as a forage plant for rich soils. It has been claimed that an enormous quantity of forage may be cut from an acre, but after extended

Fig. 32.—Egyptian Clover (*Trifolium alexandrinum*).

trials in this country it has been determined to be of less value than the clovers, and is now rarely grown. It is propagated from the roots, which are set in rows 18 inches apart, and 16 inches in the rows. Its cultivation is not recommended, except when it is desired to procure an enormous bulk of forage from a small amount of very rich land. Prickly comfrey has proved a success only in New York, Michigan, and Florida, in the latter State having been recommended as a good forage plant for waste lands.

Taraxcum dens leonis (Dandelion).—A weed, widely distributed over the United States, introduced from Europe in grain and grass seed. Its leaves furnish a scant but palatable and nutritious early forage in pastures for sheep, and the seed is therefore sometimes used as an ingredient of pasture mixtures.

Tetragonia expansa (New Zealand spinach).—An annual herb of the order Ficoideæ, native of the seacoasts of Chili, Japan, Australia, and New Zealand.. Used as a vegetable, and also recommended as valuable in sheep pastures and arid regions, and on alkaline or saline soils.

Fig. 33.—*Trifolium amphianthum.*

Trifolium agrarium (Golden clover ; yellow meadow trefoil ; yellow hop clover ; field clover ; hop clover ; yellow clover ; gold colored clover ; large golden clover).—A perennial wild European clover, widely naturalized on sandy fields and by roadsides in the eastern States as far south as Virginia. It is of considerable value for sandy pastures.

Trifolium alexandrinum (Egyptian clover ; alexandrine clover ; bersine clover. Fig. 32).—An erect, annual clover, native of Egypt, which in warm climates and upon rich soils makes an exceedingly rapid growth. Two or three heavy crops may be taken from a field in one season. Twenty pounds of seed are required for an acre. An excellent species for trial in the southern States, wherever cane and cotton may be grown.

Trifolium alpinum (Alpine clover).—A European alpine species of little value in cultivation, although it has been recommended abroad as a forage plant for mountain meadows.

Trifolium amphianthum. Fig. 33.—A low, slender stolonifierous species occurring in Louisiana and Texas upon the most sterile soils. It spreads rapidly, and re-seeds itself freely, producing a large amount of early spring pasturage. It comes into blossom about the middle of May. It is one of our most promising native wild clovers for cultivation.

Trifolium arvense (Rabbit foot clover ; haresfoot clover ; field clover ; field trifolium ; stone clover in part ; Welsh clover, in part ; hard clover ; hair clover ; hare clover ; hare's little paw ; mouse clover ; cat clover ; kitten plant ; pussy-wort ; grey clover ; lamb's tail).—A silky branching annual, 5 to 10 inches high, with soft, grayish oblong heads of flowers. Common in old fields and on barren lands in the eastern and southern United States. Of little value.

Trifolium badium (Brown clover, English ; chesnut-brown clover, German).—A clover, native of England and northern Europe, which has some slight value as a forage plant in pastures.

Trifolium beckwithii (Beckwith's clover).—A native of the eastern Rocky Mountain and upper Missouri prairie regions. It has ascending stems 4 to 9 inches high, from strong perennial creeping rootstocks. It is very persistent, and endures all kinds of hard usage. Being much relished by stock, there is a possibility that it may prove of value as a cultivated forage plant. The dry hay contains nearly 14 per cent. of crude protein. Beckwith's clover is highly valued by stockmen in the north-west.

Trifolium carolinianum (Carolina clover).—A small, perennial, procumbent, tufted clover, widely disseminated in waste places from Pennsylvania to Florida and Texas. It furnishes a small amount of forage, especially in the south-western extension of its range.

Trifolium filiforme (Suckling clover ; yellow suckling clover ; slender clover ; small-flowered clover ; thread clover ; slender-stalked clover ; little yellow hop clover ; golden clover).—Indigenous to northern Europe on sandy clay soils. A very nutritious forage in sheep pastures, it is often used in mixtures with grasses and clovers for wet, sandy meadows.

Trifolium fragiferum (Strawberry clover ; strawberry-headed trefoil ; bladder clover).—A wild clover, native of England and northern and central Europe, which much resembles white clover in appearance and nutritive qualities. It is a valuable species for cultivation in wet meadows.

Trifolium furcatum.—A rank-growing clover two to three feet high, native of the Pacific Coast. The flowers resemble those of common red clover, but are larger, sometimes two inches in diameter, and borne on long stalks. It is abundant throughout the coast ranges and affords good pasturage.

Trifolium hybridum (Alsike clover ; Alsace clover ; hybrid clover ; bastard clover ; Swedish clover ; white Swedish clover ; giant white clover ; perennial hybrid clover ; elegant clover ; pod clover. Fig. 34).—A perennial, in size and general appearance intermediate between white and red clover. It is better adapted than any other species in general cultivation to wet meadows or marshy lands, but because of its shallow root system will not withstand drought. The

FIG. 34. Alsike *(Trifolium hybridum).*

branching leafy stems grow one to three feet high, and the young flower heads are at first white and later become rose-colored. Its leaves are slightly bitter, and on this account the forage is not so well liked by stock as that of red or white clover ; but it will grow on lands which are too wet for the other species, thriving even in marshy places where the subsoil is impervious to water and the drainage is bad. It may also be cultivated in the far north and in high altitudes, as it has the power of withstanding severe cold. The forage is succulent and more difficult to cure for hay than red clover. The air-dried hay contains from 10 to 13 per cent. of crude protein. It is a very good honey plant for bees. The seed weighs 65 pounds to the bushel, and 12 pounds will sow an acre.

Trifolium incarnatum L. (Crimson clover; scarlet clover; German clover; German mammoth clover; Italian clover; French clover, in part; Egyptian clover, in part; carnation clover. Fig. 35). —An annual, native of the Mediterranean region, which has been long cultivated in the warmer portions of Europe, and is now grown

Fig. 35. Crimson clover (*Trifolium incarnatum*.

in many of the eastern and southern States for an early soiling crop. The stems are erect, tufted, soft-hairy all over, from one to two feet high, and the bright scarlet flowers are borne in elongated heads. In Virginia and southward it should be sown in autumn to furnish winter and early spring forage. It is susceptible to drought. It is not suited to the northern and north-western States, as it suffers severely from excessive cold. Twenty pounds of seed should be sown per acre. Hay made of crimson clover contains about 13 per cent. of crude protein. To make the best hay, it must be cut when in full bloom ; cut later, there is some danger in feeding it, especially to horses, on account of the bristly hairy bracts of the inflorescence, which form hair balls in the stomach. A number of such cases, resulting in considerable loss, have been reported during the past season.

Trifolium involucratum.—An annual one or two feet high, with leafy, branching stems, terminating in from one to three purplish heads. It has a wide range throughout the west.

Trifolium medium (Cow grass ; cow clover ; large American clover ; mammoth clover ; large clover ; fall clover ; saplin or sapling clover ; pea-vine clover ; meadow clover ; sand clover ; zigzag clover ; clover trefoil ; medium clover ; early clover ; wavy-stemmed clover ; zigzag hare clover ; red perennial meadow clover ; soiling clover ; perennial red clover).—A rank-growing perennial, with zigzag stems, oblong, entire, spotless leaflets, and stalked heads of purple flowers. It is better adapted to wet meadows or marshy lands than is the ordinary clover, and in such places makes a very rank and rapid growth. It has about the same feeding value as red clover, and is well adapted to soiling purposes. Ten pounds of seed should be sown per acre.

Trifolium megacephalum.—This wild clover grows in the mountains from Montana to California. It is distinguished from red clover, which it somewhat resembles, in having unbranched stems about a foot high, and wedge-shaped five to seven parted leaves which nearly all arise from the base of the stalks. The terminal flower head is about one and a half inches long. It is one of the best native pasture plants of that region.

Trifolium microcephalum.—A wild species, very common on lowlands in southern California, and well liked by stock. It should be valuable in cultivation.

Trifolium minus (Yellow clover).—A European annual, extensively naturalised in the eastern and southern states in sandy fields and along roadsides. It has a habit similar to that of Japan clover, for which it is often mistaken. It affords a small amount of forage in early summer, but its chief value is that it spreads rapidly over the most barren soils, and thereby prevents the washing away of the surface.

Trifolium ochroleucum (Sulphur clover).—A perennial European species ten to fifteen inches high, with elongated heads of pale yellow flowers. It grows wild upon the driest calcareous soils, and when cut makes a palatable and nutritious hay, which is greedily eaten by cattle.

Trifolium pannonicum (Hungarian clover).—A perennial species indigenous to southern Europe, closely allied to red clover and much earlier, but less readily eaten by stock.

Trifolium pratense (Red clover; June clover; early clover; small red clover; red top clover; medium red clover. Fig. 36).—A biennial or short-lived perennial clover, native of the old world, but now extensively cultivated in both hemispheres. It is ascending, more or less branching, one to two feet high, with trifoliate leaves on long leaf-stalks and oval or blunt leaflets half an inch to an inch and a half long, with a large pale spot on the upper side, and pink flowers in large, rounded, stemless heads. Red clover holds the same position as a forage plant in the eastern and northern states as alfalfa in the south-west and west, or as cow peas in the south. Its cultivation is almost universal. The seed is sown at the rate of from 15 to 20 pounds per acre, from March to May, either alone, or

FIG. 36.—Red clover (*Trifolium pratense*).

more commonly with grain. It requires a deep, rich, fertile, calcareous loam, neither too wet nor too dry. On the black-waxy and gumbo soils of the Mississippi Valley, red clover is almost sure to freeze out or "heave" in winter, and on rocky or light sandy soil it suffers from drought in summer. It is mown for hay twice in the season, the yield varying from three-fourths of a ton to two tons at each cutting. The hay contains from twelve to sixteen per cent. of crude protein, varying according to the fertility of the soil. The yield of seed ranges from three to nine bushels, of sixty pounds each, per acre. It is one of the best money crops of the eastern farmer, and is an excellent one for pasturage, soiling, hay, or to turn under for green manure.

FIG. 37.—White clover (*Trifolium repens*).

Trifolium procumbens (Hop clover ; yellow clover ; shamrock clover ; brown clover ; lesser clover ; low hop clover ; hop trefoil). —A low, annual, yellow-flowered species, with spreading or ascending stems, widely naturalised in the eastern and southern states. It is common on sandy fields and roadsides, and furnishes scanty pasturage for stock in early summer. It resembles Japan clover, and in the south is often mistaken for it.

Trifolium reflexum (Buffalo clover ; Pennsylvania clover).—A native annual or biennial species with ascending downy stems, oblong, finely toothed leaflets, and rose-red flowers, on short stalks in a round, stalked cluster. The flowers are reflexed and brownish in fruit. Widely disseminated from western New York to Nebraska, Kansas, and southward, and especially abundant in the middle prairie region, where it furnishes a considerable amount of palatable and highly nutritious forage, greedily eaten by all kinds of stock. It is a species which should be brought into cultivation.

Trifolium repens (White clover; white Dutch clover; Dutch clover; creeping trifolium ; white trefoil ; stone clover, in part ; honeysuckle ; honeysuckle grass ; honeysuckle clover ; shamrock. Fig. 37).—A smooth perennial, growing wild in New England and Europe, and now widely cultivated. The slender spreading and creeping stems are from four to eight or ten inches long ; the trifoliate leaves are on rather long leafstalks ; the flowers are white or rose colour, borne in loose heads an inch or less in diameter, on very long stalks. It grows on a great variety of soils, forming excellent turf either for pastures or lawns, and thrives under all sorts of hard usage. If sown alone from six to eight pounds of seed should be used, but it is usually mixed with the seed of grasses or other clovers. The forage, though produced in small quantity, is sweet and nutritious and eagerly sought for by all kinds of stock.

Tamarix Gallica. (Linné).—This shrub is a native of southern Europe, north and tropical Africa, southern and eastern Asia, and will withstand prolonged drought and intense cold. "It adapts itself in the most extraordinary manner to the most different localities. It will grow alike in water and the driest soil, also in salty ground, and is one of the most graceful and tractable plants in culture. It is readily multiplied from cuttings, which strike root as early as a willow, and push forth stems with universal vigor." (B. V. M.) Two years ago the Bureau of Agriculture obtained cuttings of the *Tamarix* from the late Baron von Mueller. Some of these were planted in the eastern district on salt patches, and others on the Swan, and all have done exceedingly well. Those planted on the Swan have made remarkable growth, and the young branches have been lopped, and fed to, and appreciated by, cattle and horses. As this is a salt-loving shrub there is no doubt that its cultivation on the alkali patches in the eastern districts would in time correct the accumulation of salt. It should also be a valuable plant for the sand plains and the arid deserts of the east. It is an ornamental plant in the garden, the delicate pink flowers in early spring, and the dark green foliage of summer making a delightful contrast to other plants.

Trifolium resupinatum (Reversed clover).—An annual species, native of the Mediterranean region, similar to white clover in its manner of growth, and better adapted to warm regions than white clover. It has been introduced into and is largely grown in northern

India as a pasture plant, and would be a valuable species to introduce for pasturage in the southern states.

Trifolium rubens (Reddish clover; also known in Germany as red clover; fox clover; fox tail clover; red goat clover; red hare clover).—A perennial species, native of southern Europe, similar in appearance to crimson clover, but with purple flowers and much narrower and longer leaflets. It is cultivated for soiling purposes in the warmer portions of Europe, and, though less hardy than the crimson clover, would be a good species for introduction into the southern states.

Trifolium stoloniferum (Running clover; running buffalo clover).—A low, smooth perennial, which sends out long runners from the base of the stem. The flowers are white, tinged with purple, in loose heads. The leaflets are broadly obovate and minutely toothed. A native species, growing in open woodlands and prairies from Ohio west to Kansas, which is greedily eaten by cattle. It should be given a trial in cultivation.

Trifolium subrotundum (Mayad clover).—A perennial species, native to and cultivated in northern and middle Africa, up to 9000 feet elevation. It is a good species for cultivation in countries too warm for red clover, and ought to do well in the Southern States.

Trifolium tridentatum.—A wild species, occurring in Nevada and Utah, which produces a palatable and nutritious forage in early summer, and is greedily eaten by cattle. It deserves to be brought under cultivation. The Western and Pacific coast states are very rich in the number of wild clovers which occur there. California alone has more than sixty species. All are valuable forage plants, but few, if any, have ever been given a trial in cultivation.

Triglochin maritimum (Seaside arrow grass; arrow grass).—A marsh plant with cylindrical leaves and flowering stalk 1 to 3 feet high, common along the Atlantic coast and westward across the continent in saline, marshy, and boggy places. It is eaten by cattle, and adds some little value to the native herbage of wet pastures.

Trigonella fœnum-græcum (Fenugreek; buckhorn clover; cowhorn; goat's horn; sevenseed; Greek hay; trigonel).—An erect annual legume, growing 6 to 12 inches high. The plant has a strong odor, and is valueless for forage unless it is cut before the plant commences to bloom. The seeds are given to horses as a condiment. It is sometimes recommended for pasture mixtures, but has small value for any purpose.

Ulex europæus (Gorse; whin; furze).—A perennial leguminous shrub, native of northern Europe, where it is highly esteemed as a forage plant for dry and barren hillsides, in places too steep, or where the soil is too thin to admit of the cultivation of better ones. In some parts of Ireland and Wales the farm horses are almost entirely maintained upon it during the winter months, the crushed two-year-old branches being fed at the rate of about 40 pounds per day. Twenty or 25 pounds of seed are required for an acre. It is a valuable forage plant to sow on barren hillsides. Sheep are very fond of and fatten quickly upon it.

Vicia americana (Common wild vetch).—A smooth perennial with compound leaves, elliptical or oblong obtuse leaflets, and four to eight purple flowers on elongated flower stalks. It grows in moist soil from New York westward to the prairie region. A valuable native vetch, which should be given a trial in cultivation.

Fig. 38.—Bird vetch (*Vicia cracca*).

Vicia cracca (Bird vetch ; chicken vetch. Fig 38).—A downy pubescent perennial, with compound leaves of 20 to 24 narrowly oblong, abruptly pointed leaflets, and numerous blue or purple reflexed flowers in a one-sided spike. Common in the borders of thickets from New England to the upper prairie region. The species is cultivated in Europe for fodder, and is recommended for cultivation in wet meadows. In the shade it yields a return three times larger than in open places. It would, therefore, be valuable in woodland pastures and alpine regions.

Vicia sativa (Vetch ; spring vetch ; tares).—An annual trailing herb 12 to 20 inches high, with four to five angled stems, simple or branched from the base. The leaflets are broadest above the middle, blunt or notched at the end, and tipped with an abrupt point ; they number usually from 10 to 14. The rather large purple flowers are borne one or two together at the base of a leaf. The plant is soft-hairy all over. This native of Europe and western Asia has been cultivated for upwards of twenty centuries, and is considered one of the best soiling crops in cool, moist climates. In the United States they have only proved adaptable to cultivation in the New England States and Canada. Vetches are sown in April or May, at the rate of two bushels of seed per acre, and the crop is ready to crop by the middle of June or the first of July. Where they can be grown, they are very good summer feed for horses, but must not be fed earlier than full bloom, on account of their diuretic action. They are good for soiling sheep and milch cows, and are said to very materially increase the flow of milk. Because of the high price asked for seed, and the extreme susceptibility of vetches to dry, hot weather, their cultivation is not recommended. A greater and surer return can always be had from red clover.

Vicia sylvatica (Wood vetch).—A perennial indigenous to Europe and northern Asia. It has been grown successfully as far north as 67° north latitude and is available for alpine or subalpine pastures. The yeld of forage is large and it is readily eaten by all kinds of stock.

Vicia tetrasperma (Lentil vetch ; lentil tare).—An old world annual which, according to Langethel, is preferable to the ordinary vetch for sandy soil. It also makes a better and more palatable forage. It is suited to cultivation in the southern States, especially upon light, calcareous soils.

Vicia villosa (Hairy vetch ; sand vetch ; Russian vetch. Fig. 39).—An annual, native to western Asia, which has been cultivated for about 50 years. Hairy vetch is an excellent soiling crop, one of the best that has been introduced into the United States, although, on account of the high price of the seed and the large amount which must be sown per acre, it has not been widely cultivated. The seed should be sown at the rate of a bushel and a half per acre, from the part of April to the middle of May for summer forage, or from the middle of August to the middle of September for winter forage. The nutritive value of the hay is very high, analyses by Coudon in 1890 showing 23 per cent. of crude portein. The yield varies from $1\frac{1}{2}$ to 4 tons per acre, according to the fertility of the soil. It has been grown successfuly in all parts of the country and has proved to be hardy in the moist coastal regions of Washington, the dry prairies of South Dakota, and the rich loamy soils along the Gulf. It is deserving of wider cultivation in all parts of the United States.

Vigna catjang (Cowpea ; southern cowpea ; pea ; field pea ; stock pea ; cherry bean ; Chinese vetch).—A leguminous annual of unknown origin, which has been cultivated in oriental countries for many centuries, both as a forage plant and for the seeds as an article of human diet. It is especially adapted to warm countries and is extensively cultivated throughout the south, having been introduced there about the middle of last century. There are many named forms or cultural varieties, all of which, however, are considered by

Fig. 39.—Hairy vetch (*Vicia villosa*).

botanists to be derived from one species. It so readily adapts itself to different soils and changes its characters so readily under cultivation, that there has been much difficulty in determining the limits of the various named forms. The cowpeas are of three general classes, according to their habit of growth, consisting of "bunch" varieties, which grow erect and compact ; "runners," which start off erect and then throw out running branches ; and "trailers," which grow flat upon the ground with long stems sometimes 15 or 20 feet in length. There is also much variation in size, shape, and color markings of the seeds, and in the manner in which the seeds are borne in the pod, the seeds of some being closely crowded together, called "crowders," and others with the seeds wide apart and the pods constricted between each seed, called "kidney" peas. The bunch varieties are the ones which are best adapted to growing for hay and ensilage, while the runners and trailers are valuable for soiling purposes or for turning under as green manure. The length of season required for maturity also varies greatly, the bunch varieties, as a rule, requiring only a very short season. The feeding value of cowpeas, either green, fed as hay, or preserved as ensilage, is very high, being considerably above that of red clover. Cowpeas require a deep, rich, sandy loam, although, because of their strong root system, they are adapted to grow upon almost any soil which is not too wet. The ground should be well prepared and the seed should be sown until the soil is thoroughly warmed. Cowpeas, by means of the tubercles on the roots, gather large amounts of nitrogen from the air, and also pump up large amounts of valuable mineral fertilizers from the subsoil. When the stubble is ploughed under after the crop has has been removed, these valuable fertilizing elements—potash, nitrogen, and phosphoric acid—are left in the surface soil for the use of succeeding crops. At the Rhode Island Experiment Station the total crop of green vines per acre was 35,000 pounds, containing 157 pounds of nitrogen, 109½ pounds of potash, and 32·2 pounds of phosphoric acid, and the additional quantity estimated to be contained in the roots was 17¾ pounds nitrogen, 10 pounds of potash, and 5·15 pounds phosphoric acid. The pecentages of fertilizers vary greatly, according to the fertility, and to some extent according to the variety grown. Experiments at southern stations have unanimously proved that the best way to utilize fertilizers so produced by a crop of cowpeas is to cut the vines for hay, returning the manure to the fields. A common practice is to plough under a crop at the end of the season, or sometimes to permit it to remain on the ground through the winter, both of which methods result in a loss of a very large part of the value of a crop through leaching. The best method, if the crop is turned under, is to at once plant a winter forage crop to cover the surface of the ground and so prevent washing by the winter rains. The cultivation of cowpeas has extended to California. Some of the varieties having a short season may be grown in the prairie region as far north as Iowa and Nebraska, and are there of considerable value for dairying purposes, because of their resistance to drought, furnishing on rich soil a palatable and nutritious food during the hottest and driest summer months.

Yucca baccata (Spanish bayonet ; bear grass).—A perennial of the lily family, with stout, woody trunk several feet high, crowned at the top with a rosette of long sword-shaped leaves. Of no value as a forage plant, except in seasons of drought, when cattle and sheep on the ranges of Texas and Arizona, where it grows, eat the leaves, perhaps as much for the water which they contain as the food

An Australian Fodder Plant for the Arid Interior (*Portulacaria Afra. Jacq.*)

The following appeared in the New South Wales *Agricultural Gazette* recently :—It is self-evident that it is desirable to grow any good fodder plant that will flourish in the arid interior. Our choice of plants for such situations is not great. Let me draw attention to what Don calls the African purslane tree. The Boers of South Africa name it spekboom (fat tree). It is a tall shrub or small tree, growing up to 10 or 12 feet in height. It has small round fleshy leaves, which is not surprising, since it belongs to the *Portulaca* family, of which we have one specially-useful member in this country, the common purslane (*Portulaca oleracea*), which has enabled many a mob of cattle to traverse a waterless stage.

Following is what Baron von Mueller says of the purslane tree in his *Select Plants* :—"Affords locally the principal food for elephants ; excellent also for sheep pasture, according to Professor McOwan ; hence this succulent shrub may deserve naturalisation on stony ridges, and in sandy desert land not otherwise readily utilised. Would likely prove acceptable to camels also. Mr. T. R. Sim states that all kinds of pasture animals eat it readily, and when grass is scarce nearly live on it. Grows on hot rocky slopes. Likes particularly doleritic soil. Displays an extraordinary recuperative power when broken by browsing animals, or when injured from other causes. The trunk will attain one foot in diameter (McOwan). Cultivated by the author already in Victoria forty years ago."

Its native home is the Karoo, the arid country in South Africa which appears to present so strong a resemblance to much of our far interior. I cannot find any record of it having been tried in the far west, and I recommend it for careful trial for the following reasons :—

1. It may be readily propagated, rooting readily from cuttings and even solitary leaves during the greater part of the year.
2. It has no thorns or prickles, nor any objectionable characteristics that I know of.
3. Like many succulents, it attains its greatest luxuriance in hot, dry localities.
4. Stock are fond of it, its succulent leaves providing both food and water for them ; it is reputed to be moderately nutritious.

I am not inclined to go into ecstasies over any plant, but I see no reason why this one should not usefully supplement the scanty vegetation of our desert country. South Africa has put some of our salt-bushes to good use ; let us make use of her purslane tree by way of reciprocity.

It is a very brittle plant ; hence stock easily break the plants up in their eagerness to eat them. The same thing applies to the Old Man Salt-bush, which will assuredly become extinct unless it is protected. This salt-bush and the purslane tree should be fenced in and cultivated, until a considerable number of plants have been raised. A reserve stock should always be kept in what may be called the "nursery." By the way, there should be a nursery on every selection and station for the propagation and acclimatisation of desirable plants.

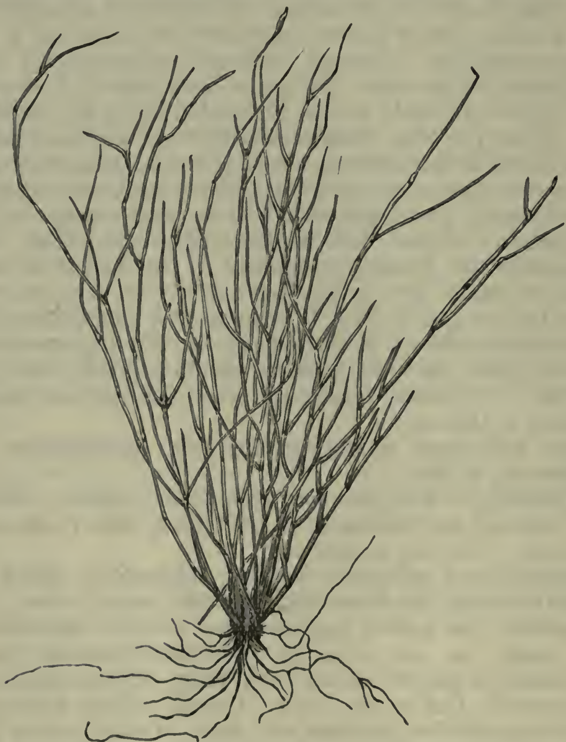
There has been published in the *Journal* of the Bureau of Agriculture from time to time a number of letters from residents of the north-west, descriptive of the indigenous valuable fodder plant known locally as the "milk-bush." The writers all agree as to its value as a fodder plant in the arid districts, and that it will not stand over-stocking. In many sections it has already from this cause entirely disappeared. To quote from Mr. G. J. Brockman—"It is a plant now only to be remembered by its name in the north." It is a pity that some measures have not been devised for its preservation in the districts where it has been entirely eaten out. The Bureau is endeavouring to raise plants from seeds and cuttings, and, if successful, young plants will in the near future be available for distribution. Under date of December 29th, 1896, Mr. G. J. Brockman sent the Bureau a number of specimens of the bush, also a pod of seed. The latter, he writes, "is very poor quality, owing to the drought." The Bureau is also indebted to Mr. A. J. Ogilvie for specimens of seeds and plants. Photographs have been taken of the plant (an illustration of which is given) and specimens sent to Mr. F. Turner, F.L.S., for identification and description, who reports as follows :—

"The 'milk-bush' belongs to the order asclepiadeæ. *Sarcostemma Australe*, R. Br.

"*Etymology.*—*Sarcostemma*, from sarx, sarkos, flesh ; and stemma, a crown, in reference to the thick, fleshy nature of the inner corona. *Australe*, southern.

"*Diagnosis.*—A glabrous, leafless, somewhat fleshy twiner, woody at the base, the branches cane-like, round, often articulate at the nodes, the leaves replaced by minute opposite scales. Umbels sessile on one side of the nodes between the scales. Pedicels about a quarter of an inch long. Calyx-segments ovate, obtuse, scarcely half a line long. Corolla white, deeply divided into ovate obtuse lobes of about two lines. Outer corona aduate to the base of the gynostegium and about half its length, much undulate and sinuate, but not lobed ; the segments of the inner corona saccate, fleshy, nearly as long as the anthers. Follicles (pod-like fruits) rather narrow, two or three inches long. These are full of seeds, each one of which is surmounted by a tuft of silky-white hairs. This is the only known species in Australia, and is endemic. *Flora Austr.*, vol. iv, p. 328.

"*Remarks.*—The plant is found in all the Australian colonies, but is more abundant in the warmer portions of the continent. It abounds in a milky juice, which is said to be used by the aborigines of Port Darwin as a remedy in cases of small-pox. In the *Botanical Magazine*, Dr. Hooker, in describing *Sarcostemma brunoniana*, an Indian species somewhat similar to the Australian plant, says:— 'It abounds in milky acid juice, and is hence eaten by the natives as a salad, and sucked by travellers to allay thirst, thus forming a remarkable exception to the usually poisonous nature of the *Asclepiadeous* juices.' A plant (*Marsdenia leichardtiana*) closely allied to the *Sarcostemma*, is figured and described in my work on the



The Milk Bush—(*Sarcostemma Australe*, R. Br.)

'Indigenous Forage Plants of Australia.' It is called 'Dooba' by the aborigines, and before they tasted the sweets of civilisation it was of considerable economic value to them. The blacks dig up the roots, roast and eat them, and they also roast the young fruits, the seeds of which are considered a delicacy. All parts of the *Marsdenia* abound in a viscid, milky fluid of pleasant taste. It is a capital forage plant, and both sheep and cattle eat the young shoots with avidity, and they seem to thrive on them.

"Bailey and Gordon, Queensland, list *Sarcostemma Australe* amongst the plants reputed poisonous and injurious to stock, and cite two instances of cattle and sheep being poisoned through eating the plant."

CHAPTER IV.

SPECIAL PRODUCTS OF THE FARM

(Compiled by the Editor.)

I have headed this chapter the "Special Products of the Farm" to distinguish the crops enumerated and briefly described, from the staple hay and grain crops of most of our farms. By-products would, perhaps, have been a more suitable expression, as many of the products mentioned could only be grown profitably under certain conditions which do not exist in this colony at the present time. There are, however, many of our farmers who have a decided experimental turn, and it is always desirable to encourage experimentation with new products and advocate diversified farming so long as it can be conducted with profit. The ideal farm is that in which the maximum variety of crops is produced and the minimum purchased. The tendency in Australia is to produce one staple crop and buy everything else. The farmer will, in spite of all advice to the contrary, and with reason on his side, follow the lines of least resistance in his practice, and when labor is dear the line of least resistance often means the line of greatest profit. The following notes will, I hope, be found of use to those who have a desire to diversify the products of their holdings, and in doing so add materially to the comfort as well as the profits of rural existence and enterprise.

Turnips and Swedes.—It may be said that the turnip is cultivated as a culinary vegetable at certain seasons of the year from one end to the other in this colony, but its cultivation as a field crop is very limited, being confined to a few farms in the eastern and south-western districts. It is a question that only the farmer himself can decide whether it is profitable to grow these root crops, and though the turnip is a staple crop in Great Britain, it is a moot point whether more nutritive crops cannot be grown here serving the same purpose with much less labor and, consequently, more profit. Turnips and swedes are cultivated only with the greatest success where the rainfall is plentiful. They are valuable crops for a rotation, their deep-working proclivities bringing to the surface plant food that would otherwise be out of the reach of shallower rooting crops. There are numerous varieties of field turnips and swedes, chief of which are purple tops, yellow mammoth, elephant, green top, white globe, and others. The soils best adapted to turnips are light loams, loose and open, and these must be deeply cultivated and thoroughly pulverised. Light soils on a retentive bottom or clay soils are unsuitable to this crop. The soil should be enriched by a liberal dressing of manure rich in phosphates, such as bone-dust, guano or superphosphates. Nitrogenous manures will cause the plants to run to top. Turnips may be sown broadcast or drilled in, the latter being preferable as permitting subsequent cultivation more freely. From two to five pounds of seed is sufficient to sow an acre, and the plants will have to be thinned out to about six inches apart. Frequent hoeings are necessary to perfect growth. Turnips may be fed on the ground or carted off and fed chopped with hay or other fodder. From 75 to 100 pounds of turnips per day with hay is reckoned a ration for an animal weighing 1000 pounds.

Kohl Rabi is a hybrid turnip or turnip-stemmed cabbage. This plant can be grown successfully when turnips cannot, and is not so subject to the fly and other diseases. The seed may be sown broadcast or in drills, and subsequent cultivation should be the same as for cabbages. The tops are as good as cabbage for table use, and the bulbs, when young, are preferable to turnips as a vegetable.

Mangold Wurzel.—This is an excellent root crop, both for stock and in rotation for improving the ground. Mangolds may be grown on salty ground, and when the crop is removed a good deal of the salt is removed with them, and the ground is thus gradually sweetened by successive crops. The mangold requires a plenteous rainfall and does best in deep, rich, well-cultivated and heavily-manured soils; though in the matter of soils it is more accommodating than the turnip. Three or four pounds per acre sown in drills and covered to a depth of about an inch is sufficient. It is usual to steep the seed in water for twenty-four hours before sowing. The after cultivation consists in thinning out, and in the free use of the horse hoe, so as to keep the ground moist and the surface free from weeds. Mangolds should be thinned out to a foot apart in the rows, the rows being not less than double this distance apart. In harvesting care should be taken not to bruise or injure the root, otherwise decay sets in very rapidly and spreads to the whole heap.

Carrots.—The carrot, as a field crop, may be said to be almost unknown in Western Australia, but no root is more appreciated by stock of all kinds and, weight for weight, it is only slightly less nutritive than the potato, while the average yield per acre is far greater. Horses are particularly fond of carrots, and they should always form a part of their diet if perfect condition is desired. A carrot ration keeps up the milk of cows, and undoubtedly adds a richer flavor and a higher color to the butter. "As clean as a carrot bed" is an old saying. The carrot requires much more attention and hand labor than any other root crop, and is consequently a more expensive plant to grow. The young plants must be kept absolutely free from weeds if a maximum crop is desired. If thoroughly rotten dung cannot be procured it is better to use artificial manure, but none of a very stimulating nature should be applied. Land enriched by previous high culture is in all cases the best for this crop, as larger roots free from forks and useless appendages will be secured. Plenteous rainfall and a mild climate suits the carrot best, and the cultivation must be deep and fine. It is most productive in deep, light, warm loams overlaying a deep and pervious subsoil. The seed, which germinates slowly and irregularly, should be fresh, and is often soaked for a few hours before sowing. From two to five lbs. of seed per acre is required, according to the quality, and the covering must be very light. Thinning after the plants are fit to handle, and thorough subsequent cultivation, are essential to a maximum crop of carrots. The tops may be fed to stock, and the roots raised by fork or ploughed out and stored for future use.

Parsnips.—The parsnip is, if anything, a more valuable root crop than the carrot. It is, in the first place, easier of cultivation, and possesses greater nutritive qualities. It is invaluable as a food for dairy cattle, and is for this purpose extensively cultivated in Jersey islands. It gives a peculiarly rich, high flavor to butter, and adds to its firmness. There are two varieties of parsnips, the round and the long, the latter being most generally cultivated both as a garden and a field crop. A mild and moist climate is essential to a maximum crop of this root, though it is surprising how well it thrives under most trying conditions. It likes a deep friable loam like the carrot and other root crops, and needs similar subsequent cultivation after the young plants are through the ground.

Jerusalem Artichokes.—This is an edible tuber, nearly as nutritious as the potato, which is almost ignored in this colony. The stalks are almost as valuable as the tubers, and its cultivation is deserving of every encouragement. It grows as well on light soils as it does on tenacious clays, and thrives where no other root crop would exist. It is not exhaustive to the soil, and it may be harvested in such a manner that the work of harvesting is at the same time the work of re-seeding. It will endure the extremes of heat and cold, and furnish an abundance of fattening fodder when all else has failed. The tubers should be planted in early fall or in the spring in the same way as potatoes, and the better the ground and the more attention the plants get, it is needless to say, the better will be the crop. The tubers, which make an excellent table vegetable, may be either forked or ploughed out, or the ground may be fenced off and the pigs turned in. In France, where this crop is cultivated largely, the stakes are either cut and used as green feed, or stacked and made into fodder like maize.

Indian Corn.—This may be cultivated either for green or dry fodder or ensilage or for the grain. If for the former, some quick growing variety should be selected and the seed sown thickly broadcast. If for grain, the seed is sown in hills at equal distances apart so as to prevent subsequent cultivation. Light and porous loams, a little on the sandy side, are the best soils for maize if well tilled, but the crops will do well on all soils, except the stiffest clays, if the land is either naturally rich, or artificially made so. Maize is a gross feeder, and requires plenty of nutriment, which it absorbs very rapidly. On light soils there is no better fertiliser than well-rolled stable manure, but this is not always available, and artificial fertilisers have to be resorted to. The manures should in all cases be broadcasted over the land, as the maize plant, during the period of its growth, sends out a great number of lateral surface roots in search of food. Thorough tillage is essential to a heavy maize crop. In sowing for grain the land should be deeply ploughed and then harrowed, and marked off into rows and cross rows three feet apart. At the intersections three or four seeds are planted and well covered, about half to two inches deep. There are numerous machines made for planting, which do the work expeditiously, and save time and labor where a large area has to be sown. The sowing should not take place until spring, when danger of severe frost is over. The pickling of maize seed prior to sowing has been described in Part II. of the Guide, and it is not an uncommon practice to soak the seed for twenty-four hours before planting. The first hoeing should be given when the thinning out is done—that is, when the plants are about two inches high, and easily handled. Subsequent cultivation should be as frequent as possible, especially in the drier districts, so as to retain as much moisture in the soil as possible. Cultivation should not be too deep, otherwise the chief feeding roots of the plants will be destroyed. With a view to securing the best seed for next season, while the crop is still standing in the field, just before the gathering, the farmer should select and mark the earliest ripened and best formed ears, so that they may be distinguished at harvesting and put on one side for seed. The crop should be harvested either by cutting the tops when the tassel begins to grow dry, using the tops for fodder, or cutting the plant altogether when the stalk has begun to ripen. The stalks should be tied in bundles and stooked, and when dry removed to the barn. The husking and shelling may be done as required, and when the most favourable opportunity presents itself. There are many varieties of maize in the market, and seed should be selected to suit the district in the matter of ripening. For green fodder Cobbets' corn or ninety day is the best perhaps.

Buckwheat.—Flour made from the grain of this plant is universally used in the United States for cakes and in general cookery. The plant itself is chiefly useful as a catch crop for growing on poor soils, and ploughing in as green manure. The plant does best on light soils, and requires a moderate amount of moisture. As a green manure it is less valuable than the clovers, but will grow where these plants will not. The seed may be sown on ploughed ground in the spring, and lightly harrowed in, from three pecks to a bushel (fifty pounds) being ample. The Japanese is the most prolific and earliest variety, yielding from thirty to forty bushels per acre. The grain is excellent feed for poultry.

Field Peas.—Leguminous plants such as peas and beans play a most important part in agronomic economy. Their exact functions and value are fully explained in the part of the Guide devoted to manures and manuring, and need not be dilated upon here, where it is sufficient to say that they add nitrogen to the soil, the most valuable and the most expensive constituent to supply by artificial means, and should find a place in the rotation of every farm where it is possible to grow them. There are several varieties of field pea on the market, those in most general use being the dun and the blue kinds. A stiffish loam is the soil the pea likes best, but it will thrive on almost any class of soil, stiff clay excepted, if well cultivated and provided with an adequate amount of moisture and nutriment. An ordinary ploughing is sufficient preparation prior to sowing the seed, at the rate of from two to three bushels per acre. The harrow and roller should follow. It is a good plan to sow a few oats with the peas if they are to be harvested and not ploughed in, as the oat stalks keep them upright and in a better position for reaping. If left to get nearly ripe the pea vines may be harvested with a horse rake. It is not necessary to say that pea vines are a most nutritive fodder for all classes of stock, almost as nutritive as the pulse. The fodder may be fed just as it is, or the pulse may be first thrashed out. Pigs should be turned on the stubble to glean whatever peas have been knocked out in harvesting, and will fatten rapidly. Peas may be sown in the south-west at any time of the year, and in the drier districts in June and July.

Vetches or Tares.—This is another leguminous plant, valuable as a soil restorer, and also for fodder. Barley tares, peas and rape make an excellent mixture for the silo. Tares are usually sown with the cereal crops at the rate of from ½ to 1½ bushels per acre. The crops should be cut green or ploughed in, as the land is soon apt to get foul. Green tares are excellent food for milch cows.

Beans.—This is a most important leguminous crop in the northern hemisphere, but very little grown in Australia. Beans grow well in a variety of soils, and there is no reason why the crop should not enter more largely than it does into the rural economy of the farmers of the southern hemisphere. A thorough ploughing is the only preliminary preparation required for the crop, unless manure has to be added to the soil. The seed should be sown thickly in drills three feet apart, the seeds four or five inches apart in the rows; from 2⅓ to 3 bushels (60 lbs.) will give an acre of tick beans. Subsequent cultivation should consist in horse hoeing and keeping the ground free from weeds and the surface well broken up. When the leaves begin to shrivel, and the pods to turn, the crop should be harvested by pulling up the plants and stacking them in some convenient spot on rails laid on the ground. They will soon become dry enough for threshing out. The seed, unless thoroughly dry, heats rapidly, consequently beans should not be kept in sacks until all the superfluous moisture has evaporated from them. The stalks are of value as a fodder for sheep and horses, and add much to the richness of the manure pile.

TEOSINTE (*Euchlæna Mexicana*).—A fodder plant, native of Southern Mexico and Guatemala, introduced into Australia by the late Baron von Mueller. " The young shoots when boiled constitute a fair culinary esculent." This plant is described as being much quicker in growth than guinea grass, and rather slower than maize, but lasting longer as green fodder. It is not so hardy as sorghum. The teosinte is said to yield an immense crop, one seed producing from 40 to 60 stalks, and growing to a height of 12 and 18 feet under favorable conditions. One pound of seed will sow an acre. Treatment as for the sorghums.

EARLY AMBER CANE.—This is a useful and valuable fodder plant, a variety of sorghum, but care must be exercised in feeding it to stock, as cases are on record of cattle having succumbed by having been allowed to eat it before it was fully matured. A check in its growth renders it bitter and unpalatable, and it should only be grown where uninterrupted progress is assured. It may be fed green, or made into ensilage, preferably the latter ; if the former, it must not be used until the seed has shot out. The seed should be sown in drills 3 feet apart or broadcast in the spring. When drilled in subsequent surface cultivation is advisable as fostering growth and early maturity. Six to 12 lbs., according to method of sowing, drill or broadcast, will sow an acre.

DHOURA, OR EGYPTIAN CORN, WHITE SEEDED.—This is a non-saccharine variety of sorghum, producing a great yield of grain. It stands drought well, and grows from six to twelve feet high, and may be repeatedly cut for green fodder. All kinds of stock are exceedingly fond of it. The seed is excellent food for chickens. Twenty pounds broadcast, or fourteen pounds in drills are required to sow an acre. Drills should be three feet apart, and the plants thinned out to a foot or eighteen inches, according to prodigality of growth. Subsequent cultivation as for other sorghums.

KAFFIR BRANCHING CORN.—Another non-saccharine variety of sorghum, of low stocky habit. It does not stool from the root, but branches from the top joints. The whole stalk, as well as the blades, cures into excellent fodder, and in all stages is available for green feed. Withstands drought well, and is said to succeed on land too poor to grow anything else. Sow from September to January. Six pounds required to sow an acre in drills, and ten to twelve pounds broadcast. Subsequent cultivation as for other varieties of sorghum.

JOHNSON GRASS, OR EVERGREEN MILLET (*Sorghum halapense*).—A variety of sorghum which has of late years come into use. It thrives well in almost all soils and situations, however warm and dry, but where it can be irrigated it produces enormous crops. Cattle, horses, and pigs are fond of it when young. The seed takes a long time to germinate. Fourteen pounds required to sow an acre broadcast. This plant should only be produced on waste corners, as it is exceedingly difficult to eradicate once it has taken hold. Pigs do well on the roots, which, under favourable conditions attain the thickness and have the appearance of a bamboo. As a fodder this plant is somewhat overrated, and is best avoided except on land that would otherwise be waste.

Jerusalem Corn.—This variety of sorghum belongs to the non-saccharine class. It grows about three feet high, makes one large head on main stalk, and several smaller heads on side shoots, often as many as eight heads on one stalk. The grains are pure white and nearly flat, six pounds of seed being sufficient to plant an acre in drills. This is claimed, and, in the practical opinion of the Editor of the Guide, quite justly, to be one of the best and surest grain crops for dry countries and seasons. Drills three feet apart, and subsequent cultivation, as for other sorghums.

Sainfoin, or Esparcette (*Hedysarum onobrychis*).—Cattle are very fond of sainfoin, whether in its green state or made into hay. It is especially valuable for dry climates, and yields two crops a year. Sainfoin is a perennial, grows upright, reaching a height of from two to three feet, and bearing a broad, flesh-colored flower. If the crop is intended to stand for more than one season, the ground should be clean and well worked. Twenty pounds (in the husk) required to sow an acre broadcast.

Sorghum Saccharatum (*Syn. holcus*).—This is a valuable plant in warm districts where the soil is good, for use as green fodder during summer, being similar to maize in that respect. It is found to be more fattening than milk-producing, and, therefore, better adapted for store than for dairy cattle. It also requires the same kind of culture as maize. Seed may be sown in September, and again in the course of the next two months for succession. It should be sown in drills three feet apart, put in thinly, as its habit is to tiller. The plants may be thinned for use as they progress, until the remainder stand a foot apart. Six pounds in drills, or twelve pounds broadcast, required to sow an acre.

Giant Spurrey (*Spergula maxima*).—The spurrey is an annual plant which is largely grown in Russia for making hay. It is said that milch cows fed on it give superior milk and butter, and sheep excellent mutton. It grows well on poor dry sandy soil almost too poor to grow any other crop. The *Rural New Yorker* says "From four to six weeks after sowing it is in its best condition for pasture. The seed may be sown from September to December." Its value as a manurial plant on light soils is pronounced. It is readily eaten by cows and sheep. 15 lbs. required to sow an acre.

Lathyrus Sylvestris Wagneri.—This at one time much-boomed fodder plant is a variety of vetch, and is said to grow from a foot to eighteen inches high, but has never attained any reputation in Australia. The seeds germinate badly, and the plant takes a long time to reach maturity, and though great claims are made for it, in the opinion of the Editor of the GUIDE, who has experimented with it now for the past eight years, it is better left alone.

EGYPTIAN, OR PEARL MILLET (*Penicillaria spicata*).—A very productive and useful forage plant, which has been grown in the driest districts with great success. It is a strong grower, and yields a great amount of green fodder. When the plant first comes up the stems are prostrate, but assume an upright position when two feet long. Stock eat it with great avidity. It can be cut three or four times, sprouting readily, and growing rapidly after each cutting. It should be sown in drills, dropping two or three seeds two feet apart in the drill; the drills should be three feet apart Four pounds required to sow an acre. The Editor of the GUIDE has cultivated this plant for the past six years and has found it to be one of the most valuable and drought-resisting fodder plants ever introduced to his notice. It, like all plants, flourishes best in rich soils, but will give a profitable return in poor soils and really under the most disadvantageous circumstances, and stock eat it readily in all stages of its growth.

NEW DAKOTA MILLET.—This new American variety, according to Mr. William Adamson's catalogue, has proved itself, in experiments, to be an immense yielder. It was tried at the Ontario Agricultural College, with twelve other varieties, and yielded a crop averaging 8½ tons to the acre, being far ahead of all the other varieties, excepting the "Pearl." It is a very strong grower, producing an immense amount of foliage stands the hot, dry weather well, and makes excellent hay, which is greatly liked by cattle. It was tried last season in New South Wales by the Agricultural Department, and gave every satisfaction. Sow in drills, three feet apart, about 4 to 6 lbs. to the acre, or 10 lbs. broadcast.

CHICORY.—The culture of this root should not be attempted unless the soil is of first-class quality, otherwise the expense of preparing the soil, keeping it clean, and digging and harvesting the crop, would exceed its value. The soil should be prepared as for carrots, and the seed dropped at intervals of nine inches, in shallow drills eighteen or twenty inches apart. The end of September and beginning of October is the best time to put in the seed. The young plants should be carefully singled as soon as large enough to handle, and the soil must be regularly cultivated throughout the season. 4 lbs. required to sow an acre in drills. There is a limited demand in this colony for the root, which is used in a dried state for adulterating coffee.

LINSEED, OR FLAX.—This should be a profitable crop to grow in the Blackwood and South-western districts, where the soil is rich and rainfall plentiful, and one to which farmers should pay attention. It is not only valuable on account of the seed, but for the fibre, which is worth about £40 per ton. The seed should be sown broadcast on well-worked soil, and either very lightly harrowed in, or both harrowed and rolled, according to the condition of the soil ; but it requires in every instance to lie very near the surface, for if deposited more than half an inch deep it will not germinate. It succeeds well in the Gippsland (Vic.) district, and should be sown very early in the spring or autumn at the rate of 1½ bushels (56 lbs.) for seed, and 2 to 2½ bushels for cordage purposes.

Broom Corn.—Is a variety of sorghum and should succeed well in this colony. In addition to its well-known commercial value for supplying the fibre for broom-making, it has to a large extent the nutritive properties of the sorghum tribe, and thus forms a useful fodder plant. The seed yield, too, is heavy, and is capital food for poultry. The seed heads (stripped, of course, of the seed) give the fibre for making the well-known American house broom, dandy brushes, clothes dusters, etc. Its value depends on its length and toughness, and these in turn depend on a proper selection of seed and method of curing. It requires similar soil and culture to corn, and the ground should be in good condition. It is frequently planted in drills three and a-half feet apart, leaving the plants six inches apart. September to November is the best time to sow the seed. The varieties now in the market are :—Californian golden long-brush, growing from twelve to fourteen feet high. Improved dwarf, an excellent variety, growing a fine brush of good length. Long-brush evergreen, this variety grows about eight to ten feet high, stands up well, and is entirely free from crooked brush. The fibre is long and fine. This is a strictly green variety, and does not get red in the field before it is cut.

Field Cabbage.—Field cabbage may be cultivated either by raising the young plants in a seed bed and then transplanting them, or by sowing the seed in drills where the crop is to go, and thinning out the young plants. The rows should be 3 feet apart and the plants 18 inches apart in the rows. One pound of seed will provide enough plants for an acre when sown in the seed bed. From four to six pounds will be required for drilling. Grant drumhead and Schweinfurt, a very early white variety, are the favorite sorts of field cabbage.

Thousand-headed Kale.—This plant, a tall, branching variety of cabbage, is, in the opinion of the Editor of the Guide (founded upon ten years' experience), one of the most valuable fodder plants ever introduced into Australia. It produces more weight of fodder per acre than any other known plant, it is relished by all stock, and may be fed safely at all seasons of the year. It will withstand drought to an extraordinary degree, the writer having secured a crop of 27 tons (weighed) from one measured acre in this colony in one of the driest localities, the rainfall from the time the plants were put out until the crop was harvested being only 3½ inches. The plant, being a deep sucker, does not impoverish the land, but, on the contrary, does it good, bringing up fresh stores of plant food to the surface for the subsequent use of shallower rooting crops. The plants will last for two and sometimes three years if not allowed to go to seed. Three pickings will yield from 35 to 45 tons of green fodder per acre. Sowing and treatment same as for cabbage. The Jersey tree kale is another and very similar variety. In reference to thousand-headed kale, a recent writer in the *Agricultural Gazette* (London) says : "A few days ago I was over the farm of a friend who farms extensively, as he has recently added another 1000-acre farm to a previous occupation of the same extent, making upwards of 2000 acres in his holding, and what impressed me was the quantity of thousand-head cabbage on the farms. All the sheep, comprising about 1500 breeding ewes and 400 tegs, were feeding more or less on this crop, and doing well on it. On my remarking on this fact, he said, ' I have given up growing swedes, as it is a most expensive and uncertain crop to grow ; moreover, the difficulty of obtaining hoers when required in haying and harvest is very great. I therefore now grow thousand-head cabbage in place of them. I drill them in May ; when they get high enough I run the harrows across the rows, and skim them about twice, and that is all the labor required.' Now contrast this with the swede crop, the uncertainty of getting plants, and all the labor of getting them set out and just at the right time. Moreover, the swede crop is very liable to total destruction from a hard frost, whereas the thousand-head cares nothing for frost ; and I knew a neighbor two winters ago, when the severe frost killed everything else, sell three acres of this crop for £50 per acre for greens. I therefore think sheep farmers in many cases would do well to reduce their swedes and replace with thousand-heads, which come in in this country (Great Britain) from about November up till the end of March." A New South Wales farmer writing about thousand-headed kale says :—" Thousand-headed kale is the least known and most desirable of any green crop I have ever seen. It is a plant that produces more feed per acre than any other, does not disagree with any stock, and does not impoverish the land. With me it has never caused sheep or lambs to blow or scour. Eighteen perches per day, with a little oat straw, have kept 270 sheep for three months without the loss of one."

HEMP.—This plant is cultivated with success in the Gippsland district of Vicloria, and should do well in the Blackwood country of this colony. It likes rich, moist bottom land, but will grow fairly well in poor soils. It should be sown in drills in autumn or spring so as to produce a more robust fibre. In its raw state hemp is worth about £43 per ton in Melbourne. 120 pounds seed to the acre, broadcast ; half the amount in drills.

Opium Poppy.—This plant might be profitably cultivated where children are available for labor on the farm. The seed should be sown in drills three feet apart and the ground must be kept well cultivated. August and September are the best months for sowing.

White Mustard.—In some countries mustard is a profitable field crop ; and, when the value of rotation of crops is fully recognised, will probably come into cultivation here also. The land requires to be well worked, and the crop will pay for a considerable application of manure. The seed may be sown broadcast, or in drills eighteen or twenty inches apart, for the sake of cleaning the land, in the end of September or the beginning of October. The seed ripens in three months, or less, so that it may be made available as a fallow crop. The crop should be harvested before any of the pods burst, as if seeds are scattered they foul the land to a serious extent. It may be covered effectually by rolling, without the use of the harrow. A yield of twenty to forty bushels of seed to the acre may be expected. It is very useful for sheep food. Eight to ten pounds required to sow an acre.

Pumpkins and Pig Melons.—The pumpkin is a field crop not to be despised. It likes rich and preferably new land ; seeds should be sown in hills as soon as the ground begins to get warm. Mulching in the late spring is a decided help. Pig, or "paddy," melons are a valuable standby. Seeds may be sown in any waste corner, new ground preferably, and no cultivation or attention is needed. The melons, chopped up, with a little bran and chaff added, make a diet much relished by cows. Pigs do well on the melons.

Sunflower.—This plant should be grown freely where poultry are kept, and the seeds are much relished by fowls. A valuable oil is also extracted from the seeds. When grown in quantities it would be profitable to express the oil and use the marc as food for stock. The stalks, which contain a large percentage of potash, are used in Russia for fuel. The large Russian variety is the best, and seeds should be sown in spring, in drills, about three feet apart.

The Sugar Beet.—The profitable cultivation of the sugar beet on a large scale is chiefly governed by the cost of labor. The following, prepared by Mr. A. Despeisses, of the Bureau of Agriculture, gives the necessary information as to culture.—Varieties.—1. *White improved Vilmorin sugar beet.*—Originally obtained from the white Silesian beet, and of the result of methodic and persevering selection, one of the richest and most regular varieties in existence. The yield is about 12 tons per acre, with a proportion of sugar in the roots amounting to 16 per cent.,* representing 1 ton 10 cwt. of extracted sugar per acre.

* N.B.—About three-quarters only of the sugar in the roots can be extracted and crystallised, and the same applies proportionately to the other kinds.

As regards its preservation, it is recognised that it holds its sugar content better than any other variety, and for that reason, in those factories in which the "Improved Vilmorin" is manufactured in connection with other varieties, it is the custom to keep this for the end of the season and to work up the less reliable beets soon after they have been pulled. It is also claimed to resist better than any other variety the unfavourable influence of certain soils, such as black soils, rich in organic matter, and of certain manures, while most other varieties under these circumstances become watery and saline in excess, thus seriously deteriorating the quantity as well as the quality of the sugar and checking its extraction.

This variety is very extensively grown where the excise tax is paid on the beet itself and not on the manufactured sugar.

2. *Green-top Brabant sugar beet.*—The top, which protrudes from the earth about a couple of inches, is coloured green and carries a foliage vigorous in growth and upright in position. The root is long, smooth and white. It is a very prolific and vigorous variety, requires deep soil, well tilled, the weight of the crop averaging 20 tons per acre, containing about 12 per cent. of sugar, representing about 1 ton 5 cwt. of extracted sugar to the acre.

3. *French rich sugar beet.*—A variation of the Brabant beet, preserving in its general aspect, and notably in its foliage, many of the characteristics of the Brabant. It differs distinctly from it in the fact that it grows entirely under the soil, is more slender, with a more reddish skin and more compact flesh. Its yield averages 16 tons of roots per acre, containing 14 per cent. of sugar, which represents 1 ton 12 cwt. of extractable sugar.

4. *White red-top sugar beet.*—Is about equal to Brabant green-top in yield and percentage of sugar, but it does not require such deep soil, and ripens earlier. It is very extensively grown in countries where the tax is paid on the manufactured sugar or on the alcohol and not on the roots.

5. *Early red-skin sugar beet.*—Is a very good and distinct kind, growing entirely under ground, with leaves lying flat on the soil. It yields about 16 tons to the acre, containing 14 per cent. of sugar, or 1 ton 12 cwt. of extractable sugar. It ripens early and keeps well.

6. *Klein-Wanzleben sugar beet.*—Has a wider cultivation than any other sugar beet. The root is conical, straight and even, quite large at the head, and rapidly tapering. It has a brighter colour than the improved Vilmorin, which enters largely in the cross from which it comes; its leaves are lighter coloured, undulating, and scalloped about the edges. This variety succeeds well in soil of an alluvial nature and mean richness and on level plateaus. In soils very rich in humus it ripens poorly and loses much of its richness. It yields slightly heavier crops than the improved Vilmorin, but its saccharine richness does not exceed 14 per cent.

Preparation of the soil.—The best time for ploughing is the autumn, the plough being first run six to seven inches deep and followed by a subsoiler regulated to tear the ground another six or seven inches, thus breaking the arable soil to the depth of twelve to fourteen inches, which is about the average length of a sugar beet root. The land is left in this rough condition all through the winter, and is again ploughed—not subsoiled—in the spring, and prepared for sowing by means of harrowing and rolling. Should the ploughing be delayed till the spring, a quantity of bad seeds will be brought to the surface, which, germinating at the same time as the beet, will over-run the ground and smother the crops ; while, on the other hand, if the soil be ploughed in the autumn the seeds which germinate in the early spring are killed by the second ploughing, harrowing, etc., which precede the sowing.

Preparation of the seeds.—The seeds are very often "pickled" or soaked previous to the sowing, especially when they are not quite fresh ; and the planting takes place in the spring, whenever the temperature reaches about 55 deg. to 60 deg. F. In the New England district by the end of September. The germinating faculty is materially increased by soaking in water at 100 deg. to 120 deg. F. for twenty-four to thirty-six hours, and the beets thus treated show a more even growth than when the seeds are not soaked. Prolonged immersion, however, in pure water, might remove from the seeds some of their soluble constituents, and for this reason the seeds are often steeped in the juices flowing from the manure heap, which are diluted with about an equal volume of water. A mixture of urine and water in equal parts is just as good. The seeds, during this time, having absorbed about their weight of water, are taken out, mixed with ashes—superphosphate of lime is often added to the ashes—dried on the surface, passed over a screen, and used for sowing.

Germination of seeds.—Few crops have been so thoroughly studied as regards their requirements, and the treatment they should be subjected to, as the sugar-beet. Experiment has shown that in a soil well prepared and sufficiently moist and ærated, the seeds require for germination a total of degrees of average temperature equal to 650 deg. F. Thus, if the average daily temperature be 55 deg., twelve days will be required for germination ; if 65 deg., only ten days will be required. Should the seeds be steeped for thirty-six hours in water, or the liquid from the manure-heap warmed to 100 deg. or 120 deg. F., the number of days required for germination will be correspondingly reduced, and only nine to ten days will be occupied. The same principle holds good for the germination and the ripening of many of our economic and ornamental plants.

Manures.—In the rich volcanic or alluvial soils of the New England district, no immediate manuring will be required, except on land which has been under crop for a great number of years. When, however, manure has to be applied, it should not be too new, but thoroughly rotten, in order that the beet roots may not be caused to fork out by coming in contact with hard straw. This forking or branching prevents proper maturing For this reason, stock-yard manure is not directly applied to the beet-root crop, but to the cereal crop which precedes it. Artificial fertilisers, such as superphosphate of lime, are often used instead of stock-yard manure, and may be applied at the time of sowing, either separately or mixed with the seeds. In the case of soluble nitrogenous manures, such as nitrate of soda or sulphate of ammonia, it is always advisable to apply them when the seeds have germinated, and the plant is able to utilise them. Manures in which the phosphoric acid is to the nitrogen in the proportion of two to one give very good results as regards the production of sugar in the crop.

Sowing.—For experimental purposes, sowing may be done by hand, but when beet growing is attempted on an industrial scale, a seed drill should be used, which delivers the seeds regularly, without waste, and facilitates the subsequent method of cultivation and harrowing. The seeds are sown thickly, at the rate of 16 to 20 lb. to the acre, in lines 10 to 14 inches apart, and not more than 1 to 2 inches below the ground, a light roller being run on the ground after the sowing. Experiments have shown that at that depth a higher percentage of the seeds will grow than at any other. Also, that close planting gives :—

Roots richer in sugar.

Containing less saline and organic matters.

Hence, it is less exhausting to the soil, and produces heavier crops. The inference is that close culture is more profitable, both to the grower and to the manufacturer. In drier localities, the distance between the rows might be increased to 16 or 18 inches each way, so as to allow to each plant a greater superficial area for drawing moisture from, and also for diminishing the evaporation through the leaves. For this colony, where hand labour is so expensive, it might be considered a good plan to sow a little wider apart—say 18 to 20 inches between the rows—so as not to impede the operations of horse hoeing and sowing 18 to 20 inches apart, whilst restricting the distance between the plants in the line to 9 inches. The thinning should be carried out when the plant has grown two to four leaves. Hoeing is begun as soon as the plants show above the ground and mark the row, and is constantly carried on at intervals of a fortnight as long as the leaves will allow. Early and constant hoeing is strongly to be recommended, as it destroys the weeds when they just show, and also keeps the surface of the soil well pulverised, thus checking the excessive evaporations in the daytime by breaking the continuity of the capillary action in the ground, and besides favouring the absorption of the moisture and dew during the night. After a dry summer a few seed-stalks may appear in the field, and should be removed.

Ripening.—The sugar-beets begin to mature in the autumn, and this is shown by the leaves turning yellow and drooping. The roots are then fit for pulling, which is done either by hand, after the root has been loosened by the assistance of the pick or the plough, or by machines which have been devised for the purpose. At all events care should be taken not to bruise or cut the root, which would then decay when stored or heaped up in silos. The leaves are removed from the roots in the field by means of a sharpened bill-hook, the earth shaken off, and the roots heaped up and covered with their leaves till carted away to the stack or silo.

Stacking.—The beet-roots are either delivered at once to the sugar factory or stored for some time. For this purpose, they should be stacked or heaped up in trenches or cellars which should not be too dry, or the roots will wither, nor too damp, or they will rot. The roots should, morever, be protected against frost, but a high temperature is highly undesirable, as favouring the sprouting of the roots and their fermentation ; good ventilation, and means of carrying away of foul air and the carbonic acid gas disengaged from the mass of heaped up roots, should also be provided.

The Uses and Cultivation of Rape.

By J. L. Thompson, Principal Hawkesbury Agricultural Coll.

(New South Wales Agricultural Gazette.)

The following brief paragraph, under the above heading, appeared in the *Adelaide Observer*, under date 5th December, 1885 :— " We have inspected a splendid crop of wheat on the Beefacres estate, in respect to which the farming community in South Australia ought to be especially interested. Two years ago the field of 150 acres was sown for wheat, but the yield was so poor that the crop was not worth reaping, this result being attributed to long cropping with cereals, which had made the land wheat-sick. Mr. J. L. Thompson, the manager, then determined to try the effect of a rape or colza crop, and this was sown at the rate of 6 lb. of seed to the acre, without manuring. The rape turned out well, and travellers by coach on Tee-tree Gully Road used to talk about the splendid crop that was to be seen on that journey. The rape served to feed many hundreds of sheep for some months, and then the land was deeply ploughed up, and, in due season, again sown with purple straw wheat at the rate of 45 lb. per acre, without any manure whatever. The crop is being reaped with three 'Hornsby's' and one 'Walter and Woods'' string binders, and stands closely at about five feet high. There are close upon two tons of straw and probably thirty bushels of wheat per acre. This extraordinary result of rotation of crops without manure and with no extra cultivation except ploughing a little deeper than usual, and especially considering the dry season experienced at Beefacres, only 12 inches of rain having fallen during the growing season, ought to be instructive to all farmers in this colony."

The growth and uses of rape.—The growth and uses of rape are not known or appreciated by the average farmer in these colonies, but a few in South Australia, Victoria, and New South Wales have grown it for many years with great success. I saw in a Victorian paper not long ago, the editor of which has some pretentions to agricultural knowledge, this plant described as a new kind of grass, and as very valuable for feeding sheep, etc. Rape has no affinity to the grass family graminaceæ ; it belongs to the crucifers. Rape (*Brassica campestris*) is extensively grown in some parts of Europe for the oil expressed from its seeds, and to provide pasture that will fatten sheep readily. The rape plant is a native of Europe, perhaps of England, but it is hard to say where it is actually indigenous and where naturalised. It bears a close resemblance to swede turnip in the early stages of its growth, but usually attains a greater height than the turnip, and produces more of stem and leaves. It has a fusiform and stringy root, while that of the turnip is bulbous. On average soils, when grown in drills, it usually reaches a height of from 18 to 20 inches, but on soils very rich in vegetable matter it sometimes attains a height of between two and three feet. There are several varieties of rape, but the only kind I have had any experience with as a pasture is known as the dwarf Essex. Like the turnip, rape is adapted to temperate climates. It will be found to grow in temperatures that are cool rather than warm. The most suitable soils for growing rape are fairly moist free-working loams, rich in organic matter. Black loams are also suitable, containing, as they generally do, a large amount of humus. Good maize, potato, or turnip land will grow rape. It will also grow on clay soils after the plants get a start, but not so luxuriantly as on the other soils I have mentioned. Rape as a rotation crop cannot, in my opinion, be excelled. As the extract at the commencement of this article shows, I had wonderful results with the plant in recuperating old worn-out wheat land in South Australia. At Dookie I had a similar experience. There, a paddock of 40 acres, which in 1886 had been sown with wheat, was not worth cutting, so poor had the returns been reduced from continued cereal growing. In January of the year following I ploughed the land deeply, and exposed the soil to the ameliorating influence of the hot summer sun. Towards the end of March I had it thoroughly cultivated fully 6 inches deep with scarifier, disc harrow, ordinary harrows and roller, until it was brought to a tilth equal to the proverbial "onion bed." Early in April, and just after the first autumn rains, with sufficient moisture to ensure the rapid germination of the seed, I sowed the rape broad-cast, at the rate of 6 lb. to the acre on the finely-harrowed surface. To cover the seed I simply passed the roller over it. This, I may say, is sufficient covering, the smaller seeds if buried too deeply do not germinate, and the seedsman is blamed unjustly. Nature sows her seeds very shallow, and they germinate and grow well, especially if they are not wanted to. The plants appeared in less than a week, and the rough leaf in a fortnight. Owing to the moisture and warmth at that season of the year, it grew like magic, and by the end of May was fit for the ewes and lambs. Over twelve head per acre were pastured on this rape, besides numerous milch cows and other cattle, until January, 1888, when the residue, with all the sheep droppings, was ploughed under, but not too deeply. The land was allowed again to sweeten for a few months, and the vegetable matter to decompose. It was next sown with "Chevalier" barley, in the proportion of one bushel to the acre—this was towards the end of April. The yield was 25 bushels to the acre of a magnificent sample of malting barley, which was sold for seed at 6s. 6d. per bushel. This prosperous result was gained in a season when the rainfall for the whole year was 14·51 inches. In the following year this land was again sown with "Chevalier" barley, and produced a prime sample, which yielded 20 bushels to the acre. In 1890 I sowed this land with Cape barley, oats, a little rape, vetches, peas, and beans for an ensilage crop, and secured a yield of fully 10 tons to the acre of prime succulent herbage. This was cut in November, the land was manured with farm-yard compost, and immediately sown with sorghum, which yielded in the following February 15 tons, being 25 tons per acre of cow feed in a dry district. But to return to rape. I have secured better results by sowing it in drills, and, when the ground requires cleaning, this is the best method of cultivation. When drilled in from 1½ lb. to 2 lb. of seed to the acre will be sufficient, but when broadcasted, 5 lb. to 6 lb. will be necessary. The seed can usually be purchased at threepence per lb., so that the cost of the seed is very small. When sown in drills, as the rough leaf appears on the plant, the horse-hoe should be freely used between the rows to keep down the weeds and to keep the soil open and loose, fracturing the capillary tubes which bring the moisture from the lower strata, and is dissipated into vapors in the air. No attention need be given to the thinning of rape. Rape being an excellent cleansing crop when grown in drills and cultivated, it may, with advantage, be grown between two tops of grain. Rape can also be grown as a catch crop, *i.e.*, as soon as a cereal crop is removed, if the land is not too stiff, the stubble land may be simply scarified, harrowed, and brought to a fine tilth, and the seed sown. The crop may be either pastured or ploughed in as green manure. Rape makes a capital soiling crop. The crop can be cut down and fed to cows or other animals in a shed, or scattered over a small paddock or yard. But it is as a farm manure that rape is of so much value to the Australian farmer in recuperating his worn-out wheat-sick soil. The question may fairly be asked, how can the growing of rape without manure, and ploughing it in, improve the fertility of the land, seeing that nothing is added to it, but that is only restored to it which was taken out, by the crop? To this inquiry I reply, the benefits of a rape crop, so far as I can judge, are as follows :—Science teaches us that a large proportion of the leaves and stalks of succulent herbage is composed of substances taken from the atmosphere, such as moisture, carbon, hydrogen, oxygen, &c. The roots of the rape plant permeate the soil, and draw to the surface from the subsoil valuable plant food. The rootlets improve the mechanical texture of the soil, and enrich it in their decay, and the whole plant when ploughed in decomposes, thus contributing considerably to the organic matter. Rape contains about 8 per cent. of carbo-hydrates, 2 per cent. of albumen, and a little fat. It cannot be excelled for fattening old ewes, or producing fat lambs for the market. When very young and succulent rape is liable to scour sheep ; to prevent this, a little hay or straw chaff should be within reach of the animals to counteract this tendency. In New Zealand and Canada half a pint of oats per sheep is allowed, with very payable results. Rock salt, in all cases, should be within reach of the sheep. Rape is not suitable as a food on which to feed milch cows exclusively, as it taints the milk. It is, however, capital food for pigs, and they are very fond of it.

Fertiliser foı rape.—Although rape will give a profitable return during an average season on fair land, thoroughly cultivated, without manure, it is responsive to an application of farm-yard manure. It is probable that the application of a complete fertilizer will give satisfactory results. From experiments carried out with fertilisers applied to this plant, at the Ontario Agricultural College experiment station, Canada, the best results were obtained from the application of nitrate of soda, and the next from the application of salt.

Precautions to be observed in feeding with rape.—Stock should never be turned into rape when hungry—otherwise they will eat too much of it and become blown, and probably a large percentage may die. When the man in charge of the sheep at Beefacres put 2,000 ewes into 150 acres of rape for the first time, he lost eleven head within two hours. He then took them out, and put them into a bare paddock ; the sheep all lay down at the gate, wanting to get in again to the rape. When the gate was opened, they required no dog to drive them back to the rape ; they rushed in at full force, and being empty with their long fast, commenced eating most ravenously, with the result that twenty-two died within an hour. The shepherd, terrified, took them all out, and came to me to report progress. I instructed him to then put the sheep in with a full stomach, and leave them there. He replied to the effect that if he did this I should lose the half of them. I assured him that I would take all responsibility. We had, at the time, a field of winter proud wheat, and next morning I went up and gave instructions to let the sheep into the wheat field, where they filled themselves thoroughly. The rape paddock adjoined the wheat one, and the gate was opened, so they quietly passed from the wheat into.the rape. Being so full of wheat, which, by the way, does not blow them like rape, they could not eat the rape so greedily, and, consequently, did not fill their stomachs with gasses. We did not remove them again for two months, nor did we lose another sheep. It is the worst possible plan to put stock into succulent herbage, such as lucerne, rape, clover, etc., for a brief period, and then remove them to a bare paddock. The sheep, which has less brain for its size than the rest of our domestic animals, has, I incline to believe, some reasoning power, and no doubt reasons somewhat thusly :—" If I am allowed to remain only half an hour in this fine rape, I must make the most of my time." The consequence is rapid feeding, which speedily distends the rumen or paunch with gas, and if relief is not soon obtained, death ensues. I have been very successful with cattle and sheep, when first put on succulent herbage, by simply putting them on with full stomachs, and then leaving them there. Owners of pure bred pedigree stock should use great care when pasturing valuable animals on rape. In my opinion there is great room for the extension of the rape industry in Australia. One acre will fatten ten lambs. I know of no other plant of the same importance so likely to assist to develop and fatten a cross-bred or long-woolled sheep suitable for the English market. In this respect rape is much superior to turnips, inasmuch as it will grow in many parts where turnips would fail.

The Potato.—In Part I of the Guide some idea is given of the extent of land in the south west division of this colony suitable to the cultivation of the potato, and it is really a reproach to Western Australia that the market for the crop is not better supplied by local producers. The hon. the Commissioner of Crown Lands recently had Mr. F. S. Brockman, of the Survey Department, report on the area of Crown Lands in the south west, suited to and available for potato growing. The report says :—

" The area generally within which the potato can be successfully grown in the colony may be considered to lie along the coast line between the Murray river on the north and Albany on the south, and between the costal range and the sea, generally not exceeding ten miles in width. Further inland than this there are many sheltered spots where a successful crop may be grown, but much land otherwise suitable is too liable to the effects of frost. In the belt of coast country referred to, with an average rainfall of about 40 inches, any locality is suitable for the industry where the soil is loose and rich. Two distinct classes of soil are almost equally good, namely, the rich moist bottom or swamp land, which produces the summer crop, and the loose, strong upland loams, which produce the winter crops. Of these I am inclined to think the upland is the more prolific, though perhaps not so certain a crop ; but, on the other hand, the swamp lands will produce other crops in the year in addition to potatoes. With regard to the unalienated land suitable for the industry, it is difficult to estimate the quantity, for, like most of the good lands of the colony, and especially of the southern district, it occurs in small patches. To begin at the northern end, we have some first-rate swamp land in the Harvey area, in the neighbourhood of Sampson's Brook, and the north Harvey, and between the Harvey and Coolup areas and the coast there are a number of splendid swamps seldom more than 100 acres in extent, and more often much smaller, but unfortunately difficult to drain. From thence south to Quindalup the coast country is practically all held in fee simple, the great locations, Wellington 1 and 41 and Sussex location 125, filling up the whole of that stretch of country. Immediately to the south of this the western spur of the coast runs to the sea at Cape Naturaliste, and practically no potato land is found on the northern slope. On the southern slope, bogs, swamps and running streamlets are numerous, but the first patch of any extent is to the north of Coweramup Bay, Miamup. Here there are many hundred acres of rich bogs suitable for the growth of the summer crop. A little further south the Margaret river runs for several miles through a splendid patch of uplands, equally suitable for either grain or root crops. Thence south to the Blackwood river there are a few fine patches, notably on the Boodjijup and Calgadup creeks, where there are many hundreds of acres of both uplands and swamps. From the Blackwood to the Warren I am personally not much acquainted with coast country, but I have gathered information from many reliable sources, and I am assured that from Donnelly river westward there is a large tract of rich boggy flats lying parallel to the coast and immediately behind the coast ridges, of surpassing richness and of many thousand acres in extent, which only require to be brought into notice. As this will probably require some general scheme of drainage (though I am assured no work of a costly character will be necessary) it should be dealt with by some scheme of subdivision before selection, and I recommend that a reliable man (an officer of the department, if possible) should be sent to make a careful inspection, and report upon the locality and the best method of dealing with it. From the Warren river easterly the country contains large tracts of good soils, but at present these are beyond possible access, as there are no ports along the coast. Roughly, I think the whole of the available lands may probably be estimated at 20,000 acres, in about equal proportions of uplands and lowlands, which should be capable of producing 50,000 tons of potatoes per annum, worth at least £150,000 on the ground, at present values."

The area mentioned by Mr. Brockman does not nearly represent the total area of potato land in the colony. The localities referred to in the report are those where the potato can be made a staple and re-current crop, but there are thousands of acres in other localities where at least one crop of pototoes can be grown between frost and heat in the year. The soils best suited to this crop, and the manuring of them, is dealt with by the agricultural chemist in that part of the GUIDE specially devoted to soils and manuring, and in these notes it is only necessary to say that whatever kind of manure is used potash should always be liberally supplied.

PREPARING SEED POTATOES.

This apparently simple operation is too often put past lightly, and without having due heed paid to the importance involved. As in the case of all other kinds of crops, the ultimate success of the potato crop depends very materially upon the character of seed deposited in the soil. Opinion, we may safely assume, is pretty well agreed that soundness and a high degree of vitality are essential qualities in the seed. Apart from these generally accepted qualifications, however, there are other questions of considerable influence which will amply repay full and careful investigation and observation. The point as to whether potatoes should be planted whole or cut into parts or "sets" is, as yet, widely disputed. With a large and important section of potato-growers the use of whole seed is preferred. It is claimed by supporters of that system that the extra cost entailed by the greater weight of tubers required is abundantly recouped by the better results obtained. The entire seed, they maintain, produces a heavier yield, and what is equally important, a crop of more regular size and shape, and therefore a much larger proportion of marketable potatoes. In potato-growing the quantity of saleable tubers is the first consideration. It is not excess in number so much as heavy weight that is deemed a profitable crop. If, therefore, the whole seed produces a better scaling crop without perceptibly reducing the number, the believers in this method have a strong case. And there is good ground for believing that in making such claims they do not overstate the facts. They adopt and advocate the planting of whole seed, because experience has proved to their satisfaction that that is, in the long run, the more profitable system. Testimony to the advantages of this method is also furnished by the fact that it is gradually extending the ranks of its already numerous followers. Further striking evidence of the utility of the practice is supplied in the favourable opinion entertained of it by the more extensive and successful growers, notably such as aim especially at producing high-class samples for the seed potato market. It is with this class of growers that the whole seed method finds its chief support. It may be observed that it is not recommended that the largest sized potatoes should be used for seed. The medium sized are preferred as being equally efficacious, while more economical. Very small potatoes should on no account be used for seed. Seed potatoes are better to have only a moderate number of eyes. The buds are more likely to be strong and vigorous in growth when this is the case. Although the greater proportion of the most skilled potato-growers advise the use of medium-sized whole seed, and the method is increasing in popularity, the plan of cutting tubers still enjoys widespread favor. The chief advantage of this more laborious system is the direct saving of seed effected. In cutting the potato it is desirable that at least two eyes be left in each set or part. A surer growth is thereby attained. It is, under all circumstances, a mistake to attempt to cut too many sets from one potato. Three sets may sometimes be got, but two will, as a rule, be more profitable. Thinly-cut sets, like very small whole seed, will only produce an irregular, inferior crop, wholly unprofitable to the grower. When misses are to be avoided in the crop the following plan of treating the seeds is a good one :—The sets are started into growth before planting, and this is how to do it most economically. Make boxes about 30 inches square, and about 10 inches deep. A thick layer of wood ashes is spread on the bottom of the box, and on this the seed is packed, either whole or cut. Then another layer of ashes, and another layer of potatoes, and so on till the box weighs about 100 lbs. The sets soon commence to sprout. They are then fit for planting. There may be a rope handle on each side of the boxes, which are moved along the rows, and the seed is put into the drills and covered up. Sets that have not started into growth can be returned to the ashes until they do sprout ; or if there is no growth in them, then they can be used otherwise. The process does not take much more time than the ordinary plan of carrying out the seed, but it adds immensely to the certainty of the crop. Where it is desired to pickle potatoes as a preventive of disease, the following device (see next page), described on page 294, part II of the GUIDE, will be found handy. The following simple hints on potato culture will be found of valueto those lacking the necessary experience :—

Seed.—1. Keep the seed as cool as possible, to avoid sprouting until wanted to do so, because the first eyes are the strongest and best, and if broken off the next eyes are weaker, and do not produce such good crops. 2. Reject any seed which looks diseased ; do not even use the part that appears sound, because the spawn, which reproduces disease, lives through the winter in the potato, and will develop in favorable weather. 3. Cut the sets a few days before planting. Don't put them in heaps, but spread them out on a dry floor, and dust them over with air-slaked lime, letting the sets take up as much lime as will stick. This allows the cut surface to dry and harden before planting, and helps to protect from disease, because the spawn, which reproduces the disease, can live in the ground a long time, and finds easy entrance into the freshly moist surface, especially when the sets are planted on warm moist dung. 4. Don't cut the sets very small, because by doing so enough nourishment is not left to support the young plant, and a sickly plant will not resist disease. 5. Don't plant the sets very close, because the more the air can play about the stalks the healthier the plant will be. 6. Plant early, so that the tubers may be well developed before the period at which blight usually sets in, because the blight always produces the worst effect on the crop when young.

7. " Don't put all your eggs in one basket," but try planting a small quantity of well-known disease-resisting varieties ; for instance, the "magnum bonum" is a heavy cropper, very disease-resisting, and though rather soft in the early season as compared with the "champion," it keeps well right through the summer. 8. Don't use the very smallest tubers for seed, because they are often not fully grown, and therefore will not produce good results. You would not use the lightest and smallest oats for seed ; why do so with potatoes ? 9. Change seed frequently, and always select seed from a perfectly different class of land to that for which it is required ; merely getting seed from a distance is of slight importance compared with getting sound seed from a different class of land.

10. Keep the crop very clean, use the hoe frequently, because by doing so you keep the plant healthy and avoid its being choked with weeds, which help the disease to spread. 11. Always try to plant on fresh ground on which potatoes have not been grown for several years, because the spawn which reproduces disease can live for several years in the ground, and could affect the sets as stated in No. 3. 12. Earth up repeatedly with fine, dry earth after each hoeing, because the coating of earth prevents a great deal of the fungus from reaching the potato when it falls from the leaves ; the coating of earth also protects the potato from injury by slugs, vermin, birds, etc.; and recollect that the disease enters the potato

most easily where the skin is broken. 13. Recollect that the potato requires potash. On most arable land 3 cwt. to 5 cwt. of kainit per acre is of great benefit. 14. To produce its full effect on the crop, kainit should be spread some weeks before planting. 15. Those who only grow small quantities of potatoes for eating would do well to try cropping every alternate row with carrots, parsnips, or some such crop, so as to let the potato drills be as airy as possible. 16. It is better to use a moderate dressing of farmyard manure, with a small dressing of artificial manure, rather than a heavy dressing of farmyard manure alone, because the warmth produced by a heavy dressing of farmyard manure encourages slugs, worms, etc., which injure the tubers, whilst the artificial manure helps to keep them away. 17. If disease shows itself, earth up well at once, so as to leave, say, 4in. of fine dry earth over the tubers, because the earth-coating protects the tubers from spawn falling from the leaves.

CHAPTER V.

TOBACCO AND ITS CULTIVATION.

The following is extracted from an article by Mr. T. Phillips-Gibson, an expert, which appeared recently in the *Gazette* of the New South Wales department of agriculture, and is thoroughly applicable to the cultivation of tobacco in this colony.

The tobacco plant is known to botanists by the generic name of *Nicotiana* (a name confirmed by Linnæus), in honor of Jean Nicot, the ambassador from the King of France to Portugal, and who first procured seeds, which he forwarded to France. The first description of the plant is given by Ovideo, in a work published in Seville in 1535; and Lobel, in an appendix to his *History of Plants* (1576), gives a drawing of a tube used in smoking by the natives of San Salvador. The genus *Nicotiana* belongs to the natural order *Solanaceæ* or nightshade family, to which order belongs the potato, tomato, capsicum, henbane and deadly nightshade, all of which are remarkable for the poisonous qualities of their foliage. Of some 50 varieties of the genus *Nicotiana* all are natives of America except two, namely, *N. suaveolens*, Lhem., which is a native of all the Australian colonies, and is known as "native tobacco"; and *N. fragrans*, a native of New Caledonia. The best-known species are as follows :—

1. *Nicotiana tabacum*, of which there are two varieties, viz., *macrophylla* (Maryland tobacco), and *angustifolia* (Virginian tobacco). Each of these two varieties is divided into several sub-varieties, chiefly distinguished by the leaves having stalks or being stalkless. *N. tabacum V. macrophylla* is the variety which affords the famous Cuban and Manilla tobaccoes; it has a broad leaf, which is fine, soft, and thin, and is much valued in the trade for the finer qualities of tobacco and cigar wrappers. *N. tabacum v. angustifolium* is the most commonly cultivated variety in the United States and India. It makes good snuff, and is stated to be the kind from which the celebrated Latakia tobacco is made.

2. *Nicotiana rustica*, best known as Hungarian tobacco, is largely grown in Europe, Asia, and America. There are also two varieties, a large leaved and a small leaved kind, both of which yield tobacco of good quality.

3. *Nicotiana persica*, a form of *N. tobacum*, produced by climatic influences, but long thought to be a distinct type. This variety affords the famous Shiraz tobacco. As this is the kind which may probably be most successfully grown in this colony, and has

been recommended for that purpose by Mr. Turner, botanist to the department (*Agricultural Gazette*, Vol. 11, part 1, page 20), special reference will be made to the Persian methods of growing at the end of this article.

4. *Nicotiana crispa*.—This species is much grown in Syria and on the Mediterranean coast, and furnishes leaves for the celebrated Levantine cigars.

5. *Nicotiana repanda*, a native of Mexico. It has small leaves, used for imparting the peculiar aroma to Mexican cigars and cigarettes. The remaining species, notably *N. glauca*, *glutinosa*, *longiflora*, *nana*, and *sanguinea*, are of no commercial importance, being of interest only to the botanist or horticulturist; but mention must be made of the beautiful white flowered *N. affinis*, now so largely used as a decorative pot plant and for bouquets.

Cultivation.—Of the many conditions which affect the quality of tobacco, the most important is climate; other conditions may be in a measure modified or else created, but very little can be done with regard to climate. The most rational mode of overcoming this difficulty would be in the selection of seed of the varieties which have been grown with success under similar climatic conditions as prevail in the district proposed to be cultivated.

Tobacco thrives best in a good soil, rich in vegetable mould; but light soil containing a good amount of organic matter and well drained will produce an excellent smoking tobacco, and on such soil the finest leaves are grown. The more clay in the soil the thicker the leaves become, and the aroma becomes less, and is consequently less suited for the finer qualities of smoking tobacco, although the weight of yield may be heavier. The opinion of an experienced Ohio planter (Mr. Popenoe) may be of interest. He says: "A rich sandy second bottom I believe to be the best for raising tobacco. Black river bottom will yield more to the acre than any other kind of land, but the tobacco is not of so fine a quality. It grows larger and has coarser stems and a heavier body, and consequently, in my opinion, is not so good for wrappers or fine cut as the second bottom or upland tobacco."

The site for a tobacco field should have good drainage and be sheltered from high winds, which would split the leaves to ribbons and thus spoil their market value. In countries where it is largely cultivated various methods of culture are adopted to secure this last object, the fields generally being bordered by rows of plants to act as wind-breaks. In Holland they are surrounded by hedges some seven feet high, and are subdivided into small plots by rows, usually tall varieties of peas, which break the force of the wind. Consequently the Dutch growers obtain as much as 50 per cent. of "first quality" leaves, while in other places 25 per cent. is considered a good average. In the United States several rows of scarlet runners, or common beans, are used for a similar purpose, while in Cuba and parts of India bananas are planted in rows through the fields, thus protecting against the wind and preventing the tobacco becoming sunburnt. The produce of any of those plants forms besides an important item in the farm receipts. It is, however, recommended that only annual plants be grown for this purpose, peas, beans, sorghum, or maize being all suitable, and thus permit of a proper rotation of crops.

Having now determined upon the site of the tobacco field the farmer has to consider what kind he will grow, and the means at his disposal to satisfy the wants of the different varieties. Though tobacco is a hardy plant, and will grow under varied conditions, yet, to become a profitable crop, it must not be grown in a situation very different from that to which it is suited by nature. It must be remembered that the plant is a native of a warm climate and thrives best in a moist atmosphere, therefore, in such a climate, by employing ordinary means, tobacco may be made to yield a profit not attainable in less favored situations. A warm, moister climate will permit of the selection of the sorts that fetch the highest price in the market, and in a suitable soil the profit will be such as is not easily realised from any other crop.

As the Havana tobaccos command the highest price, growers everywhere attempt to introduce and cultivate them. There is, indeed, no difficulty in growing these varieties, but they speedily degenerate if the conditions are not favorable. Virginian tobacco is the most favored in temperate climates, as it does not require such a high temperature, but on account of its botanical characteristics it is not much liked by cigar or cut tobacco manufacturers. For these reasons the Persian tobacco, as recommended by this department, will generally prove most satisfactory in this colony, the climate of Persia nearly approaching that of New South Wales, and the formation of the leaf permitting its use in manufacturing the higher qualities of tobacco, or even cigars. It fully meets the requirements of the trade, as stated in the following extract from one of the trade journals, reviewing the results of the 1889 crop :—
" A high price is generally commanded by the tobacco, no matter of what variety, that has a smooth, thin, and elastic leaf, and which possesses an even golden color and fine aroma, with thin ribs, far apart and even. The wider the leaf, and the less they are torn, the greater the number of wrappers which can be cut from one pound of tobacco, and consequently manufacturers will pay more for brands possessing these qualities than for others that are unreliable."

There are among growers as many varieties of tobacco as there are varieties of cabbage, each district favouring a particular kind. It may, however, be said of the varieties most generally known in this colony, that the Connecticut seed leaf, and Havana, are most in use for wrappers, while the Kentucky, Virginia, and Maryland are employed for smoking and chewing tobacco.

Seea Beas.—The first operation necessary in starting tobacco growing is the formation of a seed bed. The soil for this must be of a light and friable nature, and should be broken up to a depth of 18 inches some months before sowing. In America a warm sheltered position, such as the side of a barn, is generally selected, and a drain is dug round the bed, the soil being used in raising the surface. It is a common plan to burn a pile of brushwood on top, thus supplying potash, and at the same time destroying the seeds of weeds, or the eggs of insects. The time for sowing in New South Wales is the end of July and the beginning of August, but it must not be sown till danger of late frost is over. Unless the soil of the seed-bed is naturally rich, it should be heavily manured with good farmyard manure soon after breaking up, and the surface must be kept free and open, a crust on no account being allowed to form. A second digging, in a couple of weeks, to thoroughly blend the manure with the soil, and reduce it to a fine tilth, will be very beneficial ; in fact the finer the soil the greater the proportion of seed that will germinate. The area of the seed-bed will of course depend upon the extent of the proposed cultivation, and as usually about 1 square inch in space is allowed to each young plant, it will require a seed-bed of 36 square feet (say 9 by 4) to supply seedlings for an acre planted at equal distances of three feet apart ; the 300 odd seedlings not being too many to allow for possible failures in the field. An ounce of seed contains, roughly, enough to plant about seven acres ; but as it has not a high percentage of vitality it is usual to sow at the rate of half an ounce for an acre ; and being so very small, a common practice is to mix it with about four times its bulk of silver sand, which ensures an even sowing. The seed-bed having been duly prepared, and made as smooth as possible, the mixed sand and seed is evenly sowed over it, and covered with the thinnest possible layer of very fine earth, after which a thorough watering with a fine rose watering pot is essential. In a hot situation the bed ought to be covered with a sheet or a layer of straw spread over rods raised about four inches from the ground. This not alone protects from the mid-day sun, but checks the rapid evaporation from the earth, keeping the surface moist. The young plants will appear in about a week after sowing, and are at first very tender ; they require frequent waterings of weak liquid manure ; a solution of guano is very suitable. All weeds must be carefully removed and grubs diligently watched for. In from seven to eight weeks the young seedlings will be fit for transplanting.

Field Culture.—Land on which it is intended to grow tobacco should be well ploughed not less than nine inches deep ; twelve inches if possible, on heavy soil, is better still. The crop will generally be more successful if the land has lain fallow the season before ; or a rotation of crops, carried out with an intelligent knowledge of the needs of the crops, will be the aim of the practical farmer. The following system of a three years' rotation will be found one of the best to adopt for ordinary farm operations, and is often followed in the tobacco districts of the United States :—First year, wheat. After the wheat harvest, the land is ploughed and sown with clover, constituting the second year's crop. This is either converted into dry feed for cattle or, when having attained sufficient growth, is grazed for some months. It is then ploughed and cross-ploughed during the late months of winter and early spring, after which the field is ready for the tobacco crop of the third year.

Before planting, the land should be ridged, the distance between the ridges of course depending on the kind of tobacco to be planted, the larger kinds requiring more room than the smaller-leaved and tall sorts, but they should be far enough apart to allow a free passage between the rows of plants without injuring the leaves. Generally, three feet apart between the rows, and the same between the plants, will be sufficient. In some localities the plough is run lightly over the field at right angles, thus forming small hills on which the seedlings are planted. Planting should only be attempted in the evening, or on a cloudy day. Before transplanting, the seed-bed should receive a good watering, so that the young plants may be lifted without injury to the roots. A good plan for lifting is to take up the seed bed, earth and plants together, by shovelfuls, carrying all in a mass to the field, where it is broken up, and each young plant, with a little lump of earth attached, placed in the position in which it is to grow. The planting is not more difficult than that required for cabbages. A good plan is for a boy to walk up along the line, placing the plants alternately to right and left, being followed by the planters, who simply dibble the seedlings in the hills or ridges. A smart boy will lay enough plants to keep two men busy. The plants are usually dibbled in a little hollow, for convenience made by the heel, which serves as a small reservoir for water to start the young plant into life. After each day's planting the ground should be well sprinkled with water, particularly if the weather is dry. Tobacco is usually planted in the quincunx system, as it affords more room for the development of the leaves. It need hardly be mentioned that in a few days any blanks which occur should be filled up, and during the whole time of growth a close watch must be kept for injurious insects. When once the plants have taken root they grow very quickly, and the after cultivation is simple, though requiring care. When they are from six to nine inches high they require to be hilled after the manner of maize and other crops, and if the ground is not naturally rich a top dressing of manure may now be applied. One or two hoeings are necessary during the growing period to keep down weeds, as it must be remembered that everything that detracts from the growth of the plant is detrimental to the quality of the leaf. The larvæ of insects may now be troublesome, and a flock of ducks turned into the field will prove useful as scavengers or collectors.

Turkeys are often allowed to roam the fields for this purpose in Virgina and Maryland.

About three months after planting the tobacco will begin to flower, when the flower bud appears the heart should be broken off or pinched out, and at the same time the lower or bottom leaves of the plant are to be removed. The pinching of the flower buds sends the sap needed in the formation of the flowers to nourish the leaves, and the bottom leaves being small, dirty, and of an inferior quality would, if harvested with the crop, only depreciate the whole. There seems to be no fixed rule regarding the number of leaves allowed to be matured on each plant, but from an analysis of the usage of different countries the minimum may be stated as six, and the maximum as twenty-two, but this is a point that can only be decided by individual experience, based on the locality and vigor of the plant. Shortly after the plants are topped, suckers will appear at the axils of the leaves, and these must be broken off as soon as possible, or the size of the leaves will be interfered with. Another operation which is, however, only practised in some parts of America and Cuba, is called "priming," and means that shortly before harvesting, the large bottom leaves, which are now probably lying on the ground, are broken off ; but this is not a universal custom, one grower may practise it while his neighbor may not, but, when cutting the crop, will separate these leaves, and sell them as "lugs," at about half the price of the good leaves. A caution may, however, be of use ; when the tobacco is not "primed" it must be "topped" lower, or a risk is run that the upper leaves will not mature.

In the above directions the expression "broken" is applied to the removal of the flower-buds and leaves ; it is to be remembered that these are not to be cut off, else the sap will run to waste, which should go to strengthen and mature the leaves.

Tobacco commences to ripen about three months after planting, and is indicated by the leaves assuming a darker green color, succeeded by a marbled appearance, yellowish blotches becoming visible, the leaves will also be found to have a sticky or gummy feel, and the tips bend downwards. The crop having reached this stage is fit for harvesting and curing.

There are two methods of harvesting, *i.e.*, cutting down the whole plant, or gathering the leaves singly. On no account must either be attempted on a damp day, or until the dew is off the plants. Both these plans of gathering have their advantages. The first is the easiest, and permits of quicker handling, but the leaves have to be sorted afterwards, while the latter, though permitting the sorting of the leaves in the first operation as well as the development of a greater number of mature leaves, is the most expensive and laborious, and in hot climates the single leaf is apt to dry too quickly. In the warmer districts the plant should be cut entire, while in the cooler parts the other method may be followed with advantage. For cutting, a chopper or heavy knife is used, and the method is similar to cutting sugar cane, the plant being caught by the left hand and cut close to the ground at a single stroke. They should be removed with as little delay as possible to a shed, to prevent them becoming sunburnt, and in large plantations temporary structures are erected in the field for this purpose, consisting of an open framework laid crosswise about five feet from the ground, and covered by a light roof of boards or straw. The plants are hung on the light cross rods, which are then carried to the drying shed. The process of curing now commences, and on the success of this operation depends in a great measure the ultimate value of the crop. No matter how fine the plants may be, or how heavy the production, an error in curing is sufficient to destroy, in a great degree, the work of the season. The drying shed should have windows and doors sufficient to ensure a free current of air, but in this colony the ordinary barn, built of slabs, will be sufficiently open to answer this purpose. The barn, or drying shed, should be high enough to permit three rows of plants being hung one above the other, say, 16 to 18 feet from floor to roof. The rods, with the tobacco still hung on them as they are carried from the field, are now placed on poles or scantlings in the shed, and may be as close as possible, so long as the tobacco is not crowded or crushed. In 8 or 10 days the leaves will turn yellow, during which time sudden changes of temperature must be guarded against. The thin veins dry first, and gradually the ribs and stalks, until at the end of from six to eight weeks they are all entirely dry, and the tobacco will be ready for stripping.

The name stripping is at once suggestive of the next operation, which simply consists of breaking the stems of the leaves from the stalk, and at the same time sorting the grades. In order that the leaf may not be damaged, this is usually done on a damp day, when the plants having absorbed some moisture from the air, are pliant and elastic; or, if the weather continues dry, water may be sprinkled over the floor, so that by evaporation moisture may penetrate through the plants. As the leaves are stripped they are sorted according to quality. The "lugs," or worse quality, are at the bottom of the plant, and should be put along with black and ragged leaves. The second quality ("shipping" tobacco), in America is a grade above the lugs; these are the red or brown leaves, and they should be tied in separate bundles. The highest quality is called "manufacturing," consisting of the finest and brightest leaves, and these are also kept separate. Other terms in use amongst tobacco-growers for these grades are—first quality, "wrappers;" medium quality, "seconds;" and the lugs are called "fillers." In forming a bundle of the stripped leaves, the butts are held in the hand and pressed tightly till the hand is full, a leaf is then folded so as to form a wrapper two inches wide, this is wound tightly and smoothly around the butts of the leaves from the end downwards for about three inches, the bundle is then opened in the middle and the end of the wrapper neatly tucked through the opening, pressing all down nice and compact; this forms what is in trade called a "hand." These hands are now laid aside until they are "bulked," an operation in which they are placed in a heap to heat, in order to develop color and flavor by fermentation. Each day's stripping should be bulked the same night before it dries. The tobacco remains in these heaps for about three weeks, care being taken that the leaves do not turn mouldy or over-heated, which is ascertained by pushing the hand into the middle of the pile. At the end of that time the whole will have assumed an even color, and may be hung up to finally dry before packing for market.

In America tobacco is usually packed (for export) in large barrels or tierces, Cuban tobacco in bales, and Indian in boxes or split bamboo baskets; in all cases, however, the butts of the hands must be to the outside, the ends of the leaves pointing inwards. They should be packed evenly and firmly to prevent shaking in transit, and each layer ought to be well pressed down until the package is filled, when it is closed down, marked with the gross and net weights, the name or brand of the grower, and usually the date of packing. On the subject of packing, it must be remembered that a well-packed parcel realises a higher price (from ½d. to 1d. per lb.) than a slovenly one, as the leaf is in a better condition, and when unpacked is in less danger of being damaged.

This, so far as as the farmer is concerned, concludes the labor pertaining to tobacco-growing, as the crop is now ready for market and should be disposed of before sweating, which will take place if held over till the hot weather of the next year sets in.

CHAPTER VI.

HINTS ON LAYING DOWN LAND TO GRASS.

(Compiled by W. Adamson.)

The utility of forming artificial pasture for stock, though generally recognised, is not so frequently practised as might be advantageous ; for, by means of it, not only double, but in some cases four times the amount of food may be obtained from an acre of land than it would produce under natural grasses. In such varieties of soil and climate as exist in this country, different modes of preparing the ground for the reception of grass seeds must be followed. In some rich soils, where the climate is moist, good results are obtained from sowing the seeds in the ashes of the burnt scrub, at the rate of 30 lbs. to the acre, without any other cultivation ; but such a mode would be inefficacious in ordinary soil, which requires to be well and deeply tilled before the seed is sown. The method of sowing grass seeds with a grain crop, as practised in more temperate climates, is entirely unsuited to this country, and should never be practised. Whether the land is new or old, it should be broken up by ploughing and subsoiling in the course of the previous season—then, on the approach of seed time, well worked and brought to a fine tilth with cultivator, roller, and harrow, any rubbish being gathered and burnt, and the ashes spread. The ground will then be ready to receive the seed, which should be put in as soon as the land is sufficiently moistened by the autumn rains. Grass seeds should be lightly covered with a bush harrow, and the ground immediately rolled ; but if clover seed is added, it may be sown after the ground is harrowed, and covered by the roller. Grass should not be allowed to seed the first year, as that tends to cause the plants to die out ; as soon as the flower stems appear, it should be cut with a scythe, or fed off by young cattle, but it must at no period, and especially during summer, be eaten bare. The seed should not be stinted in quantity or variety, as better crops are obtained where different sorts are grown together and the ground well covered, which can only be attained by using a sufficiency of seed ; and though that is not always done, it is decidedly uneconomical to limit the quantity. No less than forty to fifty pounds to the acre should be sown on ordinary soils, with clover seeds in addition. With regard to the proportion of the different kinds to use, that depends so much on the nature of the soil and the kind of stock to be grazed, that no definite list can be given that would be suitable everywhere. The permanency of pastures depends even more upon the good management they receive than upon any other circumstance, for the best pastures will succumb if grazed bare in hot weather; and, therefore, the only sure policy is to use the paddocks alternately, so that each may have time to recuperate while the others are being grazed. In soils that are not very rich, it is advisable to top-dress the ground with manure the following spring after sowing. Natural pastures may be improved to a certain extent by sowing grass seeds and harrowing them in, without the ground being prepared; but the benefit to be derived is seldom commensurate with the expenses incurred.

Crested Dogstail (*Cynosurus cristatus*). Perennial; height, 1 to 1½ feet.—A valuable fine short grass. It forms a close, dense turf of graceful nutritive herbage, and is little affected by extremes of weather. Stock of all kinds, especially sheep, are very fond of it, until it commences to ripen, when it becomes wiry. On account of its close-growing habit and evergreen foliage, it is particularly valuable for lawns, tennis-grounds, &c., and other places kept under by the scythe. It succeeds well in Gippsland, and is a capital winter grass. From 3 to 6 lbs. per acre may be sown along with other grasses. The late Dr. Schomburg, of Adelaide, in one of his reports on his experimental grass plots during the continued drought of the eighties, states:—"The drought had no effect on crested dogstail (*Cynosurus cristatus*). All stock are fond of it, and it forms a close sward."

Hard Fescue (*Festuca duriuscula*). Perennial; height, 1½ feet. —A dwarf-growing, hardy, and robust grass. It is one of the most valuable and important of the fescue tribe of pasture grasses. It retains its verdure during continued drought in a very remarkable manner, and is one of the best of pasture grasses. All kinds of stock eat it with avidity, but especially sheep, which always thrive well on the succulent herbage it produces. From the fineness of its foliage and evergreen appearance during winter, it is eminently adapted for sowing in parks and ornamental grounds. Sow (if alone) 40 lbs. to the acre.

Rib Grass (*Plantago lanceolata*). Perennial; height, ½ foot.— Is one of the best-known of our grasses, and holds a place in almost every pasture. Its root is perennial; its leaves are numerous, lanceolate acute, tapering towards both ends, spreading or prostrate, and of a deep green color, and they stand upon broad, flat, ribbed footstalks, and are accompanied at their insertion with large tufts of soft, white, woolly fibres. It produces its foliage at an early period of the year, and is readily eaten by cattle, sheep, and horses, and is therefore to be recommended as an ingredient in all mixtures for spring and summer pasturage. Sow with other grasses, 2 lbs. to the acre.

Meadow Foxtail (*Alopecurus pratensis*). Perennial ; height, 2 feet.—This is one of the most desirable of all grasses for permanent pasture, being early and rapid in growth. It thrives best on well-drained, rich, loamy, and clayey soils, and makes excellent hay. It is eagerly eaten by all kinds of stock. Being somewhat coarse in habit, it is not suitable for lawns or bowling-greens. It is admirably adapted for irrigation, as it grows very early pasturage, and soon revives again with water. Sow (if alone) 15 lbs. to the acre.

Tall Fescue (*Festuca elatior*). Perennial ; height, 3 feet to 5 feet.—This is a very productive and strong growing variety, and is greatly relished by stock, both as hay and green food. It is most suitable for moist and strong soils, and is considered to be one of the best grasses in cultivation. Being very tall, it is not suited for lawn purposes. Sow (if alone) 40 lbs. to the acre.

Prairie Grass (*Bromus unioloides*). Perennial ; height, 2½ feet to 3 feet.—This is one of the most nutritious of fodder and pasture grasses. It produces enormous crops, and can be cut four or five times a year, providing it is not allowed to go to seed. It succeeds well in almost any soil, but prefers that which is wet or moist. Stock will eat it greedily, either in the green or dry state. A small proportion of it is valuable in mixtures, but upon the whole it is best alone. The demand for this grass increases year by year, proving that it will well repay cultivation. Sow (if alone) 40 to 60 lbs. to the acre.

Couch, or Bermuda Grass—Doob grass of India—(*Cynodon dactylon*). Perennial.—Valuable in dry situations. It is of a similar nature to the buffalo grass, but very much finer in appearance. It is exceedingly useful for binding railway embankments, sand hills, dam and river banks, on account of its long creeping shoots, which root at every joint. It also makes a very good lawn when kept well cut. March, April, October, and November are the best months to sow, as during the cold winter months it is unlikely to germinate if put down. Sow 7 lbs. to the acre.

Yorkshire Fog, or Wooly Soft Grass (*Holcus lanatus*). Perennial ; height, 1½ to 2 ft.—Although it is not as valuable as many of the other grasses, nevertheless it will grow well in any description of ground, whether poor or rich, swampy or dry, producing crops under the most unfavourable circumstances. In the interior of central Australia, where rain seldom falls, it is said to succeed admirably. On marshy lands, where scarcely any other kind of grass will grow, it should be sown. Sow (if alone) 20 lbs. to the acre.

Red Top Grass (*Agrostis vulgaris*). Perennial ; height, 1 to 2 feet.—This is a valuable variety for permanent pasture, and succeeds almost anywhere, but best in rich moist soil. If for pasture, it should be fed close, as cattle do not relish it after growing up to seed. It is usually sown with Timothy and red clover. Sow (if alone) 40 lbs. to the acre.

Tall Meadow Oat Grass (*Avena elatoir*). Perennial; height, 2 to 4 ft.—A most valuable grass for pastures on account of its early and luxuriant growth. It succeeds well on sandy soils, and also withstands drought better than rye grass. Sow (if alone) 40 lbs. to the acre.

Wood Meadow Grass (*Poa nemoralis*). Perennial; height, 1½ to 2 feet.—This grass, which is common in England in the woods and thickets, has never been used to any great extent for pasture purposes. It is a valuable variety, and is splendidly adapted for moist and shady places, and should be included in most mixtures for permanent pasture. For lawns and pleasure grounds, overshadowed by trees, it is especially valuable. It is of a much thicker growth than either *Poa pratensis* or *trivialis*, and has a rather drooping panicle, supported on a thin stalk, and the leaves are long, narrow, and soft. If sown in good ground of a rather light character it produces a considerable quantity of succulent herbage. Sow (if alone) 30lbs. to the acre.

Sheep's Fescue (*Festuca ovina*). Perennial; height, 1 to 1½ ft.—It is supposed to have received its name from Linnaeus on account of sheep being so fond of it. Gmelin, the eminent Russian botanist, says that the Tartars generally pitched their tents during the summer months in close proximity to it, on account of its value to their herds. A large proportion of this grass should be included in all mixtures for dry districts, especially for sheep grazing, as they greatly relish it. Excellent for its nutritive qualities. Being short and dense in growth, combined with its fine foliage, it is exceedingly valuable for grass plots, etc. Sow (if alone) 40 lbs. to the acre.

Italian Rye Grass (*Lolium Italicum*). Biennial; height, 1½ to 2 ft.—A valuable biennial variety, which succeeds well in almost any soil. It yields an abundance of food in the early spring. A little is sometimes introduced into permanent pastures on account of its early growth. Sow (if alone) 40 lbs. to the acre.

Kentucky Blue Grass; known also as smooth-stalked meadow grass, green grass, June grass (*Poa pratensis*). Perennial; height, 1 to 2 ft.—It is one of the most popular grasses for pasture purposes in America. It adapts itself to almost any variety of soil, from dry to moist, and yields very productively at an early period of the season (when all other grasses are comparatively dormant) herbage of the most nutritious properties. It is quite distinct from poas in the colour of the foliage and leaves. When once established it will stand the driest summers. For lawn purposes it is exceedingly valuable, forming a thick turf of even growth. It makes excellent hay. Sow (if alone) 40 lbs. to the acre.

Rough-stalked Meadow Grass (*Poa trivialis*). Perennial; height, 2 to 2½ ft.—A valuable grass for good, deep, rich, moist loams, and stiff heavy clays. It produces a constant suppy of nutritive herbage, which is greatly relished by sheep, horses, and cattle. It should be sown in mixture with other grasses for moist and congenial soils. Being very tender and succulent, it is not adapted for severe cold situations. In appearance it is somewhat like *P. pratensis*, but very different in habit and general properties. Sow (if alone) 30 lbs. to the acre.

Meadow Fescue (*Festuca pratensis*), English blue grass; perennial; height, 1½ to 2 feet.—One of the best of our natural grasses for permanent pastures, being very early, productive, and most nutritious. It is greedily eaten by all kinds of stock, and has excellent fattening qualities. It succeeds best in moist soils, although it does well in almost any kind of land. In some parts of North America it is said to remain green under the snow throughout the winter, and is not uncommonly called "evergreen grass." Commander Mayne refers to it thus in his book, *Four Years in British Columbia and Vancouver's Island*:—"Cattle and horses are very fond of *F. pratensis*, or sweet grass, and it has a wonderful effect in fattening them. I have seen horses on Vancouver's Island, where the same grass grows, which had been turned out in the autumn, brought in in April in splendid condition and as fresh as if they had been most carefully treated all the time." Sow (if alone) 40 lbs. to the acre.

Red, or Creeping Fescue (*Festuca rubra*). Height, 2 to 3 feet. —A valuable grass of creeping habit, excellent for enduring severe droughts. Its roots penetrate so deeply into the soil that it retains its fresh green appearance when all others are burnt up. It is particularly adapted for dry pastures. When just in flower it is more nutritious than at an earlier period. Sow (if alone) 30 lbs. to the acre.

Cocksfoot, or Orchard Grass (*Dactylis glomerata*). Perennial; height, 3 to 6 feet.—Of all the pasture grasses, cocksfoot has now become the greatest favourite with stock-holders and farmers in this colony, and is considered a most excellent permanent pasture grass, the selectors of Gippsland preferring it far before the rye grass. All kinds of stock are fond of it; sheep fatten on it, and eat it most readily; it grows well on high, ridgy land, or in shady places, and stands our summer heat first rate, making it a valuable grass for this climate; it is very productive during the summer, say from the month of September to that of February; if it once gets a good root it will stand both floods and drought; it does well on high, light land, which would not be suitable for many of the other grasses referred to; it yields a large quantity of herbage, and from the rapidity of its growth after cutting or feeding off, it is a very desirable grass to introduce into all pastures; it is, perhaps, the hardiest of all the perennial varieties. I have no hesitation in recommending this as a pasture grass that must prove of the highest value to all who are engaged in pastoral and agricultural pursuits. Sow on scrub land 20 lbs. to the acre.

Various-Leaved Fescue (*Festuca heterophylla*). Perennial; height, 2 to 2½ feet.—A native of France, where it is largely grown, especially valuable for permanent pastures on account of its immense yield of herbage. Having beautiful dark green foliage, it is very suitable for parks, ornamental grounds, etc. Sow (if alone) 30 lbs. to the acre.

TIMOTHY GRASS (*Phleum pratense*). Perennial, height, 2 to 3 feet. —This grass thrives best on moist soils or rich wheat-bearing alluvial clay lands ; also on newly-reclaimed moorish soils. It affords twice as much nourishment when its seeds are ripe as when it is cut in flower, and it is peculiarly valuable for either permanent grass or alternate husbandry on strong, stiff, rather moist soils, in consequence of its first yielding a hay crop and still continuing nutritious. It is of strong growth, and yields abundant feed. On dry soils timothy form a bulbous swelling at the base of the stems, from which next year's growth starts, therefore stock should not be allowed to pasture on it. Sow (if alone) 30 lbs. to the acre.

WATER MEADOW GRASS (*Poa aquatica*). Perennial ; height, 2 to 3 feet.—This variety is particularly valuable for damp meadows and flooded grounds. In such places it grows luxuriantly and produces a great quantity of herbage, and can be cut three or four times a year. Although rather coarse in growth it is nevertheless very nutritious. Sow (if alone) 28 lbs. to the acre.

SWEET-SCENTED VERNAL (*Anthoxanthum odoratum*). Perennial ; height, 1 to 1½ feet.—It is valuable on account of its delicious perfume, to which our pastures owe so much of their fragrance that it should be included in all mixtures. The scent which it emits is not so discernible in a fresh as in a dry state. Stock relish it greatly in its young state, or when mixed with other grasses ; and it is well-known in England that pastures in which this grass abounds produce the finest flavoured meats. Having broad foliage, it is not well adapted for lawns. It is not so productive as some of the stronger growing varieties, such as cocksfoot and meadow foxtail, but is of finer quality and comes early. Sow (if alone) 20 lbs to the acre.

CREEPING BENT, OR FIORIN (*Agrostis alba var. stolonifera*). Perennial; height, 1½ to 2 feet.—This grass, although not particularly nutritious for cattle, should be included in permanent pasture mixtures, in consequence of its value in affording herbage early in spring and late in autumn, before and after other grasses have commenced or left off growing. Its long fibrous roots and creeping habit render it valuable in damp or moist situations. Sow (if alone) 25 lbs. to the acre.

CHEWING'S FESCUE (*Festuca duriuscula var. Chewing's*). Perennial ; height, 1 foot.—A variety of hard fescue, successfully grown in Southland, N.Z., and elsewhere. It thrives luxuriantly on the light, stony soils, and on it sheep fatten rapidly. Its habit is to form a close tuft, and by no means does its roots spread, like many of the other varieties of natural grasses. Sow (if alone) 40 lbs. to the acre.

Perennial Rye Grass (*Lolium perenne*). Perennial ; height, 1½ to 2 feet.—This is one of our most largely cultivated and valued grasses, and its merits are becoming more and more recognised every year. It adapts itself to almost any soil, germinating freely from seed, is easily propagated, and seeds abundantly. It is of upright habit, bearing abundance of nutritious foliage, which is at all times relished by stock ; it stools out freely, but does not grow in tufts ; its roots are fibrous and penetrating, giving it a permanency that does not belong to many others. In selecting this seed, it is advisable to obtain the heaviest samples, which, although perhaps a little more expensive at the outset, will always prove the most satisfactory in the end. Sow (if alone) 40 lbs. to the acre.

New Hungarian Forage Grass.—It originated in Russia, and is recommended on account of the manner in which it has stood on the Hungary plains, where the dry, sterile nature of the country and the long-continued droughts make so many plants succumb. This, however, stands well, and has been known for thirty years to stand when such robust crops as lucerne have been destroyed. It gives a luxuriant crop, particularly on fresh sandy loam soil, and where the climate is warm. It is found that animals eat it greedily, whether in the green or dry state, so that it can be used as mown or saved for winter use. The seed is sown in the early spring. It is also useful in filling up gaps where lucerne or clover crops have failed. It will stand under favourable conditions for years, and give as much food in one month as lucerne gives in three months. Sutton and Sons, Reading, say :—" It is a perennial, and in our experiments has proved to be one of the earliest grasses to start in the spring. It grows with remarkable rapidity, and yields an immense quantity of succulent herbage, equally suitable for soiling or for ensilage. All kinds of stock eat it greedily, and the analysis made shows that it is richer in flesh-formers than the Italian rye grass."

Paspalum Dilitatum.—A very valuable hardy grass, producing enormous crops of fodder, and remaining green during the driest summer. It stools out very strongly, and soon fills all gaps if sown very thinly. Four pounds sufficient to sow an acre. An official report from the Department of Agriculture, New South Wales, gives 13 tons 7 cwt. per acre as the result of one cutting at the experimental farm, Richmond river, and three or four cuttings a year are predicted. As a pasture it is described as excellent.

CLOVERS.

Trefoil, or Hop Clover. Black medick (*Medicago lupulina*).—This clover is very distinct, bearing a yellow flower, is erect and branching, and yields a large crop. It should be sown sparingly, otherwise it will smother the other clovers. It is useful for sowing with other grasses, at the rate of 2 to 3 lbs. per acre. If sown alone it may be cut for hay. This is a clover highly esteemed in England, where it is known under several different names. It grows on any soil that contains lime, and although it is an annual, it seeds itself so freely that it may almost be classed as perennial. Stock of all kinds like it, and it should be included in mixtures for all inferior soils except such as are absolutely devoid of lime. 20 lbs. required to sow an acre.

Birdsfoot Trefoil (*Lotus corniculatus*).—Excellent for dry and sandy soils. It is greatly liked by cattle and sheep. Very productive. Perennial.

Japan Clover (*Lespedeza striata*).—This variety is said to succeed well in any kind of soil—rich or poor, clay or sandy, dry or wet, and is deep rooted. It is also wonderfully fattening. Very distinct.

Cow Grass, or Perennial Red (*Trifolium pratense perenne*).—This is distinct from the common red clover, possessing a strong and more penetrating root, and is less affected by either drought or frost. It is of quicker growth than the other varieties, and yields an immense crop, which is highly nutritious. This should be introduced into all permanent pastures. 20 lbs. required to sow an acre by itself, or 4 lbs. if mixed with other grasses.

Red, or Broad Clover (*Trifolium pratense*).—This variety yields an immense crop, but is only of biennial duration. 20 lbs. required to sow an acre by itself, or 4 lbs. if mixed with other grasses.

White Clover (*Trifolium repens*).—Its proper place and treatment are—prominence among the grasses of a long continuance of artificial pasture, and intermixture with the seeds of those grasses at the time of their being sown. Though creeping, and of low growth, it luxuriantly intertwines with the grasses so as to form a thick and massive mat of herbage; and is at once so sweet and so very nutritive as to serve in the highest manner all the immediate purposes of pasturage. Another recommendation in its favour is that it thoroughly withstands the attacks of caterpillars. 14 lbs. required to sow an acre by itself, or 2 lbs. if mixed with other grasses.

Egyptian Clover (*Trifolium alexandrinum*).—A white flowered variety especially adapted for dry districts. Yields heavy crops.

Alsyke, or Hybrid Clover (*Trifolium hybridum*).—A perennial variety, hybrid between the red and white, but of much stronger growth than the latter, and will do well on all kinds of soil, yielding a heavy crop where no other clover will succeed. Alskye clover is highly valuable for permanent pasture. 12 lbs. is required to sow an acre by itself, or 2 lbs. if mixed with other grasses.

Bokhara Clover (*Melilotus leucantha*).—This variety is greatly cultivated for bees. It attains a height of six feet when in bloom; is very productive, and useful for ensilage. 10 lbs. required to sow an acre.

Italian Scarlet Clover (*Trifolium incarnatum*).—It yields an abundant supply, and makes a capital hay, which is much relished by all kinds of stock, especially horses. Excellent for an early crop. 14 lbs. required to sow an acre by itself, or 4 lbs. if mixed with other grasses.

CHAPTER VII.

NOXIOUS WEEDS.

By Richard Helms.

Much depends upon the surroundings and circumstances certain plants are found in to what extent they may become mischievous. In cultivated ground all plants which spring up spontaneously, to the detriment of those specially sown, are noxious, although in other places they may be very useful. For instance, many grasses would soon smother the cultivated plants in a garden, whilst in pasture their usefulness goes unchallenged. Again, other plants, objectionable to the agriculturist or pastoralist, may be much admired by the horticulturist. Considerable elasticity must therefore be conceded to the term "noxious weeds," as according to different rural pursuits the evil done by certain "weeds" varies. The space occupied by one species of plant, it is certain, cannot at the same time be utilised by another. On this axiom is focussed the objectionable nature of undesirable weeds. The husbandman, whatever his special calling may be, should never neglect bearing this in mind, and constantly endeavour to root up undesirable plants in order that those more useful to him may prosper the better.

Introduced weeds, as a rule, become so much more harmful in comparison with indigenous plants, chiefly owing to the frequency and rapidity with which they multiply, and great surprise is often expressed at this objectionable proclivity. It is, however, common to many exotics, including animals as well as plants. Throughout nature the struggle for existence is narrowed down to "eat, and be eaten"; this means that in their original habitat every plant and every animal has a natural enemy, and it is mainly by this means that a check is established to prevent the preponderance of a species and the balance restored. In a new habitat and at a distance from its original home the equalizing agent or natural enemy generally is wanting, and no substitute is found in the native fauna or flora to take its place. A still more important factor influencing the spread of exotic introductions, is the change of climate. The advantages of a mild climate to plants originally found in colder climates is enormous. They develop more luxuriantly; may, under certain conditions, produce several crops of seeds in succession during the same year; and may also change their habits considerably. Several instances of plants introduced into Australia from colder climates and distant lands might be quoted as examples. These plants which in their native countries are strictly annuals, dying off at the approach of winter, have become biennials, and in some instances perennials.

Again, it is obvious that plants which have evolved special organs for an expansive distribution are those which will most likely be carried to distant lands, because their seeds become mixed with more varied material than those of the less prolific kinds, and are, in consequence, the more frequently introduced. It is for this reason that many of the weeds introduced into Australia are extremely aggressive.

A number of people argue that, because some introduced weeds furnish food to domesticated animals, they are not noxious. But these people entirely overlook the fact that such compensation is only one of degree ; for unless a plant is equal in value to the one it has displaced there is a loss, which increases in proportion to the rate the aggression extends. It may thus happen that a not entirely useless but prolific plant becomes more noxious than one that possesses no compensating qualities whatever, but which is less prolific. Stock soon surfeit of plants found in great abundance, because too uniform a pasture does not furnish every element for their well-doing. The more variable the herbage, the better they thrive ; consequently the poor pasture derived from introduced and rapidly spreading weeds will never compensate for the loss of the plants they suppress. At the best the professed compensation derived from weeds is a poor consolation, and merely serves to hide the indolence displayed over the neglect of their early eradication.

Another excuse for neglecting an active destruction of weeds is the assertion that if left alone they will disappear by themselves. This may appear to be the case with a few species on very poor soil, but it is then only at the almost complete exhaustion of the same. Anyone who believes that by doing nothing against weeds these will get "sick" of the soil, will have to wait a long time, and then find that the devil was driven out by Beelzebub—a more noxious weed occupying the place of the first intruder,—and in the meantime the usefulness of the land has gone from bad to worse.

A considerable number of exotic plants (upwards of 300 species) have from time to time been introduced into Australia, many of which have reached Western Australia. The most objectionable hitherto introduced into our colony have been briefly described in this chapter, as well as some of those which, having already become specially noxious in the other colonies, may at any time invade our lands.

Some general remarks regarding the suppression and eradication of objectionable plants seem desirable.

It is highly important to root out the invading plants immediately after they have made their first appearance. Many at first spring up in cultivated land or near homesteads, and therefore become readily observable and, as a rule, can then easily be mastered before they spread beyond control, which should be taken advantage of. Too much stress cannot be laid upon the necessity to destroy them before the seeds have ripened. But it should be borne in mind that the mere cutting down of plants is not always sufficient. With many succulent kinds, and more especially in those with thick stems, the seeds ripen after the plants have been cut down. Such plants, after being cut, should therefore be immediately heaped together and burnt. It is, at the same time, worth bearing in mind the fact that the majority of plants are easier killed when coming into flower ; indeed perennials can only successfully be dealt with when they have arrived at this stage, unless they are grubbed out by the roots. Cutting down plants just below the surface is in any case advisable.

In cultivated land a thorough tillage is the best means of coping with weeds, and is comparatively easy. The greater difficulty arises in eradicating them from pastures and waste lands, particularly when once they have taken a firm hold. To prevent this in such places much more depends upon taking early action to prevent excessive spreading than even in cultivated lands. Anyone discovering foreign plants in such situations, whether it be on waste lands, commons, highways or byways, or any other place, will serve both himself and his neighbor a good turn by destroying them. Concerted action should at all times be resolved on to confine, where possible, noxious weeds to limited areas. It stands to reason that if one individual in a district neglects the destruction of objectionable plants, whilst his neighbors are contending against them, he places their endeavors at a great disadvantage, as they will have to constantly guard against a reinvasion from his neglected lands.

A few of the leading agencies of the various ways by which plants get introduced into new habitats may also deserve mentioning, and be profitably discussed.

A good number have undoubtedly been introduced together with seeds of culture plants. Not only should always the ripest and heaviest seed be sown, but attention should also be directed to its purity. The best and purest seed will be found the cheapest in the long run, even at a cost of double the price of ordinary or inferior seed.

Another great source of noxious weeds (and this in late years seems to be particularly applicable to Western Australia) is the introduction of forage. Chaff cut from unclean hay is certain to bring seeds into paddocks or on to open lands where horses run, for many seeds will pass undamaged through them, and germinate all the better after being softened in the intestines. Birds also in this manner sometimes introduce plants from great distances. From this it may naturally be inferred that stable manure often contains large amounts of seeds. Manure brought from town stables, where the horses are mostly hand-fed, may easily contaminate clean land with weeds, and it is therefore advisable to heap such manure together, and let it rot well before using it.

Goods of all descriptions, but more particularly fragile articles, are extensively packed in hay, and generally in such that it is naturally of low value for feeding purposes, and probably contains objectionable plants. Many articles are sent in their original packing to all parts of the country, and in this way weeds may become introduced simultaneously in places widely apart from each other.

Plants coming from nurseries, in pots, or having the roots packed in moss, or, as is sometimes done, in green weeds to keep them moist, are conveyors of many seeds, as has frequently come under my notice when examining such importations.

Seed capsules, with burs, attach themselves to the hair of animals, and are often carried about for a considerable time before they drop off. Sheep in particular may, in this manner, carry such seeds over long distances. The discovery of the Bathurst bur in the Albany stockyards is a case in point. Little doubt can exist that the seeds of this plant were brought by sheep from one of the other colonies.

Besides the means of further distributions that suggest themselves from the foregoing as applying to weeds already introduced, two other important agents must be added, namely, wind and water.

Many, and particularly the more aggressive plants, produce seeds to which feathery or winglike organs are attached, specially developed for wind distribution. They are thus possessed of the means of floating in an air current, and get widely disseminated from, may be, a single plant that was allowed to mature. Rivers help the wind materially to carry such seeds still further along, and during inundations the rapid currents move those seeds from place to place, which naturally are too heavy to drop far away from the mother plant. Among the *debris* left behind during floods plants are frequently found to develop which previously were not seen in these localities.

Descriptions.

Argemone Mexicana (Mexican poppy; prickly poppy; devil's fig).—Indigenous to Mexico. An erect annual of hardy growth, reaching a height of several feet. Leaves, whitish-green, deeply incised and spinous; flowers, large, yellowish-white; seeds, small, enclosed in a many-chambered capsule. A very objectionable weed. The seeds are more powerfully narcotic than opium.

Fumaria officinalis (Common fumitory).—Indigenous to Europe and Asia. A succulent erect or decumbent annual of delicate green colour. Stems soft, and sometimes reaching a length of several feet, but then the plant is always more or less trailing; leaves much divided; flowers in racemes sometimes one to two inches long,

Argemone mexicana ("Devil's fig," "Mexican poppy.")

Reference to Plate.—A, capsule, open; B, ovary; C, showing how the stamens are arranged around the ovary; D, pitted seed. All variously magnified, with the exception of the capsule.

terminal or opposite the leaves, colour variable, from pale pink to purplish. A very profusely seeding plant and growing luxuriantly in cultivated lands.

Capsella bursa pastoris (Shepherd's purse).—Indigenous to Europe and Western Asia. Stem erect, sometimes over a foot high; leaves spreading on the ground radiating from the stem, pinnatified, with a large ovate or triangular lobe at the apex ; a few narrow, entire or toothed leaves clasping the stem ; flowers white, minute ; seed-pods, triangular, flattish, notched at the top and with the angles rounded, attached with thin stalks along the stem. A profuse seeder and one of the commonest weeds in tilled soil and waste places. It has a strong tapering root which deeply penetrates the soil.

Raphanus raphanistrum (Wild radish; Spanish radish; jointed or white sharlock).—Indigenous to Europe and temperate Asia. An erect or spreading annual or biennial, growing to over two feet high, much branched ; stem covered with stiff hairs at the base ; leaves divided or lobed, the terminal segment large and oblong, covered with short hairs, the upper leaves narrow ; flowers white, pale yellow or lilac ; pods cylindrical, from one to one and a half inches long. A rapidly spreading weed, and very troublesome in cultivated land.

Oxalis cernua (Drooping yellow-flowered wood-sorrel).—Indigenous to South Africa. An herbaceous bright-green plant, with four-lobed leaves (resembling clover leaves, and therefore in Germany called "Sauerklee," (sour clover), on slender stalks, and producing yellow flowers. Very aggressive in light cultivated soil. I have seen parts of orchards densely covered with this weed. It is difficult to eradicate on account of the bulbs formed at the roots, which rapidly multiply, and from which the plant will repeatedly spring up again after having been pulled, except during very dry weather. Inviting as the plant looks, it is not eaten by stock ; even pigs soon tire of it.

Malva sylvestris (Marsh mallow; cheeses).—Indigenous to Europe and Central Asia. A biennial (and in Australia often triennial), with semi-erect or trailing stems, sometimes more than 3 feet long, more or less hairy on the upper ends ; leaves on a long stalk, almost circular or approaching kidney-shape, smooth above and somewhat pubescent underneath ; flowers violet to purplish-red ; seeds forming a flat-ribbed carpels, mucilaginous, and known as cheeses or cat-cheeses by children. An aggressive weed in cultivated soil, and common on waste lands and roadsides. The plant is eaten by stock when better plants are wanting.

Sida rhombifolia (Paddy's lucerne in New South Wales; jelly leaf in Queensland. Synonym—*Sida retusa*).—Indigenous to many warm parts of both hemispheres. A shrub, with thin stems, growing in protected situations to 6 feet ; leaves approaching lozenge-shape, hence its scientific name ; when old, hard and dry, but when young mucilaginous, which characteristic accounts for the Queensland vernacular ; flowers yellow, nearly half-inch across when open ; fructification held in a cup-shaped calyx, and containing a number of seeds with hooked awns. This plant is said to have been introduced into Queensland on account of its fibre, which in India is a commercial product. In Australia, except experimentally, the fibre has never been produced ; but since its introduction the plant has become very noxious in the tropical and sub-tropical portions of the eastern colonies, and is spreading to the cooler parts. It is found in the southern parts of New South Wales, although not growing so luxuriantly as in the north, where I have seen it entirely occupying the ground over considerable stretches of cleared land. The plant becomes very aggressive where it gets established, and as it seeds freely it will spring up from these again for several years after it has been rooted out, unless this is done on its first appearance, and before it has matured. Cattle and horses will feed on the young shoots, and under stress, on the old leaves, but neither does them much good. F. M. Bailey mentions that the awned seeds have caused the death of young fowls.

Euphorbia Peplus (Petty spurge wort).—Indigenous to Europe and Asia. A small erect branching herbaceous annual, rarely more than eight inches high. Stem reddish when exposed to the sun ; leaves small, bright green, smooth, entire, ovate to elliptical ; flowers minute, greenish yellow ; fructification three-lobed. The plant is readily recognisable by its milk-like sap. This juice is acrid, and must be looked upon with suspicion as being poisonous. Found generally in cultivated land and by the roadsides where the ground is disturbed, railway embankments, etc. It spreads rapidly, but is easily suppressed if not allowed to seed.

E. lathyris (Caper spurge; myrtle spurge), and *E. helioscopia* (Sun spurge ; cat's milk) have been recorded by Mr. F. Turner as introduced to New South Wales.

Ricinus communis (Castor-oil plant).—Indigenous to India. A shrub, assuming a treelike growth under favorable conditions. Stems reddish or purplish, often covered with a bloom, and many jointed ; leaves, stalked, large, deeply incised, composed of seven long, pointed segments ; flowers numerous, in spikes, the male and female separate ; fructification covered with soft spines. From the nuts the castor oil of commerce is obtained. This plant is very ornamental, and when grown under restriction may become a valuable adjunct to other products. It is extensively cultivated in India and America on account of the oil derived from it. In temperate countries it spreads rapidly, and will occupy river banks and other rich lands to the detriment of the native vegetation.

Urtica dioica (Stinging nettle).—Indigenous to Europe and Central Asia. A perennial plant with numerous erect stems springing from the creeping root. The whole plant is covered with stinging bristles. Leaves, dark green, triangular to lanceolate, with the lower corners rounded ; flowers generally dioecious, (meaning that the male and female flowers are found on different plants), numerous, clustering on spikes. The stems, often more than three feet high, yield a fibre which formerly was extensively converted into fine cambric. On waste lands, roadsides, and along hedges.

Urtica urens (Small nettle).—Indigenous to Europe and temperate Asia. An erect branching annual, reaching in Australia sometimes to a height of over eighteen inches, covered with stinging hairs ; leaves roundish or ovate, deeply and regularly toothed ; flowers numerous, greenish. Spreading rapidly in cultivated and on waste lands.

Cerastium vulgatum (Chick-weed ; mouse ear).—Indigenous to Europe. A succulent and rather variable much-spreading weed, forming matted tufts when growing luxuriantly ; leaves small, ovate to oblong ; near base of stems stalked, higher up closely attached to stem ; flowers white, star-shaped. A very common weed in cultivated soil and waste lands once broken.

Silene gallica (Catchfly).—Indigenous to Europe, Western Asia, and North Africa. A hairy and viscid plant, with rather wiry stems and a straggling habit ; leaves narrow, the lower widening towards the tip ; flowers small, pinkish white, set in a hairy calyx. Generally found in cultivated land and made-up roadways. It has been reported as poisonous, but I think erroneously. There is little to fear from it in this direction, as none of the domesticated animals feed upon it. It is entirely useless, although not very aggressive.

Spergula arvensis (Corn spurry).—Indigenous to Europe, Asia, and Africa. A slender annual, branching at the base into several ascending stems, reaching a height of sometimes over a foot ; leaves, slender, narrow, almost cylindrical, one to two inches long, growing six or eight together in opposite clusters and spreading so as to form a whorl ; flowers small, white, on slender stems ; seeds abundant, black, slightly flattened. In northern Germany, immediately after the rye has been harvested, this plant is frequently sown and mown for fodder, but more frequently it is later ploughed under to manure the succeeding crop of the winter corn.

Atriplex hortensis (Garden orache ; mountain spinach).—Indigenous to eastern Europe and western Asia. An erect annual with robust woody stem, reaching a height of upwards of five feet ; leaves triangular, the upper narrow, green above and whitish or mealy underneath ; flowers small, numerous, crowded in a long panicle. Found in cultivated soil. In Europe it is cultivated for spinach. It makes good feed, but spreads readily in tilled soil, and is very exhausting.

Chenopodium album (White goosefoot ; fat hen).—Indigenous to Europe and central Asia extending to the Arctic regions. A hardy, tough, erect annual, from one to two and a half feet high ; pale green or more or less mealy white, especially the flowers ; leaves stalked, mealy below ; the lower ovate more or less toothed, the upper ones narrow and entire. Flowers numerous in dense, sometimes branched clusters. In cultivated and waste places. An exhausting weed, but furnishing food to stock which compensates to some extent for its aggression.

Chenopodium ambrosioides (Stinking goosefoot).—Indigenous to America. A weak perrennial shrub, branching from the base, and attaining a height of upwards of four feet ; stems slender, becoming woody when old ; leaves lanceolate - elliptical, emarginate and toothed, smooth, stippled, with numerous minute glandular openings on the underside, the lower between three and four inches long and from one to one and a-half inches wide, the upper gradually diminishing ; flowers small, numerous, in axillary and terminal racemose spikes. The whole plant emits a strong offensive smell, and in consequence is rejected by domesticated animals.

Chenopodium murale (Nettle-leaved goosefoot).—Indigenous to temperate Europe and Asia. An erect much branched annual reaching a height of over eighteen inches in cultivated lands. Stems redish, robust, succulent ; leaves intensey green, broadly ovate, deeply toothed ; flowers small, abundant, and crowded at the base of the leaves or terminal. A useless and very aggressive weed ; abundant in cultivated lands and waste places.

Polygonum aviculare (Wire grass ; crab ; knot-weed ; knot-grass ; iron-weed).—Indigenous to Europe, probably originally from Asia. A prostrate much branched weed ; often erect when drawn up by other plants ; stems knotty, wiry, and sometimes upwards of two feet long ; leaves small, narrow, oblong ; flowers whitish, small, and in clusters. This weed is not entirely useless, as stock will eat it, but its feeding qualities are probably not very great, and when old it is not readily digested.

Rumex acetosella (Sorrel ; sour dock).—Indigenous to Europe. This troublesome weed is, unfortunately, too widely spread not to be known by everyone. The trailing root generally sprouts from the smallest part which makes the eradication of this plant extremely difficult. It has been introduced on many lands with stable manure brought from towns.

Emex australis (Doublegee ; three-cornered jack ; tanner's curse).—Indigenous to South Africa. An erect or trailing succulent annual, sometimes developing stems over 18 inches long ; leaves ovate or heart-shaped, rounded at apex, on stems, the lower sometimes over 2 inches long and 1½ wide, and including stem 3½ long, the upper diminishingly smaller ; flowers insignificant, situated at the axils of the leaves, the female flowers forming three-cornered spinescent fructifications close to the stems. One of the most aggressive introductions, which during late years has spread to an alarming extent, and seemingly finds its way to almost every piece of newly-disturbed land in certain districts. Wherever it once gets a start it will rapidly expand and suppress all other vegetation. Bentham received this plant from Western Australia in Drummond's second collection, but regarded it at this early date as a probable introduction. The late Baron von Mueller, who met with the plant soon after reaching South Australia, always considered it an introduction, and, although he includes it in his "Census," made a note to this effect. "I think I am in a position to set the still existing doubt at rest, and prove its introduction; which, moreover, was a deliberate one, for the purpose of cultivating the plant as a culinary vegetable under the name of 'Cape spinach.' My informant is Mr. D. Wansborough, who landed at Fremantle in 1831. He, with his wife, came from England under contract with Mr. William Tanner. On their way out the ship put in at the Cape of Good Hope, where Mr. Tanner obtained the seed. Eighteen months after arrival in Western Australia Mr. Wansborough entered the services of Mr. J. Phillips as gardener, and in this occupation sowed a bed with the seed of this 'Cape spinach' at Mr. Phillips's place on the Canning river in 1833. The seed was obtained from Mr. Tanner, and this is the first authenticated instance of the plant having been cultivated; but it is probable that it was sown the year before, and certainly in the following year. As, however, the plant did not prove a very palatable spinach, and soon became a troublesome weed, causing constant annoyance to the workmen, on account of its spinous seeds (the greater part of the rural work having to be done by hand in those days), it received the name of 'Tanner's curse' throughout the settlement."

Phytolacca octandra (Ink plant).—Indigenous to America. A tall, much-branching herbaceous plant, growing from four to ten feet high; leaves large, ovate; flowers small, greenish; fruit very juicy, blackish-purple. A prolific seeder. In damp soil this plant rapidly spreads, mainly through the agency of birds, who greedily eat the berries. Besides this, a closely allied plant, *P. decandra* is recorded as having been introduced into Queensland.

Medicago denticulata (Burr medick; toothed medick; burr clover; creeping burr).—Indigenous to Europe, West Asia, and North Africa. An annual with spreading stems, semi erect or trailing on the ground. In humid costal regions I have seen the stems reaching a length of over three feet, and in New Zealand I have known the plant to be biennial. Leaves, cloverlike, dark green, and sometimes marked with small dark brown spots; flowers yellow, very small, in little beads on stalks; pods spirally twisted and covered with hooked or curved prickles. This weed is mainly objectionable on account of the burred pods it produces in great profusion, and which deteriorate the value of wool to an enormous extent when attached to it. As a fodder plant it is only of mediocre value, and as it generally dies down in the dry season and leaves bare patches in the places it has been growing on, it is of little service, but ojbectionable because it suppresses better pasture plants.

Emex australis (" Three-cornered jack," " doublegee," " Tanner's curse.")

Reference to Plate.—A, vertical section of a male flower ; B, stamen ; C, ovary, showing the three styles, with large fringed stigmas ; D, fruit, with three spinescent lobes ; E, fruit seen from abo\e ; F, a seed-like nut. All details of the plant variously magnified.

Ulex europaeus (Furze ; gorze ; whin).—Indigenous to Europe and Africa. This perennial thorny shrub, almost perpetually decked with yellow flowers, is well known in Australia. It was introduced to form hedges, but has spread extensively and become a great nuisance in many parts. Owing to its formidable character, which protects it against outward attack, together with its enormous production of seeds, it becomes rapidly aggressive and smothers all neighboring vegetation. Birds assist also in distributing the seeds. When kept in check, it makes an impenetrable hedge, but as these are easily ignited, it is in many places prohibited to use the plant for this purpose.

Rosa rubiginosa (Sweet briar ; eglantine).—Indigenous to Europe and Central Asia. This well-known shrub was originally purposely introduced to form hedges as in Europe. The different conditions of the two countries were, however, not taken into consideration. In Europe, where the lands are mostly under high cultivation, the plant is not allowed to spread. In Australia, on the other hand, the large tracts of uncultivated and partly cultivated lands afforded the plant numerous undisturbed centres. It has consequently spread in many places to an alarming extent, and ruined thousands of acres for pasturage. In New Zealand it is equally aggressive. Birds are mainly instrumental in spreading it. It should on no account be allowed to spread, as it is one of the most difficult plants to eradicate.

Opuntia vulgaris (Prickly pear).—This large cactus is well known throughout Australia. In Western Australia it is found in many gardens and, as far as I know, has not yet escaped on to pasture lands, etc. In New South Wales it is occupying thousands of acres, making the land next to useless for depasturing stock upon, and for a number of years the Government has spent large sums of money on its eradication with only partial success. It is one of the most difficult plants to kill as the smallest parts of it will grow. It flourishes particularly well in dry regions. Attempts have been made to utilise the plant as food by chopping it into bits and in this manner breaking its sharp spines, when stock will eat it for a time.

Arctium majus (Giant burdock).—Indigenous to Europe and Western Asia. A perennial plant with a stout tap-root ; stems stout, many branching, and reaching a height of from two to five feet ; leaves large, entire, and fairly hairy ; the lower sometimes 18 inches long and 12 wide ; the flower-heads are terminal and form a dense burr of hooked bristlets ; a large plant often developing several hundred of these containing numerous seeds. I do not think that this plant is eaten by a single animal, at least, this is my European experience. The utter uselessness makes this plant particularly objectionable as it spreads rapidly and smothers every other plant under its large leaves. Few plants exhaust the soil to such an extent as this weed.

Arctium minus.—Similar to the previous, but smaller, and differing in some minutae. This weed is reported from New Zealand by Mr. F. W. Kirk.

Carduus arvensis (Perennial thistle ; falsely called Californian thistle in Australia and New Zealand. In England called common thistle or green thistle ; and in Canada, cursed thistle). Syn. *Cnicus arvensis*, *Cirsium arvense*, *Seratula arvensis*.—Indigenous to Europe, Western Asia and Northern Africa. Recognisable by its perennial roots which makes it the most difficult of all thistles to suppress , the male and the female flowers are produced on separate plants ; flower heads of moderate size, purplish, and in clusters on short stalks ; height from two to four feet, and even more in very rich soil.

Carduus lanceolatus (Spear thistle ; also, but incorrectly, called Scotch thistle. Syn. *Cnicus lanceolatus*, *Cirsium lanceolatum*).—Indigenous to the countries surrounding the Mediterranean and of early introduction into several of the Australian colonies. A robust plant with formidable spines ; easily recognisable by its deeply lobed leaves, which always carry long spines at their points. The lower leaves are very large, and all are covered on the underside with a soft webby coating ; flower-heads large, pinkish, and developing many seeds which have a large pappus attached, admitting of them being carried long distances. The plant, like most thistles, is very exhaustive to the soil ; it flowers but once, but sometimes may take two years to arrive at maturity, reaching a height of three feet and upwards, and, not rarely, over six feet in good land. In New Zealand I have seen this plant over ten feet on one occasion.

Carduus Marianus (Milk thistle; varigated th.; spotted th.; Maria th.; blessed th.; holy th.; Our Lady's th. Syn. *Gilybum Marianum*).—Indigenous to Europe, Asia, and Africa. A very robust thistle with large variegated or mottled leaves, which give the plant a conspicuous appearance. Producing large flower beads and abundant seeds it becomes very aggressive, and rapidly occupies the whole ground on which it once has settled. It is terribly exhausting to the soil, and grows generally to several feet, and not rarely over six feet high. In New South Wales I have several times met with it reaching more than 10 feet, and covering many acres of ground so densely as to be impenetrable. The plant is very nutritious and liked by horses, who in preference feed upon it when it wilts through ripening, as then the prickles are less pungent. Ensilage also has been successfully made of it on several occasions in New South Wales. Fowls, and particularly chickens, do not despise the seeds.

Carduus pycnocephalus (Shore thistle ; winged thistle ; slender thistle).—Indigenous to Middle and Southern Europe, Northern Africa, and South-western Asia. In general appearance resembling *Carduus arvensis*, but differing from it by the absence of a perennial root, and having flower-heads without stalks, which, besides, are more slender.

Centaurea calcitrapa (Star thistle; purple star thistle.)—Indigenous from Middle Europe to Western Asia and Northern Africa. A slender stemmed annual, with straggling branches, reaching occasionally

Carduus pycnocephalus ("Winged thistle;" "Slender thistle.")

a height of three feet; stem smooth; leaves small, pinnately lobed, the upper undivided slightly hastate; flower-heads purplish-blue, either terminal or laterally sessile to stem, armed with formidable spines.

Centaurea melitensis (Malta thistle ; saucy sack ; cockspur th.) —Indigenous to Southern Europe, Northern Africa, and South-Western Asia. A slender plant with few small entire leaves. Flower heads small, always terminal, spinulous, and yellow. Height

Centaurea calcitrapa ("Purple star thistle.")

to three feet and upwards, particularly when crowded. In New South Wales this plant has become a great nuisance in wheat fields. In Western Australia I have found it sparingly near Perth, but near Pinjarrah it occurs abundantly.

Centaurea solstitialis (St. Barnaby's thistle ; yellow star thistle). Indigenous to Europe, Northern Africa, and South-Western Asia.

Centaurea solstitialis (" Yellow star thistle.")

In general character of growth this plant resembles C. *calcitrapa ;* but its flowers are yellow, surrounded by reddish spines. In the latter characteristic it resembles C. *melitensis.*

The three last mentioned thistles possess no compensating qualities whatever, and on account of their aggressiveness and enormous reproductive powers must be considered amongst the worst introductions. No kind of stock eats them, and when occurring on cultivated land they become a great nuisance to the workmen, both during harvesting and later, when hay is to be cut into chaff, which article, moreover, their presence causes to lose considerably in value.

Cryptostemma calendulacea (Cape weed," "Cape dandelion").

Cryptostemma calendulacea (Cape weed ; Cape dandelion).—Indigenous to South Africa. A perennial, succulent, low-growing plant ; leaves usually from 4 to 6 inches long, lobed to the midrib, the lobes faintly serrated and incised on the lower margin near the midrib, green above and whitish cottony below ; below the midrib is distinctly lined with white. Flowers star-shaped, yellow, with a dark centre, from half to 1 inch in diameter ; the outer half of the petals is greyish underneath. A very prolific seeder. The seeds being surrounded with a wooly fluff are readily disturbed by wind. In many places a marked variety is common, and often found growing together with the typical plant. This variety is characterised by its more slender leaves, which have the lobes irregularly and deeply incised, and are of a darker green above and a less intense white below. The linear markings on the underside of the stems are less white also, and become indistinct towards the tips. This weed must be considered one of the most aggressive introductions. It appears to grow more luxuriant within the region of winter rains in Western Australia than in any part of the other colonies. In cultivated ground I have seen it produce central stems (quite an abnormal characteristic) of over two feet, and some of these, when lying down, develop roots from every node. During late years this weed has spread at an alarming rate, and at present the greater number of orchards, vineyards, and gardens, and many fields as well, are infested with it. To some extent this is undoubtedly due to gross carelessness and the pernicious habit of using it for packing, as adopted by some nurserymen. The succulent weed is well adapted to keep the trees, vines, &c., in excellent condition whilst these are in transit, but it is a deliberate method of distributing a noxious plant far and wide, which should not be tolerated. Although the moist coastal climate seems to be specially favorable to its development, it nevertheless is certain to spread into the drier portions unless great precautions are taken to limit its distribution. Having met with the plant myself in the arid parts along the Darling River in New South Wales, and there found it to flourish, proves that it will not be seriously affected by heat and the absence of rain. Wherever the plant establishes itself it suppresses all other pasture herbage. In New South Wales I have observed it to cover large stretches of country, which, when fresh and green and bearing thousands of yellow flowers, looked attractive. But when, after prolonged dry weather, the plants had died and shrivelled to insignificant vestiges, the ground was bald of all native vegetation. Sheep feed upon the plant to a moderate extent, pigs eat it, and cattle do not altogether despise it, and under stress eat it freely, but it imparts an objctionable flavour to the milk. Still, as it possesses scarcely any nutritious qualities, they soon get tired of it, and will, as a rule, not touch it if other herbage is present. In pasture land it becomes even more objectionable than in cultivated ground, wherein, by perseverance, it may be suppressed. After being apparently killed by prolonged dry weather, it springs up again after the first shower of rain, in some instances even from the old roots, but principally from the abundantly produced seeds, which rapidly germinate on being moistened, and grow faster than most other plants.

Graphalium luteo-album (Jersey cudweed).—Indigenous to the greater part of the temperate world. An annual or biennial from a few inches to over a foot high, covered all over with a silvery soft down ; stems erect ; leaves narrow, flexid ; flowers small, yellowish, generally clustered at the termination of the stem. In waste places becoming aggressive in cultivated lands. Quite useless.

Galinsoga parviflora (Small flowered galinsoga).—Indigenous to South America. An erect branching succulent annual, reaching frequently a height of two feet. Leaves stalked, ovate-lanceolate,

Galinsoga parviflora ("Small flowered *galinsoga*").

Reference to Plate.—Apex of plant (reduced) ; A, flower head (much enlarged).

flexid, slightly hairy, and of a vivid light green colour. Flower heads small, numerous, yellow, with five white petals at the margin, situated at the apex and the extremities of the branchlets. The plant is a very profuse seeder, and makes a rapid growth. In cultivated land it soon becomes very aggressive during winter and spring. Except in damp soil it dies oft during the hot summer, nevertheless it should be actively suppressed as soon as it makes its appearance.

Hypochoeris glabra (Annual cat's ear).—Indigenous to Europe, West Asia, and North Africa. An annual plant in its native home, but in humid parts of Australia it lasts beyond the first year. It besides grows far more luxuriantly in its new habitat than in Europe, where the stems are mostly single and rarely above one foot long. In Western Australia I have seen specimens with six and more stems rising from the same root, and reaching a height of over 2½ ft. The weed was noticed by me to be very common in places in New South Wales. Stems smooth, erect, leafless, branching towards the top ; leaves moderately emarginate, upwards of six inches long at times, radiating from the root stock on the ground ; flowers bright yellow, situated at the apices of the stem and its branches ; seeds numerous, furnished with a feathery pappus. A useless and aggressive weed, which is never touched by stock, except under stress of circumstances.

Inula graveolens (Stinkwort).—Indigenous to the Mediterranean region. An annual (but sometimes a biennial in Australia) of branching growth, reaching a height of over three feet ; stem woody near base ; leaves oblong elliptical, moderately toothed and emarginate below, slender and entire above ; flowers yellow, forming headlets situated at the nodes and terminally ; seeds with a pappus composed of upwards of 32 bristles; on an average 30 seeds to each headlet. The whole plant is covered with hairs, and produces a viscid exudation of a powerfully offensive odour. Probably the most aggressive, and at the same time an entirely useless plant. The bristles of the pappus are covered with four irregular rows of fine spicules. These, sometimes amounting to over 400 to each bristle, are, when dry, of glassy sharpness and cause acute and painful eczema where they touch the skin. (A full description of such an attack may be found in No. 14, vol. iv.—June 30th, 1897—of the *Journal of the Bureau of Agriculture* of Western Australia).

Kentrophyllum lanatum (Gaffron thistle ; woolly thistle. Syn. *Carthamus lanatus*).—Indigenous to Southern Europe, Northern Africa and South-western Asia. Under ordinary circumstances an annual plant, but sometimes it springs up again from the same root. A moderately robust plant reaching a height of three feet and sometimes more. Leaves, bright green, stiff, moderately lobed, and sharply spinous ; flower-heads, large, terminal, deep yellow, and surrounded with numerous spinous leaflets.

Onopordon Acanthium (The heraldic Scotch thistle).—Indigenous to Europe, Western Asia, and Northern Africa. Heads large, pinkish, and single on terminating branches ; leaves much drooping, almost entire or only moderately lobed or indented, irregularly spinous on margins ; stem more or less densely spinous. The whole plant, but more particularly the underside of the leaves, is more or less covered with a webby wooly vestment. This thistle never grows to the height of the falsely called "Scotch thistle" *carduus* *lanceolatus.* It only resembles the latter superficially in the flower-heads. The leaves, however, differ markedly, and make one plant from the other readily distinguishable.

Senecio vulgaris (Common groundsel).—Indigenous to Europe and Eastern Asia. An erect succulent herb growing to the height of a foot; leaves irregularly imarginate, glossy green on the upper side, and pilose below; flowers small, yellow; seeds with a profusely hairy pappus attached. Generally found only in cultivated soil. It is a very exhausting plant which readily spreads. Hogs and cattle eat it occasionally.

Inula graveolens ("Stinkwort").

Reference to Plate.—A, branchlet showing flowers (less than natural size); B, flowerhead (much enlarged); C, seed with pappus attached (greatly magnified); D, piece of a bristle of pappus showing shape of spicules (very highly magnified).

Sonchus oleraceus (Common sow thistle).—Indigenous to Europe. An annual growing to over 3 feet, with a hollow, smooth stem, containing a milky juice; leaves stalked, lobed, broadly triangular at tip, margined irregularly with weak prickles ; prickles also on leaf stalk ; flowers, citron yellow, set in irregular clusters ; seed with pappus. A prolific seeder, and found abundantly in many cultivated localities. Unless where this weed becomes obnoxious to cultivated plants it cannot be regarded as very objectionable, as it produces excellent food to all domesticated animals. It is an excellent tonic for horses.

Tagetes glandulifera (Stinking Roger ; wild marigold).—Indigenous to South America. A tall annual, growing sometimes over 6 feet high ; leaves simple, and sometimes pinnate, bright green ; flowers yellow, in large bunches ; seeds with pappus. The foliage is covered with glands containing a strong smelling oil. The plant rapidly occupies cultivated ground, and is very exhausting, but also thrives in other places. Milch cows browsing upon it get their milk contaminated with the odour of the plant, which is also imparted to the butter or cheese made from it.

Taraxacum Dens-leonis (Dandelion ; children's clock).—Indigenous to Europe. A perennial plant, with thick taproot descending to a considerable depth in the soil and containing a milky juice ; leaves close to the ground, forming a shallow funnel, rather variable in shape, but generally more or less incised near the base, and ending in a broad, lanceolate or rounded lobe ; flowers large, yellow, rising from the centre on hollow tubes ; seeds numerous, attached to a large pappus. Generally found in grassy places, and abundant in cultivated soil.

Tripteris clandestina.—Indigenous to South Africa. An erect herbaceous annual, branching towards the upper part, and reaching a height of over two feet. Stems almost smooth, or sparingly covered with short soft hairs ; leaves elongate, moderately dentate and emarginate, lightly pilose, at the base often clasping the stem ; flowers brownish to purple in centre, and yellow on outer margin, terminal in clusters ; seed-heads resembling a bur-tool ; seeds, three-winged. The plant secretes a sticky substance, particularly near the flowers and on the young shoots, and has a strong unpleasant smell. A useless and very aggressive plant.

Xanthium strumarium (Small burdock ; ditch burr ; burweed ; Noogoora burr, Queensl., clot or cockle burr, Am.)—Indigenous to Europe. A tall bushy plant, with broad irregularly toothed leaves, producing numerous burrs ; these are larger than those of the Bathurst burr, more densely covered with hooklets, and with a couple of larger ones at the apex. In Queensland the plant reaches a height of from six to eight feet. It was introduced to Queensland with cotton from America, and to New Zealand it is supposed to have been brought with ballast. A useless and dangerous plant, for besides producing objectionable burrs it is poisonous. The young shoots are eaten by cattle, in which it produces paralysis of the heart, according to Chief Inspector

Gordon's report. Dr. Bancroft confirmed the poisonous nature of the plant from experiments made by him. At Noogoora the first case of poisoning stock was authenticated, whence it received its local name.

Xanthium spinosum (Bathurst burr).—Indigenous to Chili, but has long been widely distributed over the warmer parts of the globe. An annual (probably at times biennial in Australia) assuming a bushy spreading growth, and sometimes ascending to over 3 ft. Stem stout, becoming woody near base ; branchlets covered with a silvery bloom, armed with sharp prickles at the nodes ; leaves three-lobed, lance-shaped, the central lobe much longer than those at the side, green above and silvery below ; flowers situated in the axils of the leaves, where they form clusters of burrs ; burrs elliptical, crowded with hooked bristles. The hard nut is too chambered, containing each a long greyish olive colored seed. A pernicious introduction and especially objectionable on sheep runs. By no other burr is produced an equal deterioration of the wool as by that of *X. spinosum*. The loss may amount to 2d. per pound, which, at the price of wool ruling at present, means upwards of one-third of its value.

Plantago lanceolata (Rib grass).—Indigenous to Europe. A perennial herb with a thick woody rootstock ; leaves erect, lanceolate, sometimes over six inches long, but varying much in size, stalked, longitudinally ribbed ; flowers small, crowding at the apex of long slender stalks. Abundant in meadows, pastures and waste lands. The plant makes fairly good fodder.

Plantago major (Broad-leaved plantain).—Indigenous to Europe and Central Asia. A perennial plant with large leaves growing from a rootstock ; leaves erect or spreading, sometimes over five inches long and nearly as broad, stalked, ovate, generally smooth but sometimes downy underneath, with a number of ribs converging towards the stalks ; flowers numerous, crowded round a stalk growing from the centre of the plants, and forming a long spike. In cultivated land, waste lands and pastures.

Anagallis arvensis (Red pimpernell ; shepherd's or poor man's weather glass).—Indigenous to Central and Southern Europe. A succulent procumbent annual from six inches to one foot ; leaves small, ovate, closely set to stems, entire ; flower bright red. In cultivated and waste places this seed spreads rapidly. Its feeding qualities are small, and it is not readily eaten by stock.

Anagallis coerulans.—This weed is by most botanists considered merely a variety of the former. It has very handsome dark blue flowers, and generally grows more robustly. In Western Australia I have met this plant in cultivation, growing with extraordinary luxuriance, and becoming very obnoxious.

Gomphocarpus fruticosus (Cape cotton).—Indigenous to South Africa. This annual is an entirely useless weed and very aggressive. On account of its handsome appearance it is sometimes cultivated in gardens. It reaches a height of over four feet ; growth branching ; stems containing a milky juice ; leaves bright green, slender, entire ; flowers white, in umbels near tips of branches ; fructification bright green, sometimes over an inch long, covered with soft prickles (superficially resembling the "thorn-apple") ; seeds numerous, bearing a profusion of long white cottony fila-

Xanthium spinosum ("Bathurst burr").

Reference to Plate.—A, branchlet of plant (natural size); B, fruit (enlarged); C, leaf, fruit and spines ; D, one of the hooks growing on the fruit (much enlarged).

ments. The organisation of the attachment of the seed fits this for wide and rapid distribution. Besides being easily carried by the wind, the many fine and flexid hairs allow it to adhere to almost anything, and when blown against railway carriages may be carried for hundreds of miles in this manner. The seed capsules should not be allowed to break, and be burnt to prevent the spread of the plant.

Cuscuta Trifolii (Dodder).—Indigenous to Europe and temperate Asia. A leafless annual parasitic on lucerne and clover. This remarkable plant sends its reddish or whitish silk-like filiform stems up the host plant and ultimately completely covers it. It supports itself by developing small warts near the nodes of the stem, and by means of these it also depletes its host. The flowers are developed at the nodes and form small headlets. The parasite is very destructive to the fodder plants mentioned, and besides is aggressive to hops and nettles. When buying clover or lucerne seed care should be taken not to have dodder seed mixed with them.

Datura stramonium (Thorn apple ; mad apple ; devil's apple ; devil's trumpet ; stinkweed. In some ports of North America known as "Jimson weed," a corruption of Jamestown weed.—T. W. Kirk). —Indigenous to Western Asia and Europe. It is a common tradition in Europe that the gipsies introduced this plant for clandestine purposes. A succulent tall annual, with bright leaves and handsome flowers ; height up to four feet, with a strong irregularly branching stem ; leaves, dark-green above and paler below, irregularly and sometimes deeply cut, and attached by slender stalks ; flower white, tubular, and five-lobed ; fruit sometimes over an inch long and three-quarters in diameter, green, egg-shaped, covered with cone-like prickles ; when ripe, the fruit splits in four parts and exposes the closely-set dark-brown seeds bedded upon the central pulp. The plant produces a nauseous smell when bruised. It is poisonous, and, although its odour is offensive, it is sometimes eaten by cattle in times of dearth. Mr. P. R. Gordon, Chief Inspector of Stock, Queensland, reported a number of instances where cattle have been poisoned by this weed. The alkaloid daturia extracted from this plant is a powerful poison, but also a valuable medicine against several diseases.

Datura tatula (Blue flowering thorn apple).—This plant differs mainly from the above in producing blue or violet-blue flowers. It is frequently cultivated as a garden plant. Both species of the thorn apple seem to spread readily when once they are introduced. Probably no plants range over a greater area on the face of the earth. The seeds are heavy and do not possess organs for self-distribution ; it can scarcely be doubted, however, that birds are the means of disseminating them, although I have never observed any to eat these poisonous grains. This plant is considered to possess stronger toxic qualities than the common stramonium.

Nicotiana glanca (Tree tobacco).—Indigenous to South America. Attaining sometimes a height of over 20 feeet with a stem of over six feet in diameter. A rapid grower, and used on this account as a shelter plant. Leaves stalked, fleshy, smooth, ovate heart-shaped, covered with a whitish bloom, the larger upwards of six inches long and three inches wide, much smaller towards the tips of the

Datura stramonium. ("Thorn apple"; "devil's trumpet"; "stink weed.")

REFERENCE TO PLATE.—A, flower laid open; B, fruit, splitting by four valves; C, seed.

Stachys arvensis ("Stagger weed," "Hedge nettle," &c.)

Reference to Plate.—A, side view of a flower ; B, flower opened out to show the arrangement of the stamens ; C, fruit enclosed in the calyx ; D, showing different views of the seed-like nuts. All variously magnified.

branches ; flowers yellow, tubular, about $1\frac{1}{2}$ inches long, clustered ; seeds in oval capsules. The plant is decidedly poisonous to stock, a reason why its spread should be checked.

Solanum nigrum (Black-berried nightshade ; black currant).—Indigenous to the greater part of the globe, and considered a native of Australia as well. A well-known common weed, generally found in cultivated soil, waste lands, and newly-broken ground, growing to a height of sometimes 3 feet. A succulent annual poisonous in all its parts. Leaves dark green, ovate, and irregularly toothed ; flowers white, small ; fruit black, soft, enclosed in a tough skin. Children frequently eat the berries without harm to them, although they are distinctly poisonous and will cause nausea. Pigs seem to be particularly sensitive to the poison of this weed and its berries. They are said to die through eating it, and in consequence the plant is known in certain parts of Germany as "Sautod" (sowdeath). A correspondent from Deniliquin, in New South Wales, writes in the *Agricultural Gazette*, vol. vi., p. 293 :—"Supposed to be the cause of blindness in horses, particularly young animals, who unknowingly eat the plant."

Solanum sodomaeum (Apple of Sodom).—Indigenous to South Africa. A shrubby plant of a spreading habit from three to five feet high, armed with strong prickles at the base of the leaf stalks. Leaves large, deeply lobed and covered on the underside with short white hairs set starlike ; flowers violet, upwards of an inch across, growing in small clusters ; berries globular, often over an inch in diameter, green, variegated with yellowish white. Generally found on the sides of roads, and often in rocky soil. A perfectly useless plant with poisonous berries.

Lithospermum arvense (Corn gromwell ; bastard alkanet).—Indigenous to Europe and Western and Central Asia. An erect annual, growing over a foot high, with a hoary stem branching towards the top. Leaves lanceolate, dark-green and hairy ; flowers small, white, closely attached to the stem, or terminal ; seeds blackish, wrinkled, very hard. Often very troublesome in cornfields, and also found in waste places. The root of this noxious weed is red externally and stains the skin if rubbed with it. Peasant girls may probably use it at times to paint their cheeks, for in Germany it is known as "Bauernschminke."

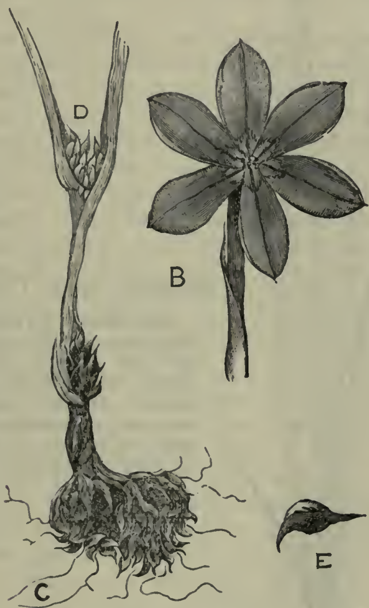
Mentha pulegium (Pennyroyal).—Indigenous to the countries surrounding the Mediterranean ; extending over Europe and Western Asia. A prostrate branching perennial ; strongly scented ; leaves small, narrow ; flowers small, in clusters. In waste places and damp situations.

Stachys arvensis (Hedge nettle ; stagger weed).—Indigenous to Europe and Central Asia. A slender, hairy annual with branched stems, erect or slightly decumbent, sometimes over one foot high ; leaves small ovate ; flowers small, of pale purple color. In cultivated or broken lands and waste places. A prolific seeder and an aggressive and useless weed which is by many considered dangerous and supposed to give cattle the staggers, hence its trivial name. When green it is not readily eaten by domesticated animals, but when mixed with hay, or particularly in chaff, it cannot be avoided by them, and then is claimed to produce the affection called "staggers." Although much doubt exists on this point, it is as well to obviate even a presumed danger, if such it only were, by vigorously suppressing this useless weed upon its first appearance.

Lantana camera (Lantana).—Indigenous to sub-tropical and tropical America. A perennial shrub attaining in rich soil a height of upwards of 20 feet ; much branched and densely matted, it

Homeria lineata.

suppresses, where it becomes established, all other vegetation except strong trees. Foliage dark green, and strong smelling ; leaves lanceolate ovate, rough on the upper surface, regularly bluntly toothed round the margin ; flowers in clusters, pink, and later yellow ; berries with a thin blackish pulp. The plant is very ornamental and originally has been introduced for decorative purposes. Its profuse production of seeds, however, has caused it to become widely distributed in many places through the agency of birds. In the northern parts of New South Wales it has destroyed thousands of acres of the most valuable land, and since its introduction into Efaté the southern island of the New Hebrides, about ten years ago, it has become in several places very troublesome. In the islands it goes by the name of the "curse of New Caledonia," probably because it was first distributed from the last named island to those adjacent. In Mauritius it is a terrible pest, where it was also introduced as an ornamental plant more than forty years ago. It can only be eradicated with the greatest trouble, as the smallest particle of its roots may throw out suckers after the plant has been cut down and the stalks grubbed up. The only way I know to deal with it successfully is by cutting it down close to the ground and letting the plants lie over the stocks till the following year. This will smother the stocks and roots, and if, after a twelve months, the dead brush is burnt the land may then be ploughed, and rarely any of the roots will sprout again.



Homeria lineata.

REFERENCE TO PLATE.—A, plant (much reduced); B, flower ; C, bulb with bulbils ; D, airial bulbils at node of stem ; E, a single bulbil. (B, C, D, and E, approximately natural size.)

Homeria lineata.—Indigenous to South Africa. A perennial plant with a bulb of considerable size ; leaves rigid, moderately strongly ribbed; and with a whitish band along the mid rib, often over a foot long; stem sometimes over 18 inches long, bearing the flowers on stalks at the head ; flowers, copper red, the segments sometimes an inch long and three-eighths to half an inch broad, with a small

Romulea rosea ("Guildford grass").

REFERENCE TO PLATE.—A, plant with seed capsule; B, plant showing flower and the growth of a new bulb; C, flower laid open to show the fertilising organs; D, seed capsule, with part of covering removed to show seeds. A, reduced by half; B and C natural size; D, reduced one third.

yellow-dotted blotch inside at the base. A rapidly spreading plant, multiplying itself not only by seeds and bulbs, but in addition also by bulbiles growing round the bulb and at the axis of the leaves which partly sheath the stem. The plant is malignantly poisonous to stock. It has escaped from deserted gardens where it had been cultivated for its flowers. Some years back a large number of stock were poisoned by it near Melbourne. The late Baron von Mueller was deeply impressed with the dangerous nature of this plant, and did all in his power to make those engaged in rural pursuits acquainted with the appearance of this plant. A coloured figure of it appeared in the *Journal of the Bureau* on the 11th December, 1894, reproduced from a drawing sent by that eminent scientist, who never lost sight of the practical side of the rural interests.

Romulea rosea (Guildford grass).—Indigenous to South Africa. A perennial bulbous plant. Leaves narrow, faintly ribbed and lined, glossy, erect, sometimes over a foot long; flowers pink, with five petals, about ½-inch across, on stalks rising from centre of plant; seeds numerous, yellow, almost spherical, about the size of a mustard seed, arranged in six rows; seed-capsules nearly ½-inch long, splitting when dry into three divisions, each of which is composed of a double compartment. The plant spreads rapidly and soon becomes the almost sole occupier of the ground wherever it establishes itself, as it multiplies by its bulbs as well as the numerously produced seeds. Any kind of soil seems to suit it, although it prefers damp localities. It is a veritable destroyer of good pasture. Although eaten —what are the poor brutes to do when there is nothing else growing?—it is extremely innutritious and when it gets old may become dangerous to stock. Its danger lies not in possessing toxic qualities, but in the toughness of the leaves, which, being very indigestible, will frequently pack into a solid ball within the stomach. Some specimens of enormous size have been taken from horses who died of internal inflammation, probably caused, but certainly intensified and accelerated by these solid accumulations. This objectionable plant is becoming very common in several parts of the old settled districts of Western Australia. Care should be exercised to prevent it getting established in new localities. On account of its grass-like leaves it may easily escape observation, as it is not readily recognised by anyone previously unacquainted with it. When flowering the pink blossoms betray its presence, and when dug up at any other time the brownish bulbs reveal the true nature of this noxious weed.

APPENDIX.

A LIST OF FOREIGN PLANTS KNOWN TO OCCUR IN AUSTRALIA.

The greater number of the plants included in the following list have been accidentally introduced through impure seeds of cereals or other plants of cultivation, with forage, with packing consisting of hay, straw, moss, &c., or soil attached to living plants. A number have strayed from cultivation, and a few have been deliberately introduced. Those marked with an * occur in Western Australia; but many more besides very probably have found their way to this colony, as only those are marked which were observed during the spring of 1897, and which in most instances were found within 20 miles from Perth.

Ranunculaceae.

Ranunculus bulbosus ; Buttercup. Eu.
Ranunculus muricatus. Mediterranean region

Papaveraceae.

Argemone Mexicana ; Mexican poppy. Mexico.
Papaver hybridum ; Wild poppy. Eu., As., Afr.
Papaver Rhoeas. Eu., As., Afr.

Fumariaceae.

*Fumaria officinalis ; Common fumitory. Eu., W.As., N.Afr.

Cruciferae.

Alyssum maritimum. S.Eu.
*Barbarea vulgaris ; Winter cress ; yellow rocket. Eu., As., Am., Tas., Vict., N.S.W., N.Z.
Brassica campestris. Eu.
Brassica oleracea. Eu., As., Afr.
Brassica Sinapistrum. Eu., As., N.Afr.
Camelina dentata. S.Eu.
*Capsella Bursa-pastoris ; Shepherd's purse. Eu., W.As., N.Afr.
Lepidium Draba. Eu., As., Afr.
*Nasturtium aquaticum ; Water cress. Eu., As., Afr.
*Nasturtium officinale ; Water cress. Eu., W.As., N.Afr.
* (?) Raphanus Raphanistrum ; Wild radish ; Spanish radish. Eu., As., N.Afr.
*Raphanus sativus. Eu., As., N.Afr.
Senebiera coronopus. Eu., As., Afr.
Senebiera didyma ; Pepper-wort. Eu., As., Afr.
Sisymbrium officinale ; Wild mustard. Eu., W.As.

Polygaleae.

Muraltia Heisteria. S.Afr.
Polygala myrtifolia. S.Afr.
Polygala virgata. S.Afr.

Lineae.

Linum gallicum. S.Eu., N.Afr.

Geraniaceae.

*Erodium cicutarium ; Storks bill. Eu., As., Afr.
*Erodium moschatum ; Musky storksbill. Eu., W. As., W. Afr.
*Oxalis cernua ; Sour grass. S. Afr.
*Oxalis versicolor. S. Afr.
Oxalis purpurata. S. Afr.
Pelargonium sp. ; Garden geranium. S. Afr.

Malvaceae.

Malva parviflora ; Small-flowered mallow. S. Eu.
Malva rotundifolia ; Dwarf mallow. Eu., W. As., N. Afr.
*Malva silvestris ; Marsh mallow. Eu., W. As., N. Afr.
Modiola Caroliniana
Modiola multifida. S. Am.
Sida rhombifolia ; Paddy's lucerne. Warm regions of both hemispheres.

Euphorbiaceae.

Euphorbia Helioscopia ; Sun spurge. Eu., W. As., N. Afr.
Euphorbia Lathyris. S. Eu.
*Euphorbia Peplus ; Common spurge. Eu., W. As., N. Afr.
*Ricinus communis ; Castor-oil plant. As., Afr.

Urticaceae.

Urtica dioica ; Perennial nettle. Eu., W. As., N. Afr.
*Urtica urens ; Small nettle. Eu., As., Afr.

Ficoideae.

Mesembryanthemum crystallinum ; Ice plant. Eu., As., Afr.
*Mesembryanthemum edule ; Hottentot fig. S. Afr.
Mesembryanthemum pomeridianum. S. Afr.

Portulaceae.

Claytonia caulescens. Am.

Caryophylleae.

Arenaria serpyllifolia. Eu., W. As., N. Afr.
*Cerastium vulgatum ; Mouse ear chick weed. North. hem.
Dianthus prolifer ; Pink. Eu., W. As.
Lychnis Githago ; Corn cockle. Eu., W. As., N. Afr.
Saponaria Vaccaria ; Cow soap-wort. S. Eu., As., N. Afr.
Silene cucubalus. Eu., As. Afr.
*Silene Gallica ; Catchfly. S. Eu.
*Spergula arvensis ; Spurry. Eu., W.As., N. Afr.
Spergula pentandra. Eu., As., Afr.
Stellaria media ; Chickweed. Temperate Northern hemisphere.

Amarantaceae.

Amarantus albus. Am.
Amarantus Blitum. S. Eu., W. As., N Am.
*Amarantus paniculatus ; Red leg. As.
Amarantus spinosus. As., Afr., Am.
Amarantus viridis ; Green amaranth. As.

Salsolaceae.

Atriplex hortense ; Garden orache. N.E.Eu., N. As.
Atriplex patulum ; Wild orache. Temperate North. hem.
Chenopodium album ; White goosefoot. Eu., As.
*Chenopodium ambrosioides ; Stinking g foot. Am.
*Chenopodium glaucum ; Oak-leaved g. foot. W. As., N. Am.
*Chenopodium murale ; Nettle-leaved g. foot. W. As., N. Afr.
*Chenopodium olidum. Eu.

Polygonaceae.

*Emex australis. S. Afr.
*Polygonum aviculare ; Knot-weed. Eu , N. and W. As.
Polygonum convolvulus ; Black bindweed. Temp. north. hem.
Polygonum lapathifolium ; Smart weed. Eu.
*Rumex acetosella ; Sorrell. Temp. north hem.
Rumex conglomeratus ; Clustered dock. Eu., W. As., N. Afr.
*Rumex crispus ; Curled dock. Temp. As., N. Afr.
Rumex pulcher ; Fiddle dock. Eu., W. As., N. Afr.
*Rumex sp. (probably R. vesicarius. S. Afr.)

Phytolaccaceae.

Phytolacca Americana. Am.
Phytolacca decandra ; Red ink plant. Am.
Phytolacca octandra ; Ink plant. Am.

Leguminosæ.

Arachis hypogæa ; Peanut, West Ind.
Argyrolobium Andrewsianum. S.Afr.
Cajanus bicolor. Trop. As.
Cytisus scoparius ; Broom. Eu., N.As.
Genista canariensis. Eu., N.Afr.
Indigofera atropurpurea. Himalaya.
Lathyrus Aphaca. Eu.
Lotus tetragonolobus. Eu., As., Afr.
*Lupinus spp. Am.
*Medicago denticulata ; Burr medick. Eu., W.As., N.Afr.
Medicago lupulina ; Black medick. Eu., W.As., N.Afr.
Medicago maculata ; Spotted medick. Eu., N.Afr.
Medicago minima ; Burr medick. Eu., W.A., N.Afr.
Medicago orbicularis. S.Eu.
Medicago sativa ; Lucerne. Eu. N.Afr.
Medicago scutellata. S.Eu.
Melilotus alba ; White melilot. Eu., N. and W. As.

*Melilotus parviflora ; Scented melilot. S.Eu., W.As., N.Afr
Ononis natrix ; Goatroot. Eu.
Psoralea pinnata. S.Afr.
Trifolium agrarium ; Hop trefoil. Eu., W.As., N.Afr.
Trifolium arvense ; Hare's-foot trefoil. Eu., W.As., N.Afr.
Trifolium glomeratum. Eu., N.Afr.
*Trifoiium pratense ; Red clover. Eu., W.As., N.Afr.
*Trifolium procumbens. Eu., As., Afr.
*Trifolium repens ; White clover. Temp. Northern Hem.
Trifolium resupinatum. Eu., As., Afr.
Trifolium subterraneum. Eu., As., Afr.
*Trifolium tomentosum. S. Eu., W.As., N.Afr.
Ulex Europeans ; Furze. Eu., Afr.
Vicia angustifolia. Eu., As., Afr.
Vicia hirsuta ; Hairy vetch. S.Eu., SW.As., N.Afr.
*Vicia sativa ; Common vetch. S.Eu., SW.As., N.Afr.
Vicia tetrasperma. Eu., W.As., N.Afr.

Rosaceæ.

Alchemilla arvensis ; Lady's mantle. Eu. W.As., N.Afr.
*Rosa rubiginosa ; Sweet briar. Eu., N. and W. As.
*Rubus fruticosus ; Bramble. Eu., N. and W. As., N. Afr.
Sanguisorba minor ; Salad burnet. Eu., N.As., N.Afr.
Sanguisorba polygama. Eu., As.

Onagreae.

Epilobium roseum. Temperate Northern Hemisphere.
*Œnothera biennis ; Evening primrose. N.Am.
Œnothera tetraptera. Mexico.

Cacteae.

Opuntia Brasiliensis ;	Prickly pear.	Brazil.
Opuntia Dillenii	,,	Am.
Opuntia ficus indica	,,	India, Trop. Am.
Opuntia Tuna	,,	Mexico.
*Opuntia vulgaris	,,	Mexico.

Umbelliferae.

Ammi majus ; Bull-wort. Eu., W.As., W.Afr.
Bupleurum rotundifolium ; Hare's ear. S.Eu., W.As.
Carum Petroselinum ; Parsley. Eu., As., Afr.
Crithmum maritimum ; Real samphire. Eu., As., Afr.
Daucus Carota ; Common carrot. Eu., N. and W. As., N.Afr.
*Foeniculum vulgare ; Fennel. Eu., W.As., N.Afr.
Peucedanum sativum ; Parsnip. Eu., N.As.

Cucurbitaceae.

Cucumis myriocarpus ; Wild melon. S.Afr.

Rubiaceae.

Galium Aparine ; Cleavers. Temp. North. Hem.
Richardsonia humistrata. S.Am.
Sherardia arvensis ; Field madder. Eu., N. and W. As., N.Afr.

Dipsaceae.

Scabiosa maritima. Eu., As., Afr.

Passifloreae.

Passiflora alba. Brazil.
Passiflora coerulea. Brazil and Peru.
Passiflora edulis; Common passion fruit. Brazil.

Compositae.

Ageratum conyzoides; Billy goat weed.
Anthemis cotula; Spurious chamomile. Eu., W. As., N. Afr.
Anthemis nobilis; True chamomile. Eu., As., Afr
Arctium majus; Giant burdock. Eu., W.A.
Arnoseris pusilla; Lamb's lettuce. Eu.
Aster dumosus. N. Am.
Bidens pilosa; Cowage. Warm parts of the North Hem.
Carduus acaulis; Stemless thistle. Eu., N. and W. As.
Carduus arvensis; Perrenial th. Eu., N. and W. As., N.Afr.
Carduus crispus.
*Carduus lanceolatus; Black thistle. Eu., N. As., N. Afr.
*Carduus Marianus; Spotted thistle. Eu.
Carduus pycnocephalus; Slender th. Eu., N. and W. As., N.Afr.
Cathamus tinctorius; Safflower. S. Eu., W. As., N. Afr.
Centaurea calcitrapa; Star thistle. Eu., W. As., N. Afr.
*Centaurea melitensis; Cockspur. Eu., W. As., N. Afr.
Centaurea solstitialis. Eu., N. W. As.
Chrysanthemum parthenium. S. Eu., N. Afr.
Chrysanthemum segetum; Corn marigold. Eu., W. As., N. Afr.
Chichorium Intybus; Chicory. Eu., N. and W. As., N. Afr.
* Cryptostemma calendulacea; Cape weed. S. Afr.
Cynara Scolymus; Artichoke. S. Eu., S. W. As., N. Afr.
Erigeron Canadensis; Canadian fleabane. N. Am.
*Erigeron linifolius; Cobblers peg. Tropics.
Euryops abrotanifolius. S. Afr.
*Galinsoga parviflora. Peru.
*Hypochoeris glabra; Annual cat's ear. Eu., W. As., N. Afr.
Hypochoeris radicata, Perennial cat's-ear. Eu., N. Afr.
*Inula graveolens. Mediteranean region.
Kentrophyllum lanatum; Woolly thistle. S. Eu.
Leontodon hirtus; Hairy hankbit. Eu.
Madia sativa; Pitch weed. Am.
*Onopordon Acanthium; Scotch thistle. Eu., N.As.
Osteospermum moniliferum. S.Afr.
Picris echioides. Eu., As., Afr.
Picris hieracioides.
Senecio scandens; Cape ivy. S.Afr.
*Senecio vulgaris; Groundsel. Eu., N.Afr.
Soliva anthemidifolia. Brazil.

*Sonchus arvensis ; Sow thistle. Eu., N. and W. As., N.Afr.
*Sonchus oleraceus ; Sow thistle. Eu., N. and W. As., N.Afr.
Tagetes glandulifera ; Stinking roger. S.Am.
Tanacetum vulgare ; Tansy. N.Eu., N.As., N.W.Am.
Taraxacum Dens-leonis ; Dandelion. Temp. North. Hem.
Tolpis barbata. S.Eu., N.Afr.
*Tripteris clandestina. S.Afr.
Tragopogon porrifolius ; Salsify. Eu., N.As.
Wedelia hispida. N.Am.
*Xanthium spinosum ; Bathurst burr. Chili.
Xanthium strumarium ; Ditch burr. Eu., N.As., N.Afr.
Zinnia pauciflora. N.Am.

Campanulaceæ.

Lobelia debilis. S.Afr.
Lobelia Erinus. Afr.

Polemaniaceæ.

Navarretia squarrosa. Am.

Plantagineæ.

Plantago coronopus. Eu., As., Afr.
*Plantago lanceolata ; Rib-herb. Eu., N. and W. As., Afr.
*Plantago major ; Large rib-herb. Eu., N. and W. Asia., Afr.

Primulaceæ,

Anagallis arvensis ; Pimpernel. Eu., N. and W. As., N.Afr.
*Anagallis arvensis, var. coerulea. S.Eu., N. and W. Asia., N.Afr.

Apocyneæ.

Vinea rosea ; Pink periwinkle. W.Indies.

Asclepiadeae.

Asclepias curassavica ; Red flower. W. Indies.
*Gomphocarpus fruticosus ; Wild cotton plant. S.Afr.

Convolvulaceae.

*Cuscuta trifolii ; Dodder. Eu., W.As., N.Afr.

Solanaceae.

*Datura Stramonium ; Thorn apple. As.
Datura fastuosa.
*Datura tatula ; Blue-flowered thorn apple.
Lycium Chinense. China.
Nicandra physaloides ; Apple of Peru. S.Am.
*Nicotiana glauca ; Tree tobacco. S.Am.
Nicotiana tabacum ; Common tobacco. Am.
Physalis Peruviana. S.Am.
Solanum aculeatissimum. S.Am.
Solanum auriculatum. E. India.
*Solanum nigrum.

Solanum Pseudo-capsicum. S.Am.
*Solanum Sodomaeum ; Apple of Sodom. S.Afr.
Solanum pyracanthum. Madagascar.

Scrophularieae.

Antirrhinum Orontium ; Snapdragon. Eu., temp. As., N.Afr.
*Bartsia latifolia. Eu., As., Afr.
Celsia Cretica ; Cretan mullein. S.Eu., N.Afr.
Linaria elatine ; Toad flax. Eu., W.As., N.Afr.
Linaria genistifolia. S.E.Eu.
Linaria vulgaris. Eu.
Vesbascum Blattaria ; Spurious mullein. Eu., W.As., N.Afr.
Vesbascum Creticum. Eu.
Vesbascum Thapsus ; Mullein. Eu., N. and W. As.

Asperifoliae.

Anchusa officinalis ; Common alkanet. Eu., W.A.
Echium violaceum ; Purple bugloss. S.Eu., N.Afr.
*Lithospermum arvense ; Common gromwell. Eu., N. and W. As.

Labiatae.

Leonotus leonurus ; Lion's tail. N. Afr.
Marrubium vulgare ; White horehound. Eu., W. As., N. Afr.
Melissa officinallis ; Common balm. Eu., W. As.
*Mentha pulegium ; Pennyroyal. G. Eu., W. As.
Mentha viridis ; Spear Mint. N. & W. As., N. Afr.
Molucella laevis ; Molucca balm. Medit. region.
Nepeta Cataria ; Cat mint. N. & W. As.
Origanum vulgare ; Marjoram. Eu., N. & W. As., N. Afr.
Rosmarinus officinalis ; Rosemary. Eu., As., Afr.
Salvia pratensis ; Common sage. Eu., W. As.
Salvia verbenaca ; Vervain sage. Eu., W. As., N. Afr.
*Stachys arvensis ; Stagger weed. Eu., N. and W. As., N. Afr.
Stachys palustris ; Swamp betony. Eu., N. As., N. Am.
*Stachys sp.?

Verbenaceae.

*Lantana camara ; Common lantana. S. Am.
Lantana Sellowiana ; Sellow's lantana. S. Am.
Stachytarpeta Jamaicensis. S. Am.
Verbena Bonariensis ; Vervain. S. Am.
Verbena hispida ; Vervain. S. Am.
Verbena venosa ; Vervain. S. Am.

Irideae.

*Hesperantha falcata. S.Afr.
*Homeria lineata. S. Afr.
*Ixia sp. p. S. Afr.
*Lapeyrousia sp. S. Afr.
*Romulea rosea. S. Afr.

Sisyrinchium Bermudiana. N. Am.
Sisyrinchium micranthum. N. Am.
Sparaxis grandiflora. Afr.
Trichonema Bulbocodium. S. and W. Eu.
Watsonia angulata. S. Am.

Amaryllideae.

*Agave Americana; American aloe. S. Am.
Zephyrantes Atamasco. Am.
Zephyrantes candida. S. Am.

Liliaceae.

Allium fragrans; Sweet scented garlic. S. Eu.
Aphodelus fistulosus. S. Eu.
*Bulbinella caudata. S. Afr.

Commelineae.

Commelina Africana. S. Afr.

Pontederaceae.

Pontederia cordata. Am.

Aroïdeae.

Colocasia antiquorum; Tars. Tropical.
Richardia Africana; Trumpet Lily. S. Afr.

Junceae.

*Juncus bufonius. Eu., As., Afr., Am.

Gramineae.

Agrostis palustris; Fiorin grass. Eu., As., Afr., Am.
Aira caryophyllea. Eu., As., Afr.
Aira praecox. Eu., As., Afr.
Alopecurus agrestis. Eu., As., Afr.
Alopecurus pratensis; Foxtail grass. Eu., As, Afr.
Andropogon Halepensis; Haleppo grass. Eu., As., Afr.
Anthoxanthum odoratum; Scented vernal grass. Eu., As., Afr.
Avena elatior; Meadow oat grass. Eu., As., Afr.
Avena fatua; Wild oat. Eu., As., Afr.
*Briza maxima; Large quaking grass. Eu., As., Afr.
*Briza minor; Small quaking grass. Eu., As., Afr.
*Bromus mollis; Soft brome grass. Eu., W. As., N. Afr.
*Bromus sterilis; Barren brome grass. Eu., W. As., N. Afr.
*Bromus unioloides; Prairie grass. Am.
Cynosurus cristatus; Dogtail grass. Eu., As., Afr.
Dactylis glomerata; Cocks foot grass. Eu., W. As., N. Afr.
*Ehrharta longiflora. Afr.
Festuca bromoides; Barren fescue grass. Eu., N. Afr.
*Holcus lanatus; Yorkshire fog grass. Eu., W. As., N. Afr.
Holcus mollis; Creeping velvet grass. Eu., As. Afr.
*Hordeum murinum; Barley grass. Eu., As., N. Afr.

Hordeum nodosum. Eu., As., Afr.
Koeleria cristata ; Crested hair grass. Eu., N. and W. As. N. Afr.
Koeleria phleoides. G. Eu.
Lamarckia aurea. G. Eu.
*Lolium perenne ; Rye grass. Eu., W. As., N. Afr.
Lolium temulentum ; Darnel grass. Eu., W. As., N. Afr.
*Panicum spectabile.
Paspalum distichum ; Silt grass. Am.
Pennisetum longistylum. Abyssinia.
*Phalaris Canariensis ; Canary-seed grass. Eu., As., Afr.
Phalaris minor. Eu., As., Afr.
Phleum pratense ; Timothy grass. Eu., As., Afr.
*Poa annua ; Annual poa. Eu., N. and W. As., N. Afr.
Poa pratensis ; Common poa. Eu., As., Afr., Am.
Poa trivialis. Eu., As., Afr.
Polypogon Monspeliensis ; Beard grass. Eu., As., Afr.
*Stenotaphrum Americanum ; Buffalo grass. Am.

CHAPTER VIII.

THE POISON-PLANTS OF WESTERN AUSTRALIA.

(By Dr. Alex. Morrison, Botanist, Bureau of Agriculture.)

The colony of Western Australia has been known from its earliest days, and even from a time prior to actual settlement, to include in its flora a number of plants having properties dangerous to animal life. Some of these grow in such quantity, and over so large an area of the colony, as to have materially hindered the progress of settlement on its soil, by making the rearing of stock impracticable. The recent impulse towards agricultural settlement has brought the subject of poison-plants into greater prominence than before, and settlers have agitated for assistance in dealing with the pest. The loss sustained by the colony through the poisons, and the detriment they cause to its progress, are of a magnitude not easily realised. The Hon. C. H. Piesse, M.L.C., in speaking of his own personal experience of their effects, has stated that on one occasion he had seen a flock of 900 sheep in a fresh-burnt patch of York Road poison, and that half an hour afterwards 522 were found poisoned. He also expressed his opinion that the south-western portion of the colony would carry 10,000 sheep where it now carries only 100, were it not for these plants.

The Bureau of Agricultuie, recognising the necessity for Governmental action in the matter, made the following statement in its Second Annual Report, for the year ending June 30th, 1895 (*Journal of the Bureau of Agriculture*, 6th August, 1895, vol. ii., p. 514): —" The Bureau is of opinion that the poison question is one of the greatest importance, and that every effort should be made to ascertain the nature of the alkaloids in those plants, which infest so large an area of the colony, with a view to discovering whether there are any simple, cheap, and effective antidotes, and whether the alkaloids have any commercial value. The investigation should be botanical, chemical, and veterinary, and the Bureau proposes, if funds are forthcoming, to undertake the botanical and veterinary branches of the investigation."

In the year 1892 Mr. Bernard H. Woodward, curator of the Perth Museum, had been authorised to collect information from settlers and others regarding the poison plants of the colony, and he accordingly issued circulars, of which a copy is given below, requesting information on the subject.

" I am authorised by the honorable the Colonial Secretary to make a report upon the poison plants of this colony. To this end I shall esteem it a favor if you will kindly fill in the blank spaces in the annexed form as far as you can, and also answer the questions asked thereunder.

The points I hope to settle, if possible, are as follows :—

1st. The botanical classification of the plants.
2nd. The nature of the poisons.
3rd. Their effects.
4th. The proper antidotes.
5th. The commercial or medical value of these poisons.

The popular and botanical names of the following plants were given :—York road—*Gastrolobium grandiflora*, *G. calycinum* (Bentham).

Heart-leaved—*G. bilobum* (R. Brown), *G. largifolium.*
Narrow-leaved—*G. longifolium.*
Berry—*G. parvifolium* (Bentham).
Rock—*G. Callistachys* (Meissner).
Bloom—*G. ovalifolium* (Henfrey), *Oxylobium retusum* (Brown).
Box—*G. parviflorum*, *O. oxylobioides* (Bentham).
Sand plain, blue, Candyup, prickly, bullock.

The following information was sought—Locality and nature of the soil on which it grows ; month of flowering ; usual height of plant ; when dangerous, if all the year or only at flowering or other season ; to what stock it is hurtful, and in what manner it affects them. The questions asked were—" Do you consider that there are two varieties of York road, viz., a large and a small, and if so, which do you consider the more dangerous ? Will you be willing to send me specimens of the plants in flower, and also seeds later on, if requested ? Do you know of any other poisonous plants?"

Replies were sent in from 30 of those to whom the schedules of enquiries had been forwarded, and a quantity of useful information on the prevalence, mode of growth, and injurious effects of the various kinds of poison was obtained by this means. On these returns the following account of the poison plants has been to a large extent based. The information obtained from them may, in some particulars, require correction, and criticism from those interested will be welcome. It is not always clear whether the facts stated in these returns have been acquired in the writer's own experience, or are of a hearsay character. Facts correctly described by the person who has actually observed them are on a different footing from statements derived from others, who on their part may also have got the information on hearsay. The statements may be correct, but there is always a risk of them becoming modified as they are passed from one to another, if not easily confirmed by each person for himself. It is also difficult to distinguish between statements of what has actually occurred and guesses, inferences, beliefs, or opinions,—many, in place of stating the facts themselves, giving what are really the impressions made on their minds by what they had seen or heard. If an animal is found to show symptoms like those produced by poison-plants, it is desirable to ascertain, if possible, that it had been seen to eat a certain plant, or that portions of it had been found in its stomach after death. Failing this, the beast's illness might as reasonably be supposed to have been due to some other cause. A knowledge of the various poison-plants would enable anyone to decide, from their presence or absence in the neighborhood, whether the animal's sickness might be put down to one of those plants or not ; and a knowledge of the way in which they affect animals would be equally useful. So many plants have been suspected of poisoning stock that simple facts, correctly stated, are much needed for fixing their character as injurious, or clearing them of suspicion ; and it is to be hoped that those having the opportunity will communicate such definite facts to the Bureau of Agriculture, in order that they may be utilised and placed on record. It will be understood, from what has been said, that the following notes, imperfect and fragmentary as they are, are not put forward as a complete account of the poison-plants, but rather that they are meant as a step towards an enquiry into the subject, with a view to elucidating their nature and properties. Before discovering antidotes, or devising means for the prevention of poisoning of stock, or putting the poisons to useful purposes, it is necessary first of all to gather all the information possible about the plants, and to follow that up with systematic observation and experiment on the action of the poisons, the effect of antidotes, and other means of treatment. Notes of the symptoms of poisoning, the order of their incidence, and the post-mortem appearances, may be made by those under whose observation the occurrence may have happened ; and if these are written down on the spot, and forwarded with specimens of the plant found to have caused the accident, our knowledge of the poisons and their effects may be materially advanced.

The first requirement in discussing any question is to have a clear understanding about the identity of the objects spoken of. In the case of a plant it is necessary to know its name, and if confusion is to be avoided that name must be one having a strictly defined application and be generally adopted by the world at large. Such a name is *Oxylobium parviflorum*, definitely associated with a species of plant having certain botanical characters, but known to colonists under a number of different English names, as box, narrow-leaf, sandplain. In order to be sure of the identity of a plant called by any of these names it is necessary to refer to its scientific description as given in an authoritative work on the subject ; and while a resident of one part of the colony may call it box, another in a different district narrow-leaf, and a third may pronounce it sandplain, the botanist has one name for the three, namely, *Oxylobium parviflorum*. While it is desirable to know a plant by a well-defined name, applicable to that species alone, it is, on the other hand, equally necesssry to those who have to study and discuss plants and their natural history to have at hand for convenient reference a collection of specimens of those plants from different localities and showing all the variations in their growth. The name is the key to the information accumulated in books, and a herbarium, as a collection of dried specimens of plants is called, is necessary, as are books, for the acquirement of information regarding all those natural objects referable to the vegetable kingdom. Hitherto it has been the custom to send specimens of plants suspected of being poisonous to other colonies, where libraries and herbaria are in existence, in order to have their identity established, but it is to be hoped that before long this course will not in ordinary cases be necessary.

It is one of the objects of this account of the poison plants of the colony to supply readers with the means of identifying for themselves such of the known species as they may meet with. A description of each is given, copied, with verbal modifications, from the second and seventh volumes of Bentham and Mueller's *Flora Australiensis*, so that any one on finding a plant supposed to be poisonous may compare it with the description here given. If it shows the characters defined in the printed description, its identity may be considered established, but any material disagreement will show that the specimen does not belong to the species described.

The most important of the poison-plants of this colony belong to the natural order *Leguminosae*, which is characterised, in its principal division, by flowers having the form well-known to all as "pea-blossoms," and by the seeds being contained in a "pod." They bear the botanical names of the genera *Gastrolobium* and *Oxylobium*, which agree with one another in having their stamens all fiee, or not united to one another, and in their leaves being simple, or not composed of more than one blade or leaflet. The main point of difference between the *Oxylobiums* and the *Gastrolobiums*, taking each genus as a whole, lies in the number of seeds in the pod—that of *Gastrolobium* containing only two, while *Oxylobium* may have four or more. In *Oxylobium parviflorum* and *O. retusum*, however, the number of seeds does not exceed four, and, in the former, it is often only one or two, probably from failure of the seeds to set. The pod may be stalked or not in either genus, but in *Gastrolobium* it is rarely without a stalk, and is shorter than in *Oxylobium*, which produces usually a greater number of seeds. The bunches of flowers in the poisonous species of *Gastrolobium* are commonly longer than in *Oxylobium*, and more frequently form the terminal points of the branches, instead of springing from the angles between the upper leaves and the stem. It is sometimes difficult to determine to which of the two genera a given plant may belong, but if more than two seeds are found in the pod it may be set down as *Oxylobium*. Plants closely allied to one another, may, however, be sometimes easily discriminated by their general aspect as they grow, although their characters as given in books may, by themselves, appear inadequate.

Heart-leaved Poison.

Gastrolobium bilobum.—A tall shrub, the young branches angular, and usually silky; leaves mostly in circles of 3 or 4 round the branches, from oval to narrow-oblong, always more or less wedge shaped, broad at the end or notched, with two short rounded lobes, and with a minute short point, $\frac{3}{4}$ to $1\frac{1}{2}$ in. long or rarely smaller, veined and hairless above, pale and often minutely silky underneath. Flowers numerous, in very short flat-topped bunches rarely exceeding the leaves. Calyx silky, two to four lines long, the two upper points broader and blunter than the others, and united to about the middle. Upper petal about twice as long as the calyx; lower ones rather shorter, the lowermost deeply coloured. Pod stalked, oval or oblong, rather sharply pointed, two, three, and even four lines long.

Var. *angustifolium.*—Leaves narrow wedge-shaped, but not otherwise differing from the common form.

The botanical and the common names of this plant both have reference to the two-lobed or heart shape of the leaf. It is reported as found from York southwards to Albany and the Blackwood River, in sandy, rocky, clayey, or loamy soil. The height to which the shrub grows is very variable, like the nature of the soil, the average being about six to ten feet, but the extremes are given as 6 inches to 20, or even 25 feet. It begins to flower in August or September, continuing till December or January. It is most dangerous to stock when the young shoots come up after bush fires, at flowering and at seeding time, and all kinds of stock are liable to be poisoned by it.

Rock Poison.

Gastrolobium callistachys.—An erect shrub of 2 or 3 feet, with twiggy branches, minutely and closely silky-hairy; leaves scattered or in irregular circles on the branches, very narrow, blunt or sometimes even indented at the end, which is tipped with a minute point, 1 to 2 inches long, flat or with recurved edges, hairless or silky-hairy underneath; flowers rather large, in terminal racemes of 3 to 4 inches; calyx silky, fully 3 lines long, the two upper lobes broadly scimitar-shaped, but scarcely united together; upper petal nearly twice as long as the calyx; the others about as long; pod about 4 lines long, broadly oval, scarcely acute, on a stalk of $1\frac{1}{2}$ lines.

Bentham adds to his description: "This is sent as one of the Swan river poison-plants."

Found in hilly and rocky country in the north and north-eastern districts of the colony, from the Murchison to the Kalgan, but not plentiful. Grows to a height of 1 foot to 3, 5, or 7 feet, and flowers between September and December.

York Road Poison.

Gastrolobium calycinum.—An erect shrub, nearly allied to *G. oxylobioides*, but quite destitute of hairs ; leaves opposite or in threes, oblong-elliptical or, more frequently, lancet-shaped, with a pungent point, one to two inches long, rigid, net-veined, and often glaucous ; flower racemes tipping the branches or in the angles formed by the upper leaves with the branch ; flowers few and large in distant pairs or threes ; calyx five to nearly six lines long, the points or lobes rather longer than the lower part, the two upper ones broad, rounded at the end and united above the middle ; upper petal about three-quarters of an inch in diameter ; lowermost deeply colored, rather shorter than the side ones ; pod on a very short stalk.

The well-known "York-road" occurs as a small shrub, varying in height from one to three or four feet, growing, according to the reports received, in any soil, from barren sand to rich, but evidently quite at home in soils of the poorest quality. Its period of flowering is from September to December. According to Mr. E. R. Parker, "this plant is very general over all the south-western division of the colony, and took its name from the fact that it destroyed sheep, cattle and goats at different places on the York Road, all the way from Guildford to York, from 1834 to 1884." It prevails much more, he says, in some other parts than in the eastern districts.

All kinds of stock are subjects to its poisonous effects—cattle, sheep, goats, and also horses—and it is dangerous at all times, but especially so while young and tender, flowering or seeding. It is often noted as particularly deadly after bush fires, when the succulent young shoots or seedlings spring up and offer a tempting morsel to stock. At a later stage, the flowers are probably as attractive ; and the seeds, later still, are likely to furnish the poison in a more concentrated and deadly form, while, at the same time, the leaves have become harsher and drier and less palatable. According to one report, the old plant will not poison in February or March.

Some believe there are two varieties of York Road poison, but others think there is only one. It is not unlikely that some other plant may occasionally be mistaken for the true *Gastrolobium calycinum*, or that variations in growth, according to soil, season, or other surroundings, may so alter it as to give it the appearance of a distinct species. In such a case, specimens forwarded to the Bureau of Agriculture may settle the point.

Desert Poison.

Gastrolobium grandiflorum.—Young branches and flowers softly silky, the full-grown foliage almost without hairs and glaucous ; leaves opposite, or the upper ones scattered, from oval to oblong, blunt or notched at the tip, 1½ to 3 inches long, flat, leathery ; racemes short, loose, in angles of leaves, and terminating the branches, with few large flowers on stalklets; calyx softly hairy, 4 to 5 lines long, the lobes or points much shorter than the lower part, the two upper ones broad, scythe-shaped, and united nearly to the middle; upper petal fully $\frac{3}{4}$ of an inch diameter, lower petals rather shorter, the lowermost much incurved and deeply colored; pod stalked, hairy, about $\frac{1}{4}$ of an inch long, oval, pointed, swollen.

According to the late Bàron von Mueller this tall shrub is a tropic species only, growing in the Nickol Bay district, and also in the tropical portions of South Australia, New South Wales, and Queensland. He has recorded that it poisoned large numbers of cattle and sheep on the Cape river in 1863-64. According to Bailey and Gordon it is a virulent poison; but drivers and teamsters state that it ceases to be poisonous after the flower appears. Analysis of dried specimens by Mr. Staiger failed to show the poisonous constituent. It is called the "wallflower" poison-bush, and is also known as the "Australian" and "desert" poison.*

Gastrolobium ovalifotium.—A low shrub, its young branches hairy, leaves mostly opposite, ovate, rounded or broadly oblong, often notched at the end, $\frac{1}{2}$ to 1 inch long, margins thickened and nerve-like, not wavy, leathery, hairless above, net-veined and hairy, or at length deprived of hairs underneath; bunches of flowers scarcely stalked, rather slender, 1 to 3 in. long; flowers nearly stalkless; calyx hairy, $2\frac{1}{2}$ to nearly 3 lines long; lower petals deeply coloured; pod with a very short stalk, ovoid, pointed, about 3 lines long.

Referred to by Maiden (Agr. Gaz., N.S.W., v. 141) as the "Broom" poison bush.

See under *Oxylobium retusum* p. 582.

Gastrolobium oxylobioides.—An erect shrub of 1 to 2 feet—nearly allied to *G. calycinum*, which, however, is quite hairless—not much branched, without hairs or the young shoots and flower stalks slightly silky-hoary; leaves opposite or in threes, elliptical-oblong, broad or narrow, tapering to a pungent point, 1 to $1\frac{1}{2}$, or rarely 2 inches long, leathery, rigid, net-veined, and often folded lengthwise; bunches of flowers terminating the branches, or situated in the angles of the upper leaves, consisting of few flowers in distant pairs or threes; stalklets of flowers short; calyx about 3 lines long, silky-hairy, the lobes or points broad, the 2 upper ones united

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* Since the above was written a specimen of this plant has been received by the Bureau from Mr. James Isdell, of Nullagine. He obtained it from Mr. F. H. Hann, an old explorer, who recognised it as identical with a bush he had often seen killing stock in Queensland. Mr. Isdell says it is a bushy shrub, reaching a height of five feet, and grows in what is generally known as Warburton's Desert, in the country where the remains of the late Messrs. Wells and Jones were found, and it may possibly account for the death of both Messrs. Wells' and Rudall's camels.

to above the middle; upper petals about twice as long as the calyx, the lowermost rather shorter than the side ones; pod about 3 lines long, on a stalk very much shorter than the calyx.

Noted in the *Flora Australiensis* is one of the poison-plants, and bracketed with *Oxylobium parviflorum* as the box poison in Mr. Woodward's circular. Specimens and authentic notes of poisonous effects caused by it, are required to settle identity and properties.

Berry Poison.

Gastrolobium parvifolium.—A rigid spreading heath-like shrub, the branches hairy. Leaves crowded, in irregular circles round the branches, narrow-oblong, blunt, with a minute point, under ½-inch long, thick and leathery, convex underneath, hairless and net-veined, the midrib scarcely conspicuous. Bunches of flowers terminating the branches, rather dense, rarely longer than one inch when in flower, often two inches in fruit, the stalk and stalklets softly and densely hairy. Calyx veinless and without hairs, broadly bell-shaped, about two lines long, the two upper divisions almost completely united into a blunt upper lip, the three lower ones much shorter. Upper petal twice as long as the calyx; side ones shorter, almost as broad as long, all narrowed near their attachment. Pod stalked, compressed-globular, oblique, very blunt, hairless.

Reported from the eastern and south-western districts, growing mostly in sandy and gravelly soils, height one to two or three feet, and flowering between September and January. There is a consensus of opinion as to the greater virulence of this poison during the flowering and specially the seeding stages, some believing it is not dangerous to stock at other times. Mr. E. R. Parker says "it is seldom that any mischief befalls a flock from this poison till October, November, or December, when it is in flower or pod."

Prickly Poison.

Gastrolobium spinosum.—A shrub of two to four feet, usually quite hairless, but sometimes the young shoots clothed with a very evanescent wool, and the calyx and stalklets with a more persistent down; leaves mostly opposite, broadly heart-shaped, ending in a pungent point, and bordered with prickly teeth, or rarely almost or quite even-edged, three-quarters to one and a half inches long, often as broad as long, rigid and often glaucous; bunches of flowers loose, stalked, one to one and a half inches long; calyx broad, about two lines long, the points much shorter than the lower portion, the two upper ones united nearly to the top; upper petal streaked, half inch diameter, side ones rather shorter and scarcely exceeding the lowermost, which is broad and deeply coloured; pod stalked, hairless, bent-oval, four to five lines long, with a narrow point.

Variety, *triangulare*; leaves triangular heart-shaped, with pungent points only at the angles; flowers smaller, the bunches looser and more stalked.

This plant, which is easily recognised from its prickly holly-like leaves, is reported from the south-west, central, and north-east districts, and is found in rough scrub and rocky places, or on clay plains. Its height is from two to four feet, and it flowers in September and October. Like the others, it is hurtful when in flower or in pod, or after fires; and it may be assumed that when its spiny leaves are old and dry, it is less likely to be eaten, whether in that state its leaves are equally poisonous or less so than when young and tender.

Box Poison.

Oxylobium parviflorum.—A tall spreading shrub, the young shoots hoary with a minute silky pubescence; leaves alternate, opposite or in threes, narrow oblong, slightly wedge-shaped or linear, blunt or notched, mostly about 1 inch long, leathery, hairless above, minutely silky pubescent underneath, the margins usually recurved; flowers small, orange-yellow and purple, in slender bunches, terminal or in the angles of the upper leaves, often 2 to 3 inches long; calyx about 2 lines long, minutely pubescent, the points acute, and scarcely so long as the lower part, the two upper ones broader curved and united nearly to the top into a square upper lip; uppermost petal nearly 4 lines diameter, the lower ones rather shorter; pod on a rather long stalk, 4 to 6 lines long, hairy, with a narrow point; seeds only one or two, instead of four, without any outgrowth near their attachment, embedded in a pithy substance lining the cell.

The box poison is found in the central, eastern, south-west and southern districts of the colony, and grows in all qualities of soil—sand, gravel, clay, rocky, or good land. Some believe it to be specially associated with the white gum, so that when that tree is met with the box poison may be looked for. It flowers between August and December, and attains a height of six or eight feet, the minimum reported being one foot. It is a virulent poison and produces a large quantity of seed, according to Mr. E. R. Parker, who states that he has known the flesh of pigeons that have been feeding on box-poison seeds kill dogs and cats.

Sandplain poison appears—judging from the only scrap of the plant available—to be referable to *Oxylobium parviflorum*, and is therefore a variety of box, modified by the particular conditions under which it has grown. It is reported from the sandplains in districts to the north and north-east of Perth, and also from ironstone gravel ridges at the Kalgan River. It is found from six inches to two, three, or four feet in height, and flowers between August and December, and, like the other poison plants, is most dangerous when in flower or in seed, or when sending up young shoots.

Narrow-leaved Poison.—This is another variety of *Oxylobium parviflorum*, reported from the southern districts, from York southwards; growing in various kinds of soil it ranges in height from 9 inches to 3 or 4, or even 5 feet, and is in flower from September to December or January. Dangerous at all seasons, and very little of it is required to kill any animal.

Box, sandplain, narrow leaf and marlock poison bushes small to be varieties of the one species of *Oxylobium*. In the box the leaf is short and very like that of the true box from which presumably it has derived its name. In narrow-leaf, on the other hand, the leaves are sometimes to be seen 2 inches in length, and arranged in clusters of 5 to 7 at one level round the branches, instead of being scattered over them.

Bloom Poison.

Oxylobium retusum.—A much-branched, rigid shrub, the young branches angular and hoary or pubscent; leaves mostly opposite, stalked, ovate or oblong, blunt, square or notched at the end, usually one to two inches long, rigidly coriaceous, hairless and net-veined above, silky or rarely hairless underneath; flowers reddish-yellow, in dense, almost stalkless, terminal clusters, or rarely also in the angles of the upper leaves; calyx very hairy, about three or rarely nearly four lines long, divided to about the middle into broadly lance-shaped lobes; petals about half as long again as the calyx; pod on a very short stalk, oval, pointed, about four lines long, very hairy; seeds with an outgrowth near their attachment.

Variety *minus.*—Leaves smaller; flowers mostly terminal; calyx less villous.

Found apparently only in the southern districts, where it grows in poor rocky or gravelly soil, flowering between August and December, and of any height between six inches and six feet. It is by most considered dangerous to stock only when in flower or in pod.

Two species of plants are set down as corresponding to that popularly known as bloom poison, namely, *Oxylobium retusum* and *Gastrolobium ovalifolium;* but from the fact that the former species is recorded in Bentham and Mueller's *Flora* only from the southern districts of Western Australia, while bloom poison is similarly reported from the same parts, the presumption is that *O. retusum* and the bloom poison are the same thing. Besides, *Gastrolobium ovalifolium*, at the date of the *Flora Australiensis* (1864), was only known from the specimens of one collector (Drummond) and was originally described by Henfrey from a cultivated plant. These facts seem to imply that the latter species is an uncommon one, and therefore less likely to have had its identity or poisonous properties recognised.

Symptoms Produced by the Leguminous Poison-Plants.

In the reports received from different parts of the colony the effects produced on animals by the poisons are often set down to the poison plants as a whole, some asserting plainly that they are all alike in their action, others placing their information opposite one or more of the varieties indicated in the schedule, according to their experience. This may, perhaps, be taken to indicate a general agreement in poisonous properties among those poison plants that are most prevalent and best known. The great majority belong to the two genera of the family *Leguminosae*, *Gastrolobium* and *Oxylobium*, which are at the same time closely allied botanically, and not always easily distinguished one from the other. It should be understood, however, that though similarity in properties may co-exist with botanical relationship,—plants in the same family often possessing similar qualities as well as similar structure, yet the agreement in both these respects does not always or necessarily follow.

The symptoms reported by the different observers include the following :—The poisoned animal has a strange expression, the eyes having a wild look ; fulness over the eyes, twitching of the eyelids ; it rushes about in any direction as if terrified or mad ; sometimes stands trembling, or shuffles along as if its limbs were stiff, or it staggers and falls. There is difficulty of breathing, and slobbering at the mouth, and if driven the animal may drop dead. Griping and stoppage of the bowels take place, with distension more particularly noted immediately after death.

So long ago as 1842 Drummond wrote as follows :—" The finest and strongest animals are the first victims ; a difficulty of breathing is perceptible for a few minutes, when they stagger, drop down, and all is over with them. After the death of the animal the stomach assumes a brown colour, and is tenderer than it ought to be ; but it appears to be that the poison enters the circulation, and altogether stops the action of the lungs and heart. The raw flesh poisons cats, and the blood, which is darker than usual, dogs ; but the roasted or boiled flesh is eaten by the natives and some of the settlers without their appearing to suffer any inconvenience."

The effect of the poison on dogs appears to be much the same as on grazing animals. Mr. John Wray says :—" I have on different occasions had dogs go mad after eating sheep that had died of poison. They rush about as if terrified, and sometimes have threatened the shepherds. They will run away till they drop dead, but I have saved a few by getting them in in time and tying them up, so that they could not run away." Violent exertion is very apt to bring the poisonous action to a climax, the animal dropping dead when allowed to rush about in its delirious condition, or when driven, especially uphill.

Chewing of the cud is said by some to be unnecessary before the poison takes effect, while a draught of water hastens its action. This indicates, of course, the necessity for the poisonous constituent to be dissolved out of the tissues of the plant before it can be absorbed by the stomach and enter the circulation of the animal. The diffusion of the poison throughout the body of one animal, so that the flesh may be similarly poisonous to another devouring it, thus escaping neutralisation on being subjected to the various vital processes in the animal economy, is in contrast with its destruction by the operations of roasting or boiling, which, according to Drummond and others, render the flesh quite wholesome.

Notes on the *post mortem* appearances observable after poisoning by these plants are somewhat scanty. A change in the blood is said to take place, becoming darker than natural according to Drummond, who also notes that the stomach assumes a brown colour, and becomes more tender than usual. Mr. H. Lukin observes that "the rough inner coating of the paunch will always strip readily on being touched, and this applies in all cases of poisoning with the above poisons." Excessive swelling takes place immediately after death, and is due no doubt to rapid decomposition giving rise to the production of gases that distend the relaxed intestines of the animal. Mr. E. R. Parker observes: "When sheep, horses or cattle die from eating this poison (York Road) decomposition *immediately* after death takes place so rapidly that in a few days the carcase has so decidedly disappeared that one would almost believe that quicklime had been used with that desire. If this was caused by some peculiar properties in the poison, it would be well to know it."

Treatment.

As might be expected in the case of sickness caused by poisons so powerful and rapid in their action, treatment does not appear to have been satisfactory, as regards any beneficial result. Removal of the poisonous material from the stomach and intestines is not mentioned, and in all probability cannot safely be done by the administration of medicines in liquid form, owing to the danger of dissolving out more of the poison, and thus promoting its absorption into the system of the animal. Common soda in solution, and bleeding, have been tried, but without benefit; indeed, either might rather hasten the death of the animals. No antidote is known to the correspondents who have sent information about the poison plants, but all seem to be in agreement in recommending that the affected animals should not be allowed to drink or to move about, much less to be driven, which is likely to bring about sudden death. Mr. Maiden quotes T.R.C. Walter, who says, "With sheep which have eaten the herb the best treatment has been found to fold them, or shut them up in a yard, so closely packed that they can hardly move, and to keep them thus without food for 36 hours." By having recourse to this method, which seems to be generally approved, the danger of over-exertion and that connected with the drinking of water are avoided, and nature is given a chance to get rid of the poison before it has had time to bring about a fatal result.

The means thus taken to save the lives of poisoned animals are preventive rather than curative, and though remedies in the form of antidotes, that would neutralise the poison in the blood, or before it has had time to be absorbed into the blood, would be most desirable, yet in the long run prevention is better than cure, and is the wisest method of coping with the evil. Keeping the sick beasts at perfect rest, and denying them water, hinders the process of poisoning, and may be considered preventive, but evacuation of the stomach and bowels of their contents would stay its further action. An antidote that would kill the poison would be of the greatest value, but it would be better still to prevent stock feeding on the plants. In taking stock through country in which poison plants grow, means should be adopted to prevent them browsing on these bushes. Mr. C. R. Fenwick says :—"Sheep and stock may be taken through growing poison without harm, if proper precautions are taken. Some shepherds lose no sheep from the poisons, others lose lose large numbers. It will be found that many of the greatest losses of sheep and stock have been occasioned through neglect and inattention on the part of the shepherds. Various devices and remedies are adopted, full particulars of which should be ascertained."

Eradication.

More effective still would be the eradication of the poison-plants. This would literally strike at the root of the evil, and when accomplished would save all further trouble. Those who have given their opinions regarding their extermination do not express any doubt as to its feasibility, and it seems to be only a question ot labor, which has its money equivalent in so much per acre. The plants grow in the form of shrubs, mostly of small size, or herbs, and pulling them up by the root, chopping them down, or grubbing, is simple enough and effectual. These operations should, of course, be carried out at such time and season as will most effectually kill the plants with the least expenditure of labor. Chopping down soon after the growth of the young shoots or seedlings, and before the formation of the seed, may be very effectual ; if not, grubbing may be carried out. Exposure of the uprooted plants to the sun in dry or hot weather would help in their destruction, but, to make sure, all should be removed and burned, especially if any seed is likely to have formed. The constant turning over of the soil in cultivation will secure their extermination, but the land so treated would only be a fractional part of the infested area. The soil in which the poison-plants naturally grow is mostly of a poor character and unlikely to give a proportionate return for labor expended on it, so that their eradication is likely to be slow and imperfect, unless special efforts are made with that end in view.

Tolerance of Poisons.

It is a well-known fact that certain substances, poisonous under ordinary circumstances, become less so when partaken of frequently in moderate and gradually increasing doses, so that the longer the habit is kept up, larger and larger quantities may be taken without the ordinary poisonous effects appearing. A tolerance of the poison is thus established, as in the case of opium-eaters, who by taking this drug habitually for special purposes become so used to it that they find it necessary to continually increase the dose in order to attain the same result. At length a dose that would have been fatal at the commencement may be taken without any immediately serious consequences. There is no lack of evidence tending to show that such a tolerance of the bush poisons may be acquired by animals feeding on them. By nibbling at these bushes while grazing on their ordinary food, they may advance from a small quantity to a larger, especially if their proper food becomes less plentiful ; and their systems may be gradually inured to the poison, and a tolerance of it at length reached. Whether, like the opium-eater, the domestic or wild animals derive special enjoyment from their consumption of the poison-plants, or acquire such an inordinate craving for them as to tempt them to take more and more till their health is ruined, is not so evident. The following facts support the view that animals may acquire an immunity from the effects of the bush poisons :—(1). Travelling or imported stock, new to the district, are more frequently poisoned than those stationed near the poison plants ; (2). Wild horses and some cattle may graze amongst poison without any ill effects ; (3). The flesh of wild animals when killed and eaten by dogs and cats sometimes poisons them, though not when cooked. Before accepting these statements as conclusive, however, the sagacity of animals in avoiding the poison, and the possibility of some portion of the plants themselves, contained in the stomachs of those eaten, being consumed along with the flesh, have to be taken into consideration. Differences in the degree of virulence of poisonous plants are also known to exist in other countries according to locality and season. A striking illustration of tolerance, as narrated by the Hon. A. R. Richardson, if correctly observed, would appear to show that some forms of animal life may be indifferent to the poisonous principles. The carcase of a poisoned goat was buried, and as it decomposed the maggots creeping from it were devoured by fowls, that sickened and died in consequence. In this case the maggots, being born and bred among the poison, seemed to have acquired a tolerance of it, and at the same time to have been so saturated with it as to convey a fatal dose into the system of the fowls. Mr. E. R. Parker, in referring to the eradication of the box poison, says : " If fed off by sheep when first it springs up it will never shoot again." The suggestion that sheep should be turned in to feed on the young shoots of this virulent poison bush indicates at the least a firm belief in the presumably acquired immunity or freedom of those sheep from the effects ordinarily produced by it on animals. That the immunity of the maggots must have been acquired seems to be supported by the interesting fact that some of the poisons are effective against such lowly animal organisms as that of scab. Mr. C. S. Brockman says: "The rock poison has been used as a dip for scab, and proved very effective."

Palm Poison.

The *Macrozamia Fraseri*, sometimes also called *Encephalartos Fraseri*, and incorrectly spoken of as zamia—is a native plant having much of the aspect of a palm or of a tree fern. It belongs, however, to the natural order *Cycadacae*, which has relationship with the *Coniferae* or pine tree family, both having their flowers arranged in cones, and their seeds naked instead of being enclosed in a seed vessel. Other members of the same family, belonging to the genera *Macrozamia* or *Encephalartos*, *Cycas* and *Bowenia*, are natives of Queensland and New South Wales, but the species found there are different from the West Australian plant, though possessing similar noxious properties.

The macrozamia is a palm-like plant having a thick stem globose underground, and growing in time to a considerable height, erect and cylindrical, bearing at its summit a crown of thick and leathery pinnate leaves, which, as they become old, bend downwards and drop off, leaving scars on the surface of the stem. The seeds are in the form of hard nuts, produced in cones that spring up at the base of the leaves, and, like the stem of the plant itself, are very tenacious of life. The plant has long been known to possess deleterious properties, due partly to indigestibility, but more from the poisonous constituents that bring on in the animals feeding on them a series of symptoms ending in partial paralysis of their hind quarters. The disease is known by the names "rickets" and "wobbles," from the "wobbling" character of the gait of the animal affected by it. In New South Wales and Queensland the same complaint affects stock, and has been found to be due to their feeding on the cycadaceous plants native to those parts.

Mr. H. H. Edwards, Government Veterinary Surgeon, has made experiments with this plant proving conclusively that it is poisonous to animals fed on it. As described by him in his paper on the subject,* a yearling calf was fed with 6 lbs. of chaffed macrozamia leaves each day, and symptoms of poisoning made their appearance on the seventh day. On the eighth, or second day of poisoning, blood appeared in the urine, but this symptom usually passes off again, seldom lasting longer than twenty-four hours. Between the third and ninth day walking becomes more difficult, the beast wobbles

* Report of the Government Veterinary Surgeon, Mr. H. H. Edwards, on the disease known as "Rickets" or "Wobbles" (*Journal of the Bureau of Agriculture of Western Australia*, 1894, I., 225-234).

and may fall to the ground ; there is constipation, but the appetite continues good, and there is no thirst ; incontinence of urine comes on, and the animal is short of breath on making any exertion. "On the tenth day, what might be called the minor symptoms pass off, leaving the animal partially paralysed, generally for life." Macrozamia poisoning, though serious, is " not a direct cause of death ; animals dying, as a rule, simply from starvation, through inability to move about and procure food." Poisoned animals fatten readily when well fed, and their flesh, as well as the milk of cows, retain their wholesome qualities.

Post mortem examinations showed that the poison had taken effect on the smaller arteries of the body, causing thrombosis or blocking of the tubes, thus interfering with the blood supply of different organs, and leading to incurable disease. The effects are similar to those produced by ergot of rye, one of the most valuable and important drugs in the Pharmacopœia. No abnormal appearances were found in the digestive canal, but the liver was studded with patches of congestion and the kidneys were congested. Thrombosis of the smallest arteries, and of those passing through the bones of the spine to the spinal marrow, was found, with paleness of the muscles, exudation between them and blood-stained patches in the neighbourhood of the small arteries ; occlusion of the capillary vessels at the tips of the ears, at the coronets and at the tip of the tail, associated with loss of hair at those parts, leaving the skin bare and shiny. In cases of old standing the horns soften, bend downwards and even drop off. The brain was found to be normal, but reddish watery fluid was found in the spinal column, the spinal membranes were injected, and in old-standing cases the arachnoid was thickened with a fatty albuminous substance under it, while the spinal cord had undergone white softening from the middle of the loins backwards.

According to Mr. Edwards, no form of treatment is of any use after the second week. A laxative—not a powerful purgative—should be given first of all to clear away the poisonous material from the digestive canal, relaxation of the constricted arteries throughout the system is to be sought, and absorption of the exudation to be promoted. He recommends the following hypodermic injection to be made :—Eserine, 1½ gr., dissolved in 2 dr. rect. spirit of wine, mixed with pilocarpine, 1½ gr., in 2 dr. water. These form a strong dose, taking effect in a few minutes, producing salivation and purging, with some constitutional disturbance. According to Mr. Edwards, it acts as a certain antidote when administered within two weeks of the attack.

Blind Poison.

Stypandra glauca.—A leafy perennial, with stems on a creeping rootstock ; under one foot, and sometimes two or three feet high ; woody and branched at the bases ; leaves in two opposite rows, usually concealing the stem, somewhat flattened or almost round, the blade erect and spreading, linear or lancet-shaped, usually three to four inches long, but sometimes twice that length, and varying from two to four lines in breadth ; flowers, in a loose terminal forked cluster, usually leafy at the base, the branches very spreading, the thin stalklets recurved, varying from a half to one inch long ; flowers blue, often turning red in drying ; the segments very acute, five-nerved, about a half inch long ; stamens very much shorter ; filaments threadlike and twisted in the lower half, with a dense oblong tow-like tuft of hairs under the anther ; anther shorter than the filament, almost spiral after shedding the pollen ; capsule oblong, 3 to 4 lines long, seeds several in each cell, smooth, but not shining.

The Candyup poison, or blind grass, has been identified with *Stypandra glauca*, a liliaceous plant met with from King George's Sound to the Swan and Murchison. It is herbaceous, and grows to the height of one foot or more, on rocky and sandy lands, and flowers between September and January. Though a native of the eastern colonies, from Queensland to Victoria, the plant has not been suspected there of possessing poisonous properties. Mr. Maiden says of it—"This plant is common in the neighborhood of Sydney, the Blue Mountains, and many other parts of this colony, but I have never heard of it having been reported as a poison plant here."—(*Agricultural Gazette*, N.S.W., 1894., v., 142). In Western Australia, however, its evil reputation in that respect appears to have been long established. The name of blind poison has been given on account of the characteristic effect it produces on the eyesight, causing the animal, according to Mr. Ash, as quoted by Maiden, to go "apparently blind and run into any sort of object." Mr. Ash adds that it seems to be the least fatal of all the poison plants, and slower in taking effect. What its precise action is on the eyes, or on the nervous system or other organs, appears to be as yet unknown. Mr. A. R. Richardson says—"It is very injurious to horses and other stock, causing extreme paralysis, sometimes blindness, and sometimes death."

The absence of any reports from the other colonies of symptoms of poisoning attributable to *Stypandra glauca*, coupled with the fact that it is often found growing side by side with *Agrostocrinum stypandroides*, a purely West Australian plant, suggests a doubt as to which of these two is really possessed of the pernicious qualities that occasion so marked an effect on the stock devouring it. Failing systematic experiments on animals fed with the plant, or subjected to the poisonous principle extracted from it by chemical means, the aid of settlers would be of great service in clearing up the matter, both as regards the identity of the plant causing the symptoms, and the symptoms themselves, particularly the effect on the pupil of the eye. A description is given below of *Agrostocrinum stypandroides*, which is easily distinguished from the other on close inspection.

Agrostocrinum stypandroides.—Stems erect, simple, often 2 to 3 feet high ; leaves narrow linear, with rather long sheaths quite closed round the stem and flattened ; flowers blue and showy, the raceme simple or once branched, stalklets thread-like, often above 1 inch long, usually rough as well as the flower stem ; staens six, shorter than the petals, filaments short and hairless, anthers linear longer than the filaments ; petals 6 to 8 lines long, all five-nerved and equal in length, spirally twisted after flowering, then dropping off, but leaving a bell-shaped base attached below the seed vessel, which is nearly globular and about two lines diameter ; seeds 1 or 2 in each cell, black, smooth and shining.

To this description Bentham appends the following note :—“ Sent by F. Barlee, with a long leafy form of *Stypandra glauca*, as the plant called *blind grass*, because it is supposed to cause blindness in cattle and sheep that eat of it.” It is easily distinguished on close examination from *Stypandra glauca* by the petals becoming twisted after flowering and afterwards falling off, leaving the lower part still attached below the swelling seed vessel.

This species may be the *blue* poison, classed by some in addition to the Candyup, which also is blue, and reported by Mr. J. F. T. Hassell as growing on granite hills between Cape Leeuwin and Mount Manypeaks, reaching two feet in height, and flowering from August to November.

Additional List of West Australian Plants said to be Poisonous.

Anthocercis sp. All the species of this genus are poisonous to stock, according to the late Baron von Mueller.

Beyeria viscosa, Miq. Reported poisonous in New South Wales.

Bulbine semibarbata, Haw. A “native onion” or “native leek.” A strong poison.

Cassia Sturtii, R.Br. Suspected in Queensland.

Centipeda orbicularis, Lour. (= *Myriogyne minuta*, Less.) Suspected in New South Wales.

Datura Leichardtii, F.v.M. Reported poisonous in Queensland.

Didiscus pilosus, Benth. “ Wild, or poison parsnip.”

Duboisia Hopwoodii, F.v.M. Used in medicine.

Dysphania littoralis, R.Br. Suspected in Queensland.

Eremophila maculata, F.v.M. Often suspected in New South Wales, and believed to be poisonous in Queensland.

Euphorbia Drummondii, Boiss. Has an old and apparently well-established reputation as a poisonous plant, but lately shown by Mr. E. Stanley and others to be sometimes harmless and good feed for stock.

E—— eremophila, A. Cunn. Suspected in New South Wales.

Exocarpus cupressiformis, B.Br. “ Native cherry.” According to Woolls, as quoted by Maiden, suspected of causing cerebral symptoms similar to those brought on by certain leguminous plants.

Gompholobium sp. Species of this genus have been suspected.

Goodia medicaginea, F.v.M. Blamed for the death of twenty-five cattle in West Australia, and believed by Baron Mueller to be poisonous.

Gratiola Peruviana, Rupp. Considered poisonous by F. von Mueller.

Indigofera australis, Willd. Poisonous according to F. von Mueller.

Isotoma Brownii, G. Don. Suspected by Drummond, of having poisoned sheep.

Isotropis juncea, Turcz. "Lamb poison." Suspected.

Lotus australis, Andr. Deadly, according to Baron von Mueller, but doubted by others.

Myoporum deserti, A. Cunn. "Ellangowan" poison bush of Queensland; "Dogwood" of New South Wales. Considered most dangerous when in fruit.

Nicotiana suaveolens, Lehm. Native tobacco. Poisonous, containing nicotin.

Sarcostemma australe, R.Br. "Caustic bush" or "vine." "Gaoloowurrah" of natives at Port Darwin. Reported poisonous in Queensland, but sometimes found harmless.

Solanum nigrum, Linné. Has an old reputation for being poisonous, but fruit sometimes eaten by children, and made into jam.

Strychnos lucida, R.Br. Reported by Mr. R. S. Ranford from Wyndham, and believed by Baron von Mueller to be poisonous.

Swainsonia sp. Some species have been found in other colonies to be virulent poisons, affecting the brains of sheep, turning them mad, and making them slaves to the poison.

Templetonia egena, Benth. Very poisonous according to Baron von Mueller.

T—— retusa, R.Br. Both this and the foregoing species, according to Maiden, produce spasm and paralysis in stock.

Tephrosia purpurea, Pers. This and other species of Tephrosia reputed poisonous.

Xanthorrhœa sp. Young shoots of a species growing at Jervis Bay, N.S.W., reported poisonous.

Since the foregoing was written, Mr. H. H. Edwards has published an account of experiments made by him with the Box poison on various animals, in the *Fourth Annual Report of the Bureau of Agriculture*, October, 1897. In this paper he states that the wild pigeon, being immune, lives entirely on the seeds of the box, and that a dog after eating its flesh will very speedily die in convulsions. At the same time the seeds will poison domestic pigeons, and their flesh is found to be poisonous. An aged bay mare was fed with ¼ pound of box leaves, and the following day symptoms of poisoning appeared—profuse sweating, head hung low, forehead against manger, hind legs wide apart, body unsteady, pupils dilated, pulse soft and slow, temp. 101° Far., mucous lining of mouth, &c., bloodshot and spotted. On the second day the breathing was tremorous, the muscles relaxed, excepting those of the jaw, which were spasmodically contracted. The nervous functions became more and more disturbed, till on the third day of poisoning the mare became unconscious and died. Four hours pass after eating the box plant before the horse shows symptoms of poisoning, and he is doubled up with severe pain in the abdomen before the brain becomes affected.

Mr. Edwards finds that dogs and carnivorous animals generally are more sensitive than herbivora to the action of the box, as of other vegetable poisons, and that they suffer more severely and disproportionately in their nervous system. The horse is more susceptible than the sheep, sheep more than goats, and these more than cattle.

Post mortem examination shows engorgement of the blood-vessels with dark blood, which coagulates only feebly, lungs engorged, and cavities of heart full of blood. Besides a distended condition of the blood-vessels of the abdominal organs generally, with small petechial spots, the mucous lining of the stomach and small intestines of the horse shows patches of inflammation.

The results of treatment have been found satisfactory by Mr. Edwards, who also recommends, as a preventive of poisoning, that stock should be travelled slowly through poison-infested country, so that the animals will have time to discriminate in the selection of their food as they go along.

PART IV.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

SHEEP HUSBANDRY.

BY "BRUNI" (GEO. A. BROWN) OF THE "AUSTRALASIAN."

WRITTEN SPECIALLY FOR THE SETTLER'S GUIDE.

AUSTRALIA has been happily named "The Land of the Golden Fleece," for since the first British pioneers landed on these shores, the wealth of the colonists has mainly consisted in their flocks of sheep. The future shows the promise of a still further development of this great industry, and we may confidently look forward to a not far distant time, when every portion of our island-continent will be beneficially occupied by the bearers of the golden fleece. With a land covering such a large extent of the world's surface, there is a great diversity of climate, aspect and pasture, and it naturally follows that each division of the country will require a different type of sheep to thoroughly develop its resources. The art of the husbandman will be employed in developing these varying types of sheep, and the more successfully this is done, the more profitable will the industry prove. It is the business of the husbandman to closely watch the tendency of the flock towards any new development of type, and, where such divergence from the general are beneficial, to make use of them.

The occupation of a husbandman has been an attractive one from time immemorial, and in all countries where the inhabitants have attained a high degree of civilisation, the breeding and treatment of the domestic animals have always occupied a high position in the estimation of the leading citizens. Those who wish to achieve success in the art of live stock husbandry, must put their whole heart into the business. An indifferent or careless sheep-farmer very rarely succeeds. In the remarks I am about to make on the subject of sheep breeding, I act on the supposition that my readers have little or no knowledge of the subject, consequently much of what I have to say will not be new to the practical sheep-farmer.

CHAPTER I.

THE FLOCK.

Type of Sheep.

Australia is such a new land that the husbandman has to make his own experience. He has not the records, written and unwritten, of many previous centuries of practical work to assist him, as is the case with the European husbandman. It is, therefore, all the more necessary that he should exercise great care and judgment in selecting the breed of sheep he intends to cultivate, for upon this selection much of the success of the business will depend. Over the greater portion of our island continent the climate, soil and pasture are better adapted to the breeding of merinos than any other variety of our domestic sheep. Some of the coastal districts, particularly those of the south and east, are too humid, and the rich soil carries too heavy a pasture for the golden-footed merino to retain his health, and in these localities the heavier-bodied British breeds of sheep will be found the more profitable sheep to raise. In the intermediate districts, between the coast country and the hot plains of central Australia, and throughout the highlands that occupy such a large area along the eastern part of the continent, the various crossbreds and downs may be raised with advantage. But throughout the whole of central Australia the merino will always be king. True, the Lincolns have invaded this home of the merino, their use being to raise freezers for exportation, but the main body of the breeding sheep are, and I believe always will be, merinos. As far as my experience goes in sheep-breeding in Australia the only sheep that have been bred with success (except merinos) in the hot dry plains of the interior, are the Shropshires. Hampshire downs have succeeded well for crossbreeding in Riverina, but how the pure breed will stand the climate has yet to be learned. An experiment is now being made with Dorset horns, which promise to become admirable farmers' sheep, particularly where lambs are raised for market. Before commencing to establish a flock, the farmer should have a clear idea of what description of sheep he wishes to breed, and he should be satisfied, before embarking in the business, that his country is well adapted for raising such sheep. If he undertakes to breed a variety of sheep that his country is not able to develop thoroughly the undertaking will not likely be successful.

Types of the Breeds.

Merinos.

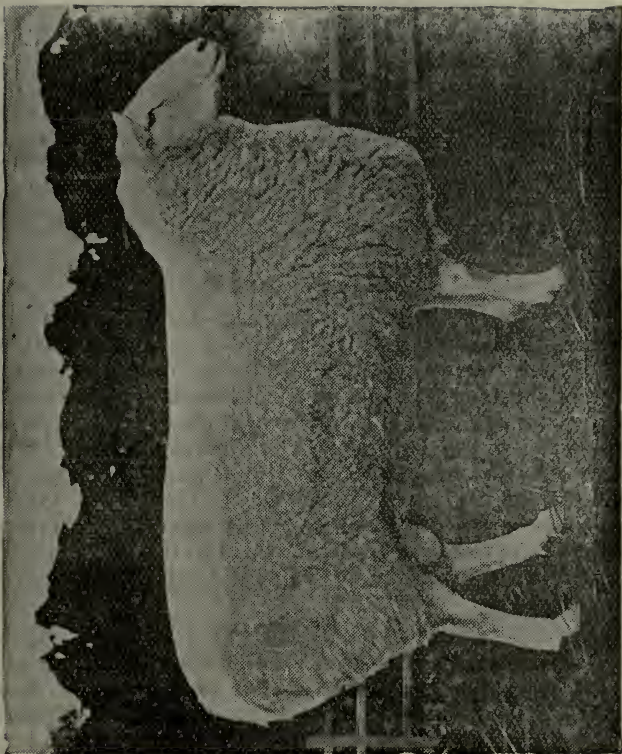
For size of carcase the sheep owner must study his locality, for though by giving a deal of room to each individual, large framed sheep may be raised, it is often done at a disadvantage. It must be borne in mind that it is not the return per individual that leaves the profit, but the return per acre. It may occur that a medium sized, or a sheep on the small side, will show a better profit on the area occupied than where large and more attractive sheep are raised. Much depends on the shape of the sheep. Hitherto it has been the general opinion that the merino is an unshapely animal, as compared with what are known as the mutton breeds, but this is not necessarily so. Though the merino will in all probability never get the shape of the South-down or Shropshire, they can be raised showing excellent points for mutton. Chief among these is a good back and shoulder ; a narrow shoulder and ridge back should be as much avoided in a merino as in any other sheep. These points are often accompanied with good wool growing qualities, and a good backed merino with a well sprung rib is less likely to become open-woolled under a hot sun than a sheep that has a narrow ridge along the back. The points of a merino sheep are usually drawn up relating almost purely to the fleece, but now-a-days the carcase is of no small importance. A good backed and chested sheep is more likely to have a good strong constitution and to be a better doer than a narrow-chested, ridge backed one. The merino, particularly the ram, should have large pronounced folds of skin on his neck, with good wool on them and between them. The wool on the back should be close, not falling open. A broad thigh down to the hock, and the arm well woolled ; the merino should be woolled to the fetlocks, not for the value of the wool grown thereon, but as a sign of breeding. A long staple should be avoided in a hot climate, Length of staple gives wool no extra value, and it has a strong tendency to become open and let in dirt. A medium staple if bred for density will give a heavier weight of fleece and as good a price per pound. The first thing is to get merinos with good backs, both in form and fleece, and work up the other good points after by careful breeding. It is well to have the under parts of the sheep well woolled, but the shape of the body and the other parts of the fleece should be attended to first. Very fine wool, once so much admired by the owners of merino sheep, is now seldom seen, even in Tasmania, formerly the home of fine woolled sheep. A robust description of wool has been found more profitable than very fine wool, but the robust wool should have character, *i.e.*, the crimps or waves in the fibre should be well marked, even, and extend from the skin to the tip. Straight, wiry wool is an abomination in a merino. The fleece throughout should be free from kemps, that

MERINO RAM.

The accompanying illustration is from a portrait of the famous merino ram, President, a champion himself, and the sire of champions. He was sold at Sydney, July 7th, 1896, for 1,600 guineas, the purchasers being Messrs. C. B. Grubb and Lawrence of Tasmania.

A LINCOLM RAM.

The Lincoln ram, of which the above sketch is a portrait was a good prize taker in Victoria in 1896.



BORDER LEICESTER RAM.

The above is a portrait of a Border Leicester ram champion at the Border Union Show at Kelso, 1895.

is, white hairs among the wool. The bone should be fairly strong; very fine bone is very frequently associated with a tendency to degeneracy. It is the fashion to decry the merinos as a mutton sheep, but this is a great error. It is superior to the longwool, and second to the southdown and the Shropshire. The prejudice against it has been caused by its dark color, and not to any lack of quality in the mutton.

The Longwools.

The Lincoln is conspicuous for the beautiful lustre of its wool. The staple is long, extending in many instances to 10 inches. The old Lincoln was a very ill-shaped sheep, with a large plain head, and very slow in maturing. All that has been altered, and the shape has been improved by a judicious cross with the English Leicester, and the large head has been greatly reduced in size by selection in breeding. Though not as large in frame as of old, the modern Lincoln is yet considerably larger than the Leicester, and he is now marked by almost as early maturity.

English Leicesters.

These are very handsome sheep, and they fatten readily; indeed their tendency to take on fat, and their well-shaped bodies, have led to their being employed in the amelioration of most of the British breeds of longwool sheep. In Australia the Leicester takes on too much fat to the proportion of lean meat. Leicester wool is now almost as lustrous as Lincoln wool, but the fleeces are lighter.

The border Leicester is a more robust animal than the English representative of the breed; its fleece is heavier; it gives more lean meat in proportion to the fat, and is consequently preferred by sheep breeders in most parts of the world to the old English type; but neither breed is as much fancied by flock masters as the Lincoln.

The Cotswold

is a very shapely sheep, a good doer, yields a fine carcase of meat, and its fleece is about as valuable as that of the border Leicester. It is used for raising crossbreds in a few districts of Victoria, but has never been much fancied by the general run of sheep-breeders.

The Romney Marsh

is a most useful sheep. It is not as attractive in appearance as any of the longwools previously mentioned, and its wool lacks lustre and is of a much coarser type than any other. But in a severe climate, where other sheep are apt to suffer from foot rot and die from fluke, it can hold its own.

This has been proved in a wet piece of coast country in Victoria. Romneys have been bred on this land for the last thirty years, and no other breed of sheep will last over two generations, and the merinos not as long.

The Romney gives a large carcase of excellent mutton, and the breed is largely employed in New Zealand in raising freezers for export. The Romney is not the sheep for a hot, dry country in which the pasture is very scanty, consequently they have made very little way in Victoria and New South Wales.

The Downs.

Of the Down breeds of sheep I place the handsome and useful Shropshires at the head of the list. It is essentially a farmer's sheep, and is very frequently the sheep of the small flock. It is of quiet disposition, yields a good fleece that realises a fair price per pound ; it develops early, and reaches a good weight, and its mutton is excelled only by the South-down. It has spread over a large area of England ; it is a favorite with the thrifty farmers of the United States, and is largely used in Argentina for raising freezers. It is only within the last few years that this sheep has attracted the notice of Australian farmers. In South Australia there are several studs of the breed, the originals of which were selected regardless of price from among the finest flocks in the old country. In Tasmania they are spreading, and there is every appearance that they will become the farmer's sheep of Victoria and New South Wales.

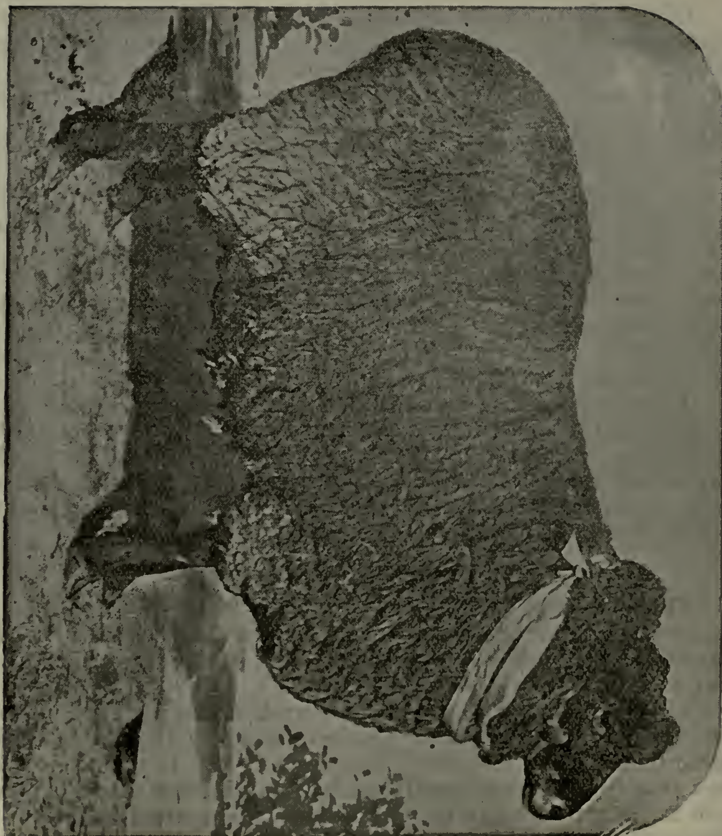
A sheep that has attracted the favorable notice of farmers over so wide and varied an area of the world's surface must have exceptionally good qualities. That this is so is acknowledged by all who have raised them. In addition to their good frame, handsome shape, heavy fleece, and excellency of mutton, they are remarkably healthy sheep and can scarcely be excelled as foragers.

The South-down.

This is the original of all the breeds of British down sheep. It is a very handsome sheep possessing all the good qualities of the Shropshire, but with a smaller frame and a lighter fleece that is not quite as valuable per pound.

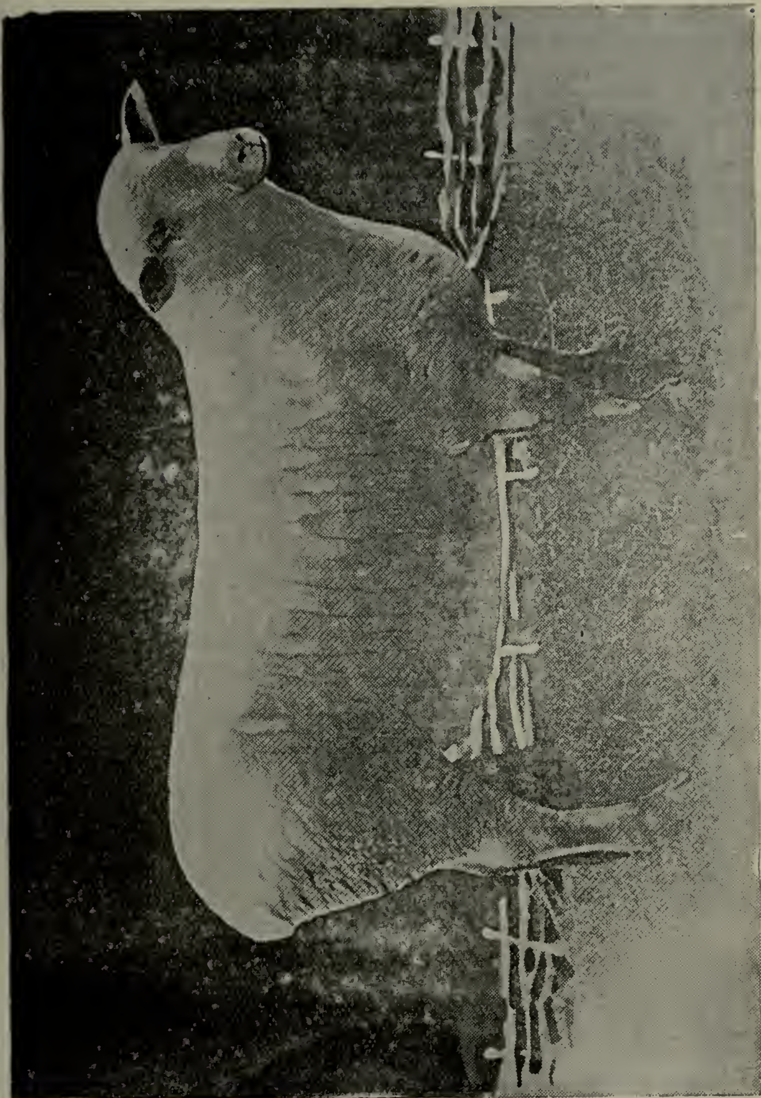
The admirers of this breed contend, and with good reason, that South-down mutton is of higher quality and realises more per pound than the mutton of any other down breed. It is much in their favor that all who have raised them become extremely fond of them. Both the Shropshire and the South-down are perfect specimens of mutton sheep, their legs and backs are equalled by no other breed.

The Hampshire down is larger than the Shropshire and not quite as well shaped. Its fleece shows the influence of the long-wool blood and its pedigree. It has been used in Victoria and Riverina for raising lambs for market, and for this purpose it has no superior. The head of the Hampshire is larger than that of the Shropshire, but it is not thick, and in cross-breeding with merinos fewer ewes are lost than when longwool rams are used. Still, it is deemed advisable to put the Hampshire ram to comeback ewes.



A SHROPSHIRE EWE.

This ewe took the champion prize at the New South Wales Sheep Breeders' Show, Sydney, 1896.



HAMPSHIRE DOWN RAM.

Our sketch is that of a young Hampshire down ram, winner of first prizes at the Bath and West of England, Royal Counties, Wiltshire, and Royal Agricultural Society, England, shows, 1895.

The Hampshire is a good mutton sheep, but his greatest recommendation is his early maturity. Up to twelve months old the Hampshire is said to make more rapid progress than any other breed of sheep. It is this quality that renders them so valuable for raising lambs for market.

The wool of the down sheep having less yolk than either that of the merino or the longwool is said to suffer when the stock are raised in a very hot and dry climate. Against this the example is quoted where Shropshires are raised in hot dry localities, that are as well covered as a merino and yield a heavier fleece of almost as valuable wool.

E. W. Hilgard

CHAPTER II.

THE FOUNDATION OF THE FLOCK.

Having decided on the variety of sheep he thinks is most likely to thrive in his country, the farmer must be careful to secure for his breeding flock animals of sound, robust constitution. This is far more important than a reputation for heavy fleeces, a high value of wool per pound, or a large carcase. A robust constitution is the foundation on which all future excellence may be most surely raised, and it is the only safe and sure foundation. Sheep that are raised in similar country should be preferred, and if possible the originals should be selected from a flock the history of which the farmer may learn somewhat.

In a new country it is often difficult to obtain the description of sheep that is desired, and in that case one must be satisfied with the best ewes that are within reach, and make future advances by means of the rams.

It is better to commence with young sheep, as nearly as possible of the one type, and drawn from the one flock. I am, of course, supposing that it is the intention of the farmer to found a permanent flock. Many flock masters purchase ewes cast for age from a first-class flock, and often pay a good price for them. Such a plan has much to recommend it, for the old ewes are kept in the breeder's flock because they are of great excellence, and often the young sheep are sold because they are not up to the standard. But the old ewes can scarcely be relied on to yield more than one or two lambs, and after that they are useless for any purpose but boiling down. At times one can obtain from good flocks a small draught of young sheep that are not culls. I know of a stud flock of the highest standing, the originals of which were very old ewes, but the flock they came from was one of the best, and the man who bought them was a thorough expert.

Uniformity.

The ewes should not only be all of the one age, but they should be of the one type of form and fleece. Uniformity is one of the greatest recommendations a permanent flock can possess. The butcher values it highly, and the wool buyers soon find it out, and will give a higher price for such a clip than for one that promises more but is irregular in the character of wool.

The character of uniformity is much more easily given to the small flock of the farmer than to the larger one of the squatter, and yet the large flocks are more noted for this quality than the small ones. This defect may be started with the foundation of the flock, and kept up by careless breeding and neglect in the culling of the ewes. With a flock ranging from a few hundreds to a few thousands the breeding should be as carefully managed as in a stud flock.

I have found that where the farmer can raise the breed of sheep he most fancies, the flock is always better managed and more profitable, than where, from the nature of the soil and climate, he is obliged to raise a variety for which he has no liking.

The most hopeless of all flocks is that of the man who bought a lot of cheap culls to commence with and breeds regularly from rams for which he pays a few shillings per head. Such a flock in a few years has no type, but possesses in a high degree every bad quality that a flock should not have.

Difficulties to Contend With.

There is practically no limit to the enterprise of the Australian sheep farmer, but this business, like every other, is not without its trials and difficulties. In taking up new country, and in entering into the business of a sheep farmer for the first time, many difficulties will be encountered ; but, as in the past we have seen these difficulties overcome, so it will in the future, particularly when resolute men put their hearts into the business. Will is power. I have seen a man go straight from the shop to the sheep walk, without the slightest knowledge of the business of sheep farming, and without any apprenticeship in the new walk of life, and yet make a success, simply because he put his whole heart and intelligence into the work, and was determined to carry it out to the best of his ability. The difficulties the sheep farmer has to contend with are always more formidable when the climate is hot and dry and the soil poor, though an excess of moisture, on the other hand, is often very unfavorable to the business.

I can remember when sheep farming was first undertaken in Riverina. The merino grew to a much larger size than in Victoria, but the fleece was of the very worst description. The staple was short and coarse, of very little strength, and full of kemps. The sheep farmers of the western district of Victoria (the Australia Felix of the early settlers) used to predict most sagely that it was an impossibility to grow wool on the northern side of the Murray river. At the present day the province of Riverina produces wool of the highest class, longer in staple than that of Victoria, stronger in fibre, and of equal lustre, and the fleeces weigh heavier. This is the experience that has been gone through with nearly every advance the sheep farmers have made into the great thirst land of central Australia. Districts that twenty-five years ago were regarded as almost desert, are now stocked with sheep that yield fleeces of an excellent and profitable description of wool.

The Conditions of Life.

The conditions of life, or, as some writers call it, the environment, require to be carefully studied before selecting the breed of sheep with which to form the flock. The influence the natural surroundings exert upon the domestic animals has been known to husbandmen from the dawn of civilisation. In his writings, Columella shows that he fully understood the matter, and the subject is referred to by many old English writers.

The experience of an old Lammermuir shepherd, as quoted by Youatt, furnishes a good illustration of the loss that may possibly follow by neglecting this important matter. He says, "I occupied a farm that had been rented by our family for nearly half a century. On entering it the Cheviot stock was the object of our choice, and so long as we continued in possession of this breed everything proceeded with considerable success; but the Dishley sheep came into fashion, and we, influenced by the general mania, cleared our farm of the Cheviots and procured the favorite stock Our coarse, lean pastures, however, were unequal to the task of supporting such heavy-bodied sheep, and they gradually dwindled away into less and less bulk; each generation was inferior to the preceding one, and when the spring was severe seldom more than two-thirds of the lambs could survive the ravages of the storm."

Another still more striking illustration of the effects of the conditions of life upon sheep is given in the *Journal of the Royal Agricultural Society of England* (1865). Mr. T. Ellman sent sixty ewes and three rams of the English Leicester breed to a French farmer. These sheep were hea ily woolled, the ewes cutting ten pounds each. On the French farm the sheep were treated in the same manner as the native race (the Norman), and each year the wool on the original sheep and their progeny became lighter and lighter, till in six years time they clipped only three pounds each of very indifferent wool. In the fourth generation they became very long legged, and in their bodies bore a considerable resemblance to the ordinary Norman sheep, with which they had not the least relationship.

An instance of the folly of attempting to work against nature was shown when several years ago the Romney Marsh sheep were "improved" by ntroducing the Leicester blood. The result was an improvement in the shape of the young stock, but they had lost the extraordinary hardiness of the Marsh race, and were unable to live in the bleak, exposed country inhabited for centur es by the Romneys.

In Victoria attempts have been made to breed high-class merinos in wet, cold lowlands, but in every instance the attempt has met with pronounced failure. In one instance it was attempted to form a stud in such a locality, and the original sheep were of the highest merit. Though the greatest care was exhibited in the breeding and management of the flock, they dwindled rapidly, and in a few generations became worthless, of small size, poorly clad, and weak of constitution.

Already the conditions of life are producing quite different types of sheep of the same breed. The most marked instances of this occur with our merinos. So pronounced is the difference between the merinos from different colonies that the veriest tyro in sheep husbandry can distinguish at a glance between those bred in Tasmania and those raised in Victoria. Riverina has another type, and Mudgee another. Experts can readily distinguish between the sheep raised in many of the districts in each colony.

The farmer who deals in sheep must have a keen eye as to the adaptation of the sheep he purchases to the natural surroundings on his farm. Master Fitzherbert, in his "Boke of Husbandry" (1532), clearly recognised this, for he gives the following shrewd advice :—"And take hede where thou byest any lean cattle or fat, and of whom and where it was bred. For if thou bye out of a better grounde than thou haste thyselfe, that cattel wyll not lyke with the." To the man who regularly deals in sheep I have nothing to say. If he does not know more about the business than can be learned from any treatise he has been premature in going into the business. To the farmer who purchases a lot of sheep to fatten off when he happens to have a self-sown crop to utilise, I would say, "Go where you will get sound, healthy stock, and pay a fair market price for them." The sheep that are put on to a farmer's hands as a great bargain at a low price are generally the last sheep he should have on his place.

CHAPTER III.

BREEDING.

The Ram.

In the selecting and mating of the breeders, the flock-master must bear in mind that the ram is half the flock. Therefore, if the farmer is not able to secure ewes of the very highest type of the breed of sheep he desires to raise, all advance toward that standard must be made by means of the rams used in the flock. To use scrub rams means to go backward, and to save money by purchasing moderate animals is false economy. It is money lost and not money saved to adopt such a practice, and he who follows that course will never make a good sheep farmer or raise a profitable flock.

The ram should be of robust constitution, this is the main point, and come of sound stock. He should be well shaped, showing a good back ; well sprung ribs ; stand squarely on his legs ; have a strong neck, and a good masculine head showing character and breeding. In all breeds there should be no weakness in the fleece on the top of the shoulder and along the back. In merinos the wool should be well supplied with yolk and there should be a pronounced black tip to the wool. This tip is not valuable in itself, save that it helps to preserve the wool from the withering effects of the hot sun. A small lock of wool is not a recommendation to a merino ram, and the Lincoln should have a heavy lock with a blunt tip, not a pointed one. The merinos and Lincolns should have wool on the head ; a bald-faced merino ram has some bad blood in his pedigree. The hair on the face of a merino should be soft, not hard and coarse. The ears should be thick and have a soft feel. A thin eared merino ram has bad blood in his pedigree. The eye should be soft, not prominent and fiery. The horn should be of fair size, with a double and spiral curve, not close to the head, or standing wide out. A polled ram is not objectionable on that account. The celebrated flocks bred by Messrs. T. and G. Passmore, Tasmania, were greatly in-bred to a polled ram used in the flock over half a century ago. The merino ram is a horned animal certainly, but I can see no more use for horns on our sheep than for horns on our cattle. It would be the saving of many a good ram's life if all the horns were off our merino sheep.

The ram's fleece should be slightly stronger than that of the ewe, and I do not dislike a little strength of wool on the thigh, particularly if such strength is free from kemps. In referring to the loose rolls of skin on the neck of a merino ram the question as to the value of the Vermont naturally crops up. The excessive folds of the skin seen on some Vermont sheep are to my mind objectionable in the farmer's flock. Indeed, until lately I disliked the Vermont cross altogether, but the facts are so much in their favor that I cannot shut my eyes to them. The Vermont cross has done so much good by adding to the weight of fleece of some very large flocks raised in Central Australia that it is rapidly coming into favor with sheep breeders in all the colonies, except Tasmania. In a dry, hot climate a dash of Vermont blood in the sire will do good by thickening the wool, and by giving it more yolk will preserve it from being withered by the sun.

Show Rams.

The sheep farmer should never purchase a ram that has been "got up" for show. In newly settled districts there is seldom much danger to be apprehended from show sheep being pampered and coddled, but in older settled districts much harm is done in this way. The training the show sheep undergoes to fit him for taking a prize unfits him for "rustling" on the pastures. When a housed and clothed ram is turned out among the ewes and left on the grass for several months, he looks a pitiable object. The beautifully fine wool that won such praises in the show-yard changes to a poorly grown fleece of withered staple. The owner finds fault with the ram, whereas it is he who is to blame. It is better to select the rams from a well-known flock that possesses the qualities it is desired to impress on the produce. They should be taken off the grass, though they may not be as attractive as show prize-takers.

Many sheep-breeders, and among them men of large experience, habitually use two-tooth rams, and though they point to large droppings of lambs and a high class of sheep, I do not like the practice. Using such an immature animal as a two-tooth ram must, in the end, have a deleterious effect on the stock. Where the climate is a hard one, it is much better to wait till the rams are four-tooth before using them as sires. With longwools there is not so much objection to the practice, as they are earlier maturing animals than merinos, and they are raised on more abundant pasture than is usually seen on country suitable only for the merinos.

The small flock-owner cannot breed his own rams—that may be taken for granted. How, then, is he to obtain them, and whence? He may swap with a neighbour, provided his neighbour's stock are suitable for his purpose. This is a thing that does not often happen, and when it does the rams are getting on in years before his neighbour wants to part with them.

When rams from a stud flock prove good sires it is an excellent plan to keep to that line of blood. This style of breeding gives great uniformity to the stock. Changing from one stud to another and getting a different type of ram every year invariably leads to disappointment.

For many years I used rams drawn from the one stock, and by careful culling I got the sheep at last to be as uniform as if they had been cast in the same mould. Of course, if the breeding in the stud falls off a change should be made, and even if there is no falling off a change is sometimes advisable if rams better calculated to improve the sheep can be obtained. The sheep-breeder should have a standard of excellence in his mind, and all his efforts should be directed to breeding up towards that standard.

Fighting Rams.

As the season for coupling approaches merino rams are much given to fighting, and the contests are so severe that a ram is occasionally killed. The Americans have adopted an excellent plan for preventing fighting among rams. This consists in fixing a broad piece of stout leather to the animal's horns in front of his face in the following manner :—A visor of stiff leather (or if that is not handy, bullock's hide will do) is shaped to extend from the horns to a little below the eyes, and broad enough to cover the face. In one top corner a hole is made sufficiently large to slip over one horn, while at the other top corner a piece is cut out to fit the horn ; ties of leather or string hold this firmly to the horn and the visor is fixed. The ram can see to graze and walk about, he can see the other sheep by slightly raising his head, but directly he lowers his head to fight the view of his opponent is lost to him, and the fight does not take place. This plan is now generally adopted by the owners of stud sheep in Tasmania. A very ancient means of preventing a ram from fighting was to bore a hole through the horn near the head with a gimlet. I have never known this plan tried, but it must be a painful operation for the ram.

Pedigree.

No matter what breed of sheep is raised, the ram should always be pure bred. I am no worshipper of pedigree merely because it is pedigree, but experience has shown me, in every variety of stock, that breeding from a pure sire is always advantageous. The pure bred sire is more prepotent than the mongrel, consequently the sheep-breeder who uses pure bred stock can make a pretty fair estimate of what the produce will be like. It is not so with the mongrel, who has no type to confer on his offspring. But while I recommend the use of pure bred sires in all cases, that purity of breeding must be accompanied by the high qualities of form and fleece which it is intended to impress on the flock.

There is considerable diversity of opinion among flock breeders as to what is the best size of sire to employ. Some are all for size of frame, while as many pin their faith to quality. Some of the most successful stock breeders in England have obtained their best results by means of moderately-sized sires. For myself, I do not object to a ram if he is a trifle on the small side, and for this reason: It is much more easy to obtain a ram on the small side, of excellent proportions, than it is to get a perfectly shaped large ram. With roomy ewes, the medium-sized well-shaped ram will throw better stock than will a large-framed ram not so well shaped.

The height a ram stands is not a proof of size, indeed, a tall animal is often lighter than one that is short on the leg, but of better proportions. All leggy stock should be avoided, no matter what breed of our domestic animals are raised.

There is a great variety of opinion as to the number of ewes a ram should serve, and some of the greatest mistakes are made by experienced sheep farmers on this point. When a very large sum is paid for a stud ram the new owner (with the view of recouping himself for his expenditure) often puts the ram to far too large a number of ewes. I have known such a ram serve several hundreds of ewes in a year, and to keep up his strength he was fed on the most stimulating food. That he did not do himself justice as a sire is not surprising. When cock fighting was practised it was found that where a game cock was allowed a dozen or fourteen hens, he got fewer really good birds than when he was given four or five hens. The late Mr. James White was the most successful breeder of racehorses in Australia, and he seldom gave a stallion more than half a dozen mares. Panic (a great sire) was given as many mares as were sent to him, and the result was that many of his stock showed temper, though he himself had a fine disposition. If the sheep farmer can afford to limit his rams to fifty ewes he will find it pay him well in the end.

Though I have recommended the use of pure rams it is not necessary that the sheep farmer should pay a fancy price for his sires. Utility, and not fancy points, are to be studied when the farmer goes to market to purchase rams.

The Ewes.

Culling.—In a new country there is generally a strong inclination manifested to breed from every ewe in the flock, so as to stock up as as quickly as possible ; but in this case it is better to make haste slowly. The ewes should be carefully gone through before shearing, and all inferior sheep rejected from the breeding flock. That man who goes through his ewes after shearing also, makes assurance doubly sure. The flock will not grow as rapidly as that of the man who breeds from "all and sundry," but the smaller flock will often yield a higher profit than the large one, while individually the returns are generally in favor of the smaller flock.

The well culled flock is steadily and surely advancing to a higher standard of excellence, while the flock where culling is neglected is almost invariably deteriorating. It is when the stock from these flocks are for sale that the advantage of strict culling is seen. There are ready purchasers for the well bred sheep at the highest market value, while purchasers for the badly bred flock are few, and prices always rule very low.

When the sheep farmer has attained sufficient knowledge of his business, it is always better for him to do the culling himself. Having the sheep always under his eye, he has the advantage of a thorough knowledge of the flock, and if he takes a keen interest in his business he will soon gain sufficient knowledge to do the work of selecting his breeding flock. Perhaps, for a year or two, if the flock owner has had no previous experience of sheep husbandry, it might be advisable to secure the services of a thoroughly skilful sheep-classer. This will be a sufficient lesson to any intelligent man who has gone into sheep farming in earnest. When little more than a lad I came into possession of a flock of sheep in which there were some really good ewes and a considerable number of inferior ones. I culled out the very best for breeding, and though it took me four years to work up the breeding flock to its full size, I was a great gainer in the end by the superiority of the sheep. For years I topped the market in Victoria in the price of wool, and I always got a high price for my fat sheep.

Directions for classing the wool at shearing time are often given. In my opinion the wool classing should be done when the sheep are bred. The farmer's flock should be of one type, and when I hear of many classes of wool from one small flock I am dubious of the system of breeding. In selecting merino rams and ewes for breeding purposes there is one defect that must be closely watched for, and that is a peculiar growth of the wool known to flock masters as "devil's grip." It consists of a patch of badly grown wool, usually situated on each side of the body just behind the shoulder blade and well up towards the back. Sometimes it runs right across the back. On these spots the wool grows in an unwholesome condition. It is divided into small twisted locks, and the yolk has a different appearance and feel to that on the rest of the body. It gives one the impression that glue has been mixed with the yolk. The cause of this defect I do not know, but sheep showing any indication towards it are avoided by all experienced husbandmen. The general impression among sheep breeders is that "devil's grip" is an indication of weakness of constitution. No matter how good such sheep may be otherwise, they should be promptly cast out of the breeding flock. A ram with "devil's grip" is worse than useless, he is harmful.

The sheep breeder in culling his ewes should always have in his mind a certain standard of excellence which in time he hopes to arrive at. The late Mr. John Murray, of Mount Crawford, South Australia, who from not very promising originals raised one of the finest flocks of merinos in Australia, said before he died that he had never attained his standard of excellence in a merino sheep. For half a century he had patiently and skilfully raised the character of his flock, and had he lived another year I fancy he would have seen his ideal fully realised. This is the way great flocks are formed, not by running after each change of fashion, but by selecting a high standard, and following the course marked out, never for a moment losing sight of the end, no matter how far away it may seem to be. He who tries to achieve this end will make a good sheep farmer ; he who succeeds will be a master in the art of sheep husbandry.

In breeding sheep, as in breeding all other pasture animals, too much stress must not be laid on individual records, either for weight of fleece or weight of carcase. A heavy fleece and heavy carcase do not always represent the most profitable animal to raise. The conditions of life in the district must be carefully studied, and an estimate made as to what combination of frame and fleece the country will best produce. This matter seldom receives that attention at the hands of Australian sheep farmers which its importance deserves. Because one district, which possesses many natural advantages, will produce highly profitable sheep of a certain type, it by no means follows that a neighboring district, similar in many respects, but not possessing so many natural advantages, will do the same. In this respect we must go with nature, for we cannot contend against her. Herein lies the benefit of an intelligent and close observation of the flock, and this is why the sheep farmer who sees his sheep every day is better fitted to cull the breeding ewes than a man who sees them but once a year.

There is a great attraction in sheep breeding, but it is a business like any other, and is followed for gain and not for sentiment ; therefore, the object of the farmer should be to raise the description of sheep which his country is best adapted to produce, and that sheep is the one that will give the greatest amount of profit per acre. As a modern writer puts it—"The art of breeding may be epitomised in the one word, 'selection,' which involves the application of every established principle of practice and a consideration of the influence of every peculiarity of form." Selection of the breeders has ever been the guiding principle of the leading stock-breeders of England, the most skilful husbandmen in the world.

In culling the ewes it is advisable to take out of the flock all small-framed weedy animals ; a ewe should be roomy to carry a lamb. In some stud flocks in which close attention is paid to the individual members of the flock, small ewes are sometimes retained among the breeders because the owner knows that they produce good sized, well-shaped stock ; but such ewes are exceptional, and one cannot have any knowledge of them in a general flock. Therefore it is safer to reject all puny ewes. Culling is nearly always performed while the sheep are in full fleece ; but the wool is not everything, and to ensure a really good flock the sheep-farmer would do well to go through his flock after shearing, when any defects of form can be seen at a glance. In all breeds of sheep it is well to breed for rounded ribs, good shoulders and quarters, and a moderate length of leg. These points are of almost equal importance with weight of fleece.

Cross Breeding.

In what has gone before, my remarks have been directed towards the establishment and maintenance of a permanent flock, and to do this it is necessary to keep only sheep of one breed. Where cross breeding is kept up, the closest attention must be paid to the breeding, as with a crossbred flock there is no such thing as stability or uniformity. The type of the flock is always oscillating towards the one breed or the other that are employed in the cross. The skill of the breeder is shown in preventing either type from becoming too pronounced, indeed he must labour to keep the sheep about midway between the breeds employed.

The crossbred sheep generally raised in Victoria are between the Lincoln and the merino, and with such widely differing types it may be readily imagined that such a thing as an intermediate breed is extremely difficult, if not impossible, to establish.

Crossbreds raised from these varieties, though they have no type, are extremely profitable both for carcase and fleece. They mature earlier than the merino, they give a much heavier carcase, and their fleece is considerably heavier than that of the merino. The wool is of a character that finds ready purchasers at prices little, if anything, below those paid for merino wool. In choosing Lincoln rams the great point is to get them well shaped, with good brisket, and well sprung ribs. The fleece must be of long staple, and with a heavy lock, not a thin pointed one. The wool should be lustrous so that the crossbred may have bright attractive wool. All Lincoln sheep should have the characteristic forelock of the breed.

In raising sheep of the Lincoln-merino cross, rams of the former breed are put to ewes of the latter breed. This is done because merinoes are so much more numerous than Lincolns. When the Lincoln rams are large headed a good many ewes are lost at lambing time. To avoid these losses many sheepbreeders use ewes for crossing that have bred several times, but experience shows that there are fewer losses in the cross with young ewes than with old ones. For a good many years the attention of the breeders of Lincoln studs has been directed to reducing the size of the head, and careful selection has effected a marked change in this respect. The general run of the heads of Lincoln sheep is much smaller than they were a score of years ago.

Cross breeding is also practised with border and English Leicesters and with Cotswolds, and each cross has its admirers. One of the best and oldest flocks of crossbreds in Victoria is that raised at Bolinda Vale under the management of Mr. Robt. Clarke, and owned for many years by the late Sir W. J. Clarke. The flock has been in existence for nearly 40 years, and has no superior in Australia. Pure sires of both breeds are used, and to secure rams of sufficiently high class two studs are maintained on the estate.

Another cross much liked by those who raise lambs for market is between the merino ewe and the down ram. The Southdown has been used for this purpose for years, and has given very satisfactory results. The lambs are of the very best quality, and though smaller than those of other cross are in great favor with many owners of small flocks. Hampshire downs make a fine cross with the merino or the comeback ewe. They give a heavy weight of carcase, a good fleece, and they mature rapidly. The Shopshire is said to be extremely valuable for lamb raising. They have been in use for this purpose for some time past in South Australia, and the results have been all that could be desired.

Many sheep farmers are of opinion that a crossbred flock cannot be maintained, for the reason that after the first cross there is too great deterioration in the stock raised. But this we have seen in the Bolinda Vale flock and others is not the case. A crossbred flock can be kept up, and very valuable animals raised, both for carcase and fleece, but it can be done only by using good rams of pure breed on each side.

Many attempts have been made to establish a variety midway between the longwool and the merino, but all the sheep so raised have, to my mind, been inferior to the crossbred raised from pure sires of the two breeds.

He who would raise good crossbreds must use good rams on a well-selected lot of breeding ewes. It seems to be a fixed idea with many owners of small flocks that a crossbred is necessarily a mongrel, in the worst sense of the term. So they are on many an Australian farm, but there is no necessity for it. Often when a farmer starts sheep breeding he buys far too many sheep, and he buys cheap, I should say, low-priced sheep. With these sheep he uses rams of whose breeding not even the most experienced sheep breeder would hazard a guess. They would have made bad wethers, and should never have been kept as rams. Such a flock, with the rams among the ewes all the year, half-starved and neglected, wandering about the roads to pick up a precarious living, is the most hopeless spectacle one could look at.

If sheep breeding is worth going into at all it is worth doing well. Good sheep are pleasant to look upon ; they cost no more to feed than bad ones, and they give a much higher profit. It is bad husbandry to keep good sheep badly, and it is still worse husbandry to keep bad sheep at all. On the large farm sheep are necessary to its full development ; on the small one they are always useful. In raising sheep of the Lincoln-merino cross the pasture should be ample to fully develop the good points of the animal. A lighter grassed country will suit the cross between the Shropshire and Hampshire downs and merino, and a still lighter country can be utilised for the Southdown-merino cross.

An old objection to the down herds is that they do not yield a good fleece of wool, but that objection does not hold good with the Shropshire, which is as well covered as a merino ; the Hampshire down has a larger staple of wool than the merino, while the fleece of the Southdown has been greatly improved during the last decade.

In-Breeding.

The practice of in-breeding, or breeding from closely related animals, is one that the tyro in sheep husbandry should never attempt. It is invaluable in the hands of a master of the art of sheep husbandry, to fix a type and give prepotency to a stud, but it must be remembered that it confers equal prepotency to fix bad qualities in a race. Where closely related animals have any weakness of constitution, breeding from them renders the produce extremely liable to contract the defects of the parents in an exaggerated degree.

It is not wise to draw rams from an unbred flock, unless the sheep composing it are noted for strength of constitution. The Murray merinos in South Australia have been in-bred for over half a century, not a single infusion of outside blood having been introduced in that time, and yet the sheep in that flock are of the most robust constitution of any sheep in Australia. In that case, however, the founder of the flock, and his sons, who now own it, are among the most skilful sheep breeders in Australia.

Lambing.

The Time for Lambing.—With merinos it is the general custom to lamb the ewes in autumn, when the rains have started the young grass. The advantage of bringing into the shed at shearing time fine grown five-months-old lambs has induced the majority of Australian sheep farmers to advance the lambing time to the earliest possible limit, and as the autumnal rains in these colonies are extremely uncertain, it has often happened that the lambing has commenced before there is a blade of green grass for the ewes, and the result has often been disastrous. Over a very large area of Australia the lambing for the last two years has been a failure, mainly owing to this cause. If one could be sure of a good rainfall towards the end of March, about the middle of May would be a good time to lamb ; but our autumn rains are so often late that it is by no means a safe plan to arrange for the ewes to lamb in the warmer districts of Australia till June. In Queensland spring lambing is a common practice, but in that colony most of the grasses are summer plants, which is in favor of the practice. A late lambing has this disadvantage, that the young lambs are exposed to the cold blasts of winter directly they are born ; but it is better to risk this than to lose the bulk of the lambs, because owing to want of pasture the ewes have no milk.

When early lambing can be practised it is not advisable to put the rams and ewes together immediately after shearing, as by doing so there will be a large number of misses. This peculiarity in sheep breeding has been observed in many parts of Australia. The explanation is generally believed to be that when the fleece is taken off a sheep the rapid growth of wool that follows for a few weeks is a strong drain on the constitution of the animal, and this weakens the generative organs.

Ewes may be bred from until they are nine years old, but this must be left to the judgment of the flockmaster. In some districts the ewes last much better than in others, and one ewe at eight years old may be in excellent form, while on another pasture a ewe of the same age may be broken down. The flock should be so managed that the ewes are cast for breeding after rearing their third or fourth lamb. Sheep have been known to breed up to twenty years of age, but these are very exceptional cases.

Weaning the lambs will depend much on the season, but the lambs should not be left too long on the ewes, as the latter will have too short an interval to recuperate before being put to the ram. Cross weaning, that is, putting the lambs of one half the flock with the ewes of the other, and *vice versa*, is a good plan to adopt, as it makes the lambs more contented. Where the weaned lambs are put by themselves they often run off all their condition and do not begin to mend for a month at least. Lambs may be weaned after four months old.

It may happen that the sheep farmer wishes to know for future guidance what ram is the sire of each lamb, and an excellent plan for accomplishing this was given in the *Field* some years ago. Before putting each ram to the ewes selected for him, his breast was marked with red, blue, or green, which was daily renewed as it was rubbed off. At the end of a week the ewes served were drawn off and put in another enclosure with a ram marked with a different colour, so that if any of the ewes returned they would show it. The ewes were marked with a dot of paint of the same colour as the ram. At lambing time each lamb was marked with the colour of his sire, so that at weaning time the flock master could form a very good idea of the value of his different sires.

In cold, wet, or exposed situations, where the country is open, there should be some shelter provided for the lambing ewes. Breakwinds are easily and rapidly constructed, and in a severe season would save the lives of many lambs. There is no better return obtained from the money spent on the sheep walk than that employed in the formation of hedges or plantations. Wherever these have been grown in the older settled districts of Australia, they have proved of very great value. I know of one property that was naturally a bare plain, and on which, so keen was the force of the winter gale, it was impossible to lamb ewes. Since then extensive plantations have been grown on this country, and ewes lamb comfortably under the shelter of thick belts of timber.

In a newly taken up country the farmer may not care to go to the trouble of forming plantations, but he can run up a breakwind with brush wood or branches of trees that will be of great benefit to his ewes at lambing time.

To find the percentage of lambs in a flock multiply the number of lambs by 100, and divide by the number of ewes.

Period of Gestation.

The period of gestation appears to bear some relation to the size of the animal. It is approximately as follows :—Elephants, twenty to twenty-three months ; giraffe, fourteen months ; dromedary, twelve months ; buffalo, from ten to twelve months ; mare, eleven months ; cow, 285 days ; bear, six months ; reindeer, eight months ; sheep and goat, five months ; sow, four months ; dog, fox and wolf, sixty-two days ; rabbit and hare, thirty days ; squirrel, twenty-eight days ; guinea-pig, twenty-one days.

Mr. Darwin states (*Animals and Plants under Domestication*) that it has been observed in Germany that the period of gestation is longer in large sized than in small sized breeds of cattle. In sheep the period varies from 143 to 156 days, but in the reports that have been made on the subject the bulk of the ewes lambed in 149 to 153 days. The period of the Southdown is shorter than that of the merino by nearly six days. It is believed by some practical sheep breeders that the period of gestation is shorter in the breeds that mature early, which may explain the difference between the Southdown and the merino. It is also the general opinion that the ewe goes longer with a ram lamb than with a ewe lamb. It is a safe thing for the sheep farmer to reckon the period of gestation in the sheep at 150 days.

Influencing the Sex.

It is a fad with many sheep farmers that they can influence the number of ram or ewe lambs at will. This has been a hobby with some sheep farmers for many centuries, and numberless experiments have been made with the view of proving the theories held. As a rule these experiments have been made on such a small scale and extending over such a brief period of time, that they are practically worthless. From what is known on this subject, it seems highly probable that there is generally a small percentage of males in excess of females. Some writers assert that the changes in the relative numbers of the sexes run in cycles, but as to what influences the sex of the offspring of sheep, or, indeed, of any other animal, man included, we are quite in the dark. Scientists know nothing definite about the matter, and the sheep farmer had better devote his time and attention to improving the general standard of his sheep than waste his efforts in futile attempts to attain results when he is ignorant of the causes that influence them. When country is sparsely stocked, it is a flattering thing for the sheep farmer to think that he can so breed his sheep as to produce a very large percentage of ewes, but I have never heard of any one doing it yet. We often see some stud ewes breed a long succession of ram lambs when put to a different sire each year, while others treated similarly will give birth to a long succession of ewe lambs.

CHAPTER IV.

MANAGEMENT OF THE FLOCK.

Over-stocking.

This is worse than a blunder, it is almost a crime There is no sadder spectacle for the pastoralist than for his sheep to be slowly but surely dying of starvation, and to have the knowledge that his own act in keeping too many sheep on his land is the main cause of the trouble. The loss is not confined to the reduction of the flock by deaths. The survivors have their constitutions enfeebled by the severe trial to which they have been subjected, and the effect is seen in the produce for several generations. The pastures are seriously injured by overstocking, as all the wholesome and nutritious plants are eaten out, and in many cases completely destroyed. This is the opportunity for the unwholesome and innutritious plants, which are enabled to take complete possession of the soil.

Though the evils resulting from over-stocking have been demonstrated time after time in Australia, it is nevertheless the most common fault committed by our flockmasters. When seasons are fairly good the temptation to "stock up"—which means to put on as many sheep as the land will carry under the most favorable circumstances—seems to be irresistible. All former experiences are neglected and the flock is increased, till a drought (for which no preparation has been made) occurs, and the injury done to the flock is far greater than any profit that accrued during the good time.

Conservation of Fodder.

There are few districts in Australia in which there cannot be some preparation made in good seasons to conserve fodder to help the stock over a bad time. This fodder in the back country, where cultivation is seldom or never practised, may take the form of bush hay or silage. It does not matter much what plants are used so long as a sufficient quantity of rough food be saved to prevent the sheep from dying of starvation. In the hottest and driest localities of our island-continent there occur seasons when there is an abundant vegetation. The wise sheep-breeder will be ready to take advantage of such opportunities, and put into hay and silage stacks as much fodder as his means will permit.

Where the natural grasses are scanty much may be done by fencing in a block of land and either sowing the seeds of the best grasses, or, if they already exist on the land, permitting them to seed and reproduce themselves. Such a block of land, if kept always understocked, will serve the same purpose as the cultivated paddocks of the localities in which the climate and soil are of a more genial nature. The full use of the land thus reserved will not be obtained for grazing, but that is a small insurance to pay for meeting a time of scarcity.

Bush Hay.

The native grasses of Australia are easily made into hay, little labor being required to perform the work beyond cutting and stacking. On a small property on the Liverpool Plains, New South Wales, I saw, some years ago, the plain dotted over with stacks of hay and silage. A good season gave a very heavy crop of grass, and the proprietor decided to make an experiment in conserving fodder. The grass was cut with mowing machines and run into central points (where stacks were erected), with hay sweeps. The stacks were of moderate size, and I was informed that the total cost of putting the hay and silage into stack was scarcely 2s. 6d. per ton. When I saw these stacks they had been up a little over a year and both kinds of fodder were excellent, indeed, the manager had to put fences around the silage stacks to preserve them from cattle and horses.

From the nature of our Australian grasses they require very little manipulation in being made into hay, indeed the trouble is to get the fodder into stack before it becomes too dry. I have seen bush hay made in Queensland, New South Wales and Victoria, and it has always turned out a most useful fodder for stock. The sheep may not care for it while they can get the growing pasture, but when a drought occurs and the pastures are bare, they are not particular, and will eat bush hay and hold their condition well on it.

Silage.

This, I believe, is the coming fodder of Australia. It is a most useful stand-by for the dairyman in the coastal districts, where the soil is rich and the rainfall generally ample, but in the interior it is invaluable for all kinds of stock. With a moderate supply of silage the sheep are safe from that accompaniment of a time of drought—impaction of the stomach—which kills almost as many in such a time as starvation. From what I have learned of experiments made in Australia there seems to be scarcely a limit to the time this fodder will retain its value.

Many years ago, during a season of luxuriant growth, a stack of silage was made on the Mt. Abundance estate, Queensland. The stack was left for over seven years, and much of the sides fell away, almost in dust. It was so dried up that the men who went occasionally to that part of the run used to camp on it. Then came a very bad year, when feed was very scanty. The stock gained access to the stack, and every particle of the silage was eaten, even the dry dust the men used to camp in.

The idea that silage to be kept for any length of time must be conserved in pits, is now completely exploded. In Australia very few silage pits are now made, and it has been found that the stack silage is much better for pasture animals than that made in pits. Silage that has undergone a thorough fermentation in stack turns out of a dark colour with a sweet aromatic flavor, while pit silage in which the fermentation is checked by heavy pressure is usually of a green color, and quite sour. Sheep do not take kindly to this sour fodder. In the experiment in stack ensilage made on the Liverpool Plains the stacks were weighted with about a foot of earth placed on the top, but on several Victorian farms weighting stack silage is entirely done away with, and the stock eat every bit of the fodder.

One of the largest makers of silage in Australia is Mr. C. H. Lyon, of Ballanee, Victoria. He uses neither silage pit nor pressure. As a result of his experience no pressure is necessary, and the silage to be good should be subjected to a thorough fermentation. If a large stack of silage is built up rapidly, the great pressure on the lower portion of the fodder prevents this fermentation, and the result is sour silage that cattle will eat if pressed for food, but that sheep will not touch. In a pamphlet which Mr. Lyon published some time back, he gives the following results of his experiment in feeding sheep on silage :—" Within the last year and a half I have fed 14,000 sheep on silage, and all these, with the exception of 1300, were Riverina wethers. In two stacks of silage I had about 1700 tons. It cost me 1s. 6d. a ton, and saved a loss of £2000. In one instance I was enabled to hold on 8000 sheep until rain came. I then sold them well. This last winter I kept nearly 4000 sheep, fed principally on silage. I will get more for the wool of these sheep than I could have got for the sheep themselves four months ago."

Mr. Lyon's stacks were made 40 feet square, and carried to a good height, but there is no occasion to make stacks of such large size ; indeed for the purposes of the pastoralist, smaller stacks scattered over the run would be more beneficial. They are safe against bush-fires and with a slight covering of earth might be left for years until required. Silage may be made in any weather. Mr. Lyon states that during the making of a large stack, 274 tons of water fell on each acre of land on which he was working, and yet he made 1000 tons of excellent silage when it would have been impossible to make a ton of good hay. The stack was 44 x 38 feet and 22 feet to the eaves, and was left entirely without pressure. I do not think it is necessary to advocate the making of silage on the sheep-walk as a reserve of excellent food during a period of drought. The experiments already made in most of the Australian colonies have fully demonstrated the value of this description of fodder. It has proved as useful in the districts of ample rainfall as in the great thirst land of Central Australia.

Feeding Sheep on Straw.

About two years ago I described the means adopted by a Victorian sheep farmer to help his sheep over a bad time. The paddocks were as bare as a road, and he saw that he must provide some fodder for his sheep or lose them all. He had a number of old straw stacks on the place, and he set to work to cut this straw into chaff. To each bag of chaff he added about a pint of molasses mixed with water and sprinkled over the chaff by means of a watering can. The sheep took to this fodder at once and held their condition well on it. Bagging fastened to four strained wires formed the troughs at which the sheep fed. During the present season this plan of feeding sheep has been adopted on many Victorian farms, and many of the owners of large flocks in Riverina have also made use of it. With a large flock, cutting the straw into chaff is found expensive, and the plan has been adopted of sprinkling the straw in layers as it is placed in the wagon, and a more liberal allowance of molasses is generally given than that previously stated. The straw thus treated is carted into the paddocks and scattered in long lines, and every particle is picked up. It is no exaggeration to say that the lives of many thousands of sheep have been saved this year in Victoria and Riverina by straw and molasses.

Conservation of Water.

Second only in importance to the securing of an ample store of fodder is the conservation of a good water supply. The means of securing this end vary so greatly in different parts of Australia that it is impossible to give directions as to the mode of procedure that will cover every instance. The usual modes of watering stock in the warmer districts of Australia are by erecting dams on watercourses or by excavating tanks. Over a large area the latter practice has been generally followed.

The Dam.

A dam on a watercourse is a less expensive mode of conserving water than excavating a tank. The main thing is to put up the dam on a good site, and where the soil is holding. But Australian streams are liable to remain waterless during long periods and often suddenly become raging torrents. In making a dam both conditions must be studied. The site of the dam should be chosen below a good-sized water hole, if possible, or where a considerable extent of level country will give a good length of back water.

In Queensland, where the watercourses are frequently empty for considerable periods and heavy floods suddenly occur, it is the practice to construct the dam with a hollow curve in the centre. These dams are faced with large stones, where they can be obtained, and floods pass over them, often doing very little harm. I have seen dams made in this way that had stood several very heavy floods and still held good.

An Australian Saltbush *(Atriplex semibaccatum)*.

This saltbush was recommended by Baron von Mueller for cultivation in the dry alkali country in America. It is worthy a trial in dry country in Australia.

Sometimes the soil where a dam is made is not retentive, but the puddling it receives from the cattle and sheep coming to drink as the water recedes makes the dam perfectly watertight. If possible sites where the soil is not retentive should be avoided, and to make sure a trench should be cut into the subsoil along the course of the proposed dam. Puddling the centre of the dam should not be neglected, and for this purpose there is nothing better than a team of bullocks driven backwards and forwards. If water cannot be had to puddle the centre of the dam the clay may be dry puddled by breaking it up as fine as possible, and working it well with the bullocks.

The Tank.

The modern practice in Rivernia and central Australia is to make large tanks. The early settlers in those localities fell into the natural mistake that a tank which held an ample supply of water during fair seasons would hold out during a severe drought. Often instead of enlarging the tank to double or treble its original size, a second small tank was made in the hope that the extra supply would serve all requirements. Sheep farmers have found out by bitter experience that when a long, hot and dry summer follows a dry winter and spring, small tanks are not of the least use, that they are certain to fail long before the dry season is over.

If it is necessary to examine the sub-soil well in making a dam it is doubly so when a tank is to be excavated. Even when the greatest care is exercised the result is at times a disappointment. Many a sheep farmer in central Australia has found when excavating a large tank that he has gone through the clay and come upon a drift, through which the water will run almost as fast as it enters the tank in wet weather.

Though the tank is often the only way in which a store of water can be conserved, it is nevertheless a wasteful mode of watering stock. To my mind economising the water is of almost as great importance as conserving it in the first instance. The sheep going to a tank to drink naturally pollute the water, and as they often go right into the tank much water is carried away in the wool of the under part of the body. This water is lost, and it serves to rot the wool that is saturated by it.

Mr. Thos. F. Cumming told me that on a station he once held in central Australia he divided 16,000 sheep into two equal portions, which were placed in adjacent paddocks. In one paddock the sheep were watered from troughs pumped from tanks, and in the other they had access to the tanks. At shearing time there was a difference of 7 oz. of wool per head in favor of the sheep watered at the troughs, while the water lasted much longer, and was much cleaner than where the sheep drank at the tank.

To Calculate Contents of Tank.

An ordinary tank is a prismoid, its horizontal sections being rectangles. The volume of any prismoidal tank may be found by the following rule :—To the top area add the bottom area and four times the middle area. Multiply the sum by the height—one-sixth of the product is the volume.

N.B.—The easiest way to find four times the middle area is to multiply the sum of the top and bottom lengths by the sum of the top and bottom widths.

Example.—A prismoidal tank is eight feet deep. The top length is 120 feet, its bottom length 80 feet ; its top width is 100 feet, its bottom width, 60 feet. Find its volume ?

$$
\begin{array}{rr}
120 \times 100 = & 12,000 \\
80 \times 60 = & 4,800 \\
200 \times 160 = & 32,000 \\
\hline
& 48,800 \\
& 8 \\
\hline
6\,| & 390,400 \\
3\,| & 65,067 \text{ (nearly)} \\
9\,| & 21,689 \\
& 2,410 \text{ (nearly)}
\end{array}
$$

Answer.—2410 cubic yards (true to the nearest yard).

Wells.

It is always advisable to test the country for well water. Unfortunately much of the underground water in central Australia is often salter than the sea, but brackish water is often obtained, and on this sheep do extremely well. I have known sheep thrive on water so full of salt and other minerals that horses would not drink it though almost dying of thirst. Where a well of drinkable water for stock can be struck it is a great relief to the pastoralist. The tube wells us d in sinking for artesian water in Queensland should be used, as this mode of sinking for water is cheaper and more quickly performed than the ordinary mode of well sinking. In some waters that is quite healthy for sheep, there are chemicals that corrode iron pipes in a very short time. In that case some mode of coating the metal with a protective substance must be employed. I know a piece of country in which the soil in low situations is full of such chemicals, and the rabbit netting sunk in the ground rotted within twelve months. A coating of coal-tar and kerosene, melted together, proved an efficient protection both for wire netting and for the pipes that were used for carrying the water to drinking places. When the water in a tube well does not reach the surface a windmill pump with a couple or more of 400 gallon tanks will furnish a good supply of water for stock.

Improving the Pasture.

Australian sheep farmers seldom take much notice of the grasses beyond noting those of which the stock are most fond. Such a thing as endeavouring to cultivate the best of the native grasses was never heard of until within the last half dozen years. Curiously enough, the general opinion was that the native grasses could not be cultivated. This is a great error ; the greatest number of our best grasses lend themselves readily to cultivation. By watching the time the plants shed their seeds, and reserving the land sown with the seeds from stock, in order to let the young plants get established, the pasture in a paddock may be greatly improved.

The native grasses of Australia are not so well known that one can say which should be grown in each locality. The sheep farmer, if he is an observant man, should be the best authority as to the grasses to cultivate in his district. The evils of over-stocking are seen in the deterioration of large areas of Queensland. The best pasture plants are eaten out, and their places are taken by grasses that the sheep will eat readily only when they are young, and will not eat when dry until they are forced to it by starvation.

I have travelled over many hundreds of miles of fine country in Queensland, in which nearly all the wholesome and nutritious herbs and grasses have long since disappeared, owing to being eaten out by over-stocking. The country was covered with a coarse, poor grass that when dry was no more fit to keep stock alive than so much shavings. Lightly stocking and burning the country is being practised to improve such pasture.

There are a great many native bushes on which sheep will browse and thrive admirably. The best of these bushes are the various forms of salt-bush, of which the large, or "old man," salt-bush is the best known. Nearly all the forms of this plant are worthy of cultivation, and no plants can be found that will withstand heat and drought better. The salt-bushes can be readily cultivated from seed, and in a good season it is said they will grow freely from cuttings. Blue bush, cotton bush, grey bush, and many other bushes may be grown with advantage. The growing of these bushes is of the greatest importance in districts where the rainfall is scanty, and it takes a good many acres to support a sheep. Where these native bushes form the principal support of the sheep portions of the run must be given a periodical rest, or what has happened in Rivernia will be repeated—the bushes will be destroyed.

In Riverina the salt and other bushes have been followed by a good sward of grass, but in warmer and drier districts, where the soil is not of a fertile description, it has been found that when the bushes were destroyed there was scarcely anything left for the sheep to eat. In such country it is useless to attempt to introduce exotic grasses. Nothing will serve the purpose as well as the native plants, and once the latter are destroyed by close feeding, it will take a considerable amount of time and trouble to re-stock the land with them.

Of the introduced grasses the Johnson grass will stand heat best, but to give a good return it requires a free, deep soil. Lucerne will stand heat well, but to thrive, its roots must penetrate to moisture. A free deep soil in which lime is plentiful is suitable to this plant. In coastal country the buffalo grass and the various couch grasses may answer. Buffalo grass has been used in Victoria on sandy hills near the coast to prevent the strong prevailing winds blowing the soil away, and it has answered the purpose admirably. It is extremely doubtful if it would grow with anything like the same vigour in a hot district with inferior soil and scanty rainfall.

The prickly pear thrives in the poorest and driest country. Its leaves are succulent and provide both water and food for stock, but the spines with which they are covered render them worse than useless. Often in Queensland the stock are driven by hunger to eat the leaves of the prickly pear, but they generally die from their stomachs being lacerated by the spines they swallow. If a practical mode of ridding the leaves of the spines could be discovered, the prickly pear, instead of being a curse, would prove a blessing to the pastoralists in the hot dry regions of Australia. Many attempts have been made to accomplish this end, but as yet no plan has been hit upon to utilise this fodder.

Mr. F. Turner in his work, *Australian Grasses*, mentions the following as growing in the arid interior of the continent :—

Silkyheads *(Andropogon bombycinus)*.—Grows principally on the plains of the interior. Will withstand a phenomenal amount of dry weather. It produces a large quantity of seed and the herbage becomes harsh when old, but it may serve as a standby for a bad year. It may be recognised by the stem when crushed emitting an aromatic perfume. The white woolly spikelets give this plant a singular appearance.

Cottongrass *(Panicum leucophæum)*.— A good pasture grass noticed by the Elder exploring expedition in Western Australia. It is easily distinguished by the spikelets being covered with long silky purple hairs. A good pasture grass and easily cultivated.

Branched panic grass *(Panicum effusum)*.—Grows all over Australia. Makes considerable growth before developing flower panicles, which renders it a good grass to cultivate for hay.

Australian millet *(Panicum decompositum)*.—This grass was collected by the Elder expedition. The natives grind the seeds to make a sort of cake.

Umbrella or spider grass (*Chloris acicularis*).—Grows throughout the interior of the continent. A good pasture grass, growing on sandy or light loamy soils. It seeds freely, and stock like it. The famous Mitchell grasses of Queensland are regarded as the best pasture plants in northern Australia. Horses prefer hay made from these grasses to any other. They should be preserved wherever found growing, and increased as much as possible.

Fences.

Where it is possible the runs should be fenced in, if only with a ring fence The more the run is divided into paddocks the more advantageously it can be worked. By dividing into paddocks parts of the run may be given a spell, and this is a great help towards preserving the best pasture. Where rabbits are plentiful there is but one fence that is of any use, and that is rabbit-proof wire-netting 1¼-inch mesh, sunk 6 inches in the ground. It is usual to employ 1½-inch mesh, but if the netting is not very well made young rabbits that can do for themselves will get through. I have known this occur on many occasions. Longwools are notorious breakers of bounds, indeed it is doubtful if a wire fence can be constructed that will keep them in. The best of wire fences is one in which the posts are set wide apart and between which two or three laths or gauges, made of light battens or iron, are stapled to the wires. This keeps the wires in place, and the gauges, being free of the ground, permit the fence to give a little when a sheep comes against it. Where the guages are used, the posts may be set double the ordinary distance apart. Iron gauges are made for use in such a fence, which are much valued. They are light of carriage and hold the wires in position more securely than wooden laths.

One of the best fences for enclosing longwool sheep that I have seen was on the Yandilla estate, Queensland. It consisted of a 2 ft. broad wire netting, 16-gauge wire and 4-in. mesh. The posts were set 12 ft. apart and a wire was run along the top and another along the bottom of the netting, which was set at 5 in. from the ground on the lower edge. A plain wire above and a barbed wire over all made it a perfectly safe cattle fence. This netting costs about £7 per mile. Where top rails are preferred, and timber of a sufficient size is somewhat scarce, the plan patented by a Victorian resident is worthy of adoption. To save weakening a light post, the tops of the posts on each side are smoothed with an adze and the rails are fitted one on one side and one on the other. Holes are bored through all three and they are firmly bound together diagonally with a stout wire, which is tightened with a twitch. Light posts will answer for this purpose, and if the wire is well tightened it is stronger than a mortice, as the wire acts as a binder on the post and prevents it from splitting. In putting up the rails they are fastened to the outside of one post and the inside of the next.

Where it is deemed advisable to run a barbed wire along the top of a line of posts, it is a good plan to fasten it in the following manner. A small hole is bored with a brace and bit two or three inches below the top of the post in the centre. The barbed wire is placed in position and strained, then small wires are passed through the holes made in the posts and twisted round the barbed wire, thus retaining it firmly in position. This plan is much to be preferred to the old practice of stapling the wire to the top of the post.

All descriptions ot log, chock and log, and brush fences are merely makeshifts. They serve to keep merino sheep within bounds, but are next to useless to retain longwools, and they do not last long. Whatever fence be used the sheep should never be left without supervision. They should be accustomed to the sight of men on horseback and on foot. It is when going through a mob of sheep in a large paddock that a good dog is found useful. Sheep left too much to themselves are apt to become wild, and if disturbed by the sudden appearance of a horseman or footman will run for miles. With a dog they can be rounded up, gone among quietly, and left standing in a mob. Good fences, though costing more than bad or indifferent ones, are the cheapest in the end. The sheep do better in well fenced paddocks than in badly fenced ones, as there is less draughting to do.

Bush Fires.

When all vegetation is dried up to the condition of so much shavings, as is but too frequently the condition of the country towards the end of an Australian summer, bush fires often do an immense amount of harm. In thinly grassed country there is not only the loss of the fodder and the seed of the grasses, but the plants are greatly weakened, if not killed outright. In thickly grassed countries a fire often does a deal of good by destroying the germs of disease ; but where the grass is scanty a bush fire is the very worst thing that can happen. If it is deemed advisable to burn a paddock, the best plan is to do it after the first rains have fallen in autumn, as there is less danger then of the roots being killed than if the fire takes place in summer.

If the country will permit it, fire breaks should be made round the run, taking in all wire fences. These breaks should be made as soon as the grass will burn in summer. On the open country in Victoria I found the night the best time to burn, as the progress made, though slower than in the day time, was much more effectual. Whether or no the burning of firebreaks is possible, patches on dry banks should be burned early in the season. Should a great fire occur these patches can be utilised as safe harbors of refuge for the sheep. In settled country it is the custom to run ploughed furrows round the fences and burn between, but this plan is not practicable in back country. These furrows render the work of burning the firebreaks more easily accomplished, and with fewer men than where no furrows are used. A boundary firebreak should be at least 80 yards wide, and with a strong gale of wind even that is not a certain protection.

For beating out or controlling a bush fire the old practice was to use boughs of trees, but these had the inconvenient habit of giving out just when they were most needed. Old bags fastened to a stout 6 ft. sapling were then tried, but they soon took fire. The best implement, and the one now in general use on well managed pastoral properties, is a piece of stout leather or bullock hide about 2ft. broad and 3ft. long, securely fastened to a 6ft. pole. Sometimes the hide is strengthened by a piece of hoop iron running for half way up the centre from the end of the pole. The hide is fastened to the pole thus : A cut is made with a saw for a few inches down the pole, and the hide is inserted in this, the whole being securely fastened together by two or three rivets.

Sheep for Home use.

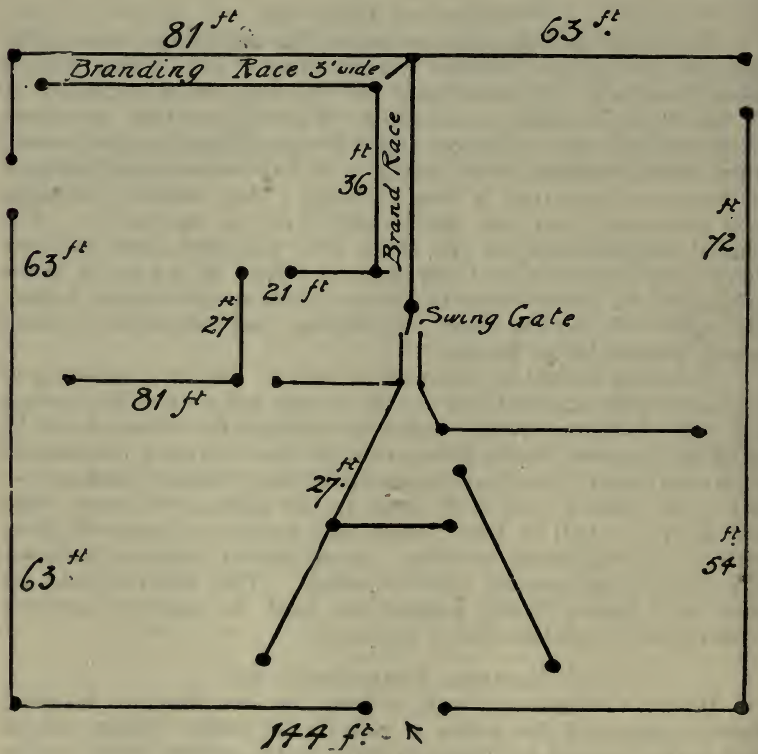
The sheep used for home consumption and rations are usually the culls for age and inferior young sheep. The killing flock is generally kept in a paddock near the steading, which on account of its handiness is usually overstocked. The result is that the sheep are generally in low condition, and it is often difficult to find among them animals that are fit for killing. To half starve sheep intended for home consumption is false economy ; they should, if possible, have a chance to get into good order, if not to become fat. The general practice is to run the sheep into the yard, catch as many sheep as are required, and kill them at once. It is a much better plan to let the sheep starve for twelve hours at least before killing, the meat will be the more wholesome and nutritious, besides having a much better flavour.

The skins should be taken off carefully. The bad skinning of Australian pelts causes them to be of less value than those from any other country. Where it can be managed the skins should be dried under cover, and to prevent the attacks of weevil, they should be dressed with a mixture prepared in the following manner :—Mix 5 lb. arsenic and 6 lb. soda in 10 gallons of water, and boil slowly for half an hour ; when th· arsenic is dissolv d dilute with twice the quantity of water. Apply with a brush to the fleshy side as soon as possible after skinning. The skins should be quite dry before being packed to send to market, and the trotters and all offal should be removed.

Yarding, Draughting, &c.

Where a permanent flock is bred the less they are knocked about in the yard the better it will be for them. Sheep can be kept perfectly quiet by those in charge going among them on the run without yarding. When it is necessary to yard the sheep, they should be brought in quietly. On such occasions some shepherds who own a dog are fond of showing off how well he can work. This exhibition, it must be remembered, is at the cost of the sheep, which are rushed along at a headlong pace, and crushed through the gateway into the yard, at a saving of perhaps five minutes' time.

I have owned a good sized flock, which was generally worked without a dog, and on the Havilah estate, near Mudgee, I saw sheep on mountain runs that never had a dog put on them. The manager had a dislike to dogs, and would not permit a shepherd to take one on the run. On this property I was much struck with the quietness of the sheep as we drove through the paddocks. The injudicious use of a fiery, active sheep dog has on many occasions caused the percentage of lambs to be a low one, by harrying the ewes and causing them to slip their lambs. When ewes and lambs are being put in the yard it is better to keep the dogs off and dodge the mob in quietly.



Sheep Draughting Yards.

Much has been said about easy working yards, but my experience is that good management will do better with very indifferent yards than negligent management with yards constructed on the most improved principle. A square receiving yard with a smaller one leading to the race is quite enough for the farmer's small flock. From the race a couple of yards will be sufficient for the farmer's purposes. An elaborate system of yards where the sheep may be draughted into five or more lots, may be required on large runs where much work is done among the sheep, but the small flock-owner has no occasion for such yards.

Ewes that are to lamb soon should not be run through the draughting yard if it can be avoided. A framework should be erected over the race and covered with sheets of bark, thatch, or corrugated iron, to give some protection to those working among the sheep.

The Draughting Yard.

When it is considered desirable to erect a draughting yard it is well to have them planned so as to work easily, and to cost as little as possible.

The draughting yards shown in the above sketch have been in use for several years by a Victorian sheep breeder, and he recommends them for owners of small flocks. The measurements are all given in the plan, but they may be modified to suit local circumstances. The erection of these yards will require the following material: 15 gates 6 ft. wide (except the draughting gate), 30 round posts for corners and gates, 420 split rails, and 150 split posts. The branding race may be shortened by omitting the one along the outside fence.

Sometimes the outside fences are made with wire instead of rails, and in that case the posts may be lighter, but must be put close together (say about 5ft. apart). Of course smooth wires must be used. The following gauge might suit :—The lower three wires 4 in. apart, and 4 in. from the ground, then two wires 5 in. apart, and above that two other wires 6 in. apart. It is a good plan to substitute boards instead of rails in the yard leading to the race, and in the race itself. They can be made of ordinary hardwood boards securely nailed on the inside of the posts.

CHAPTER V.

SHEARING.

On large pastoral properties there are always proper conveniences for the shearing of the sheep. The owner of a small flock is often placed at a disadvantage. He naturally thinks that it will not pay him to erect a special building for the purpose to be used for two or three weeks at the outside once a year and remain idle for the rest of the time and constantly in danger of fire. A building that will serve as a barn and shed for vehicles and machinery may be easily utilised as a shearing shed, all that is necessary being to clean it up thoroughly before commencing to shear. Such buildings are now coming into use on many Victorian farms.

I am a great believer in the shearing machine patented by Mr. Wolseley, but few sheds on small sheepwalks are strong enough to stand the strain of their use. In a few years time all the sheep in Australia will be shorn by electric machines. I have seen one in Melbourne which worked in a very satisfactory manner, much more so than did the Wolseley machine for a considerable time after it first came into use. With the electric shearer, any shanty can be utilised, as there is no vibration, the power being conveyed to the cutters by means of insulated wires twisted into a cord.

The power can be provided in a very easy way. The tread power, which has lately come into so much favor with American farmers, is the one for the purpose. To work this tread power what can be better than a couple of heavy bullocks. I believe this tread power requires only to be known to Australian farmers and pastoralists to come into general use. It is the cheapest, the most available, and the most effective power that can be applied for cutting chaff, pumping water, cutting firewood, shearing the sheep, working the separator, threshing, grinding and crushing grain, etc., and a thousand and one other purposes.

In putting sheep under cover, no more should be kept in than can be shorn by ten o'clock the next day. Sometimes in bad weather the flock-owner is apt to crowd as many sheep under cover as will last nearly all next day, but when newly shorn sheep are turned out with empty bellies they are ill fitted to stand exposure, and empty sheep are generally badly shorn.

Early shearing is generally practised, as most sheep farmers are anxious to get their clip to market as soon as possible. I have seen great mistakes made by early shearing in the capricious climate of western Victoria. Shorn sheep exposed to one of the cold storms and heavy rains that at times occur in spring, suffer great hardship, and at times many deaths are the result. In shearing the sheep all double cuts by the shearer should be avoided. Where an over-thickness of wool has been left on the skin at the first cut, it is almost better to leave the wool on the sheep than take it off with a second cut. Such short lengths of fibre as these second cuts give are a detriment to the fleece, and when noticed by the buyer are apt to cause a reduction in the value of the wool.

Cuts in the sheep's skin are frequent with careless shearers, anxious only to make a tally. The old practice was to dress these cuts with tar, but of late Little's dip has come into general use for this purpose. Carbolic oil in the proportion of one to fifteen of olive oil is sometimes used.

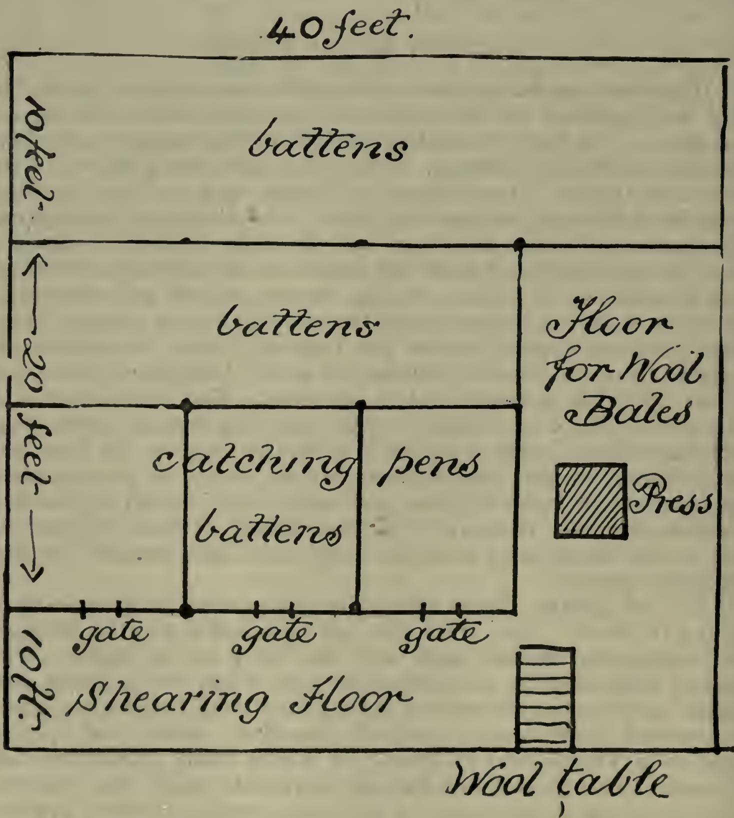
Treatment of the Fleece.

The fleece on being taken up from the shearing floor should be kept well together and spread out on the wool table with the cut end down. The belly should be taken off and thrown into a separate receptacle with the skirtings. These are the lower portions of the arms and thighs. Overskirting is a waste, as good wool is taken from the fleece and put into the pieces, which sell at a lower price. All discolored pieces and wool full of seeds should be removed from the fleece and put with the bellies or the locks, according to their condition. The locks are the heavily stained and very seedy pieces of wool. All dags should be thrown into a manure heap. On no account should they be put into the locks. It occasionally happens from the effect of disease, or a very bad season, that some of the wool has a weak spot in the fibre. This the person who rolls up the fleece can readily tell by removing a small piece from each fleece and trying its strength with the fingers. If there is a decided break in the fibre all such fleeces should be put together, and if a bale or bales of them are made they should be marked "broken fleece." If there is less than a bale of these fleeces the bale should be made up of bellies and pieces, and marked "broken fleece and pieces."

To roll up the fleece, fold up the sides so as to leave it from $1\frac{1}{2}$ to 2 ft. broad. Roll from the tail end, and it may be fastened by thrusting the twisted neck into the body of the fleece. The general usage is to tie with string, smooth white string being preferred, as it does not leave any fibres in the wool, but the tying may be omitted if the fleece is carefully handled. Black and spotted wool should be packed by itself. If it is in small quantity it may be packed with pieces, and the bale marked to show the contents. The wool from a well managed flock has a very attractive appearance, while that from sheep that have done badly and been frequently yarded is dull and not as well grown. Washing wool on the sheep's back is now very seldom practised in Australia. Shearing in the grease is a saving of time and money, and a great benefit to the sheep.

THE PRESS.

In the early days of sheep farming in Australia, the great trouble in the back country was the wool press. A lever made of the trunk of a good-sized tree was often used, and many thousands of bales of wool have been pressed by such means. The agricultural machinery firms in Sydney and Melbourne now turn out excellent wool presses that are within the reach of the smallest flock owner. They are strongly made, easily worked, and of sufficiently light construction that their carriage is easily managed. The screw is absent from these presses, which is a great advantage.



In most of the colonies there are regularly established wool sales, at which representatives from the great European and American wool firms are present. It is better for the owner of a small or moderate sized flock to sell his wool at the nearest of these markets than to send it to Europe ; but, whatever plan he adopts, he should keep to it, as by changing he may hit a bad market at both places.

Woolshed, Barn and Shed.

One of the most useful buildings I have seen to serve the purposes of a woolshed, barn, vehicle shed and store for all sorts of materials required on a farm, is the one of which a sketch is given opposite. It has been in use on a small property carrying about 5,000 sheep for many years, and has been found extremely useful for a great variety of purposes. The main building is 20 ft. wide by 40 ft. long, and there are two skillions 10 ft. broad along two sides. The divisions in the interior are made by hurdles which have two small projections at each end, which fit into receptacles on the posts (these are shown in the plan, but the post is inverted). The hurdles are made 10 ft. long, and the posts at the catching pens are that distance apart. When the shearing is over the hurdles are removed and put away till next shearing. This leaves a wide space, in which fencing-wire, timber, vehicles, sheepskins, and many other articles may be safely stored and kept from the weather. There is a wide entrance-door on to the batten yard at the other side of the catching pens. This plan may be altered to suit a smaller flock, and the material may be wood or iron. To fill the catching pens small gates are made in the hurdles adjoining to the middle battened yard. This shed was erected at moderate cost ; indeed most of the work may be done by any man handy with tools. An iron roof gives a good supply of water, which is saved in large iron tanks.

Ear Marking.

Formerly all ear marking was done with the knife, but the machine made for the purpose is now in general use. The advantages of using the machine are that it makes a clean and uniform mark, and is quicker than the knife. The marks generally used are a half circle, a V and a square, all cut out of the edge of the ear. These marks may be used singly or double with a short space between. The V mark may be cut doubly close together, and thus forms what is called a W. Besides these marks there is the punch hole, which is placed in the centre of the ear, and the swallow tail at the tip of the ear, which is made with a larger V than the one mentioned. There is also a square mark like a quarter taken out at the tip. The slit is a bad mark, for if it is not deep the sides of the cut may grow together again, and if it is sufficiently deep, one side, or both sides, of the slit may droop, which gives the sheep's head an ugly appearance.

All ear-marks should be registered ; this should be compulsory, and what is described as the rogue's mark, *i.e.*, the ear cut off close to the head, should not be permitted under heavy penalties. The ear-mark for age is a very simple matter. For this five positions are sufficient. As an illustration, say, the small half circular mark is chosen (it is usually called "half-hapeny"). For the first year it may be placed on the back of the near ear; for the second year on the back of the off ear; for the third year on the front of the near ear; for the fourth year on the front of the off ear; and for the fifth year a double mark on the back of the near ear. The mark for age can then go back to the first year's mark. This virtually gives marks for six years, as there is no mistaking the weaners for the old ewes.

Then comes the mark for the flock, which may be called the owner's or station mark. The station or flock mark and the marks for age should be in opposite ears to mark ewes from wethers. It may consist of a square, round, or diamond punch-hole in the centre of the ear. I have seen a Maltese cross punched out of the body of the ear look very well. Punches of any pattern the owner may fancy may be obtained with the ear-markers supplied by the leading ironmongers.

There is an elaborate system of marking recommended for stud sheep by which each individual sheep may be identified, but I have never seen it in practice. The usual custom with stud stock is to tattoo with Indian ink a number on the inside of one ear, and the flock mark on the other. The metal loop having letter or mark and number is often used with stud sheep, but never with a general flock.

Sheep Branding.

A perfect sheep brand—one that can be clearly distinguished, and will yet do no harm to the wool—has yet to be discovered. The European manufacturers are loud in their complaints of the mischief wrought to the weaving machinery by tar brands, and strongly recommend their disuse. The substance sold for sheep branding, known as "tattoo oil," is said to be much superior to tar. It is not high priced, and it is mixed ready for use. Lamp black and boiled oil are frequently used for sheep marking in the proportion of 1 lb of lamp black to three quarters of a gallon of boiled oil.

Some years ago I saw in the *Scientific American* the following recommended as a waterproof marking for sheep:—"Shellac 2 oz., borax 2 oz., water 25 oz., gum arabic 2 oz., lamp black sufficient. Boil the shellac and borax together in water till they are dissolved and withdraw from the fire. When the solution has become cold complete 25 oz. with water and add lamp black enough to bring the preparation to suitable consistency. For red marking substitute venetian red; for blue, ultramarine; and for green a mixture of ultramarine and yellow." This plan might be used for stud sheep where it was desirable to have a distinct brand.

Fire Branding.

This plan of marking sheep is not now commonly practised, but with some studowners it is still employed. The brand consists of sometimes a letter branded on the side of the face, but more frequently it is one or more strokes on the side of the face or across the nose. One well known brand is down the centre of the nose. Fire brands should be carefully put on or they cause a great disfigurement. The usual plan is to put the sheep's neck into a fork, made by sinking a forked branch of a tree to a convenient height for the sheep to stand ; an auger hole is bored through both branches of the fork and a peg run through to keep the sheep's head firmly fixed during the operation.

Ink Marking.

Where a small stud is kept it is a wise precaution to mark the members of the flock with Indian ink. This is done in the following way :—A small die, with steel points forming the letter required, can be bought in Melbourne and Sydney, and with this the inside of the ear is punctured. As soon as the points are withdrawn Indian ink, or a substance made for the purpose, is rubbed into the punctures and a permanent mark is established. Besides the letter, figures are marked in the same way. These figures may be the individual number of the animal (this is done where a record of the breeding of each animal is kept), or it may represent the year of its birth.

Dentition.

The age of sheep is determined by the incisor or front teeth. At a month old a lamb has eight incisors or milk teeth, which are temporary. At from ten to twelve months the centre pair of incisors give place to two larger teeth, which are permanent. At from fifteen to twenty months old the second pair of incisors are replaced by permanent teeth. The third pair of milk teeth are replaced by permanent teeth at about two years and three months, and the fourth pair of permanent teeth begin to show at about $3\frac{1}{2}$ years. Though the age of sheep is generally taken from the teeth, it is by no means an infallable guide, as the changes in the dentition are greatly influenced by the nature of the country on which the sheep are grazed. With a dry country and hard pasture the changes in the dentition will be advanced, and where the pasture is of a succulent nature they will be later. With sheep farmers, when the two permanent teeth are well up the sheep is regarded as a yearling ; with four permanent teeth fully grown he is regarded as a two-year-old ; with six permanent teeth, a three-year-old ; and with eight, a four-year-old.

The following diagram shows the relative positions of the various pairs of permanent teeth in the order of their growth :—

4	3	2	1	1	2	3	4

1 1 are the central permanent incisors, or pincers ; 2 2 are the second pair of pincers ; 3 3 are the third pair of pincers ; 4 4 are the fourth pair of pincers, or corners. When the eight permanent incisors are developed the sheep is said to be full-mouthed. After the fourth year the teeth begin to give way, and the sheep is then said to be broken-mouthed. With fair treatment sheep will last for several years after their eight permanent teeth are fully grown, and will hold their condition well ; indeed, it is often found that broken-mouthed ewes when kept in good condition give the best lambs.

Cutting the Lambs.

This is usually done when the lambs are about six weeks old, but if the lambs are stout and healthy it may be done earlier in the small flock with advantage. At an early age the lambs bleed less and suffer less pain, consequently they are not likely to loose condition as a result of the operation. The tail is generally cut off about 2½ to 3 inches from the body. The knives should be very sharp, and perfectly clean. Many a lamb has died from blood poisoning through a dirty knife having been used in cutting its tail off. The old plan of castrating the lambs was to cut the end of the purse off, press out the testicles with the fingers, and draw them away with the teeth. Many sheep farmers now-a-days prefer to make a slit down the purse to the tip, just sufficiently long to permit the testicles to be pressed out. Lambs cut this way are said to heal more quickly than when the end of the scrotum is cut off, and to present a better appearance when the butcher handles them as fat wethers.

Lambing.

Every effort must be made to reserve a paddock with good feed for the lambing ewes. One that has plenty of shelter from the prevailing winds is best adapted to the purpose. With large flocks of ewes, the best plan to adopt is to secure them from being disturbed in any way, and then let them alone. Some owners of small flocks draw off every day the ewes that give signs of being about to lamb. This work must be done very gently and quietly or there will be a loss of lambs. Sometimes young ewes with their first lambs are inclined to run away from their lambs, and in this case it is usual to confine the ewe in a small space, generally made with four hurdles, until she allows the lamb to suck, after which she may be put with the other ewes. When a lamb dies it is the custom, in small and stud flocks, to skin the lamb and put the skin on a twin from another ewe. A very short confinement with the lamb thus treated will make the ewe take to it. It requires a deal of patience, close attention, and no mean amount of skill to manage the breeding ewes in this way, but the percentage of lambs is sometimes (in case of very severe weather) largely increased by it.

Where the locality is subject to severe storms at the time for lambing, a few rough windbreaks or shelter sheds come in very

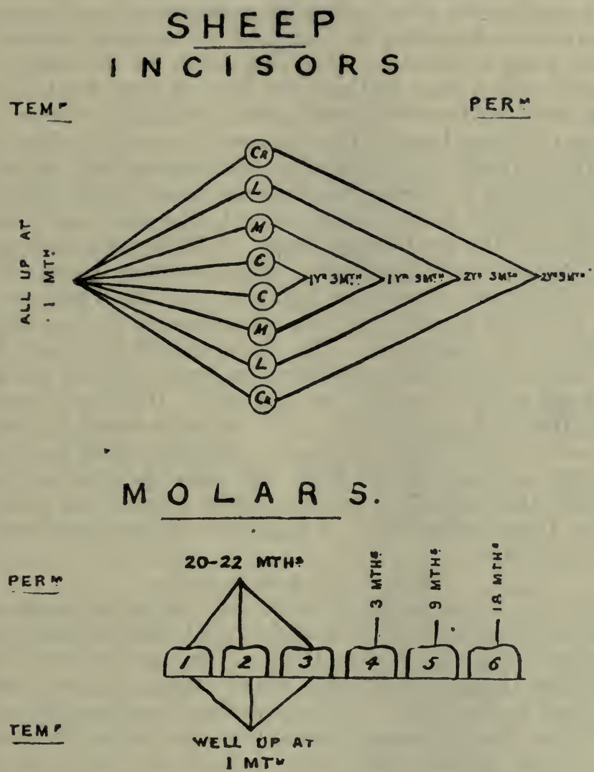


TABLE OF DENTITION.

The above table of dentition was arranged by Mr. E. L. Stroud, V.S., and published by Messrs. Simpkin, Marshall, Hamilton, Kent, and Co., London. On the left hand side are shown the temporary incisors and on the right the permanent. The line of appearance of the molars is shown underneath.

useful. Merinos are excellent mothers, though at times a little flighty over the first lamb. All the down breeds are good mothers and the longwools are also fairly good in this respect. At times a ewe will hide her lamb, and in a bushy country they are sometimes lost. A close supervision of the flock will prevent these losses without knocking the sheep about by unnecessary interference.

Where cross-breeding is practised on merinos, lambing ewes sometimes have a difficulty in giving birth to the lamb; a little assistance at such a time will save the lives of both lamb and ewe. The large heads of the crossbred lambs (particularly where Lincoln rams of the old large-headed type are used) annually kill a considerable number of ewes from difficulties at lambing time. Even where no cross-breeding is employed, the ewe occasionally finds a difficulty in giving birth to the lamb, owing to the head and sometimes the shoulders of the lamb being large. A little assistance given at the right moment, with gentleness, will save many a ewe's life.

In bringing the ewes and lambs up to the yards for lamb-marking, a deal of trouble is often experienced if the work is not gone about in the right way. The flock should be gently brought together and edged quietly towards the yard without using a dog. Have a good wing of hurdles on one side. If there is any trouble in getting the flock to enter the yard, cut off a small lot and drive into an inner yard. These will form a decoy to bring in the others. Lambs that are excited by dogs and men shouting as they are brought into the yard often become quite frantic, and will run till they drop from exhaustion. A lamb will not recover from such a gallop for months.

Stags (or ram stags).

Rams that are no longer wanted for use in the flock, and for which a purchaser cannot be found, are a trouble if kept as rams, and it seems a waste to destroy them. The usual plan is to castrate them, and use them for food next season when in good condition, or send them to market fat. The castration is performed in various ways. Some sheep farmers merely use the knife, and lose very few. A rough edged table knife to rub the cord through by scraping up and down is used to castrate horses, and should answer well with rams. Some tie a string round the cord outside the scrotum and above the testicles; this is twitched very tight, and kept in position by securely tying. By this means the testicles gradually wither away. In other cases what is called blocking or knocking is employed. The cord is placed between two blocks of wood, and the top one is struck heavily with a mallet. This destroys the spermatic cord, and the testicles wither. Ram stags when fattened make excellent mutton, though some people have a prejudice against it.

CHAPTER VI.

DISEASES OF SHEEP.

Throughout the greater portion of Australia sheep, particularly in the newly settled districts, are singularly free from disease. Indeed it would be safe to say that the sheep in Australia (with the exception of the coastal districts) suffer from no ailment but such as have been introduced into the country. The pioneer sheep farmers in central Australia used to say that their sheep suffered from no disease save starvation in a season of drought. It is a proof of the healthy condition of our sheep that over the greater portion of our island continent such a thing as a remedy for disease in the sheep is almost unknown on the sheep walks. The usual course on a run when a sheep is attacked by disease is to let him take his chance. Where a number of sheep die from some unknown cause, it is usually ascribed to poison plant.

It has been noticed, however, in the older settled districts that the sheep are beginning to be attacked by a number of diseases which, until lately, were unknown in the land. Many of these diseases have caused serious losses during seasons that have been favorable to their development and dispersion. Some diseases that are now established in the old settled districts are not amenable to treatment, while others yield to remedies but very slowly.

The pulse of the sheep at rest beats at the rate of from sixty to eighty beats per minute. It is usually examined by placing the hand on the left side, where the beating of the heart may be felt. Any material deviation from the rate given may be taken as an indication of disease. If rapid, hard and full, it is a symptom of high fever or inflammation. If rapid, small and weak, it is an indication of low fever, loss of blood and weakness. If slow, the probabilities are that the trouble is in the brain ; if irregular, the heart is probably affected.

The great point in attempting a cure is first to ascertain the real nature of the disease, and not to rush to violent remedies on a mere supposition.

When sheep die from some unknown cause a careful *post-mortem* examination should be made, in order to locate the trouble. In making this *post-mortem* examination the hands should be free from any cuts or wounds, or the operator may suffer seriously from blood poisoning. It is well to have a supply of carbolic acid to apply in a strong solution to the hands, after being well washed

Flockmasters have found salt licks extremely useful in keeping their sheep healthy. At first rock salt was generally used for this purpose, but of late Liverpool salt, sea salt, and salt from salt lakes have come into use, and are generally preferred. In some cases sulphate of iron and lime are added to the salt with great advantage. I know of a flock of sheep in a decomposed granite country (which is generally regarded as not healthy), which has been kept in excellent health for many years through the sheep being constantly supplied with a lick composed of the following :—Sulphate of iron, 6 lb. ; lime, 6 lb. ; crushed salt, 1 cwt. The whole is thoroughly mixed, and supplied to the sheep in troughs, which are protected from the rain by a small roof. Many licks are used, but the one given has stood the test of a long experience in doubtful country, and can therefore be confidently recommended. Sheep should always have the opportunity of taking salt. From the very earliest times salt has been regarded by husbandmen as a great factor in keeping sheep and cattle healthy ; therefore, it is advisable to keep sheep and cattle always well supplied with salt.

Foot Rot.

This disease is very common among merino sheep when kept on a rich soil country with abundant pasture. Of old it was common in the richer coastal districts of western Victoria, but that part of the country has long since been given up to the longwool breeds, which are not so susceptible to the disease. When the sheep were shepherded it was common, but in Victoria it readily yielded to treatment. A strong solution of bluestone is an excellent remedy. When sheep were dipped in arsenic for scab it was found that the dipping cured those sheep that were suffering from foot rot. This led to the use of troughs to run the foot rot sheep through a strong solution of arsenic. The strength used was about ½ oz. of arsenic to a gallon of water. Some sheep farmers use double the quantity of arsenic. In treating the sheep for foot rot it is necessary to pare away every portion of the diseased hoof, so as to expose the disease thoroughly to the action of the remedy. Sharp knives must be used to avoid wrenching the sheep's foot and causing unnecessary pain to the animal. A little knowledge of the anatomy of the sheep's foot is necessary to make good work ; but this is soon acquired by an intelligent man who wishes to learn. Cutting the large vein of the toe must be carefully avoided, as the bleeding is difficult to stop, and the slightest blow will cause it to break out afresh. When sheep have been left with long hoofs till the heat has hardened the horn they should be shortened by using the powerful seccateurs made for the purpose, and sold in most of the leading ironmongers' shops in Australia.

During the last ten years foot-rot has invaded Riverina, and in that district, particularly on the rich lands bordering the river Murray, it has proved very intractable. The ordinary remedies, such as bluestone and arsenic, have failed to effect a cure in many instances. In Riverina the disease has assumed a much more virulent shape than in the western district of Victoria. It frequently extends to the joints of the fetlock and in a very short time the sheep becomes a complete wreck.

This form of foot-rot has been attributed to the Vermont merinos, to whom its introduction into the country is ascribed by some pastoralists. This I believe to be an error, for I have known the very worst form of foot-rot in a flock that had no Vermont blood in their veins and had never been brought into contact with Vermont sheep. In the country where this virulent form of foot-rot has appeared the merinos are rapidly giving way to longwools and crossbreds, and much of the land is being cultivated for wheat-growing on the share system.

A pastoralist in New South Wales has kept his sheep sound in their feet by the use of the following dressing :—1 oz. arsenic to each gallon of water, with a handful of salt to each gallon ; boil four hours. When the sheep display symptoms of foot-rot they are run through the mixture twice a week. A Victorian grazier says he has found the following treatment very effective :—Pass the sheep through a trough 14 or 15 feet long and as many inches wide with three or four inches of water in it, with which a small quantity of lime has been mixed. The lime-water should not be made so caustic as to harden the hoof or injure a healthy skin. It can be used frequently.

A Vermont sheep farmer claims to have found a cure for foot-rot. He dips his sheep's feet into kerosene and puts a pinch of sulphur between the hoofs. One repetition of the treatment at the end of two weeks, he claims, will effect a cure.

The trough for running sheep through can easily be made. It should be about 14 inches broad, as many feet long, and about 10 inches deep. Sometimes planks or pieces of sheet iron are placed on each side of the trough to save the splash. I believe I was the first person in Victoria to use a trough for foot-rot, and not having any planks at hand, I morticed out a straight tree trunk, which answered the purpose well and was used for some time. Where the sheep are liable to foot-rot, they should be run through the trough directly they scald in the feet. Young lambs are often saved from a bad attack of foot-rot by being run through directly they show a scald in the feet. I think a half ounce of arsenic to the gallon of water the best remedy. That foot-rot is contagious I am convinced, as I have known it introduced to healthy flocks by bringing foot-rot sheep on to the run. Unless the conditions of soil and climate are suitable to the development of the disease, foot-rot will never give much trouble.

Fluke.

Also known as rot, liver-rot, and by other names, is a parasitic disease caused by the presence in the bile ducts of the sheep's liver of a flat parasite, generally known as the fluke, the *Fasciola hepatica* of zoologists. It is shaped like a flounder, hence its common name. It is of a light-brown color, changing sometimes to flesh-color, and ranges in size up to half an inch in length, though specimens are sometimes found much larger. This disease is known over the greater part of the earth's surface where sheep are raised. In wet seasons it occasions very serious losses among the European flocks.

The life history of this parasite is now fully known, consequently measures may be taken to control it. As yet no means of destroying the fluke in the sheep have been discovered. The fluke deposits an immense number of eggs, as many as seven millions having been obtained from the gall bladder of a single sheep. The eggs are voided by the sheep, and under favourable circumstances (the presence of moisture) they are hatched, and the larval flukes find a host in small snails. Should this host not be forthcoming the larval flukes die. On quitting the intermediate host the parasite, in another intermediate stage, attaches itself to the stems of grass, when it is taken up by the sheep, after which it bores through the internal organs to the liver, where it develops into the mature fluke.

In the case of fluke it is apparently useless to attempt a cure, consequently the best thing to do is to adopt preventive measures. These are draining marshy, low-lying lands, and if possible top dressing with lime or salt, or both. These kill the small snails, and thus cut off one link in the chain of changes the larval flukes undergo.

With most of the internal parasites that trouble the domestic animals the parents die after laying their eggs, but the fluke is an exception. I know of a case in point. A number of flukey sheep were brought on to a property which, though containing several nasty spots, was always free from fluke. The sheep were kept on the place for four years, and experiments made showed that they voided fluke eggs all that time. Owing probably to the marshy land being almost a lime bed there were no intermediate hosts for the larval fluke, and consequently they must have died, as sound sheep brought into the place did not become flukey. This shows the danger of bringing flukey sheep into sound country, as there is apparently no end to the mature flukes as long as the sheep lives.

Where the country is such that the larval flukes may develop, great care should be exercised in selecting the sheep that are brought on to the place, as the flukes multiply with such amazing rapidity that one infected animal is sufficient to infest the run. Various licks are recommended as preventives of fluke. Most of them would improve the health of the sheep and might possibly prove injurious to the fluke when first taken up with the grass. One favorite lick is 8 lb. sulphur to 100 lb. Liverpool salt. The lick described in another place, composed of lime, sulphate of iron and salt, is excellent. Where the soil is at all favorable to the development of the larval fluke, one of these licks should be constantly kept within reach of the sheep.

The symptoms of fluke are easily recognised. The eyes lose their brightness and the whites assume the hue of bad tallow. The skin becomes moist and has a dull appearance, quite different to the bright hue of a healthy skin, and the wool is easily detached from it. As the disease progresses, dropsy sets in, and the sheep dies almost in a state of rottenness.

Fluke is seldom, if ever, seen in the hot plains of central Australia, and what is known as salt country is also free from it. One of the best preventives of fluke is to burn the pastures every now and again. This kills the snails that form the intermediate host of the larval fluke. Heavy stocking greatly assists in spreading the disease.

Anthrax.

Also known as carbuncular murrain and splenetic apoplexy in England, is one of the most fatal of the diseases to which the sheep are liable. Like the fluke, it has a very wide range and is dreaded by sheep farmers all over the world. It is a blood disease, and is caused by a microbe which is capable of leading an independent existence for years in the soil. It has the character of an acute inflammatory fever and is communicated by contagion from one animal to another. It thrives best in rich, deep soil, such as that usually bordering the margins of rivers and creeks. Warm, rainy weather is favorable to its developments. There are few, if any, premonitory symptoms and it is difficult to say whether the animal attacked is diseased or not until it is dead.

The symptoms usually noticed are, the animal is dull and languid, the back is arched, and shortly before death a bloody, slimy matter is, in most instances, ejected from the nostrils and the anus. The *post mortem* examination shows all the internal organs to be discolored and almost decomposed. It is dangerous to make a *post mortem* examination of a sheep that has died of anthrax if there should be any cuts or sores on the hands. Anthrax is communicable to human beings, the well known wool-sorter's disease being a form of it.

Where anthrax is suspected as the cause of death in sheep, the best plan is to burn the body as soon after death as possible. Anthrax is seldom met with in sandy calcareous country, and frost at once arrests its destructive tendency. There is no cure for sheep attacked by anthrax, indeed, the first intimation the flock-master has that the disease is in his sheep, is the finding of the dead animals, usually the best conditioned ones in the flock.

Fortunately there is a safe and certain preventive of this fatal disease, the discovery of which we owe to the great French scientist, M. Pasteur. He discovered that the attenuated virus of the disease gave immunity to the sheep, and annually many millions of sheep are now inoculated in Europe. The inoculation of sheep with the attenuated virus of anthrax has been successfully practised in New South Wales and Victoria since 1888. It gives immunity to the animal, certainly for two years, and, it is generally believed, for life. Inoculation with the virus of anthrax requires a skilful operator, and the preparation of the virus is a matter the sheep farmer cannot undertake. The inoculation of sheep in New South Wales and Victoria is performed by experts at a charge of so much per 1,000 head of sheep.

Ticks and Lice.

Badly bred and badly managed flocks are a nuisance to all the adjoining sheep farms, as such flocks are usually infected with ticks and lice, which spread rapidly in every direction. Though sheep troubled with these pests can scarcely be described as diseased, they nevertheless give the flock master almost as much trouble as any of the diseases to which sheep are liable. The remedy is a simple one, easily applied, and should be made compulsory. Many dips for killing ticks and lice are put on the market, all of which are probably effective, and some of the best known ones have been specially recommended by the most careful sheep farmers in Australia. The remedy for ticks and lice is to dip the sheep soon after shearing in a dilution of some well known "dip." In the older colonies small dips are made of iron suitable for the farmer's flock. These dips can be obtained at a moderate cost, and are easily shifted from place to place, which is a great advantage.

When a farmer cannot obtain one of these dips, he can readily construct one that will serve his turn by making a framework of hardwood and lining it with tongued and grooved inch pine boards. The size is not material, but if it is to be a permanency, the dimensions may be 2½ ft. broad, 10 ft. long, and 4 ft. deep at one end, with a battened slope at the other end to allow the sheep to walk out easily. This dip should be well puddled at the back. With a small flock the half of a large cask can be utilised if the materials to construct a permanent dip are wanting. In such a receptacle a good many sheep can be got through in a day. Before dips were made for curing scab, such means were employed for dressing the diseased animals. A stout frame about the size of a dining table was covered with bullock hide, and on this the scabby sheep used to be saturated with some scab-killing compound. Any means that will rid the sheep of these troublesome pests is better than waiting till a properly-constructed dip can be erected.

Coast Disease.

Over a considerable portion of the littoral of southern Australia the sheep are subject to a disease which, for want of a better name, is generally described as the "coast disease." As the districts liable to this disease are limited, and generally not good growing country, the nature of the disease has not attracted much attention. It is the general opinion of those having any experience of coast disease that there is no cure for pasture animals attacked by it as long as they remain in the coast country, but removal to a sound pasture further inland almost invariably effects a cure. This disease is often described as rickets, but the two complaints are dissimilar.

Rickets.

The disease is more frequently seen in cattle than in sheep. It is prevalent in some portions of the coast country where the soil is a sandy loam that has in it scarcely any lime. The animals raised in such country grow weak and stunted, their bones are extremely brittle, and without strength, the slightest fall occasioning a fracture. No stock should be bred on such country, and any animals kept on it should have access to a lime lick.

Flies.

The common-blow fly frequently causes much mischief by depositing its eggs about the tails of sheep that have been scouring. Unless the sheep are attended to at once the maggots soon effect so much mischief that the animal dies. This trouble generally occurs in autumn, when the growth of young grass causes a slight scour in the sheep. It is much worse in Tasmania than in any part of the mainland of Australia. The remedy is to clear away the soiled wool, and rub in a strong solution of one of the ordinary dips. When a sheep is struck by flies it makes sudden, short movements, and constantly works its tail with a quick motion.

The Worm.

Under this description are included all the worm-like internal parasites that affect the sheep. There are in reality many forms of these worms. There are at least three distinct forms of *strongylus* that inhabit the lungs and air passages of sheep, and probably as many inhabit the stomach and intestinal organs. The most common of the worms inhabiting the air passages is the *strongylus filaria*, a white-colored worm which is found blocking up the air passages of the bronchial tubes. The disease known in the old country as husk in calves and lambs is occasioned by this worm. Its presence is easily recognised by the attempts of the animal to dislodge them by coughing.

The life history of these lung and stomach worms is not clearly known, but that they produce an immense number of eggs is certain. Though these eggs often contain living embryos while in the sheep it is doubtful if they ever advance to maturity while they remain there. It is supposed they are expelled from the sheep and undergo some changes before they seek a host in the sheep. Scientists have as yet discovered no remedy for this disease. The practice among sheepowners has been to subject the infected sheep to the fumes of certain drugs in a close building. This is said to have had a beneficial effect in many instances, but the slightest mismanagement often causes serious losses by the sheep being choked by the fumes. The introduction of drugs into the windpipe by means of a specially made syringe is also said to have given good results, but the operation is not as easily performed as one would think at first sight, and often the windpipe is not punctured and the operation is consequently useless. The latest scientific statement in reference to a remedy for lung worm is that injection into the windpipe or, indeed, any other form of treatment, may be looked upon as nearly useless. The embryos of the worm have been found alive in a portion of lung which had been kept for several hours in a strong solution of corrosive sublimate. It is doubted that any drug which could be introduced would kill these worms, even if it killed the sheep. Top dressing of lime and salt, sufficient draining to prevent the formation of marshy spots, is recommended, but probably the best remedy is to remove the sheep to a different pasture.

Stomach and intestinal worms are usually found in country that is infested with lung worms. The most prominent symptom is scouring, accompanied by loss of appetite and wasting. Abnormal thirst is often shown, and a strong tendency to lick sand or earth. These worms, like those of the lungs, are more severe on lambs than on older sheep. In a worm infested country, when a season favourable to their development occurs, the losses of lambs, or rather weaners, are very heavy. In such seasons the worms are not confined to the rich soil and heavily grassed districts, which are known to be "wormy," but are spread over the soundest and healthiest districts. Such a season occurred about ten years ago in a portion of Victoria, and healthy, lightly grassed plains, on which the sheep never knew disease, were affected, and considerable losses among the weaners occurred. As many of the flocks affected were permanent ones, the sheep of which never left the place till they left it for good, and no fresh sheep were introduced, it is difficult to account for the rapid spread of the disease. As in the case of the lung worm, veterinary science has not yet discovered a remedy for this disease. Turpentine has given the hint its action is not to be depended on, though repeated doses are said to have a good effect by killing the young worms. Lysol (a watery solution of tar oil) is regarded as likely to prove the best agent for the destruction of these parasites of the sheep. In the present state of our knowledge, prevention, in the way suggested for lung worms, is about all that can be done, though there are in Australia, in America, and in Britain many so-called cures for the disease. The advice given by those veterinary surgeons who have carefully studied the subject, to keep up the strength of the young stock by good feeding and changing them from old, low-lying pastures to newer and higher ones, is, doubtless, the best that can be given. Some years ago, in a neighboring colony, in a district that was badly infected with worms, an experiment was tried by the manager of a large flock of high-class sheep. On weaning the lambs, instead of putting the young sheep on the pasture, he put them on turnips which he had grown for the purpose. Instead of taking the worm, as was usually the case on that property, the young sheep throve remarkably well and came into the shed as two-tooths fully as large as ordinary four-tooths. It was generally believed in the district that there must be some principle in the turnip that gave the weaners immunity from the disease, but it is much more probable that the food gave the sheep sufficient strength to resist it. The cultivation of the land may have the effect of destroying the larval worms. The sheep farmer should, if possible, avoid bringing any sheep infected with worms on to his run, and in this lies the advantage of breeding up the flock from thoroughly healthy originals and drawing the same from flocks that are known to be sound. I give the following remedies that have been tried and recommended by Australian pastoralists.

On the Jimbour estate, salt and chloride of potassium, in the proportion of ten of the former to one of the latter, is said to have given relief.

An American remedy is, a tablespoonful of turpentine in four times as much oil. Of this mixture a tablespoonful is a dose for a sheep.

The remedy generally used in Queensland some years ago, when the worm was very bad, was 1 oz. arsenic, 1 oz. washing soda, 1 oz. carbonate of soda, boiled in two quarts of water for an hour and kept well stirred. Add ten gallons of cold water, and of the mixture a gill is a dose for a grown sheep. This remedy was strongly recommended, but I fancy many of the lambs died from it.

A Victorian remedy is, 1 quart of turpentine and 11 quarts of milk, well mixed. Of this mixture 3 oz. is a dose. It must be kept well stirred or the turpentine will separate from the milk.

Running turpentine along the back from the withers to the rump is said to kill the internal worms, but it is a very severe remedy.

Scab.

This is a skin disease caused by a minute insect, which is very difficult to distinguish without the aid of a powerful magnifying glass. These insects multiply in warm, moist weather, when there is a rush of green grass. The disease has not been seen in Australian flocks for many years, and as all imported sheep are carefully examined there is not much danger of its being again introduced into our flocks. The old idea that scab was generated by low conditioned sheep being exposed to severe weather without sufficient food has long since been exploded. The insect *(Acarus)* must be present, or the sheep will never take scab.

Arsenic was used as a cure in the proportion of from $\frac{1}{4}$ to $\frac{1}{2}$ oz. to the gallon of water. It killed the scab insect, but it occasionally killed a good many of the sheep, particularly when a sudden change from warm to cold wet weather occurred immediately after dipping. Some of the dips for tick are used for scab in countries where it still exists, and they are said to be very effective. Tobacco is a safe and effective cure in the proportion of 1 lb of tobacco to 8 gallons of water. The strong, coarse, "knock-me-down" tobacco grown formerly in Victoria and Tasmania, was a good cure for scab, but it has not been seen in these colonies for many years.

Hydatids.

This disease is known in almost every country where sheep are raised. It is caused by the larval state of a species of tape worm (*Tænia echinococcus*) infesting the dog and wolf. It is not frequently met with, fortunately, as it is difficult to treat, a cure being rarely effected. The mature parasite is about $\frac{1}{6}$ to $\frac{1}{3}$ of an inch long. It reproduces itself by ova, which dogs infested with the tapeworm are continually throwing off in the fæces. This ova will float in the air, and if it settles in water may be taken up by sheep when drinking.

When an animal swallows the ova of the tapeworm the walls that enclose it are broken down and minute embryos of a spherical shape are set free. These find their way into the blood vessels and are carried to various organs, principally the liver, lungs, and brain. Here they become encysted—that is, surrounded by a sac formed of the tissues of the host. The fluid in this sac is of a milky hue, and in the centre is a membrane surrounding a central granular mass. This disease is communicable to human beings principally through the drinking water. Well-cooked mutton is quite safe. The cure for human beings affected with hydatids is to tap the sac and draw off the contents, but this remedy is seldom, if ever, employed with sheep. The number of sheep that die of this disease is not large, but it may be said to be ever present in some part or other of the country.

Terms Used by Sheep Farmers.

Lamb.—A sheep is called a lamb until it is weaned from its mother.

Weaner.—This term is used to describe young sheep just weaned.

Hogget.—The term hogget is applied to wethers and ewes till they are shorn as two-tooths, though some people apply the term for a few months longer. Ewes and wether hoggets off the shears are often spoken of. For the ages above this see "Dentition."

Wether.—A male sheep castrated when a lamb.

Broken mouth.—A term used to describe sheep whose permanent incisors have decayed.

Full mouth.—A term applied to a sheep that has its full complement of eight permanent incisors fully developed. See "Dentition."

Stores are sheep, both male and female, in low condition, generally purchased for fattening for the market.

Cull is a sheep rejected from the breeding flock for old age, or some defect of form or fleece.

Comeback.—This term is applied to a sheep raised from a crossbred ewe from a ram of one of the original breeds. It is sometimes described as a Lincoln comeback or a merino comeback.

Crossbred.—Sheep bred from two distinct varieties, such as merino and any of the longwool breeds, and merino and any of the down breeds.

Stag, or ram stag, is a ram emasculated after being used as a sire.

Yolk.—The natural grease or oily matter in the wool of sheep.

Black tip.—This is the formation of the yolk into a hard black spot on the outer edge of the fibres of wool.

Staple.—The length of the wool fibre. A long staple of merino wool may reach 5 inches, a short one be just over 1¼ inches.

Combing wool is merino wool that is sufficiently long in the fibre to be worked by the combing machine. Anything over 1¼ inches is now called combing wool. Formerly it was required to be longer.

Clothing wool is any merino wool that is under 1¼ inches in length of fibre.

Kemps are white hairs seen in badly bred merino wool. These are objectionable, as they do not take the dye like true wool, and their presence reduces the value of the wool per lb.

Lock.—This term is applied to the way the wool grows on the sheep's body. Thus, the Lincoln wool has a heavy blunt lock. Small pointed locks are not liked by sheep farmers. Such fleeces do not weigh well.

Locks.—The stained wool and coarse pieces sometimes growing low down on the thighs of merino sheep; in fact, all dirty coarse or badly seeded parts of the fleece are termed locks.

Pieces.—These are the parts of the fleece not sufficiently coarse, stained or seedy as to go with the locks, and yet not good enough to go with the fleece.

Break in wool.—This is a weak spot in the fibre caused by deficient growth during a period of illness, starvation, or exposure to very severe storms. Where the break occurs the wool is much weaker than elsewhere.

Dags.—This term is applied to the lumps of manure formed on the wool under the sheep's tail, owing to the animal having scoured through a rush of young grass or other cause. Longwools are apt to have dags.

Preparing Wool, Hides, etc., for Market.

The following directions for preparing wool, hides, sheep skins, furred skins, etc., for market, have been compiled by Messrs. Connor, Doherty and Durack, Limited :—

Wool.—After separating the stained pieces and locks, the fleeces should be skirted well (especially if the bellies are burry) and then rolled tightly and pressed into bales. The pieces, bellies, stained pieces, and locks may then be baled separately, or if there is not sufficient of either to be packed in bales, sacks may be used. On no account should fleeces be tied with string.

Sheepskins.—Immediately after being taken off, the skins should be hung out lengthways on wires or rails (wool side down), if possible under trees or other shade, until dry ; the trotters should then be cut off, and the skins painted with anti-weevil composition. They may then be stored in a dry place until sufficient have accumulated to make a consignment. On no account should skins be allowed to hang out exposed to the weather after they are once dry.

Hides.—When flaying, *i.e.*, skinning the beast, care should be taken that the hide is not cut or scored with the knife, as this takes off, at the least, a third of the value. The head of the beast should not be skinned, as that portion of the hide is of no value. As soon as flayed the hide should be spread out under shade and well salted ; after a day or two the blood should be drained off, and the hide rolled up with the hair side out, and plenty of salt inside. When rolled the hide may be tied with binding twine, but on no account should wire be used. Calf skins should be treated in the same manner.

Kangaroo skins should be pegged out in the shade (all shanks, scalps, and tails cut off closely). After drying the skins should be painted with anti-weevil composition and packed quite flat in bundles. Care should be taken that each skin is thoroughly dry before being packed.

Opossum skins.—When the body is cold strip off the skin, leaving the tail on, and peg out as squarely as possible. When dry paint with anti-weevil composition, and pack flat, fur to fur. Opossums should be trapped or snared, as shooting them or hunting them with dogs destroys the fur. The proper time for opossum catching is from May to end of August, as during that time the fur, which constitutes the value, is thicker and better.

Recipe for anti-weevil composition.—Take six lbs. arsenic and five lbs. common washing soda. Dissolve the soda in ten gallons of water in a copper or boiler. When dissolved add the arsenic and boil until the latter is thoroughly dissolved. To every gallon of this preparation add three gallons of cold water ; mix thoroughly and apply to the flesh side of the skin with a whitewash or other suitable brush. As this preparation is extremely poisonous, care should be taken to keep it where children or animals cannot get access to it.

All consignments sent to market should be distinctly branded or marked (stencil plates should be used for branding wool, and labels for skins, hides, etc.) and each consignment should be fully advised by letter to the consignees.

PART V.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

SOILS AND MANURES.

PART V. of the SETTLER'S GUIDE AND FARMER'S HANDBOOK is devoted to a description of the various kinds of soils, and of the science and practice of manuring. Every effort has been made by the author to keep the work as free from technicalities and scientific names, and to write in such a style as to make his observations readily understood. It is, however, a very difficult matter, well nigh impossible, to treat a scientific subject properly and fully without using scientific terms, but it is to be hoped that the readers of the GUIDE will profit by the knowledge conveyed in these pages, and when they are in doubt upon any particular point, or desire further information, they have only to apply to the Bureau of Agriculture and it will be freely accorded.

CHAPTER I.

SOILS.

By S. S. Dougall, F.I.C., Agricultural Chemist to the Bureau of Agriculture.

Earth, or soil, acts as the holder or conveyor of nourishment necessary to the growth of plants, and also gives support to their roots in enabling them to maintain a position best adapted to their growth.

Soils are the results of the disintegration, weathering, or denudation of rocks. The forces that are concerned in the formation of soils are both of a physical and a chemical nature. The alternate action of heat and cold on rocks produces expansion and contraction, creating small cracks and fissures which, by the further actio i of water, are enlarged, and small fragments of the rock are consequently disengaged. This action may go on until large pieces of the rock are disengaged, which, in their downward course, grind away part of the surface of he rock, which goes to make up the soil. The water not only acts mechanically, but also chemically. All rocks contain something in their mineral composition that is liable to chemical decomposition by the action of oxygen and carbonic acid. The rain falling to the earth takes up oxygen and carbonic acid from the atmosphere. The oxygen acting on the sulphides oxidizes them into sulphates, which are dissolved in the water and carried away, leaving the rock a porous mass which eventually is broken up into fragments.

Carbonic acid exerts a greater action on the rocks than oxygen, even the hardest granite crumbling under its agency. It converts the alkalies—potash and soda—and alkaline earths—lime and magnesia—into carbonates and bi-carbonates, which, being soluble in water, are carried away in solution with the separated silica, leaving, in the case of a felspathic rock, a deposit of kaolin. The rain falling on these decomposed rocks carries away small particles which are deposited on the lower levels, or in the nearest stream or river, to be again deposited at some distance, or finally carried out to sea.

Soils are also formed *in loco* by the weathering or disintegration of the surface of rocks which underlie the soil. Being composed of particles of the rock from which they are derived they are precisely of the same nature, or very little modified. When the rock under the soil is a shale or slate, a clay soil will be found on the surface ; sandy when overlying a sandstone rock ; calcarerous when overlying limestone ; and overlying granite a soil composed of clay and sand, rich in potash, and modified in its other mineral constituents, according to the nature of the granite it is derived from. From the trap rocks is derived a rich, fertile soil, well proportioned in clay, sand, lime, magnesia, oxide of iron, and rich in potash. With a knowledge of the rocks which went to form a soil, we are in a position to say whether it is likely to be a soil that will grow any particular crop. The soils derived from rocks of the same age are the same in character in one part of the world as in another.

Geologists divide the rocks into two classes—stratified and unstratified. This division is quite suitable to the requirements of the agriculturist. The unstratified rocks are called chrystalline or igneous rocks, and for agricultural purposes may be divided into two classes—granite and trap rocks. The stratified or sedimentary rocks cover the greater portion of the earth's surface, and go to form the greater part of the soils. They lie over each other in horizontal layers, like the leaves of a book when laid on its side, and always in a definite position, no matter in what part of the world they are found.

Granite consists of quartz, felspar and mica in varying proportions, and when hornblende replaces the mica it is called a syenite. The fertility of a granite soil is governed by the felspar. It is principally the felspar that goes to make a fine soil, and its fertility will greatly depend on whether the felsite is a potash or magnesia felsite. Granites generally form mountain ridges. The rains wash out the fine felsite clay or kaolin, carrying the clay down into the low flats, forming a cold, impervious, clayey soil, and leaving only the barren quartz on the mountain side, more especially on the side exposed to the prevailing wind and rain, while on the other side may be a comparatively fertile slope, not having been denuded of its fine clay. It is evident that a granite soil to be fertile must lie over a granite, and be derived from a granite containing a potash felsite.

The trap rocks consist of felspar, hornblende, or augite, and comprise basalt and the greenstones generally. The felspar and hornblende in the trap rocks are both reduced in the weathering to form a soil. By a glance at the composition of these two substances it will be quite evident why trap rocks produce some of the most fertile soils :—

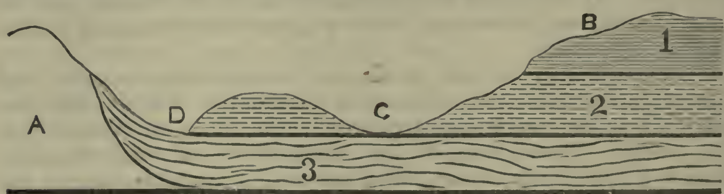
	Felspar.	Hornblende.
Silica	60·00	52·00
Alumina	18·00	12·00
Potash and soda	17·00	Trace
Lime	Trace	10·00
Magnesia	,,	15·00
Oxide of iron	,,	10·50
Oxide of magnesia	,,	·50
	100·00	100·00

Such a soil must naturally be rich. It also shows how a trap rock soil is very little benefited by an application of lime, except on first breaking it up into arable land. The rain having washed the lime down into the soil, it is brought up again by continual ploughing.

I have said that the stratified rocks lie over each other in horizontal layers. It might be supposed that only the later layers of the sedimentary rocks would be exposed on the surface of the earth. However, the upheavals that have taken place from time to time have tilted up extensi e ridges of the lower rocks and exposed them on the surface. Also the denudation of the upper strata have exposed large tracts of the older strata, forming a variety of soils. Of these soils, where one finds a soil produced from the new or old red sandstone, or the millstone grits, it is almost always naturally productive. When the soils from the different strata intermingle there is generally produced a productive soil, even though each of the strata from which it is composed is individually of a poor nature.

Thus the intermingling of a sandy and calcareous soil will generally produce a good barley soil, and when a clay and limestone mix there is generally produced a soil good for growing wheat.

Soils are generally uniform in their mineral constitution in the same district; but it not infrequently happens that a great difference occurs within a very short distance. This is accounted for by some physical characteristic of the land, or the manner in which one rock lies on another. The following sketch will explain to some extent how the different soils are formed, and how there may be a variation within a comparatively short distance :—



A is an unstratified rock; 1 is a limestone; 2, a sandstone; and 3 a slate.

Supposing that the points A and B are some miles apart, it is quite evident that there will be a diversity of soils between these points. By the denudation that has taken place on 1, and to a greater extent on 2, an undulation is caused which has exposed 3 at D and C, and the soils at C and D will be similar. That on the rise on 3 up to A will be different to C and D; 1 and 2 will be different to either of these; there will still be a different soil at the place where 1 and 2 intermix. Further, if we say that 1, 2, and 3 in themselves are comparatively poor soils, it will generally be found that where 1 and 2 mix, and at C and D, the soils are fairly good. Thus, by a knowledge of the underlying rocks, we can judge of the fertility of the soil. Yet this knowledge is not without its disturbing elements, as in the case of rocks which are covered by alluvial deposits that may have been carried from some distance. These cases are few, and at any rate the soil generally contains a large proportion of the rock it overlies, or those in close proximity to it. On the coast line there are to be found some places where a deposit of arenaceous sand has taken place, where the soil has no relation to the underlying rocks. These deposits of sand are carried by the winds from the sea shore inland, and deposited in greater quantities in some places than in others, owing to some physical contour of the land. But these do not disturb the general conclusions of judging the fertility of the soils by the rocks they are formed from.

There is another method of judging the value of soils and their adaptibility to certain crops, which I may call that of natural selection. It is a well-known fact that certain plants are only found growing in certain soils, but these selections are modified by climatic influences. The selection may be extended to more than one class of soil, owing probably to these soils containing some element of food conducive to the growth of the plant, but generally other plants are found growing with it that point to an alteration in the nature of the soil from that in which it is generally found.

The following is taken from Mr. A. Despeissis', M.R.A.C., *Handbook of Horticulture and Viticulture*, first edition :—

"In the ironstone gravel soils are to be found the following trees giving indications of soils of various degrees of fertility. Underneath the ironstone gravel soil is to be found a clay at various depths, which is generally indicated by the growth of the following trees:—Gravelly ironstone is indicated by jarrah, but where there is a certain depth of brown loam the jarrah is associated with grass trees or blackboys. Pockets of deep loam amongst the ironstone gravel are indicated by red gum trees, and wherever jarrah, red gum and blackboys grow together and attain large proportions, there the soil is c rtain to be deep, well-drained, and fertile. Pipe-clay is revealed by the presence of white gum trees. White gum alone is an indication of the predominance of pipe-clay, or of a cold retentive clay and gritty sand soil. Small blackboys growing amongst white gums are evidence of the presence of this stratum of loam on the surface. Jarrah and white gum growing together are indicativ of a mixture of ironstone gravel and pipe-clay. Flooded gums are often associated with blackboys alongside brooks and on alluvial soils bordering water courses, and mark out fertile strips of land rich in potash. In the south-west district the yate tree grows on such soil. Chocolate loam, sometimes of great depth, varying in texture from a heavy loam, is characterised by a greater or smaller admixture of the York gum tree, to the wattle or jam tree. Such land marks splendid corn land, and is generally found on the slopes of the undulating country which constitutes its home. On the flats the soil is often of a lighter character, there the wattle or jam bush predominates. A lighter loam still is found on the river banks, and is generally overgrown with the above named trees, in company with the banksia and at times with the sheoak. The chocolate loam, or wattle and jam, or York gum land, is considered one of the best balanced in the elements of plant food in the south-west district of this colony. Fields not long cleared and well cultivated, yield in average seasons from 16 to 26 bushels of wheat to the acre, and from one and a half to two tons of hay. Rich patches of land occur in this country, and are found where the manna gum tree grows."

Light Colored Loam and Decomposed Granite.

Vast areas of land extend beyond the jam country from the Midland railway line in an eastward direction towards Meckering, covered mostly with salmon bark gum tree, with which is associated the gimlet wood or fluted gum tree. By ringbarking, the soil is easily brought under cultivation. The soil consists of a dun colored loam, rich in potash. A corn growing area.

Sandy Soils.

This country supports shrubs of different growth, such as banksia and, in places where it is not deep, either white or red gums with, at times, blackboys, and near the coast the willow myrtle or peppermint tree, and on the limestone coast ranges east of the Darling ranges, the tooart. Where limestone or a loam sub-soil underlays the sand at a shallow depth, there vines and stone fruit trees grow with great luxuriance.

While these conclusions are correct in the main part, they are not to be taken in any way as positive. In fact, so far as the white gums are concerned, the analyses of soils I have made lately where the white gum tree was the only or principal timber, are the richest in potash, with the exception of No. 8 (*see* analyses, page 668). They are not only to be found on clay soils, but also on calcareous clays, where the limestone and clay juncture with each other, and which will be generally found to be rich in potash, and good land for wheat. From the analyses of soils the white gums and morrell gums would seem to indicate a soil rich in potash. I have only given a few of the analyses of soils which I have made, but they point to the jarrah and redgum soils as poor in potash. It would be rash to come to any definite conclusion from the few analyses I have made up to the present, that is, few when we consider the extent and variety of soils that are to be found in this colony. With a more extended series of analyses of the soils, together with analyses of the ashes of the indigenous trees of the colony, we shall have much more light thrown on the subject, which will enable us to come to more definite conclusions as to what soils we are to expect from the indications given by the varieties of trees that grow on the land.

Soils are divided into two parts, the surface soil, which is the most fertile, and composed of the finer parts of the s il, and the subsoil, which may be composed of similar substances to the surface, or it may be a coarse gravelly sand or even a stiff clay.

Soils are mainly composed of four constituents, clay, sand, lime and organic matter, and generally derive their name from whichever of these constituents predominates. There is a good deal of vagueness in the terms applied to soils by different persons. They are variously called heavy, light, stiff, cold, damp, sandy, clayey, peaty, calcareous, or loamy, none of these terms meaning anything definite. Professor Johnstone gives the following classifications:—Soil, not peaty, that contains no more than 10 per cent. of clay is called a sandy soil; 10 to 40 per cent., a sandy loam; 40 to 70 per cent., a loamy soil; 70 to 85 per cent., a clay loam; and 85 to 95 per cent., a strong clay.

The fertility of a soil depends mostly on its chemical, physical and biological properties.

Absorbtion of Water.

This is a very important property of the soil. Much depends, for its fertility, on its power to absorb moisture, to take in and retain water that may fall on it in the form of rain. This depends greatly on the constitution of the soil, and also on the fineness of its particles. Sandy soils possess this power in the lowest degree, then clay, limestone, and humus in their order. Schübler gives the following powers of different soils to absorb water:—

Per Cent. of Water Absorbed by 100 Parts of Earth.

Silicious sand	25	Gypsum	27
Calcareous sand	29	Sandy clay	40
Strong clay	50	Arable soil	52
Fine calcareous earth ...	85	Garden earth	89
Humus	190		

It is necessary that the soil should hold sufficient water for the nourishment of the plants, as they require water in order to assimilate their food.

The capillary action of a soil depends greatly on the fineness of the particles. The finer the particles, up to a certain degree, the more water is the soil enabled to draw from the deep sub-soil for the benefit of the plants, hence the necessity of a good tilth.

The Retentive Power of Soils.

This power is very much allied to that of the power of absorbtion. As the rain falls only at intervals in some places, as in this colony, the periods between the showers of rain being often of long duration, it is necessary that the soil should be able to retain a sufficiency of moisture to enable the plant to take up an adequate supply of food in order to attain maturity. It has been shown that silicious sand has the lowest power of absorbtion, and consequently the lowest power of retention, and that humus has the highest power of retention. Hence the great benefit of green manuring a sandy soil, which means the addition of a certain amount of organic matter, or humus. It is also evident that drainage is of the utmost necessity in clay and peaty soils. Too much moisture in a soil is just as bad, if not worse, than too little. Maerker gives the effect of different proportions of water in the soil upon the growth of summer rape as follows :—

Water in soil in per cent. of total water-holding capacity.	Produce (Six plants in each case).				
	Number of Pods.	Weight of Plants (air dried).			
		Seeds.	Straw.	Chaff.	Total.
		Grains.	Grains.	Grains.	Grains.
10	43	1·4	2·8	1·4	5·6
20	61	2·4	4·4	2·6	9·7
40	142	6·9	10·4	6·7	24·0
60	97	4·3	8·1	4·4	16·8
80	95	3·9	7·3	3·9	15·1
100	19	0·3	2·0	0·6	2·1

It will be seen that from 40 to 80 per cent. is the amount of water a soil can hold in the best proportions. When less or more the results are not so favorable, as it affects the plant growth in every part. When too much water is in the soil it becomes cold, and a free circulation of air, absolutely necessary to healthy growth, is prevented. A dry soil develops the plant quicker than a damp one.

The amount of evaporation that takes place in any soil is greater when under cultivation than when bare. It also depends on the openness of the soil. An open soil does not lose water so quickly as a close compact one, owing to the capillary power being less.

The addition of clay to sandy soils greatly increases their retentive powers. On the other hand, clayey and peaty soils are more liable to contract when dried than sand or limestone. The result of this shrinking of clay and peat is to compress the roots of the plants and form such a hard compact mass that air is not allowed to enter into the soil. Sand does not contract on drying. When sand is mixed with clay it keeps it in a porous state, so that the air can always pass through it.

Soils have the power of absorbing moisture from the air when not exposed to a hot sun, as at night time. This is a matter of the highest importance in a hot climate, and the value of a soil is greatly dependent on its power of absorbing and retaining moisture. The more power it has of absorbing and retaining water, the more hygroscopic will be the soil. Peat will absorb in one night one twelfth of its weight in moisture, clay one-thirtieth of its weight, while sand absorbs none, or, at most, a mere trace. It will thus be seen that the absorbing, retentive, and hygroscopic powers of a soil are directly dependent on the amount of organic matter or clay that enters into its composition, and that the power can be increased by the judicious addition of clay and organic matter to a sandy soil. In a hot climate, such as we have in this colony, these various powers of a soil necessary to their profitable cultivation should be maintained at their best and improved as far as possible where they are deficient. The physical properties of a soil are just as important as the chemical properties for keeping a soil in a fertile state.

We have seen that clayey and peaty soils contract when they dry, and do not allow of the passage of oxygen and other gases necessary for the plant growth. In the wet state they are so saturated with stagnant water that oxygen cannot enter them, hence the great necessity for drainage in these soils, which also prevents sourness of the land, and enables them to absorb oxygen, carbonic acid and ammonia in the form of gases.

The Absorbtion of Gases by Soils.

Soils have the power of absorbing gases from the air, both direct and from rain, which takes up oxygen, carbonic acid and ammonia in its passage through the air to the earth. The soil also receives carbonic acid from the decomposition of organic matter in the earth, and in larger proportions than from the atmosphere. The atmosphere is principally composed of oxygen and nitrogen, both of which gases are absorbed by the soil, more especially oxygen, for which it makes a greater demand than for nitrogen. To enable the soil to receive sufficient of these gases it is necessary that it should be open so as to allow of the free access of air ; this is accomplished by tillage and drainage. It is a well known fact, first proven by de Sausaure, that plants absorb oxygen directly through their roots. The amount any plant absorbs varies at different periods of its growth, and if not supplied freely at that time the growth of the plant is delayed or stopped altogether.

When seeds are germinating they require a good supply of oxygen to enable them to sprout vigorously, and the young plants require a plentiful supply, as they have not the strength or roots to stretch out in search of supplies at a distance. Hence the great necessity of a good seed bed, and not burying the seed too deep in the soil. The soil absorbs nitrogen from the atmosphere, although not in such large quantities as oxygen ; yet it does absorb it, more especially when it is sown with leguminous plants. The method by which the plant absorbs the nitrogen from the soil was firstly clearly defined by Schloesing and Muntz, who showed that it was through the agency of micro-organisms. Carbonic acid and ammonia are partly obtained from the atmosphere being carried into the soil by rain. Soils absorb ammonia direct from the atmosphere, but damp soils have a greater power of absorbing ammonia than dry soils. Soils greatly differ in their powers of absorbing gases. Soils that are rich in organic matter absorb gases to a much greater extent than those poor in organic matter.

It will now be seen that the improvement of a soil in any one of its physical aspects has also the power of improving it in that of others. The addition of sand and lime to a clayey soil, in conjunction with drainage, improves it ; while the addition of lime and clay, along with drainage, to a peaty soil improves it and brings it within cultivation.

The Chemical Composition of Soils.

We have stated that soils are composed principally of sand, clay, lime and vegetable, or organic, matter. They contain, besides these principal constituents, several others in smaller proportions, such as oxides of iron, alumina, potash, soda, magnesia, phosphoric acid, chlorine and sulphuric acid.

The first group of constituents, with the exception of vegetable matter, acts mostly as a support to the plant, enabling it to maintain itself in an upright position. The second group, with vegetable matter and lime, supplies food to the growing plants. The combined action of both groups of constituents is that of holder, or fixer, of the plant food, as well as the medium whereby the chemical changes take place that are necessary for the proper preparation of the food of the plants. The principal elements of the soil that enter into the plant food are nitrogen, potash and phosphoric acid, and these are most likely to be deficient in the soil, or in a state in wh ch they are inert, or not immediately available to the plant. Lime, magnesia and other elements of plant food, with the exception of nitrogen, potash and phosphoric acid, are generally to be found in soils in sufficient quantities for the requirements of a crop.

The sufficiency or deficiency of the three principal constituents of plant food, in a state fit for the plant to absorb them within the time required for its growth, will generally measure the fertility or barrenness of a soil, so far as its chemical constituents are concerned. The climate, as well as the physical state of a soil, has a great deal to do with the fertility of any soil.

The following analyses of some soils of Scotland, England, and Western Australia will give some idea of the chemical constitution of soils. The late Professor T. Anderson gave the following result of analyses :—

	1		2	
	Soil.	Subsoil.	Soil.	Subsoil.
Silica	74·5529	82·5874	61·1954	61·6358
Peroxide of iron ...	5·1730	3·4820	4·8700	6·2303
Alumina	6·9350	5·3250	14·0400	14·2470
Lime	1·2290	·9392	·8300	1·2756
Magnesia	1·0827	·8366	1·0200	1·3938
Potash	·3544	·1687	2·8001	2·1761
Soda	·4335	·0649	1·4392	1·0450
Sulphuric acid ...	·0443	·0970	·0911	·0396
Phosphoric acid ...	·4300	·1970	·2400	·2680
Chlorine	Trace	Trace	·0098	·0200
Organic matter ...	10·1981	4·8358	8·5508	6·8270
Water	2·6840	1·7670	2·7000	4·5750

No. 1 is a soil on the sandstone of the coal measure under the brow of the Corstorphine Hill, Midlothian. No. 2 is a soil from the Carse of Gowrie, Perthshire. Both of these soils are wheat soils and very rich in potash, especially No. 2.

The following are the results of some analyses of soils from different parts of England :—

No. 1 is a sandy soil from Staffordshire ; No. 2 is a clay soil from Cambridgeshire ; No. 3 is a loam soil from Kent (a hop soil) ; No. 4 is a chalk soil from Norfolk ; No. 5 is a peaty soil from Devonshire.

	1	2	3	4	5
* Organic matter and water ...	2·82	7·21	5·07	3·13	64·66
Oxide of iron	·92	5·77	3·63	1·52	13·96
Alumina	·88	4·45	3·51	1·63	
Carbonate of lime	·18	2·26	1·68	28·84	1·80
Magnesia	·12	·79	·42	·36	
Potash	·07	·76	·30	·18	
Soda	·06	·06	·01	·11	·98
Phosphoric acid	10	·16	·10	·15	
Sulphuric acid	·01	·10	14	·11	
Insoluble silica	94·84	78·44	85·14	63·97	18·60
	100·00	100·00	100·00	100·00	100·0c
* Containing nitrogen	·12	·16	·19	·18	2·47
Equal to ammonia	·15	·19	·23	·21	2·99

The following are analyses that I have made recently of some soils from different parts of Western Australia :—

	1	2	3	4	5	6
Moisture	·8286	1·6684	2·3950	2·0000	1·9560	7·0540
* Organic matter ...	3·4449	3·1546	3·9044	5·6829	5·4387	9·9862
Insoluble silica ...	90·3924	88·1200	71·7496	82·7640	78·5160	71·2940
Soluble silica ...	·1312	·2744	·1024	·1681	·1360	·1600
Phosphoric acid ...	0332	·0599	·0447	·0358	·0652	·0460
Oxide of iron and alumina	4·7908	6·1081	4·6512	9·1721	13·2028	10·9520
Carbonate of lime ...	·4160	·8000	16·9080	·6966	1·0160	·6880
Potash	·0310	·0979	·1117	·1134	·1394	·0982
* Containing nitrogen ...	·0275	·0435	·0442	·042	·084	·1918
Equal to ammonia ...	·0334	·0576	·0537	·051	·102	·2329

No. 1, from Midland railway, 183 miles, York gum and scrub country; No. 2, from Midland railway, 183 miles, morrel gum, 3 feet over limestone; No. 3, from Midland railway, 183 miles, sub-soil from No. 2; No. 4, from Armadale, slope of hill, white gum chiefly; No. 5, from Armadale, slope of hill, white gum chiefly; No. 6, from Armadale, alluvial soil, flooded gum, ti-tree, bracken, reeds.

	7	8	9	10	11	12
Moisture ...	1·7820	1·7120	·5160	1·0160	·5060	1·0960
* Organic matter	8·0475	6·1444	6·8940	4·2240	1·9940	1·9040
Insoluble silica ...	72·8360	85·4200	89·4750	90·6250	93·9750	93·2000
Soluble silica ...	·2800	·2900	·0700	·2000	·1790	·1590
Phosphoric acid	·1445	·0606	·0321	·0322	·0971	·0307
Oxide of iron and alumina ...	16·5035	5·6254	2·6779	3·6078	2·4231	2·3803
Carbonate of lime	·3160	·6280	·9200	·7350	1·1400	·9403
Potash	·1356	·0238	·0267	·0433	·0578	·0466
*Containing nitrogen	·006	·008	·119	·070	·042	·070
Equal to ammonia	·008	·010	·144	·085	·051	·085

No. 7, from Mooraloo district, mahogany; No. 8, from Mooraloo district, white gum; No. 9, from Coolup, near river, red gum and jarrah; No. 10, from four miles inland from Busselton, red gum, paper-bark, and peppermint; No. 11, from Mooranoppin, sand plain; No. 12, from Mooranoppin, salmon gum.

It will be seen from the analyses that soils contain some proportion of all the elements that enter into the plant food. In the analyses of the soils of this colony the magnesia and sulphuric acid were not determined, although they were present in small quantities. Good fertile soils in Europe contain from ·1 to ·43 per cent. of phosphoric acid, and from ·1 to ·2 per cent. of potash. These soils are more liable to be depleted of their phosphoric acid than their potash. In the soils of this colony the potash appears to be less in quantity than the phosphoric acid ; except in such places where the white gum and morrell gum are found growing, there the potash is from one to three times the amount of the phosphoric acid. It will also be noted that where the iron, alumina and potash are in large proportions in these soils, the lime decreases. No. 3 might appear to be an exception, but it is not, it is a limestone subsoil which has had some of the potash from No. 2 washed into it. That the lime should be low when the potash is high, and the potash high when the lime decreases, will appear natural, when we consider the composition of the rocks that the soils are formed from. The soils are chiefly made up from the granite or the trap rocks, or a mixture of both. Granites are mainly composed of quartz and felspar. The soil from granite will depend for its fertility on the class of felspar the granite contains ; whether it is a potash felspar (orthoclase), a soda felspar (albite) or a magnesia felspar (oligoclase).

The late Professor Anderson gives the following analyses of these felspars :—

	Orthoclase.		Albite.		Oligoclase.	
	1	2	1	2	1	2
Silica	65·72	65·00	67·99	68·23	62·70	63·51
Alumina	18·57	18·64	19·61	18·30	23·80	23·09
Peroxide of iron ...	trace	·83	·70	1·01	·62	none
Oxide of manganese ...	trace	·13	none	none	none	none
Lime	·34	1·23	·66	1·26	4·60	2·44
Magnesia	·10	1·03	none	·51	·02	·77
Potash	14·02	9·12	none	2·53	1·05	2·19
Soda	1·25	3·49	11·12	7·99	8·00	9·37
	100·00	100·00	100·00	100·00	100·00	100·00

The trap rocks are composed of felspar and hornblende. Sometimes augite replaces the hornblende. No matter which of these is in combination with the felsite, it will be seen from the following analyses that a soil made from the decomposition of such a rock would naturally be a complete and fertile soil, so far as its mineral constituents are concerned.

	Felspar.	Hornblende.
Silica	65·5	52·0
Alumina	18·5	12·0
Oxide of iron	trace	10·5
Oxide of manganese	,,	·5
Lime	,,	10·0
Magnesia	,,	15·0
Potash and soda	16·0	trace
	100·0	100·0

It would appear as if in a soil made from the disintegration of a trap rock the potash would be found in greater proportions than the lime, but it is not so, for the reason that, in the process of denudation, the potash is carried away in larger proportions, by the action of water and carbonic acid, either to a lower depth than the soil, or into water courses, where it is lost to the soil.

It will be quite evident from the above analysis that it will be very seldom found that lime will benefit to any great extent soils made from the disintegration of trap rocks after they have been brought into cultivation. That is what has been found in practice.

These soils derive a certain amount of phosphoric acid from the rocks that they are formed from, and it is less easily washed out of the soil than potash or lime, being more insoluble and not so easily acted upon by carbonic acid. The granites, including syenite, gneiss, and trachyte contain from ·2 to 1·5 per cent. of phosphoric acid. Trap rocks and red sandstone from ·5 to 1·5 per cent. of phosphoric acid. Limestones and marl from 1·2 to 3·5 per cent.

We have seen how soils obtain their potash and phosphoric acid. The analysis of soils that I have given show the amount of these plant foods. It is not only necessary to know the amount, but also what is available.

A soil containing ·1 per cent. of potash or phosphoric acid will contain from 3,500 to 3,800 lbs. per acre in a soil 12 inches deep. Yet that soil may be barren to a crop owing to the potash or phosphoric acid not being in a soluble enough state for the plant to absorb it in the time that it requires to mature in the soil. These analysis show potential power in the soil. Although we cannot imitate the action of the plants on the fertilisers, as we do not fully understand the process at the present time, we can approximate it so closely by treating the soil with very dilute acid that the results of such an analysis are correct for all practical purposes. Such an analysis is sometimes called a fertility analysis. The field analysis is probably the best for practical purposes, and will be treated with further on. It must not be understood that I place no value on these analyses; on the contrary, I place a high value on them with regard to the application of manures. The amount of those plant foods that are soluble in water is very small. Potash is more soluble than phosphoric acid, the amount of potash that is soluble in a soil varying from ·001 to ·010 per cent. Suppose the soil to be cropped contains ·001 per cent of potash, soluble and immediately available, and the total potash amounted to ·1 per cent., or 3,500 lbs. per acre of 12 inch soil, then the available potash is only 35lbs. per acre for the same depth. If no potash were added, and the soil cropped with mangels, you could not get a full crop, as that would require the soil to give up about 180 lbs. of potash. Although the soil contained 3,500 lbs. of potash, and a full crop required only 180 lbs. per acre, there would be either no crop or a very poor one, as the 35 lbs. of potash would be so diluted, being spread over so much soil, that the plants would not obtain enough nourishment to maintain their growth. Or if a crop of potatoes were planted in that soil the same thing would happen. A full crop of 6 tons would take 76 lbs. of potash from the soil.

The potash in the soil is brought into an available state by various agencies, such as the action of water and carbonic acid. Gypsum also acts on the insoluble potash compounds and frees the potash. Tillage has a great influence in liberating the constituents of the soil by breaking it up and exposing new surfaces to the action of water and carbonic acid, as well as to the action of the oxygen of the atmosphere. There are other influences at work which increase the fertility of a soil, such as the earth worms, but these will be treated more fully in dealing with the biology of the soil.

Phosphoric acid, like the potash, must be in an available state and in sufficient quantities for the requirements of the plants. Phosphates are very insoluble in water, and plants cannot assimilate solid mineral matter. It must be dissolved in water before the plant can take it up into its system. The plants have a power in their roots of dissolving phosphates by the action of the acids they contain acting on the phosphates and dissolving the phosphoric acid.

For this to take place the phosphates must be within the reach of the roots. As the acids that are exuded from the roots are not very strong in their action, for them to have full power the phosphates should be in a fine state in the soil. Inorganic salts, sulphates and nitrates, especially the nitrates, have the power, to some extent, of decomposing natural phosphates, but natural humic compounds, in the state they occur in arable soils or peaty earth, do not decompose natural phosphates. The humoid products of the decomposition of farmyard manure have scarcely any effect on natural phosphates ; nor has carbonic acid from the decomposition of organic compounds any effect in accelerating the disintegration of the natural phosphates, at least not to any practical degree.

I have been treating only of the mineral constituents of the soil, but no less necessary is the organic matter of the soil to its fertility. If the organic nitrogen was not in the soil in sufficient quantity and readily available, although the potash and phosphoric acid were there in the best proportions, the soil would be either barren or produce but very small crops. The nitrogen, before it can be absorbed by the plant, must be converted into nitric acid or a nitrate. This is accomplished through the agency of micro-organisms in the soil. This brings us now to the consideration of the biological properties of soils.

Every cultivated or fertile soil has within it an enormous number of bacteria; in fact, the soil is generally said to be teeming with them. The number that is estimated to be contained in 15 grains of soil is variously stated to be from one half to a million. These micro-organisms are the silent workers in the soil that prepare the necessary food for the plants, as the plants themselves are not capable of absorbing nitrogen in the state in which it is found in organic matter. The importance of these micro-organisms to the agriculturist is very great. The soils should be kept in a condition most suitable for these micro-organisms to fully carry out their proper functions. If the soil is not kept in a condition suitable for the nitrification of the organic nitrogen, the very opposite effect may be produced, and loss may take place in the soil by another class of bacteria, which causes the dentrification of the nitrates in the soil with liberations of free nitrogen.

Our knowledge of the nitrification of the organic nitrogen in the soil is of recent date. The first to discover that it was caused by the action of bacteria in the soil were the two French chemists, Schloesing and Muntz, who announced their discovery in 1877. It was not till 1890 that we knew the true action of the bacteria on nitrogen in the process of nitrification, when R. Warington and Professor P. Frankland discovered and isolated two different bacteria or micro-organisms that take part in the process of nitrification. One of these bacteria acts by converting the nitrogen into nitrites, and the other converts the nitrites into nitrates, in which state the plants can absorb it.

They appear to be able to obtain their carbon from a purely mineral source when no organic matter is present—a fact that is opposed to our previous ideas of those micro-organisms, as it has always been held that micro-organisms must obtain their carbon from a vegetable source. The conditions necessary, or favorable, to nitrification are that phosphoric acid must be present for nitrification to take place ; it requires the presence of an alkaline base such as carbonate of lime for the nitric acid to combine with as it is formed. The presence of carbonate of soda, except in minute quantities, has a prejudicial effect, or may stop the process entirely. Gypsum has been found to have a good effect. It probably acts by neutralizing the excess of alkalinity, which stops the process.

Oxygen is necessary to the development of these micro-organisms. If the air is excluded they are certain to die. They can only develop in a soil that has a good supply of air. This will show the necessity of a good tillage. The better the soil is tilled the more freely will the air have access to it. Moisture in the soil is necessary, and absence of light. Nitrification takes place best at 99° F., and diminishes from that down to 40° F. and up to 130° F. Certain substances are poisonous to these micro-organisms ; common salt, for instance.

There are other bacteria that act in quite the reverse way to the nitrifying micro-organisms by decomposing the nitrates in the soil. These bacteria are only active when air is excluded from the soil, or when the air is limited in the soil and it contains large quantities of organic matter which uses all the oxygen for its oxidation. These conditions will be found in water-logged, peaty, heavy and badly tilled soils.

There is a third class of bacteria, which are only active in the presence of leguminous plants. They fix themselves on the roots of these plants, and by their action, combined with that of the plant itself, are able to convert the nitrogen of the atmosphere into a state in which the plant is able to assimilate it. The conditions necessary are much the same as for nitrification. No other plants have this power except those of the leguminous order. It is for this reason that leguminous plants enrich the soil with nitrogen.

Nitrification usually takes place near the surface ; at least, very little takes place at a depth below 18 inches. The depth to which it takes place will greatly depend on the openness of the soil. Roots assist greatly in allowing nitrification to take place at a greater depth by allowing free access of air to the depth they go down. Drainage has the same effect by opening channels for the passage of the air to a greater depth and removing any excess of water from the soil, which would otherwise prevent the free passage of air through it.

Ammonia is the easiest of all the nitrogenous compounds to convert into nitric acid through the agency of these micro-organisms. The earthworms, when present in great numbers, play a very important part in the amelioration of a soil. Feeding on the organic matter of the soil, in order to secure a sufficiency of food they have to pass a very large quantity of earth through the intestinal canal, which they deposit at the mouth of their burrows as a fine earth or casting. These castings contain a very large quantity of organic matter and other plant food readily available for the plants, so that the surface of the soil is enriched by fertilisers brought from a depth by the earthworms. The organic and mineral matter in the castings are thoroughly mixed together in such a state that each of the elements of plant food are easily obtained by the plants. By means of the burrows which the earthworms make in the soil, water can penetrate to a much lower depth, and air can penetrate more freely along their passages. By the combined action of the freely admitted air and water large quantities of mineral and organic matter are converted into plant food.

The soil is made up of organic and inorganic matter. The inorganic matter is the result of the decomposition of rocks, and the organic matter, or humus, from the decomposition of vegetable or animal matter.

There is a certain amount of vegetable matter in the soil derived from leaves, branches, and roots of previous crops, which decay by oxidation, or slow combustion from the action of oxygen on the vegetable matter, or from the combined action of oxygen and the micro-organisms in the soil. The organic matter, or humus, is converted into nitrates and carbonic acid, which acts on the mineral matter in the soil by converting some of the inert food in the soil into active food for the plants. The percentage of organic matter, or humus, in a soil is, to a great extent, a measure of that soil's fertility. The amount found in a good soil is from 5 to 10 per cent. Humus is not directly a plant food, but the product of its decomposition is a very rich source of plant food. Humus is very insoluble in water, but has a very high power of absorbing and retaining moisture. Humus has also the power of absorbing or fixing ammonia. The humates have the power of fixing bases, such as potash, soda, lime, magnesia, carbonates, or, in other words, they combine with these bases to form insoluble humic salts. When a soil contains too much humus, as in a wet peaty soil, it is very liable to contain free humic acid, which is poisonous to plants. The best cure is drainage and a liberal dressing of lime, which neutralizes the free acid. Light sandy soils are very light in humus. Most of the soils of this colony are low in humus, therefore they are greatly benefited by the application of farmyard manure, which adds a large amount of humus, or organic matter.

Green manuring is valuable for the same reason, and improves the soils physically as well as chemically. If such crops as mustard, lupins, vetches, or peas are grown and ploughed in when they come to flower, they not only enrich the soil with organic matter, but they bring up mineral matter fit for plant food from a lower depth by virtue of the length of their roots, which go down into the soil in search of food. They return not only all they took from the soil, but also what they obtained from the nitrogen of the atmosphere.

Burning some of the surface clay on a heavy clay soil is a means of rendering that class of soil more porous. Clay is a hydrated silicate of alumina. When wet it forms a stiff plastic mass impervious to water and difficult to work. When clay is burned it loses its power of hydration and is no longer plastic when mixed with water. The clay is made into a heap on some timber, which is then fired. It is burned until it assumes a red color. It is then scattered on the land, which by this means is made more porous.

Mixing of soils, as I have already said, greatly improves them both physically and chemically. The addition of sand to a heavy clay makes it more pervious and admits of a freer circulation of water and air through it. Water is one of the most necessary elements of the plant food ; at least it is required in larger proportions than any of the others. Water to be of any use to the plant must be a moving water and well ærated.

If the subsoil is a heavy clay the water gets stagnant in it, and does not allow a free passage of atmospheric air. The organic matter decomposes very slowly, forming poisonous organic compounds, which are retained in the deep soil. The roots of the crop passing down into the deep soil in search of food come in contact with these poisonous substances and die off. What was, up to that time, a strong healthy crop, sickens and droops, till it either dies away or remains of a stunted growth. Even if the roots do not pass down to these poisonous substances, as soon as the surface water evaporates, there will be an upward movement of water which will affect the crop more or less according to the amount of these deleterious substances it carries with it from below. Hence the great necessity of deep drains on heavy clay and peaty soils. The drainage of the soils increases their fertility in several ways. Wet soils are cold, and lack a genial warmth. After a long drought they contract and crush the roots, and do not allow the free passage of the roots through them in search of food. When the quantity of water in a soil is too great, the food for the nourishment of the crops will be in a very diluted condition, and the plant will require to absorb a very much larger quantity of water than is necessary for its proper growth. The presence of so much water in the plant will necessitate a greater evaporation from the leaves, thus producing a lower temperature in the plant than is natural to it, thereby delaying the chemical changes that take place during the plant's growth. The water being carried into the drain will take with it the injurious compounds out of the reach of the roots of the plant. It will cause a downward flow of water, which will carry with it a good supply of fresh air into the soil, which is necessary to its fertility. The free passage of air into the soil causes a rapid oxidation of the vegetable matter, converting it into plant food, carbonic acid, and prevents the formation of noxious acid compounds. The decomposition of the mineral matter in the soil fit for plant food is then more active. The formation of hardpans is greatly prevented by keeping the subsoil open. Soluble plant food is carried down to the roots from the surface.

Tillage improves the soil by dividing the particles of the soil more minutely, rendering it more open and light, and allowing an easier access of air and a freer passage for the roots in their search for food. By turning over the soil more of the insoluble particles are exposed to the weathering agents for the preparation of the available plant food. Nitrification is more active when there is a good tilth. The roots find their food more easily, as well as an abundant supply of oxygen for the further preparation of supplies. Soils lose their water by two means—transpiration, that is, through the leaves of plants, and evaporation from the surface of the soil. The soil draws to the surface water from its deeper store by capillary attraction. Ploughing and surface cultivation by widening the capillary tubes and breaking their continuity, lessens the loss by capillary attraction.

A well-tilled soil enables more plants to grow on the same space of land, as the roots do not require to spread themselves in search of supplies, but can go down deeper for them. Hoeing and scarifying not only destroys the weeds but prevents too great an evaporation from the surface of the soil by breaking up the continuity of the capillary tubes, and more air enters by the loosening of the surface soil. A good tilth is necessary for the preparation of a good seed bed.

Lime improves land and increases its fertility by acting on the insoluble potash compounds in the soil and liberating the potash. It decomposes organic matter and promotes nitrification. It fixes phosphoric acid in the soil. It neutralises the acidity in peaty soils, and in soils that are deep and heavily charged with organic matter. It specially improves clay soils by precipitating the fine floculent particles of the clay, and prevents it from puddling, thereby making it easier to till. Lime should not be put into the land at the same time as ammonia salts or nitrogenous organic matter, as this would cause a great loss of nitrogen. Lime does no good in poor or sandy soils ; in fact, it does them more harm than good, as these soils, being poor in organic matter, the action of lime would be, by reason of its rapid action on the organic matter, to make them poorer still. If it is necessary that these poor soils should have lime, it is best added as phosphate of lime or as gypsum.

The best method of improving the soil is by a judicious application of manure in conjunction with good tillage. The judicious application of manure pre-supposes a knowledge of what elements of the plant food are deficient in the soil. That information can be obtained by a chemical analyses, or by the field or plot analyses of the soil. There is no soil, no matter how poor it may be, but can be made fertile by the proper addition of manure.

I have already spoken of the chemical analyses of the soil, and will now describe the method of conducting the field or plot analyses. Under manures and manuring I describe the methods of analysing the soil by field or plot experiments for one class of crops. It is better and more thorough to test the soil with two classes of crops, a deep rooted one and a surface feeder, such as wheat and potatoes. It would show at once whether the s il was deficient in any of the plant foods for surface and deep-rooted feeders. The experiments are made in the following manner :—Each plot to be the same size, say about one-tenth of an acre, and may be either square or rectangular. A small path divides each plot, and a stake must be placed at each corner of the several plots to mark their boundaries. The following is a plan of the blocks :—

1	2	3	4	5
A	B	C	D	E

1 to 5 are sown with wheat. No. 1 gets no manure ; No. 2, a complete wheat manure ; No. 3, the same manure as No. 2, with potash left out ; No. 4, the same manure as No. 2, with nitrogen left out ; No. 5, the same manure as No. 2, with phosphoric acid left out. In each of these plots the straw and grain are to be weighed separately.

A to E are planted with potatoes. E gets no manure ; D gets a complete potato manure ; C, the same manure as D, with the exception of phosphoric acid ; B, the same manure as D, with the exception of potash ; A, the same manure as D, with the exception of nitrogen.

In the case of the wheat plots, Nos. 1 to 5, if the soil required no manure, then No. 1 would be as good, or nearly so, as Nos. 2, 3, 4 and 5 ; but if the soil needed manure then No. 2 would be much better than No. 1. If 2 was much better than 3, 4 or 5, then a complete manure was required. If either 3, 4 or 5 was as good as 2, that part of the complete manure was not required and could be left out.

In the case of the potatoes the same reasoning will apply to them as to the wheat, but the results may not come out the same. The wheat might show enough of potash and the potatoes a deficiency, then the surface was short of potash, while there was enough at a depth, or in the subsoil. Or the potatoes might show a good supply of phosphoric acid, while the wheat was deficient, showing that there was not enough for deep-rooted crops. Something of the same kind might happen with the nitrogen.

After the exact condition of the soil is known, then you are in a position to say what manure should be used for any given crop. After the crop has been gathered and weight is known, then, by reckoning from the table of the ash of different crops given under manures and manuring, you will find out how much the crop has taken from the soil of nitrogen, potash and phosphoric acid. Deduct that from the different amounts in the manure used, the condition will give you the condition of your soil for the next crop, and so on from year to year.

It must be remembered that ammonical salts or nitrates cannot be reckoned beyond one year, but if leguminous crops have been sown, they enrich the soil in nitrogen.

CHAPTER II.

MANURES AND MANURING.

There are many systems of farming in different countries. While some of these are governed by the differences in soils and climate, others are the results of the investigations of scientists into the requirements of the soils and plants in order to ensure a healthy growth. What is best suited to one country is not always the best for others with differing soils or climate. It cannot be expected that a system of farming which would suit the cold climate and damp soils of England would in every way suit the warm climate and light soils of Western Australia. Each country has, in a measure, to investigate the matter for itself, that is, so far as to the method and time of applying manures to the maintenance of its soils in a fertile state, and also as to the class and quantity of manures it is best to apply. The food that is required by any particular plant in one country is just the food that will be required by the same kind of plant in another country ; so we are not called upon to investigate the actual food required by any given plant, as we have plenty of records of a large number of practical and scientific investigations on this subject from a great many parts of the world ; but what we are called upon to investigate is how best to apply the plant food required by the crops in this climate so as to produce a good and profitable crop to the producer. It is the first principle of husbandry to produce at a profit. To do so the farmer must first know what is the food required for the plant he intends to grow ; then to ascertain if the soil contains that food in sufficient quantity to maintain the plant during its growth ; and not only to know if it is there in sufficient quantity, but whether it is in a state that the plant can easily assimilate. If the soil does not contain sufficient food for the plant, or it is in such an insoluble state that the plant cannot assimilate it in sufficient quantities for its requirements, it will be necessary for the farmer to supply what is deficient in the soil to maintain the plants, and to supply it in such a state that the plants can easily absorb it.

The foods that are required by plants in varying quantities are nitrogen, phosphoric acid, potash, lime, magnesia, soda, silica, oxide of iron, sulphuric acid and chlorine. Most soils contain these in sufficient quantities for all the requirements of any crop, but unfortunately they may not be in a condition for the plants to absorb them. More especially does this apply to the phosphoric acid and potash. Of the constituents of plant food, nitrogen, phosphoric acid, and potash are the most useful, and are generally in smaller quantities in the soil than any of the others enumerated. Plants require more of these three substances than any of the others, therefore the soil is more easily depleted of them, and we shall in consequence have to deal mostly with them. These three substances must not only be in the soil, but they must be made easily soluble, so that the plant can absorb them as they are required. The soil may contain more than twenty times the amount of potash required by any crop, and yet be barren to that crop, simply because the plant and the other agencies that assist the plant had not the power to cause the disintegration of the insoluble compound, that the potash was in combination with, quickly enough for the requirements of the plant. No crop is likely to take more potash out of the soil than 150 lbs. per acre, and very few as much as that. A soil may contain as much as ·1 per cent. of potash, that is equal to 3,500 lbs. of potash per acre in a soil 12 inches deep. Yet, with all that amount in the soil, the crop sickens and refuses to grow, or is of a stunted growth, simply because the potash was not then available for its requirements. The same remarks apply to nitrogen and phosphoric acid. If either of these were not present, or in a state not immediately available to the crop, that soil would be in a state from barren to that of being able to grow only small crops. While it is necessary to maintain a proper supply of available food for the plant, care must be taken that neither of these substances are supplied in too great an excess of the requirements of the plant, as they may act deleteriously to the growth of the plant, or even act as a poison. This is brought about by over manuring and using a rotation of crops that takes up chiefly the same foods. Such a system is not only expensive and a waste of valuable manure, but very often gives short crops. Different plants take up different proportions of nitrogen, phosphoric acid and potash, according to their likings and requirements. Whatever they require most must either be in the soil or supplied to them in proportions according to their needs, by manuring.

Some plants have a greater capacity for the assimilation of certain constituents of their food than others, although the one with the greater capacity for assimilation may not require so much of that particular kind of food as the other. For instance, mangolds have a less capacity for assimilating nitrogen than turnips, but they must be given a rich nitrogenous manure, as they need and take more nitrogen than turnips, which requires a phosphatic manure. Again, wheat sown in the winter has a longer time to gather nitrogen than barley sown in the spring, which, being a shorter time in the soil, requires a more active nitrogenous manure.

As a rule the different plants in a class of crops resemble each other in this respect. Thus, the cereals or gramineous crops have a small capacity for assimilating nitrogen, therefore they require a liberal supply of nitrogenous manure. The leguminous crops such as beans, peas, clover, etc., have a small capacity for potash, and require a good supply of potash. Roots generally have a small capacity for assimilating phosphoric acid, and require a phosphatic manure.

When the soil is cropped, the crop abstracts a certain amount of the substances necessary to the nutriment of plants, which, if carried away, will impoverish the land to the extent of the amount of the different elements of nutrition that the crop has abstracted from the soil. To maintain the fertility of the soil, that which was abstracted from the soil must be put back into the soil, such as in green manuring where the crop is ploughed into the soil, or it must be made up by the addition of artificial manures.

Before we can put in an amount equivalent to what was abstracted we must first know what has been abstracted and the amounts. That we get by an analysis of the ash of the crop.

The tables I. and II. will give some idea of what the different crops extract from the soil.

TABLE I.—The composition of the ash of plants in per centage (excluding carbonic acid) :—

	Potash.	Soda.	Magnesia.	Lime.	Ferric Oxide.	Phosphoric Acid.	Sulphuric Acid.	Silica.	Chlorine.
Wheat grain	31·54	2·66	12 10	3·14	trace	48·50	·08	1·88	·10
Barley grain, with husk	21·28	4·00	9·10	2·40	·15	33·17	2·10	27·50	·30
Oat grain, with husk	37 48	2·40	7 80	3·00	·60	20·80	1·80	25·90	·22
Rice grain	23 70	4 00	12·10	3 15	trace	55·00	·05	2·00	trace
Indian corn	37·95	3·00	7·50	3 40	·40	44 80	1·50	1 45	trace
Peas (pods)	45·40	2·00	8 00	5·50	·85	32 55	4 73	·67	30
Beans (pods)	42·50	3·34	7 30	6·00	·40	34·66	3·50	·90	1·40
Flax seeds	30·55	2 61	16·23	9·45	·38	35·99	1 43	1 76	1·70
Potatoes (tubers)	61·60	1·00	5·00	2·40	·85	17·67	6·25	1·00	2·23
Yellow globe mangels	35 09	28·90	2·50	2 50	66	6·16	3·19	3·00	18 00
Long red mangels	25 18	32·10	2·26	2·20	·50	2 16	4·00	1·60	30 00
Cow cabbage leaves	34·85	4 60	4·40	19 60	·17	16·63	17 31	2 44	trace
Carrot root	41·46	17 60	5·36	18 86	·32	12·68	6·93	2·00	4·70
Wheat straw	12·16	1 00	4 00	6 82	1·02	3·20	5·78	65·34	·60
Oat straw	20·60	6·00	3·60	8 10	0·83	4·16	13 32	50 08	3·25
Barley straw	19 32	4 50	2·70	7·00	·26	4 83	3 78	56·85	·76
Pea straw	22·00	6·00	7·34	39·00	1 08	6 84	6 30	6·18	5·26
Red clover hay	31·86	2 16	12·16	31·09	·66	9 00	3·03	6 71	3·33
Meadow hay	26·80	5 80	4 32	12·86	·76	6 95	4·45	31·04	7·02
Grasses in Flower: Bromus erectus ..	25 92	50	4 80	10·20	·23	8 00	5 42	38·10	6 83
Grasses in Flower: Solium perenne ..	30·79	9·90	8·25	3·00	trace	9·00	5·20	21·56	17 30
Grasses in Flower: Annual rye grass ..	27·07	2·87	2·59	6·82	·28	10·07	3 45	41·79	3·06

Table II.—The average amount of ash, nitrogen, phosphoric acid and potash per cent. and per ton in some plants :—

	Per cent.				Pounds per Ton.			
	Ash.	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Ash.
Wheat grain	1·9	1 8	·85	·53	40·32	19·04	11·87	42·56
Wheat straw	5·0	·45	·24	·80	10 08	5·38	17 92	112 00
Barley grain	2 2	1 65	·75	·55	36·96	16·80	12 32	49·28
Barley straw	4 5	·40	·18	1·00	8 96	4 03	22·40	100 80
Oats grain	2·8	2·00	·60	·50	44·80	13 44	11 20	62·72
Oats straw	5·4	·50	·24	1·00	11·20	5 38	22 40	120 96
Beans grain	3·0	4·00	1·10	1·30	89·60	24 64	29 12	67·20
Beans straw	5 0	·90	·30	1·00	20 16	6·72	22 40	112·00
Peas grain	2·5	3 60	·85	·96	80·64	19·04	21·50	56·00
Peas straw	5·5	1 00	·35	1·00	22·40	7·84	22·40	123·20
Indian corn	1·4	1·7	·60	·37	38·08	13·44	8·29	31·36
Clover hay	7·0	2 40	·57	1·50	53·76	12 77	33·60	156·80
Meadow hay	6·5	1·50	·40	1·60	33·60	8·96	35·84	145 60
Turnips, yellow ..	·65	20	·06	·22	4·48	1·34	4 92	14·56
Turnips, white ..	·68	·18	·05	·30	4 03	1·12	6 72	15·23
Turnips, Swedish ..	·60	·25	·06	·22	5 60	1·34	4 93	13 44
Potatoes	1·0	·25	·15	·55	5 60	3 36	12 32	22 40
Mangel wurzel ..	1·0	·22	·07	·40	4·93	1·57	8·96	22·40
Carrots	·9	·20	·09	·28	4 48	2·02	6·27	20·16
Parsnips .. .	1·0	·22	·19	·36	4 93	4 26	8·06	22·40

In table I. we see the actual components in 100 parts of the ash or mineral matter taken from the soil by various plants.

No. II. gives the amount of ash, nitrogen, phosphoric acid, and potash in 100 parts of the different crops mentioned. They are also reckoned out to lbs. per ton of the crops.

It would seem from table II. that the leguminous plants require a larger supply of nitrogenous manures than the cereals, as they contain more nitrogen. They do not require more, in fact, they are more benefited by potash. The reason for them containing more nitrogen than the cereals is that they have the power of absorbing nitrogen from the air, a power not possessed by other plants, in fact, they are considered to enrich the soil with nitrogen. Thus it is that cereals which require a good supply of nitrogen, should follow leguminous crops in the rotation. To show how severe some crops are on the fertility of the soil we will take the case of wheat and potatoes. Suppose we had a crop of, say 30 bushels of grain and 3,100 lbs. of straw per acre. If the grain alone was sold off the farm it would carry away 34¼ lbs. of mineral matter, containing 15½ lbs. of phosphoric acid, equal to 113 lbs. of superphosphate of 30 per cent. tricalcic phosphate made soluble ; 9½ lbs. of potash, equal to 68 lbs. of kainit and nitrogen, 32½ lbs., equal to 162 lbs. of a 97 per cent. sulphate of ammonia. If the straw was also sold, as in the case of chaff, it would take away 189·2 lbs. of mineral matter, containing 21½ lbs. of phosphoric acid, equal to 153 lbs. of superphosphate; $34\frac{1}{2}$ lbs. of potash, equal to 245 lbs. of kainit; and $46\frac{1}{2}$ lbs. of nitrogen, equal to 232 lbs. of sulphate of ammonia.

In the case of potatoes, a crop of six tons per acre would abstract $134\frac{1}{2}$ lbs. of mineral matter, containing 20 lbs. of phosphoric acid equal to $145\frac{1}{2}$ lbs. of superphosphate; 74 lbs. of potash, equal to $528\frac{1}{2}$ lbs. of kainit; and $33\frac{1}{2}$ lbs. of nitrogen, equal to $167\frac{1}{2}$ lbs. of sulphate of ammonia.

Thus it would not be advisable to follow a wheat crop with another nitrogen-loving crop without giving it a liberal supply of a nitrogenous manure; nor to follow potatoes with a crop that needs potash and phosphoric acid without giving a good supply of both. I have already stated that a soil may contain twenty times more of a certain plant food than any plant requires, and yet that soil may be barren. The reason for this is, that it is in combination with other substances that are very insoluble, such as potash in combination with silicates. The plant has not sufficient power in itself to decompose them, and the actions of the disintegrating agents, such as carbonic acid, water, etc., are too slow for the immediate requirement of the plants. If it were not so, the whole, or nearly the whole of the potash and phosphoric acid would be lost to the soil in one year. Ploughing the land assists greatly in the disintegration of the soil and in freeing the potash and phosphoric acid by exposing fresh surfaces to the action of oxygen, carbonic acid and water. A manure may also be in such a physical state as to be of no use to the plant. A bone manure is a good manure when the bones are ground fine or are dissolved. If bones in pieces were put into a soil with a crop of wheat that is entirely dependent on the bones for its supply of phosphates, it would simply die off, as it could not obtain enough phosphoric acid from the bones to allow it to live. Or another case which may be more to the point, if raw mineral phosphates were used in a tolerably fine state, the result would be that there would be either no crop, or one not worth cutting. This does not include Thomas' phosphate manure. The mineral phosphates to be of any good would require to be ground extremely fine, so that the different solvent agencies could have a greater surface to act on. At the best they would prove unsatisfactory. It is false economy to manure the ground, the crop is what should be manured in high class farming. Manuring the ground is not only costly and wasteful, but requires a very long purse and a great deal of patience, and in the end is unprofitable. Give to the crop what it needs so that it can make a rapid and healthy growth, and let next year's crop look out for itself. No crop can take all out of the soil, so there is bound to be some left for next year.

The soils derive their phosphoric acid and potash as well as the other mineral constituents, from the rocks from which they originated, by a process of disintegration and denudation. The different rocks contain different amounts of mineral matter fit for plant food. Those soils derived from the green sandstone, trap-rocks, lavas and millstone grits are generally considered the most fertile. It is, then, quite evident that the phosphoric acid and potash is inert to plant life until they are freed from their silicates by some decomposing agency.

The organic matter is derived from the dead vegetables and animals that lived on the land. The most of our knowledge of how plants absorb the organic matter they contain has been obtained within the last fifty years. The carbon is generally considered to be absorbed from the soil and from the atmosphere. The manner in which the plant absorbs its nitrogen has in the last half century given rise to a good many theories and occasioned no small amount of contention between scientists until twenty years ago, when a solution of the problem was given by the discovery in 1877 of the two eminent French chemists, Schloësing and Müntz, that soils were teeming with micro-organisms, or bacteria, converting ammonia salts and nitrogenous matter into nitrates, in which state the plants absorb their nitrogen. This has been investigated by a great many chemists, but the investigations of the two English chemists, R. Warington and Prof. P. Frankland, fully explained the real action that takes place in the soil. They found that there are two different bacteria at work in the soil in the process of converting the nitrogen into nitrates. The one converts the ammonia salts and nitrogenous matter into nitrites, and the other converts the nitrites into nitrates, in which state the plants absorb the most of their nitrogen. In the case of the leguminous plants they have a power of absorbing nitrogen from the atmosphere which is not possessed by other plants. This power of absorbing nitrogen direct from the atmosphere is obtained through the agency of another micro-organism ; but the manner of their actions on the leguminous plants is at present not known.

This process of converting nitrogen into nitrates is called nitrification, and is of the utmost importance to farmers. Every farmer should know the conditions under which nitrification takes place. There is still another micro-organism which, under certain conditions, acts the very reverse of nitrification, and causes a loss of nitrogen.

R. Warington gives the following conditions for nitrification to take place :—First, in moist soil ; second, when the soil is sufficiently porous to admit air ; third, the process is most active in summer, and ceases at the freezing point of water ; fourth, gypsum, carbonate of lime, potash and soda compounds promote nitrification; fifth, the nitrifying bacterium cannot live in presence of light ; sixth, the bacterium of nitrification can only live at certain depths in the soil, it is not generally found in the subsoil. He found no nitrification going on at a depth of seven feet ; seventh, ammonia is always one of the products formed when dung is decomposed. The bacterium is supposed to be capable of converting this ammonia into nitric acid.

Nitrification will not commence if the alkalinity of the ammonia solution exceeds four hundred parts of nitrogen per million, and an alkalinity far below this figure retards nitrification.

Nitrification is more vigorous in the autumn than in the spring. If the land is allowed to be bare in the autumn there is liable to be a great loss of nitrogenous matter. It would be best to put in a catch crop and plough it in as it begins to flower.

Denitrification is the reverse of nitrification. It is the result of the action of a micro-organism or bacterium on the nitrates, which it decomposes and sets the nitrogen free, which escapes into the air, causing a loss of nitrogen.

It occurs in soils that are water-logged, or in soils with a large amount of organic matter, such as peaty soils, that oxygen cannot enter. There not being enough oxygen in the soil to allow nitrification to take place, the denitrifying bacteria become active. It cannot take place in free open soils. A plant not only requires nitrogen, potash, phosphoric acid, and the other constituents that are found in the ash for its maintenance ; it requires water just as much as any of the other parts of its food, and in greater proportions. If the plant cannot get enough for its requirements, it sickens and shrivels up. Different soils have different powers of absorbing and retaining water. Soils with a large amount of humus, or decayed vegetable matter, have the power in the highest degree ; light sandy soils possess it in the lowest degree ; clay, not much less than those with a large amount of vegetable matter.

Schubler gives the following table as the absorptive power of the different soils at 60 deg. Fahr. :—

	Per cent. of water absorbed by 100 parts of earth.
Siliciqus sand	25
Gypsum	27
Calcareous sand	29
Sandy clay	40
Strong clay	50
Arable soil	52
Fine calcareous earth	85
Garden earth...	89
Humus	190

Schubler in the following table gives the rate of evaporation in different soils at 60 deg. Fahr. :—

	In four hours. Per cent.	Time required to evaporate 90 per cent.
Quartz	88	4hrs. 4min.
Limestone	76	4 ,, 44 ,,
Sandy clay... ...	52	5 ,, 1 ,,
Stiffish clay ...	46	6 ,, 55 ,,
Loamy clay ...	46	7 ,, 52 ,,

	In four hours. Per cent.	Time required to evaporate 90 per cent.
Pure grey clay ...	32	11 hrs. 17 min.
Loam	32	11 " 15 "
Fine calcium carbonate	28	12 " 51 "
Humus	21	17 " 33 "
Magnesium carbonate ...	11	33 " 20 "

Light soils are not able to stand a drought or a dry season. To improve light soils, dressing with clay, a liberal use of well-rotted farmyard manure, also ploughing in green crops, makes them more retentive. Carbonate of lime (ground limestone), and magnesium salts assist both the absorptive and retentive powers of a soil.

Plants not only have special likings for certain kinds of food, but they have also special likings for certain soils, at least they thrive best on certain soils.

Wheat thrives best in a clay soil.

Oats and clover in heavy and compact soil.

Barley and turnips in open and free loam.

Maize in open, free and even sandy soil.

Potatoes in open rich sandy soil.

Rye in sandy soil.

Rice in a stiff, wet, impervious soil.

Beans and peas in stiff, well drained clay.

Cocoa tree in a sandy soil of the coast.

Cotton in dry open alluvial, dry and porous uplands, hot, dry, and somewhat droughty climate.

Tea plant on warm sloping banks, or light dry loam, free from clay.

Earth nut in light sandy soil.

Oil palms in moist sea sand.

Cinnamon tree in almost pure sand.

Hops in fat and fruitful land, open, rich, and calcareous loam.

Date in sandy but well watered places.

Coffee in rich dry soils and warm situations.

Although they do best in these classes of soils the most of them can adapt themselves to other soils, but generally with a change as to quality and quantity. It is well known to farmers that different districts, or in other words, different soils, influence not only the quantity of a crop, but also the quality.

Oats grown on a clay are of the best quality. Barley on a clay land may give a good crop, but the quality is not so good for malting as that grown on sandy marls. Potatoes grown on clay soils are generally waxy, and those on sandy soils mealy. The late Prof. T. Anderson investigated the influence of different soils on turnips, as to their quality for feeding stock. He examined those grown on heavy clay land. Second. Those grown on the black land between the clay land and the hill land. Third. Those grown on the hill land or light loam. He found that those grown on the light loam had a value almost twice as great for feeding purposes as those grown on the clay. Those in the black land were almost intermediate between the clay and light loam.

It has been shown that soils with the lack of one of the elements of plant food can be wholly barren to a crop. While that is so, any barren soil, even pure sand in which there is none of the elements of plant food, can be made fertile by the judicious addition of artificial manures.

We will now examine the manures; what they are composed of and how they are made.

Manures, or Fertilisers.

It is the general practice to divide them into three classes, and this division I intend to follow.

1. Natural or organic manures. This does not include guanos, or those obtained from deposits in the earth, such as mineral phosphates or other salts.
2. Artificial manures.
3. Special manures.

Natural or organic manures are composed of decayed vegetable matter, the refuse from animals or the organic parts of animals and fish. They may even be a mixture of all these. They depend principally on the organic matter they contain to be classed as manures, especially that of their nitrogen, which is high. They have a low manurial value as regards their mineral matter.

1. Farmyard manure, or the excreta of animals with a mixture of vegetable matter such as straw.

This is considered by a great many farmers to be a typical or complete manure, that is, that it contains all the ingredients necessary to the growth of a crop. While this is the case, it is, nevertheless, far from being a complete manure, as the ingredients are not in the best proportions. The mineral matter is there in very small quantity, and in a state that a plant cannot easily assimilate, as it is so insoluble. The nitrogen is also very insoluble and slow in its action. It is generally considered that farmyard manure has a very slow action in supplying food to the plant for the first year as compared with other manures. A great many experimentalists and scientists place a very small value on it as a manure. Ville and Leibig attach very little importance to it. Ville says an artificial manure can be made to give better results and at a less cost. Leibig says, if no other manure was used, the soil would become almost barren to some crops. Sir J. B. Lawes says, all labour spent on the dung adds certainly to the cost, but does not add with the same certainty to its value.

On his Rothamsted farm he used most of the farmyard manure that was made on the farm, for mangolds. It depends mostly on its nitrogen for its manurial value, in fact it is virtually a nitrogenous manure. It contains only about 48 lbs. of plant food per ton

The nitrogen in farmyard manure is not half so valuable as the nitrogen in ammonia sulphate, as it is so very slowly available. Its composition varies greatly from several causes. The food used, the class of animal, the age of the animals from which it was obtained, the treatment of the animal, the amount of litter used, and the method employed in making it, all act on it so as to alter its composition.

SOLID EXCRETA.

The value of the solid excreta of animals as a manure depends on the nitrogen, phosphoric acid and potash it contains, and these depend on various circumstances. The excreta from horses, cows, sheep and pigs differ from each other in composition and physical properties. Solid excreta is composed of the undigested food, therefore the class of food taken has the greatest influence on the composition of the excreta. If an animal feeds on a poor diet, the excreta will also be poor. As already stated, the class, age, condition and treatment of the animal will alter it. Young animals use more nitrogen and mineral matter for their growth than adults. Cows in calf, or giving milk, will use more nitrogen than dry animals. A horse in the stall assimilates more of its food than when at work. Under these conditions less nitrogen and potash will pass off in the dung and more in the urine.

As the composition of the solid excreta varies under so many conditions any analysis will only represent that individual sample. By taking the average of a large number of analyses we can get in close proximity to its composition.

The following analyses will give some idea of the composition of solid excreta :—

PERCENTAGE COMPOSITION OF FARMYARD MANURE.

	Lawes and Gilbert.	Anderson.	Baussingault.	Voelcker.		Wolff.	Cameron.	
				Fresh.	Rotten.		Fresh.	Long exposed to rain.
Water	70·00	72·48	79·30	66·17	75·42	75·00	69·14	73·22
[1] Organic Matter	27·23	13·94	14·08	28·24	16·53	18·09	24·21	21·17
[2] Ash	2·77	13·58	6·67	5·59	8·05	6·91	6·65	5·61
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
[1] Cont'ng Nitrogen	0·64	·38	·410	·64	·71	·53	·50	·12
[2] ,, Potash ...	0·53	·32	—	·67	·49	·68	—	—
[2] ,, Phosphoric acid	0·23	·31	—	·31	·45	·32	—	—

Stoeckhardt found the following percentages of nitrogen, phosphoric acid and alkalies in the fresh solid excreta of horses, cows, pigs, and sheep :—

	Water.	Nitrogen.	Phosphoric Acid.	Alkalies.
Horses (winter feed)	76	·50	·35	·30
Cows ,, ,,	84	·30	·25	·10
Pigs ,, ,,	80	·60	·45	·50
Sheep (2 lbs. of hay per day) ...	58	·75	·60	·30

By the above table it will be seen the dung of the sheep is lowest in water and richest in nitrogen and phosphoric acid; therefore for equal weights it is the most valuable manure.

If we take the dried solid excreta from the above analyses and compare them together, we get the following results :—

	Nitrogen. per cent.	Phosphoric Acid. per cent.	Alkalies. per cent.
Horse	2·08	1·45	1·25
Cow	1·87	1·56	0·62
Pig	3·00	2·25	2·50
Sheep	1·78	1·42	0·71

By this it will be seen pigs' dung is the richest as a fertiliser in the three substances of its composition. I would not advise the use of pigs' dung alone on any crop, as it is liable to give a peculiar taste to the crop. It should always be mixed with other farmyard manure.

Wolff, from investigations he has made, calculates that from 100 parts of the organic matter, nitrogen, and mineral matter in the food, dried and free from water, the following percentages are passed in the solid excreta :—

	Cow.	Ox.	Sheep.	Horse.	Average.
Organic matter ...	39·5	42·5	44·0	44·1	42·5
Nitrogen	47·5	33·9	46·7	32·4	40·1
Mineral matter ...	53·9	64·6	57·9	62·5	59·7

Urine, or Liquid Manure.

What has been said about the solid excreta, regarding the variation of its composition, can also be said of urine. As it contains the substances digested, naturally the quality of the food will have a good deal to do with its composition. The class of animals, the age and conditions of treatment, will also have an effect on it. The quantity of water drunk will alter the composition. This will be balanced in the case of a large quantity of water being drunk, by the large quantity of urine voided. As the quantity of urine passed by the different animals differs greatly, naturally its composition will also. A horse passes about 12 lbs. a day, a cow about 70 lbs. per day. Urine is richer in nitrogen and potash than the solid excreta, but poorer in phosphoric acid, in fact it contains very little phosphoric acid. The liquid excreta has a higher manural value than the solid.

Stoeckhardt found the following percentages of water, nitrogen, phosphoric acid, and alkalies in the urine of different animals.

	Water. per cent.	Nitrogen. per cent.	Phosphoric Acid per cent	Alkalies. per cent.
Sheep (2 lbs. hay per day)	86·5	1·4	·050	2·0
Pigs (winter feed) ...	97·5	·3	·125	·2
Horses (hay and oats) ...	89·0	1·2	...	1·5
Cows (hay and potatoes) ...	92·0	·8	...	1·4

The above table shows that phosphoric acid is only in small quantities in the urine of farm animals, in fact we might say that it is absent, except in the case of pigs.

Taking the dried urine we get the following results :—

	Nitrogen. per cent.	Phosphoric Acid. per cent.	Alkalies. per cent.
Pigs	12·0	5	8
Horses	10·9	trace	13·6
Sheep	10·4	3·7	14·9
Cows	10·0	trace	17·5

The urine of the pig is richest in nitrogen and phosphoric acid, and poorest in alkalies. The horse comes next in nitrogen, and the cow lowest, but it is highest in potash.

If we compare Wolff's investigation of urine in the same way as for the solid excreta, we get the following results. From 100 parts of the organic matter, nitrogen and mineral matter dried and free from water, the percentages passed in the liquid excreta are :—

	Cow.	Ox.	Sheep.	Horse.	Average.
Organic matter ...	4·0	4·4	2·0	3·3	3·4
Nitrogen	31·0	54·8	42·3	60·7	47·2
Mineral matter ...	43·1	34·3	41·0	37·5	39·0

It will now be evident from what has been said, that the solid and liquid excreta should be used in conjunction with each other to make anything like a complete manure. The solid excreta contains about all the phosphoric acid, lime and magnesia; the liquid excreta almost all the potash.

Litter.

The litter that is generally used is one of the straws. For the composition and quantity of the ash in straw see tables 1 and 2 (pages 681 to 682).

The litter is used principally as a bedding for the animals, but it has other values as regards the manure. It prevents too rapid a fermentation in the manure, increases the bulk of the manure so that it can be spread over the soil more evenly; it binds light soils and enables them to retain more moisture; it loosens heavy clay soils if put in fresh; it greatly helps to prevent the loss of the liquid portion by absorbing it.

Peat has also been used as a litter; it not only absorbs more of the urine than straw, but it fixes the ammonia to a greater extent. Peat has not only a greater power for absorbing and retaining moisture, but it has a higher manurial value.

The common bracken has been used as a litter, more especially when young. It is more valuable as a manure, and contains more nitrogen, potash and lime than straw. Rushes and sawdust are frequently used in this colony, the former particularly.

Horse manure contains less moisture than that from either cows or pigs, and, being drier, ferments quicker than the other two, and is called a hot manure. That from cows and pigs containing so much moisture, the fermentation is slow, and consequently they are called cold manures. The hot and cold manures are best mixed, as the former assists the latter in setting up active fermentation, while the addition of the cold manure to the hot prevents too rapid fermentative action and consequent loss of ammonia, which is volatilized. To prevent this to some extent fixers have been used, such as gypsum, which is spread over the bedding. Munro recommends ground peat. These fixers act by absorbing the ammonia.

In making farmyard manure the pit should be so constructed that the liquid portion cannot drain away, otherwise it will carry away the most valuable constituents of the manure and considerably reduce its value. Manure made under cover is far more valuable than that made in the open, more especially in a hot climate like Western Australia, where there is a long season of dry weather. Continued exposure to the heat of the sun deteriorates it.

Lord Kinnaird experimented with the manure from an equal number of animals of the same kind and age, and similarly fed. One lot of animals was kept under cover, also the manure; the others were kept in an open yard. The following are the results of the experiments :—

Manure produced under cover.	Manure produced in open yard.
1st year—Potatoes, 11¼ tons per acre	1st year—Potatoes, 7 tons 12 cwt. per acre
2nd „ Wheat grain, 45 bush. „	2nd „ Wheat grain, 42 bush. „
Straw, 215 stones „	Straw, 156 stones „

A great part of this difference is due to the loss of urine that takes place in the open yard. The fermentative action in a manure is somewhat similar to that which takes place in the soil during nitrification. The decomposition will greatly depend on the amount of nitrogen it contains, on the temperature, amount of moisture, and access of air. The temperature in the centre of the heap should not be allowed to rise above 150deg. Fahr., or otherwise it gets what is called fire-fang.

The temperature should be regulated by the addition of liquid manure or water. The heap must not be drenched, or there will be a large loss from drainage. If the fermentation is too rapid it will generally be found to give off a strong odor of ammonia, which is a loss. The heap should be trodden down to moderate the fermentation. A great deal of the value of the manure depends on the manner in which it is made. By want of proper care, the manure by drainage and other causes may be of very little value. Of course the value of farmyard, manure will mostly depend on the food supplied to the animals.

This will be better explained by giving Lawes and Gilbert's theoretical estimation of the money value of farmyard manure derived from various foods, which is given in the following tables :—

AVERAGE COMPOSITION OF CATTLE FOODS FREED FROM WATER.

Foods.	Per cent.			
	Dry Matter.	Nitrogen.	Phos. Acid.	Potash.
	Per cent.	Per cent.	Per cent.	Per cent.
Linseed	90·00	3·60	1·54	1·37
Linseed cake	88·50	4·75	2·00	1·40
Decorticated cotton cake	90·00	6·60	3·10	2·00
Palm-nut cake	91·00	2·50	1·20	0·50
Undecorticated cotton cake	87·00	3·75	2·00	2·00
Cocoanut cake	90·00	3·40	1·40	2·00
Rape cake	89·00	4·90	2·50	1·50
Peas	85·00	3·60	0·85	0·96
Beans	85·00	4·00	1·10	1·30
Lentils	88·00	4·20	0·75	0·70
Tares (seeds)	84·00	4·20	0·80	0·80
Indian corn	88·00	1·70	0·60	0·37
Wheat	85·00	1·80	0·85	0·53
Malt	94·00	1·70	0·80	0·50
Barley	84·00	1·65	0·75	0·55
Oats	86·00	2·00	0·60	0·50
Rice meal	90·00	1·90	(0·60)	(0·37)
Locust beans	85·00	1·20	...	...

AVERAGE COMPOSITION OF CATTLE FOODS FREED FROM WATER. (*Continued.*)

Foods.	Per cent.			
	Dry Matter.	Nitrogen.	Phos. Acid.	Potash.
Malt combs	90·00	3·90	2·00	2·00
Fine pollard	86·00	2·45	2·90	1·46
Coarse pollard	86·00	2·50	3·50	1·50
Bran	86·00	2·50	3·60	1·45
Clover hay	83·00	2·40	0·57	1·50
Meadow hay	84·00	1·50	0·40	1·60
Pea straw	82·50	1·00	0·35	1·00
Oat straw	83·00	0·50	0·24	1·00
Wheat straw	84·00	0·45	0·24	0·80
Barley straw	85·00	0·40	0·18	1·00
Bean straw	82·50	0·90	0·30	1·00
Potatoes	25·00	0·25	0·15	0·55
Carrots	14·00	0·20	0·09	0·28
Parsnips	16·00	0·22	0·19	0·36
Swedish turnips ...	11·00	0·25	0·06	0·22
Mangel-wurzels ...	12·50	0·22	0·07	0·40
Yellow turnips	9·00	0·20	(0·06)	0·22
White turnips	8·00	0·18	0·05	0·30

While there is not much value placed on farmyard manure in Europe, I am inclined to place a much higher value on its use in Western Australia, not only as a fertilizer, but also for the physical or mechanical effect it has on the light soil, which, unfortunately, we have too much of in some parts of this colony. These light soils are easily depleted of their plant food and their moisture, as they are not sufficiently retentive. Farmyard manure adds a large amount of organic matter to the soil, thereby making it more retentive of moisture for subsequent use of the crop. This is a matter that is of the highest importance to the farmer and should be looked after as much as possible in a hot climate like this, where the intervals between the falling of rain are very long and droughts are not of unfrequent occurrence.

Two methods of putting farmyard manure into the land are generally followed. The first is by depositing the manure on the land in small heaps some time before it is ploughed in. This plan is unsatisfactory, as a large quantity of the soluble plant food is absorbed into the soil, so that the remainder of the heap is impoverished. Under these circumstances one part of the land receives an extra supply of plant food and the other very little. This accounts to some extent for some fields being very patchy. It is considered best to cart the manure direct from the pits on to the ground, spreading it out on the land, and ploughing it in as soon as possible, so that every part of the land will be equally enriched.

ESTIMATE OF THE

Showing the data, the method and the results of the estimation of

Description of Food.	Fattening increase in live weight, oxen or sheep.		Nitrogen. In food.		Nitrogen. In fattening increase, at 1·27 per cent.		Nitrogen. In manure.				
	Food for 1 lb. increase.	Increase per ton of food.	Per cent.	Per ton.	From 1 ton of food.	Per cent of total consumed.	Total remaining for manure.	Nitrogen equal to ammonia.	Value of ammonia at 6d. per lb. £	s.	d.
	lb.	lb.	p. c.	lb.	lb.	p. c.	lb.	lb.	£	s.	d.
Linseed	5·0	448	3·6	80·64	5·69	7·06	74·95	91·0	2	5	6
Linseed cake ..	6·0	373·3	4·75	106·40	4·74	4·45	101·66	123·4	3	1	8
Decorticated cotton cake	6·5	344·6	6·6	147·84	4·38	2·96	143·46	174·2	4	7	1
Palm-nut cake ...	7·0	320·0	2·5	56·00	4·06	7·25	51·94	63·1	1	11	7
Undecorticated cotton cake	8·0	280·0	3·75	84·00	3·56	4·24	80·44	97·7	2	8	10
Cocoanut cake ...	8·0	280·0	3·40	76·16	3·56	4·67	72·60	88·2	2	4	1
Rape cake	(10)	(224)	4·90	109·76	2·84	2·59	106·92	129·8	3	11	11
Peas	7·0	320·0	3·60	80·64	4·06	5·03	76·58	93·0	2	6	6
Beans	7·0	320·0	4·00	89·60	4·06	4·53	85·54	103·9	2	11	11
Lentils	7·0	320·0	4·20	94·08	4·06	4·32	90·02	109·3	2	14	8
Tares (seeds) ...	7·0	320·0	4·20	94·08	4·06	4·32	90·02	109·3	2	14	8
Indian corn ...	7·2	311·1	1·70	38·08	3·95	10·37	34·13	41·4	1	0	9
Wheat	7·2	311·1	1·80	40·32	3·95	9·80	36·37	44·2	1	2	1
Malt	7·0	320·0	1·70	38·08	4·06	10·66	34·02	41·3	1	0	8
Barley	7·2	311·1	1·65	36·96	3·95	10·69	33·01	40·1	1	0	1
Oats	7·5	298·7	2·00	44·80	3·79	8·46	41·01	49·8	1	4	11
Rice meal	7·5	298·7	1·90	42·56	3·79	8·91	38·77	47·1	1	3	6
Locust beans ...	9·0	248·9	1·20	26·88	3·16	11·76	23·72	28·8	0	14	5
Malt combs ...	8·0	280·0	3·90	87·36	3·56	4·08	83·80	108·8	2	10	11
Fine pollard ...	7·5	298·7	2·45	54·88	3·79	6·91	51·09	62·0	1	11	0
Coarse pollard ...	8·0	280·0	2·50	56·00	3·56	6·35	52·44	63·7	1	11	10
Bran	9·0	248·9	2·50	56·00	3·16	5·64	52·84	64·2	1	12	1
Clover hay	14·0	160·0	2·40	53·76	20·3	3·78	51·73	62·8	1	11	5
Meadow hay ...	15·0	149·3	1·50	33·60	1·90	5·65	31·70	38·5	1	19	3
Pea straw	16·0	140·0	1·00	22·40	1·78	7·95	20·62	25·0	0	12	6
Oat straw	18·0	124·4	0·50	11·20	1·58	14·11	9·62	11·7	0	5	10
Wheat straw ...	21·0	106·7	0·45	10·08	1·36	13·49	8·72	10·6	0	5	4
Barley straw ...	23·0	97·4	0·40	8·96	1·24	13·84	7·72	9·4	0	4	8
Bean straw	22·0	101·8	0·90	20·16	1·29	6·39	18·87	22·9	0	11	6
Potatoes	60·0	37·3	0·25	5·60	0·47	8·39	5·13	6·2	0	3	1
Carrots	85·7	26·1	0·20	4·48	0·33	7·37	4·15	5·0	0	2	6
Parsnips	75·0	29·9	0·22	4·93	0·38	7·71	4·55	5·5	0	2	9
Swedish turnips ...	109·1	20·5	0·25	5·60	0·26	4·64	5·34	6·5	0	3	3
Mangel wurzels ...	96·0	23·3	0·22	4·93	0·30	6·00	4·63	5·6	0	2	10
Yellow turnips ...	133·3	16·8	0·20	4·48	0·21	4·69	4·27	5·2	0	2	7
White turnips ...	150·0	14·9	0·18	4·03	0·19	4·71	3·84	4·7	0	2	4

Original Manure Value.

the original manure value of cattle foods after consumption :—

Phosphoric Acid.						Potash.						Total original manure value per ton of food consumed.
In food.		In fattening increase, at 0·86 per cent.		In manure.		In food.		In fattening increase, at 0·11 per cent.		In manure.		
Per cent.	Per ton.	From 1 ton of food.	Per cent. of total consumed.	Total remaining for manure.	Value at 3d. per lb.	Per cent.	Per ton.	From 1 ton of food.	Per cent. of total consumed.	Total remaining for manure.	Value at 2½d. per lb.	
p. c.	lb.	lb.	p. c.	lb.	s. d.	p. c.	lb.	lb.	p. c.	lb.	s. d.	£ s. d.
1·54	34·50	3·85	11·16	30·65	7 8	1·37	30·69	0·49	1·60	30·20	6 3	2 19 5
2·00	44·80	3·21	7·17	41·59	10 5	1·40	31·36	0·41	1·31	30·95	6 5	3 18 6
3·10	69·44	2·96	4·26	66·48	16 8	2·00	44·80	0·38	0·85	44·42	9 3	5 13 0
1·20	26·88	2·75	10·23	24·13	6 0	0·50	11·20	0·35	3·13	10·85	2 3	1 19 10
2·00	44·80	2·41	5·38	42·39	10 7	2·00	44·80	0·31	0·69	44·49	5 11	3 5 4
1·40	31·36	2·41	7·68	28·95	7 3	2·00	44·80	0·31	0·69	44·49	9 3	3 0 7
2·50	56·00	1·93	3·45	54·07	13 6	1·50	33·60	0·25	0·74	33·35	6 11	4 5 4
0·85	19·04	2·75	14·44	16·29	4 1	0·96	21·50	0·35	1·63	21·15	4 5	2 15 0
1·10	24·64	2·75	11·16	21·89	5 6	1·30	29·12	0·35	1·20	28·77	6 0	3 3 5
0·75	16·80	2·75	16·37	14·05	3 6	0·70	15·68	0·35	2·23	15·33	3 2	3 1 4
0·80	17·92	2·75	15·35	15·17	3 9	0·80	17·92	0·35	1·95	17·57	3 8	3 2 1
0·60	13·44	2·68	19·94	10·76	2 8	0·37	8·29	0·34	4·10	7·95	1 8	1 5 1
9·85	19·04	2·68	14·08	16·36	4 1	0·53	11·87	0·34	2·86	11·53	2 5	1 8 7
0·80	17·92	2·75	15·35	15·17	3 9	0·50	11·20	0·35	3·13	10·85	2 3	1 6 8
0·75	16·80	2·68	15·95	14·12	3 6	0·55	12·32	0·34	2·76	11·98	2 6	1 6 1
0·60	13·44	2·57	(19·12)	10·87	2 8	0·50	11·20	0·33	2·94	10·87	2 3	1 9 10
(0·60)	(13·44)	2·57	(19·12)	(10·87)	(2 8)	(0·37)	(8·29)	0·33	(4·00)	(7·96)	(1 8)	(1 7 10)
..	..	2·14	..	..	..	..	..	0·27	..	..	..	..
2·00	44·80	2·41	5·38	42·39	10 7	2·00	44·80	0·31	0·69	44·49	9 3	3 10 9
2·90	64·96	2·57	3·96	62·39	15 7	1·46	32·70	0·33	1·01	32·37	6 9	2 13 4
3·50	78·40	2·41	3·07	75·99	19 0	1·50	33·60	0·31	0·92	33·29	6 11	2 17 9
3·60	80·64	2·14	2·65	78·50	19 8	1·45	32·48	0·27	0·83	32·21	6 8	2 18 5
0·57	12·77	1·38	10·81	11·39	2 10	1·50	33·60	0·18	0·54	33·42	7 0	2 1 3
0·40	8·96	1·28	14·28	7·68	1 11	1·60	35·84	0·16	0·45	35·68	7 5	1 8 7
0·35	7·84	1·20	15·31	6·64	1 8	1·00	22·40	0·15	0·67	22·25	4 8	0 18 10
0·24	5·38	1·07	19·89	4·31	1 1	1·00	22·40	0·14	0·63	22·26	4 8	0 11 7
0·24	5·38	0·92	17·10	4·46	1 1	0·80	17·92	0·12	0·67	17·80	3 8	0 10 1
0·18	4·03	0·84	20·84	3·19	0 9	1·00	22·40	0·11	0·49	22·29	4 8	0 10 1
0·30	6·72	0·88	13·10	5·84	1 5	1·00	22·40	0·11	0·49	22·29	4 8	0 17 7
0·15	3·36	0·32	9·52	3·04	0 9	0·55	12·32	0·04	0·32	12·28	2 7	0 6 5
0·09	2·02	0·22	10·89	1·80	0 5	0·28	6·27	0·03	0·48	6·24	1 4	0 4 3
0·19	4·26	0·26	6·10	4·00	1 0	0·36	8·06	0·03	0·37	8·03	1 8	0 5 5
0·06	1·34	0·18	13·43	1·16	0 4	0·22	4·93	0·02	0·41	4·91	1 0	0 4 7
0·07	1·57	0·20	12·74	1·37	0 4	0·40	8·96	0·03	0·34	8·93	1 10	0 5 0
(0·06)	(1·34)	0·14	(10·78)	(1·20)	(0 4)	(0·22)	(4·93)	0·02	(0·34)	(4·91)	(1 0)	(0 3 11)
0·05	1·12	0·13	11·61	0·99	0 3	0·30	6·72	0·02	0·30	6·70	1 5	0 4 0

Poisoned Manure.

Manure made from straw that has been affected by rust, mildew, smut and bunt, should not be mixed with the general manure. The spores of the fungi that cause these diseases are in the straw as well as in the grain. They hibernate well until the spring in farmyard manure, and are then ready for active life. Such a manure should not be used to manure cereals, otherwise one is sure to have another attack of these diseases in the next crop. The land from which the diseased crop has been removed should not be used for cereals or the same class of crop at least for two years following. It is very possible that some of the failures of rust-proof wheats that have occurred have been due to the application of infected manures, or through being sown in land where fungoid spores were lying dormant until the time of the growth of the crop commenced. The haulms and diseased tubers of potatoes that have been attacked by the potato disease should not be thrown on the manure heap. If they are mixed with the manure the fungus of the potato disease is introduced into the whole of the dung. The diseased tubers and haulms should be burnt. For manure made from straw affected by the fungi of either rust, mildew, smut, or bunt, Griffiths recommends an application of férrous sulphate, one pound to the gallon of water, to be applied to the manure before ploughing it into the land. He also recommends a top dressing of half a cwt. of ferrous sulphate per acre to wheat likely to be attacked by the fungi, shortly after it has appeared above ground.

Farmyard manure is estimated to contain from 13 to 14 per cent. of organic matter containing ·4 to ·65 per cent. of nitrogen. The mineral matter from 4 to 6·5 per cent., containing 4 to ·7 per cent. of potash and ·2 to ·4 per cent. of phosphoric acid.

From these figures Warington has calculated that one ton of farmyard manure contains from 9 to 15 lbs. of nitrogen and potash, and 4 to 9 lbs. of phosphoric acid. These quantities of nitrogen and phosphoric acid calculated to (95 per cent.) nitrate of soda (97 per cent.) sulphate of ammonia, and (25 p r cent.) superphosphate, give respectively equal to 96 lbs. of nitrate of soda, 45 to 75 lbs. of sulphate of ammonia and 35 to 79 lbs. of superphosphate.

A light dressing of farmyard manure is from 7 to 10 tons per acre, medium or ordinary from 12 to 18 tons, heavy 20 to 28 tons, and very heavy 30 tons. Farmyard manure should always be used in conjunction with artificial manures.

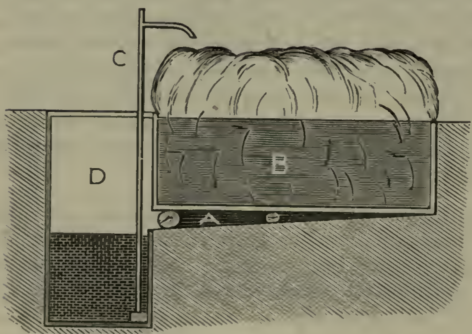
Irrigation with Liquid Manure.

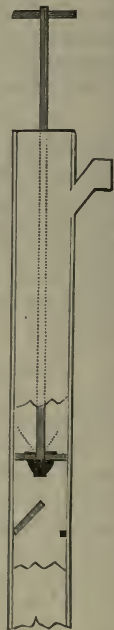
It is held by not a few practical market gardeners that it is an economical method to apply the liquid portion of farmyard manure, by irrigation, as a top dressing to the young crop. It not only supplies moisture, but also a large amount of soluble plant food easily assimilated by the young crop, which will enable it to maintain a healthy and rapid growth at the most critical period. By the filtration of the liquid into the soil, carrying with it the soluble manure to the roots of the plants, they have an immediate supply of food and are not placed under the necessity—to the same extent—to expand in all directions in search of food ; and in the later stages of their growth they will be better able to take up supplies from the more insoluble manures. A healthy and rapid growth in the early stages will better enable the crops to resist the attacks of the various pests that they are liable to. This is pure and simple a method of top dressing. The great benefits to be derived from top dressing will be treated later on. Liquid manure should be applied in a very dilute state. It is too concentrated as it runs from the stable or barn drains or from the manure heap ; it should be diluted with a large addition of water. If the liquid manure is applied in a concentrated form it is liable to do more harm than good.

Liquid manure is not a complete manure. We have seen that the liquid excreta of cows, horses, sheep, and pigs contains a large percentage of nitrogen, and most of the potash and the solid excreta contains all the phosphoric acid. To convert the liquid portion into a more complete manure the tank for the reception of the liquid manure should be placed at the end of the manure heap. The heap should be drenched occasionally with water to dissolve out as much as possible of the mineral and organic matter which is allowed to run into the tank.

The following device taken from *Stewart's Irrigation for the Farm and Garden* for a cheap and simple manure tank, of which a section is shown in the accompanying woodcut, may be made as follows :—A pit or vat, D, is dug and cemented with water-lime, or lined with plank, so as to be perfectly water-tight. This vat is covered with a plank floor, through which a wooden pump passes, and rests upon the bottom of the tank. The size of the vat, of course, will correspond with what is required of it. A useful size for a market garden, or for a farm where a few acres of soiling crops are raised each year, will be 16 feet square and 8 feet deep. At the end of the vat another excavation is made sufficiently large to contain the pile of manure or materials for a compost that can be gathered and used. This excavation, seen at B, may be 24 to 30 feet long, as wide as the vat, and gradually increasing in depth from 3 or 4 feet at the further end, to 6 or 8 inches more at the end connecting with the vat. The excavation should be floored with double boards, with a coating of asphalt or tar between them, and the sides cemented. A coarse grating of stout poles or timbers are laid across this shallow portion of the vat, and is supported in the centre by blocks or short posts placed at intervals beneath it. Smaller poles or rails are laid upon these timbers not more than 6 or 8 inches apart.

Upon these poles the manure is piled in a flat heap, made hollow or dishing at the top, so as to collect all the water that may fall upon it. The heap need not be more than five feet high, which is sufficient to cause an active fermentation to be kept up through the whole of it. The materials of which this heap is composed will include everything of a mineral or organic character useful for manure, that can be procured—stable manure, straw, rushes, weeds sawdust, peat muck, leaves, wood, earth, night soil, leather scraps, tanner's waste, butcher's offal, ashes, plaster, and bone dust—and the skilful operator will add from time to time such chemical substances as he needs to enrich the compost. The water in the vat





should be frequently pumped out for use and a fresh supply poured upon the heap. A pump that will not readily be choked should be used. One with a collapsing bucket, with leathern sides, and of a conical form, is the most useful. The waste water from the roofs might be discharged upon the heap by a simple arrangement of spouts. The object desired, viz., to gather every soluble part of the manure into the vat, should be forwarded by every possible means. The distribution of the liquid manure may be done by horse or hand cart distributors, or by pipe and nozzle, according to whichever is most suitable.

Blood Manures.

Blood in the natural state contains from 2·5 to 5 per cent. of nitrogen and about ·7 per cent of ash. Dried blood contains 6 to 16 per cent. of nitrogen. The commercial article seldom contains more than 12 per cent. nitrogen and a little over 1 per cent. of phosphoric acid. Blood dried by means of hot water or steam does not char and is easily ground to a powder. Acid clotted blood is made by adding sulphuric acid to the blood to prevent its decomposition, and then drying it by steam. It contains 6 to 7 per cent. nitrogen. It is generally in small semi-dried pieces. Mixed with ground bones, bone ash, or mineral phosphates, it makes a dark coloured manure with a very strong smell, something like a guano. Lean flesh has a composition nearly similar to that of blood. The carcases of diseased horses, cows, dogs, etc., are treated with sulphuric acid and dried by means of steam. The mixture is generally mixed with superphosphates to give them nitrogen. Blood and flesh manures are principally valuable as nitrogenous manures. The nitrogen is not so valuable in these manures as in sulphate of ammonia, it is not soluble enough for many crops. The crops that are most benefited by blood and flesh manures are wheat, hops, turnips and fruit trees. These manures are best adapted to light soils. Whether these manures can be compared in any way with nitrate of soda or sulphate of ammonia, so far as economy is concerned, will depend on circumstances. If they have to be carted long distances, the charges will preclude the use of them as manures, as they are very bulky. One thing against the use of them to any great extent in Western Australia will be the ash, which, although small in amount, contains about 70 per cent. of chlorides, which is not an element that it is advisable to introduce into the soils here, as in a great many cases they are already too highly charged with them.

Horn, Hides, Leather Clippings, and Hair.

These contain nitrogen from 14 to 17 per cent., and ash about 1 per cent. They are only valuable for the nitrogen they contain. Although they contain so much nitrogen they are of very little value as a manure, as their action is too slow in the soil, taking from two to four years for complete decomposition. They are mostly used in manure works for mixing with mineral phosphates and sulphuric acid in the making of superphosphates. It is a cheaper method of adding nitrogen to these superphosphates than using ammonium sulphate. Woollen waste or shoddy contains about four to ten per cent. of nitrogen. It is principally used as a cheap method of addng nitrogen in manufacturing superphosphates, and after treatment with sulphuric acid it is used as a manure for hops.

Animal, or Meat-meal Guano.

This is made from the refuse after treating the carcases of cattle by the Liebig's process for the making of the extract sold as meat, or Liebig's extract of meat. It contains from 3 to 8 per cent. of nitrogen and from 15 to 20 per cent. of phosphoric acid. It is principally made in South America, New Zealand and Queensland, in the tinned meat works. It is also made in Germany from the carcases of diseased animals by treating them with steam to extract the fat and gelatine, the refuse being dried and ground up for a manure. This manure generally contains less phosphoric acid and more nitrogen than that made in the tinned meat works. These manures are not of a high class value, their action in the soil being slow, owing to most of their constituents being in a very insoluble state, and not in such a state that they can be readily taken up by growing crops. These manures are mixed up with dried blood and flesh, and further mixed with bone ash, steamed bones or mineral phosphates, and sold under the name of bone dust. They have no right to be called or sold as bone-dust, as they are nothing of the kind, nor are they of the value of bone-dust as a fertilizer. I would consider that any manufacturer or merchant who sells such a mixture is committing a fraud if he sells it as bone-dust.

Fish Manures, or Guano.

These are made from the refuse of fish after extracting the oil, also from fish that is not marketable, as well as from that which has become tainted, and from the fish bones, scraps, and entrails from canneries in America, Norway, and to some extent in England. These manures contain from 6 to 8 per cent. of nitrogen, and 6 to 7 per cent. of phosphoric acid. Those fish manures made from the raw fish are not so valuable as those made from the boiled fish, as the oil in the raw fish guano retards the fermentation of the manure in the soil. The same also applies to the meat-meal or flesh guano.

Dr. A. Vollcker gives the analyses of two samples of dried fish manures :—

	1	2
Moisture	14·31	13·87
[1] Organic matter and water of combination ...	53·80	46·91
[2] Phosphoric acid	6·05	7·38
Lime...	11·27	14·48
Iron oxide, alumina, magnesia, &c.	11·43	12·22
Insoluble matter	3·14	5·14
	100·00	100·00
[1] Containing nitrogen	8·06	6·62
Equal to ammonia	9·79	8·04
[2] ,, tricalcic phosphate	13·21	16·11

T. Fairley gives the following analysis of a sample :—

Moisture	16·46
Organic matter and salts of ammonia	58·10
Phosphate of lime, magnesia, etc.	15·20
Calcium sulphate	0·96
Alkaline salts	6·55
Insoluble silicious matter ...	2·73
	100·00
Containing nitrogen	7·87
Equal to ammonia	9·55

These manures should be used at a rate of 5 cwt. per acre in conjunction with potash and a small quantity of soluble phosphates and some ammonium sulphate. They should be placed in the ground some weeks before the seed in autumn to allow them plenty of time to ferment.

Fish guanos are made in Norway with a large percentage of potash. One firm manufactures two kinds of these manures—cod and potash, and herring and potash. The first is branded C.P. on the bags, the other S.P. on the bags. The following are analyses of the two brands :—

	C.P. Brand.	S.P. Brand.
Nitrogen (equal to ammonia) ...	7·0	7·5
Phosphates (fish bone) ...	20·0	8·0
Potash sulphate	15·0	15·0
Magnesia	10·0	10·0
Sand	1·0	1·0
Water	5·0	5·0

They are recommended for cereals, roots and leguminous crops, spread broadcast on the land and harrowed in. They are also recommended for vegetables, using 7 cwt. to the acre.

There is no doubt that the fish manures are valuable, although slow in their action in the ground. They are cheap manures, and to be compared with the high class manures, they must be cheap to come into general use. With so much fish all along our coast, and the amount of waste, not only from those fish that are not saleable, but also from those that are saleable, I am surprised that something has not been done to convert these valuable waste products into readily saleable manures. I am sure it would prove a remunerative business to any company or firm undertaking the making of them.

These manures are sometimes used by unscrupulous manufacturers to mix with superphosphates with the view of adding nitrogen to their superphosphates. The analysis would not show whether the nitrogen was from bones or fish. The nitrogen in fish is not so valuable as that in bones.

Green Manuring.

This system of manuring, like most others, has its drawbacks as well as its benefits. It is not so much used now as formerly in the older countries, on account of the more general supplies of artificial manures, and their soils are not so much benefited by green manuring as those we have here will be. The soils generally in Western Australia are of a light nature, and low in humus matter, which gives them a low retentive and absorbtive power, and are more rapidly depleted of their mineral plant food. They are, then, in a state of not being able to fix the manures added to them so well as those with plenty of organic matter and mineral matter. One of the great benefits to the soils here by growing a catch crop, of say mustard, rye, lupin, rape, buckwheat, vetches, clover or turnips, is that by ploughing in the crop just as it flowers, the soil receives a large amount of organic matter, also the large amount of mineral matter which the crop brings up from the sub-soil to the surface is returned to the soil, binding the particles more compactly together, the soil becomes more tenacious, and being better able to retain more moisture and increasing its power to fix ammonia and the inorganic plant food. This is only one of the means that can be used for increasing the tenacity of the soil. It would be more beneficial still if before ploughing in the green crop, it had a good heavy dressing of clay, and the two would act much better than if used singly. Another reason for its use in this colony is that so much of the crops that are grown are made into chaff and sent away from the farm, so that the entire amount of organic and inorganic matter taken from the soil by the crop is lost for ever to that soil, and artificial manures cannot make the humus good, at least to any great extent. Were it not for the particular benefits to be derived from it in this hot climate, no one would care to advocate green manuring while we have so many cheap artificial manures, which are much better by far as manures.

Oil Cakes.

The several oil cakes that are to be found in the market have a very high value as manures. Although they have a high manure value, they are too high priced to be used as manures direct. They are best used as feeding stuffs, and the manure obtained from the dung of the animals. The values of the manures from the different feeding stuffs will be found in Lawes and Gilbert's table of values (pages 694 and 695).

Artificial Manure.

We have already seen that farmyard manure is not in itself capable of maintaining the soil in a fertile condition, even where the straw is used on the farm. Where the whole or part of the straw is sent away, as when chaff is made and sold off the farm, the soil will be brought to an impoverished condition in a much shorter time. By the employment of artificial manure, we are enabled to maintain the conditions of complete fertility, if we use them in a judicious manner. They supply large quantities of the mineral and organic matter necessary for the crop, and that in small bulk. They act as direct carriers of food to the plant. They act both chemically and mechanically on the soil, by stimulating and aiding the disintegration of the inert mineral matter, and rendering active the process of nitrification, they enable the soil to attract a larger amount of moisture as well as act in the capacity of fixers of plant food in the soil. It has been said that artificial manures are exhausted in a year, and this is used as an argument against them, but it has been proved that with the exception, perhaps, of nitrate of soda, which is liable to be washed out of the soil, they are not exhausted in the first year; even if we were to acknowledge that they are exhausted so speedily, it is always more economical to manure the crop than the ground. Some scientists harp on the point that we are still in the dark as to the action of many of these manures in the soil. Granted this is so, we have still sufficient light to guide us to an intelligent and profitable use of them. Rather than sit down in our partial darkness doing nothing it is better we should march on with the light we have, hoping that science will still further enlighten us some day on the dark points.

Of course no single simple manure would be of any good to a crop unless the other elements required were in sufficient quantities in the soil. The farmer again may have taken it for granted that the merchant has supplied him with the manure he ordered. Unfortunately in too many cases these manures are not what they are intended to represent. Further, the soil may not be suited to the crops, and climatic influences may have something to do with failures as well as the manures.

To apply them with economic success the farmer must know the requirements of his soil and the action of the individual manures upon them.

The first of these manures that we will consider will be the bones in their various states.

Raw Bones.

Bones in a coarse state of ½ and ¼ inch were at one time used largely for pasture land. To a great extent this use of coarse bones has been abandoned and the more economical bone dust or bone meal has taken its place. Bones are a rich phosphatic manure containing nitrogen equal to 4 to 5 per cent. of ammonia and 45 to 54 per cent. of phosphate of lime. The Royal Agricultural Society of England's standard requires a guarantee of nitrogen equal to 4 per cent. of ammonia and 45 to 48 per cent. of phosphatic lime. The following are analyses of bones :—

	No. 1.	No. 2.
Moisture	12·02	12·31
1. Organic matter	28·71	30·73
Phosphate of lime	49·28	49·72
Carbonate of lime	4·37	4·25
Alkaline salts	4·55	2·78
Sand	1·07	0·21
	100·00	100·00
1. Nitrogen	3·44	3·73
Equal to ammonia	4·17	4·53

Bone Dust, or Bone Meal.

Bones ground to a very fine state are far more active in the soil than when coarse. In the fine state a larger surface is exposed to the action of oxygen and other agencies which cause the bones to ferment and render them more easily soluble. Bone dust is a slow manure. That made from steamed bones is more soluble than that made from raw bones. Bone dust is much more valuable than mineral phosphates or the phosphatic guanos, not only because it contains a fair percentage of nitrogen, but also because it is more soluble in the soil than either of these other phosphatic manures. It is beneficial as a top dressing for pasture land if 7 to 10 cwt. per acre is given. The crops that are most benefited by it, however, are turnips, potatoes, hops, vines, and tobacco, giving from 5 to 6 cwt. per acre as a dressing in conjunction with potash. It is best adapted for light soils.

I must protest against the mixtures sold in Western Australia under the name of bone dust, which are merely composts of dried blood, flesh, and some bones, with either bone ash or mineral phosphates. Bone ash and mineral phosphates have not an agricultural value equal to bone dust. They are not so easily rendered soluble in the soil. A compost, or any other substance, should be sold only under the name that would designate its composition, and not under the name of something entirely different from it. I understand the merchants are not entirely to blame for this state of things, the farmer being in a great measure culpable. When speaking to a merchant about this, he informed me that he could not sell pure bone dust. Farmers would not have it. What they want is something that stinks. If smell is the farmer's criterion of a manure, in these composts they certainly get all they want. If manures are bought and applied to the soil on the basis of smell, one need not be surprised that the results are not so satisfactory as are often anticipated.

Fermented bones are prepared by mixing the bones with heavy soil or clay. The heap is then drenched with urine and covered with peaty soil or clay and allowed to ferment for two or three weeks. Fermented bones are more soluble and quicker in their action than raw bones.

Boiled bones are prepared by boiling the bones or by treating them with steam under a high pressure, which extracts a large proportion of the fat and gelatine they contain. The bones are rendered more porous and brittle. They contain from 1½ to 2 per cent. of nitrogen and from 54 to 63 per cent. of phosphate of lime. They are of less value, as far as the nitrogen is concerned, than raw bones, but they are more valuable in the phosphates, which are not only higher but more soluble. König found that raw bones did not disappear before four years from the soil, while boiled bones disappeared in ten months.

Dissolved bones are prepared by treating them with sulphuric acid to convert part of the insoluble phosphate of lime into a soluble state. This is the most valuable bone manure, and one of the best soluble phosphatic manures. There is not so much of this manure made now as formerly, the cheaper superphosphates made from mineral phosphates, phospho-guanos, bone ash, and bone charcoal taking its place.

Bone Ash.

By burning bones the organic matter and moisture is burned out of them, leaving a white ash which contains from 64 to 86 per cent. of phosphate of lime, but no nitrogen. It is principally used for the manufacturing of superphosphates. It is sometimes used to adulterate bone manures, or when dissolved, sold as dissolved bones, which it has no right to be called, as it is no more bones than mineral phosphates are. It is certainly inferior to bones in its action in the soil.

Bone black or bone charcoal is made by burning bones in closed retorts or kilns. The nitrogen distills over as ammonia, and is collected in sulphuric acid. The black charred mass is taken out of the retorts and cooled. Bone black is principally used in sugar refining. After some time it loses its power of clarifying the sugar solution from coloring matter, and it is then used to make superphosphates. It is slightly superior to bone ash, but very much inferior to bones as a manure.

The use of these two phosphates in the soil will be best dealt with when we come to superphosphates, as they are generally made into these.

Coprolites, or Mineral Phosphates.

Coprolites have been found in a great many parts of the world. Those found in the sedimentary rocks are generally in an amorphous or non-crystalline state, and called coprolites. Those found in the older rocks are crystalline, are called apatite, and the non-crystalline, phosphorite. Those that are sent into the market contain from 60 to 88 per cent. of tricalcic phosphate. As a manure they are of very little value in the raw state, although there are some people who hold a different opinion. For them to be of any value in the raw state they must be ground to a very fine powder and used on soils deficient in lime. They must be used in large quantities to do any good, 10 cwt. per acre, and even more than that. They are mixed and sold in enormous quantities every year for making superphosphate, which is the principal use they are put to.

Superphosphates, or Dissolved Mineral Phosphates.

These manures are made from coprolites, bone ash, bone charcoal, and phosphatic or mineral guanos. They are made in very large quantities in almost every part of the world. So great is the demand for these manures that about 600,000 tons are made annually in England alone. This will give an idea of the great faith the farmers in England have in superphosphates, and that not without good reason, as the results derived from the use of them fully justifies anything that has been said in their favor. They are made by mixing ground coprolites, apatite, bone ash, bone black, or phosphatic guanos, with sulphuric acid, specific gravity 1·60 to 1·70. The mixing is done by machinery constructed for the purpose, and the mass is then run into a closed pit which is connected with a flume that carries the fumes or gases (fluorine, carbonic acid, etc.) to a condensing tower, or otherwise they would be very annoying to the workmen, as well as dangerous to their health. After the mass has spent itself in the pit, when it becomes somewhat dry it is thrown out by workmen with wooden shovels. It is then ground in a roller mill for the purpose of more thoroughly mixing and breaking up the lumps into a state fit for the market. The action of the sulphuric acid on the phosphates is to convert the insoluble tricalcic phosphate into soluble monocalcic phosphate. The sulphuric acid does this by combining with the lime that is in combination with the phosphoric acid. They are made in two qualities or quantities of phosphate of lime made soluble. The lower class contains about 25 per cent. soluble phosphates, and the high class 30 to 40 per cent. soluble phosphates. This does not mean, as might appear, that there is 25, 30, or 40 per cent. of the soluble monocalcic phosphate in the manure, but that these are the percentages of tricalcic phosphate made soluble. There are also the concentrated or double superphosphates, containing from 60 to 85 per cent. of soluble phosphates. These concentrated manures are very costly to make and necessarily are dear. Whether it is any benefit to use them will greatly depend on whether they have to be conveyed long distances where the carriage is high, otherwise there is no special benefit from them over the ordinary superphosphates. By using them you lose the benefit of the sulphate of lime that is in the ordinary manure, which might necessitate the use of gypsum or sulphate of lime. The enormous extent to which the manure is used in every country proves it is the universal method of applying phosphates to the soil to obtain a quick and increased return for the money invested.

The superphosphate, when applied, being soluble in water, is dissolved by rain and the moisture in the soil, and thoroughly permeates the soil, where the lime, iron, and alumina salts decompose it, rendering it insoluble and depositing or fixing it in the soil in such a fine impalpable state that the plants can easily assimilate it and have no difficulty in obtaining a good supply. By being in this very fine state equal dissemination through the soil is secured, and the micro-organisms can obtain an unlimited supply of food for their growth and activity in order to supply the plants ; whereas if the manure had been placed in the soil in an insoluble state, even if in a fine powder, its uneven distribution through the soil would limit the action and numbers of the active micro-organisms. By reason of the great activity of this manure a quick and healthy growth is secured to the young plant, which is consequently better able to cope with any attack from the pests that plants are liable to.

Although superphosphate is one of the most valuable manures, it is not in itself a complete manure. It is simply a supplier of phosphoric acid and lime. It has to be used in conjunction with either a potash or nitrogenous manure, or both, according to the requirements of the crop. A great many manufacturers make superphosphates with either potash or nitrogen, or both, in them. These superphosphates are generally sold under special names, such as turnip manure, potato manure, &c., &c. As a rule these special manures are not worth the high prices asked for them. They are very often made up of some nitrogenous substance that is of very little value in the soil as a manure, such as ground, steamed or vitrolised leather, ground spent tan bark, shoddy, etc. The farmer who supplies himself with these, generally from reading some glowing advertisement or handbill, will have more of sorrow and vexation of spirit to trouble him at harvest time than the burden of his crops. The chemist is not able to discriminate, by mere analysis, between the almost valueless nitrogen in leather and the highly valuable nitrogen in bones when mixed with superphosphates.

Although there are a great many special manures made, for which a high price is charged, this has no relation to their value. There are also a good many firms who manufacture special manures that contain all they say, and which are made of the best materials. Those who buy them generally get full satisfaction, as far as this class of manures can give satisfaction. Even if they should be genuine, why buy them ? They are made for whoever will buy them, the same to all round. Surely the requirements of every soil are not the same. The farmer should know the requirements of his soil for any given crop better than the manufacturer. This unintelligent manner of buying manure has had much to do with the failure in the use of superphosphates in the hands of some farmers. It will prove more satisfactory and cheaper for the farmer to buy superphosphates, potash salts, and nitrogenous manures separately, and mix them on the farm according to the requirements of the soil and crops. He will then know what he is putting into the soil, and can wait patiently for the results, with a little more certainty of obtaining a crop.

There is scarcely any doubt that superphosphates will benefit most crops that require phosphoric acid, and give a larger return than insoluble phosphates. From our present knowledge of the soils of Western Australia, I am inclined to think more superphosphates will be required here than in England, as they are generally poorer than in England as regards phosphoric acid. The crops that are benefited by superphosphates are turnips, potatoes (but not mangolds), wheat, barley, but not so useful for oats. The amounts generally used are for turnips, 3 to 4 cwt. ; potatoes, 4 to 6 cwt. in conjunction with potash ; wheat and barley, 3 cwt. per acre.

Dr. Aitken, of the Highland and Agricultural Society of Scotland, experimented with root crops and bone meal, coprolites and apatite, dissolved and undissolved. The soluble gave an increase of 50 per cent. over the insoluble. Grain crops in a rotation following the roots, showed the effect of the soluble phosphates, increasing the yield of grain 15 per cent. and straw 12 per cent., clearly proving that the roots did not exhaust the soluble manure.

Professor J. M. Cameron obtained an increase of 39 per cent. with root crops for soluble as against insoluble phosphates. Although superphosphates will benefit most crops, they are not of much benefit in soils that are poor or very deficient in lime, owing to the want of the necessary base to render the soluble phosphates insoluble ; the soluble phosphates having an acid reaction which injuriously affects the young plant. This is putting an extreme case, as there are few soils so deficient in lime that they cannot fix the soluble phosphates. This acidity in the superphosphates is reduced to a minimum by the use of dryers in the finishing of the manure. Twenty-five to thirty years ago, they were so badly made that there was scarcely a superphosphate in the market that did not contain free sulphuric acid. Looking over my laboratory note-book of the analyses of superphosphates and dissolved bones sent by members of the Highland and Agricultural Society, Scotland, for 1872, the free sulphuric acid ranges from a trace to 6 and 7 per cent.

The following are average samples of superphosphates and dissolved bones as supplied to the market at the present time:—

	Mineral Superphosphate.	Dissolved Bones.
Moisture	16·24	12·06
[1] Organic matter ...	8·97	32·06
Soluble phosphates ...	17·42	14·65
Equal to tricalcic phosphate rendered soluble	(27·28)	(22·94)
Insoluble phosphates ...	3·08	20·95

	Mineral Superphospates.	Disolved. Bones.
Sulphate of lime and alkaline salts ...	49·61	18·87
Insoluble	4·68	1·41
	100·00	100·00
[1] Containing nitrogen ...	...	3·09
Equal to ammonia ...	...	3·75

It will be as well to delay making a comparison between superphosphates as a fertiliser and other phosphatic manures, until we get t› the basic slag or Thomas's fertiliser, which I intend to take next.

THOMAS S PHOSPHATES, OR BASIC SLAG.

In the year 1879 Thomas and Gilchrist patented their process for the dephosphorising of iron in the making of steel. Before that time the process in use was that known as the Bessemer, which fai'ed so far as to be ineffectual in reducing the amount of phosphorous in the pig iron made from iron ore, which contained too large a percentage of phosphorous to make steel. The Bessemer process, known a; the acid process, had a fire-brick lining in the converter. The Thomas-Gilchris process is the reverse, or basic process. The converter is lined with a dolomite limestone; the molten pig-iron is poured into the converter, a quantity of lime equal to about 20 per cent. of the iron in the converter is added, a hot blast of air, under pressure, is injected through the molten mass, oxidising the phosphorus, which in turn combines with the lime in the slag to form phosphate of lime. The basic slag was first made in England, but it was in Germany that it was first used as manure. To bring the slag into a fit state to be used as a fertiliser, the molten slag is treated with super-heated steam or poured into hot water to break it up into small fragments and make it more easy to grind into the fine powder which is necessary before it can be profitably applied to the land. Many patents have been taken out to make or improve the slag as manure. These have all been abandoned, as they were founded on illconceived notions of how the slag would act on plant life. The great desideratum with the basic slag as a manure is that it should be in a very fine powder, and if not in this state it should not be bought.

It contains from 14 to 20 per cent. of phosphoric acid, equal to 30 to 42 per cent. of tricalcic phosphate. The phosphoric acid in the slag is not in the tricalcic state as in all other animal and mineral phosphates, but it is in the tetracalcic form. So far I have avoided, as much as possible, the use of scientific terms, but in this case I must resort to scientific formula to explain the difference between these two kinds of phosphates in order to enable the reader the better to understand how the phosphates in the slag are more soluble than those in natural phosphates.

Tricalcic or insoluble lime phosphate has the formula 3 $Ca\,O$, $P_2\,O_5$.

Basic slag has the formula 4 $Ca\,O$, $P_2\,O_5$. To put this more graphically, although less scientifically, the insoluble phosphate would be composed thus :—

$$\left.\begin{array}{l}\text{Lime}\\ \text{Lime}\\ \text{Lime}\end{array}\right\}\text{ Phosphoric acid.}$$

Basic slag.

$$\left.\begin{array}{l}\text{Lime}\\ \text{Lime}\\ \text{Lime}\\ \text{Lime}\end{array}\right\}\text{ Phosphoric acid.}$$

It is a well-known fact that the more lime there is in combination with phosphoric acid the more insoluble the compound is. Basic slag is an exception ; it is more soluble than the tricalcic phosphate in any other mineral or animal phosphate. Before we explain the reason for the basic slag being more soluble, we will show the formula of two other phosphates.

Soluble or mono-calcic phosphate $Ca\,O, 2\,(H_2\,O), P_2\,O_5$ obtained by treating the tricalcic phosphate with an acid thus :—3 $Ca\,O$, $P_2\,O_5 + 2\,H_2\,SO_4 = Ca\,O,\,2\,(H_2\,O),\,P_2\,O_5 + 2\,Ca\,SO_4$, the soluble phosphate may be shown thus :—

$$\left.\begin{array}{l}\text{Lime}\\ \text{Water}\\ \text{Water}\end{array}\right\}\text{ Phosphoric acid.}$$

The other phosphate called dicalcic or precipitated phosphate of lime and reverted phosphates $2\,Ca\,O,\,H_2\,O,\,P_2\,O_5$

$$\text{or }\left.\begin{array}{l}\text{Lime}\\ \text{Lime}\\ \text{Water}\end{array}\right\}\text{ Phosphoric acid.}$$

The mono-calcic or soluble has 56 par s of lime for every 142 parts of phosphoric acid and is the most soluble. The dicalcic phosphate has 112 parts of lime for every 142 points of phosphoric acid, it is far less soluble than the mono-calcic, but more soluble than the tricalcic.

The tricalcic phosphate has 168 parts of lime for every 142 parts of phosphoric acid, it is the most insoluble of phosphates.

The basic slag has 224 parts of lime for every 142 parts of phosphoric acid. Although it has more lime than the tricalcic it is much more soluble than and differs little from the dicalcic.

The reason for this is, that the tetrabasic phosphate is a supersaturated salt. It has less chemical affinity to resist decomposition when brought in contact with any substance or agency that can cause decomposition.

Professor Wagner has experimented with basic slag, superphosphates and other manures, as to the amount of phosphoric acid each of the manures supply to a crop, and also the amount to the after crops. These show that 100 lbs. of phosphoric acid in superphosphate has the same effect as 200 lbs. of phosphoric acid in basic slag, but the after effects are better from the basic slag. Of 100 parts of phosphoric acid there was removed by the first year's crop :—

Superphosphate	63 parts.
Peruvian guano	22 parts.
Bone meal	7 parts.
Coprolites	6 parts.
Basic slag, No. 1, finest ...	39 parts.
Basic slag, No. 2, fine	43 parts.
Basic slag, No. 3, coarse ...	15 parts.

Wagner then gives the amounts out of 100 parts of phosphoric acid left by the first year's crop and that was removed by the three succeeding crops. I have calculated these figures out to parts, or percentages of the original 100 parts used, which shows the after effects more clearly.

		Calculated to percentage of original 100 parts.
Superphosphate ...	30 part	11·10 per cent.
Peruvian guano ...	9 parts	7·02 ,,
Bone meal	13 parts	12·09 ,,
Coprolites	6 parts	5·64 ,,
Basic slag, No. 1, finest ...	14 parts	8·54 ,,
Basic slag, No. 2, fine ...	29 parts	16·53 ,,
Basic slag, No. 3, coarse...	24 parts	20·40 ,,

Wagner found that 36 per cent. of slag was soluble in carbonic acid water, while only 8 per cent. of mineral phosphate was soluble. The amounts found to be soluble in citrate of ammonia were slag 74 per cent., mineral phosphates 4 per cent. To have any effect the slag must be in a fine powder. If used alone, it should be applied four or five weeks earlier than superphosphates. The following analyses of basic slags are : 1, by Munro and Wrightson ; 2, by A. H. Griffiths :—

	No. 1.	No. 2.
Lime ...	41·54	43·04
Magnesia ...	6·13	6·20
Ferrous oxide ...	14·66	11·64
Ferric ...	8·64	5·92
Alumina ...	2·60	1·72
Phosphoric acid ...	14·32	18·11
Sulphuric acid ...	·31	·41
Sulphur ...	·23	·30
Vanadium ...	·29	·24
Silica ...	7·40	6·90
Manganous oxide	3·81	3·51
	99·93	99·99

Basic slag is specially suited to clay, peat and sandy soils, also moor-land and wet meadows. Maercker has found that for barley, potatoes, oats and sugar beets on moor-land soil, basic slag is better than superphosphates and precipitated phosphates. He recommends when sown in the spring 2 cwt. of basic slag and 1 cwt. of superphosphates as being the most profitable. They can be mixed and sown with potash and nitrate of soda. The mixture should be made just before sowing, as if it is allowed to stand for a week or two it sets. It cannot be sown or mixed with sulphate of ammonia, as it contains free lime, and would cause a loss of ammonia. The ammonia must be applied some time after the slag. It will be found very advantageous to sour land by neutralizing the acidity, as well as acting as a manure. The phosphoric acid in basic slag has only half the effect that the phosphoric acid in superphosphate has; that is, 100 lbs. of phosphoric acid in superphosphates will have the same effect as 200 lbs. of that in basic slag will have. The results of the following experiments by Wagner will show this, and also the difference between basic slag and superphosphates and Peruvian guano, bone-meal, and ground coprolites on the same crops. Nitrogen and potash were added to the superphosphates, slag, bone-meal, and coprolites, so as to make them equal in other respects to the Peruvian guano, and so that the test should be confined to the phosphoric acid. The crops experimented on were barley, wheat, and flax. The amount of crops obtained by the use of superphosphate Wagner called 100, the other amount of crops by the different manure shows the percentages, as compared with superphosphates, as 100. This will give the manurial values of the other phosphates :—

	Manure. per acre.	Barley.	Wheat.	Flax.
Superphosphate ...	3 cwt.	100	100	100
Peruvian guano ...	4 ,,	33	29	32
Bone-meal ...	$5\frac{3}{4}$,,	10	8	10
Coprolite (ground)	$5\frac{1}{2}$,,	9	9	9
Basic slag (finest)	$4\frac{1}{4}$,,	65	61	57
,, (fine) ...	$4\frac{1}{4}$,,	59	61	55
,, (coarse)	$8\frac{3}{4}$,,	13	12	16

As basic slag generally contains about 80 per cent. of fine and 20 per cent. of coarse phosphates, its value compared with superphosphates will be 50 or one-half, that of Peruvian guano one-third, bone meal and coprolite one-twelfth. The after effects of the basic slag are superior to those of superphosphate, and it is again superior to superphosphates in soils deficient in lime.

Liechti and Vogt experimented with oats by the pot-culture method as carried out by Wagner. They used a meadow soil, poor in phosphoric acid and which had never received any manure. The same quantities of nitrogen and potash were added to each of the mineral manures so that they should equal the bone manures in that respect. The following are the results :—

Amount of phosphoric acid applied.	Manure.	Weight of crop, grain and straw.
	None	14·3
·35	Superphosphate	167·0
1·00	"	325·9
·35	Basic slag	171·5
1·00	"	318·4
1·00	Phosphorite	15·1
4·21	"	14·0
·35	Raw bone meal	15·9
1·00	" "	18·4
·35	Glue free bone meal (fine) ...	16·6
·35	" " (coarse)	16·0

These experiments of Liechti and Vogt's confirm what has been discovered by others, that basic slag is equal to superphosphates in some soils. We have seen that, as far as after effects in the soil are concerned, bone meal compares very badly with basic slag or superphosphates, although formerly the reverse opinion was held. More information on this subject can be gained by reference to some of Professor Maercker's experiments, undertaken at the request of the Association of Bone-meal Manufacturers of Saxony. The experiments were conducted in the same manner as Wagner's, by pot culture, which gave corresponding results in the field. They proved the conclusions of Wagner and others as to the immediate and after effects of the manure.

Working with barley in a sandy soil, which is considered favourable to bonemeal, each pot, in addition to the manure, to be operated on, received an equal quantity of ammonium nitrate, sulphate of potash, chloride of potash, sulphate of magnesia and carbonate of lime.

The following are the results :—

Amount of Phosphoric Acid applied.	Manure.	Weight of Crop. Grain and Straw.
·6	Superphosphate.	101·56
1·5	"	114·38
·6	Bone Meal.	5·96
1·5	" "	12·18

These exper ments were carried on for several years with practically the same results. Another set of experiments was carried out with a mixture of superphosphates and bonemeal to see how far the one would assist the other. The same class of soil and barley was used as in the previous experiments, and the following are the results :—

Amount of phosphoric acid applied.	Manure.	Increase of yield over unmanured pot.	Increase due to bone meal.
·6	Superphosphate	167·29	
·3 } ·3 }	Superphosphate } Bone Meal }	90·97	+ 7·32
·3 } ·9 }	Superphosphate } Bone Meal }	104·67	+21·02
·3 } 1·5 }	Superphosphate } Bone Meal }	105·91	+22·26
·6 } ·6 }	Superphosphate } Bone Meal }	152·74	−14 55
·6 } 1·2 }	Superphosphate } Bone Meal }	156·05	−11·24

this shows that the addition of bone-meal to superphosphate gives little or no advantage to the crop, in fact, when the superphosphate is given in sufficient quantities for the requirements of the crop, the addition of bone-meal is injurious and causes a loss.

The next set of experiments will show the after-effects of the manures on oats sown in the soil in which wheat has been grown the previous year. There was only a nitrogenous manure added the second year. The following are the results :—

Amount of phosphoric acid added first year.	Manure.	Increase of yield of oats second year.
·6	Superphosphate	14·74
·6	Raw bone meal	12·36
·6	Glue free bone meal	16·14
1·2	Superphosphate	43·41
1·2	Raw bone meal	13·58
1·2	Glue free bone meal	22·14
1·8	Superphosphate	65·57
1·8	Raw bone meal	35·40
1·8	Glue free bone meal	26·11

The results in the above experiments show that where only enough superphosphate was applied for the previous year's crop, the results are about equal, but where more manure is applied than is required for the first crop, the effects on the second crop are more marked in the case of superphosphate than bone-meal. To carry the experiments still further the same pots after the oats were gathered, with only the addition of some nitrogenous manure, were compared with the pot that had not received any manure. The crop that was chosen was mustard. The following are the results :—

Amount of phosphoric acid added first year.	Manure.	Increase in third crop (mustard) over unmanured pots.
·6	Superphosphate	+ 52·9
·6	Raw bone meal	— 0·3
·6	Glue free bone meal	+ 34·2
1·2	Superphosphate	+ 173·9
1·2	Raw bone meal	— 4·9
1·2	Glue free bone meal	+ 15·2
1·8	Superphosphate	+ 196·9
1·8	Raw bone meal	+ 85·2
1·8	Glue free bone meal	+ 33·9

Professor Maercker further experimented with superphosphates, dissolved raw bone meal, dissolved glue free bone meal. The copy of the results of these experiments with dissolved bones, which I have, does not say whether he added nitrogen to the superphosphates to equalize it with the nitrogen in the bones. From the results it is almost evident he must have done so, otherwise we could not expect the results he obtained. He says that dissolved bone meal is almost equal in value as a fertilizer to superphosphate. I should be inclined to place a higher value on dissolved bones as they contain a certain percentage of nitrogen, and the insoluble phosphate in bones is more valuable than the insoluble phosphate in superphosphates. He may, however, mean that the addition of nitrogen to the superphosphate equalises it with the dissolved bones and that they are then equal; but this will greatly depend upon what form of nitrogen he is adding. If it is in the form of a nitrate or ammonia salt, he is adding a more valuble nitrogen than that found in dissolved bones, and he would then be comparing the dissolved bones with a superphosphate and a valuable nitrogenous substance and not with a superphosphate alone. It will take more experiments to convince scientific men that a mineral superphosphate is as valuable a manure as dissolved bones. The following are the experiments made by Professor Maercker upon barley in a light sandy soil, very poor in phosphoric acid :—

Amount of phosphoric acid applied.	Manure.	Increased yield of barley over unmanured pots.
·6	Superphosphate	167·29
·6	Dissolved raw bone meal ...	128·71
·6	,, glue free bone meal	160·29
1·2	Superphosphate	204·44
1·2	Dissolved raw bone meal ...	184 02
1·2	,, glue free bone meal	180·42
1·8	Superphosphate	202·40
1·8	Dissolved raw bone meal ...	200·65
1·8	,, glue free bone meal	227·50

The next year oats were grown in the pots after the barley, nitrogenous manure being added to each, but no phosphates. The following were the results :—

Amount of phosphoric acid added first year.	Manure.	Increase yield of second crop (oats) over unmanured pot.
·6	Superphosphate	14·74
·6	Dissolved raw bone meal	16·06
·6	,, glue free bone meal	12·80
1·2	Superphosphate	43·41
1·2	Dissolved raw bone meal	30·67
1·2	,, glue free bone meal	40·13
1·8	Superphosphate	65·03
1·8	Dissolved raw bone meal	42·99
1·8	,, glue free bone meal	75·04

The third year's crop was mustard, sown in the pots after the oats, nitrogenous manure only being added to each pot, and the following are the results :—

Amount of phosphoric acid added first year.	Manure.	Increase yield of second crop (mustard) over unmanured pot.
·6	Superphosphate	52·9
·6	Dissolved raw bone meal	121·2
·6	,, glue free bone meal	103·7
1·2	Superphosphate	173·9
1·2	Dissolved raw bone meal	151·2
1·2	,, glue free bone meal	117·9
1·8	Superphosphate	196·9
1·8	Dissolved raw bone meal	206·2
1·8	,, glue free bone meal	175·7

These experiments may be disconcerting and unpalatable facts to those who feel it difficult to give up long cherished ideas as to the different values of manures. But they are facts, and facts that it would not be advisable to discard, if one wishes to make the best of the soil and manure applied to the crop. They point out that the most profitable manure is that which has the quickest action on the crop and produces the greatest yield, and that it is more economical to manure the crop than the soil.

Guanos.

These manures are varied in their composition and equally as varied in their action upon crops. Many of the so-called guanos would be more properly called mineral phosphates, as they are of little more value as manures than mineral phosphates. No matter what their origin and composition may be, they have passed through a transition of partial decomposition into a state differing but little from a deposit of mineral phosphates. Since the introduction of guano into England in 1841, by the Earl of Derby, its use as a manure has passed through many stages. So rapid was the increased consumption of this product, that it rose from about 2,000 tons in 1841 till it reached, in 1870, almost 300,000 tons annually, since when it has declined until it probably does not now reach 50,000 tons a year. The reasons for this are that the rich Peruvian guano deposits have been worked out and large quantities of inferior guanos have been brought into the market, but the chief reason of all for this decline in the use of guano is the introduction of superphosphates, which are found to be not only cheaper but to give better results than most of the guanos now on the market.

The best guanos that have been found are those on the west coast of South America and the south-west coast of Africa, most of which have long ago been worked out. It is scarcely within the scope of this book to give a historical account of these earlier deposits, or even to enter into any lengthy account of those in existence at the present time. Some of these are nitro-phosphatic, containing from 3 to 13 per cent. of ammonia, and some of them contain as much as 3 per cent. of potash. Other very large deposits are purely phosphatic, containing no nitrogen, or at most a fraction of a per cent.

Guanos of the nitrogenous class that are imported into England at the present time contain from 3 to 6 per cent. of ammonia, and 20 to 45 or even 50 per cent. of phosphatic lime, excepting those from the Ichaboe islands, on the south-west coast of Africa, and Angamos Island, in Peru, which contain from 8 to 14 per cent. of ammonia, and 12 to 30 per cent. of phosphates. These islands annually furnish only small quantities of guano, which consists of the fresh excreta of birds, and is gathered every year by the natives. The nitro-phosphatic guanos are scarcely to be found in the market of Western Australia, nor are they likely to be so for some time to come, unless fresh discoveries are made near at hand. The chief supply of guanos sent to the markets of the world is purely phosphatic, and is used for the purpose of making superphosphates. Of this class there are some enormous deposits in various parts of the world. The guano deposits found on the coast of Western Australia are of this class and are best suited to the making of superphosphates. As a manure, direct, this class of guano, even if used in conjunction with potash and nitrogenous matter, is slow in its action and inferior to bone-meal and not much better, if any, than coprolite mineral phosphate. This guano should be applied in a very fine state to give the best results. At the best these guanos are not the most profitable manures that can be used. The phosphatic guanos may be applied at the rate of 3 to 9 cwt. per acre, according to the percentage of phosphoric acid they contain and give the best results on soils low in lime.

Nitrogenous Manures.

The two best nitrogenous manures are sulphate of ammonia and nitrate of soda. They are by far the richest in nitrogen and also the quickest and most certain in their action on crops.

Some time back the most favoured method of applying nitrogen to the soil by means of artificial manures, was by the use of guanos rich in ammonia. Since these rich guanos have become more scarce in the market, sulphate of ammonia and nitrate of soda have taken their place.

Sulphate of ammonia is the most concentrated form of nitrogen as a manure, and one of the most active and readily available plant foods. It is much quicker in its action than any form of organic-nitrogenous matter. Ammonia is principally obtained from the destructive distillation of some organic matter, as in the manufacture of gas from coal, when it is obtained as a by-product in the water used to purify the gas. The gas liquor contains from four to eight ounces of ammonia per gallon. The crude gas liquor is placed in a large boiler with some burnt lime, and heated by means of steam to drive off the ammonia gas, which is passed into a tank containing sulphuric acid. The ammonia combines with the sulphuric acid to form sulphate of ammonia, which crystallises out, the crystals being ladled out of the tank on to a shelf to drain, where they are dried, and the mass is then ready for the market. Large quantities are also obtained in the process of manufacturing shale oil by the Beilby-Young furnace ; from blast furnaces, coke ovens, and also in the process of manufacturing bone charcoal. Sulphate of ammonia, when pure, contains 25 per cent. of ammonia. The best sulphate of ammonia found in commerce contains only 98 per cent., equal to 24·5 per cent. of ammonia. Sulphate of ammonia is a whitish crystalline powder, some samples being colored grey to a dirty brown. These latter samples should be tested for impurities, such as ammonium sulpho-cyanate, which is very poisonous to plants. This can be easily detected in a sample by dissolving a little in water, then adding one or two drops of ferric chloride, when, if the sulpho-cyanate is present it will give a deep red color to the solution of ammonium sulphate.

It has its best action on clay and loam soils, but should not be used on soils rich in lime or otherwise, there will be a loss of ammonia through its being set free by the lime. It should not be used in a mixture with basic slag or Thomas's phosphates for the same reason.

The ammonia in the sulphate is not absorbed directly by the plants. It is first converted into nitric acid in the process of nitrification by the micro-organisms in the soil, in which state it is absorbed by the plant. It is more easily converted into nitrates than any other organic compound of nitrogen. In about six months the most of the ammonia will be converted into nitrates. It is easily fixed in the soil, which prevents the loss by drainage that takes place in the case of nitrates, nor is it carried down into the sub-soil out of the reach of the crops, as happens with nitrates.

Its application to cereals, potatoes, and other root crops has been very successful, but not so with rye, lupins, or leguminous crops.

Sulphate of ammonia is very seldom used by itself, being generally employed in conjunction with phosphates and potash. For cereals 1 to 1½ cwt., and for root crops from 1½ to 2½ cwt. per acre should be applied. It is best to use one-half at the time of sowing and to use the other half as a top dressing when the young crop is a short length up, and the application should be made in wet weather when possible. When sowing it alone as a top dressing, it should be thoroughly mixed with six or seven times its bulk of soil to ensure an equal distribution. It has the effect of increasing the grain yield without any detriment to the straw.

It is stated by some authorities that by steeping seeds in a solution of sulphate of ammonia the crop is greatly increased, more especially with potatoes, which are said to have given phenomenal crops. This action is said to hasten germination, to supply readily available nourishment to the embryo plant and hasten a healthy growth to the young plant when it is most liable to disease, thus enabling it to resist and overcome the attack of pests. The best solution to use is 1 lb. of ammonium sulphate, 1 lb. potassium nitrate, and 5 galls. of water. There are other authorities who either deny or doubt any such benefit from the steeping of seed in a solution of ammonia. At the present time the matter is so much in dispute that, until further investigations are made, the value of the solution must remain a matter of opinion.

Until we have dealt with nitrate of soda and potash we will postpone any comparison between ammonium sulphate and the nitrates.

Sodium and Potassium Nitrate.

Nitrate of soda is principally obtained from the west coast of Southern America, Peru, Chili, and Bolivia. It is sometimes called Chili nitre and Chili saltpetre. It is found in the desert or barren sand that stretches from north to south for over 600 miles along the foot of the Cordilleras. The sand is lixiviated with water to extract the nitre, the solution is then evaporated. The crude salt obtained is called caliche. It has the following composition, according to Roscoe and Schorlemmer :—

	I.	II.
Sodium nitrate	64·98	27·85
,, sulphate	3·00	43·20
,, chloride	28·69	18·30
,, iodide	0·63	—
Calcium sulphate	—	·68
Magnesium sulphate	—	4·20
Insoluble matter	2·70	0·32
Moisture	—	6·00
	100·00	100·55

The caliche sand does not rise to the surface, and is generally covered with two layers. The top layer or chuca consists of sand and gypsum, while the intervening layer called costra is a conglomerate of clay and breccia or small fragments of rocks. The caliche when purified generally contains from 95 to 98 per cent. of nitrate of soda. The purified salt is greatly used for the manufacturing of sulphuric and nitric acids, also for making nitrate of potash to be used in the manufacture of gun-powder. It is largely used in agriculture as a source of nitrogen, and it is when put to this use that we have to deal with it.

Nitrate of soda is purely and simply a nitrogenous manure. Its nitrogen is in the most valuable form and one most easily assimilated by plants which absorb their nitrogen from the soil in the form of nitric acid. The use of this manure greatly assists the absorbtion of phosphates by plants from the soil. Lawes says that organic matter in the soil is reduced much quicker by nitrates than by ammonia. Nitrate of soda, as a general rule, increases the weight of a crop more than sulphate of ammonia. The crops most benefited by nitrate of soda are the cereals, beet-root, mangolds and potatoes, the leguminous crops only when used in small quantities, as they are able to obtain a large part of the nitrogen necessary for their growth from the atmosphere. Nitrate of soda is sometimes said to be an exhauster of the soil. This is scarcely correct, and the ill-founded assertion has caused a great deal of unjust prejudice against the use of nitrate of soda as a manure. The fact of the matter is that it gives an increased crop. The increase must naturally take more mineral matter out of the soil, but only in the proportion to the increase of crop. For what it takes out it gives a large return, or as Storer puts it, " You cannot eat the cake and have the cake," but if the crop eats the cake it gives you more money to buy more cakes. There is no increase of the per centage of the ash in the crop, as will be shown by the following results of Maercker's on the use of nitrate of soda.

Unmanured soil.		Soil manured with ½ to 2 cwts of nitrate of soda.	
Result of four experiments.		Result of twelve experiments.	
Corn.	Straw.	Corn.	Straw.
2·8 per cent. ash.	6·42 per cent. ash.	2·73 per cent. ash.	6·45 per cent. ash.

Nitrate of soda, when pure, contains 16·4 per cent. of nitrogen. It is generally sold with a refraction of 5 per cent, or 95 per cent. of purity, which contains 15·75 per cent. of nitrogen, about equal to 19 per cent. of ammonia, therefore 125 parts will equal as much as 100 parts of ammonium sulphate in ammonia. Nitrate of soda is very soluble and difficult to fix in the soil, so is easily washed out, more especially if there is no crop growing to take it up at once. It gives no results the second year, or at least very little. It is generally applied as a top-dressing at different times, which gives the best results. Part may be put in at the same time as the artificial or farmyard manure and the remainder in one or two dressings. This saves it from being lost by being washed out by rain or the moisture in the soil. The usual amount applied is from 1 to 2 cwt. per acre, and the part used as top-dressing should be mixed with some soil to ensure uniform distribution of it over the land.

The relative manurial values of nitrate of soda and sulphate of ammonia are dependent on several circumstances. In some cases the nitrate of soda is superior to the sulphate of ammonia and in others the reverse is the case. Sulphate of ammonia cannot be used in calcareous or chalky soils and is injurious to beet-root, rye, and lupines, more especially when the plants are young. In the case of barley, Prof. Tanner says, "that sulphate of ammonia improves, and nitrate of soda invariably injures the malting character of barley." But nitrate of soda gives the highest yield of albuminoids, therefore, barley grown with nitrate of soda has a higher feeding value than that grown with sulphate of ammonia. Tobacco appears to be most benefited by sulphate of ammonia, and Lawes and Gilbert prefer it for their wheat experiments at Rothamstead.

Most soils can easily convert the ammonia into nitrates and also fix it in the soil. When nitrates are applied to wet soils, or after rain, they are liable to be washed from the soil or out of the reach of the crops. Owing to their extreme solubility no result can be expected from nitrates after the first crop, for the reason, if the crop does not use up all the nitrates put into the soil, they are beyond the reach of the next year's crop. Even granting that nitrates are more rapid in their actions on plant growth than the ammonium sulphate, there are other things to take into consideration that may counterbalance any superiority nitrates may have. In this colony nitrate of soda is much dearer than sulphate of ammonia, and, further, 100 lbs. of the sulphate contains as much nitrogen as 125 lbs. of nitrate of soda. The price of nitrate of soda is from £16 to £17 per ton, while sulphate of ammonia is from £12 to £12 10s. per ton. The sulphate of ammonia is by far the cheapest, as it is only about 75 per cent of the price of the nitrate and it contains 25 per cent. more nitrogen. Where it can be applied in place of the nitrate of soda, it will be the cheapest and very nearly as effective. The following experiments by Griffiths will show to some extent the agricultural value of various nitrogenous manures and the importance of top dressing :—

Gypsum.

The crops taken for the experiments were wheat, potatoes, and clover. Twenty-one plots of land of one acre each were taken. The first seven consisted of good quality clay land, and grew wheat, the second seven consisted of sandy loam, and grew potatoes ; the third seven plots were laid down with clover.

The manures were as follows :—

Plots 1, 8, 15 each was manured with 1½ cwt. of nitrate of soda as a top dressing in three instalments of 56 lbs. each.

Plots 2, 9, 16 each was manured with 1½ cwt. of nitrate of soda at one time.

Plots 3, 10, 17 each received 2 cwt. of potassium nitrate in one instalment.

Plots 4, 11, 18 each received 1 cwt. of sulphate of ammonia in one instalment.

Plots 5, 12, 19 each received 1 cwt. of chloride of ammonia in one instalment.

Plots 6, 13, 20 each was manured with 24 tons of farmyard manure in October (for wheat), and September (for potatoes and clover) they did not receive any dressings of artificial manures.

Plots 7, 14, 21 received no artificial or farmyard manure. Each plot of land (except Nos. 6, 7, 13, 14, 20, 21) received 12 tons of good farmyard manure in the month of October (for wheat), and September (for potatoes and clover).

Wheat Crops.

Plots Nos. 1 to 7 had previously grown root crops, and each was sown in the month of November with six pecks of good wheat. The following are the results :—

Dry wheat crop.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
	lbs.	lbs	lbs	lbs.	lbs.	lbs.	lbs.
Grain ...	4000	3360	1680	2720	2240	1418	880
Straw ...	8126	6241	2201	4354	4002	2200	2480
Total crop ...	12,126	9601	3881	7074	6242	3618	1600
Grain in bushels	50	42	21	34	28	18½	11

Potatoes.

Plots Nos. 8 to 14 had previously grown oats ; on each plot were set 7 cwt of potato tubers. The following are the results :—

	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.	No. 13.	No. 14.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Tubers ...	22,400	18,480	15,680	17,360	13,440	15,120	11,300
Haulm ...	8126	5992	5226	5521	4628	5023	3909
Total crop ...	29,728	26,472	20,906	22,881	18,068	20,143	15,209
Tubers in tons	10	8¼	7	7¾	6	6¾	5

Clover Crop.

Plots Nos. 15 to 21 had the season before grown barley. Each plot was sown with 12 lbs. of red clover seeds in the autumn. The following are the results :—

	No. 15.	No. 16.	No. 17.	No. 18.	No. 19.	No. 20.	No. 21.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Red clover hay (dry)	7840	6720	4481	6160	3922	4476	336c
Produce in tons	$3\frac{1}{2}$	3	2	$2\frac{3}{4}$	$1\frac{3}{4}$	2	$1\frac{1}{2}$

Each of the crops was grown under similar circumstances as far as the date of sowing, composition of the soil, the amount of rainfall, sunshine, etc., were concerned. All the experiments were performed in duplicate with almost identical results. The conclusions that Griffiths draws from these experiments are :—

1. That nitrate of soda is a good manure for cereals, root and leguminous crops generally, increasing the yield over other nitrogenous manures.

2. That it is better to use the nitrate of soda in fractions as a top dressing, as the crops progress in growth, rather than at one time, for a larger yield is obtained in each case. This appears to be directly due to the manurial value of the nitrogen contained in the nitrate of soda, and indirectly due to its action on the dormant nitrogenous constituents of the soil, for there is an increase in the nitrogen of the crops over that applied in the form of nitrate of soda. It is probable that nitrates favor nitrification.

3. It was found that in those crops grown with nitrate of soda the albuminoids are increased, and, generally speaking, the soluble carbo-hydrates are also increased. Hence their higher value as feeding stuffs.

4. The amount of chlorophyll (green coloring matter) and starch grains in the leaves of those crops grown with nitrate of soda, are increased more than in the others.

5. That nitrate of soda is a better manure for potatoes than potassium nitrate, although potash manures are generally used for these crops.

6. When nitrate of soda is used, the harvest of all crops is fully two weeks earlier than by other nitrogenous manures.

7. Crops grown with nitrate of soda resisted the attacks of micro-parasitic organisms, while the use of potash manures encouraged the attacks of these organisms. The resistance to the germinating power of the spores of parasitic fungi on the part of the crops grown with nitrate of soda is due to the rapid development of the chlorophyll in the leaves, and so places the plants beyond the destructive influence of parasitic fungi.

8. Ammonium chloride is not a good nitrogenous manure. This is attributed to the chlorine in the ammonium chloride, which may act as poison. When we come to the potash manures I shall have more to say regarding the poisonous effects of chlorides.

From these experiments of Griffiths it is evident that the labour spent on fractional dressing is more than repaid by the large increase of crops.

In comparing the values of nitrate of soda and sulphate of ammonia, it is generally stated that a dry soil is best for the nitrate of soda, and that the sulphate acts better in a wet soil, in fact, nitrate of soda is more liable to do injury than good in a heavy clay soil, while the sulphate of ammonia will do good in almost any soil.

From these conclusions it might be argued that nitrate of soda is by far the best nitrogenous manure to apply to the soils of Western Australia. This, at the present time, I am not inclined to admit, at least not until we have proved it to be so by practical experiments. The conclusions I have given are those arrived at by a great many experimenters in Great Britain, Europe and America, where the conditions and soils are not quite the same as we have in Western Australia. The soils here are much lighter and the rains are confined to a much shorter period, although the total rainfall is not so very much different in the actual amount for a year. The rains being heavier and soils lighter than in these countries, the nitrates will be more easily washed out, causing a large loss of valuable manure, whereas the same thing would not take place in the case of the sulphate of ammonia. Although we have not yet had any experiments here as to the relative values of the two manures, there have been some made in Victoria by A. N. Pearson. From the results of these experiments he comes to the following conclusions, which I will give in his own words. "In Europe, with its cold winters, the nitrogen in the nitrate of soda is more quickly taken up by fruit trees and by root crops than the nitrogen of sulphate of ammonia; but I have tried the two in comparison with each other five or six times on fruit trees and root crops in this country, and find that this superiority does not exist here; in fact, if anything, the nitrogen in the sulphate of ammonia gives the better results." Our soils and climate being more comparable to those of Victoria than to those of Europe, we can accept the results of Pearson's experiments in Victoria as being applicable to this colony, at least until the contrary is proven.

Potassium Nitrate.

Potassium nitrate, saltpetre or nitre, is found as an efflorescence on the surface of soils in a great many parts of the world, but principally in India. The greater part of the nitrate of potash is made from nitrate of soda by a double decomposition with a potash salt. It does not give the results that might be expected from it; on potatoes, that require both nitrogen and potash as a manure, nitrate of soda gives quite as good results and is much cheaper. Nitrate of potash is too dear to be used much as a manure.

Potash Manures.

Potash is one of three main elements that enter into the food of almost all plants. It is found in large quantities in the ash of root and leguminous crops ; more than the half of the ash of potatoes is potash, varying from 55 to 60 per cent. The crops that are most benefited by the application of potash are legumes, which require a liberal supply. Potash for agricultural purposes is principally obtained from the deposits at Stassfurt, in Germany. The chief potash salts used as manures are kainit and the double sulphate of potash and magnesia. Kainit contains from 12 to 14 per cent. of potash. The following is an analysis of a fair sample :—

Moisture	3·21
Water of combination	10·41
Potassium sulphate ... ... (equal potash 13·20)	24·43
Calcium sulphate	3·13
Magnesium sulphate	13·83
Magnesium chloride	14·54
Sodium chloride	29·59
Insoluble	·86
	100·00

The double sulphate contains about 50 per cent. of potash. Most soils contain a good percentage of potash from ·1 to 3·0 per cent. and will average about ·2 per cent. Most of the soils that I have analysed in Western Australia contain less than ·1 per cent. and very few over ·2 per cent. of potash. The soils in this country being lower than most other countries in potash, this should be taken into account when applying manure, and more especially where potatoes are grown and chaff sold off the farm, or otherwise the land will become too poor in potash to produce good crops. Potash is easily fixed in the soil, and various soils have different powers of retaining or fixing it. The clay soils have the greatest power, peaty soils less, and sandy soils the least. This fixing is accomplished by chemical double decomposition, whereby the soil forms insoluble compounds with potash.

Professor Way found from ·00003 to ·00031 per cent. of potash in drainage from arable land. Potash is not a manure that should be applied alone, but in conjunction with some other manure, such as superphosphates or farmyard manure, and will then give surprisingly large crops. The quantity generally used is from one to two cwt. of the sulphate of potash and five to seven cwt. of kainit per acre.

Another compound of potash that has been used to a great extent is the chloride or murate of potash. It is a manure that is not to be recommended, more especially for the soils of this colony. Professor Jamieson and others have shown that in a great many cases it acts as a plant poison. The action that appears to take place in the decomposition of the chloride of potash by lime is the formation of calcium chloride, which is very poisonous to plants. Tobacco grown with it is not good, only an inferior quality of tobacco being manufactured from the leaf. Potatoes become waxy when grown with it, and it acts injuriously to sugar-beet by lowering the percentage of crystallizable sugar. This does not occur with the sulphate of potash, but only when the chloride or murate is used. Another danger from the use of it is that it increases the amount of chlorides in the soil. It is much easier putting these into the soil than taking them out of it. In a great many places in this colony there is too much chlorides in the soil. In some cases the soil is fairly poisoned with them, so that hardly anything will grow in it, and in others in a very sickly state. This state of affairs is also brought about by irrigating with water containing a large percentage of common salt, (chloride of sodium) also by using water from saline springs flowing over land. A case in point came under my notice lately, that of a large spring near Northam, where nothing grows near the course of the stream that flows from this spring for a mile along its course. Before using water for irrigation one should find out whether it contains anything injurious to vegetation. The crops that do best in saline or salty soils are mangolds and cabbage.

Lime.

Lime is one of the principal plant foods, and is as necessary to the plant as nitrogen, phosphoric acid and potash. Most soils contain lime in suffi.ient quantities for the requirements of all kinds of crops, although there are soils too poor in lime to supply the requirements of a crop, such soils being generally poor and sandy. Pasture land, as far as its surface is concerned, is liable to become too poor in lime. The lime in a soil tends to sink down, at least in pasture land. Thus we see how permanent pasture land is benefited by lime. In arable land the plough brings the lime back t› the surface until such time as it passes beyond the reach of the plough.

Until recent years we had no clear ideas as to the action of lime in the soil, and still a great deal remains clouded in obscurity. What I might call the multiplicity of the actions of lime on the soil a›d the ill-conceived notions of these actions, probably the result of the contradictory experiences of farmers in different parts of England has had much to do with the condemnatory ideas some farmers hold regarding lime. There is no doubt its actions are beneficial on some soils. It acts in three different ways—mechanically, chemically, and biologically.

Lime, as applied to the soil, is in three different states :—Carbonate of lime, a compound of lime and carbonic acid, such as limestone or chalk, and sometimes called mild lime. Also as burnt or caustic lime obtained by burning the carbonate to drive off the carbonic acid, and sometimes called quicklime. As gypsum, a compound of lime and sulphuric acid obtained as a by-product in several manufactures ; having a manurial value differing from the carbonate and the caustic lime. The mechanical actions of the carbonate and the caustic lime are much the same, only the caustic is much quicker than the carbonate.

Heavy or clayey soils when they get wet puddle and become sticky, so that they are difficult to handle. This puddling is owing to the particles of the soil being in a very fine state, and getting into what may be called a semi-state of suspension. The clay when it dries contracts and gets caked or packed, which makes it difficult to work. The effect of lime on such a soil is to precipitate or coagulate the fine particles of clay, something in the manner in which sewage is purified by lime, which causes the suspended solid matter to be precipitated and leaving the water clear. The soil is also made more open and pervious, thereby allowing the water to drain away. It also makes the soil more friable and easy to work. The lime does not contract when it gets dry, as the clay does, thus making the soil more porous, friable and easy to break up.

Lime, while thus acting on clayey soils, curiously enough, has a reverse action on light sandy soils. It assists to bind the soil, making it more retentive of moisture and giving it a greater capacity for absorbing moisture from a depth by increasing its capillary power.

When caustic or burnt lime is used, it should be first slacked by allowing it to absorb moisture or pouring water over it. Caustic lime is best for clayey and peaty soils and soils rich in organic matter. The rules are :—

For heavy soils use caustic lime.
For light soils use carbonate of lime.
For soils rich in organic matter use caustic lime.
For soils poor in organic matter use carbonate of lime.

Chemical Action of Lime.

Lime acts more powerfully chemically than mechanically. It acts directly as a plant food. It acts by liberating potash from its insoluble and inert compounds, and bringing it into a state fit for the plants to absorb. It also promotes the formation of hydrated double silicates, which fix or retain in the soil the ammonia and potash supplied by manure and in a state fit for the plants to absorb them. Soils rich in organic matter, such as peaty soil or rich meadows, generally give rise to an excessive amount of organic acids, which cause sourness in the soil and act as a poison upon plants. The herbage that grows on these is generally coarse, and with very little value as a feeding stuff. The action of lime on these soils is to neutralise these organic acids and prevent their formation, to sweeten the soil and promote the growth of the fine and nutritive grasses and to kill the coarse scrub. It decomposes organic matter in the soil, bringing it into a more soluble state and fit for the plants to absorb.

Biological Action of Lime.

This is one of the most important actions in the soil of lime, which is one of the most active agents in the process of nitrification. Its presence enables the micro-organisms in the soil to decompose and convert the nitrogenous compounds into nitric acid, which combines with the lime, the lime holding the nitric acid in readiness for the use of the plants. I have already shown that aicidity stops the process of nitrification, and may even cause the reverse process of denitrification. I have also stated that too great an alkalinity will also stop nitrification, and care must be taken that not too great an alkalinity is created in the soil. In the case of over liming the best cure is farmyard manure.

Gypsum.

This salt of lime acts much in the same way as lime. It decomposes the insoluble compounds of potash, setting them free and making them available to the plants. It absorbs and fixes ammonia in the soil. It promotes nitrification. When superphosphates are used, the soil always receives a certain amount of gypsum, as it is one of the largest component parts of superphosphates.

The crops that are most benefited by lime are the cereals, more especially barley, and clover, potatoes, turnips and mangolds. The quantity that it was usual to apply unde the old method of liming was from four to six tons per acre every 12 to 14 years. It is now, however, considered more economical to apply one to two tons every three or four years. Lime should be lightly harrowed in.

Special Manures.

These will be best treated upon when specifying the manures for the different crops. Special manures should contain potash, phosphoric acid and nitrogen in some form.

There are a great many special manures made and sold as such. Some of these, I am afraid, are only special in name, with very little speciality in their nature. There are certainly some special manures that are all it is professed for them, made by firms who not only make manures, but wish to make a name for themselves also ; while there are others, and those in large numbers, whose sole aim is how to make, and how to increase their profits at the expense of farmers. Why buy these special manures ? The farmer who does so trusts blindly to what the manufacturer tells him, and throws over his own judgment.

The prices paid for these special manures are as a rule far beyond their agricultural value. The chemist by ordinary analysis is not able to help the farmer to discriminate between the valuable nitrogen in bones and the almost valueless nitrogen of leather. The manufacturer very often sells the manures through merchants who know nothing of the constitution of the manure and less of the requirements of the farmer, and the merchant's traveller will almost go as far in his praises of these manures as to declare that one can grow potatoes on a bare boulder of granite with only a dose of their extra-special potato manure.

The farmer knows, or ought to know, more about his land and its requirements than either the manufacturer or the merchant, then why should he not use that knowledge and buy the different substances he requires, and mix them as required. He can have them analysed to see what they contain and that they are what they were sold to him for. He may, if he is unwise, take it for granted that their substances are as they are stated, but if he does the crop will not. Should the analysis prove them to be different to what it was intended to purchase, the farmer should either refuse to take them, or insist upon reduction in the price, which no right-minded merchant will ever object to. I do not intend to refer to any of these special preparations in detail, but will give the requirements of the different crops as found by practical experience. The farmer can then, from his own knowledge of what his land requires, use his own discretion as to the class of manures he purchases.

In order to show that the purchaser of artificial manures is fully protected against fraud on the part of the vendor, the Feed Stuffs and Fertilizers Act of Western Australia, with its regulations, is here introduced. A perusal of this will show that it is entirely the farmer's own fault if he is victimised.

An Act to Regulate the Sale of Agricultural Fertilisers and Feeding Stuffs.

[*Assented to, 11th September, 1895.*]

BE it enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the Legislative Council and Legislative Assembly of Western Australia, in this present Parliament assembled, and by the authority of the same, as follows :—

1. (1.) Every person who sells for use as a fertiliser of the soil any article manufactured or found in the said Colony, or imported from abroad, shall sign and give to the purchaser an invoice stating the name of the article and whether it is an artificially compounded article or not, and what is at least the percentage of the nitrogen, soluble and insoluble phosphates, and potash, if any, contained in the article ; and this invoice shall have effect as a warranty by the seller of the statements contained therein.

(2.) For the purposes of this section an article shall be deemed to be manufactured if it has been subjected to any artificial process.

2. (1.) Every person who sells, for use as food for cattle, any article which has been artificially prepared, shall give to the purchaser an invoice stating the name of the article and whether it has been prepared from one substance or seed, or from more than one substance or seed, and this invoice shall have effect as a warranty by the seller of the statements contained therein.

(2.) Where any article sold for use as food for cattle is sold under a name or description implying that it is prepared from any particular substance, or from two or more particular substances, or is the product of any particular seed, or of two or more particular seeds, and without any indication that it is mixed or compounded with any other substance or seed, there shall be an implied warranty by the seller that it is pure, that is to say, is prepared from that substance or those substances only, or is a product of that seed or those seeds only.

(3.) On the sale of any article for use as food for cattle, there shall be implied a warranty by the seller that the article is suitable for feeding purposes.

(4.) Any statement by the seller of the percentages of nutritive or other ingredients contained in any article sold for use as food for cattle, made after the commencement of this Act, in an invoice of such article, or in any circular or advertisement descriptive of such article, shall have effect as a warranty by the seller.

3. (1.) If any person who sells any article for use as a fertiliser of the soil or as food for cattle commits any of the following offences, namely :—

(*a.*) Fails without reasonable excuse to give, on or before, or as soon as possible after the delivery of the article, the invoice required by this Act ; or

(*b.*) Causes or permits any invoice or description of the article sold by him to be false in any material particular to the prejudice of the purchaser ; or

(*c.*) Sells for use as food for cattle any article which contains any ingredient deleterious to cattle, or to which has been added any ingredient worthless for feeding purposes and not disclosed at the time of the sale :

he shall, without prejudice to any civil liability, be liable, on summary conviction, for a first offence, to a fine not exceeding Twenty pounds, and for any subsequent offence to a fine not exceeding Fifty pounds.

(2.) In any proceeding for an offence under this section it shall be no defence to allege that the buyer, having bought only for analysis, was not prejudiced by the sale, or that the article sold, though deficient in one or more constituents, was not defective in other constituents.

(3.) A person alleged to have committed an offence under this section in respect of an article sold by him shall be entitled to the same rights and remedies, civil or criminal, against the person from whom he bought the article as are available to the person to whom he sold the article, and any damages recovered by him may, if the circumstances justify it, include the amount of any fine and costs paid by him on conviction under this section, and the costs of and incidental to his defence on such conviction.

4. The Governor may appoint an agricultural analyst (hereafter referred to as the analyst), and may, from time to time repeal or alter regulations for carrying this Act into effect. Such regulations shall be published in the *Government Gazette*, and shall be laid before both Houses of Parliament within fourteen days after such publication, if Parliament be then sitting, and if Parliament be not then sitting, within fourteen days after its next meeting ; and all such regulations, when so published, shall have the force of law, and shall continue in force, unless repealed as aforesaid, or disallowed by both Houses of Parliament.

5. Every seller and every buyer of any article used for fertilising the soil or as food for cattle shall be entitled, on payment to the analyst of a fee in accordance with the regulations, to have the article analysed by the analyst and to receive from him a certificate of the result of his analysis.

The certificate of the analyst as regards fertilisers shall be in the form and contain the particulars mentioned in the Schedule hereto or as near thereto as circumstances permit, and every analyst shall report to the Minister as he directs the result of any analysis made by him in pursuance of this Act.

6. If the buyer, on receiving delivery of any fertilizer or feeding stuff and before otherwise breaking the bulk thereof, shall, in the presence of the analyst, a Justice of the Peace or a police constable, and in accordance with the regulations, take three samples of the article and cause them to be marked, sealed, and fastened up, and shall deliver or send by post prepaid one sample with the invoice or a copy thereof to the analyst and shall deliver or send by post as aforesaid another sample to the seller, and retain the third sample for future comparison, then the following paragraphs (*a*) and (*b*) shall have effect :—

(*a.*) At the hearing of any civil or criminal proceeding with respect to any article analysed in pursuance of this section, the production of a certificate of the analyst shall be sufficient evidence of the facts therein stated, unless the person against whom the certificate is proposed to be put in evidence requires that the analyst be called as a witness.

(*b.*) The costs of and incidental to the obtaining of any analysis in pursuance of this section shall be borne by the seller or the buyer, in accordance with the results of the analysis, and shall be recoverable as a simple contract debt.

In this section the word "delivery" shall not include delivery to an agent for the purpose of carriage.

7. On the request of the buyer or the seller of any fertiliser or feeding stuff and on payment of the fee prescribed by regulations, the analyst or some person appointed by him in that behalf shall, before or at the delivery of the article, take the samples on behalf of the buyer, and thereupon paragraphs (*a*) and (*b*) of the last preceding section shall apply. The word "delivery" shall have the same meaning in this section as in the sixth section of this Act.

8. If any person knowingly and fraudulently—

(*a.*) Tampers with any parcel of fertiliser or feeding stuff so as to procure that any sample of it taken in pursuance of this Act does not correctly represent the contents of the parcel ; or

(*b.*) Tampers with any sample taken under this Act ;

he shall be liable on summary conviction to a fine not exceeding £20, or to imprisonment for a term not exceeding six months.

9. A prosecution for an offence under this Act may be instituted either by the person aggrieved, or by any person authorised in that behalf by the Minister.

All offences against this Act shall be summarily punishable upon conviction before any two or more Justices of the Peace in Petty Sessions.

10. Section A of the schedule to "The Shortening Ordinance, 1853," shall be incorporated with, and taken to form part of this Act to all intents and purposes, and in as full and ample a manner as if the said section had been introduced and fully set forth in this Act.

11. (1.) This Act shall apply to wholesale as well as retail sales.

(2.) For the purposes of this Act the words "soluble" and "insoluble" shall respectively mean soluble and insoluble in water ; and the word "cattle" shall mean horses, camels, asses, mules, bulls, cows, oxen, heifers, calves, sheep, goats, swine, poultry, and dogs.

12. This Act may be cited as "The Fertilisers and Feeding Stuffs Act, 1895," and shall come into operation on the first day of January, 1896.

In the name and on behalf of the Queen I hereby assent to this Act.

ALEX. C. ONSLOW, Administrator.

SCHEDULE.

Form of Certificate by Analyst.

I, the undersigned, A.B., analyst, do hereby certify that on the day of , 18 , I received a sample, labelled [*here state name* *of fertiliser, and of the manufacturer or importer, his place of business, trade mark, or figure (if any)*] for analysis, the result of which is as follows, viz. :—

Percentage of nitrogen.
Percentage of soluble phosphates.
Percentage of insoluble phosphates.
Percentage of potash.

REGULATIONS.

(Gazetted June 5, 1896.)

"FERTILISERS AND FEEDING STUFFS ACT, 1895."

By virtue of the provisions of Section 4 of "The Fertilisers and Feeding Stuffs Act, 1895," His Excellency the Governor in Council has been pleased to make the following regulations :—

Regulations under "The Fertilisers and Feeding Stuffs Act, 1895."

1. The fee payable to the Agricultural Analyst (of the Bureau of Agriculture) by the buyer or seller of any article manufactured or found in the colony of Western Australia, or imported from abroad, used for fertilising the soil, for an analysis of same, shall be as follows :—

	s.	d.
For determining percentage of nitrogen	7	6
" " " " potash	7	6
" " " " phosphoric acid in soluble form ...	12	6
" " " " " " in insoluble form ...	12	6

2. The fee payable to the Agricultural Analyst by the buyer or seller of any article used as food for live stock, which has been artificially prepared or manufactured in the colony of Western Australia, or imported from abroad, for an analysis of same, shall be as follows :—

	s.	d.
For determining percentage of water	2	6
" " " " albuminoids	7	9
" " " " oil	5	3
" " " " fibre	5	3
" " " " ash	2	6

3. Every seller and every buyer of an article used for fertilising the soil shall be entitled, on payment to the analyst of the fee or fees in accordance with Regulation 1, to have the article analysed by the analyst, and to receive from him, within fourteen days, a certificate of the result of his analysis.

The certificate of the analyst shall be in the following form :—

I, the undersigned, A.B., analyst, do hereby certify that on the day of , 18 , I received a sample, labelled [*here state name of fertiliser, and of the manufacturer or importer, his place of business, trade mark, or figure (if any)*], for analysis, the result of which is as follows :—

Percentage of nitrogen.
Percentage of soluble phosphates.
Percentage of insoluble phosphates.
Percentage of potash.

4. Every seller and every buyer of any article used as food for live stock, which has been artificially prepared or manufactured in the colony of Western Australia or imported from abroad, shall be entitled, on payment to the analyst of the fee or fees in accordance with Regulation 2, to have the article analysed by the analyst, and to receive from him, within fourteen days, a certificate of the result of his analysis.

5. The buyer, on receiving delivery of any fertiliser or feeding stuff, and before otherwise breaking the bulk thereof, shall, in the presence of the analyst, a Justice of the Peace or a police constable, take three samples of the article and cause them to be marked with the date and place of sampling, the names of the persons present, the figures or trade mark on each package, sealed, and fastened up, and shall deliver or send by post (prepaid), one sample with the invoice or a copy thereof to the analyst, and shall deliver or send by post as aforesaid another sample to the seller, and retain the third sample for future comparison.

6. On the request of the buyer or seller of any fertiliser or feeding stuff, and on payment of the fee prescribed by Regulations Nos. 1 and 2, the analyst, or some person appointed by him in that behalf, before or at the delivery of the article, shall take the samples on behalf of the buyer.

L. LINDLEY-COWEN,

4th June, 1896. Secretary, Bureau of Agriculture.

Rotation of Crops.

The best results from soil and manure are obtained by following some system of rotation of crops. The method of growing the same crop year after year on the same land tends to give weak crops, which are more liable to be attacked by insect and fungoid diseases. By using a system of rotation, the crops are more vigorous in their growth and are therefore better able to resist these attacks. The pests that attack one class of crops do not generally attack that of another. The pests attacking one class die out for the want of the nourishment they require before the time recurs for the crop upon which they thrive to be replanted in that soil. Again, a system of rotation economises manure. One class of crops require more of one kind of plant food than another. By varying the crops according to requirements of each, the best immediate and after results are obtained from the manure, and at the same time the soil is maintained in a fertile condition. Whatever system of rotation is followed will be dependent greatly on the soil and the climate. A rotation that suits well in one district does not necessarily suit so well in another. The laws of supply and demand for certain crops will also govern to a certain extent what is best to grow, for it is no use growing a crop that one cannot sell at a profit.

M. Ville's system of manuring is so much quoted by different authorities that I think it will be best to give it in his own words, and then suggest such modifications of it as I think will be more suited to the requirements of this colony. This distinguished French chemist, as already stated, places a very low opinion on farmyard manure as a manure, and states distinctly that a soil can be maintained in a high state of fertility by the use of artifical manures only. In all his formulæ he gives potash, phosphoric acid, lime, and nitrogen as the only substances which it is necessary to add to the soil, all the others being contained in the soil in sufficient quantities for the requirements of the crop.

The following table gives the composition of the chemical manures according to Ville's formulæ :—

Normal Manure No. 1.

For colza, hemp, wheat, barley, oats, rye, and meadow land, 528 lbs. per acre only.

Strength per cent. in fertilizing matter.			Per cent.	Per acre.
				lbs.
Nitrogen ...	6·5	Ammonic sulphate ...	20·83	220
Phosphoric acid	5·0	Calcic sulphate ...	29·17	308
Potash	8·0	Calcic superphosphate	33·34	352
Lime	17·0	Potassic nitrate ...	16·66	176
			100 00	1056

Normal Homologous Manure No. 1a.

Used for the same purposes and in the same quantity as No. 1.

Strength per cent. in fertilizing matters.			Per cent.	Per acre.
				lbs.
Nitrogen ...	6·6	Calcic superphosphate	33·34	352
Phosphoric acid	5·00	Potassic chloride at 80 °/o	16·66	176
Potash	8·33	Ammonic sulphate ...	32·50	343
Lime	13·00	Calcic sulphate ...	17·50	185
			100·00	1056

Normal Manure No. 2.

For cabbages, beetroots, carrots and garden stuff.

Nitrogen ...	6·5	Calcic superphosphate	33·34	352
Phosphoric acid	5·00	Potassic nitrate .	16·66	176
Potash	8·00	Sodic nitrate	25·00	264
Lime	15·00	Calcic sulphate ...	25·00	264
			100·00	1056

Normal Homologous Manure No. 2a.

Used for the same purpose and in the same quantity as No. 2.

Nitrogen ...	6·5	Calcic superphosphate	33·33	352
Phosphoric acid	5·00	Potassic chloride at 80°₀	16·66	176
Potash	8·33	Ammonic sulphate ...	11·66	123
Lime	14·00	Sodic nitrate	25·00	264
		Calcic sulphate ...	13·35	141
			100·00	1056

Normal Manure No. 3.

For potatoes, tobacco, flax and vines.

Nitrogen ...	4·00	Calcic superphosphate	40·00	352
Phosphoric acid	6·00	Potassic nitrate ...	30·00	264
Potash	14·00	Calcic sulphate ...	30·00	264
Lime	19·00			
			100·00	880

Normal Manure No. 4.

For vines, tobacco, fruit trees and ornamental plants.

Nitrogen ...	4·60	Calcic superphosphate	40·00	528
Phosphoric acid	6·00	Potassic nitrate ...	33·34	440
Potash	15·5	Calcic sulphate ...	26·66	352
Lime	17·00			
			100·00	1320

Normal Manure No. 5.

For maize, Jerusalem artichokes, sorghum, turnips, sugar-cane.

Strength per cent. in fertilizing matters.			Per Cent.	Per Acre
				lbs.
Nitrogen ...	2·50	Calcic superphosphate	50·00	528
Phosphoric acid	7·5	Potassic nitrate ...	16·66	176
Potash	8·00	Calcic sulphate ...	33·34	352
Lime	22·00			
			100·00	1056

Normal Manure No. 6.

For flax, for lace making, leguminous plants, lucerne.

Nitrogen ... 2·70	Calcic superphosphate	40·00	352
Phosphoric acid 6·00	Potassic nitrate ...	20·00	176
Potash ... ... 9·00	Calcic sulphate ...	40·00	352
Lime ... ... 22·00			
		100·00	880

Incomplete Manure No. 1 (without potash).

For colza, cereals, meadow land.

Nitrogen ... 7·00	Calcic superphosphate	40·00	352
Phosphoric acid 6·00	Ammonic sulphate ...	35·00	308
Potash ... ... 0·00	Calcic sulphate ...	25·00	220
Lime ... ... 17·00			
		100·00	880

Incomplete Manure No. 6 (without nitrogen).

For clover, sainfoin, lucerne, and leguminous plants.

Nitrogen ... 0·00	Calcic superphosphate	40·00	352
Phosphoric acid 6·00	Potassic chloride at 80°/o	20·00	176
Potash ... ... 10·00	Calcic sulphate ...	40·00	352
Lime ... ... 22·00			
		100·00	880

M. Ville gives the following manure for a single crop without the addition of farmyard manure.

For wheat 528 lbs. of No. 1A, and in the spring 44, 88, or 132 lbs. of sulphate of ammonia. He says, on condition that this manuring is repeated every year, a crop of 33 bushels per acre is obtained.

For barley, oats, rye, and natural meadow land, he gives 528 lbs. No. 1 A, for the meadow land, he applies one-half in the autumn, the other half in the spring. If the oat crop appears too light, a further quantity of 44 lbs or 88 lbs. of sulphate of ammonia is given in early spring.

Beetroot, cabbages, carrots, hops, and garden stuff, he gives 1056 lbs. of normal No. 2. In the case of beetroot, if he wished to obtain the largest possible yield, he used the normal stimulating No. 2 instead of the above, which is composed thus :—

Normal Stimulating Manure No. 2.

Calcic superphosphate	...	352	lbs. per acre
Potassic nitrate ...	...	176	,, ,,
Sodic nitrate ...	...	396	,, ,,
Calcic sulphate ...	...	220	,, ,,
		1144	

For potatoes he used normal manure No. 3, 880 lbs. per acre. With exhausted soil 1056 lbs. per acre of normal No. 2 should be used.

Vines and fruit trees, he uses 1320 lbs. of normal, No. 4. Turnips, swedes, Jerusalem artichokes, sorghum, sugar-cane and maize, 1056 lbs. per acre of normal, No. 5.

For beans, horse beans, haricot, clover, sainfoin, tares and lucerne, he uses 880 lbs. of incomplete manure, No. 6.

For a rotation of crops for two years of colza and wheat. First year, 1056 lbs. of normal manure, No. 1. Second year, wheat, only ammonium sulphate, 264 lbs. per acre.

A rotation of maize and wheat. For the first year maize gives 1056 lbs. per acre normal manure, No. 5. Second year, wheat, only ammonium sulphate, 264 lbs. per acre.

With a rotation of four years. Potatoes, wheat, clover and wheat. First year, potatoes, 880 lbs. per acre of normal manure, No. 3. Second year, wheat, ammonium sulphate, 264 lbs. per acre. Third year, clover, 880 lbs. per acre of incomplete manure, No. 6. Fourth year, wheat, ammonium sulphate, 264 lbs.

Rotation for five years. Potatoes, wheat, clover, colza and wheat. First year, potatoes, 880 lbs. of normal manure, No. 3. Second year, wheat, 264 lbs. of ammonium sulphate. Third year, clover, 880 lbs. of incomplete manure, No. 6. Fourth year, colza, 352 lbs. of ammonium sulphate. Fifth year, wheat, 264 lbs. of ammonium sulphate.

With the use of farmyard manure in a five-year rotation of potatoes, wheat, clover, wheat and oats, he uses the following mixtures :—First year, potatoes, farmyard manure 44 tons per acre and 440 lbs of normal manure, No. 6. Second year, wheat, 176 lbs. of ammonium sulphate. Third year, clover, 880 lbs. of incomplete manure, No. 6. Fourth year, wheat, 176 lbs. of ammonium sulphate. Fifth year, oats, 244 lbs. of ammonium sulphate.

It will be seen from the above that Ville has two standard elements in all his manures, that of superphosphate and sulphate of lime, and that they vary only in the nitrate of potash, chloride of potash, nitrate of soda and sulphate of ammonia. This is narrowing the manure elements, or sources of manure, down to an unnecessary limit to the exclusion of other valuable manures. It was seen from Drs. Liechti and Vogt's experiments that as good results were obtained from basic slag as that from superphosphates.

It must also be remembered that superphosphates do not give such good results in soils that are low or deficient in lime. In a soil low in lime a large dressing of farmyard manure in conjunction with either bone-meal, ground steamed bones, or basic slag, gives better results than superphosphates.

I have calculated Ville's formulæ to the manures that are more in use at the present time, omitting that of the sulphate of lime which may be added, if required, or ground limestone may be applied in its place. If ground limestone is added, it should be put into the soil some weeks before the other manure, more especially if sulphate of ammonia is to be used, the same may be said of basic slag. Lime and basic slag are liable to cause a loss of ammonia by decomposing the sulphate and setting the ammonia free. Then in calcareous soils there is no need for the addition of the sulphate of lime. In the following recalculations of Ville's formulæ the sulphate of lime is left out :—

NORMAL MANURE, No. 1.

	lbs. per acre.	When kainit is used in place of sulphate of potash,	
Superphosphate of lime...	176		176
Sulphate of potash, 50 °/₀	74	Kainit ...	263
Sulphate of ammonia ...	165		165
	415		604

NORMAL MANURE, No. 2.

	lbs. per acre,	When kainit is used in place of sulphate of potash.	
Superphosphate of lime...	350		350
Sulphate of potash, 50 °/₀	148	Kainit ...	525
Nitrate of soda	345		345
	843		1220

Normal Manure, No. 3.

		When kainit is used in place of sulphate of potash.	
	lbs. per acre.		
Superphosphate of lime...	350		350
Sulphate of potash, 50 °/o	176	Kainit ...	628
Nitrate of soda	235		235
	761		1213

Normal Manure, No. 4.

		When kainit is used in place of sulphate of potash.	
	lbs. per acre.		
Superphosphate of lime...	528		528
Sulphate of potash, 50 °/o	200	Kainit ...	700
Nitrate of soda	350		350
	1078		1578

Normal Manure, No. 5.

		When kainit is used in place of sulphate of potash.	
	lbs. per acre.		
Superphosphate of lime...	528		528
Sulphate of potash, 50 °/o	140	Kainit ...	525
Ammonium sulphate ...	112		112
	780		1165

Normal Manure, No. 6.

		When kainit is used in place of sulphate of potash.	
	lbs. per acre.		
Superphosphate of lime...	350		350
Sulphate of potash, 50 °/o	148	Kainit ...	148
Ammonium sulphate ...	112		112
	610		987

In the above formulæ I have taken out the chloride and nitrate of potash. In the first place, I consider the chloride of potash is not a desirable manure to use in this colony; and the nitrate of potash is too dear and does not give any better results than the nitrate of soda. When sulphate of ammonia is intended to be used in place of nitrate of soda, a fifth less of the sulphate will be required. When nitrate of soda is to be used in place of sulphate of ammonia one fourth more will be required than of the sulphate. It must be remembered that the nitrate of soda is much dearer than sulphate of ammonia ; and that Pearson in Victoria obtained better results with the latter than the former, as it is better adapted to the soils and climate there, which will most probably be the case here.*

When farmyard manure is used less quantities than those mentioned by Ville can be used. The quantities laid down must not be considered as hard and fast lines in any case, as one soil differs from another. A great deal also depends on the previous manuring and crop that has been taken off.

The cereals generally require a rich nitrogenous manure. When wheat is grown in a rotation after roots or a leguminous crop, it is considered economical to have sufficient mineral manure left in the soil for the wheat from the previous crop, and only to supply a rich nitrogenous manure, such as sulphate of ammonia or nitrate of soda. In the case of a light soil it is also advisable to add some superphosphate or bone-meal, 2 cwt. of the former and 3 cwt. of the latter.

Lawes and Gilbert have grown year after year wheat on the same land with the following mixture added annually :—

Potassium sulphate	...	200lbs.
Sodium sulphate	...	100lbs.
Magnesium sulphate	...	100lbs.
Superphosphates	...	3½cwts.
Ammonium sulphate	...	200lbs.

The yield per acre during the thirty-seventh season was 35¼ bushels and 40 cwts. of straw.

Land continuously unmanured gave in the thirty-seventh season 11½ bushels and 10¼ cwts. of straw. The following experiments were made by Lawes and Gilbert with wheat and different manures, and extending over a period of 40 years (1852-91). They show the difference between the mineral manure and the nitrogenous, and the mixture of mineral and nitrogenous. The mineral manure in itself gives very little over the unmanured land ; the nitrogenous manures give a very decided increase, but the combination of the two gives a very large increase.

* Since calculating out these formulæ, I have been informed that several large deposits of gypsum are said to exist near the Midland and Yilgarn railways, and also in a smaller degree in the Swan district. The gypsum or calcic sulphate was omitted, as I did not know it could be obtained at a sufficiently low rate to allow of its being used as a manure. By adding the amount of calcic sulphate given in Ville's formulæ to those I have calculated out, a more extended use of superphosphates can be employed on soils poor in lime. At present I have no knowledge of the purity of these deposits of gypsum, but there is every possibility that they are not pure, so it would be advisable to use at least 25 per cent. more than that stated by Ville.

Wheat grown continuously with artificial manures, farmyard manure and unmanured.—Average of forty years, 1852–91 :—

Manure per acre per annum.	Produce per acre—Average per annum.								
	Dressed grain.						Total straw.		
	Quantity.			Weight per bushel.					
	20 years, 1852-71.	20 years, 1872-71.	40 years, 1852-91.	20 years, 1852 71.	20 years 1872-91.	40 years 1852-91.	20 years, 1852-71.	20 years, 1872 91.	40 years, 1852-91.
	bushl	bushl.	bushl.	lb.	lb	lb.	cwt.	cwt.	cwt.
Farmyard manure, 14 tons per annum since 1843	$35\frac{7}{8}$	$33\frac{1}{2}$	$34\frac{7}{8}$	60	$60\frac{3}{8}$	$60\frac{1}{4}$	$33\frac{7}{8}$	$31\frac{3}{8}$	$32\frac{5}{8}$
Unmanured continuously	$14\frac{1}{2}$	$11\frac{1}{2}$	13	$57\frac{5}{8}$	$58\frac{3}{4}$	$58\frac{1}{4}$	13	$8\frac{5}{8}$	$10\frac{5}{8}$
(1) Mixed mineral manure and $3\frac{1}{2}$ cwt. of superphosphates	17	$12\frac{7}{8}$	15	$58\frac{7}{8}$	59	$58\frac{7}{8}$	15	$9\frac{3}{4}$	$12\frac{3}{8}$
Mixed mineral manure, $3\frac{1}{2}$ cwt. of superphosphates and 200 lb. ammonium salts	$26\frac{1}{2}$	$21\frac{3}{4}$	$24\frac{1}{8}$	$59\frac{3}{8}$	60	$59\frac{5}{8}$	$24\frac{1}{2}$	$19\frac{1}{8}$	$21\frac{7}{8}$
Mixed mineral manure, $3\frac{1}{2}$ cwt. of superphosphates and 600 lb. ammonium salts	$38\frac{1}{4}$	$34\frac{3}{4}$	$36\frac{1}{2}$	59	60	$59\frac{1}{2}$	$41\frac{3}{8}$	$39\frac{5}{8}$	$40\frac{1}{2}$
Mixed mineral manure, $3\frac{1}{2}$ cwt. of superphosphates and 275 lb. nitrate of soda	$36\frac{7}{8}$	34	$35\frac{3}{8}$	$58\frac{3}{8}$	$59\frac{5}{8}$	59	$41\frac{1}{2}$	$37\frac{3}{4}$	$39\frac{5}{8}$
275 lb. nitrate of soda	26	$19\frac{3}{8}$	$22\frac{3}{4}$	$56\frac{5}{8}$	$56\frac{5}{8}$	$56\frac{5}{8}$	$28\frac{1}{4}$	$18\frac{1}{2}$	$23\frac{3}{8}$
400 lb. of ammonium salts every year since 1845	$22\frac{1}{2}$	19	$20\frac{3}{4}$	58	$57\frac{3}{8}$	$57\frac{5}{8}$	$24\frac{3}{4}$	$16\frac{1}{4}$	$20\frac{1}{2}$
400 lb. of ammonium salts, $3\frac{1}{2}$ cwt. superphosphate	28	$22\frac{1}{4}$	$25\frac{1}{8}$	$57\frac{3}{8}$	58	$57\frac{5}{8}$	$26\frac{3}{8}$	21	$23\frac{3}{4}$
Mineral manure, $3\frac{1}{2}$ cwt. superphosphate, 400 lb. of ammonium salts in autumn ...	$31\frac{5}{8}$	$29\frac{1}{2}$	$36\frac{1}{2}$	$59\frac{1}{2}$	60	$59\frac{3}{4}$	$31\frac{3}{4}$	$28\frac{3}{4}$	$29\frac{3}{4}$

(1) By the term "mixed mineral manures" is meant a mixture of mineral fertilisers not including phosphates.

Oats.

Oats, like all cereals, require a good supply of readily available nitrogenous manure. It is a shallow rooted crop, deriving all its food from near the surface. It is generally sown in spring in England, requiring a much shorter time for its growth than wheat. For these reasons it requires a more soluble and readily available manure than wheat. Farmyard manure is not considered a suitable manure for oats, as it is too slow and insoluble for the requirements of the quick growing crop. If it is intended to use farmyard manure for the crop it should be put in with the previous crop in sufficient quantities to leave plenty for the oat crop. Even then, to get any good results superphosphates or steamed bonedust with a soluble nitrogenous manure should be sown with the crop, and a top-dressing of either nitrate of soda or sulphate of ammonia after the crop is well through the ground. It is wonderful the results of the top-dressing with either of these nitrogenous manures on a backward crop.

Lawes and Gilbert used the same manure in their experiments on the continuous growing of oats on the same land as they used for wheat, with the exception that they used 400 lbs. of sulphate of ammonia for the oat crop, and 200 lbs. for the wheat. Stockhardt experimenting with oats found that they greedily absorb nitrogen during nearly the whole of the period of their growth, therefore sulphate of ammonia should prove the better manure than nitrate of soda. The experiments show how several top-dressings of the crop act beneficially.

Barley.

Barley, like all cereals, requires a liberal supply of nitrogen, although it is scarcely so greedy in this respect as wheat and oats. It is in a great many respects like oats, and in England is generally sown in the spring. It is also a shallow rooted and quick growing crop, drawing its food from the surface soil, necessarily the manure used must be easily assimilated and within ready access of the roots, as they have to absorb all they require during a very short period of growth. The same remarks in reference to oats apply, also to barley, regarding the unsuitableness of farmyard manure, which can only be profitably used under the same conditions.

Greater care is required in the manuring of barley than oats, so that the distribution is equal all over the field, in order to obtain a uniform sample, more especially if it is intended for malting purposes.

Lawes and Gilbert, for the continuous growth of barley on the same land, use the following mixture :—

275 lbs. of nitrate of soda	100 lbs. of sulphate of soda
200 ,, sulphate of potash	100 ,, ,, magnesia

$3\frac{1}{2}$ cwt. of superphosphates.

This produced in the twenty-ninth season, on the same plot of land, a crop of $59\frac{3}{8}$ bushels of grain and $32\frac{7}{8}$ cwts. of straw per acre. The land continuously unmanured for twenty-nine years gave only $18\frac{3}{4}$ bushels of grain and $9\frac{7}{8}$ cwts. of straw.

Cooke from his experiments recommends the use of 1 cwt. of nitrate of soda, 2 cwt. of superphosphate, and $\frac{1}{2}$ to 1 cwt. of sulphate of potash ; these quantities to be maintained or lowered according to the previous treatment of the soil. Professor Tanner, in his investigations in the growth and qualities of barley, found that for malting purposes, that grown with ammonium sulphate was much superior to that grown with nitrate of soda, so if the barley is meant for malting purposes the nitrate of soda in the above mixtures should be changed to 210 lbs. of sulphate of ammonia in the first, and 90 lbs. sulphate of ammonia in the second. The barley grown with nitrate of soda was highest in albuminoids, consequently the best for feeding purposes. To grow barley for malt, use sulphate of ammonia ; to grow it for feeding, use nitrate of soda.

Phosphates alone give very poor results, in fact no better than no manure, unless the soil is very rich in nitrogenous matter.

Root Crops.

Root crops demand a liberal supply of manure, which they use in large quantities. They require more manure than any other crop and give a larger proportionate return per acre than other crops. Phosphates may be said to be the prime essential manure for all root crops, but a general manure containing nitrogen and potash, as well as phosphates, must also be applied if a maximum crop is desired. The varieties of root crops differ somewhat from each other as to their actual requirements beyond phosphates. Potatoes require and assimilate a large amount of potash, while mangolds and beet roots are more greedy of nitrogen.

The different reqirements of each variety should be attended to very closely in the manuring of root crops, as they are so liable to diseases, more especially in the early stages of their growth. By supplying proper nourishment they are more able to resist the attacks of the pests that are apt to prey upon them. Root crops are grown in a great many places entirely with farmyard manure, enormous quantities are scarcely profitable, as the root crops do not appear to be able to assimilate their food readily from farmyard manure. Some of the benefits they derive from this manure appear to be of a mechanical rather than chemical nature, its action on the soil being more in the direction of keeping it open, creating warmth, retaining moisture. The best effects have been produced with not more than ten tons per acre of farmyard manure ploughed in some months before sowing, with an addition of mineral manures at the time of sowing.

Turnips.

Turnips have a peculiarity of absorbing a large amount of sulphuric acid, and this may account for the opinion held by some farmers that gypsum is necessary to the growth of this crop. Most soils contain sufficient sulphuric acid in themselves for all the requirements of a crop of turnips. The benefits from gypsum are more indirect through its action on the soil than by any direct effect on the crop. By using superphosphate enough gypsum or sulphate of lime is given, as it is largely contained in superphosphate. Large crops are obtained by using 10 to 12 tons of farmyard manure per acre, ploughing it in in the autumn and using 3 to 4 cwts. superphosphates, ½ cwt. of sulphate of potash (if kainit is used, 1½ to 2 cwts.) at the time of sowing. Instead of the superphosphate, 10 to 12 cwts. of Thomas's phosphate or genuine bone-meal may be used with good effect, but of course, for reasons previously given, superphosphate has the best effect on turnips.

Mangolds.

Mangolds require more of a nitrogenous manure than turnips, and although they require a large supply of phosphates, they are enabled, being a deep-rooting plant, to obtain a large supply from the soil. A good nitrogenous manure is what they delight in. The following mixture will prove beneficial and give good crops :—Ten to twelve tons farmyard manure in the autumn followed at sowing time with 3 cwts. of superphosphates, 1 cwt. sulphate of ammonia and 1 cwt. kainit, or 8 cwts. of Thomas's phosphates or genuine bone-meal may replace the superphosphates.

There is one thing regarding mangolds, and even cabbages, that I would call the attention of farmers in this colony to, and this is that they can be grown on soil with a percentage of salt in it that would sicken most other crops ; in fact they appear to be benefited by some salt.

Beetroot.

Beetroot requires a good complete nitrogenous manure containing phosphates and potash. The nitrogen may be given either in the form of nitrate of soda or sulphate of ammonia. If the beetroot is grown for sugar-making, nitrate of soda should be used as it gives a greater production of chrystalizable sugar. Ville's No. 2 manure modified may be used ; using 12 tons of farmyard manure in the autumn, and at the seed-time 2½ cwt. of superphosphates, or 7 to 8 cwts. of Thomas's phosphates (basic slag), 2½ cwt. of nitrate of soda, and 1 cwt. of sulphate of potash. The nitrate of soda to be sown at seed-time.

Potatoes.

Potatoes may be grown in almost any soil if they are liberally treated to manure. This crop demands a good supply of phosphates and also potash, but the manure used must be complete if the best results are to be obtained. Potatoes are very exhaustive to a soil making great demands on its fertility, but no farm crop responds better to a liberal manuring, and re-pays it better in the crop.

As already stated, farmyard manure is used in some places in large quantities, as much as 44 tons per acre being applied. The potato is a plant that cannot easily assimilate its food from farmyard manure as it is a surface feeder and should be liberally supplied with readily available nourishment. A great deal of the apparent benefit potatoes derive from farmyard manure is owing to its mechanical action on the soil.

Nitrate of potash has no better effect on the crop than nitrate of soda, and the former is much dearer than the latter. Nitrate of soda naturally gives better results than sulphate of ammonia. Potash is best used in the form of a sulphate. The chloride of potash should never be used for growing potatoes, and the same thing applies to tobacco. Jamieson has proved that it acts as a poison on these crops, and this has been confirmed by Munro and Wrightson. Potatoes grown with the chloride of potash are generally waxy. Although this crop demands a large amount of potash, of which the ash contains from 55 to 60 per cent., yet the application of too much is liable to increase the potato disease. Superphosphate is undoubtedly the best form in which to apply phosphates to this crop. The following mixture should ensure a maximum crop, everything else being favorable:—Fifteen tons farmyard manure, 3 cwts. of superphosphates, 1 cwt. nitrate of soda, or 9 cwts. of Thomas's phosphate might replace the superphosphate, and 4 cwt. of kainit the sulphate of potash. If farmyard manure is not used, then use 5 cwts. superphosphate, 3 cwts. sulphate of potash, and 2 cwt. of nitrate of soda.

Leguminous Crops.

Leguminous crops are benefited most by potash manures, for which they have a special liking. Although they absorb a large amount of nitrogen, more than even cereals, yet they derive no benefit from the addition of nitrogenous manures, on the contrary, such manures may prove hurtful to them. This is a fact that has been known to farmers for a long time, but only lately has the explanation been made known by the discovery that leguminous plants have the power (which is not possessed by any other class of plants, at least to any great extent) of absorbing nitrogen from the air. This, as already explained, takes place through the agency of micro-organisms in the soil. Leguminous plants not only absorb large quantities of nitrogen from the air; but they also greatly enrich the soil with nitrogen. Thus we see how land that has grown leguminous crops for some time becomes so charged with nitrogenous matter that it does not appear to grow any more ; such as a field growing clover for some years when it gets clover-sick. It is for this reason that cereals do best in a rotation after clover, the large amount of nitrogen left in the soil by the previous crop being available for the cereal crop.

Beans and Peas.

Farmyard manure was at one time considered to be the necessary manure for peas and beans, and is still held by some to be the best manure for them. But it has been proven that they can be grown even more successfully with artificial manures than farmyard manure. The manure must have potash in it to be of any use. Phosphates and nitrogen, either singly or together, have very little effect on the crop when potash is absent. Gypsum is said to have a good effect on them, but the only action it appears to have is to influence the decomposition of the insoluble compounds of potash, thus setting the potash free for the use of the crop. It will be found cheaper to add potash ready for the crop than adding gypsum to hasten the decomposition of combined potash.

Beans and peas may be manured with success with the following mixture :—Eight to 10 tons of farmyard manure and 2 cwts. of superphosphates, or 4 cwts. of Thomas's phosphates, and 1 cwt. of sulphate of potash, or 2½ cwts. of kainit.

If no farmyard manure is used, then 3 cwts. of superphosphates, 2 cwts. sulphate of potash, or 6 cwts. kainit and ½ cwt. nitrate of soda, mixed with the phosphates and potash, but not to be used as a top-dressing.

Clover may be treated with farmyard manure, or 6 cwt. of Thomas's phosphates and 2 cwt. sulphate of potash per acre.

Poudrette as a Manure.

This manure is made from nightsoil by drying the collected excreta, either by itself or with the addition of some chemical. It contains sometimes as much as 2 per cent. of nitrogen, but more often not more than 1 per cent., about 3 per cent. of calcium phosphate and 1·5 per cent of potash. It is very seldom worth the price asked for it. Sometimes it is enriched by the addition of superphosphate. It is too bulky to allow it to be used except near to where it is made. Poudrette, made from earth-closets, Gilbert and Voelcker have shown to be of very little value.

Sewage also is of very little value to the farmer. Sanitary authorities use it from a hygenic point of view, irrespective of cost, rather than from an agricultural standpoint. It is very variable in its composition, being governed by the refuse from which it is made. Scott and Morton state that London sewage contains 3 lbs. of solid matter per ton, consisting of 1 lb. of organic matter containing nitrogen equal to 3 ozs. of ammonia ; and 2 lbs. of mineral matter yielding ½ oz. of phosphoric acid and 1½ ozs. of potash, equal to 5 ozs. of fertilizing matter. If this is valued at the same price per unit as an ammoniacal guano, it would be worth only 2d. per ton of sewage. One ton of guano contains as much fertilizing matter as 1200 tons of sewage. Sir C. A. Cameron gives the value of Dublin sewage at 1½d. per ton. If the sewage is passed on to land for irrigation purposes the whole of the fertilizing matter is received into the land. If some of the precipitation methods are used to purify the sewage, the sludges obtained contain almost all the phosphoric acid, very little of the ammonia, and almost none of the potash. The late Prof. Way gives the following analyses of sewage before and after treating it with lime.

	Grains per gallon.	
	Before.	Afterwards.
Phosphoric acid	2·63	·45
Potash	3·66	3·80
Ammonia	7·48	7·50

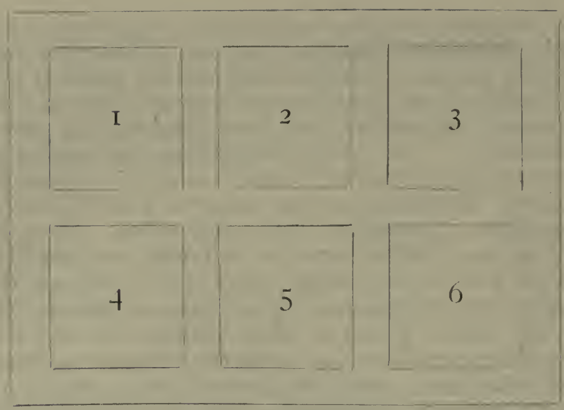
It is evident very little can be expected from sewage-sludges, except from the phosphoric acid. Sewage irrigation farms have been most successful in growing grass and green fodders for feeding milch-cows, but both the milk and butter are liable to be tainted. Vegetables have also been grown successfully with sewage.

In the buying of manures too much must not be taken for granted. It does not follow that because so-and-so used a particular manure last year or the year before, and had a good crop by using so much of it per acre, that the same results will be secured on the land in another season. The farmer may have seen his neighbor's good crop which was obtained by using so many hundred pounds per acre of a particular manure, and he comes to the conclusion this is just what he wants to give him a good crop on his land. But he arrives at this conclusion without a proper knowledge of the constituents of the manure, as well as without knowing what is required by his soil for a particular crop. His neighbour's soil may contain a sufficiency of potash. The manure may contain little or none, but he gets a good crop, because the soil already contains all the potash required, and the manure contains all the other elements of food for that crop, while his neighbour's soil contained sufficient potash his might be deficient in this constituent, and no matter how much nitrogen and phosphoric acid he gives to the crop which requires a liberal supply of potash, the result will, in most cases, be little better than if he applied no manure. What he wants to know, when he has decided what he intends to grow, is, what is his land deficient in that the crop requires. This knowledge can be obtained by chemical analysis and also by the use of experimental plots. This latter method should be undertaken by all farmers so that they may know in what respects their soils are deficient, and thus be able to maintain them always in a fertile state. Further reference will be made to these experimental plots. The farmer is now supposed to know what his crop will require, and also the constituents of fertility his soil is deficient in. He must then see that the manure he proposes to buy contains all the plant food necessary for the crop and is in such a state that it can be easily assimilated by the crop. He should not accept the word of the vendor in too great faith, for the majority of the merchants who sell manures, though honest enough, know nothing about their composition themselves, and have to accept the statements of the manufacturers. The former should have the manure analysed, and find out definitely whether it does or does not contain all that is said to be in it. No merchant can object to have his merchandise analysed and give a guarantee of its composition. Very often the percentage is given from so much to so much, and one may safely reckon on the lowest percentage when calculating out the value. It is the experience of almost every agricultural chemist that there is scarcely any class of goods so much adulterated and sold under so much misrepresentation as manures. Supposing the manure does possess the good qualities claimed for it, are the different elements of plant food combined in sufficient quantities and in the best proportions? This should be ascertained before purchasing.

What I have already stated in these pages I will reiterate: That unless one knows thoroughly what a compound manure is composed of, it is best to buy the different elements of food for the crops separately, and mix them on the farm; one has then some definite idea of what is going into the ground, and can expect a return from it. When one buys sulphate of ammonia, nitrate of soda, phosphates or potash salts, one should always obtain a guarantee of the percentages and have them analysed. It generally pays to do so.

I have said that every farmer should find out what plant food his land has in sufficiency, and what it is deficient in. Chemical analysis will tell a great deal about the soil, but it will not tell all, as there are a great many things regarding the assimilation of the food by the plants that the chemist has not yet solved. By field experiments or analysis we can obtain the knowledge of what the soil is deficient in and what it has sufficient of. Every farmer should not only be able to analyse his land by field-plot experiments, but should make a point of doing it, and thus acquire the knowledge as to how to get his land into a complete fertile state, and then maintain it in that state. Until he does so, it is generally a process of plough, harrow, and guess. Guess stands for manuring.

These field-plot experiments are conducted in the following manner:—In the field, whether rich or poor land, that is to be tested, a spot should be chosen as nearly level as can be found, with as uniform a depth and quality of soil as possible. The plots may be six in number, one-tenth of an acre each, with a small path dividing each, as shown in the sketch. At every corner of each plot a post is placed to mark the boundary. The plots are best square, but they may be parallelograms, but it is absolutely necessary they



should all be exactly of the same size. All the plots are to be ploughed in the one day, and also sown and manured on the same day.

If we take, say, wheat as the test crop, each plot must be sown with the same quantity and same variety of wheat. No. 1 receives no manure ; No. 2 receives one-tenth of what is required for an acre, of normal manure No. 1 ; No. 3 plot receives the same manure, with the nitrogen omitted ; No. 4 receives the same manure without the phosphates ; No. 5 plot receives the same manure without the potash ; No. 6 plot no manure. The crop from each plot should be gathered the same day, and the grain and straw weighed separately. This completes the analysis of the soil, and we have only to calculate the results from the figures obtained ; and to show how this is done we will take a series of experiments made by G. Ville, at Vincennes, on wheat, with the following results :—

	Crop per acre, bushels.
No. 2 plot, normal manure ...	43
,, 3 ,, manure without nitrogen	14
,, 4 ,, ,, ,, phosphates	$26\frac{1}{2}$
,, 5 ,, ,, ,, potash ...	31
,, 1 and 6 plots, no manure, averaged	12

The conclusions are evident. This soil requires, above all, nitrogenous matter, it is also insufficiently supplied with potash and phosphates of lime. From the above results we are in a position to say what quantity and class of manure is required for any given crop. But we have still another thing to consider, how to maintain the soil in a fertile condition, and to know when it is getting deficient in any of the plant foods.

To accomplish this the amounts of phosphoric acid, potash, and nitrogen added in manure from the commencement of the year in which the test has been made, must be kept account of in a book for the purpose and for every succeeding year, thus, the amounts per acre, were, say :—

		per acre.
176 lbs. superphosphate containing 20 % phosphoric acid		35·2 lbs.
74 lbs. sulphate of potash containing 50 % potash	...	37·0 lbs.
165 lbs. sulphate of ammonia containing 20 % nitrogen		35·0 lbs.

Then, from the weight of the crops the amounts of these plant foods which are annually carried away can be calculated from the tables on pages 681 to 682. That carried away by the crops, subtracted from the amounts added in the manure, will leave either a plus or a minus quantity for each of the plant foods. Where a minus quantity occurrs it must be made good in the next year's manuring, and where a plus quantity occurs it can be credited to next year's manuring, thereby keeping a constant balance of plant food in the soil. It must be remembered that leguminous crops take little or no nitrogen from the soil, on the contrary, they generally enrich the soil with nitrogen.

Anyone wishing to commence these tests and desiring fuller information on any point can have it on applying to the Secretary of the Bureau of Agriculture ; and after having conducted his experiments can, by sending the full data of the seeds and manures used, with the complete weght of the crops removed, have the conclusions to be arrived at from the data sent, forwarded to them.

The great aim of manuring is to produce a full crop by supplying food readily available to the plant. Once more I repeat it is more economical to manure the plant than the soil, giving in unstinted quantities where required ; when the requirements of the soil are not known it is always best and cheapest to supply a complete manure containing phosphoric acid, potash and nitrogen, excepting the last in the case of leguminous crops. Manuring should be done with discretion, a judicious but not too large a supply of any of the elements of plant food that may be required must necessarily increase the profits of the farmer. Too heavy an application of manures does not produce sufficient increase in the crop to compensate for the extra cost, in some cases it may be actually injurious.

In manuring it would be as well to remember :—

1. That wheat and oats require more nitrogen than rye and barley.

2. That a dry light soil requires more nitrogen and potash than a damp, heavy one.

3. That organic soils or those rich in humus, require more phosphoric acid and less nitrogen (nitrate) than soils poor in organic matter.

4. That if the previous crop was a nitrogen gatherer, that is, a leguminous crop, a less quantity of nitrogen is required for the next crop.

5. That if the previous crop was a nitrogen consumer, that is, cereals, potatoes, etc., a large quantity of nitrogenous manure is required to keep the soil in a fertile condition.

6. That seed drilled in requires more nitrogen than that sown broadcast.

7. That soil rich in lime requires more superphosphate than one poor in lime.

I have been writing these pages for farmers who not only admit the necessity of manuring their land but actually do manure it. There are not, it is to be hoped for the credit of the colonies, any farmers who will deny the benefits to be derived from manuring ; yet there is, I am sorry to say, a large number who never give their land any manure but that derived from stocking. Cropping takes a large amount of the plant food from the soil, and this must be returned in some way or other if the soil is to maintain its fertility. Stock only enrich the land to less than the extent of what they take off it. The droppings do not necessarily return all that is taken from the soil. In the case of milch cows, for instance, a large amount of fertilizers is carried away in the milk, and fat stock also remove all that has been eaten into their systems to make up the flesh and bone. Within the last few days I have heard of a man who has followed the course of cultivation without manuring for forty years. His land now produces, when cropped, the remarkable amount of four bushels of wheat to the acre. Does it seem surprising that that man should be in pecuniary difficulties?

It is scarcely worth while attempting to follow the reasons, or absolute want of them, of this ruinous method of farming. The excuse a great many farmers make is that they are going to take one more crop and then manure the next, but the next never appears to be any better treated. These are the men who rail most about farming being unprofitable, the bad markets, bad government and bad seasons. Sometimes they will tell one all they need is a good shower of rain in order to secure a good crop. This reminds me very much of a gentleman farmer in Scotland who was too mean to pay for manure. His land got so poor that he thought it advisable to sell the estate. A certain wealthy Scotch iron manufacturer, who had been brought up on a farm in his young days, went to see the estate with the view of buying it. After examining the land the following colloquy took place between Mr. Ironmaster and Mr. Want-to-sell-an-estate :—

Mr. Ironmaster : "Your land seems to be very barren."

Mr. Want-to-sell-an-estate : "Not at all sir, not at all ; it only wants a good shower of rain to make everything spring up and show that it is exceedingly fertile."

Mr. Ironmaster : "What is that you say, a shower of rain, did you say ! a shower of dung would do it more good."

PART VI.

THE WEST AUSTRALIAN SETTLER'S GUIDE AND FARMER'S HANDBOOK.

DAIRYING.

BY ALEX. CRAWFORD,
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INTRODUCTION.

IN Western Australia there is probably no branch of agricultural industry offering so good an opening to the investment of capital, nor one promising such immediate success, as dairying.

At the present time, and for some years to come, the bulk of the butter consumed here comes, and will come, from the Eastern colonies ; but before it can reach here and be put on the retail market it has to undergo the many vicissitudes of climate and carriage, and is generally three weeks old at the least. By this time the delicate aromatic flavor so desirable in fresh butter is nearly always gone, and although the butter may be sound and sweet, it is almost flavorless and fails to tempt the appetite in the way that freshly made butter does. The result is that really first class dairy butter made in the colony commands almost double the price that the imported article brings, and the demand is far beyond the supply, and still growing.

At the present time there are very few dairy farms in Western Australia, and still fewer where really good butter is made. This is not the fault of either the climate, the land, or the cattle. In many districts of the colony no one need ask nor seek for better soil to dairy on, and the terms upon which the land can be obtained from the Government are such that a very small capital indeed is required to secure an area large enough to keep in comfort a family able and willing to work, and not only in comfort, but allowing a fair sum to be put by each year for a rainy day. Probably in no other part of the world at the present time can an independence be secured with less capital and less hard work in agricultural pursuits than in Western Australia.

While the goldfields are attracting thousands from far and near, and the influx of people continues in a steady flood, it is to be feared that many are forsaking the solid substance when they set their faces towards the great gold-centres eastwards, only to grasp at the shadow, leaving a competence and the fertile districts of the south-west behind to still await the plough of the husbandman and the cheering sound of happy and successful industry The Government of Western Australia, being fully alive to the fact that the small farmers are the back-bone of a country, is offering inducements sufficient to tempt settlers from all parts of the world.

Under the Homesteads Act of 1893 any person who is the head of a family, or a male over 18 years of age, and who does not already hold over one hundred acres of land, may apply for a free grant of land on simple conditions, which are briefly :—

That after the application for the land has been approved he shall, within six months, take personal possession of the land, and reside upon it for at least six months out of each year for the first five years.

This opens up a prospect to the working man such as can be had nowhere else in Australia. For six months in the year he can go—say at harvest and shearing or ploughing time—and earn money sufficient to keep himself and family in actual necessities that cannot be raised on the farm, while the other six months can be spent in improving the farm and preparing it for crops or pasture.

On his holding the farmer can have his home and family, who, while he is away, can keep the household going by rearing pigs, poultry and bees, and by cultivating a small garden that will grow vegetables sufficient for themselves, and if there is any surplus it can be sold or fed to the poultry and pigs. If money is available to purchase a cow or two, the returns will probably be at least £10 a year from each cow, and in a climate like this the necessities outside those which can be raised on the farm are few, and will require a very small outlay of ready money. That the first condition is not meant to be oppressive is found by the land not being forfeited if the residential clause is not complied with in case of sickness or other valid reason.

The next condition is that within two years a habitable house of not less value than £30 be erected, or £30 value be expended in clearing or cropping. This does not mean that £30 cash must be laid out, but improvements worth that amount must be effected, which can be done by the owner's own labour. Or two acres of orchard or vineyard, properly prepared and planted, can be substituted. Within five years one-fourth of the land must be substantially fenced, and one-eighth cleared and cropped. At the end of seven years, if the conditions are fulfilled, a Crown grant may be obtained on payment of the Survey and Crown grant fees, which in most instances would not exceed £7 7s.

If it is desired to obtain the freehold of the land earlier, this can be done after twelve months residence, putting on all the required improvements, and paying five shillings per acre in addition to the fees already mentioned. In what is known as the south-western portion of the colony certain areas have been selected that are suitable for homestead farms, the quality of the soils and the rainfall having been taken into consideration. But if dairying is the object in view, the areas to the south and south-east of Perth are the most suitable. Here they are nearly all within a reasonable distance of the railway, the soil is rich, water is easily obtained, and the rainfall is good.

One word of warning is perhaps needful to the intending settler, either from the old world or the new. In the districts immediately south of Perth there are few natural grasses, low scrub taking their place, some of which is edible, and on which horses and cattle do fairly well, but require a very large area on which to pasture. For this reason it is not advisable that a start should be made unless sufficient capital is in hand to keep the selector going for at least three months. The districts in which land may be secured for homestead farms suitable for dairying, are as follows:—

Jandakot is the nearest area to the capital, the nearest part being about 15 miles distant. The soil consists of sandy loam, chocolate soil, and in the swamps, heavy black loam, which when drained is suitable for intense cultivation. This area being so conveniently situated to both Perth and Fremantle is admirably adapted for milk producing and sending it to the city to be retailed. The cost of clearing in many cases would be almost repaid by sending firewood either to Perth or to the lime and brick burners. The chief drawback is the want of good main roads through the district, but this is being remedied each year. Milk could easily be taken into the railway morning and night for dispatch by train to the capital. To anyone not accustomed to the sandy soils of Western Australia, much of the country, at first sight, is no doubt disappointing, the presence of sand and the absence of natural grasses making it appear poor, and it is not until one actually sees what can be done that any idea of the value of the land can be formed. Crops of oats five feet high, maize twelve and thirteen feet, fruit trees bending and breaking under their burden, potato and other root crops thriving, actually turn the wilderness into a garden. The rainfall is about 30 inches, coming down mostly in the winter and spring, while little or no rain falls in the summer months, so that a considerable quantity of ensilage would be required to feed the cattle during the dry season. This can be easily and cheaply done on account of the wonderful growth in the spring time. Where couch grass is sown in this district it produces a large amount of green feed in the summer, but it becomes a very nasty weed when it gets into the orchard or vineyard. In many parts lucerne would grow well and provide good summer forage, the roots going down to the moisture, often not more than 8 or 10 feet below the surface.

The Serpentine agricultural area is on the South-western railway, not far from Pinjarrah, and about 30 miles from Perth. It is situated not far from the Serpentine river, and in the near future will probably have irrigation works in connection with it, much of the land being admirably adapted for irrigation. The soil is rich, and will grow almost anything, and the location is also well adapted for producing milk to be sent to Perth by rail. The rainfall is about 38 inches per annum.

The Coolup agricultural area is on the South-western railway line, the nearest portion being about 56 miles from Perth. The soil in this reserve is sandy loam, very rich in some places, and fairly good all over. The land is undulating in places, and the timber not very heavy. Nearly all the timber found here will burn readily green, so that the cost of clearing is not very heavy. The nearest station is Pinjarrah, from which there is a good train service to Perth. There is a good rainfall (about 35 inches), and well distributed.

The Harvey agricultural area is about 76 miles from Perth, on the South-western railway. The land varies considerably in quality, but is mostly good, some of it especially rich and suited to any kind of agriculture. Water, in many places, is obtainable at a depth of from 12 to 20 feet, and from a good well sufficient land could be irrigated to provide crops for ensilage for a large number of cattle at a very small expense. On some of the best land the timber is rather heavy, and it is worth from £5 to £6 per acre to clear the land, but once cleared it will yield very good returns. There are in this area some very large flats consisting of alluvial deposits, in some places from six to eight feet deep, that would make magnificent pasture if laid down with artificial grasses, such as rye, cocksfoot, timothy, or some of the fescues. The rainfall is good, being between 30 and 40 inches per annum.

Collie is the next area set apart in this direction, it is about eight miles from the important seaport of Bunbury. Most of the land here is taken up, being very fertile and especially well watered. About 18 or 20 miles distant is the Boyanup area, on which there is a large proportion of really good land. It is situated on the line of railway running between Bunbury and Donnybrook, and about 12 miles distant from the former. Much of the land here is admirably adapted for dairying.

The Preston agricultural area is distant about 25 miles from Bunbury, and not far from Donnybrook railway station. Much of this area is first-class land, consisting of deep alluvial deposits, and water is easily obtainable. The flats are well adapted for lucerne growing or intense cultivation. The best of the land is rather heavily timbered, and it is worth up to ten pounds per acre to clear the densest of it. There are many creeks and small rivers running through it, and in many places irrigation could be carried out at a very little outlay. The rainfall is over 30 inches per annum.

The Tweed agricultural area, although the most distant from Perth, is perhaps the most suitable for dairying. It is about 35 miles from Donnybrook and close to the town of Bridgetown, on the Blackwood river. The railway is now being constructed close to it. The physical features are quite distinct from any of the others already mentioned, the country being very undulating, and consisting of in some places rich chocolate soil, and in others of ironstone gravelly soil. The timber in places is very heavy. The rainfall is over 30 inches and in places almost 40 inches per annum. The cost of clearing is considerable, but as a cheese and butter district it is scarcely to be surpassed in the colony, and will be a very important agricultural centre shortly after the railway is completed. Water in most places is obtainable at from 60 to 100 feet.

There are many more agricultural areas, all, as well as those I have alluded to briefly, fully described in Part I. of the Guide, but most of them are more adapted for cereal, or fruit or wine growing, than for dairying, being in warmer districts, with a much smaller rainfall. In various districts many kinds of poison bushes are found, but on the areas mentioned little or none grows. When speaking of dairying it is taken as including poultry and pig rearing, so as to get the best returns from the waste products, and in order to give some idea of the profits that may be obtained in these lines, the following are the wholesale quotations for dairy produce at the date of writing, January, 1898 :—

Bacon, 10d. to 1s. per lb. ; rolls, 1s. ; flitches, 10½d. ; hams, 1s. to 1s 2d. ; butter, in bulk, 1s. 2d., in half pounds, 1s. 4d. to 1s. 7d. if the brand is favourably known ; cheese, 9d. to 9½d. ; eggs, 2s. 6d. to 2s. 9d. per doz. ; fowls, 6s. 6d. to 7s. 6d. per pair ; ducks, 7s. to 8s. per pair ; turkeys, 14s. to 25s. per couple.

From the foregoing it will be seen that there is a large margin for profit, and that the rearing and selling of a few pigs and poultry alone would keep the household expenses going.

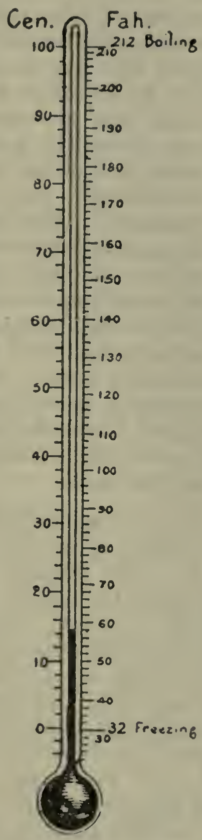
CHAPTER I.

OLD AND NEW METHODS.

The dairying industry within the past seven years has advanced from being a comparatively small and insignificant branch of farm work to a position of importance second to none in the eastern colonies, not only on account of the amount of money that it brings in, but also because of the quickness of the returns. Monthly accounts are the general rule, but among some farmers, who make their own butter instead of sending their milk to the creamery or factory, the terms are cash weekly from the agents. In fact, until of late years dairying was looked down upon, at least by the male portion of the community, and if any of them were asked about how the cows were milking, the reply would be, "Ask the old woman! She attends to the butter-making.' On their part, the women folk were not slow to recognise, to a certain extent, the advantages of this state of affairs, and they claimed as their perquisite the money obtained from the sale of the dairy produce. When the factory system came to be introduced, this was one of the principal objections that was urged against it by the women—that they would not get money then as in the past, and in many cases it was hard work to overcome it.

It was not difficult to show that under the new method of working women were the most benefitted by the change, and we would ask to day: What is the position of a woman who attends to a moderate-sized dairy, run on the old-fashioned lines? With many it is a drudgery that few of the negroes in the old slave days were subjected to. It may seem a simple matter to attend to a dairy under the old system, to those who have never tried it, but the work is not only much of it hard, but it is continuous, commencing early in the morning and continuing on until often all hours of the night. The following is about the routine:—Up early in the morning milking, when that is over, straining and setting the milk, then washing and scalding all the milking utensils. After breakfast, skimming the dishes, then feeding the calves with skim milk, again washing and scalding dishes—no mere "wipe round," as every good dairy woman knows, but a thorough good scrubbing. Then comes the churn, washing it out, scalding and cooling it; then the churning, in the cold weather keeping at it hour after hour, and the butter will not break, or in the hot weather the cream swells up and fills the churn with froth, and when the butter does come it is so soft and oily that the buttermilk cannot be worked out of it, and it has to be put away to harden, which means getting up next morning perhaps about three or four o'clock to salt it and get it printed in time to send to market.

The mere physical exertion in working butter on the old system with the hands, especially in winter, was downright hard work, and with some almost a matter of impossibility, not having what are known as cold hands. Some persons seem to have naturally hot hands, and do as they will, they cannot prevent the butter sticking to them and getting greasy, while others can work the butter and have no trouble of that kind at all. Now all this handling either is, or ought to be, a thing of the past, as butter-workers are made that can extract the butter-milk and thoroughly incorporate the salt much better and more quickly than can be done by hand. Then there came another general wash-up of churn and all connected with it. Under this old system, with many life was a mere existence, hardly worth living — toiling and slaving week days and Sundays, Heaven only knows how many hours a day! In the days of ignorance there was, perhaps, some excuse for this state of things, but there is certainly none now-a-days. Dairy information is spread broadcast over the land, the cream separator has taken the place of the old-fashioned milk dishes, the butter worker has done away with the handling of the butter and labour of salting. By the old methods, physical strength was required; under the new, brains and skill. With those who make their butter at home, a good deal of work still remains, but the improved churns, the use of a thermometer, and the working on recognised lines, instead of by rule of thumb, has reduced the work to a minimum. But to dairy in the most profitable way, the milk should be taken to a factory or or creamery, or if there is none sufficiently near, the milk can be separated and the cream sent twice or three times a week to the nearest butter factory, as there the cream can be looked after and attended to in a way that is not possible on the farm, unless expensive machinery is erected. There is also this advantage in having butter manufactured at the factory, that a more regular and uniform article can be turned out than when it is made at home. Where butter is made from the milk of a comparatively small number of cows, if one of them eats anything that affects the milk, the butter is more apt to be tainted than where the milk of a great number is blended, or at least the taint is more easily



Dairy Thermometer.

detected. Again, unless a proper place has been built for keeping the milk or cream the probabilities are that taints of many kinds will be absorbed by the cream while waiting for churning ; while at the factory suitable arrangements are made for the care of the cream from the time it comes in to the factory until it is packed ready for the market in the form of butter.

Much discussion has arisen at times as to the comparative merit of first-class home-made butter and first-class factory. All things considered, the home-made butter will probably satisfy the taste of a connoisseur better than the factory, for the reason that more delicate flavors are to be found in it at times. All the cattle supplying milk on the farm are probably grazing on the same pasture, and if it be rich in clover or particular kinds of grasses which give a flavor to butter, it will be much more distinct than where the milk is mixed up with that of other cattle that are on different pastures. But however the home-made butter may at times surpass the factory, it can never compete with it for regular and uniform quality. Under the old system a considerable amount of skill was required to make passable butter, and as no rules were laid down that people could go by, every one was a law unto him or herself, and this deterred very many from going into dairying, not knowing how to make good butter, and not having the means of learning at their disposal. A considerable amount of expense is required under the home system, as it is not much use trying to make good butter without having a convenient dairy and the requisite dairy utensils.

But here comes in the great advantage of the modern method. Anyone with ordinary common sense can start dairying with a fair chance of doing well at it. The milking is perhaps the hardest work attached to it, and even that after some practice becomes comparatively easy. With a factory near at hand, all the dairy work can be done with a few milk tins and milking buckets. Many persons who have been brought up in the towns, and who have longed to go out into the country, have been deterred therefrom on account of not knowing anything about farming. If they can only secure a piece of fairly good grass country they need not fear to commence dairying with a few cows, and as they gain experience with the few they can be improving their land and increasing their herds at the same time, and feel assured of at least a good living and a healthy life. It opens up the way for those to go on to the land who could never have done so before, because with a few cows to start with they have an assured income that will keep the house going, while it leaves time for them to improve their land or grow other crops, the returns of which will be so much clear profit. In the other colonies to-day there are hundreds on the land doing well notwithstanding the bad times—the agricultural depression and low prices—who, were it not for dairying, would to-day be simply existing as workmen in some of the large cities on a mere pittance, but who now, with their families, can live in comfort.

But in all this, one must not go away with the idea that dairying is easy work. In one sense it is, but it is very binding work also—night and morning, wet or dry, hot or cold ; Sundays and during the week the cows must be milked, and milked at regular hours. Want of regularity interferes greatly with the yield of milk, and to get the best returns the temper of the master, and all who come about the cattle, must be kept in check. A good dairy cow is a delicate fragile machine in the hands of man, that very little will put out of order and destroy its utility.

In this country at the present time, with the thousands of acres available in the southern districts that can be obtained on the most liberal terms ever offered anywhere, with a good soil and a good rainfall, any man, married or single, with the desire to make an independence for himself, can do so, and with a less amount of hard work than could be done on the land in any other part of the world. With the rapidly growing population it will be many years before the supply here will be equal to the demand, and those who go in for dairying in the early days of the colony's prosperity are the ones who will obtain the "cream." Owners of large properties in the southern districts could not do better than to sub-divide them and let them on a sharing system, supplying the cattle and farm, and getting so much per cent. of the gross returns from the dairy produce. The calves could all be reared, and would be quiet and lay on flesh better than if reared in the bush. In the other colonies this is looked upon as by far the most profitable way of dealing with the land in many districts.

As to whether a person should go in for dairying solely and on a large scale depends upon many things—the district in which he is situated, the amount of his capital, and on the quality and quantity of the land at his disposal, and also on his taste and judgment for cattle. But it may be safely said that there is no farm in the southern district of Western Australia on which a moderate amount of dairying would not pay, and in conjunction with it, poultry and pigs would help considerably to swell the yearly income.

One important fact should constantly be kept in mind in dairying, that a few cows, well looked after, will pay much better than double the number neglected.

CHAPTER II.

LAYING OUT THE DAIRY FARM.

The ultimate success of dairy work will depend to a great extent on the farm and how it is laid out, the soil, the rainfall and the water supply. It is quite possible to make a living on a poor farm badly attended to, but every dairy farmer wants to make something more than a mere existence. There is an old saying, and a very true one, "Poor land makes poor farmers," and it keeps them poor too. If a person can afford it, it is better to pay a fair price for good land than get bad land for nothing. It is most discouraging for the worker on a poor farm to see his neighbour, who does not work nearly so hard as he does, always having better crops, his cattle always in better condition, and the whole family in better circumstances. Of course, there will always be some farms that are better than others, but while land is so plentiful and cheap there is really no excuse for a man going on bad land when there is so much good available at the present time.

Those who are intending to settle on the land should not be in too great a hurry to do so without having a good look round to see which are the best districts. If dairying is to be the sole or main industry, secure land in a district with a good rainfall and as temperate a climate as possible, with good natural water, if available, and good drainage. If a good flat or two can be secured, so much the better. The advantage of this will be felt in growing summer fodder. The farm should be undulating, but the hills not too steep. Although a temperate climate is the best adapted for dairying, if the factory system is at work it will not matter much if it is rather on the warmer side, provided the rainfall is good and there is plenty of water available. Some of the most successful dairies are in hot districts, where water is plentiful and green feed is grown all the summer through by means of irrigation.

The soils in this colony differ so much from those of the eastern colonies that a new-comer is apt to judge by appearances, and neglect land that is sandy and think it is valueless. Anyone who has not actually seen the results obtained from some of the sandy loams here could not credit the amount of crop that is grown upon them. Make inquiries from those who have been in the district for a considerable time as to what the capabilities of the land are. When a farm has been secured and the improvements been gone on with, do not ring all the timber. Leave some growing here and there for shelter as well as for appearance. It is often said that stock do not need any shelter in this or that district. They may do well running about without it, but they will do much better with it and amply repay any attention in this direction. Milch cows require shelter from the heat of the summer's sun and from the cold, bleak winds of winter, and they should never be put into a paddock that is not provided with it. If the trees are such as do not afford a good protection, plant some quick growing ones in clumps that will. In commencing dairying, attention should be given as to the means of getting milk to a creamery or cream to a factory.

It is not much use starting to dairy if the farm is so far away, or the roads so bad that it is impossible to send the cream either to the railway station or butter factory, unless the farmer is prepared to invest a fair amount of capital in dairy appliances. If the dairy is a large one, it will pay well to do that, especially if cheese-making is gone in for.

Where it is possible, it is well to have the milking yards nearly in the centre of the farm, so that all the paddocks may be available for the cattle with as little exertion as possible.

Above all things, if you wish to live at peace with your neighbours, see that your fences are thoroughly sound ; even if they cost you a little more to put up, the money is well spent, and will be repaid to you a hundredfold in days to come.

Do not go in for large paddocks, as cattle like a change of pasture frequently and do much better if they are moved from paddock to paddock without being kept in one until everything is eaten out of it. If the cattle are treated thus they will fall off in their milk, and although it may increase again when they are put on better feed, still they will never do as well as if they had not been allowed to fall away. More feeding value will be obtained from the small paddocks when they are not allowed to be eaten down too close and the cattle are continually walking over them. The various grasses that come in at different periods of the year will have a chance of coming forward and providing food that would otherwise have been nipped off at the start. Land treated in this fashion will carry nearly half has much more stock as it would in large paddocks.

Try and arrange that your yards shall be on the slope of a hill, so that they may be well drained and all surface moisture be readily got away. If there are any large trees growing on the proposed site, if they can be used for shelter from the sun, by all means let them remain. The difference in the behaviour of cattle in the summer time in a sheltered yard and one without it, needs only to be seen to be appreciated. In the one where shade is available the cows may be seen contentedly either standing or lying down chewing their cud ; in the other, exposed to the sun's rays, they are restless, whisking their tails about, tossing their heads, and every now and again rushing one another, and all the time uneasy and out of temper, which means that when they come to be milked the milkers will get of temper also, to the great loss of the dairyman.

Have the milking bails well under cover, so that when being milked the cows may be protected from the weather, and if possible have the milking sheds darkened, then in the summer the flies will not be nearly so troublesome, and thus save much irritation to both man and beast. See that the bails are securely erected, so that when young cattle are being broken in they may not break away and thus give more trouble afterwards. In fact, let everything about your farm that cattle have anything to do with be substantial and solid.

Do not encourage your cattle in bad habits, they learn them soon and easily enough. For instance, do not put a crop for fodder in with only an apology for a fence round it. Some of the cows will soon see that if the fence is not ornamental, neither is it useful, and will find a weak spot and get through. If one gets in others will soon follow, and when they are discovered there will be the usual shouting and chasing and the cattle rushing through the fence without looking for the place they came in. Much damage will probably be done to the crop, the cattle be worried and excited, and worse still, they know the fence is weak and whenever they are near there again they will break in. Nor is this the worst feature, they have learned to break fences and they will break down or through fairly good fences by keeping at it, pushing and pulling with their horns until something gives way. Many cows, old in the knowledge of fences, will walk round one and pick the weakest parts with as much certainty as a man would. If the fences are good, so that stock cannot get through them, they will soon cease to try, and much petty annoyance will be saved. I wish to speak strongly on this subject of substantial fences, for only those who have kept quiet milch cows, or have lived among neighbours who do, can have any idea of the amount of ill-feeling they continue to create among neighbours who would otherwise be on most friendly terms. An outlay of a few pounds, or a few days' extra work at the beginning, would have saved the trouble. In a country like this, one may think it does not matter much, as the feed outside is not much better than the feed inside. Quite true at present, but it will not be always so. The agricultural people have scarcely awakened in many districts yet to the possibilities around them; but this will not long continue, and where only native grasses and scrub are now growing, in a few years or less will be cultivated land, and the good fences will be needed then, and remember that once a fence is up, if it is not the right kind, there is but a small likelihood of its ever being made right until a new one is needed in its place through its days of usefulness having expired, and this may only be expected about once in a lifetime. Do not use slip-rails; lazy people coming into a paddock are apt to leave them down or not put all of them up, or put them up carelessly, and cattle soon learn how to take them down themselves. Of course they can be made fast—pegged or locked—but as boys are often sent to bring in or out the cattle, something attracts their attention and the fastening is overlooked, and perhaps in one afternoon many pounds' worth of crops may be destroyed. Several strong and cheap gates, as well as all classes of fencing, are fully described in Part II. of the GUIDE. Wherever cattle are kept all fences should at least have a top rail; if they have two, so much the better, but a top rail and six wires will make a very good and economical fence. A paddock should always be made to keep the bull in, and the fence of this ought to be made extra high, with at least two rails, or better still, three. In laying out the paddocks, if there is not natural water available, wells or tanks should be sunk, say where four paddocks join, in the corner of one. By doing so one set of troughs will do for all four, as they can be moved through the fence into whichever paddock they are required; or if it is preferred to have the troughs permanently fixed, one set of troughs set close along side or partly under the fence will serve two paddocks.

The cultivation paddock should also be so arranged as to adjoin three or four grass paddocks, when, in case of green feeding or ensilage making, the cattle could be fed with the least amount of labor of carting. Much time, money, and trouble might be saved if, instead of laying out the farm haphazard, as careful attention were given to it as in the laying out and building of a house. There is no sense in having to cart feed a mile or two when it need not be carted a quarter the distance. Neither is it a wise thing to cart green stuff to a silo a mile in one direction when it has to be taken perhaps two miles in another afterwards. I can fancy I hear many farmers say, "Sure, any fool knows that," or, "Does he take us all for idiots?" No, I do not; but for the past ten years, having had a very close connection with farm life, inspecting farms, reporting on them, and judging them, I can say that many farmers act as though they had no brains at all, and often make their horses and themselves walk a mile with a load when 100 yards would do, and my experience has been that few farmers sit down and consider how to lay out their farms so that they may be worked to the greatest advantage and at the greatest saving of labor. This colony being young, and many of the farms not having been laid out, I would draw particular attention to the necessity of working to a plan. Go over your farm, carefully examine it, and see where you will build your house and outbuildings, where you will cultivate, and then lay it all out on paper and see how you can sub-divide it so as to work economically and to the best advantage. You may not perhaps be able to complete your plan for years—never mind, keep on working with that end in view, and ultimately you will reap your reward—having a farm where no unnecessary expense is required to work it.

CHAPTER III.

DAIRY BUILDINGS.

Owing to the scattered population in the farming districts of this colony, for some years to come most of the milk will be separated on the farm, and either the cream churned there or sent to a factory. This being so, it will be necessary to have a dairy of some kind to keep the cream in, and the cooler the dairy can be kept in summer the better will be the result in making the butter. Many expensive plans have been recommended, but none I have seen answer better than those I will describe, and the buildings are cheap and easily constructed. One kind is built above ground of either weather-boards, slabs, stone or sun-dried bricks. A very convenient size for the produce of a small herd is 12 feet by 12 feet, which leaves plenty of room to store the cream and move about. The walls eight feet high, and the roof should have a good pitch, the length of the rafters being, say, three-fourths the width of the building. The dairy should be ceiled with tongued and grooved soft wood if available, if not, hard wood can be used, but it should be lined with calico to prevent dust dropping down. In both gables, above the ceiling, there should be louvre windows or shutters that can be opened or shut at will, so that after a hot day, if a cool breeze comes at night, the cool air may be allowed to circulate over the ceiling. In the dairy there should be two windows, and these lined with wire gauze to keep out insects. If the windows are hinged, so much the better, as when required to be opened they will allow the greater draught. The windows should be of such a size as will allow the light to get in and keep the dairy bright and cheery. Sunlight is a splendid disinfectant, and no dairy should be kept dark. Another reason for having the dairy bright is, that dirt and all kinds of offensive matter may be seen at once. If the dairy is dark it will rarely be kept as clean as it ought to be. The floor, where possible, should be of stone, concrete or bricks, with a fall in one direction, so that it may be thoroughly washed and easily dried. A small gutter running along the low side with an exit through the wall will be found to answer well, as then plenty of water can be used and get away freely. The roof should be of shingles, or if they are not available and good bark can be obtained, it will answer the purpose. A verandah all round the dairy will add much towards keeping it cool. A building erected as above would not of itself keep cool in the hot weather, but to obtain that result quick growing creeping plants should be planted all around and trained right up over the roof. Amongst those that may be used are *dolichus* and *lacsonia exoniensis*. The common passion vine *(passiflora edulis)* may be grown with other creepers, and will give good returns from its fruit, bearing heavily after the first season. Once the creepers cover the dairy right over, it will keep cool even in the hottest weather.

The other kind of dairy is one that is either under ground or partly so. An economical one is made by excavating, say, to a depth of four feet and putting a wall four feet high above that, the earth that is taken out being packed up against the walls nearly level with the top. The eaves of the roof should be carried at least a foot below the wall plate. The roof should be made as described in the first-mentioned. If the ground is such that it is difficult to get a drain from the floor of the dairy, a hole, say a foot or 18 inches square and 1 foot deep, should be made at the lower corner, so that all the washing water may run there, when it can be taken out and carried away. A concrete or brick floor will be the best for this. Creepers should be grown over the roof of this dairy ; also, whenever it is at all possible, water should be laid on to the dairy.

The dairy should always be at a considerable distance from the milking-yard, or any other place that gives off unpleasant smells. It should not be near the fowl-house or stable, neither should the fowls, pigs, or calves be allowed about the building. If a separator is used it should never be worked in the dairy during the summer, for the separator gives off a continual current of heated air. A separate building, or part of the dairy verandah, may be used for separating, and the cream cooled before taking it into the dairy. On large dairy farms a little forethought in laying out the milking yards and dairy may save a great deal of labor, such as arranging that the milk may run from the milking yards by gravitation to the separator, and from there again to the calf pens or pig troughs.

If dairying is to be carried on successfully it will be necessary in most districts that a supply of artificial feed should be produced for both winter and summer use. Green feed, such as maize, sorghum, etc., may be used with advantage in the summer, but in the winter, when the weather is cold and bleak, the cattle will require something not so cold and watery as these, and nothing answers better than good ensilage, fresh from the pit or stack, for it is not only appetising but warm, and cattle milk well on it in winter. To have this always available it will be necessary to cultivate to a certain extent, and for this purpose some of the best land should be set apart. After the first few crops are taken off the best of land it will begin to need manure, for it is the height of folly to cultivate two acres of land if the same quantity of produce can be obtained from one ; and yet this is being constantly done. Year after year the same land is cultivated and nothing put into it to compensate for all that has been taken away, consequently new land has to be cleared and broken up so as to obtain the same amount of forage ; and people complain about the land and grumble because it is not like what it used to be. [Part V. of the SETTLER'S GUIDE is devoted to the manuring of lands, and those who contemplate dairying in the most profitable manner cannot do better than thoroughly study this part.] Manure the land heavily, and do not be afraid to demand big returns. Take two, three, or even four crops off the land in the year. It can be done if you look after it well. Wherever possible sow all crops in drills, so that the land between the drills may be cultivated and kept stirred and open as long as may be without damage to the growing crops. Keep the weeds down and the soil loose and open, and even in a dry season fair crops may be looked for, and not in vain. What is wanted is not large areas of poor land under cultivation, but small areas of rich land, and if not naturally rich, made rich—thoroughly well cultivated and forced to yield heavy crops.

A dairy farmer has other work to do than to spend half his time in ploughing and working poor land. It is a waste of time, so much extra work on the horses, so much extra wear and tear on the implements, and the results unsatisfactory. If you think it is not possible, try one acre, or even half an acre. You can get in, say, barley or rape early and have one good cutting, probably two, then a crop of turnips or peas, and then maize, or sorghum, in the one twelve months, and see what returns you get from it as compared with the other land in proportion to the time and labor expended on it. One fair trial will convince you that there is money in it. As to the matter of what crops should be grown and how they should be treated, I will not go into that now, but will deal with it later on.

As to the permanent pastures in some parts of this colony, many of the better class of English grasses might be grown with great advantage instead of couch grass, which, in nearly all other parts of Australia, is looked upon as little better than a weed, and steps taken to eradicate it and stop it spreading. Of course, the grasses that are suitable to one district are often not suitable to other districts, and experiments will have to be made. These experiments will be of the greatest value to the agriculturist and dairy farmer, as he will then have reliable information to go upon and save himself years of fruitless endeavour. In districts where there are good native grasses it would be well worth the time and labor to gather the seeds of the best of them, sow in pots and then cut for seed to be sown on the farm. Many of these grasses stand our climate much better than any of the so-called artificial grasses will, and not only so, but in the other colonies some of the best flavored and best keeping butter comes off the pastures where the cattle are fed entirely on native grasses. With a very little trouble in a couple of years enough seed could be saved to sow a number of acres, and would amply repay the small expense.

As before mentioned, a good water supply is essential for dairying successfully, and so far as I have seen this is to be found principally in the hilly country. Most of the hilly country is fairly heavily timbered and has a good rainfall, but would not pay to clear, and in its present state does not grow much grass suitable for pasture for cattle. Judging from my experience in other countries, I should say that if most of the timber was rung and all the scrub cut and burnt, and on top of the burnt ground cocksfoot and English rye grasses with clover were sown, in a very short time, if not too heavily stocked, there would be a magnificent pasture where the rainfall is adequate. On some of the loamy hill sides where the rainfall is 40 inches or over, other grasses might be used, such as meadow foxtail, prairie, timothy, and both white and red clovers. The first year the grasses should not be allowed to seed, but cattle should not be put on them until they have a firm root in the ground. In obtaining grass seeds, farmers should be careful to see that they are reliable. Poor seed is dear at any price. On rich flats that are not wanted for cultivation lucerne and prairie grass may be grown to advantage. When lucerne is sown it should always be sown in drills and kept cultivated between the rows until it is well up. On no account sow Italian rye grass, as it is not perennial, and will probably not be seen after the first season. When sowing grasses a very calm day should be chosen.

When laying out the dairy farm, fence off a piece of the best land you have and sow the grasses that will thrive best in it, and reserve this for your calves and never overstock it. A good paddock for calves will be a wonderful help to them, and even when milk is scarce they will often thrive well in it. See that there is good, warm shelter in it for winter and good shade for summer.

CHAPTER IV.

THE LIVE STOCK.

Before treating upon the cattle, I would like to say a few words about the horses required upon the farm. Unless the roads or paddocks that are being cultivated are exceedingly heavy, do not go in for very heavy horses. They are nearly always slow, and downright wasters of time. If you are ploughing they crawl along at the rate of from a mile to a mile and a half an hour, and it is no use trying to hurry them up—they will spurt for a few yards and then drop back again into their old gait. They are not built for fast work, and they cannot do it except at great exertion to themselves. They may be all there for good solid, heavy pulling, but life is too short to use them where a lighter and more active horse will do. If you can get a horse that will walk three miles an hour and do his work comfortably, instead of an animal that will walk one and a half miles, it means that you will do twice as much work with him in the day, and this is a most important consideration, for on a dairy farm time means money. In fact, in heavy ground a good, strong, clean-limbed, active horse will show less symptoms of fatigue after a hard day's work than a heavy, hairy-legged Clydesdale, notwithstanding that the former may have accomplished half as much more work during the day. The active, clean-legged horse is also more adapted for general use, and can be used in the buggy and spring-cart as well as in the plough and harrow. As a matter of fact, really first-class farm horses are few and far between. There is a mistaken notion that any horse is good enough for a farm, and never was a greater mistake made. It is this same principle carried out all through that makes so many farmers poor. If you want to be successful the *best* is not too good, and you cannot afford to sell your best horses. You may sell them, but you are out of pocket in the long run. We find the same principle when applied to the farmers themselves. If a lad is not so sharp and intelligent as his brothers, you hear : "Oh, make a farmer of him ; he is good for nothing else !" Well, if he is not he will never make a farmer. A successful farmer must be intelligent, wide-awake, and a keen observer. If the cleverest boys were made farmers, and their less endowed brothers put to business, it would be better for both. Some of the most successful farmers I have ever met with were men who had good business training, and had made money at it, and who went on the land from pure love of it, or because their health had broken down at other work. They applied their business knowledge and habits to their farm work and did well from the very start—made money where many of their neighbors, on the same kind of land, could scarcely keep the wolf from the door. But, to return to our horses, where you have to use more than one together, see that they are evenly matched as to pace. It will be economy to give a good price for a horse that will walk at the same rate as the one you have, better than get a quicker or a slower one at a lower price. If they are not matched thus one horse will all the time be having the greater share of the work, and it will be irritating to the tempers of both the horses and the driver to keep trying to make the one keep up with the other, or holding the faster one back. It will not signify nearly so much if one be smaller than the other, so long as their pace is equal.

Cattle.

We shall now proceed to describe the cattle that we have to choose from, and in doing so I would ask my readers to bear in mind that it is a dairy farm that we are writing about, and what would be suitable for a dairy farm may not suit general farming, nor would the animals that are most profitable in general agriculture pay on a dairy farm.

There is no hard and fast rule that can be laid down as to what kind of cattle is most suited for dairying. Dairying may be divided into three kinds, viz. : First, producing milk for daily consumption ; second, producing milk for butter-making ; third, producing milk for cheese-making. These three divisions may be considerably mixed up, and often are. Thus, a dairyman may make butter at one time of the year, and find that at another time it pays him better to make cheese. Or, he may make butter when milk is plentiful, and find that it pays him much better to sell his milk when it is scarce. So the kind of dairying to be adopted will have to be considered in establishing a herd of milch cows. Nor is this all, the character of the farm itself must be taken into account. If the feed is poor, or the land very hilly, no one need expect success from large framed cows, which have to keep walking about all day long to try and fill themselves, never having a moment for rest. The amount of nourishment required to keep up the wear and tear upon the muscles is so much taken from the milk, represented either by a smaller quantity, or less butter fat. Where a large framed beast would be always poor, a smaller beast might thrive and do well. On rich pastures, where there is plenty of feed, put on as large cattle as you wish, but never put them on the hills and poor country. Where a cow has to walk about all day she does not even get the good of what she eats ; to get the full benefit she should have time to lie down and chew her cud. When eating, cows to a great extent simply bolt their food for the time being ; and as soon as the cravings of hunger are over they lie down and masticate it all over again thoroughly, when it then passes into the stomach and is properly digested. If a cow has not time to thus fulfil the provision of nature, much of her food passes through without being properly digested, and this is a dead loss to the cow and her owner. Every effort an animal makes exhausts a certain amount of nourishment; therefore, the less exertion made the greater quantity of nourishment there will be available for milk and cream. As to the different kinds of cattle that are available for dairying, nearly all the various breeds can be utilised, with the exception of the Polled Angus and Devons, and I have heard of individuals of this latter breed giving good butter results, but it is very exceptional, and for all practical purposes they may be left out of our consideration.

We would then have Durhams, or Shorthorns, Herefords, Holsteins, Ayrshires, Alderneys, and included in these are Jerseys and Guernseys, as in these colonies these three separate breeds are rarely kept distinct. Kerries and Dexter Kerries—so far as I can find out, I do not think there are any of the two latter breeds in this colony, but lately they have been introduced into the hilly districts of the eastern colonies, and with great success. Then we have the various crosses of all the above breeds, and we continually meet with people who tell us that the crosses are far superior to the pure bred cattle for dairy purposes. Against that we have the fact that all the great records ever made have been from pure bred cattle, carefully bred for many generations. Thus we have the pure bred Jersey cow, "Lily," at five years old, giving 23 quarts of milk a day, and yielding $24\frac{1}{2}$ lbs. of butter in the week. Then we have three pure bred cows, Ayrshires, belonging to the Duke of Westminster, that gave 1106 gallons, 1110 gallons, and 1448 gallons respectively in 12 months; this last one being at the rate of almost 16 quarts per day the whole year through. There is also the record of three Holstein cows at Troy (N.Y.). One gave an average of 27 quarts a day, another $28\frac{1}{2}$ quarts, and the third $29\frac{1}{3}$ quarts per day during a week's test. The first one gave 25·2 lbs. of butter for the week, the second 23·7 lbs., and the third 28·75 lbs. These were not only good milkers, but two of them had won prizes in the open class at the New York show, for Holstein cows. No records from cross-bred cows that I have ever seen or heard of come near these. Not that I would for a moment deny that there are good cross-bred dairy cattle. I have known what are called common cows give as high as 16 and 17 lbs. of butter in a week, but pure bred cattle have beaten their records, and from a pure bred beast you are far more likely to get a calf that will inherit the milking properties of its mother than you are from a crossbred. All dairymen will know as a fact, as well as all breeders of any kind of stock, that if you breed from cross-bred stock you never can tell what the result will be. It may take after its sire, or after its dam, or it may strain back for generations to a great-grandsire, dam, or even father.

I am not by any means advising dairymen to go to the expense of purchasing a pure bred herd right off; but, what I would strive to impress upon each and all is, to use only pure bred bulls in their herds, and see that the bull is from a good milking strain, even if one has to give a seemingly big price for him. His cost will be nothing compared to the herd when the heifers begin to come in. Let no one think when he commences dairying that he can go and buy a good dairy herd right off. It may happen that a fair herd can be purchased at a *bona-fide* clearing sale, but that is only a chance in a lifetime. The probabilities are that if you are a fair judge of cattle about one out of every four you buv will be fit to keep and rear calves from. The only sure way to get together a really good herd is to breed it. You will have to buy the best you can get to start with, then pick out your cows according to how they turn out, and have the heifer calves from the best, and making sure the bull is from a milking strain and pure bred. By doing this, in a few years you can get together a really good herd, and, by judicious culling, every year it will be improving and the average yield gradually rising. The best investment that can be made for the dairy farm is a good bull. Even with poor cows to start with, no man need despair of getting a fair herd together if he can only obtain a milking strain on the sire's side. It is then only a matter of time and careful selection.

The Channel Islands Cattle.

Of these we have three sub-varieties, viz., the Jerseys, Guernseys, and Alderneys ; but they are often indiscriminately spoken of, and in many shows are all shown under the name of Alderney. There is a difference in them, more as regards colour in the case of Jerseys and Alderneys, as in size and form they are the same, but the Guernsey is a larger framed beast, and coarser in all its points, and is seldom self-coloured, being generally fawn coloured, or yellow, with patches of white. They get the credit of being heavier milkers than the others, the mik being equally rich. They are not often found outside the Island of Guernsey at present, as mostly all breeders have gone in for the more graceful types found in the other islands.

For a great number of years these cattle have been noted for the richness of their milk and the fine quality of their butter, and have been particular favorites for families keeping a cow for their own use, not only for their milking qualities, but also on account of their quiet habits and handsome appearance. It is a strange fact, that of all cattle the cows of this breed are the most docile, and the bulls the most wicked and uncertain in their tempers. Of late years many herds have been established and kept pure both in the United Kingdom and the United States for dairy purposes only, and have returned very good results. The one great objection to them is that as a rule they are more delicate and require more care and attention than any of the other breeds. In Australia when on good pasture they thrive and do well, and in many places are used for crossing purposes to improve the quality of milk, and the young stock seem hardy and much better able to thrive on coarse food than the pure bred animals. The milk of this breed is more adapted to butter making than for cheese, being rich in butter fat, and the fat globules so large that the cream rapidly rises to the surface, and when the milk is used for cheese-making there is generally a considerable loss of butter fat.

While on the subject of Channel Island cattle mention may be made of the Brittany, as a number of them have been imported at one time and another into the Australian colonies, but never seem to have taken well with the public generally. They would be admirably suited to many of the hilly and colder districts, being small and active, very hardy and good foragers, yielding large milk returns for their size, and of good quality. They do not stand nearly so high as the Jerseys, and have very short legs and are of much thicker build. Their color is either black, or black and white.

The Holstein-Fresians.

Of late years these cattle have become remarkably popular in America, and for quantity of milk given in twelve months, and best return of butter for the same time, held the world's records. They were originally Dutch cattle, and have been bred with great care a d attention in America until they far surpass the original stock both in appearance and milking qualities. They are very striking in appearance, having large frames and a glossy black color with white patches. The steers are said to make very good beef. In the United Kingdom they have never obtained a footing, being considered delicate and subject to all the diseases that cow flesh is heir to. At one time they, or closely allied stock, were largely kept in the dairies around London, but the death rate was so high that the dairy people gave up keeping them. This has not been the experience of American breeders, nor of those who have kept them in Australia, and at the present time they are very largely used for crossing by many of the most experienced dairymen in Victoria. Their milk is not very rich, but is quite equal to the average quality, and the amount given in one day frequently reaches over 20 quarts, and sometimes 25 and 27 quarts. They have, as a rule, good teats and are easily milked, are quiet and docile, and bear house-feeding well. Not many have been imported into the colonies. Young bulls bring good prices, and are well worth the money paid for them, many of the half-bred cattle almost equalling the pure in quantity and often excelling them in quality. To be kept successfully they must be well fed and not have to wander far in order to fill themselves. Their milk is well suited for cheese-making. The last of the dairy breeds that we have are the

Kerry and Dexter Kerries.

These are a purely Irish production, and are about the smallest cattle known. In height they are frequently not more than 36 or 37 inches, and their udder reaches so near the ground that sometimes it is rather difficult to milk them. They are generally pure black in color, but sometimes they are found of a rich blood red. They are docile, very hardy and active, can climb hills almost like goats, and will live and thrive where other breeds would die of starvation. For their size they are the greatest milkers of any of the dairy breeds, often giving four or five times their own weight of milk in a single season. When crossed with other cattle they generally degenerate as milkers, but the cross-bred stock show a great adaptness for laying on flesh which is of the finest quality. A few of them have been introduced to Australia, but the prices asked for their stock put it out of the reach of most dairymen to obtain them. They are so admirably suited for the hilly country and poor districts that it is a pity there are not more of them in the colonies. For use in private families they cannot be surpassed and are very economical to keep.

As the breeding of pure-bred stock is not within the reach of all dairy farmers, the question will naturally arise as to what are the best crosses, or what is the best breed of bull to introduce into a herd ; so much depends upon the class of cattle that we already possess that no hard and fast rule can be laid down, at the same time certain lines may be followed with advantage. Thus, if the cows are hardy and good milkers, and it is desired to improve the quality, a cross with some of the Channel Island breeds will probably have very good results. If the cattle are not very good milkers and generally a weedy lot, the Ayrshire might be used ; or, if small in size, a shorthorn from a good milking strain. A really good all-round cross is that between the Ayrshire and any of the Channel Islanders, they are good, useful, all-round dairy cows, whose milk is fairly rich in butter fat, and suitable for either butter or cheese. Some magnificent milkers have been the produce of Jerseys and Holsteins, and are remarkably handsome cattle to look at.

I have given up to the present a general idea of what the characteristics of the various breeds of cattle are ; but even if pure-bred cattle only are kept they will need most careful culling to keep them up to the highest standard. Only the calves from those that prove themselves by actual test ought to be kept, and those that do not come up to the fair standard should be sold or got rid of at the first opportunity. A good beast eats no more than a poor one, but may give double the return in cash in a single season. Every cow in a herd ought to be thoroughly and constantly tested, not only for quantity and quality, but also for her staying properties. Some cows will give, shortly after calving, a great quantity of milk for a few weeks and then drop off until the yield is very small, while others will only give a moderate supply at first, but will keep it up for months with little or no falling of. Any cow that does not give at least 3·6 per cent. of butter fat is not good enough to keep, and should be replaced with a better animal as soon as possible. By attention and culling in a very few years it is quite possible to bring a herd up to a stan ard of 4 per cent. to 4·4 per cent. of butter fat in their milk, while specially good cows may go up as high as 5 or 6 per cent. of butter fat; these, however, are very few and far between.

CHAPTER V.

FEEDING DAIRY CATTLE.

One of the most important things for a dairyman to remember is, that the returns he gets from his cattle are greatly dependent on the food provided for them and the treatment they are subjected to. If cows are neglected in the winter time and kept in cold, bleak paddocks, without shelter, they will not yield anything like the returns they would if properly cared for. In fact, they would thrive much better if they had less food and more warmth. It is very poor policy to starve or neglect a cow in winter, thinking she can make it up in the spring, for in the first place the cow has to make up flesh again before she can be expected to come to her full milk, and that is a tedious and wasteful process. It is much easier to keep a cow in good condition than to get one into it. Again, if the cow is dry she will probably be in calf, so that a great deal of extra nourishment is required ; or it may be that she is in calf and milking also, and in that case the strain upon her system is very great, and unless properly looked after, the cow, the calf and the milk returns will suffer. It will pay much better to keep fewer cows, and see that they are properly attended to and have plenty to eat, than to keep more that are continually on short rations. There is one mistake that many dairy farmers make, and that is, they think that the *quality* of the milk can be greatly improved by feeding very rich foods. As a matter of fact experiment has shown that the food has very little effect on the quantity of butter fat in the milk. A cow, by good and judicious feeding, may be made to increase the quantity of her milk up to 50 per cent. or over, but if the milk is tested the percentage of butter fat will be found to have changed but little. Some years since the writer made the experiment as follows :— Three good milking cows about two months calved were taken, each averaging 12 quarts of milk a day on ordinary grass feed. They were put into a small paddock and in the mornings given a large bucket of bran that had been steamed, with about four pounds of treacle added to it. They then had as much chaffed green maize as they would eat ; at noon they had a bran and treacle mash again, and chaffed oaten hay mixed with chaff d maize ; at night they had a mash of maize meal and treacle and chaffed oaten hay and maize. One cow steadily increased in quantity for nine days, and from twelve quarts per day went up to 19½. The amount of butter fat in her milk, as shown by a Babcock milk tester before she was put on extra rations, was 3·8 per cent. ; at the end of two weeks the milk went only one per cent. higher, giving 3·9 per cent.

Another cow increased to 18 quarts in eight days, and there was no increase in the percentage of butter fat. The third one before the exper ment gave 4·2 per cent. of butter fat, and at the end of two weeks, when she had increased to 20 quarts, her milk was found to be two-tenths per cent. less, only giving 4·0 per cent. butter fat.

Of course, the total yield of butter for the week in each case was very much greater than it had been before, but that was on account of the extra quantity of milk the cows gave, and not due to the increase in the percentage of butter fat. The experiment was kept up for a month and the percentage of butter fat varied very little after the first fortn ght.

A similar result took place among the suppliers to a large butter factory in the Western district of Victoria. A number of farmers bought ten tins of treacle among them, and fed it to their cows night and morning. When the milk was tested they were greatly astonished to find that there was little or no increase in the percentage of butter fat, and immediately charged the manager of the factory with swindling them. There was a great row, and the suppliers refused to furnish any more milk to the factory, unless they got what they called fair play. The manager tested a quantity of milk in their presence, but they were not satisfied, and then said the tester was wrong. At last it was decided to obtain the services of one of the Government analysts. He came down and tested the milk, and proved that the manager was correct, much to the disgust of the farmers ; but they all admitted that the quantity of milk had increased considerably, but they did not reckon that the increase was equivalent to the extra expense. That this is approximately correct almost any one can prove for himself. Suppose you have a Jersey cow, and that she is in poor condition and on poor feed, you will find that although she gives very little milk it will always be rich in cream. The quantity may increase or fall off, but the milk will always be rich. From the foregoing it will be seen how important the question of feeding is in order to get the best returns possible from the cows. Of course, it will not pay to feed cows on a large scale with as much bran and chaff and treacle as they can eat, at prices such as are quoted for them now, but both in summer and winter milch cows should have something more than can be obtained in the ordinary grass paddocks. For summer feed a good supply of green fodder should be grown, and in almost any part of this colony, with a little care and trouble, green feed could be had at almost any time of the year, or if it cannot be grown, an excellent substitute can be used in the form of ensilage, of which I shall speak later on. For winter feed something more nutritious is needed, and if bran is not too expensive it is one of the best winter fodders, so also is maize, boiled or steamed until it is quite soft. At that time of year what is wanted is some food rich in carbo-hydrates to supply warmth and make up for the extra amount of animal heat required. A really first-class food for milking cows in winter is ensilage made of good sweet oaten straw and rape. The rape and oaten straw are put in the silo layer about, and the dry straw absorbs a great deal of the juice from the succulent rape, so that when it comes to be taken out the whole mass is of a green colour. One winter I fed about 100 cows on this mixture, all the winter through, and never had better results. The silage was taken fresh out of the pit in the morning and fed direct to the cows. Coming out fresh it was warm and the cattle not only milked well, but kept their condition remarkably well. They had the same ration at night also, each cow getting on an average about 30 pounds of silage a day. They also had the run of grass paddocks with fair grass in them. Another good useful winter fodder I found to be oaten chaff and green barley, the latter also chaffed, mixed up together about 24 hours before use and put in a heap and allowed to heat and then fed warm to the cattle.

Good results were also obtained from maize stalks that had been gathered and carefully stacked and protected from damp after the cobs had been taken off. These were cut up in the chaffcutter and mixed with green cape barley or green oats, and allowed to heat, also fed warm to the cows. On each of these mixtures the cattle milked well and kept their condition all through the winter. For summer feed, ensilage was found to be excellent, especially the sour ensilage, although the cows did very well on the sweet ensilage, but not so well as on the former. The best crops for dairy cattle, to be fed in the form of silage, are maize (chaffed), sorghum (chaffed), peas and oats, or peas and barley, oats, wheat and cape barley.

For direct green feeding all the foregoing were found excellent, also lucerne, (where only milk is required for use, but not if it is to be made into butter or cheese, as both these are tainted by it), mangolds, and on a piece of river flat one can scarcely get a better return from any crop than from the long red variety, and no crop will more amply repay care and trouble than mangolds. Manure heavily, do not leave them too close, cultivate often and deep, and keep all weeds down. Thirty to forty tons per acre is no unusual crop if well looked after, and for summer feed when the grass is dry it can scarcely be surpassed. They may also be used in winter if chaff or bran is mixed with them.

Pumpkins, and the still more humble pig-melon, chopped, and fed into chaff and bran, are not to be despised. The latter can be grown anywhere perfectly on newly broken land without any care or attention, and yield an enormous return and come in at a time of the year when succulent feed is most scarce.

Potatoes are also good feed, and they have the property of making the butter very firm. Turnips are not good for dairy cattle, as they taint milk, butter and cheese, and the taint is so unpleasant that few people care even to use the milk. Ensilage has also been charged with tainting milk, but if it does, it is not when it comes from the cow. If milk is allowed to remain for some time in the cow-shed, and ensilage is lying about, it will certainly absorb some of the taint from it. If, however, it is taken away from the milking-yard or shed immediately beyond the smell of the silage there will be no taint from it, and the butter made from the milk resembles that made from spring grass.

If the district where cows are kept for dairy purposes is devoid of salt naturally, it ought to be always kept in troughs within easy reach of all the cattle. Rock-salt is not so good as the ordinary salt, and the cattle will take just as much as their systems require and will thrive and milk much better than if kept without it. Before leaving the matter of feeding, it may of be some advantage to give a few hints on ensilage-making, both in pit and stack.

CHAPTER VI.

ENSILAGE.

If the average farmer a few years ago had been asked, "What is ensilage, or silage?" very few could have given an intelligent answer, but now probably ninety per cent. would have a very good idea of not only what it is but also how it is prepared.

It is unfortunate that the knowledge thus possessed is not put into more general practice, and the loss to dairy farmers more especially converted into gain by a free use of ensilage. If dairy farmers generally could only be induced to try the making of ensilage for one season, and compare the returns obtained from their cattle for that time as against the results of previous years, by comparison with the outlay in capital and labor, very few of them would ever be without a supply on the farm again.

Silage comes in useful for feeding nearly all the live stock about the farm. The milch cattle—the young stock—the calves, horses, pigs, sheep, and even poultry and geese, seem after a time to like it, especially if it is green and juicy. Brood sows while suckling their young do very well on it with other food as well, for if that is not supplied they get thin, as the ordinary silage is deficient in the fat-producing constituents, although this can be overcome by growing proper crops.

At the present time probably those who suffer most from not using silage are the milk producers who sell milk in the cities. As a rule there is no good pasture near enough for the cows to go out to daily, and where they are allowed to graze on the commons the feed is rough and not at all calculated to cause a good flow of milk, or even keep the cattle in good condition. Consequently other food has to be bought, mainly chaff and bran, and at the present prices (£8 a ton for chaff and £6 to £7 for bran) the margin left for profit is very small indeed. An objection may be raised by those engaged in the trade that they have no farms on which to grow crops, but it does not require a farm to grow sufficient ensilage to feed twenty or thirty head of cattle. Three or four acres of land could easily be rented close to our large towns that would grow enough to do away at least with the use of chaff and to reduce the bran ration by at least one-half. At all the urban and suburban dairies there is always a good supply of manure, and this could be carted to the cultivation paddock and ploughed in in due time. Maize could be sown in the proper season, or, if the land is naturally damp, amber cane or some other of the various varieties of sorghum. The reason for suggesting the latter is that a second or even a third cutting may often be obtained and may be used as green feed, or cut for silage as desired. Maize will yield a heavier crop, if well manured, than a single cutting of sorghum, but if more than one cutting of the latter be secured it may more than make up the difference. In sowing the maize it is always well to put it in in drills and cultivate afterwards, as long as it is possible without injury to the plants. The seeds should be sown close together in the drill so as to have the stalks thin and easily cut and eaten. Treated thus, and well manured, a return of at least twenty tons of green fodder per acre might be looked for and if this is made into ensilage, that amount of feeding matter, less a very small percentage of loss, may be looked fo . That means that twenty cows getting between thirty and forty pounds of silage per day could be fed for two months, or giving them fifty-six pounds per day, it would last them forty days. Six acres properly looked after and well manured could be made to keep twenty cows for a year, and only a small quantity of bran or maize meal would have to be purchased.

Notwithstanding all that has been written about the use of silage, there are many still who refuse to believe in it. A gentleman in England some little time ago made the following experiment. He had a 26-acre paddock of English rye grass, one half of which he made into hay, the other into silage. Twenty cows in full milk were then taken, and to ten he fed as much of the hay as they would eat. The other ten got as much of the silage as they wanted. The experiment was carried on for some months and the silage was found to last quite three times as long as the hay. During the time of the experiment the silage-fed cattle gave much more milk, and kept up the quality, than those fed on hay. Outside persons were asked to compare the conditions of the cattle and they all gave it in favor of the silage-fed. They were in better condition and their skin softer than the hay-fed animals. The result, therefore, was that the silage-fed beasts gave more milk, were in better condition, and were fed three times as long from 13 acres of land as those that were fed on hay produced from the same area. With some, thinking that ensilage taints the milk, there is still a prejudice against it, and there is no doubt that milk sometimes is tainted by ensilage, but that is not through the cow eating it, but through carelessness on the part of the milkers.

Some time since a farmer who had invested a considerable amount of capital in making silos wrote to me saying that he had gone to all this expense on my recommendation, and the result was that he had only lost his time and money and all his crops he had put into the silos, but the creamery he sent his milk to refused to take it, as the milk smelt of the ensilage and spoilt the butter. I wrote telling him it was a matter of impossibility, and in reply I was asked to come and see for myself. I gladly availed myself of the invitation and arrived late at night. Next morning I went out to the cow sheds and saw the men feeding the silage to the cattle. It was brought along the cow sheds in a cart, and was lifted by the men into the feed-boxes by their hands. As soon as all in the shed were fed the same men started milking without washing their hands. The first thing they did was to milk a little on each hand to wet it and then start milking, and every now and again they would dip their fingers in the milk. When the milking of that lot of cows was finished, a distinct flavour of silage could be smelt in the milk. That lot of cattle were turned out and another lot brought in and fed in the same way, but before the men started to milk I said they should wash their hands with soap in warm water. This was done and the milk was perfect and without the least trace of the smell of the silage. After that the silage was fed to the cattle with a fork, and the hands always washed before milking ; and now that farmer swears by silage, and has twice obtained the prize for the best silage in the district. No one need have the slightest fear of tainting the milk, no matter how much is fed to the cattle, if the milk is not allowed to stand near the silage and thorough cleanliness and common sense are used.

The use of silage is far beyond the experimental stage, and on most of the farms in England a silo is considered one of the most useful adjuncts of the farm. In America and Canada it has come into general use, not only for the milch cows but for general fattening, and the results obtained from the use of silage and straw or a little mixed meal have resulted in giving much better results at less cost than any other feed.

In the report of the Ottawa experimental farms there is a full account of a series of experiments lasting over several years, in which the silage-fed steers gained in weight 35·8 pounds per head more, and cost 2¾d. less per day for feeding than those fed on hay, roots, straw and meal, and on the average for two years the cost for food consumed per 100 pounds increase in live weight was 64·64 per cent. greater in the ration of hay, roots, straw and meal than it was in the ration for silage, straw and meal.

The actual rations were :—No. 2, consisting of cut hay 20 lbs., roots 40 lbs., straw (cut) 5 lbs., oil-cake 2 lbs., ground peas 2 lbs., ground barley 2 lbs.; total, 71 lbs.

No. 3, the silage ration consisted of corn silage 50 lbs., straw (cut) 5 lbs., oil-cake 2 lbs., ground peas 2 lbs., ground barley 2 lbs.; total, 61 lbs., thus the gain in feeding the latter ration for every 100 pounds the beasts put on was 35·36 per cent., or a saving of £35 14s. in every £100 spent. In the face of facts like these the wonder is that the use of silage has not become universal in this colony, where there are such long and dry summers, and such a scarcity of feed for at least four or five months every year, and at the present price of cattle and sheep it would pay to top them up on a similar ration, provided the farmer grows all the feed himself, letting maize and meal take the place of oil-cake.

The result of a long series of experiments in feeding milch cattle at Chicago was also strongly in favor of the use of ensilage, not only as regards the increased quantity of milk obtained, but also in the saving in the cost of feed. For fattening purposes it was found that corn or maize silage was deficient in the quantity of fat producing food and what is known as Robertson's mixture has been found to give good results. It consists of whole plants of Indian corn, horse beans (*Faber vulgaris*) and the heads of sunflowers. This mixture should be composed of about ten tons of Indian corn to two and a half tons of horse beans and one ton of sunflower heads. To obtain these proportions a quarter of an acre of sunflowers and half an acre of horse beans should be grown for each acre of maize. It gives good results for either milch or store cattle, but, for the latter, requires some meal added to it. Many farmers object to the making of silage on the score of expense, thinking it is necessary to make expensive pits. This is a great mistake. First-class silage can be made in stacks with very homely appliances. At the same time there is no doubt that a pit is most convenient, nor is it at all necessary to go to much expense in the construction thereof. In good solid clay lands, if not wet, only a foot or two of the top need be boarded up, or waste timber from the saw mills can be used for slabbing if the soil requires it. For weighting many contrivances are used, some very expensive if not very effective, others very simple and effective also ; such as throwing back some of the earth, using logs or posts and rails. One of the most convenient forms of applying pressure, if a windmill is available, is to have several iron tanks and let the mill pump water into them, this answers for either stacks or pits, and when it is desired to empty them the water can be easily allowed to run away, using a piece of hose as a syphon.

There is another advantage in having a pit, that is, the green fodder can be chaffed and by means of a traveller carried direct into the pit, and where coarse fodder such as maize, amber cane, sugar cane, etc., is used, this is a great improvement, for not only is the silage more easily taken out, but it loses much less than if the green stuff had not been chaffed, as in that case it would not have lain close together, and all the spaces would have been full of air, and there would probably be bad spots in it. In a properly constructed pit there is practically no loss, except, perhaps, a little on the very top, and even that can be prevented by pulling a little straw over it and under the weights.

Stacks have this advantage, they can be built anywhere that is most convenient for feeding the cattle, and require no expense to speak of in their preparation. It must be remembered, however, that in all stacks there is more waste all round, unless protected by straw or some other material on the top also.

Stacks should be built wide and high, for after a few days the green stuff shrinks greatly, and a stack 10ft. high the day it is built may only be five a few days after. Where water is not available a very simple and effective means of securing pressure is to get good strong saplings about 4ft. wider than the stack. Two can be used every 5ft. along the stack, one above and one below, put down before the stack is built, the ends of the saplings extended 2ft. on either side beyond the stack; on the upper sapling a stout rope is fixed on either side, 2 or 3 feet longer than the stack is to be high. When it is required to press the stack a double block and pulley is used, and the upper sapling is hauled down by means of the block and pulley as near the lower one as possible, and then made fast by the rope already attached to it. The best way to do it is to start at one side of the stack, and with the rope attached to the upper sapling haul one end down and then make fast, then on the other side fix the block and pulley and haul down until the sapling is level. Haul the next one down first on the opposite side to the first one, and by thus alternating them the stack can be kept plumb.

It is not necessary to either fill a pit or complete a stack right off; they can be added to almost any time, and, if thoroughly trodden on at first, will take no harm for several days without pressure. Both pits and stacks should be made deep, as by that means a considerable amount of pressure is obtained from the weight of the material alone.

Every dairy farmer ought to always have a considerable quantity of silage on hand; if not needed one season it will keep over until the next, or for a good many seasons; and should a dry year come there is always a stand-by for the cows or any other stock that may require it. Sheep, pigs and horses will all eat it and do well.

The making of silage is quite independent of the weather, it can be made in wet weather as well as in dry; thus crops can be grown and utilised for silage at any time of the year. The expense attached to making it is small, while the feeding value is very great.

The crops suitable for ensilage are many, and can be grown to suit all climates, thus, grasses, clover, tares, peas, beans, lucerne, trefoil, oats, wheat, barley, rye, and all the sorghum tribe, and maize. Silage can be fed entirely to cattle from 50 to 70 pounds per day, according to size, and they will thrive on it, or it may be given as a ration with any other kind of food.

Cattle will nearly always eat sweet ensilage right off, but sometimes they refuse the sour silage for some days, but eat it greedily enough after.

Fair average silage weighs about 48 to 50 pouuds to the cubic foot, and for either summer or winter feed no dairy farm should be without a good supply of silage.

CHAPTER VII.

MILK AND CREAM.

In order to realise the proper manipulation and methods of dealing with milk either for butter-making, cheese-making, or retailing, it is necessary to understand its composition, its characteristics and peculiarities.

Milk is composed of a number of substances held in solution or suspension in water. The proportions of these vary greatly in different animals, and even in individuals of the same breed a considerable amount of variation is found, more especially in the percentage of butter fat. The chief constituents of cow's milk are: water, varying from 82 to 88 per cent.; butter fat, from 1·7 to 6·6 per cent.; casein, from 2·8 to 5·5 per cent.; albumen, from ·38 to ·60 per cent.; milk sugar, 2·9 to 5·25 per cent.; mineral substances, 6 to 9 per cent. These are about the outside limits of variation, but the following may be taken as a fair average composition of ordinary milk:—

	Per cent.
Water - - - -	87·60
Fat - - - -	3·25
Albumen - - -	0·45
Casein - - - -	3·40
Sugar - - - -	4·55
Ash or mineral substances -	0·75
	100·00

Milk when drawn from the udder of the cow, if she be quite healthy, is free from germs of any kind, and if put into a vessel thoroughly sterilized, without being allowed to be contaminated with any of the germs that are constantly floating in the air, or that are continually falling from the body of the cow, will keep for months or even years in a perfectly sweet condition, and will not turn sour; but, unless the most extraordinary precautions are taken, it is almost impossible to obtain the milk germ-free, and, commercially, it is impracticable.

In diseased animals germs of the particular disease by which they are infected pass through with the milk, and may thus cause disease in the systems of those who drink the milk. This is especially the case in tuberculosis, which is readily conveyed from an affected cow to the human system; in fact, it has been pointed out by many scientists, who have made this matter a careful study, that this dreaded disease is rarely ever found among those who do not use cow's milk or flesh in any form, whilst among those who do use the milk or flesh, the proportion of humanity suffering with tuberculosis increases almost in the same ratio as the quantity per head per annum used. Hence the great and urgent necessity of having all dairy and butchers' stock under regular, constant and capable inspection. Not only should the stock be inspected at regular intervals, but all the surroundings where stock are kept should be constantly inspected, and in any place where proper precautions are not taken no milk should be allowed to be used for human consumption ; and not only should the stock and the premises be under constant supervision, but the persons who milk the cows should be inspected also, to see that they are not suffering from any skin or other infectious disease, and severe punishment should in all cases be meted out to any person milking or having anything to do with the preparing of the milk, suffering from any disease. Milk is at the same time one of the most useful and also one of the most dangerous articles of human food, and it is the duty of the state to see that its people are protected from the ignorance and carelessness of those who sell milk or its products in any form.

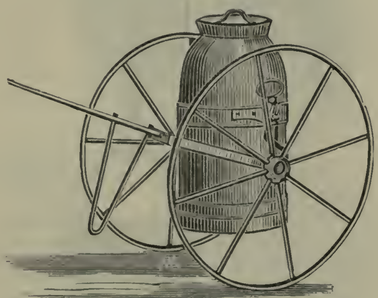


Fig. 1.—A convenient method of carrying the milk from the milking shed to the dairy where a large number of cows are milked.

The most common sources of infection are : Keeping or milking animals in close, ill-ventilated sheds where the atmosphere becomes fairly saturated with germs of all kinds, good and bad, the latter often greatly out-numbering the former.

Dirty cow-yards, where manure is allowed to accumulate, and where the drainage is deficient or non-existent, compelling cows to feed on unhealthy pastures, or allowing them to drink impure water, are all sources of infection. How can pure milk be obtained from cattle allowed to wander about the suburbs drinking stagnant drainage water and eating all kinds of refuse.

Milk should never be kept after it has been drawn from the cow, in the cow-shed or milking yard, or in rooms not properly constructed, or in badly ventilated dwelling-houses ; or in places opening off the dwelling-rooms. The sources of infection are from germs or bacteria, but in addition to these many extraneous substances are found in milk for which there is no excuse, such as manure particles, fungoid growths, cow hair, human hair, particles of skin (cattle and human), insects, threads of various kinds, earthy matter, etc. These are often the result of improper straining, not cleaning the cattle, or washing their udders or teats when they are dirty before milking. All this want of care, atten-

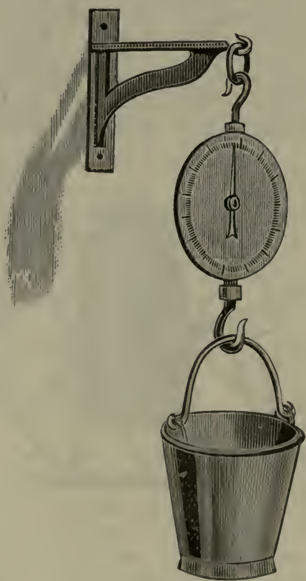


Fig. 2.—Apparatus for weighing milk immediately after milking.

tion, and cleanliness is not only injurious to the consumer, but tells heavily against the suppliers, as milk in a condition like this will not keep half the time that it would if it were properly looked after. Neither will the butter or cheese have as good a flavor or bring nearly as good a price ; so that, outside all reasons of health, the pocket alone should make people more careful in all things pertaining to dairy matters.

When the milk is just fresh from the cow, it has a considerable amount of animal flavor in it, and if kept without being thoroughly exposed to the air, this flavour remains, and its presence deteriorates the quality of the butter and cheese made from it, while the milk itself has an unpleasant taste, and rapidly goes sour. In order to do away with this the new milk should be thoroughly exposed to the air and, if possible, cooled. This can be done most effectually by means of a Lawrence cooler, figure 3.

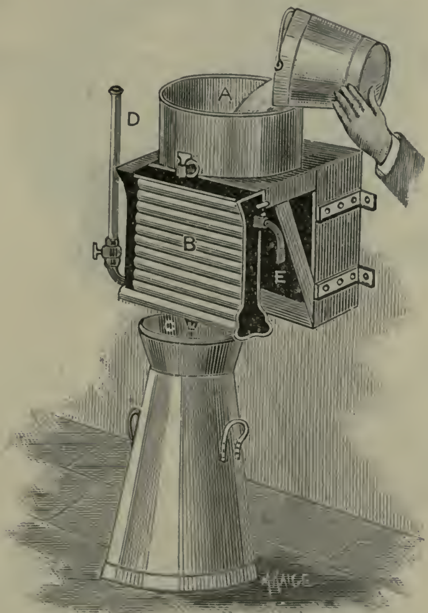


Fig. 3.—A is a vat into which the milk or cream is poured and runs out from a wide-mouthed tap into a V shaped trough which is perforated with holes so that the milk or cream can escape over both sides of the cooler. B is a corrugated copper cooler, thoroughly tinned over all, and hollow inside, over which the milk or cream slowly flows. C is where the milk or cream escapes into the can. D is where cold water is allowed to flow into the cooler, and rising up in it overflows at the outlet E. The cooler can be swung under the cream spout of the separator and thus save the trouble of lifting and carrying

By this contrivance a stream of cold water is constantly passing through two corrugated sheets of copper, tinned on the outside, over which the milk is allowed to run in a very thin layer. Milk thus treated will keep nearly as long again as milk not so treated, and all animal odour is removed. Where this appliance is not procurable the milk can be greatly improved by means of passing a current of fresh air through it.

The specific gravity of ordinary milk is given at 1·031, which means that a vessel holding, say, 1000 pounds of water if filled up with the same quantity of milk, would weigh 31 pounds more. But the various constituents of milk, if separated, differ greatly in their specific gravity, thus the fat is lighter than either milk or water, having only a specific gravity of ·930, and thus it is that the fatty

Fig 4.—Lister-Babcock Milk Tester.

portion, or cream, rises to the surface when the milk is allowed to remain quiet. The fat in milk is in small globules, and they vary greatly in size in different breeds and individual cows. The size of these globules varies from $\frac{1}{1500}$ part of an inch in diameter to $\frac{1}{25,000}$ and it is this variation in size that makes the cream from some cow's milk rise so much more quickly than the cream from others.

The larger the globules are the more quickly they rise to the surface ; while the smaller, the slower they rise. This also explains why it is that in the hot weather we cannot get so much cream from the milk by the ordinary setting system as in winter, for in summer the milk rapidly sours and thickens, which stops the upward progress of the fat globules, but in winter the milk keeps sweet and fluid much longer, when most of the globules are apt to reach the surface.

Fig. 5.—Lister-Babcock Milk Tester.

This is one of the advantages of the cream separator, that all the cream is obtained from the milk independently of the weather.

Milk in which the fat globules are very large, or in which the cream rises very rapidly, is more suited for butter-making than for cheese. If used for cheese-making the cream rises so rapidly that in setting the milk much of it rises to the surface and is not

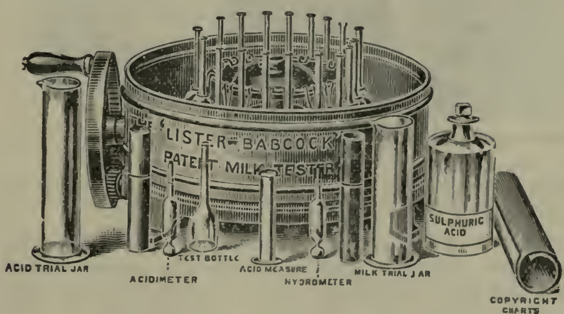


Fig. 6.—Lister-Babcock Testing Outfit.

incorporated in the curd, but is lost in the whey. The milk with the small fat globules rising slowly has not time to reach the surface before coagulation takes place, and the globules are well incorporated throughout the curd.

We have spoken of the milking-sheds, the yards, cooling and testing of milk, now we will follow the course of the milk from the time that it is drawn from the cow until it is made into butter.

We will suppose the cow has been brought into the milking bail and is ready for milking. Having been properly secured, the udder and teats should be carefully washed and dried. Before milking each cow the milker should wash his or her hands. The milker should sit in close to the cow, and it will be well for the proprietor or manager to see that the milker's finger nails are not allowed to be long, for this is a very common source of giving cows sore teats; the nails cutting the teats during milking. To milk properly and in a cleanly manner, the teats ought not to be wet, but the milking done dry. Many persons, who have been milking all their lives, will object to this and say that a cow cannot be properly milked unless the teats are kept constantly damp with milk. This is a great mistake, and although when tried for the first time it may feel a little awkward, after a short time it will be found easier than the other way. The wet method is a filthy one, and, where the udder and teats have not been washed, great drops of dirty milk may frequently be seen dropping into the milking bucket and leaving a dirty stain on it, while the milker's hands are covered with dirt. Such treatment as this serves to spoil the flavor of the butter and induces bad fermentations, which make the butter rapidly lose its keeping properties.

Fig. 7.—Babcock Testing Bottle.

The milk immediately after milking is taken to the cream separator, and the cream as it comes from the cream spout is run over a cooler and then into cans, while the warm new skim milk is fed to the calves. When the separating is over, the cream is taken to the dairy which, in the summer time, is kept as cool as possible, while in the winter, if the weather is very cold, it may require to be heated. The cans containing the cream are left uncovered, unless it may be with muslin to keep flies and other insects out. The cream should be stirred up with a wooden ladle at least three times a day, so that it may all mature evenly. If not stirred a hard cream forms on the top, and this sometimes will not break up in the churning, and thus leaving lumps of cream in the butter, which will spoil its appearance and prevent its keeping.

In hot weather, if the cream is not cooled and put into a perfectly sweet vessel, a rapid fermentation will sometimes occur, and the cream swell up to several times its original bulk. When such a change as this occurs it is a very difficult matter afterwards to churn it, and the resultant butter will be of very little value. Where the number of cows warrant it, cream of the same age should only be churned, as the result is more satisfactory, but of course in small dairies this cannot be done, so particular care should be taken to have all the cream at the same stage of ripeness.

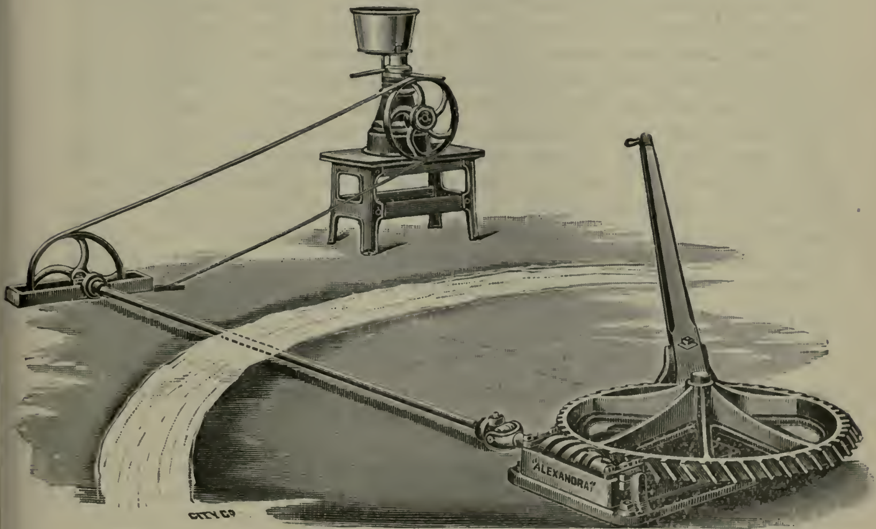


Fig. 18.—Simple arrangement for driving separator by horse works.

On no account should fresh cream be mixed with matured cream just before churning. If it is desired to churn the cream of a late milking it should be mixed with the matured cream at least 12 hours previously and thoroughly stirred several times. If fresh cream is mixed with matured or ripened cream and churned at once we have the following result :—If the churning is stopped immediately the butter breaks, as it should be, there will be a great loss of butter in the butter-milk, as it takes longer to churn fresh cream than ripened ; or if the churning is continued until all the butter has come, that of the matured cream will lose in quality and become greasy through over churning. In either case there is a waste.

The word ripened, or matured, has been used several times, and what is meant by the term is, that the cream has undergone a certain amount of fermentation and become slightly sour, after which we get butter with a better flavor, better keeping quality, and more of it.

Some persons prefer what is called sweet-cream butter, that is butter made from fresh cream when perfectly sweet. To some this kind of butter seems perfection, but to most it is devoid of flavor, and even were it equal to that made from ripened cream, it does not keep sweet for more than a day or two. From the dairyman's point of view it is not at all profitable, as there is a very serious loss of butter in the butter-milk, often as much as 7 or 8 per cent., and this alone would prevent this process being followed if it were more generally known, but it is rare that a dairyman ever tests his buttermilk to see whether there be any loss or not.

Another disadvantage is that the fresh cream is hard to churn in warm weather, often taking hours and sometimes swelling up, the butter not coming at all unless a quantity of the cream be taken out of the churn and cold water added. Before the cream is put into the churn its consistency should be examined, and if on the thick side, water should be used to thin it down, as it is better to err on the side of having the cream too thin than too thick. With very thick cream there is nearly always a considerable loss in the buttermilk. The thicker the cream, as a rule, the greater the loss. Cream that gives about 45 per cent. its weight of butter is about correct, and less likely to be over-churned or leave any loss than when it is either thicker or thinner. I have not infrequently known cream to vary from 30 per cent. to 90 per cent. of butter ; in the latter case it was almost a solid mass and had to be worked through a sieve and mixed with a great quantity of water to get it to churn at all, and even then the butter was not good. This cream was obtained from a separator that was driven at a speed almost double the average rate, through a wrong sized driving pulley having been put on the shaft. It was fortunate that no serious accident occurred. Where no separator is employed and the old method of setting milk in dishes is used, the cream is more likely to be on the thick side, especially if the milk is scalded. Where it is desired to scald the milk, the temperature should never be raised above 180 degrees—from 170 to 180 degrees is a good temperature, and in the hot weather better results will often be obtained from scalded milk than that set naturally. After the milk is heated up to, say, 170 degrees, it should then be cooled as rapidly as possible. If a fair supply of water is available the dishes may be set in a trough made for the purpose, and a constant stream of water allowed to flow around them.

By scalding in summer more butter may be obtained from the milk than by ordinary setting ; as the milk will keep sweet longer and thus give the cream more time to rise. In warm weather, if the milk is set immediately after milking, it will sometimes go thick in 12 or 15 hours, and when that occurs the cream globules cannot force their way through the thickened milk to the surface, and thus so much cream is lost, or, at least, the butter returns are short, and the calves or pigs get the benefit of it. It is a rather suspicious sign, if no other feed is given, to see calves keep very fat, and a close examination into the method of skimming might disclose where a heavy loss takes place. It will not pay a butter farmer to fatten calves at the expense of the churn.

Having seen that the cream is of the right thickness for churning, the next thing to do is to see that the temperature is correct. If this is looked after it will save many a weary hour's work in turning the churn. Always use the thermometer, and never depend on the feel or touch to gauge the temperature. To show how deceptive the touch is, any one can try an experiment for themselves. Have some water at 60 degrees and cool the hand by putting it into very cold water for a little time, then put it into the water at 60 degrees. The water will feel quite warm. Now put the hand into warm water and let it get thoroughly heated and put it back into the water at 60 degrees and it will feel quite cold. Thus the temperature to the touch will depend altogether upon the state of the hand at the time of trial. As a general rule, the proper temperature to churn at is about 58 to 60 degrees, but a certain allowance can be made according to the outside temperature. Thus, if the weather is very cold, it will not do any harm if the temperature goes up to 62 or 63 degrees, or, if very hot, down to 55 or 56 degrees. If allowed to go lower, the time of churning will probably be greatly prolonged, or if higher, the butter may come too quickly and be soft and greasy, or it may not come at all.

CHAPTER VIII.

CHURNS.

Of churns and churn-making one might truly say there is no end. New churns, for which all kinds of advantages are claimed, from making butter in the space of a few seconds to that of extracting from 25 to 50 per cent. more butter from the cream than any other variety, are being continually put on the market.

The operation of churning consists of separating the fat globules from the milk, and to so separate them that they are not broken is the whole art of churning. Rapidity in churning, although it may save labor, frequently results in the breaking of the fat globules, thus causing a greasy butter. It must be remembered that the ability of a churn depends greatly on the temperature and ripeness of the cream at the time of churning, and no churn has yet been made that will give satisfactory results at all times unless these important conditions are attended to. So far as is known the earliest form of churn consisted of skins of animals, into which the whole milk was placed, and these were hung on the back of a camel or ass, which was kept at a trot until the process of churning was completed. Since that time churns, fearfully and wonderfully made, have been put before the public, many of them at enormous cost, but of late years it has been proved that the principle of the old skin churn, viz., concussion, is in reality the correct one.

There is no doubt that good results are obtained from many different varieties, but if quality of butter and quantity, together with good keeping properties, are wanted in a changeable climate like that of Australia, so far the best results have been obtained from the concussion churns. These vary greatly in shape and method of working, still the principle involved is the same in all. Until within late years in many places the whole milk was churned, and in large dairies this involved churning every day, and sometimes several times daily. The churning was generally done by hand power, and not till within comparatively recent years was horse or steam power applied.

The most common form of churn was the "barrel," not such as we understand the barrel churn of the present day, but a conical structure that stood upright, narrowing into a neck to clasp the lid, and then widening out again. A wooden splasher in the form of a cross had a pole inserted into the centre of it, and this pole stood about two feet above the top of the churn, coming through a hole in the lid. When churning commenced this pole or handle was moved up and down, the splasher attached to it moving through the milk, and if the churning was accomplished in an hour and a half or two hours the dairyman or maid was quite satisfied. It was hard work and slow, but the butter thus obtained, if the milk was properly ripened, was of good keeping quality. After a time it was seen that to swing the barrel horizontally, and have a moveable beater in the churn would save labor, and this was the next form. Then someone thought it would be better to have the churn revolving and fixed beaters inside, and for a long time this form of churn was very popular, but there was always one very great objection to it—the difficulty in cleaning—and the impossibility of being able to see if the churn was properly clean through the necessarily small opening in the side.

The next step was back to the churn in vertical position, but instead of the old splasher, beaters were put in that were attached to cog-wheels, so that they could be turned with a crank handle, or have a pulley attached and be driven by horse power. From this time forward the shape of the churn began to change to oblong, square, round at the bottom

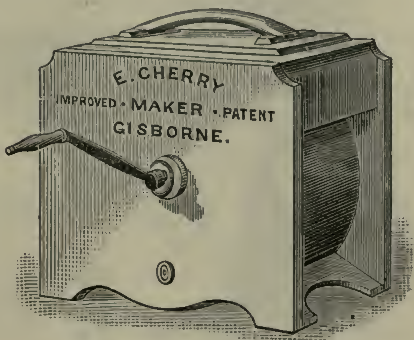


Fig. 9.—Cherry's Churn.

and square at the top, and many forms of beaters were used, some so fixed as to be revolving in opposite directions at the same time were once fashionable as they churned quickly, but the results were not satisfactory, some of the butter being invariably over churned and its keeping qualities spoilt.

At the present time the churn most used in small dairies is that shown in figure 9, and is known throughout Australia as the Cherry churn. It is a beater churn, which is a point against it, but in all others it has much to recommend it, being well-made, easily cleaned, and well ventilated all through the churning process. It is made in many sizes, but where a large machine is required a concussion churn would give better results, both as to the quantity and quality of butter obtained.

Of late years very few, if any persons, churn the whole milk, the cream only being used, and this requires, comparatively speaking, very small churns, and the labour is thus reduced to a minimum.

The reason that concussion churns are not used for very small dairies is that the small churns of this kind are difficult to clean unless the whole top is made to open, and this adds greatly to the initial cost.

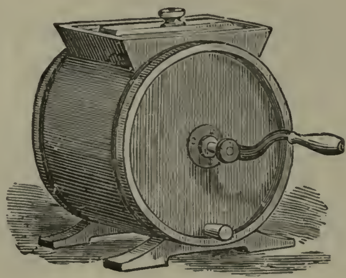


Fig. 10.—Barrel Churn.

Another kind of churn used for small dairies is that shown in figure 10, the action is similar to the Cherry, but it is not quite so easy to clean, nor can it be inspected so as to make sure that it is properly washed.

Fig. 11.—Rectangular Churn.

Figure 11. shows a concussion churn suitable for comparatively small dairies. It is a square box swung diagonally, the churn revolving, and it answers its purpose fairly well, but has the same objection as the former—its interior cannot be inspected thoroughly.

Figure 12. is another square box churn and differs from the last in that it is swung from the centre at both ends, it gives good results in every way, but no churn is perfect that cannot be thoroughly inspected, and with the lid made in this fashion, that is impossible.

For large dairies and factory purposes the concussion churns were first made in the form of figure 13, but owing to the difficulty of keeping them clean that form was changed and that of figure 14 has been almost universally adopted. Here it will be seen that the whole top of the churn lifts off, and every part of the churn can be thoroughly cleaned, and the butter obtained from this class of churn is as nearly perfect as butter can be.

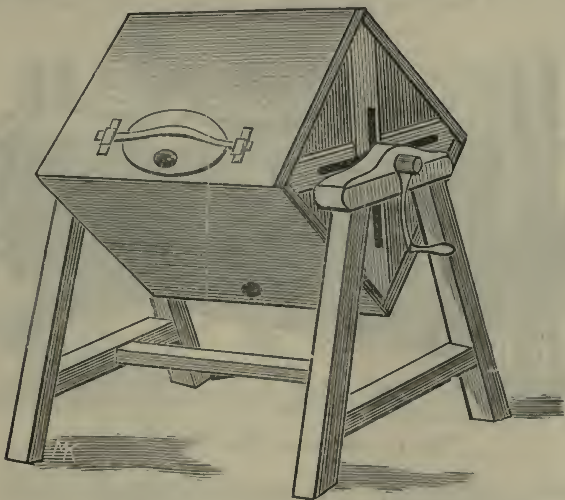


Fig. 12.—Square Box Churn.

There are many other kinds of concussion churns that give good results, thus, a barrel churn is made with spindles in either side at the centre of the bulge and the barrel revolves end over end, but there is often a difficulty, where the whole end comes out, of preventing a leakage, and when made of large size it is heavy to turn. Then there is the swing churn that is hung on four rods and swings to and fro. In this, however, the churn is apt to be slow.

One form of beater churn gives very good results, and this is known as the "Streamlet." Here the churn is divided into two compartments, the beaters being on one side. At the back of the beaters is a board perforated at the bottom for about six inches. When the beaters revolve the cream is kept going round in a constant current and as the butter breaks it rises to the surface, and is prevented from getting to the beaters by the board, the unchurned cream and buttermilk being drained through the perforations, so that there is no chance of the butter being over-churned; where the buttermilk is used for sale or feeding purposes this churn does not answer well, as a large quantity of water has to be used so as to keep the cream thin enough to flow ; otherwise the results are good. Another form of churn that great results were looked from was a beater churn that was used, and is still to a certain extent, in Denmark. It is barrel-shaped, set vertically, with a beater revolving in the centre. This beater is hollow, as is also the shaft driving it ; all round the beater small holes are perforated, and by means of an air pump a constant current of air is sent through the cream. This was supposed to add greatly to the keeping properties of the butter, as all foul and

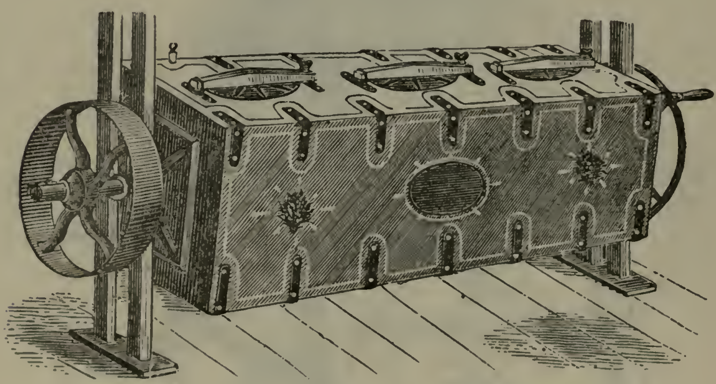


Fig. 13.—Revolving Box Churn.

noxious gasses and vapours were expected to be carried off. The results, however, did not come up to expectations, and although the churns are still used in many places, the air attachment is not used with them.

Some years ago a churn was invented that performed the operation of churning by means of air only. The cream was put in a glass vessel with an opening at the top to let the surplus air out, and air was pumped in through a hole in the bottom. The process certainly in time produced butter, but a pint of cream swelled to such an extent that a gallon measure would not hold it. As showing what could be done it was a success, but as a practical utensil it was a failure.

There is one more method of obtaining butter that has been written about a great deal some years ago, but which the writer has never tried nor seen tried. As a novelty it is mentioned. The cream is placed in a calico bag and buried about 10 or 12 inches deep in the earth and allowed to remain from 18 to 24 hours, and it is claimed at the end of that time that perfect butter will be the result. One man writing in the *Scientific American* some years ago claimed that he won a great many prizes for butter made in this way. The method is given for what it worth.

In all churns what is wanted is an instrument that will churn the cream equally—that some of the cream will not be churned some time before the rest. In beater churns this is the difficulty, the cream that comes into actual contact with the beaters often turning into butter a considerable time before the cream that does not. The consequence is that if churning is stopped as soon as the cream breaks, a great deal of butter is lost in the buttermilk, while, on the other hand, if churning is continued until all the

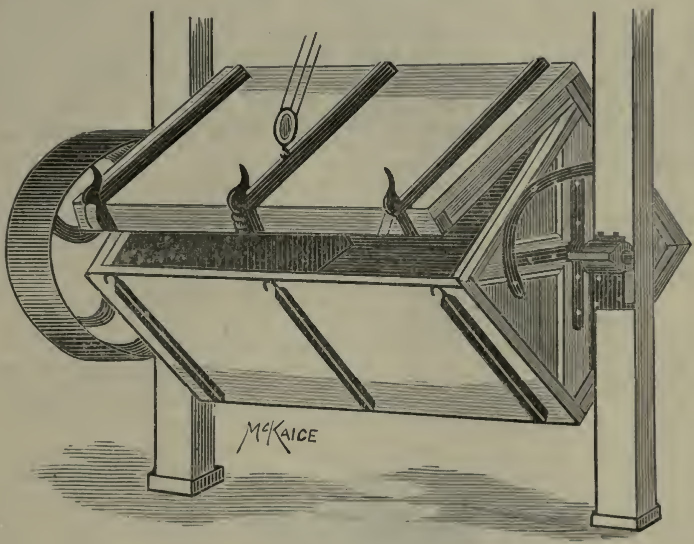


Fig. 14.—Factory Churn.

cream is thoroughly churned, the butter that came first gets over-churned, *i.e.*, the small sacs holding the fat globules are broken and the butter becomes greasy. When this latter is the case the butter loses its keeping properties. This any one can verify for themselves by stopping churning as soon as the butter breaks and running off all the buttermilk, leaving only the butter behind. The buttermilk is then churned for some time longer and butter will be found in it.

A perfect churn will churn the cream evenly, provided all the cream is of the same degree of ripeness. If the buttermilk from the churn is analysed, it will be found to be almost free from butter fat, only a trace being discovered (often as little as ·02 per cent.) ; while with badly-constructed churns it is not uncommon to find from 2 to 5 per cent. of butter fat in the buttermilk, and in this case the loss to the dairyman is very great, and in even a small-sized dairy will run into pounds in the course of a single season, and may make all the difference between a profit and a loss in the dairy accounts.

Many kinds of material have been tried for making churns, but none give such good results as wood. Oak is probably the best, but it is heavy and expensive, and in these colonies the best churns are made out of well-seasoned kauri pine, and these, if properly looked after, will last a lifetime or longer.

After churning, when washing the churn do not put boiling water into it first. If that is done it hardens the casein in the cracks and corners and makes it almost impossible to remove. Tepid water should first be used to thoroughly rinse the churn, and after that boiling water, quickly emptied out and the churn allowed to dry. The churn should always be kept in as cool a place as possible, with plenty of fresh air about it, and left open so as to keep it sweet.

CHAPTER IX.

BUTTER-MAKING.

The churn, before being used, should first be thoroughly washed with cold water. Boiling water should then be put in and care taken to let it have access to every part of the churn. The hot water is then allowed to escape and the churn thoroughly cooled down with cold water, by so doing the pores of the wood are contracted and the sticking of the butter to the wood prevented. Some dairymen use brine for cooling the churn, and its use is advantageous if the churn is not made of first-class wood, or if it is very old. But with a new churn, made of well-seasoned wood, it is not necessary. If this practice is followed immediately after and before churning there will never be any necessity for the use of soda or other chemicals. Of course, it is taken for granted that the churn has been properly made and there are no crevices or cracks to allow the cream to lodge in ; if such should be the case, there is only one remedy, and that is to *burn it*, for a little bad cream remaining in the cracks is sufficient to spoil every churning, and it is almost impossible to thoroughly cleanse such a churn.

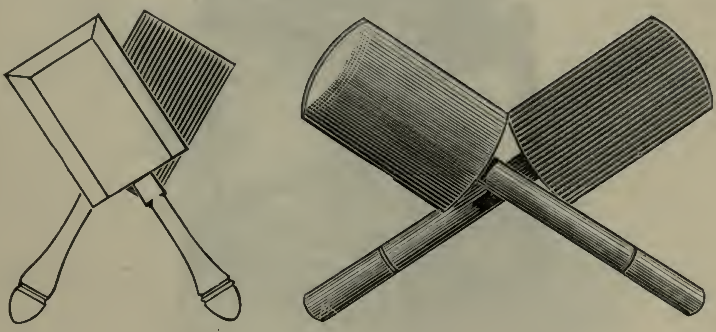
The cream should be poured through a wire sieve into the churn, so that any lumps that may be in it can be broken up and thus ensure uniformity of churning. It is also useful in case any foreign matter may have dropped in.

We now come to the question of colouring. In the winter and spring, if the cattle are on green feed, there will never be any necessity for artificial colouring, but when the pastures dry up the butter comes out a sickly white, then colouring is required, but care must be taken not to overdo it, as one extreme is quite as bad as the other. The usual way of colouring butter is to add some annatto prepared in oil, which mixes with and is thoroughly incorporated with the butter. As soon as the cream is put into the churn the required quantity of colouring is added and churning started at once.

Damage is often done to the butter by churning too fast. When starting the speed should be slow and then gradually increased up to the usual rate, which, taken as an average, is about 45 turns a minute ; then, just before the butter breaks, the speed should be reduced again. When churning is first started the cream gradually swells and compresses the air, and unless this is allowed to escape there is a danger of straining the churn. After a few turns, if there is an air hole in the churn, it should be opened every now and again, so long as there is any air coming away. With many people there is a difficulty in knowing exactly when to stop churning, and consequently there is a danger of over-churning. If the churning is done by hand, as soon as the butter commences to break, the cream will sound watery and can be distinctly heard splashing in the churn ; it will also be much easier to turn. The churn should now be opened at once, and if the grains of butter are as large as sago the churning has gone far enough, and care must be taken not to over-churn. Cold water is now added in the proportion of about one-sixth of the original quantity of cream, and the churn started again very slowly and only a few turns given. If the butter is very fine and the grains not larger than the head of a pin, the same proportion of cold water is added, but the churn is turned quickly a few times and this brings the grains to about the proper size.

The reason for adding cold water is, that it hardens the globules and prevents them sticking together, and thus allows the butter-milk to get away for freely. It also thins the milk and allows the fine particles of butter to come to the surface quicker, and helps to clear them of any casein that might otherwise stick to them. Just before the butter comes, or when it is coming, the lid of the churn should be taken off, and the lid and slides, and wherever any cream is adhering, should be carefully washed down with cold water, otherwise the cream that remains unchurned may get into the butter and spoil its appearance by causing white specks in it. The butter-milk is now allowed to drain off, passing through a hair sieve to catch any particles that pass away in it. If a proper sieve cannot be easily obtained the butter-milk may be strained through a piece of muslin doubled. When all the milk has been allowed to run off, the churn should be half-filled with cold water again and all adhering particles of butter to the sides or beaters of the churn carefully washed off. The churn should then be slowly rocked if it is a concussion churn, or if a beater, turn the beaters slowly so as to allow every particle of butter to come in contact with the water, then allow the water to escape. This should be continued so long as the water shows any sign of milkiness at all. Of course, during all this time the butter is supposed to be in a granular state, if it should have gone into lumps it cannot be properly washed in the churn. If the butter is in a correct condition it will readily separate one grain from another, and although it may appear in lumps in the churn after the water has been run off, as soon as fresh water is added the granules will all separate again and float on the water.

If the weather should be rather warm and a difficulty be ound in getting the water cool, salt added to the water will help greatly in hardening the granules and getting rid of the butter-milk. The amount of water required and the number of changes will depend greatly on the quality and condition of the cream. If the cream is composed of globules that are large they will rapidly rise and wash freely, but if the globules are small they will wash slowly. As to the condition, if the cream has been well looked after, thoroughly stirred and allowed to ripen to a proper degree and churned at the correct temperature, it will wash freely, and about three changes of water will be sufficient. If, on the other hand, the cream has been rather fresh or over ripe, or the temperature too hot, it may take six or seven, or even more changes, but in all cases the butter milk should be got rid of before the butter leaves the churn—if not, the probabilities are that it will subsequently be over-worked and the grain spoiled. The correct amount of washing can always be gauged by the colour of the wash water as it comes away. If it is desired to brine salt the butter, it should be done before removing it from the churn. A strong solution of brine is made—there is no difficulty in making it the required strength, as more salt can be added to the water than will be dissolved, so if the salt and water are mixed an hour or two before being used and the mixture is well stirred occasionally, and it is found that some of the salt remains undisturbed in the bottom of the vessel, then a saturated solution is obtained, only the clear



Scotch Hands.

liquid must be poured off, and the residue can be used again. The brine is then poured into the churn and the butter allowed to float in it, being gently turned every few minutes for about half an hour. It will readily be seen that unless the butter is in a granular form the brine cannot get at all the particles, so if the butter has by any means got into lumps it cannot be properly brine salted. After half an hour the butter may be taken from the churn, being lifted with wooden pats, or, as they are sometimes called, "Scotch hands," and placed on the butter-worker loosely ; it is then allowed to drain for five or ten minutes, and then slowly worked so as to get all the surplus moisture out of it, and to consolidate it into one mass. When this has been done, it is ready for printing. If it is desired to dry salt the butter, the following process may be followed :—Put the butter from the churn in a tub or wooden vessel and weigh it, then place it on the butter-worker, or, if a butter-worker is not available, on a board that has been carefully scalded and cooled, and allow it to drain for a few minutes. Turn the worker a few times so as to squeeze out most of the water remaining, then add salt according to taste, at the rate of from a quarter of an ounce to one ounce to the pound of butter. The salt should be rolled out and all lumps well broken and then dusted in the butter through a fine sieve. Then give the worker a few turns slowly and put the butter away in a cool place for a few hours. This allows the salt to get thoroughly dissolved and mixed with the butter, and will save over-working. When the salt has thus been thoroughly dissolved

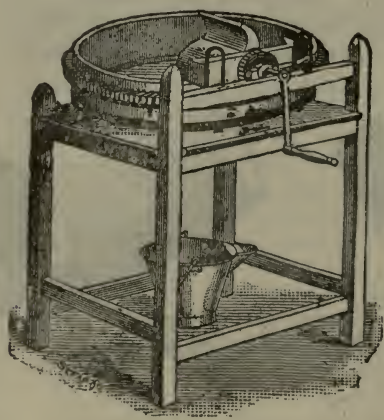


Fig. 15.—Butter Worker.

the butter is again put on the worker, and a few turns will extract all the surplus moisture and leave the butter with a perfect grain, and not a trace of streakiness. If a butter worker is not available a very fair substitute can be used by having the board already spoken of and a wooden flour roller, the latter should be well scalded and cooled, and used for no other purpose. When the butter has been placed on the board and allowed to drain the roller is slowly passed over it, up and down and across, the salt sprinkled on as before described, and then the butter turned up into a lump with the pats, and slowly rolled again. About one-half the salt should only be put on at first, and the rest after the second salting, the butter then put together again and put away until the salt dissolves. When that has taken place the roller may be used again to press out the moisture, and the butter will be ready for printing. The roller should be used slowly, and not worked rapidly backward and forward, or by so doing the grain of the butter may be broken.

Fig. 16.—English Butter Worker, for small dairies.

The butter has now reached that stage when it is ready for being packed for market. The method of getting up the butter is one of great importance and is well worthy of care and trouble. Many farmers seem to think that so long as the butter is of good quality it matters little what it looks like. No greater mistake can be made.

If the butter is good to start with, well and neatly got up and properly packed, it will often bring wholesale 1d. per lb. more than the same butter would if roughly packed. In fact, I have seen inferior butter, well got up, bringing more money in the salerooms than much better butter that had not the same care and attention spent on it. If this is so in the wholesale market, how much more

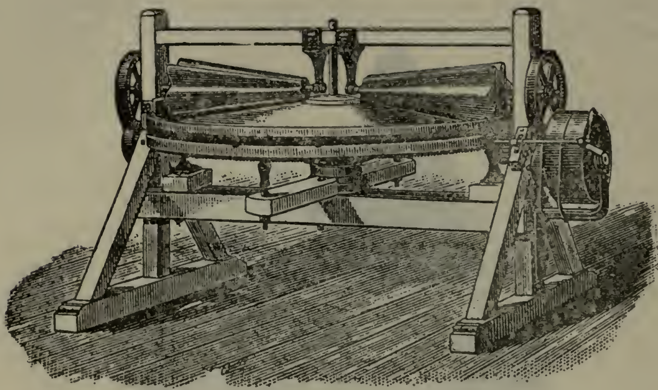


Fig. 17.—Compound Butter Worker, for power.

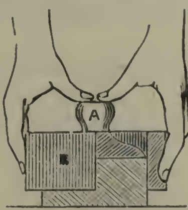
Fig. 18.—Triangular Butter Worker.

will it hold good in the retail? The very fact of butter being nicely and tastefully got up tempts the appetite, and causes far more to be consumed.

The foregoing remarks apply to packing both in bulk and in rolls, blocks, or prints, but more especially to the three latter.

The case should not be forgotten, either, and if one with trays in regular use, should be thoroughly well scalded, both inside and out, and kept nice and fresh-looking. Butter that has to be kept for a length of time in boxes is often spoiled by the germs of old stale butter that have been left from many previous consignments.

Printing.—The old-fashioned round print is now gradually becoming a thing of the past, and the sooner it has disappeared the better, for many reasons. It is almost impossible to print it without letting the hands come in contact with the butter—a thing that should be studiously avoided. The prints do not lie close together in packing, and consequently take up space that could be better utilised. Not packing well in the case they are more apt to get knocked about and disfigured when in transit. They are not suitable for table use, being difficult to cut if the butter is firm, and when the print is cut in two it is unsightly. The best form for domestic use is the half pound block, either oblong or round. These pack well, lying close together; they cut well and look well, either perfectly plain or with the name or initials of the owner, or any other design upon them.



Printing.

They can be quickly made without the hands touching the butter at all, with the ordinary butter pats, or Scotch hands. After they are made, a small block, bearing any device, can be used for pressing on them, or, if that is not desired, the plain look can be taken from them by making diagonal marks with the edge of the pat and crossing them. Numerous devices can be arranged by any one possessing a little taste. Where a large quantity of butter is to be printed it will be found more economical to use a mechanical weigher and printer.

A very simple and efficient form is that of an oblong box that holds exactly half-a-pound, or pound, as the case may be. All that is required is a butter board and the box print, any design can be put on the top of the box that is desired to go on the print. The butter board is well scalded and cooled, and the butter put in a heap on one end, the other end left free for printing. A wooden tray for putting the butter on is placed on one side, and if parchment paper is used, a quantity of it is placed beside it.

The print is now taken firmly in both hands, and, face downwards, stuck into a heap of butter and then rubbed backwards and forwards on the clear part of the butter board to get rid of the surplus. The print is then put on a square of butter paper and the paper turned up at the sides and ends, this is then placed on the tray close to the side, and each succeeding print is placed closely up against its neighbor; by this means the butter on the tray forms an almost compact solid mass that will not move unless the case is turned right over.

The parchment paper prevents one print from sticking to the other. By using these appliances, after a little practice, 150 to 200 prints per hour can be weighed and printed. So long as the box is the correct size each print will be exactly the correct weight.

When the boxes are first bought they are generally made a little on the large side, and when it is first used the print should be weighed and if found over weight a shaving can be taken off the bottom of the print, or, if that would be too much, it can be rubbed

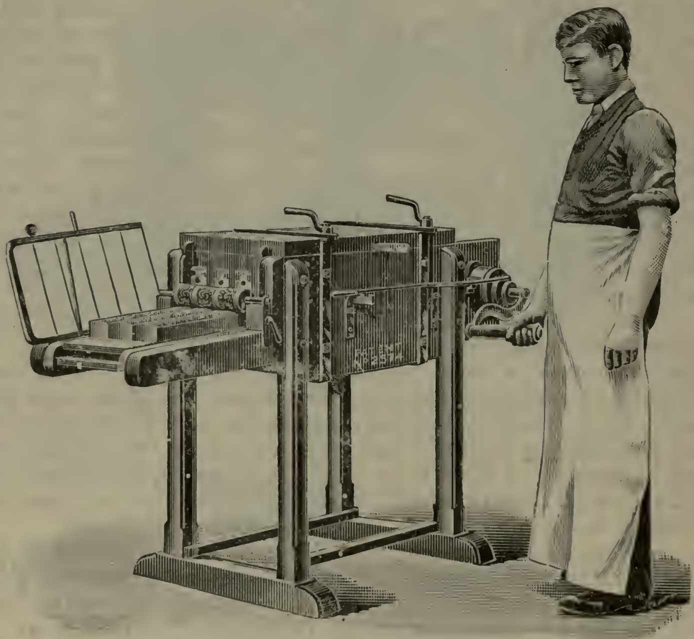


Fig. 19.—Machine for Weighing and Printing Butter

down with sandpaper until the exact weight is given. After a time the weight will be light, as the bottom of the box wears away, and this can be remedied by taking, say, a quarter of an inch off all round and putting four slips of wood on, fastening them with brass screws. The slips should be $\frac{5}{8}$ of an inch in thickness, and the correct size got by planing or sand-papering down as in the first case. The cost of a well-made print of this kind varies from about 5s. for a plain one, to 20s. or 30s., according to the design that is engraved upon it.

For those who have a still larger quantity of butter to get through, there are large printing machines made that hold from 50 to 120 pounds, and print and weigh from 3 to 12 blocks or rolls at a time. These are worked on quite a different principle, and consist of a large box with two or three small holes at one end where the butter is forced through. These holes can be made either square, oblong, round, or half round. A sliding block, the exact size of the box and worked by a screw, forces the butter out on a set of small wooden rollers that allow it to pass freely over them, and when the rope has reached the end a wire cutter is brought down that divides the butter into the proper lengths and weight. This wire cutter can be adjusted by means of thumb screws so as to give the exact weight, and can be used for making pounds and half-pounds.

These machines are generally used in the large factories, where thousands of pounds have to be weighed and printed daily. They cost from five guineas up to fifteen, these latter being driven by power. There are many other kinds of mechanical printers, but these described here are the ones that have given most satisfactory results and require least adjusting.

For packing bulk butter, by far the best method is in square boxes, containing 28 or 56 pounds; these pack well and require little space for storing, and the butter can be taken out in the form of a solid cube. Great care must be taken to see that the wood used is absolutely tasteless, otherwise the butter will soon acquire the taste and flavour of the wood, and spoil. So far as is known there is no wood indigenous to Australia that can be used, but the kauri and white pine of New Zealand answer the purpose admirably. Kauri being the more expensive, the white pine is exclusively used. If it is desired to keep the butter a considerable time, and no proper cool room or chamber is available, good casks are the best, as they can be made almost air-tight, but the casks must be good and clean and nothing ever have been used in them that would in any way taint the butter. The great object in packing to make the butter keep well, either in boxes or casks, is to get the butter into all the corners in a solid mass, and thus prevent the air remaining in. To do this it is necessary to have a rammer and put the butter in in small quantities, and thoroughly ram each layer. Much butter is spoilt for want of this precaution. Great care should be taken to keep the outsides of the boxes clean as well as the insides, buyers do not care to look at boxes that have a dirty appearance.

In everything connected with butter remember that appearances go a long way.

CHAPTER X.

CHEESE MAKING FOR FARMERS.

The method of cheese making that is given here is not the usual method adopted at the factories, nor even among the very large dairies, but is more suitable for small farmers milking up to say 100 cows. Cheese making is much more difficult to learn and properly carry out than butter making, and it would pay anyone who has never made cheese to go and get a few practical lessons in the art be ore commencing on his own account. Every dairy farmer should thoroughly understand how to make both cheese and butter. At some times of the year it may pay better to make cheese, while at others butter will pay best. Approximately speaking, two and one half gallons of milk will make one pound of butter, or two and one half pounds of cheese. From this, by comparing the prices of cheese and butter, it can easily be seen which is likely to pay the better. There is also this to be taken into consideration, that the butter is ready for sale and consumption at once, while the cheese will not be for at least six weeks or two months.

In the manufacture of cheese, if anything, more care is required to be taken of the milk than for butter making—especially of the night's milk. No preservatives must be used to keep the milk sweet, as they interfere with the process of making. On no account must the milk of newly calved cows be used for at least seven days after calving.

The plant required consists of a double-jacketted vat, curd knife, strainer or cooler, quantity of cheese cloth, thermometer, press, hoops, and measuring glass. The size of these depends upon the quantity of milk to be treated and will vary in price from £35 to £100. To make the best cheese the whole milk is required, that is, milk from which no cream has been removed. It is always advisable to have some of the night's milk to mix with the morning's, and in very cold weather milk a day old will not do any harm if it has been properly looked after. Both the old and the new milk is put into the vat, or, as it is called by some people, the tub, and the temperature gradually raised to 80 degrees. Coloring matter (a preparation of annatto) is then added at the rate of from 2 to 6 fluid ounces to the 100 gallons. It will be found that the quantity required will vary greatly according to the feed the cattle get. This can only be found by experience. When the coloring matter has been thoroughly mixed and the milk has become uniform in colour, the rennet is added. The quantity varies according to the quantity of old and new milk used. If there is much old milk, less rennet will be required, if there is much new milk, more will be needed. If it is desired to have the cheese rapidly mature, about double the quantity is used, but, when this is done, the cheese must be sold and consumed quickly, as otherwise it will get hard and dry.

When the prepared rennet is used, from six to eight ounces to the 100 gallons is an average amount, but when home made rennet is used only practice will tell how much is needed. Before adding the rennet to the milk mix it with about double the quantity of warm water, then add it to the milk and mix thoroughly and rapidly. Allow the milk to sett'e and then keep the surface gently in motion until it begins to thicken. By doing so it will keep the cream from rising to the surface and afterwards being lost in the whey. The vat should then be covered with the cheese cloth and allowed to remain for about forty minutes, when it should be ready for cutting.

To tell if the curd is properly set, put a piece of wood into it about as thick as a finger and push it along ; if the curd threads in long lines before it, it is quite ready for cutting ; if it gives, and is soft, it is not long enough set.

The horizontal curd knife is first used from end to end of the vat, and then the vertical knife, both across and lengthwise. The curd is now allowed to settle, and the whey to rise, for about five minutes. Heat is then added, and the whole slowly heated up to 100 degrees Fahr., stirring it almost constantly all the time to keep it from sticking together. This process is called cooking the curd.

In the early stage the curd is soft, and requires careful handling, but, as the cooking goes on, the curd grows firmer and begins to contract in size as the whey is being gradually expelled. The time that is required to cook the curd will vary from half an hour to several h urs, and until the cooking is complete the temperature must be kept up to 100 degrees Fahr. To tell when the curd is properly cooked and when it has reached the proper stage of acidity is one of the most important things in cheese making. When the curd is first cut the whey is sweet and sugary, but, as the cooking process goes on, this sweet taste is gradually lost, and the whey becomes slightly acid. It is just at this stage that the cooking in the vat is stopped, and the whey allowed to run off. This is generally done by means of a tap with a strainer, or with a syphon. A cheese cloth is then put over the strainer and the curd is put on it and all the whey allowed to drain off. In order to do this freely, the curd is kept constantly turned and not allowed to cake. When it has cooled to about 68 degrees Fahr., it is salted at the rate of about 2½ pounds of salt to 100 gallons of milk. The curd is now ready for the press, and is put into hoops, and slight pressure applied, which will force the whey gradually out. As the whey escapes the pressure can be increased until the whey stops coming. After this the curd is taken out of the hoop and a muslin bandage put on, put back in the hoop again and in the press. Heavier pressure is now applied, which should be increased a few hours later on. Next day the cheese is taken out of the press and put into the curing room, where it has to be turned every day for six weeks or two months. The temperature of the curing room should be kept as nearly as possible at about 65 degrees Fahr., and not allowed to become too dry. Should the temperature rise above that the newer cheese should be turned twice a day. The cheese in the curing room should be kept dry by wiping with a cloth, and should any crack, or get broken, th cracks should be filled up with butter to keep the flies out. Should a cheese swell up a knitting needle should be pushed down into it to let the gas escape. If the weather is cold the temperature of the curing room should be kept up at nights. This can be done by putting a small charcoal fire in the centre of the room. If calves are to be fed on the whey it must be run off before it becomes at all acid, otherwise it will cause scouring and perhaps kill them. With properly made cheese there will be little nourishment in the whey, so that it is desirable to add something to it for the calves. Flour, maize-meal, treacle, or linseed, or cotton seed cake are mostly used. Calves fed on whey only do not thrive well ; pigs will do much better on it.

A bucket of whey should be allowed to stand over for an hour or two after each making and then carefully examined to see if there is any fat on it. If so, the milk has not been properly set, or the curd has had too rough handling afterwards. When the whey is taken off it should be a greenish colour ; if white, there is waste, and more care must be exercised. In careless setting most of the cream may be lost, and a poor hard cheese produced instead of a rich one.

The Factory System of Cheese Making.

In making Cheddar cheese the greatest care is required in examining the milk, and any in the least tainted should be returned to the supplier. Only whole milk should be used, that is, milk that has had none of the cream taken from it. When the milk is received it should be thoroughly strained and put into the vat and heated up to 80 deg. Fah. The rennet is then added, and in most factories it is the custom to use the artificial article, as it is made of a standard strength and, as a rule, is more to be relied upon than that made direct from the calf's stomach. The usual proportion of rennet is 4 ounces to 100 gallons, but before adding it five ounces of the milk is measured out and one teaspoonful of rennet added. Stir the milk and rennet well for about five seconds and watch it carefully, and if it should thicken in from 14 to 17 seconds the milk in the vat is then ripe enough and ready for adding the rennet. The colouring matter (annatto) is then added at about the proportion of two ounces to 100 gallons of milk ; the milk is well stirred for about three minutes, until it is all a uniform colour, and the rennet then added, the milk being kept well stirred all the time and for about five minutes afterwards ; then allow it to settle. The surface of the milk can be kept in very gentle motion until it shows signs of thickening, which ought to be in about twelve minutes. By so doing it prevents the cream rising to the surface, much of which would be lost in the whey.

Up to the present we have supposed that the milk has been of exactly the right degree of ripeness, but should the milk in the tea cup not thicken within the time mentioned, 14 to 17 seconds, as will often be the case in cold weather, often taking from 20 to 30 seconds to thicken, then the milk must be kept up in temperature in the vat for some little time longer and heated up to 88 or 89 degrees Fah., and the tea cup test tried every now and again until the correct result is obtainable.

Unless a person has had a considerable amount of practice it is often difficult to tell the exact time when the milk begins to thicken, and the following simple test may be of use :—When the milk is put in the tea cup put a small piece of wood into it, half a wooden match will answer very well, then add the rennet and stir rapidly and the moment the milk begins to thicken the match will cease revolving and come to a standstill. The milk when set is covered over with a cheese cloth and allowed to remain until the proper time for cutting the curd arrives, and the way to know when the curd is ready for cutting is as follows :—The milk took 12 minutes to thicken after the rennet was added, or should have done so, if it was exactly ripe. The exact time should always be noted by the watch and a note taken of it. Twice and a half times the time taken to thicken will give the time when the curd should be cut ; for instance, if the milk thickened in 12 minutes the curd would be ready for cutting in 30 minutes, that is, twice 12 = 24, and the half of 12 six, that is 30 minutes from the time of thickening, or 42 minutes from the time of setting.

The curd is now ready for cutting and for this purpose two knives with many blades are used, one of which has the blades horizontal, the other vertical.

The knife with the horizontal blades is the one most used, and great care should be exercised to see that the cutting is done sharp and clean and that the curd is not bruised and broken during the process. The horizontal knife cuts the curd into layers by using it up and down the whole length of the vat, then the vertical knife is used in the same direction and this cuts the curd into long strips, but cutting them across the vat the curd is cut into cubes of the required size.

When the curd is thus cut heat is added so as to raise the temperature up to 100 degrees Fah., the curd all the time being kept gently in motion, care being taken not to break it or bruise it ; a special kind of rake is used for the purpose ; about three-quarters of an hour is the usual time for getting the heat up. When this temperature has been reached the hot water surrounding the vat is allowed to run off and the curd allowed to settle and to remain for about an hour and a half, the vat being kept well covered so as to retain the heat. By that time the curd should have developed the amount of acidity required and the whey should be allowed to run off. In order to be sure that the proper amount of acidity has been developed, what is known as the hot iron test is applied. A piece of round iron is heated almost to redness and a handful of the curd taken and well squeezed in the hand so as to get rid of as much of the whey as possible and the hot iron is applied to it. When the iron is drawn away from the curd it draws out fine threads one-eighth of an inch long ; the time has come for drawing off the whey. If, however, the threads are not produced, the proper amount of acidity is not yet come, and the whey must be left in the curd for some time longer.

After the whey has been taken off the curd is removed to the cover and allowed to remain about 10 minutes so as to allow it to mat, that is, to stir together so as to form a solid lump. After matting the curd is cut into squares for convenience for going through the curd mill and also to allow of the drainage of the whey.

The curd is still kept covered and turned about every quarter of an hour. This is kept up for an hour to an hour and a half until a further stage in acidity has been developed. The hot iron test is again applied and if now the threads spin out to about three-quarters of an inch in length it is time to put the curd through the curd-cutter. If the threads are not the proper length the curd will have to remain some time longer in the cooler and be tested until they are of the proper length. The curd, after being put through the cutter, comes out in strips about three inches long by about half an inch thick, and this must be kept stirred and worked about to prevent matting until it has cooled down to about 72 degrees Fah., when it is ready for salting.

The salting is done at the rate of two pounds of salt for each 100 gallons of milk ; after thoroughly mixing the salt allow the curd to remain for about 15 minutes so that the salt may get properly dissolved. There is no fear of it matting now, once the salt is added all inclination to stick together is lost. The curd is now ready for putting in the hoops and pressing. There are numerous kinds of presses, but the most convenient form is that known as the gang press, where a number of cheeses can be pressed in the one press. When the hoops with the curd are first put into the press only a light pressure should be applied for at least the first half hour, later on a steady heavy pressure may be applied. After the curd is firm enough it is taken out of the hoops and bandaged and then returned to the hoops again and dressed for about 16 to 18 hours, when they are ready for removal to the cheese room.

APPENDIX I.

CUSTOMS STATISTICS.

AGRICULTURAL IMPLEMENTS AND PRODUCE IMPORTED.

The following figures, furnished by the Collector of Customs will show most clearly the prospects before the producers of Western Australia. The amount of produce imported, that might be just as well grown in this colony, is really wonderful, and is evidence of the consuming power of an ever-expanding population.

	1890	1891	1892	1893	1894	1895	1896	*1897
	£	£	£	£	£	£	£	£
Agricultural Implements ...	9,387	8,450	11,519	6,937	7,909	11,491	17,756	5,693
Animals, living...	11,618	32,022	67,003	36,254	111,331	158,473	190,675	52,718
Bacon, Hams, etc.	4,615	7,097	9,111	11,871	22,120	26,193	68,182	20,820
Beans	...	...	...	...	84	277	352	91
Bran and Pollard	7,998	7,014	14,135	11,485	10,805	26,644	43,394	12,631
Butter	16,023	22,781	29,059	36,148	50,354	73,999	148,971	28,429
Cereals	14,249	28,285	49,112	30,394	48,147	126,557	160,80[illegible]	23,884
Cheese	5,219	7,001	7,064	6,870	7,235	11,201	30,118	5,029
Coffee	1,477	1,679	1,629	1,490	3,186	3,895	5,178	...
Eggs	161	849	1,874	2,122	4,996	11,920	33,389	9,831
Flour	27,846	19,113	48,323	46,120	44,300	62,712	152,135	54,071
Fruit, dried ...	4,925	6,056	6,848	5,622	6,463	4,426	6,649	1,832
Fruit, green ...	1,164	1,551	2,229	2,743	5,431	8,878	13,402	3,975
Hay and Chaff ...	2,574	9,381	15,753	2,060	37,745	51,819	73,245	14,539
Honey	...	...	...	...	...	1,340	2,831	838
Milk, preserved...	3,609	6,937	8,048	9,792	17,639	37,167	47,466	21,573
Oatmeal... ...	1,464	1,725	2,325	2,974	6,023	5,353	9,698	1,551
Onions	376	854	1,329	1,234	3,254	3,989	10,620	3,660
Pepper	...	...	...	...	...	1,215	1,791	...
Plants, Seeds, etc.	1,518	2,385	3,278	3,529	5,823	4,686	955	1,552
Potatoes... ...	3,276	5,880	7,238	7,147	10,121	10,219	33,601	11,436
Sacks	6,219	17,181	5,260	4,994	2,631	...	...	7,570
Vegetables, preserved ...	1,212	1,794	3,220	2,828	8,614	14,987	35,989	6,507
Wines	11,449	13,732	14,806	12,716	19,320	36,604	71,693	19,281
Woolbales ...	3,553	4,066	1,868	1,998	2,790	2,158	2,630	24

* To April 1st.

APPENDIX II.

LAND LAWS.

CONDITIONAL PURCHASES.

There are several modes of obtaining land under conditional purchase, as prescribed by the following clauses of the Land Regulations and Homesteads Act :—

SELECTION WITH RESIDENCE INSIDE A SURVEYED AGRICULTURAL AREA.

Section 33 of the Homesteads Act takes the place of Clause 46 of the Land Regulations—

This section is only applicable to land within a surveyed agricultural area.

The maximum area allowed to one person is 1000 acres, and the minimum 100 acres.

The price is 10s. per acre, payable as rent at the rate of 6d. per acre per annum for 20 years ; application must be accompanied by the rent due for the first year, or part of a year, as prescribed by Clause 101 of the Land Regulations.

The lessee must, within six months from the date of approval of his application, take personal possession of the land, and must reside upon portion of it, as prescribed by the Act.

The improvements required are that within two years one-tenth of the land shall be fenced, the whole within five years, and within ten years a sum equal to 10s. an acre shall be expended in prescribed improvements, in addition to the cost of the exterior fencing.

At the expiration of the lease, or at any time after five years from the date of commencement of the lease, provided that all conditions have been complied with, and the fencing and improvements maintained, a Crown grant may be obtained on payment of the balance of purchase money and prescribed fee of 30s.

A statutory declaration, in the form prescribed by Schedule No. 16 of the Land Regulations, shall be furnished to the Minister on or before the 1st of March in each of the first five years of the lease, and at the end of the tenth year, and also when applying for the Crown grant, setting forth that the required conditions of residence, fencing, and improvement have been fulfilled.

PERSONS NOW HOLDING LAND IN FEE SIMPLE OR UNDER SPECIAL OCCUPATION LICENSE WISHING TO TAKE MORE LAND.

Section 34 of the Homesteads Act takes the place of Clause 47 of the Land Regulations.

This section is intended for those who possess land in fee simple or special occupation under the present or any former Land Regulations, or who may be the holder of a lease of such land from the owner, and reside upon a portion of such land, and is applicable either within an agricultural area or outside of it.

Under this section a person can take up from 100 to 1000 acres anywhere from land available for selection within 10 miles of his homestead.

The rent and conditions, excepting residence, are the same as under Section 33 ; but if the land is not surveyed, the conditions shall date from the date of survey instead of from the commencement of the lease.

FREE SELECTION WITH RESIDENCE.

Clause 48 of the Land Regulations—

This clause is intended for those who wish to apply for land outside an agricultural area, and intend to reside upon it.

The rent and conditions are the same as under Section 33 of the Homesteads Act; the only difference being that Section 33 is intended for a surveyed agricultural area; and Clause 48 for land outside of an agricultural area; but if the land is not surveyed, the conditions shall date from the date of survey instead of from the commencement of the lease.

SELECTION WITHOUT RESIDENCE EITHER IN A SURVEYED AREA OR BY FREE SELECTION.

Clause 49 of the Land Regulations—

This clause is intended for those who do not reside upon their own land, and who do not wish to reside upon the land taken up.

This clause is equally available for land within an agricultural area and land outside of an area.

The rent and conditions, excepting residence, are the same under this clause as under Section 33 of the Homesteads Act, but double the expenditure on improvements is required in lieu of residence; and if the land is not surveyed, the conditions shall date from the date of survey instead of from the commencement of the lease.

SELECTION BY PASTORAL LEASEHOLDERS INSIDE THEIR LEASES.

Clause 50 of the Land Regulations—

Any pastoral lessee in the South-west Division, at any time within 14 years from the 2nd March, 1887, may select land within his lease (not in an agricultural area) in one block adjoining his homestead, not exceeding 5 per cent. of the area held by him on lease within such division. The minimum area shall be 500 acres, and the maximum 3000 acres. The rent and conditions, excepting residence, are the same as under Section 33 of the Homesteads Act; but if the land is not surveyed, the conditions shall date from the date of survey instead of from the commencement of the lease.

DIRECT PURCHASE.

Clause 54 of the Land Regulations—

The price of land under this clause is not less than ten shillings an acre, payable as follows, viz.:—Ten per cent. on application, and the balance within one month after the application has been approved.

This clause is equally available for land within an agricultural area and land outside of an area, and residence is not required under it.

From 100 to 5000 acres can be held outside of an agricultural area, and from 100 to 1000 within an agricultural area by one person, but in either case only three separate selections can be made.

The improvements required are that the land shall be fenced in within three years from the date of survey, and 5s. an acre expended upon it in improvements within seven years from such date, but if the land is surveyed at the time it is applied for, the conditions shall date from the commencement of the license.

The foregoing clauses refer only to the South-west Division of the colony, or to lands in the Eastern and Eucla divisions set apart under Section 31 of the Homesteads Act.

GARDEN BLOCKS—FIVE TO TWENTY ACRES.

Clause 55 of the Land Regulations—

The price of land under this clause is not less than £1 per acre, payable on application. It is intended for those persons who require land for vineyards, orchards, and gardens in small blocks of from 5 to 20 acres, either within an agricultural area, if small blocks have been surveyed in it, or outside of an area.

Residence is not required, and not more than 20 acres can be obtained under this clause by any one person.

The improvements required are that the land shall be fenced, and one-tenth part shall be planted with vines or fruit trees, or otherwise be cultivated as a vegetable garden, within three years from the date of survey.

If the land required is outside the South-west Division, it must be within a special area, or within ten miles of a town site.

SELECTION IN SPECIAL AREAS OUTSIDE THE SOUTH-WEST DIVISION.

Clause 52 of the Land Regulations—

This clause is applicable only to land within a surveyed special area. The price is 10s. per acre, payable at the rate of 1s. per annum for ten years, and application must be accompanied by the rent due for the year or part of the year, as prescribed by clause 101 of the Land Regulations of 1887.

The maximum area allowed to one person is 5000 acres, and the minimum is 100 acres, and not more than five applications shall be entertained from one person.

The improvements required are that within two years the whole of the land shall be fenced on the surveyed boundaries, and that before the expiration of the lease an amount equal to 10s. per acre shall be expended on the land in prescribed improvements, in addition to the cost of the exterior fencing.

At the expiration of the lease, or at any time during its currency, provided all the conditions have been complied with, a Crown grant may be obtained on payment of the balance of purchase money, and the prescribed fee of 30s.

PASTORAL LEASEHOLDERS OUTSIDE THE SOUTH-WEST DIVISION MAY SELECT UNDER CERTAIN CONDITIONS.

Clause 53 of the Land Regulations—

Under this clause any pastoral lessee in the Kimberley, North-West, Gascoyne, and Eucla divisions, who, at any time within fourteen years after the 1st March, 1887, shall have stocked his land in accordance with the regulations, may obtain, for the purpose of a homestead, a block of land within his lease not exceeding one per cent. of the total quantity held, on the same terms and conditions prescribed for purchase under Clause 52 of the regulations. The minimum area shall be 500 acres, and the maximum 5000 acres.

In any case on failure to comply with the conditions, the land shall be forfeited and revert to the Crown, with any improvements that may be upon it, and any purchase money paid shall be forfeited.

No person under eighteen years of age can hold land under conditional purchase.

PASTORAL LEASES.

Leases of pastoral lands within the several divisions are granted on the following terms:—In the South-West Division, in blocks not less than 3000 acres, at a rental of £1 per thousand per annum. In the Gascoyne and North-West Divisions, in blocks of not less than 20,000 acres, at a rental of 10s. per thousand per annum; in the Eucla Division, in blocks of not less than 20,000 acres, at a rental of 10s. per thousand per annum for all that portion of the division situated to the westward of a north line from Point Culver, and 5s. per thousand per annum for the remaining portion of the division; in the Eastern Division, in blocks of not less than 20,000 acres, at a rental of 2s. 6d. per thousand per annum for the first seven years, and 15s. for each of the remaining years of the lease; in the Kimberley Division, in blocks of not less than 50,000 acres when on a frontage, and not less than 20,000 acres when no part of the boundary is on a frontage, at a rental of 10s. per thousand per annum.

In any case where land applied for is shut in by other holdings, and does not contain the minimum area fixed by the regulations, a lease may be granted for a lesser quantity.

A pastoral lease gives no right to the soil or to the timber, except for fencing or other improvements on the lands leased, and the lands may be reserved, sold, or otherwise disposed of by the Crown during the lease.

Any pastoral lessee upon being deprived by the Commissioner of the use of any land held under pastoral lease shall, subject to the provisions of the Land Regulations, receive fair value for all improvements on the land of which he has been deprived ; in the event of the land being selected from his lease under conditional purchase, he is entitled to claim from the conditional purchaser fair value of any lawful improvements on or appertaining to the land applied for, and for severance ; the value of the improvements to be ascertained by arbitration as prescribed by Clause 108 of the Land Regulations. All pastoral leases expire on 31st December, 1907.

Reduction of Rent for Stocking—Any lessee in the Kimberley Division, or in that part of the Eucla Division westward of a north line from Point Culver, may have a reduction of one-half the rental due under the regulations, if within fourteen years from the 1st day of January, 1887, he have in his possession, within the division, 10 head of sheep or one head of larger stock for every thousand acres leased.

Penalty for Non-Stocking—A penalty of double rental for the remaining portion of the lease is imposed, except in the South-West Division, if the lessee has not, within seven years, complied with the conditions as to stocking.

160 ACRES GRANTED FREE.

Free Homestead Farms.

Under "The Homesteads Act, 1893," and Amending Act, 1894, any person who is the sole head of a family, or a male 18 years of age or over, and who does not already hold over 100 acres of land, may apply for any Crown land which has been surveyed and thrown open for selection in the South-Western Division of the colony, or in the Eastern and Eucla Divisions, if situated within 40 miles of a railway, as a free homestead farm, subject to the undermentioned conditions :—

Application in either case must be made on the prescribed form, accompanied by a fee of £1. On approval an occupation certificate is issued, within six months from the date of which the selector shall take personal possession of the land, and shall reside thereon for at least six months during each of the first five years of occupancy.

In certain cases, of illness or for other valid reasons, absence may be allowed, and forfeiture waived.

Within two years a habitable house must be erected of not less than £30 value ; or £30 expended in clearing and cropping ; or two acres of orchard or vineyard properly prepared and planted. Within five years one-fourth of the land must be substantially fenced, and one-eighth cleared and cropped. Within seven years the whole must be fenced, and at least one-fourth cleared and cropped.

At the end of seven years, if all the conditions have been fulfilled, a Crown grant may be obtained on payment of survey and Crown grant fees, but if the conditions are not carried out, the land is forfeited.

The Crown grant may be obtained after twelve months' residence if the required improvements have been made, and on payment of 5s. per acre, together with the fees referred to in preceding paragraph.

A homestead farm cannot be mortgaged or transferred until all conditions entitling the holder to a Crown Grant have been fulfilled.

The holder of a homestead farm may hold other land under existing Land Regulations.

Any person holding land, not exceeding 100 acres, and residing upon such land, may obtain a homestead farm from any Crown lands adjoining his holding, subject to all the preceding conditions except that of residence, which in that case may be performed upon his former holding in lieu of on the homestead farm.

SECOND AND THIRD CLASS LAND MAY BE SELECTED AS HOMESTEAD LEASES.

Homestead Leases.

Under Part II. of "The Homesteads Act, 1893," leases of second or third class land are granted, called homestead leases, but which are really another form of conditional purchases.

The area of a homestead lease shall not be less than 1,000 acres, or more than 3,000 acres in second class land, nor less than 1,000 acres, nor more than 5,000 acres in third class land.

The lease is for a term of 30 years, dating from the 1st January preceding the date of application.

The rent for third class lands is 1d. per acre per annum for the first 15 years of the lease, and 2d. per acre per annum for the remaining period of 15 years, and for second class lands 2d. and 3d. per acre per annum respectively.

The conditions are as follows:—The lessee shall pay one half the cost of survey, in five yearly instalments; within six months from the date of the approval of his application, he shall take possession of the land either by himself or by an agent, and for the next five years, for at least nine months in every year, reside upon the land.

Within two years from the 1st January or July, as the case may be, preceding the date of the approval of his application, he shall fence in at least half of the land, and within the next two years shall fence in the remainder.

During every year of his lease, from the sixth to the fifteenth year, both inclusive, he is required to expend in improvements on the land comprised in his lease, if second class land, an amount equal to 8d. per acre, and if third class land, an amount equal to 5d. per acre for the whole area comprised in his lease.

Any excess of moneys expended during one year shall be carried forward to the credit of the sum required to be expended in the succeeding year or years.

The following shall be deemed improvements:—Sub-division, clearing, cultivating, grubbing, draining, ringbarking, tanks, dams, wells, and any other work upon the land which increases or improves its agricultural or pastoral capabilities.

If the land is not surveyed, the conditions shall date from the date of survey, instead of from the date of the lease.

At the expiration of his lease, if all the conditions have been complied with, the Crown grant of the land may be obtained on payment of the prescribed fee.

If at any time during the continuance of the lease, on proof that he has paid the prescribed rent and survey fees, and that he has complied with the conditions of residence, and that he has fenced the land on the surveyed boundaries, and has expended on prescribed improvements, in addition to the cost of such fencing, a sum equal to the aggregate rents payable in respect of the lease for the last 25 years of the term, and that the improvements so made are in good order and condition, and has paid to the Minister the difference between the aggregate amount of rents then already paid in respect of the lease and the value of all the lands comprised therein, calculated at the rate of 6s. 3d. per acre, if the land is second class, and 3s. 9d. if third class, the lessee shall, upon payment of the prescribed fee, be entitled to a Crown grant of the land comprised in his lease.

No transfer of a homestead lease shall be approved until the lease has been in existence for five years.

RENTS

All land rents are calculated from 1st January to 31st December, and are payable in advance to the Collector of Land Revenue, Perth, or at the various resident magistrates' offices throughout the colony, on or before the 1st March.

The rent on leases and licenses applied for during the year shall be calculated from the 1st day of the quarter preceding the application (except in the case of poison leases and homestead leases, for which a full year's rent must always be paid).

In the event of the lessee not paying his rent on the 1st day of March, he is subject to a fine of 5 per cent. for the first month, 10 per cent. for the second, 15 per cent. for the third, and 20 per cent. for the fourth month, after which, if the rent and fine be still unpaid, the lease or license shall be forfeited.

During the month of January in each year a complete list is published of all leases and licenses, showing the rents or instalments and purchase money due for the current year, and after the 31st of March another list is published, giving particulars of all those on which the rents have not been paid.

APPENDIX III.

AGRICULTURAL BANK ACT, 1894, AMENDMENT ACT, 1896.

Under these Acts advances can be made to holders of land in fee simple special occupation lease, conditional purchase license, or under the provisions of "The Homesteads Act, 1893."

Advances.—Advances are only made for the purpose of effecting improvements, and no advance will be made upon any land which is otherwise encumbered, nor will any security over fee simple lands other than a first mortgage be accepted as sufficient. When the proposed security consists of lands held under special occupation lease or conditional purchase, the applicant will be required to execute an absolute transfer of all his right, title, and interest in the land, together with all improvements thereon, to the manager of the bank ; and when the security consists of land held under the provisions of "The Homesteads Act, 1893," the applicant will be required to transfer his interest to the Crown.

Form of improvements.—Advances are made for the purpose of effecting either one or more of the following improvements :—Clearing, cultivating or ploughing, ringbarking, fencing, draining, wells of fresh water, reservoirs, buildings, and any other form of improvement which, in the opinion of the manager, will increase the agricultural or pastoral capabilities of the land.

Proportion of value of proposed improvements to be advanced.—In cases where, in the opinion of the manager, ample security is offered, *three-fourths* of the fair estimated value of the proposed improvements may be advanced, but *one-half* is the proportion generally allowed.

Mode of payment of advances.—All advances are paid proportionately as the improvements are effected, *i.e.*, applicants can have "draws" while the work is proceeding.

Rate of interest.—Interest at the rate of five pounds per centum per annum will be charged upon all advances, and must be paid half-yearly, on the 30th June and 31st December in each year. Interest is only charged on the actual amount of the advance made, or such proportion of the loan or loans as the applicant may have drawn.

Fees payable.—All applications must be accompanied by a valuator's fee equivalent to 1 per cent. of the amount applied for. No charge is made for the purpose of drawing any mortgage or transfer.

Repayment of loans.—All loans have a currency of thirty years. During the first five years simple interest only is payable. At the expiration of five years from the 1st day of January or the 1st day of July, as the case may be, following the date of every advance, the borrower shall begin to repay the principal sum at the rate of one-fiftieth of the amount half-yearly, until the whole has been paid. Provided always, that the advance may be repaid sooner than is herein provided, and in larger instalments, at the option of the borrower. All applications must be for one or more of the following sums, viz. :—£50, £75, £100, and extending up to £800.

Further particulars and application forms may be had on application to the Manager, Agricultural Bank, Perth.

APPENDIX IV.

THE STOCK ACTS AND REGULATIONS.

WHAT THE LEGISLATURE HAS DONE—THE ACTS AND REGULATIONS.

(Compiled at the request of the Bureau, by Mr. Norman Malcolm, Stock Inspector.)

The Western Australian Government has succeeded, in the drafting of its Stock Acts and Regulations, in doing that which the Parliaments of the various other colonies have failed in, viz., in presenting them to the public in so concise and concentrated a form as to make the intention of the Legislature patent to all. The law relating to diseases in stock is consolidated (with the exception of scab in sheep) in "The Stock Diseases Act, 1895," which gives the Governor in Council almost unlimited range of power in the control of stock matters. As an instance of this the Governor may, by Order in Council, published in the *Government Gazette*, prohibit or permit the introduction or importation of stock from time to time from any country or place, while he may exempt any stock from the operation of certain provisions of the act. But even here the power does not rest, for the Governor may make, vary, alter or revoke from time to time, any regulations made under the act, and, in cases of special emergency, any such Order of the Governor in Council may be transmitted by telegraph. The penalty for wilfully disobeying, contravening or omitting to observe any such order is limited to £100.

OUTBREAKS OF DISEASE.

In the event of a stock-owner discovering any infectious or contagious disease or if he suspects the presence of any such disease among his stock, within 24 hours he must give written notice to the nearest inspector, at the same time isolating the infected or suspected animals until the arrival of the inspector. Should the inspector deem it necessary, he may, on finding such diseased stock, or stock affected with tick, or lice, or any parasite, seize and place them in quarantine, where they are treated as the inspector may direct, at the owner's expense, until clean ; or if the disease is of such a nature that, in the opinion of the inspector, such stock should be destroyed, the inspector shall report the case to the Minister controlling the department, who may order the destruction of the stock at the owner's expense. In the latter case the carcases of any infected stock must be destroyed by the owner, his agent or servant, within 24 hours, in default of which either is liable to a penalty not exceeding £100, while a similar penalty may be inflicted if the carcase of an infected animal is cast into any stream, river, pond, lake or other water.

A special clause is also inserted in the Regulations under "The Stock Diseases Act, 1895," for dealing with animals suspected of being affected with tuberculosis, by which an inspector may subject such animal to the tuberculine test.

IMPORTED STOCK.

All stock imported into Western Australia from the Australian colonies and New Zealand, excepting Queensland and the Northern Territory of South Australia, must be accompanied by the certificate of a government inspector at the port of shipment, that they are clean, in addition to the declaration of the owner or breeder, or the manager of the farm or station from which they come, that the stock were free from disease at the time of their departure, and had been, to the best of his belief, for three months preceeding shipment. On being accompanied by such documents, if passed by an inspector at the port of landing, all stock are admitted into the colony without further restriction, with the exception that cattle not intended for immediate slaughter have to perform 30 days' quarantine, and camels, 40 days.

In the cases of Queensland and the Northern Territory of South Australia, all stock are prohibited from entering the colony on account of the tick pest, with the exception of working bullocks, and horses used in the carrying trade, and for station work between the Northern Territory and Western Australia.

In addition to the declaration of an owner and breeder, stock coming to Western Australia from outside the Australasian colonies and New Zealand must be accompanied by the certificate of a qualified veterinary surgeon, to the effect that when the stock were placed on board the vessel conveying them they were in a sound and healthy condition, entirely free from any disease, or any indication of it. They must also perform the following periods of quarantine :—

Sheep	14 days.	Pigs	30 days
Horses	14 ,,	Dogs	6 months
Cattle	30 ,,	Goats, Deer, Liama, and Antelopes	30 days
Camels	40 ,,		

But if during the period of quarantine any sign of disease be exhibited, then, if not ordered to be destroyed, they shall be kept in quarantine for any period an inspector may direct, and treated as he deems necessary.

All cattle and sheep intended for immediate slaughter may be landed on the permit of an inspector, and removed to such place as he may direct, and shall not be again removed alive without his written permission.

No stock can be landed in the colony at any port other than Fremantle, Albany, Champion Bay, Cossack, Eucla, and Esperance, unless first inspected and passed by an inspector of stock at one of these ports.

With regard to the introduction of cattle by land into Western Australia, it is provided that notice must be given in writing to the inspector of stock in the district into which they are to be introduced seven days prior to the introduction of the cattle, and a certificate, signed by a qualified Government inspector, must be produced, showing that the cattle were successfully inoculated against pleuro-pneumonia immediately prior to their departure for Western Australia.

The crossing place for stock in the Kimberley district, via South Australia, is that portion of the Ord station where the Negri crosses the border of the two colonies, and in the Eucla district the crossing is where the present road from South Australia enters this colony, about eight miles north-east from Eucla.

An inspector can prevent any stock he considers diseased from entering Western Australia, and any person introducing such diseased stock is subject to a penalty of five pounds per head.

In connection with those stations where land is held by one owner in South Australia and Western Australia adjoining, a special regulation provides, that, on the written authority of the Chief Inspector of Stock, stock may be brought over the border from the owner's land in South Australia to his land in Western Australia for a specified period within six calendar months, for the purpose of depasturing. Stock entering the colony by reason of such permission do not become "introduced" stock, and they are not allowed to be on any other land in Western Australia than that mentioned in the permission.

No imported stock, nor the effects of any attendant, shall be landed or introduced into the colony until the same shall have been examined by an inspector, and a permit granted by him for their landing, this permit to be exhibited when required by an inspector or member of the police force. No fodder put on board any vessel for the use of imported stock, or any fittings used therewith, can be landed on any account.

The fees for examination of stock imported from beyond the Australasian colonies are as follows :—

	£	s.	d.
For horses and cattle, 1 to 5, ...	0	10	0
For every additional head, ...	0	1	0
For sheep, swine, and goats, 1 to 50, ...	0	10	0

			£	s.	d.
For every additional head,	...	...	0	0	1
For each dog, ...	...	...	0	10	0
For camels, 1 to 3,	...	...	0	10	0
For every additional head, each,	...	...	0	1	6

The fees for examination of stock imported from the Australasian colonies and New Zealand are :—

			£	s.	d.
For horses and cattle, 1 to 3,	...	...	0	10	0
For every additional head,	...	...	0	0	6
For sheep, swine, and goats, 1 to 50,	...	...	0	5	0
For every additional head,	...	...	0	0	1
For each dog, ...	...	...	0	2	6
For camels, 1 to 3,	...	...	0	10	0
For every additional head, each,	...	...	0	1	6

Provided that the whole amount of fees for inspection of any one shipment by the same owner shall not exceed £5.

QUARANTINING OF STOCK.

The chief quarantine ground for stock in the colony is at Woodman's Point, a distance of seven miles from Fremantle, where excellent accommodation has been provided for the care of animals while performing the prescribed periods of isolation. A special quarantine ground has, however, been declared for camels, to the north of Fremantle, and dogs imported from any place outside the Australian colonies and New Zealand must be quarantined either at Rottnest Island, near Fremantle, or Geake's Island, near Albany.

The Governor may at any time proclaim temporary quarantine stations anywhere within the province, either for the purpose of isolating imported or diseased stock. In the case of the latter, the period of quarantine is left entirely to the discretion of the inspector.

All expenses in connection with the quarantining of stock must be paid by the owner, and in default of payment the stock may be sold by the inspector to recover the cost of quarantine.

"THE DROVING ACT, 1894."

Under this Act all stock become "travelling stock" which are taken or driven, or are about to be taken or driven, to any place more than forty miles from the run upon which such stock were depastured previous to starting.

If the actual proprietor of any stock intends to act as drover he shall provide himself with a way bill in the form of the first schedule, and sign it in the presence of a subscribing witness ; but whenever any person other than the proprietor, or the proprietor's manager, acts as drover, he must be provided with a delivery note in the form of the second schedule. Should the way bill or delivery note be accidentally lost or destroyed, the drover shall apply in writing to the nearest justice of the peace, stock inspector, or officer in charge of a police station, for an interim way bill or delivery note, as the case may be ; such interim note or way bill only to be granted on the production of satisfactory proof of the loss of the original, and the payment of £1. Any justice of the peace, constable, inspector of stock, or authorised agent of an inspector, or the owner of any run through which stock are travelling, may inspect the way bill or delivery note and the stock. Any proprietor, manager, or drover failing to comply with the requirements of this section shall, on conviction, be liable to a penalty not exceeding £50.

All travelling horses, asses, mules, camels, and horned cattle shall be moved not less than eight miles per diem, and sheep or goats not less than five, or when through enclosed lands seven miles per diem towards their destination. If it can be satisfactorily proved to any justice of the peace or inspector, or the occupier of the run through or along which such stock are travelling, that, owing to some unforseen cause the compliance with the foregoing provisions would entail unnecessary hardship, they may be varied as deemed expedient.

Drovers must give notice before allowing stock to approach within ten miles of the head station or homestead on any run, not less than 24 hours, nor more than three days prior to the approach. Notice is not necessary in the case of horses, camels, or cattle *bona-fide* used for saddle, packing, or draught, or where the number of horses, camels, cattle, or other stock (excepting sheep) shall not exceed 20. Any drover neglecting to give the notice required by this section shall be summarily punished before two justices of the peace, and is liable on conviction to a penalty not exceeding £50.

Travelling sheep have to be branded with the letter T on the rump, the brand to be at least three inches in length. The penalty for neglecting to comply with this section does not exceed £20.

If any travelling sheep or cattle are brought back to the run from which they started to travel, or to any run in the same district, the proprietor of such sheep or cattle shall pay to the inspector of stock in the district, or to the resident magistrate, a travelling charge at the rate of twopence per hundred sheep, and twopence per ten head of cattle per mile for the whole distance travelled from the time they started, provided always that the provisions of this section shall not apply to any sheep or cattle being *bona-fide* moved to another run of the some owner for change of pasture, nor to any sheep or cattle sent *bona-fide* to, and returning unsold from market.

FIRST SCHEDULE.

"DROVING ACT, 1894."

Proprietor's Way Bill.

I, , do solemnly and sincerely declare that I am the actual proprietor [*or* the manager of the proprietor] of the stock named in the schedule below, consisting of *(number in words) (description of s ock)* which are travelling from
to by

Signed at this day of 18

Before me, (Signature)

(Witness) Proprietor *or* Manager.

SCHEDULE REFERRED TO ABOVE.

Number.	Description of Stock.	Brands or Marks of Stock.

(Signature)

Superintendent *or* Proprietor.

SECOND SCHEDULE.

"DROVING ACT, 1894."

Delivery Note.

This is to certify that I have this day delivered into the charge of , as my drover, the (*state number in words*) (*description of stock*) mentioned in the schedule below, for the purpose of their being by him to at

Signed at this day of

(Signature)
Proprietor *or* Manager.

Before me,
(Witness)

SCHEDULE REFERRED TO ABOVE.

Number.	Description of Stock.	Brands or Marks.

(Signature)
Proprietor *or* Manager.

THIRD SCHEDULE.

"DROVING ACT, 1894."

Interim Way Bill (*or Delivery Note*).

18 .

It having been represented to me that , the drover of the (*state number in words*) (*description of stock*) belonging to mentioned in the schedule below, has accidentally lost his way bill [*or* delivery note] while travelling from to , this interim way bill [*or* delivery note] is hereby granted to such drover for such stock.

(Signature)
Inspector *or* Officer.

SCHEDULE ABOVE REFERRED TO.

Number.	Description of Stock.	Brands or Marks.

(Signature)
Inspector *or* Officer.

"THE BRANDS ACT, 1881."

The laws regulating the branding of live stock, and providing for the registration of brands, are consolidated in "The Brands Act, 1881," and came into operation on the first day of January, 1882. This act compels every owner of cattle and horses to have a brand, which must be registered, and penalties are provided for neglecting to brand. A justice of the peace may authorise any person to drive in and impound any unbranded cattle above one year old, and horses above two years old, which may be at large in the bush, and these may be sold if unclaimed ; should proof of ownership be established, however, prior to the sale, the property is protected.

Owners of sheep may also register fire and wool brands, and ear marks ; this is not compulsory, but such brands and marks are protected.

Persons convicted of branding stock not their property, or defacing brands on stock, are punished by imprisonment.

SCAB IN SHEEP.

Although no cases of scab have been reported in Western Australia since May, 1895, "The Scab Act, 1891," is still in force, and gives almost unlimited power to the inspectors of sheep. This act provides that the owner must muster his sheep at any time if called upon to do so by an inspector ; that the owner who obstructs an inspector in the exercise of his duties is guilty of an offence ; that a list of diseased flocks must be published every month in the *Government Gazette ;* that at the entrance of every diseased run must be posted the notice :—" Scab on this run "; that notice of infection must be given to the inspector or resident magistrate of a district within forty-eight hours thereafter ; that infected runs must be quarantined ; that flocks must be dipped as often as an inspector shall require and direct ; that infected flocks must be shepherded during the day, and folded at night ; that any infected or stray suspected sheep may be destroyed ; that the carcases of such sheep must be destroyed ; that the cost of carrying out the act be defrayed by owners by contribution fixed each year by the Governor in Council ; that every owner must furnish a return to the resident magistrate of the number of sheep owned by him in that district each year ; that when a district has been declared clean for three years it shall be exempt from the yearly contribution ; that no owner shall be entitled to compensation for sheep destroyed under the authority of the act ; that an inspector may burn, without compensation, any enclosures or yards in which he may know infected sheep to have been within the preceeding six months.

APPENDIX V.

STOCK AND CROP RETURNS, 1896.

The following returns for the year 1896 were compiled by the Registrar-General, and give the number of stock and acreage under crop in Western Australia for that year.

LIVE STOCK.

SOUTH-WESTERN DIVISION.

Magisterial District.	Horses.	Cattle.	Pigs.	Sheep.	Goats.	Camels.	Donkeys.
Victoria	6,043	12,985	3,726	256,435	821	4	1
Toodyay	6,004	7,397	8,508	136,284	345	—	—
Swan	2,261	4,492	1,880	8,518	74	—	1
York	3,128	1,664	5,474	121,600	104	—	2
Perth	2,811	2,416	1,109	826	11	96	2
Fremantle ...	1,222	1,397	1,418	1,036	18	247	1
Murray	1,850	3,542	934	9,076	201	—	—
Wellington ...	2,799	10,088	1,392	17,121	3	—	—
Williams	3,717	1,960	2,669	141,862	72	—	—
Blackwood ...	1,547	8,266	454	23,870	7	—	—
Sussex	1,885	6,446	656	452	1	5	2
Plantagenet ...	1,547	2,342	746	59,344	10	—	—
Total ...	34,814	62,995	28,966	776,424	1,667	352	9

NORTH AND NORTH-WESTERN DIVISION.

Magisterial District.	Horses.	Cattle.	Pigs.	Sheep.	Goats.	Camels.	Donkeys.
Gascoyne... ...	2,575	7,572	67	380,141	540	3	11
Ashburton ...	1,872	5,495	116	189,277	4	—	—
Roebourne ...	3,975	7,759	145	347,270	32	6	1
Pilbarra	2,544	14,774	114	160,552	174	4	3
Broome	152	5,424	206	3,650	107	—	18
West Kimberley...	980	30,772	52	179,364	224	10	20
East Kimberley ...	512	6,071	137	—	221	—	1
Kimb'y. Goldfields	1,791	52,457	25	43	494	8	4
Total ...	14,402	130,324	862	1,260,297	1,796	31	58

Central and Southern Divisions.

Magisterial District.	Horses.	Cattle.	Pigs.	Sheep.	Goats.	Camels.	Donkeys.
Broad Arrow	332	5	27	76	71	9	4
Murchison ...	1,429	4,327	154	52,766	22	416	1
East Murchison ...	476	2	—	397	9	23	—
Yalgoo	914	1,510	39	103,497	158	—	—
Coolgardie ...	1,929	143	595	1,594	110	2,557	7
N.E. Coolgardie ...	434	11	2	324	15	44	—
East Coolgardie ...	589	30	61	96	12	2	—
North Coolgardie	827	50	102	1,272	31	430	10
Yilgarn	166	7	57	267	110	9	—
Dundas	197	34	56	450	4	29	1
Esperance ...	1,018	355	233	51,516	22	32	14
Total ...	8,311	6,474	1,326	212,255	564	3,601	37
Grand total for the colony ...	57,527	199,793	31,154	2,248,976	4,027	3,984	104

GRAIN CROPS.

South-Western.

North and North-Western.

District.	Maize.
Broome	1

Central and Southern.

District.	Wheat.
Dundas	400
Esperance	6
Total	406

District.	Wheat.	Maize.	Oats.	Barley.	All other Grain Crops.
Victoria	7,031½	2	478	1,141½	—
Toodyay...	9,693½	1	484¼	354	44
Swan	1,078½	0½	107	6½	80
York	6,820¾	—	126½	163¼	—
Perth	20	1½	10	—	28
Fremantle	25½	0½	20	12	11
Murray	219¼	—	60	11	17½
Wellington	820	16	234¾	7½	45
Williams	4,917	—	157	201	7
Blackwood	339¼	4¾	39	2¼	3
Sussex	108	3	26	—	101
Plantagenet	26½	—	10½	4	3½
Total	31,082½	29¼	1,753	1,903	340

GRAPE VINES AND OTHER FRUIT CROPS.

SOUTH-WESTERN.

District.	Grape Vines. Wine Making.	Grape Vines. Table.	Grape Vines. Not Bearing.	Other Fruit Crops. Productive.	Other Fruit Crops. Not Bearing.	Miscellaneous Crops.	Total Area under Crops.
Victoria	11	14¼	6½	25½	27½	4	20,364½
Toodyay... ...	317	130¼	262	131	161	—	28,283½
Swan	381¼	154¾	194½	164	223¼	—	7,204½
York	24¼	53¼	30¼	114½	98	1	23,124¾
Perth	14¼	33¼	111¼	76	140¾	9½	1,237¼
Fremantle ...	7¾	38¾	19¼	38¾	26	—	945½
Murray	82½	15¾	42	82¼	130½	7	3,203
Wellington ...	46¾	50	51	116¼	165	—	6,676½
Williams ...	30½	35¾	55¼	105½	105½	—	15,513¾
Blackwood ...	16¼	12½	10	97½	102	—	1,597¼
Sussex	8¼	3	3¾	23	34½	—	1,601½
Plantagenet ...	½	2¾	14¾	53¼	143½	—	1,337½
Total ...	937¼	544½	810½	1,027½	1,357¼	25	111,089½

NORTH AND NORTH-WESTERN.

District.	Wine Making.	Table.	Not Bearing.	Productive.	Not Bearing.	Miscellaneous Crops.	Total Area under Crops.
Broome	...	...	½	2¾	2¾	...	9¾
Gascoyne ...	...	...	...	...	...	...	29
Ashburton ...	...	...	...	...	...	...	...
Pilbarra	...	...	...	...	...	...	32
East Kimberley...	...	...	...	...	...	...	10
Kimb. Goldfields	...	...	...	...	3	...	4½
Roebourne ...	...	...	...	½	½	...	7
Total ...	...	...	½	1	6¼	...	92¼

CENTRAL AND SOUTHERN.

District.	Wine Making.	Table.	Not Bearing.	Productive.	Not Bearing.	Miscellaneous Crops.	Total Area under Crops.
Esperance ...	1¼	...	...	...	...	...	151
Murchison ...	...	...	...	...	...	...	5½
Dundas	...	...	...	...	...	...	400
Total ...	1¼	...	...	...	...	...	556½
Grand total							111,738¼

To which must be added :—

Acreage under permanent artificially sown grasses ...	4,043½ acres.
New ground cleared during season and prepared for next season	24,945¼ acres.
Land in fallow	22,561¼ acres.

HAY, GREEN FORAGE, AND ROOT CROPS.

South-Western.

District.	Hay.	Green Forage.	Potatoes.	Onions.	All other Root Crops.	Market Gardens.
Victoria ...	11,505¼	56	36¾	2¾	4½	35½
Toodyay ...	16,607	70	9¾	2	8¼	8¼
Swan	4,635½	107	24½	1¾	1	43½
York	15,639½	8	17¾	1¼	—	19½
Perth	645	40	33¾	6½	14½	53
Fremantle ...	632¾	10½	50	10¾	8¾	33¼
Murray ...	2,370	67¼	26½	0¼	28¾	42½
Wellington ...	4,742	118½	239¼	6¾	12½	3½
Williams ...	9,738	125	3¾	1¾	28	2¾
Blackwood ...	904	16	36	2	4	6¼
Sussex	967	178	104	8¾	5	28
Plantagenet ...	874½	19	136	14½	16½	17
Total ...	69,260½	815¼	718¾	59	132¾	293½

North and North-Western.

District.	Hay.	Potatoes.	Onions.	Market Gardens.
Gascoyne	10	—	—	19
Pilbarra	30	—	—	2
Kimberley Goldfields	—	1	0½	—
Roebourne	—	—	—	6
Broome	—	—	—	5
East Kimberley ...	—	—	—	10
Total ...	40	1	0½	42

Central and Southern.

District.	Hay.	Potatoes.	Onions.	Market Gardens.
Esperance ...	136	0½	—	—

APPENDIX VI.

RAILWAYS.

TABLE OF PASSENGER FARES.

EASTERN RAILWAY.

From Fremantle Station to the following Stations and Stopping Places.

Height above sea level.	Distance Miles.	STATIONS.	SINGLE. 1st Class.	SINGLE. 2nd Class.	RETURN. 1st Class.	RETURN. 2nd Class.
			s. d.	s. d.	s. d.	s. d.
5·00	...	Fremantle	...	...	...	...
5·00	½	Fremantle, East	0 3	0 2	0 5	0 3
20·50	1¼	Fremantle, North	0 3	0 2	0 5	0 3
34·35	4	Cottesloe (late Bullen's)	0 7	0 4	0 11	0 6
51·35	6	Claremont	0 11	0 6	1 4	0 9
78·40	9¾	Subiaco	1 6	0 10	1 2	1 3
37·60	11½	Perth, West	6 7	0 11	1 5	1 5
35·05	12	Perth, Central	1 9	1 0	2 6	1 6
34·10	12½	Perth, East	1 11	1 1	2 10	1 8
52·70	16¼	Bayswater	2 4	1 4	3 6	2 0
		Junction to Racecourse.				
25·40	20	Guildford	2 11	1 8	4 5	1 6
41·65	22	Midland Junction	3 3	1 10	4 10	1 9
...	24	24-Mile Siding	3 6	2 0	5 3	3 0
202·15	25	Greenmount	3 8	2 1	5 6	3 2
479·80	27¼	Darlington	4 0	1 4	6 0	3 6
685·45	29	Smith's Mill	4 4	1 6	6 6	3 9
925·10	31	Mahogany Creek	4 8	1 9	7 0	4 2
1018·65	34	Mundaring	5 2	3 1	7 9	4 8
971·50	35	Sawyer's Valley	5 4	3 2	8 0	4 9
898·75	37	Lion Mill	5 8	3 4	8 6	5 0
1005·75	41¼	Chidlow's Well	6 4	3 9	9 6	5 8
980·60	44	Lacey's No. 3 Mill	6 10	4 1	10 3	6 2
723·95	48	Byfield's Mill	7 6	4 6	11 3	6 9
905·00	54	Coates'	8 6	5 2	12 9	7 9
964·90	58	Mount Baker	9 2	5 7	13 9	8 5
778·20	62	Clackline	9 10	6 0	14 9	9 0
		Junction for Newcastle.				
609·65	67	Mokine	10 8	6 6	16 0	9 9
519·50	72	Spencer's Brook	11 6	7 0	17 3	10 6
		Junction for Northam.				
533·10	75	Muresk	12 0	7 4	18 0	11 0
534·05	77	Woodside	12 4	7 6	18 6	11 3
547·90	82	Gregson's	13 2	8 1	19 9	12 2
547·90	82	Burges's Siding	13 2	8 1	19 9	12 2
576·90	84	Mackie's Crossing	13 6	8 3	20 3	12 5
579·50	89½	York	14 4	8 9	21 6	13 2
610·65	96	Hicks'	15 9	9 9	23 8	14 8
607·00	99	Gilgering	16 0	9 10	24 0	14 9
639·40	103	Dale Bridge	16 8	10 3	25 0	15 5
646·55	107	Edward's Crossing	17 4	10 8	26 0	16 0
647·00	110	Beverley	17 10	11 0	26 9	16 6
		Racecourse Branch, Junction Station.				
...	17	Bayswater	...	...	...	...
...	...	Racecourse	...	...	...	...
		Newcastle Branch, Junction Station.				
778·20	62	Clackline	...	...	...	...
715·00	43	Coorinja	11 8	7 1	17 6	10 8
470·30	76	Newcastle	12 2	7 5	18 3	11 2

TABLE OF PASSENGER FARES—*Continued.*

Height above sea level.	Distance. Miles.	STATIONS.	SINGLE. 1st Class.	SINGLE. 2nd Class.	RETURN. 1st Class.	RETURN. 2nd Class.
		Northam Branch, Junction Station.	s. d.	s. d.	s. d.	s. d.
519·50	72	Spencer's Brook	...	16 11	...	...
...	73	Springhill Siding	11 8	18 3	17 6	10 8
...	76	Burlong Pool	12 2	19 9	18 3	11 2
490·80	78	Northam	12 6	...	18 9	11 6
490·00	79	East Northam	12 10	23 11	19 3	11 9
643·00	87	Grass Valley	14 2	25 4	21 3	13 0
695·00	101	Meckering	16 4	26 5	24 6	15 0
735·00	115	Cunderdin (Boorabbin)	18 10	27 9	28 3	17 6
774·00	129	Tammin	21 4	28 10	32 0	19 9
809·00	144	Kellerberrin	23 8	30 7	35 6	21 11
831·00	154	Doodlekine	25 2		37 9	23 5
822·00	166	Hines Hill R	27 4	34 4	41 0	25 5
1048·00	180	Merredin	29 6	36 4	44 3	27 5
1133·00	194	Burracoppin	31 10	38 10	47 9	29 8
1291·00	219	Boddalin (29-Mile Rocks)	...	...	...	...
1211·00	234	Parker's Road	38 6	7 1	57 9	35 11
1163·00	248	Southern Cross	40 10	7 5	61 3	38 0
...	266	Yellowdine	42 5	7 8	63 8	39 0
...	278	Karalee	44 7	7 10	66 11	41 8
...	289	Koorarawalyee	46 3	8 8	69 5	43 3
...	306	Boorabin }	49 1	10 0	73 8	45 11
...	321	Woolgangie }		11 7		
...	342	Bullabulling	55 1	13 2	82 8	51 6
...	360	Coolgardie	58 3	14 7	87 5	54 6
...	384	Kalgoorlie	62 3	15 7	93 5	58 3

TABLE OF PASSENGER FARES—*Continued.*

GREAT SOUTHERN RAILWAY.

Fares from Beverley.

Height above sea level	Distance Miles.	STATIONS.	SINGLE. 1st. Class.	SINGLE. 2nd. Class.	RETURN. 1st. Class.	RETURN. 2nd. Class	Return Tickets available
			s. d.	*s. d.*	*s. d.*	*s. d.*	
8	241½	Albany	40 0	30 0	60 0	45 0	1 month
47	230½	Marbellup	38 6	28 11	57 9	43 5	"
432	214¾	Hay River	35 10	26 11	53 9	40 5	"
830	203½	Mount Barker	34 0	25 6	51 0	38 3	"
802	191	Kendenup	31 10	23 11	40 7	35 11	"
946	181¼	Tenderden	30 2	22 8	45 3	34 0	"
835	175	Cranbrook	29 4	22 0	44 0	33 0	"
803	108½	Pootenup	28 0	21 0	42 0	31 6	"
867	154	Tambellup	25 8	19 3	38 6	28 11	"
1073	138¾	Broomehill	23 2	17 5	34 9	26 2	"
1022	126¾	Katanning	21 2	15 11	31 9	23 11	"
923	113½	Yaraben	19 0	14 3	28 6	21 3	"
814	102½	Lime Lake	17 2	12 11	25 9	19 5	"
840	91¾	Wagin Lake	15 8	11 9	23 6	17 8	7 days
935	83¾	Buchanan River	14 0	10 6	21 0	15 9	"
1014	73¼	Wolwolling	12 2	9 2	18 3	13 9	"
1114	63½	Narrogin	10 8	8 0	16 0	12 0	"
1109	54½	Cuballing Pool	9 2	6 11	13 9	10 5	"
962	42½	Popanying Pool	7 0	5 3	10 6	7 11	"
73	31¾	Pinjelly	5 4	4 0	8 0	6 0	"
786	19½	Brookton	3 4	2 6	5 0	3 9	"
667	7¾	Mount Rokeby	1 4	1 0	2 0	1 6	"
647	..	Beverley					
		Torbay Branch.					
15	..	Torbay Junction					
442	17	Torbay Mills	0 10	0 8	1 3	1 0	

SOUTH-WESTERN RAILWAY.

From Perth to the following Stations.

Height above sea level	Distance Miles.	STATIONS.	SINGLE. 1st. Class.	SINGLE. 2nd. Class.	RETURN. 1st. Class.	RETURN. 2nd. Class.
			s. d.	*s. d.*	*s. d.*	*s. d.*
68·10	3	Burswood	0 6	0 4	0 9	0 6
18·45	8	Cannington	1 4	0 10	2 0	1 3
102 00	16	Kelmscott	2 8	1 8	4 0	2 6
181 40	19	Armadale	3 2	2 0	4 9	3 0
170 65	21	Wongong	3 6	2 2	5 3	3 3
128 40	29	Jarrahdale Junction	4 10	3 0	7 3	4 6
106 85	34	Serpentine	5 8	3 7	8 6	5 5
146 90	..	North Dandalup				
27·00	54	Pinjarrah	19 0	5 8	13 6	8 6
66·70	62	Coolup	10 4	6 6	15 6	9 9
111 55	70	Drake's Brook	11 8	7 4	17 6	11 0
108·90	76	Wagerup	12 8	7 11	19 0	11 11
89·55	80	Cookernup Brook	13 4	8 4	20 0	12 6
120 10	86	Harvey	14 4	9 0	21 6	13 6
69·25	93	Mornington	15 6	9 8	23 3	14 6
96·20	99	Brunswick	16 6	10 4	24 9	15 6
34·50	102	Collie	17 0	10 8	25 6	16 0
44·30	107	Waterloo	17 10	11 2	26 9	16 9
27 60	111	Picton Junction	18 6	11 7	27 9	17 5
10 50	115	Bunbury	19 2	12 0	28 9	18 0

TABLE OF PASSENGER FARES—*Continued.*

SOUTH-WESTERN RAILWAY.

Height above sea level.	Distance Miles.	STATIONS.	SINGLE. 1st. Class.	SINGLE. 2nd. Class.	RETURN. 1st. Class.	RETURN. 2nd. Class.
		Bunbury and Donnybrook Branch.	*s. d.*	*s. d.*	*s. d.*	*s. d.*
10·50	..	Bunbury				
26·75	5	Picton Junction	0 8	0 5	1 0	0 8
89.00	9	Dardanup	1 8	1 1	2 6	1 8
122·15	16	Boyanup Junction	2 8	1 8	4 0	2 6
208·35	25	Donnybrook	4 4	2 9	6 6	4 2
		Bunbury, Boyanup, and Busselton Branch				
10·50	..	Bunbury				
122·15	16	Boyanup	2 8	1 8	4 0	2 6
48·50	27	Coolingup	4 6	2 10	6 9	4 3
49·60	32	Ludlow	5 4	3 4	8 0	5 0
20·05	36	Wonnerup	6 0	3 9	9 0	5 8
6·50	42	Busselton	7 0	4 5	10 6	6 8

NORTHERN RAILWAY.

Table of Passenger Fares from Geraldton to the following Stations :—

Height above sea level.	Distance Miles.	STATIONS.	SINGLE. 1st. Class.	SINGLE. 2nd. Class.	RETURN. 1st. Class.	RETURN. 2nd. Class.
		Geraldton and Walkaway.	*s. d.*	*s. d.*	*s. d.*	*s. d.*
5·30	..	Geraldton				
84·30	6	Race Course	1 0	0 8	1 6	1 0
70·75	12¼	Bootenal	2 0	1 3	3 0	1 11
95·60	15½	Wiley's	2 8	1 8	4 0	2 6
90·90	19¾	Walkaway	3 4	2 1	5 0	3 2
		Geraldton and Northampton.				
5·30	..	Geraldton				
48·35	4	Chapman	0 8	0 5	1 0	0 8
116·25	10	White Peak	1 8	1 1	2 6	1 8
391·15	19	Taylor's	3 2	2 0	4 9	3 0
461·60	21	Oakabella	3 6	2 2	5 3	3 3
446·30	25	McGuire	4 2	2 7	6 3	3 11
363·70	27	Mercy's	4 6	2 10	6 0	4 3
354·00	28	Ryan's	4 8	1 11	7 9	4 5
409·25	30	Bower's	5 0	3 2	7 6	4 9
560·85	34	Northampton	5 8	3 7	8 6	5 5
		Geraldton and Mullewa.				
5·30	..	Geraldton				
421·35	8	Mullewa Junction	1 4	0 10	2 0	1 3
797·80	13	Moonyoonooka	2 7	1 8	3 11	2 6
818·10	19	No. 1 Tank	4 1	2 8	6 2	4 0
713·70	22	Newmerracarra	4 10	3 2	7 3	4 9
799·05	34	Greenough River Crossing	7 10	5 2	11 9	7 9
903·25	65	Mullewa	15 7	10 4	23 5	15 6

The following table gives an approximate idea of the present general rates of freight on the Goverment railways :—

Hay, Chaff, Potatoes, Flour, Oats, and other Cereals, Fruit, Farm and Garden Produce.

50 miles.	75 miles.	100 miles.	150 miles.	200 miles.
Rates per ton.				
s. d.	s. d.	s. d.	s. d.	s. d.
6 8	8 9	10 10	14 0	17 1
Bricks, Coal, Sand, Gravel, Lime, Limestone, and Road Metal.				
s. d.	s. d.	s. d.	s. d.	s. d.
5 0	6 1	7 1	9 2	11 3
Aerated Waters, Butter, Cheese, Honey, Ice, Soap, Beef, Pork, Ale and Stout, Bacon, Hams, and Candles.				
s. d.	s. d.	s. d.	s. d.	s. d.
13 4	17 6	21 8	27 11	34 2

TABLE OF PASSENGER FARES—*Continued.*

MIDLAND RAILWAY.

Height above sea level.	Distance. Miles.	STATIONS.	SINGLE. 1st. Class.	SINGLE. 2nd. Class.	RETURN. 1st. Class.	RETURN. 2nd. Class.
			s. d.	*s. d.*	*s. d.*	*s. d.*
41·65		Midland Junction				
	10	Upper Swan	1 9	1 3	2 6	1 9
165·84	23	Muchea	3 9	2 9	5 9	4 3
	30	Chandala	5 0	3 9	7 6	5 6
329·46	40	Gingin	6 9	5 0	10 0	7 6
602·22	48	Mooliabeenee	8 0	6 0	12 0	9 0
	52	Callalla	8 9	6 6	13 0	9 9
	61	Wannamal	10 0	7 6	15 0	11 6
568·64	69	Mogumber	11 6	8 6	17 3	13 0
	76	Gillingarra	12 9	9 6	19 0	14 3
	86	Koogan	14 3	10 7	21 6	16 0
665·56	98	Moora	16 3	12 3	24 6	18 3
	110	Coomberdale	18 3	13 9	27 6	20 6
852·17	122	Watheroo	20 3	15 3	30 6	22 9
	140	Marchagee	23 3	17 6	35 0	26 3
866·27	152	Coorow	25 3	19 0	38 0	28 6
880·81	169	Carnamah	28 3	21 0	42 0	31 6
	183	Three Springs	30 6	22 9	45 9	34 3
860·35	195	Arrino	32 6	24 3	48 9	36 6
	207	Yandanook	34 6	25 9	51 9	38 9
503·33	217	Minginew	36 0	27 0	54 3	40 9
	223	Lockier	37 0	27 9	55 9	41 9
	230	Strawberry	38 3	28 9	57 3	43 0
159·37	241	Irwin	40 0	30 0	60 0	45 0
	243	Yaradino	40 6	30 3	60 9	45 6
30·10	253	Dongara	42 0	31 6	63 3	47 6
	268	Bokara	44 9	33 6	67 0	50 3
	274	Greenough Road	45 9	34 3	68 6	51 3
90·90	277	Walkaway	46 3	34 6	69 6	51