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SPOLIA ZEYLANICA.

NOUVEAUX CHIRONOMIDES (TENDIPEDIDAE) DE CEYLAN.

(*Avec 9 figures dans le texte.*)

Par J. J. Kieffer, Doct. phil. nat. (Bitsch).

Toutes les espèces qui sont décrites dans ce travail proviennent de l'île de Ceylan et sont conservées à l'Indian Museum de Calcutta. Elles m'ont été envoyées en communication par Monsieur N. Annandale. On remarquera que, dans l'île de Ceylan comme dans les Indes, le groupe *Orthocladius* est faiblement représenté ; nous n'avons que deux espèces à y rapporter pour Ceylan, tandis qu'il y en a vingt pour le groupe *Tendipes* (*Chironomus*). En Europe c'est l'inverse qui a lieu.

I.—CULICOIDINÆ.

1.—Genus **Forcipomyia**, Megerlé in Meigen 1818, Walker 1856 (*Ceratopogon*, Meigen 1818, non Meigen 1803).

1. Métatarse postérieur plus court que l'article suivant..Subg. *Prohelea*, n. subg.
— Métatarse postérieur plus long que l'article suivant..Subg. *Forcipomyia*, Meg.

1.—Subgenus Prohelea, n. subg.

(*Ceratopogon*, Meigen 1818, non Meigen 1803 ; *Helea*, Speiser 1910, non Meigen 1800).

1. Partie dorsale des tibias avec des écailles dressées et pétiolées.. 1. *F.* (*P.*) *ornaticrus*, n. sp.
— Tibias sans écailles..2.
2. Ailes assombries, avec un point blanc et cinq grandes taches blanchâtres..2. *F.* (*P.*) *tetraclada*, n. sp.
— Ailes sans tache, mesonotum à pubescence jaune et assez dense..3.
3. Patte avec des poils dressés, épars et 3–4 fois aussi longs que son épaisseur..4.
— Pattes sans longs poils dressés..3. *F.* (*P.*) *calcarata*, n. sp.
4. Ailes avec une petite tache blanche située un peu en arrière de l'extrémité du cubitus..4. *F.* (*P.*) *noctivaga*, n. sp.
— Ailes sans tache blanche..5. *F.* (*P.*) *theobromae*, n. sp.

(1) Forcipomyia (Prohelea) ornaticrus, n. sp.

♀ Brun noir ; balanciers blancs, front, face, scape, dessous du thorax, hanches, pattes et lamelles anales jaunâtres, le reste du

thorax jaune brunâtre ou brun noir, pleures toujours plus claires, flagellum brunâtre. Yeux largement confluents au vertex, bouche allongée, subcylindrique, suçoir proéminent sous forme de fine pointe. Article 2e des palpes long et élargi, les trois autres courts. Articles 2–9 des antennes coniques, de moitié plus longs que gros, à verticille dense et plus long que l'article, 10–13 plus minces, 10–14 cylindriques, deux fois aussi longs que gros, faiblement poilus. Thorax très convexe, pas plus long que haut, lisse, brillant, à poils jaunâtres et épars. Scutellum bordé de soies longues et assez denses. Ailes densément poilues, sombres, avec une tache blanc jaunâtre couvrant l'extrémité du radius et du cubitus, une bande enfumée longe le bord depuis l'extrémité du cubitus jusqu'au dernier quart alaire, cubitus soudé au radius dans sa moitié proximale, aboutissant au bord à peine avant le milieu de l'aile, radius aboutissant au bord vis à vis du milieu du cubitus, discoïdale bifurquée bien avant la transversale, ses deux rameaux également distants de la pointe alaire, bifurcation de la posticale située à peine distalement de l'extrémité du cubitus. Pattes parsemées de poils plus longs que leur grosseur et dressés, tous les tibias ont en outre, sur la partie dorsale, des écailles pétiolées, spatuliformes, noires, à peine plus courtes que la grosseur du tibia ; fémurs et tibias deux fois aussi gros que les tarses, métatarse de toutes les pattes plus court que le 2e article, aux tarses postérieurs le 2e article est de moitié plus long que le métatarse, quatre fois aussi long que gros, 3–5 graduellement raccourcis, le 5e deux fois aussi long que gros, à peine plus court que le 4e, crochets arqués fortement, grêles, aussi longs que la pelote. Abdomen déprimé, ayant sa plus grande largeur au milieu, à poils épars. Corps trapu. Taille : 1, 8 mm.—Peradeniya, 9. VIII. 1910 et 11. VIII. 1910.

(2) Forcipomyia (Prohelea) tetraclada, n. sp.

♀ Brun noir ; dessous du thorax et abdomen bruns, balanciers blancs, pattes jaune blanchâtre, extrémité des fémurs, base des tibias et anneau avant l'extrémité des tibias noirs, tarses noirs avec l'extrémité des articles jaune ; parfois le thorax et l'abdomen sont brun roux, le dessous toujours plus clair. Antennes à articles 3–9 subglobuleux ou un peu transversaux, 10–14 cylindriques et guère plus longs que gros, sauf le 14e. Mesonotum mat, subglabre. Scutellum bordé de longs poils pâles. Ailes enfumées avec un point blanc à l'extrémité du cubitus et 5 grandes taches blanchâtres, dont l'une au quart distal, touchant le bord antérieur, les 4 autres au bord postérieur, l'une entre les deux rameaux de la discoïdale, l'autre entre la discoïdale et la posticale, la 3e entre les deux rameaux de la posticale, la 4e entre le rameau proximal de la posticale et le lobe alaire qui demeure assombri ; ces taches ne sont séparées l'une de l'autre que par les 4 stries brunes qui longent les 4 nervures aboutissant au bord postérieur ; les poils sont blancs sur les taches, assombris sur le reste de la surface alaire ; cubitus soudé au radius, aboutissant au milieu de l'aile, bifurcation de la discoïdale située sous la transversale ou proximalement, bifurcation de la posticale vis à vis de l'extrémité du cubitus, le rameau distal deux fois aussi long que le proximal. Fémurs et tibias un peu grossis, à poils épars, dressés, deux fois aussi longs que la grosseur des pattes, éperon velu, tarses sans longs poils, métatarse postérieur à peine plus court que le 2e article, le 5e deux fois aussi long que gros, à peine plus court que le 4e, empodium égal aux crochets. Abdomen déprimé, 2½ fois

aussi long que large, d'égale largeur, mat, très faiblement pubescent, avec quelques longs poils sur les côtés des deux derniers segments. Taille : 1, 5 mm.—Peradeniya, 23. V. 1910.

(3) Forcipomyia (Prohelea) calcarata, n. sp.

♀ Brun noir, mat ; balanciers blancs, pleures, hanches et pattes jaune clair, tiers distal des fémurs postérieurs et base des tibias postérieurs bruns. Articles antennaires 2–9 globuleux, les 5 derniers allongés, cylindriques, chacun 2–3 fois aussi long que le 9e. Mesonotum avec une pubescence jaune et assez dense. Ailes densément poilues, assombries, cubitus et radius juxtaposés et noirs, le radius dépassant à peine la moitié du cubitus, qui dépasse un peu le milieu de l'aile, la fourche intercalée est indiquée par un vestige, bifurcation de la discoïdale distante proximalement de la transversale, qui est oblique, bifurcation de la posticale située vis à vis de l'extrémité du radius. Tibia antérieur avec un peigne et un éperon lisse, glabre et aussi long que la grosseur du tibia, tibia postérieur avec un double peigne, fémurs et tibias assez gros, métatarse antérieur égalant presque la moitié du 2e article, tous deux avec des spinules ventrales, assez denses, aussi longues que la grosseur des articles, 3e article égal au 1er, 4e un peu plus court que le 3e, trois fois aussi long que gros, 5e deux fois aussi long que gros, empodium égal aux crochets. Abdomen allongé, déprimé, sublinéaire, faiblement pubescent, sans longs poils. Taille : 1, 8 mm.—Peradeniya, 2. VI. 1910.

(4) Forcipomyia (Prohelea) noctivaga, n. sp.

♀ Noir ; sternum et ventre brunâtres, hanches et pattes jaunâtres, balanciers blancs, antennes brunâtres. Articles antennaires 3–9 subglobuleux, un peu transversaux, 10–14 subcylindriques, à peine plus longs que gros. Mesonotum densément pubescent de jaune. Ailes assombries, surtout le long du bord jusqu'au tiers distal, avec une tache blanche et petite, située à l'extrémité du cubitus, lequel atteint le milieu de l'aile, radius juxtaposé au cubitus, bifurcation de la discoïdale distante proximalement de la transversale, bifurcation de la posticale à peine distante distalement de l'extrémité du cubitus. Pattes avec des poils dressés, épars et longs ; métatarse postérieur plus court que le 2e article, 5e article égal au 4e, pas plus long que gros, empodium égal aux crochets. Abdomen déprimé, un peu plus large au milieu qu'aux deux extrémités. Taille : 1 mm.—Peradeniya, 19. IX. 1910, capturé la nuit á la lumière.

(5) Forcipomyia (Prohelea) theobromae, n. sp.

Fig. 1.

♂♀ Brun noir ; balanciers blanc sâle ou noirâtres, pattes brunes, hanches, extrémité distale des fémurs, des tibias et des articles tarsaux jaunâtres. Bouche allongée ; palpes composés de 4 articles, dont le 2e est élargi et le plus long. Panache brun noir, composé de verticilles dont les soies se touchent à leur base et atteignent le milieu du 14e article, les articles 2–10 des antennes du mâle subglobuleux, avec deux appendices sétiformes et hyalins, 11e égal aux 4 précédents réunis, globuleux à sa base qui est munie d'un long verticille, 12e et 13e cylindriques, chacun égal à la moitié du 11e, renflé en calote à la base, qui est munie d'un verticille, le 14e un peu plus long que le 13e, terminé par un stylet. Chez la femelle, les articles

2e et 9e sont subglobuleux, 4–9 subconiques et à peine plus longs que gros, 2–9 avec un verticille de soies un peu distantes à leur base et presque deux fois aussi longues que l'article, au-dessus du verticille, se trouve de chaque côté, un appendice linéaire, hyalin, obtus, à peine incurvé et un peu plus court que le verticille; articles 10-14 subcylindriques, un peu plus longs que les précédents, sans verticille et sans appendices, le dernier un peu plus long que le 13e, terminé par un stylet (Fig. 1).

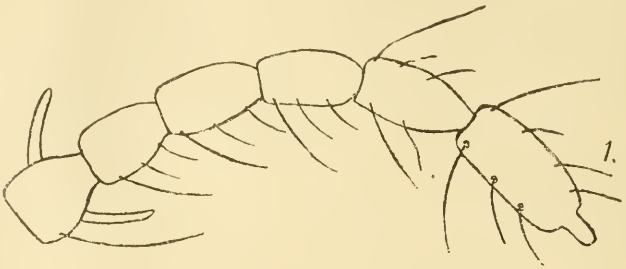


Fig. 1.—*Forcipomyia* (*Prohelea*) *theobromae*, n. sp.—Six derniers articles des antennes de la femelle.

Mesonotum avec une pubescence jaune et assez dense. Ailes assombries, densément poilues, sans tache blanche, radius juxtaposé au cubitus dont il atteint presque l'extrémité, cubitus aboutissant un peu avant le milieu de l'aile, bifurcation de la discoïdale distante proximalement de la transversale, bifurcation de la posticale située sous l'extrémité du cubitus, rameau distal pas deux fois aussi long que le proximal. Pattes grosses, avec des poils dressés, 3–4 fois aussi longs que la grosseur des pattes, 2e article du tarse postérieur de moitié plus long que le 1er, 3e égal au 1er, 4e à peine plus long que le 5e, qui est presque deux fois aussi long que gros, empodium égalant les crochets qui sont fortement arqués. Abdomen deux fois aussi long que large, sublinéaire. Taille : 1, 5 mm.—Peradeniya, 6. VI. 1910, 7 ♂ et 7 ♀ obtenus de larves vivant dans les fruits décomposés du Cacaotier (Theobroma cacao, L.).

2.—Subgenus Forcipomyia, Megerlé.

1. Ailes densément poilues . . 1. *F. longicalcar*, n. sp.
— Ailes glabres, tiers distal et bord postérieur faiblement poilus . . 2. *F. semipilosus*, n. sp.

(1) Forcipomyia longicalcar, n. sp.

Fig. 2.

♀ Brun noir, sternum et ventre roux, balanciers sombres, hanches et pattes jaune clair, antennes brun sombre. Face renflée comme d'ordinaire, 2e article des palpes élargi; bouche longue. Articles antennaires 2–9 subglobuleux, à verticille deux fois aussi long que l'article, 10–14 subcylindriques, chacun presque deux fois aussi long que gros. Mesonotum avec une pubescence dense et grisâtre. Ailes (Fig. 2) hyalines, densément poilues, intervalle des poils ponctué,

cubitus aboutissant au bord au milieu de l'aile, radius aboutissant vis à vis du milieu du cubitus, paraissant soudé au cubitus étant vu à la loupe, presque juxtaposé au cubitus et uni à lui avant son extrémité étant vu au microscope, transversale oblique, discoïdale bifurquée sous la transversale, posticale bifurquée vis à vis de l'extrémité distale du cubitus. Partie dorsale des pattes à poils dressés et

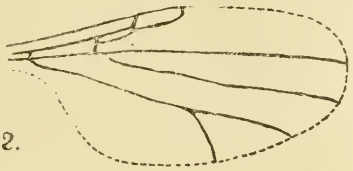


Fig. 2.—*Forcipomyia longicalcar*, n. sp.—Aile.

très longs, tibias postérieurs avec un peigne et un éperon qui atteint le milieu du métatarse, métatarse postérieur un peu plus long que le 2e article, le 4e de moitié plus long que gros, 5e pas plus long que gros et dépourvu de longs poils, crochets en demi-cercle, un peu plus longs que l'empodium. Abdomen déprimé, un peu plus large au milieu. Taille : 1 mm.—Peradeniya, 20. V. 1910.

(2) Forcipomyia semipilosus, n. sp.

♀ Tête et scape jaunes, flagellum brun, thorax et hanches roux, balanciers blancs, abdomen noir. Corps subglabre. Yeux confluents, face renflée, bouche longue, 2e article des palpes long mais non élargi. Articles antennaires 2–9 globuleux, leur verticille égal à l'article, 10–14 allongés, chacun 3–4 fois aussi long que le 9e. Mesonotum glabre, lisse et brillant. Ailes hyalines, glabres, faiblement poilues au tiers distal et le long du bord postérieur, cubitus parallèle au bord, atteignant presque le quart distal de l'aile, sa partie distale quatre fois aussi longue que sa partie proximale, cellule radiale distale trois fois aussi longue que la proximale, radius très rapproché du cubitus, presque parallèle à lui, sa 1e partie égale à la transversale, double de la 2e, transversale un peu oblique, bifurcation de la discoïdale à peine distante distalement de la transversale, bifurcation de la posticale située vis à vis de l'extrémité du radius. Pattes sans longs poils, les poils pas plus longs que la grosseur des pattes, tibias postérieurs à double peigne, le métatarse postérieur égalant les trois articles suivants réunis, le 4e à peine plus long que gros, 5e presque deux fois aussi long que le 4e, empodium égalant les crochets. Abdomen déprimé, ellipsoïdal, égal au reste du corps. Taille : 1, 8 mm.—Peradeniya, 4, VII. 1910.

2.—Genus **Culicoides**, Latr.

1. Ailes enfumées avec 2 taches noires et de nombreuses taches blanches..1. *C. ceylanicus*, n. sp.

— Ailes hyalines, avec une minime tache blanche sur la transversale et à l'extrémité distale du cubitus..2. *C. bilobatus*, n. sp.

(1) Culicoides ceylanicus, n. sp.

♀ Brun noir ; balanciers blancs, abdomen brun roux, pattes blanchâtres, fémurs postérieurs sauf la base, un large anneau avant le milieu des tibias postérieurs et l' extrême bout distal du tibia brun noir. Articles du flagellum subglobuleux, un peu transversaux, les

derniers guère plus longs. Mesonotum subglabre. Ailes enfumées, à soies microscopiques; une tache noire, sur le bord antérieur, englobe le radius et le cubitus; une tache noirâtre, sur le bord antérieur, est plus rapprochée du cubitus que de la pointe alaire; les autres taches sont blanches, l'une va transversalement du bord antérieur jusqu' au delà de la nervure transversale, une autre transversale borde distalement la tache noirâtre, les autres taches sont circulaires et encore plus petites, l'une est située au bord antérieur entre la tache noire et la tache noirâtre, une autre entre la tache noirâtre et la nervure discoïdale, deux entre les rameaux de la discoïdale, vis à vis de la tache noirâtre, une entre les rameaux de la posticale, deux entre l'extrémité du pétiole de la posticale et la discoïdale, une sous l'extrémité de ce pétiole, 4 à 6 taches très petites sont alignées sur le bord inférieur; radius et cubitus juxtaposés, aboutissant un peu distalement du milieu de l'aile, transversale oblique, longue, un peu plus courte que le radius, bifurcation de la discoïdale située sous la transversale ou un peu distalement d'elle, bifurcation de la posticale à peine distante proximalement de l'extrémité du cubitus. Pattes sans longs poils, métatarse postérieur égalant les trois articles suivants réunis, muni de spinules ventrales denses, 4e article pas plus long que gros, 5e égal au 3e, deux fois aussi long que gros, empodium nul, crochets avec des soies basales. Abdomen ellipsoïdal, presque glabre. Taille : 0, 8 mm.—Peradeniya, 25, VI. 1910.

(2) Culicoides bilobatus, n. sp.

♂ Noir; pattes brunâtres. Yeux séparés au vertex et glabres, bouche longue, terminée en pointe, élargie de chaque côté, près de l'extrémité, en un lobe triangulaire; 2e article des palpes non élargi, aussi long que le 3e et le 4e réunis. Panache brun noir, articles antennaires 2–11 globuleux, les trois derniers cylindriques, chacun 2–3 fois aussi long que le 9e, le 2e ayant, outre le verticille, deux soies aussi longues que l'article, 3–11 avec un seul appendice subuliforme, étalé et un peu plus long que l'article. Ailes hyalines, avec des soies microscopiques, une minime tache blanche couvre la nervure transversale, une autre est située à l'embouchure du cubitus; radius et cubitus à peine séparés, subégaux, dépassant distalement le milieu de l'aile, transversale très oblique, bifurcation de la posticale distante proximalement de la transversale, bifurcation de la posticale située vis à vis de l'embouchure du cubitus, la fourche intercalée est assez bien marquée. Pattes minces, tibias sans éperon mais avec un double peigne, aussi longs que le tarse, métatarse égalant les trois articles suivants réunis, 4e article deux fois aussi long que gros, 5e de moitié plus long que le 4e et beaucoup plus mince, crochets avec des soies basales, empodium nul. Abdomen déprimé et presque linéaire. Taille : 1 mm.—Peradeniya, 14. V. 1910.

3.—Genus **Dibezzia.**

Dibezzia ceylanica, n. sp.

♀ Noir brillant et subglabre; antennes sauf l'extrémité qui est assombrie, face, un large anneau avant l'extrémité des fémurs et moitié distale des tibias roux, les deux premiers articles tarsaux blanc jaunâtre, balanciers blanc sâle. Yeux séparés au vertex par une ligne, face proéminente en bosse, bouche longue et pointue. Article 2e des palpes non épaissi, long et cylindrique. Article 2e des antennes un peu plus long que le 3e, 3–9 subcylindriques, à peine

renflés au milieu, chacun 3–4 fois aussi long que gros, 10–14 cylindriques, chacun presque trois fois aussi long que le 9e, tous les articles du flagellum ont des soies éparses, non en verticille, 3–4 fois aussi longues que la grosseur des articles. Mesonotum densément pointillé, avec une pointe à peine distincte, située au milieu du bord antérieur. Ailes hyalines, radius égalant le quart du cubitus, qui est rapproché du bord et parallèle à lui, son extrémité proche de la pointe alaire, aussi rapprochée que le rameau inférieur de la discoïdale, bifurcation de la discoïdale distante proximalement de la transversale, qui est perpendiculaire, posticale bifurquée vis à vis de la transversale, rameau inférieur de l'anale oblitéré. Fémurs cylindriques et inermes, les pattes antérieures sont plus courtes que les autres, mais leur fémur est encore plus long que la hauteur du thorax, tibia antérieur égal au tarse, métatarse un peu plus court que les quatre articles suivants réunis, 4e article pas plus long que gros, 5e égalant les deux précédents réunis, avec 4–5 paires de spinules noires et obtuses ; aux pattes intermédiaires le tibia et le tarse sont conformés comme aux antérieures ; tibia postérieur plus long que le tarse, avec un peigne double, métatarse plus long que les quatre articles suivants réunis, 2e article double du 3e, 4e un peu plus court que le 3e, trois fois aussi long que gros, 5e un peu plus court que les deux précédents réunis, avec 4–5 paires de spinules noires ; crochets tarsaux des pattes antérieures égaux, simples, égalant les deux tiers de l'article ; aux tarses intermédiaires et postérieurs, les crochets sont inégaux et bifides, le grand crochet égale les deux tiers de l'article et est 3–4 fois aussi long que son lobe inférieur, le petit crochet ne dépasse guère le quart du grand, et est deux fois aussi long que son lobe basal. Pétiole de l'abdomen brillant, cylindrique, 2–3 fois aussi long que gros, égalant les cinq articles suivants, ceux-ci deux fois plus larges que le pétiole, faiblement convexes dorsalement, plus fortement ventralement, à peine incurvés, sans longs poils. Taille : 3, 5 mm.—Peradeniya, 9. VIII. 1910.

4.—Genus **Stilobezzia**, Kieff.

1. Article 5e des 4 tarses antérieurs armé, à sa base, d'une paire de 2 fortes spinules noires..1. *S. festiva*, Kieff. var, *Scutellaris*, n. var.

— Article 5e des tarses inerme..2. *S. inermipes*, n. sp.

(1) Stilobezzia festiva, Kieff. var. scutellaris, n. var.

♀ Thorax brun roux, scutellum et abdomen verts, les tergites ont un point noir au milieu et un de chaque côté, front, face, antennes, hanches et pattes jaune clair, balanciers noirs à tige rousse, un trait sur le dessous des fémurs postérieurs, extrême bout distal de tous les fémurs et de tous les tibias brun ou noir. Bouche pointue et longue, yeux confluents, article 2e des palpes long mais non élargi. Article 2e des antennes presque double du 3e, 3–9 subcylindriques, 2–3 fois aussi longs que gros, à poils disposés sans ordre et égalant l'article, 10–14 à poils plus denses, chaque article 2–3 fois aussi long que le 9e. Thorax glabre, brillant, un peu plus long que haut ; scutellum avec six soies noires. Ailes hyalines, avec deux petites taches brunes, dont l'une couvre la nervure transversale, l'autre va de l'extrémité du cubitus jusque près de la discoïdale ; le reste comme chez le type. Pattes comme chez le type ; le grand crochet tarsal est simple, le petit a une dent basale. Taille : 1, 8 mm.—Peradeniya, 24. V. 1910.

(2) Stilobezzia inermipes, n. sp.

♀ Brun ; tige des balanciers, hanches et pattes testacées, sauf l'extrême bout des tibias et des quatre premiers articles tarsaux, palpes noirs, bord postérieur des tergites blanchâtre. Yeux séparés au vertex par une ligne, bouche longue et pointue, 2e article des palpes non grossi. Articles antennaires 2–5 subcylindriques, deux fois aussi longs que gros, 6–9 plus minces et graduellement allongés, le 9e trois à quatre fois aussi long que gros, 10e plus long que le 9e mais plus court que le 11e, les cinq derniers plus fortement allongés et filiformes. Mesonotum glabre et brillant. Ailes blanchâtres, avec de petites taches brunes, dont l'une couvre la transversale, l'aréole et l'extrémité du radius, l'autre est située sur l'extrémité renflée du cubitus, une tache transversale touche le bord antérieur et se trouve entre le cubitus et la pointe alaire, les autres sont ponctiformes, peu distinctes et sont situées à l'extrémité de chaque rameau de la discoïdale et du rameau distal de la posticale ; pétiole de la discoïdale pas plus long que la nervure transversale qui est perpendiculaire et un peu plus longue que le bout distal du radius ; bifurcation de la posticale distante proximalement de la transversale. Pattes et crochets tarsaux comme chez *festiva* sauf que le 5e article tarsal de toutes les pattes est dépourvu de spinules. Abdomen sublinéaire, plan dessus et dessous. Taille : 2 mm.—Peradeniya, 2. VI. 1910.

5.—Genus **Bezzia.**

Bezzia indecora, n. sp.

♂ Noir ; base des fémurs et les deux bouts des tibias brunâtres, tarses blanchâtres, balanciers noirâtres. Articles antennaires 2–9 globuleux ou un peu transversaux, pubescents, sans longs poils, 10–14 subcylindriques, chacun deux fois le 9e. Thorax mat, subglabre ; scutellum avec quelques soies. Ailes hyalines, cubitus 2½ fois aussi long que le radius, atteignant le tiers distal de l'aile, bifurcation de la discoïdale oblitérée, bifurcation de la posticale vis à vis de l'extrémité du radius. Pattes subglabres, les antérieures un peu plus courtes que les autres, fémurs antérieurs avec 2 spinules dans leur moitié distale, tibia postérieur égalant les deux premiers articles tarsaux réunis, trois premiers articles tarsaux avec 2 rangées de soies bulbeuses sur le dessous, le métatarse égalant les 4 articles suivants réunis, 4e article tronqué obliquement au bout, guère plus long que gros, 5e égal aux deux précédents réunis, crochets de toutes les pattes simples, égaux et petits. Abdomen cylindrique, beaucoup plus mince que le thorax. Taille : 1, 2 mm.—Peradeniya, 14. V. 1910.

II.—PELOPIINÆ (*Tanypinae*).

Genus **Pelopia,** Meigen 1800.

Synonymes : *Tanypus*, Meigen 1803 ; *Isoplastus*, Skuse 1889 ; *Ablabesmyia*, Johannsen 1905.

1. Pattes blanches, annelées de noir..1. *P. annulatipes*, n. sp.
— Pattes blanchâtres, non annelées..2. *P. pallidipes*, n. sp.

(1) Pelopia annulatipes, n. sp.

♀ Rouge ; antennes, sauf le dernier article qui est brun noir, balanciers et pattes blanc de lait, extrémité des fémurs avec un

mince anneau brunâtre, tibias noirs à l'extrémité et avec deux anneaux noirs, dont l'un près de la base, l'autre au milieu, métatarse avec un anneau au milieu et l'extrémité noirs, articles tarsaux 2 et 3 noirs à l'extrémité, 4e et 5e brun noir ; mesonotum cendré, avec trois bandes longitudinales brunes, dont la médiane est raccourcie en arrière, les latérales en avant. Articles du flagellum subglobuleux, verticilles 3–4 fois aussi longs que la grosseur des articles, appendices subuliformes hyalins, atteignant le milieu de l'article suivant, article terminal aussi long que les trois précédents réunis et deux fois aussi gros, terminé par un stylet, son verticille est remplacé par une seule longue soie. Ailes densément poilues, blanches, avec trois ou quatre taches noires et de nombreuses taches enfumées ; une tache noire est transversale et s'étend de la base du cubitus, englobant les deux nervures transversales, jusque dans la bifurcation de la posticale, une seconde est à l'extrémité du radius une troisième, presque ponctiforme, à l'extrémité du cubitus, en outre les deux nervures transversales situées à la base alaire sont bordées de noir ; le tiers distal de la posticale et la moitié distale des deux rameaux de la posticale sont bordés d'une teinte enfumée, une bande oblique et enfumée relie entre elles ces trois nervures à l'endroit où commence leur bordure enfumée ; une grande tache irrégulière est située sur le lobe anal ; en outre une teinte légèrement enfumée longe tout le bord postérieur de l'aile. Cubitus presque double du radius, son extrémité trois fois plus éloignée de la pointe alaire que la discoïdale, seconde transversale à peine distante proximalement de la 1e, aboutissant à la base arquée du rameau supérieur de la posticale. Tibia antérieur un peu plus long que le métatarse, articles 4 et 5 subégaux, 3–4 fois aussi longs que gros. Taille : 1, 2 mm.—Peradeniya, 17. V. 1910.

(2) Pelopia pallidipes, n. sp.

♀ Roux clair, antennes et balanciers plus clairs, dernier article antennaire brun noir, pattes blanchâtres, extrémité des fémurs brunâtre, mesonotum blanchâtre, avec trois bandes rousses, dont la médiane est raccourcie en arrière, les latérales en avant. Antennes de 12 articles, les articles du flagellum sont globuleux, le dernier en massue comme chez l'espèce précédente. Ailes densément velues, blanches, extrémité distale enfumée, une large bande transversale enfumée va de l'extrémité du radius jusqu'à l'extrémité du rameau inférieur de la posticale, un espace enfumé entre la posticale et le bord inférieur, depuis la base alaire jusqu'au milieu de la tige de la posticale ; cubitus double du radius, fortement arqué, touchant presque le bord, aboutissant aussi près de la pointe alaire que la discoïdale, transversale bordée de noir, aboutissant à la seconde transversale, qui est reliée à la base arquée du rameau supérieur de la posticale. Abdomen faiblement comprimé, à peine plus long que le reste du corps. Taille : 2 mm.—Peradeniya, 29. V. 1910.

III.—TENDIPEDINÆ (*Chironominae*).

A.—Groupe Tendipes.

Extrémité des tibias intermédiaires et postérieurs avec un anneau noir, crénelé distalement et incomplet ; métatarse antérieur ordinairement plus long que le tibia ; pince du mâle ayant ordinairement

quatre appendices internes. Toutes les espèces décrites ici ont les pulvilles—courts et le cubitus non dépassé par la costale.

1.—Genus **Tendipes,** Meigen 1800 (*Chironomus*, Meigen 1803).

Ailes à surface glabre et à base ressortant sous forme de lobe.

1. Ailes tachetées..2.
— Ailes hyalines, sans tache..7.
2. Ailes noires ou brun noir avec des taches blanches, pattes annelées; 5e article antennaire avec un col chez la femelle..1. *T. pretiosus*, n. sp.
— Ailes enfumées avec des taches blanches ou bien ailes blanches avec des taches enfumées ou noires, 5e article antennaire sans col..3
3. Ailes avec trois taches noires et quatre taches enfumées ou bien ailes enfumées, avec des taches noires et blanches..2. *T. sumptuosus*, n. sp.
— Ailes n'ayant que des taches qui sont toutes de même couleur ..4.
4. Ailes enfumées avec cinq grandes taches blanches..3. *T. elatus*, n. sp.
— Ailes blanches avec six à neuf taches enfumées ou noires..5.
5. Ailes à 6 taches noires..5. *T. gloriosus*, n. sp.
— Ailes à 8 ou 9 taches enfumées ..6.
6. Métatarse antérieur deux fois aussi long que le tibia..4. *T. superbus*, n. sp.
— Métatarse antérieur d'un tiers plus long que le tibia..6. *T. ceylanicus*, Kieff.
7. Noir brillant, métatarse antérieur blanc pur, 3–6 premiers articles des quatre autres tarses blanc sâle..7. *T. albiforceps*, Kieff.
— Coloration autre ..8
8. Abdomen vert au moins en partie..9.
— Abdomen sans couleur verte..11.
9 Nervure transversale noire ; abdomen brun noir avec un étroit bord postérieur des segments vert. 9. *T. perichlorus*, n. sp.
— Nervure transversale pâle ; abdomen vert en entier ou jaune avec un large bord antérieur et postérieur et les côtés verts..10.
10. Article 5e du tarse antérieur 8–10 fois aussi long que gros, mesonotum avec une bande noire unique, abdomen jaune, et vert ..8. *T. allothrix*, n. sp.
— Article 5e du tarse antérieur 3–4 fois aussi long que gros, mesonotum à trois bandes ferrugineuses, abdomen vert en entier 10. *T. chlorogaster*, n. sp.
11. Bandes du mesonotum ferrugineuses et bordées de noir..11. *T. nigromarginatus*, Kieff.
— Bandes du mesonotum autrement colorées..12.
12. Antennes de la femelle de 7 articles, mesonotum avec 3 bandes noires, 5e article des tarses antérieurs 8–10 fois aussi long que gros..13. *T. heptatomus*, n. sp.
— Autennes de 6 articles chez la femelle..13
13. Mesonotum avec deux bandes noires..14. *T. hexatomus*, n. sp.
— Mesonotum sans bande ou à trois bandes..14.
14. Antennes blanches avec les nodosités noires ou brun noir, corps brun noir, mesonotum sans bande..15. *T. variicornis*, n. sp.
— Antennes sauf les deux premiers articles brunes, corps jaune, mesonotum avec trois bandes noires..12. *T. fuscitarsis*, n. sp.

(1) TENDIPES PRETIOSUS, n. sp.

Fig. 3.

♂♀ Noir mat ; flagellum jaunâtre ou brunâtre, panache gris, balanciers blanchâtres, pattes annelées de blanc jaunâtre, tous les fémurs avec deux petits anneaux situés l'un avant le milieu et l'autre avant l'extrémité ; tibias antérieurs avec un petit anneau avant l'extrémité ; tibias intermédiaires avec deux anneaux, dont l'un, très petit, est situé près de la base, l'autre, égal à la moitié du tibia, atteint presque le bout distal ; tibias postérieurs avec deux petits anneaux, dont l'un est très près de la base, l'autre un peu au-dessus du milieu ; tarses blancs, extrême bout distal du métatarse et, aux pattes antérieures, le tiers distal du 2e article et la moitié distale des trois suivants noirs, aux pattes intermédiaires et postérieures les articles 4 et 5 et au métatarse postérieur, encore un anneau près de la base sont noirs ; les 4 premiers tergites du mâle ont une tache médiane, elliptique d'un blanc pruineux. Bouche un peu plus courte que la tête, yeux arqués, séparés de leur largeur au

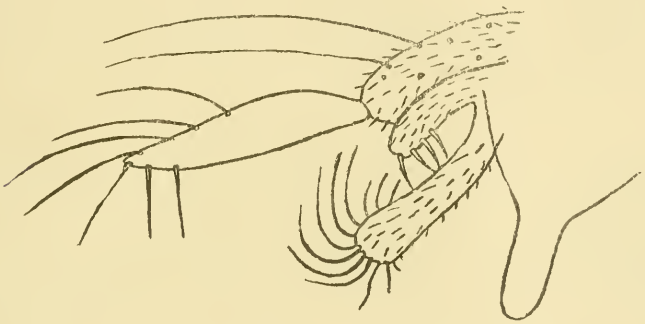


FIG. 3.—*Tendipes pretiosus*, n. sp.—Pince.

vertex ; palpes longs, composés de quatre articles. Antennes de la femelle de six articles, dont le 2e est subcylindrique, deux fois aussi long que gros et a deux verticilles, 3–5 grossis au milieu, terminés par un col plus court qu'eux, avec un verticille 3–4 fois aussi long que leur grosseur, 6e article subfusiforme, de moitié plus long que le 5e, terminé par trois longues soies. Antennes du mâle de 14 articles, 2–13 aussi longs que gros et avec deux verticilles, 2e et 3e à verticille unique, 2–4 un peu grossis, 14e de moitié plus long que 2–13 réunis. Ailes noires ou brun noir, avec des taches blanches, dont une grande et circulaire occupe la pointe alaire et est traversée par un trait brun qui borde la discoïdale, elle a pour limites l'extrémité du cubitus et du rameau supérieur de la posticale ; une mince bande noire, transversale et sinueuse sépare cette tache distale de deux grandes taches transversales, dont l'une est située au bord antérieur, l'autre au bord postérieur ; deux petites taches circulaires et séparées seulement par le cubitus, sont situées près de la nervure transversale, l'une entre le bord et le cubitus, l'autre entre le cubitus et la discoïdale ; vis à vis d'elles, au bord postérieur, se trouve une grande tache formée par la réunion de trois petites et englobant la moitié distale du rameau inférieur de la posticale, en s'étendant du bord postérieur de l'aile jusqu'au rameau supérieur de la posticale ; parfois le bord antérieur de l'aile offre encore une tache ponctiforme entre l'extrémité du radius et la tache circulaire ; le tiers proximal de

l'aile est blanc et offre deux petites taches d'un brun noir, dont l'une, transversale, va du bord inférieur jusque près de la tige de la posticale, l'autre, circulaire et plus petite, est située vis à vis de la précédente, entre la tige de la posticale et celle de la discoïdale ; transversale oblique, 2e nervure longitudinale bien plus rapprochée de l'extrémité du cubitus que du radius, aussi près de la pointe alaire que le rameau supérieur de la posticale, cubitus droit, éloigné du bord, aboutissant près de la pointe alaire mais moins près que la discoïdale, bifurcation de la posticale distale de la transversale. Pattes pubescentes, les postérieures avec des poils deux fois aussi longs que l'épaisseur des pattes, fémurs et tibias élargis, métatarse antérieur de la femelle de moitié plus long que le tibia, 4e article double du 5e, qui est 5–6 fois aussi long que gros, empodium filiforme, à longs poils, égal aux crochets, pulvilles très petits, plus courts que le tiers des crochets. Abdomen de la femelle à poils aussi longs que le tiers de la largeur des tergites ; pince du mâle (Fig. 3) noire, lamelle avec une pointe arquée et plus longue qu'elle, article terminal de la pince presque d'égale largeur, tronqué un peu obliquement à l'extrémité, avec des poils épars dans sa moitié basale et 5 soies peu longues, alignées à l'extrémité, les appendices intermédiaires manquent, les internes sont courts, glabres, arqués et subfiliformes dans leur moitié distale. Taille : 2, 5–3 mm.—Peradeniya, 21 V., 2 VI., 11. VI. 1910.

(2) Tendipes sumptuosus, n. sp.

♀ Brun roux ; mésonotum avec trois bandes plus sombres, balanciers blanchâtres, scape, palpes, hanches et pattes blanc brunâtre, fémurs brun clair, avec un large anneau jaunâtre avant leur extrémité (tarses antérieurs brisés). Palpes longs, de 4 articles. Antennes brisées. Mesonotum glabre et luisant. Ailes blanches, avec trois taches noires et quatre taches enfumées ; une tache noire et carrée est située au milieu du cubitus et atteint la discoïdale, la 2e tache noire est située dans la bifurcation de la posticale, la 3e, plus grande, va du milieu de la tige de la posticale jusqu'au bord postérieur ; sur le bord postérieur se trouvent les taches enfumées et irrisées, dont l'une entre la discoïdale et le rameau supérieur de la posticale, l'autre entre les deux rameaux de la posticale, la 3e relie l'extrémité du rameau inférieur de la posticale au lobe alaire, la 4e, éloignée du bord, se trouve entre la bifurcation de la posticale et la discoïdale ; 2e longitudinale indistincte, cubitus non arqué, un peu plus rapproché de la pointe alaire que la discoïdale, presque deux fois aussi longue que le radius, bifurcation de la posticale un peu distale de la transversale, ses deux rameaux à peine arqués, transversale oblique. Fémurs et tibias un peu élargis, à poils courts, fémur antérieur de moitié plus long que le tibia, empodium filiforme, pulvilles égalant la moitié des crochets, tarse postérieur d'un quart plus long que le tibia. Abdomen de moitié plus long que le reste du corps. Taille : 2 mm.—Peradeniya, 2 VI. 1910.

(3) Tendipes elatus, n. sp.

♀ Brun noir ; antennes et tarses blanchâtres, fémurs et tibias brun clair, balanciers brun noir, mesonotum brun jaunâtre, avec trois bandes d'un brun noir, dont la médiane est raccourcie en arrière, les latérales en avant. Antennes de 6 articles, dont le 2e est cylindrique et un peu plus long que le 3e, 3–5 ellipsoïdaux, le 3e et le 4e avec un col court, verticilles quatre fois aussi longs que la

grosseur des articles, 6e article mince, cylindrique, égal aux articles 4 et 5 réunis. Mesonotum luisant et glabre. Ailes enfumées, avec quatre grandes taches blanches près du bord postérieur qu'elles n'atteignent pas, l'une entre le cubitus et la discoïdale, la 2e entre la discoïdale et le rameau supérieur de la posticale, la 3e entre les deux rameaux de la posticale, la 4e sous le tiers distal de la tige de la posticale, une 5e tache se trouve entre la discoïdale et le tiers distal de la posticale ; nervures jaunes, auxiliaire atteignant presque le milieu du radius, 2e longitudinale 4 ou 5 fois plus rapprochée du radius que du cubitus, celui-ci presque double du radius et un peu plus proche de la pointe alaire que la discoïdale, transversale oblique, bifurcation de la posticale faiblement distale de la transversale, les deux rameaux déviant peu de la direction de la tige. Fémurs et tibias élargis, fémur antérieur de moitié plus long que le tibia, tarses manquent, tibia postérieur avec quelques soies dorsales 3–4 fois aussi longues que son épaisseur, tarse postérieur de plus de moitié plus long que le tibia, 5e article 3–4 fois aussi long que gros. Abdomen comprimé, égal au reste du corps. Taille : 2 mm.—Peradeniya, 2. VI. 1910.

(4) Tendipes superbus, n. sp.

Fig. 4.

♂♀ Brun noir ; antennes sauf le scape, balanciers, hanches et pattes testacés, aux tarses antérieurs les articles 4 et 5 et la base des articles 2 et 3 sont noirs ; mesonotum avec une trace de trois bandes pruineuses. Yeux arqués, glabres, distants de leur largeur au vertex. Palpes de 4 articles, le 1er article court, inséré à un prolongement imitant un article, les suivants, surtout le 4e, longs et cylindriques. Antennes de 12 articles chez le mâle, panache gris, articles 2–11 à peine transversaux, 12e égal aux dix précédents

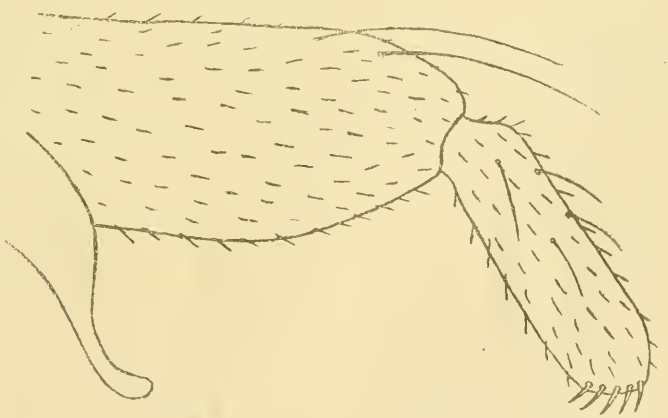


Fig. 4.—*Tendipes superbus*, n. sp.—Moitié de la pince.

réunis. Antennes de la femelle de 6 articles conformés en tout comme chez *C. gloriosus*, sauf que l'article terminal porte seulement une longue soie, qui est presque double de l'article. Mesonotum mat chez le mâle, brillant chez la femelle, avec des poils longs et gris, qui forment des rangées longitudinales. Ailes blanches avec huit taches enfumées et irrisées, trois taches sont situées entre le cubitus et la discoïdale, la proximale à l'origine du cubitus, la médiane, subtriangulaire, vers le milieu du cubitus et la distale

près de la pointe alaire ; quatre autres taches sont situées sur le bord postérieur, l'une sous l'extrémité de la discoïdale, la 2e et la 3e sous l'extrémité de chacun des deux rameaux de la posticale, la 4e va du bord postérieur jusqu'au milieu de la tige de la posticale ; l'espace compris entre la discoïdale et le rameau supérieur de la posticale est plus ou moins enfumé ; bord postérieur avec de longs cils blancs, nervures jaunes, l'auxiliaire dépasse la transversale, cubitus un peu plus de moitié plus long que le radius, un peu plus rapproché de la pointe alaire que le rameau supérieur de la posticale, 2e longitudinale soudée au radius, transversale petite et oblique, distante proximalement de la bifurcation de la posticale, dont les deux rameaux dévient peu de la direction de la tige. Poils des quatre pattes postérieures 2–3 fois aussi longs que la grosseur des pattes, pattes antérieures sans longs poils, leur fémur de moitié plus long que le tibia, métatarse deux fois aussi long que le tibia, 4e article presque double du 5e, qui est 5–6 fois aussi long que gros, empodium filiforme, un peu plus court que les crochets ; pulvilles n'atteignant pas la moitié des crochets, les 4 tibias postérieurs avec un éperon et un anneau crénelé noirs. Pince (Fig. 4) á lamelle terminée par un prolongement linéaire et plus court qu'elle, article terminal plus long que le basal, glabre, pointu, en lame de couteau, ayant dans sa moitié distale 7–8 longues soies dressées ; grands appendices plus longs que les articles basaux, leur extrémité à longs poils recourbés ; petits appendices atteignant l'extrémité des articles basaux, conformés comme les grands, pubescents, et avec 4 soies distales au côté interne. Abdomen de la femelle pas plus long que le reste du corps, un peu comprimé et faiblement arqué. Taille : 1–2, 5 mm.—Peradeniya, capturé la nuit, à la lumière, 14. V., 17. V., 25. V., 29. V. et 2. VI. 1910.

(5) Tendipes gloriosus, n. sp.

♀ Brun roux ; antennes, balanciers et pattes blanchâtres, fémurs un peu plus sombres. Antennes de 6 articles, dont le 2e est subcylindrique, et plus de deux fois aussi long que gros, 3e et 4e en ellipse et terminés par un col égalant presque leur moitié, 5e ellipsoïdal et sans col, 6e subcylindrique, aussi long que le 4e et le 5e réunis, appendices subuliformes situés à deux sur les articles 2–5 et dépassant peu la base de l'article suivant, au 6e article ils sont nombreux, au nombre de 5 ou 6 paires ; * verticilles à deux au second article, le basal plus court, les articles 3–5 ont un verticille unique, qui est 3–4 fois aussi long que l'article, le 6e porte à son extrémité quatre soies aussi longues que lui. Ailes blanches, longuement ciliées, à six taches d'un brun noir et bien limitées, irisées et subcirculaires, à savoir, deux entre le cubitus et la discoïdale, l'une située à l'origine du cubitus, l'autre après le deuxième tiers ; les quatre autres se trouvent près du bord postérieur, l'une sous la discoïdale, l'autre sous le rameau supérieur de la posticale, la 3e dans la bifurcation de la posticale, la 4e entre la tige et le rameau inférieur de la posticale ; parfois encore une sur le bord, près du lobe. Cubitus d'un tiers plus long que le radius, arqué faiblement, à peine plus distant de la pointe alaire que la discoïdale, bifurcation de la posticale distante

* A cause de ce grand nombre d'appendices subuliformes et de sa conformation particulière et allongée, l'article terminal des antennes des Chironomines est à considérer comme le résultat d'une série d'articles connés ; de cette façon on s'expliquerait pourquoi la femelle n'a que six ou sept articles aux antennes, tandis que le mâle en a douze ou quatorze.

de la transversale Poils des quatre pattes postérieures 2 à 3 fois aussi longs que la grosseur des pattes, aux pattes antérieures le fémur est d'un tiers plus long que le tibia, le métatarse de deux tiers plus long que le tibia, l'anneau crénelé des quatre tibias postérieurs noir. Taille : 1 mm.—Peradeniya, capturé la nuit, à la lumière ; 20.V. 1910.

(6) TENDIPES CEYLANICUS, Kieff.

Colombo. (Records of the Indian Museum, 1911, vol. VI., p. 136.)

(7) TENDIPES ALBIFORCEPS, Kieff.

♀ Peradeniya, capturé à la lumière, la nuit, 17. V. 1910 ; cette espèce n'était signalée que pour Calcutta (Memoirs of the Indian Museum, 1910, vol. II., p. 231).

(8) TENDIPES ALLOTHRIX, n. sp.

Fig. 5.

♀ Jaune blanchâtre, glabre et brillant ; palpes, flagellum, aux pattes antérieures l'extrémité du fémur, le tibia et le tarse brun noir, aux pattes postérieures l'extrémité du fémur, du tibia et les deux ou trois derniers articles tarsaux obscurcis, mesonotum avec une bande noire, brillante, unique, large, tronquée en arrière, où elle atteint le milieu, balanciers blancs, abdomen jaune, large bord antérieur et postérieur sur les tergites et les sternites, ainsi que les côtés vert clair. Palpes longs et grêles. Antennes (Fig. 5) de 6 articles, dont le 2e est un peu rétréci au milieu et plus de deux fois aussi long que

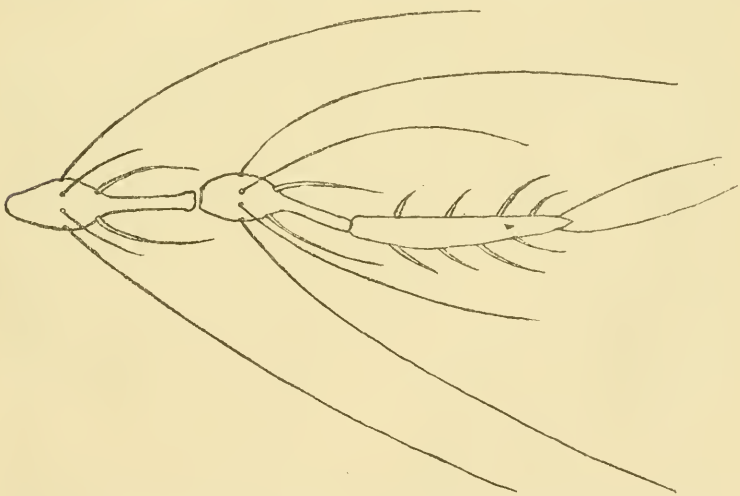


FIG. 5.—*Tendipes allothrix*, n. sp.—Trois derniers articles antennaires.

gros, avec un col égalant la moitié de sa longueur, 3–5 ellipsoïdaux ou presque fusiformes, le 3e à col aussi long que lui, les deux suivants à col plus long qu'eux, 6e mince, subfusiforme, de moitié plus long que l'avant-dernier ; 2–5 avec deux appendices subuliformes atteignant le milieu de l'article suivant, le 6e avec 8–12 appendices subuliformes et deux soies distales aussi longues que lui, verticille des articles 2–5 très long, 3–4 fois aussi long que l'article, aux articles 3 et 4 deux soies du verticille sont très courtes et n'ont que le 1/5 ou le 1/6 de la longueur des quatre autres ; le 2e a encore, comme d'ordinaire, un

verticille basal plus court que le distal. Ailes subhyalines, ciliées, nervures antérieures jaune brunâtre, auxiliaire atteignant le milieu du radius, 2e longitudinale juxtaposée au radius, cubitus un peu arqué, atteignant presque la pointe alaire, dont il est plus rapproché que la discoïdale, transversale oblique, distante un peu proximalement de la bifurcation de la posticale dont les deux rameaux sont peu divergents. Pattes à poils guère plus longs que leur grosseur, fémur antérieur de moitié plus long que le tibia, métatarse 2½ fois aussi long que le tibia, 4e article 2½ fois aussi long que le 5e, qui est 8–10 fois aussi long que gros. Abdomen subcylindrique, de moitié plus long que le reste du corps. Taille : 2, 8 mm.—Peradeniya, 25. V. 1910, capturé la nuit, à la lumière.

(9) Tendipes perichlorus, n. sp.

♀ Jaune blanchâtre ; article terminal des antennes, palpes et, aux quatre pattes postérieures, l'extrême bout distal du tibia et des articles tarsaux 1–4 et le 5e article tarsal brun noir, mesonotum à trois bandes ferrugineuses mates, dont l'intermédiaire est raccourcie en arrière, les latérales en avant, balanciers blanchâtres, abdomen brun noir, étroit bord postérieur des segments vert. Palpes longs et grêles. Antennes de six articles, dont le 2e est subcylindrique, au moins deux fois aussi long que gros, avec deux verticilles de soies, deux appendices hyalins, et un col un peu plus long que gros ; articles 3–5 en ellipsoïde, avec un verticille 4–5 fois aussi long que leur grosseur, deux appendices hyalins atteignant le milieu de l'article suivant et un col aussi long qu'eux, 6e article subcylindrique, graduellement aminci en stylet à l'extrémité, d'un tiers plus long que le 5e article, avec de nombreux appendices hyalins, sans longs poils. Ailes hyalines, transversale noire et oblique, nervures antérieures jaunes, auxiliaire atteignant le tiers proximal du radius, celui-ci atteint presque les deux tiers du cubitus, qui est arqué, proche du bord, aboutissant aussi près de la pointe alaire que la discoïdale, 2e nervure non distincte du radius, bifurcation de la posticale considéralement éloignée distalement de la transversale, les deux rameaux déviant peu de la direction de la tige, cils blanchâtres. Fémur antérieur d'un quart plus long que le tibia, tarses antérieurs brisés, pattes pubescentes, 5e article des tarses postérieurs trois fois aussi long que gros, de moitié plus court que le 4e, pulvilles larges, un peu plus courts que les crochets. Abdomen subcylindrique, presque deux fois aussi long que le reste du corps, à pubescence blanchâtre et assez longue. Taille : 3 mm.—Peradeniya, 17. V. 1910.

(10) Tendipes chlorogaster, n. sp.

♀ Thorax brun roux, abdomen vert, antennes, mesonotum et scutellum blanchâtres, mesonotum avec trois bandes ferrugineuses, dont la médiane est raccourcie en arrière, les latérales en avant, pattes jaune clair, aux antérieures le tibia et le tarse sont brun noir. Palpes longs. Antennes de six articles, 3–5 guère plus longs que gros, sans col, à verticille 3–4 fois aussi long que leur épaisseur, 6e article cylindrique, deux fois aussi long que le 5e, sans longues soies. Mesonotum brillant et glabre. Ailes hyalines, finement ponctuées et longuement ciliées, auxiliaire et 2e nervure non distinctes, cubitus un peu plus de deux fois aussi long que le radius, deux fois plus distant de la pointe alaire que la discoïdale, qui aboutit presque à la pointe, transversale oblique, bifurcation de la posticale distale de la

transversale, les deux rameaux déviant peu de la direction de la tige. Pattes pubescentes, fémur antérieur d'un tiers plus long que le tibia, métatarse presque double du tibia, second article égal à la moitié du premier, guère plus long que le 3e, 5e n'atteignant pas la moitié du 4e, 3–4 fois aussi long que gros. Taille : 1, 5 mm.—Peradeniya, 17. V. 1910.

(11) Tendipes nigromarginatus, Kieff.

Cinq exemplaires femelles capturés à la lampe, la nuit, à Peradeniya, 14. V., 17. V. et 17. VI. 1910 ; mesonotum jaune entre les bandes ; pulvilles égalant la moitié des crochets, empodium filiforme, aussi long que les crochets. Cette espèce était connue pour Orissa ; elle se trouve encore à Kuching, Sarawak, Borneo.

(12) Tendipes fuscitarsis, Kieff.

Cette espèce, connue déjà pour la Birmanie, a été capturée aussi dans l'île de Ceylan, à Peradeniya, le 2. VI. 1910. L'unique exemplaire diffère du type par les tibias intermédiaires et postérieurs qui ne sont pas noirs au bout, tarses peu obscurcis (les antérieurs manquent), le dessous du métatarse postérieur porte des crochets hyalins et alignés, ce qui est aussi le cas pour *nigromarginatus* et probablement la règle dans les Tendipédines, car je les ai observés aussi pour le groupe *Orthocladius ;* les articles tarsaux suivants sont dépourvus de ces crochets.

(13) Tendipes heptatomus, n. sp.

♀ Brun noir, y compris les palpes et les antennes ; toutes les hanches, trochanters antérieurs, pattes intermédiaires et postérieures sauf l'extrémité des tibias et les deux ou trois derniers articles tarsaux testacés, balanciers blanchâtres, mesonotum roussâtre et pruineux, avec trois larges bandes noires, dont la médiane est raccourcie en arrière, les latérales en avant, tergites tachetés de brun roux. Antennes de 7 articles, articles 2–6 avec un verticille de soies et deux appendices subuliformes hyalins, ces derniers n'atteignent pas le milieu de l'article suivant, les soies sont 4–5 fois aussi longues que la grosseur des articles, la forme des articles est presque ellipsoïdale, le 2e non prolongé en col, le 3e à peine prolongé en col, les trois suivants avec un col dépassant la moitié de leur longueur, 7e article subcylindrique, obliquement tronqué à l'extrémité, trois fois aussi long que le 6e, avec de nombreux appendices subuliformes, sans longues soies. Ailes hyalines, nervures antérieures jaune brunâtre, auxiliaire indistincte, radius atteignant presque les deux tiers du cubitus, 2e nervure aussi bien marquée que le radius, dont elle est très rapprochée, cubitus un peu arqué, très proche du bord, aboutissant presque aussi près de la pointe alaire que la discoïdale, transversale oblique, bifurcation de la posticale distale de la transversale, les deux rameaux déviant peu de la direction de la tige. Pattes très faiblement pubescentes, sans longs poils, métatarse antérieur au moins deux fois aussi long que le tibia, un peu plus long que le 2e article, 3e et 4e subégaux, 5e un peu plus court que la moitié du 4e, 8–10 fois aussi long que gros. Abdomen presque deux fois aussi long que le reste du corps, à peine pubescent. Taille : 5, 5 mm —Peradeniya, cinq exemplaires capturés le 2. VI. 1910.

(14) Tendipes hexatomus, n. sp.

♀ Tête, palpes, antennes et thorax brun roux, mesonotum glabre et brillant, ayant dans sa moitié postérieure, de chaque côté, une bande noire, scutellum et balanciers blanchâtres, l'extrémité de ces derniers assombrie, pattes jaunes, abdomen brun noir. Antennes de 6 articles, 2–5 avec un long verticille de soies et deux appendices subuliformes, ceux-ci aussi longs que l'article, les soies du 5e article atteignent l'extrémité de l'article terminal, articles 3e et 4e ellipsoïdaux, avec un col un peu plus long qu'eux, le 5e ellipsoïdal, à col plus court que lui, 6e article aussi long que les deux précédents réunis. Ailes hyalines, nervures antérieures jaunes, radius conné à la 2e nervure, atteignant au moins les deux tiers du cubitus, qui est plus rapproché de la pointe alaire que la discoïdale, transversale oblique, bifurcation de la posticale un peu distale de la tranversale. Pattes sans longs poils, fémurs antérieurs au moins de moitié plus longs que les tibias (tarses brisés). Abdomen comprimé, aminci en avant, un peu plus long que le reste du corps, ayant sa plus grande hauteur au milieu, à peine pubescent. Taille : 2, 5 mm.—Peradeniya, 2. VI. 1910.

(15) Tendipes variicornis, n. sp.

♀ Brun sombre ; balanciers, hanches et pattes blancs, antennes blanches avec les nodosités brun noir. Palpes longs. Antennes de 6 articles, verticilles 3–4 fois aussi longs que la grosseur des articles, second article subcylindrique, à col court, 3e et 4e un peu plus longs que gros, avec un col aussi long qu'eux, 5e article ellipsoïdal et sans col, 6e mince et cylindrique, égalant les deux précédents réunis, avec 3 ou 4 soies distales un peu plus courtes que lui. Ailes hyalines, longuement ciliées, radius égalant la moitié du cubitus, 2e nervure non distincte, cubitus arqué, aboutissant presque à la pointe alaire, dont il est plus rapproché que la discoïdale, transversale oblique, un peu proximale de la bifurcation de la posticale. Pattes sans longs poils, fémurs antérieurs de moitié plus longs que les tibias, métatarse antérieur presque double du tibia, de moitié plus long que le 2e article, 4e plus de deux fois aussi long que le 5e, qui est 3 à 4 fois aussi long que gros. Abdomen comprimé, d'égale hauteur partout, pubescent, un peu plus long que le reste du crops. Taille : 1, 5 mm.—Peradeniya, 22. V. 1910.

2.—Genus **Tanytarsus,** Van der Wulp.

Ailes à surface poilue, généralement sans lobe basal.

1. Ailes avec un lobe basal..1. *T. lobatus*, n. sp.
— Ailes sans lobe, graduellement amincies basalement..2.
2. Ailes avec une nervure transversale..2. *T. transversalis*, n. sp.
— Ailes sans nervure transversale, ou plutôt, la transversale continue la direction du cubitus..3.
3. Abdomen vert..3. *T. prasiogaster*, n. sp.
— Abdomen brun noir..4.
4. Ailes à surface densément poilue..4. *T. ceylanicus*, n. sp.
— Ailes à surface parsemée de rares poils..5. *T. poecilus*, n. sp.

(1) Tanytarsus lobatus, n. sp.

♀ Thorax et antennes roux brun, mesonotum plus clair, avec trois bandes mates un peu plus sombres, dont la médiane est raccourcie

en arrière, les latérales en avant, pattes faiblement brunâtres, balanciers blanchâtres avec l'extrémité assombrie, abdomen brun noir. Antennes de 6 articles, 2e article subcylindrique, avec deux verticilles de soies et deux appendices subuliformes hyalins, articles 3–5 deux fois aussi longs que gros, sans col, mais graduellement amincis distalement, comme le 2e, avec un verticille de soies 4–5 fois aussi longues que l'épaisseur de l'article et deux appendices subuliformes atteignant le milieu de l'article suivant, 6e article mince, de moitié plus long que le 5e, ayant outre les appendices subuliformes, deux soies distales aussi longues que lui. Ailes à poils denses et noirâtres, avec un lobe basal et une transversale oblique, cubitus touchant presque le bord auquel il est parallèle, de moitié plus long que le radius, 2e nervure non visible, bifurcation de la posticale à peine distale de la transversale, les deux rameaux déviant peu de la direction de la tige. Tibia antérieur égal aux deux tiers du fémur ; tarse brisé. Taille : 2, 8 mm.—Peradeniya, 2. VI. 1910.

(2) Tanytarsus transversalis, n. sp.

Fig. 6.

♂♀ Blanc roussâtre, mesonotum avec trois bandes plus sombres, dont la médiane est raccourcie en arrière, les latérales en avant, pattes et balanciers blanchâtres, antennes brunes chez le mâle, blanchâtres chez la femelle. Antennes du mâle de 14 articles, panache d'un gris sombre ; articles 2–13 aussi longs que gros, le 14e un peu plus court que les 12 articles précédents réunis ; antennes de la femelle de 6 articles (Fig. 6) dont le 2e est subcylindrique, graduellement aminci distalement, deux fois aussi long que gros, avec deux verticilles de soies et deux appendices subuliformes, 3e

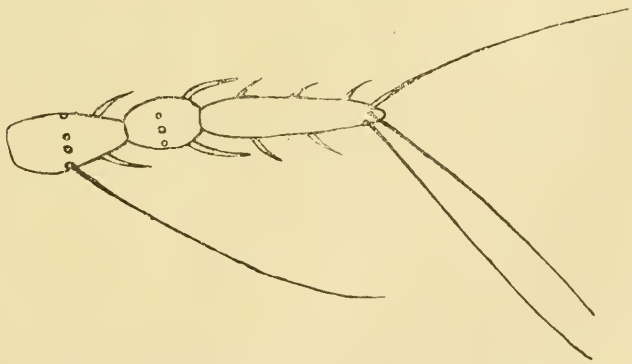


Fig. 6.—*Tanytarsus transversalis*, n. sp.—Derniers articles de l'antenne.

et 4e articles aussi longs que le 2e, un peu épaissi au milieu, avec un verticille de soies 4–5 fois aussi longues que l'épaisseur de l' article et deux appendices subuliformes n'atteignant pas le milieu de l'article suivant, 5e article presque globuleux, un peu plus long que gros, non aminci à l'extrémité, 6e mince, subcylindrique, aussi long que les deux précédents réunis, avec trois soies terminales aussi longues que lui. Ailes non lobées, densément poilues, transversale oblique et assez longue, cubitus rapproché du bord auquel il est parallèle, aboutissant assez loin de la pointe alaire, bifurcation de la

posticale distale de la transversale. Pattes sans longs poils, tibia antérieur guère plus court que le fémur, métatarse de moitié plus long que le tibia. Thorax fortement prolongé au-dessus de la tête. Taille : 0, 8–1, 2 mm.—Peradeniya, 2. VI. et 23. VI. 1910.

(3) Tanytarsus prasiogaster, n. sp.

♂♀ Antennes brunes chez le mâle, blanchâtres chez la femelle ; thorax roux, balanciers et pattes blancs, abdomen vert ; chez le mâle, le tiers postérieur et un étroit bord postérieur des segments antérieurs sont brun noir. Antennes du mâle de 13 articles, à panache noirâtre, articles 2–12 plus longs que gros, 14e à peine plus long que les 11 précédents réunis. Antennes de la femelle de 6 articles dépourvus de col. Mesonotum brillant. Ailes hyalines, presque glabres, sauf l'extrémité qui est densément poilue (♂♀), sans lobe basal et sans transversale, cubitus presque double du radius, droit, aboutissant assez loin de la pointe alaire, bifurcation de la posticale distale de la base du cubitus. Pattes sans longs poils, fémur antérieur double du tibia, métatarse presque double du tibia. Abdomen du mâle long et grêle, pince à lamelle graduellement amincie en un pétiole plus court qu'elle, article terminal plus long que le basal, convexe dorsalement, ayant sa plus grande épaisseur au milieu, tiers distal avec 5–6 soies au côté interne, appendices poilus dépassant un peu les articles basaux, appendices glabres petits et minces. Taille : 2 mm.—Peradeniya, 30. V. 1910.

(4) Tanytarsus ceylanicus, n. sp.

Fig. 7.

♀ Roux jaune, sans bande au mesonotum, antennes, pattes et balanciers blanchâtres. Yeux arqués, distants de leur largeur au vertex. Antennes de 5 articles (Fig. 7), dont le 2e est subcylindrique, faiblement aminci distalement, avec deux verticilles de soies et deux appendices subuliformes, articles 3 et 4 allongés, un

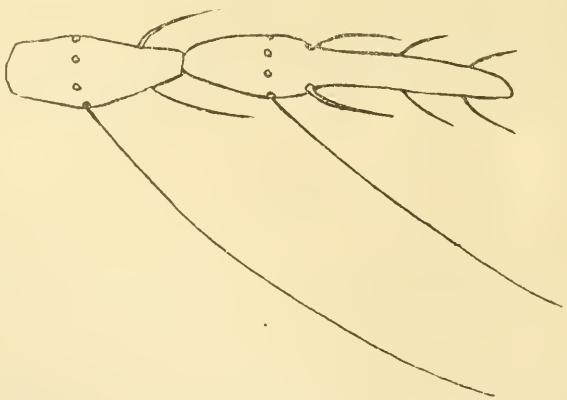


Fig. 7.—*Tanytarsus ceylanicus*, n. sp.—Deux derniers articles antennaires.

peu grossis au milieu, amincis graduellement à l'extrémité, avec un verticille de soies 4–5 fois aussi longues que la grosseur de l'article et deux appendices subuliformes n'atteignant pas le milieu de l' article suivant, 5e article formé par une partie basale subfusiforme, ayant un verticille et deux appendices subuliformes, et par une partie

distale de moitié plus longue, plus mince, subcylindrique et sans appendice subuliforme. Ailes densément poilues, hyalines, sans lobe et sans transversale, cubitus arqué, proche du bord auquel il est parallèle, de deux tiers plus long que le radius, assez éloigné de la pointe alaire mais moins que la posticale, discoïdale aboutissant à la pointe, bifurcation de la posticale distale de la base du cubitus, les deux rameaux déviant peu de la direction de la tige. Thorax fortement prolongé au-dessus de la tête, à poils blanchâtres. Pattes sans longs poils, fémur antérieur plus de deux fois aussi long que le tibia, métatarse trois fois aussi long que le tibia, $2\frac{1}{2}$ fois aussi long que le 2e article, 4e presque double du 5e qui est 8–10 fois aussi long que gros, empodium très petit, égal au quart des crochets. Abdomen un peu plus long que le reste du corps, faiblement arqué. Taille : 1–1, 5 mm.—Peradeniya, 17. V. et 19. V. 1910.

(5) Tanytarsus poecilus, n. sp.

♀ Brun ; abdomen roux brun, plus clair dessous, balanciers et pattes blanchâtres, antennes blanc brunâtre. Antennes de 6 articles, 3–5 en ellipse allongé, aminci au bout, verticilles et appendices subuliformes comme chez le précédent, 6e article graduellement aminci en pointe, plus de deux fois aussi long que le 5e, ayant avant le milieu deux soies aussi longues que lui et une autre à l'extrémité. Ailes hyalines, à pilosité très éparse, un peu plus dense à l'extrémité, base alaire non lobée, transversale nulle, cubitus arqué, à peine deux fois aussi long que le radius, plus éloigné de la pointe alaire que la discoïdale, bifurcation de la posticale distale de la base du cubitus. Fémur antérieur deux fois aussi long que le tibia, tarse brisé. Abdomen un peu plus long que le reste du corps. Taille : 1 mm.—Peradeniya, 13. V. 1910.

B.—Groupe Orthocladius.

Tibias postérieurs avec un peigne à leur extrémité distale, les tibias antérieurs et intermédiaires sans peigne et sans anneau crénelé ; métatarse antérieur toujours plus court que le tibia.

Pince du mâle généralement sans autres appendices qu'un lobe de l'article basal, ou sans appendice.

1.—Genus **Dactylocladius**, Kieff.

Dactylocladius ceylanicus, n. sp.

Fig. 8.

♂ Brun noir et mat, balanciers et pattes brun clair. Palpes assez longs. Antennes de 14 articles, 2 à 10 transversaux, 11e et 12e aussi longs ou un peu plus longs que gros, 14e de moitié plus long que les 12 précédents. Ailes hyalines, cubitus droit, presque double du radius, à peine plus rapproché de la pointe alaire que le rameau supérieur de la posticale, non dépassé par la costale, transversale oblique et très courte, bifurcation de la posticale distale de la transversale. Pattes sans longs poils, cils du tibia et du tarse des quatre pattes postérieures deux à trois fois aussi longs que leur grosseur, tibia antérieur égalant le fémur, de moitié plus long que le métatarse, 2e article un peu plus court que le 1er, 3e presque double du 4e, 5e un peu plus court que le 4e, trois à quatre fois aussi long que gros, extrémité distale du fémur postérieur avec la dent ventrale glabre et hyaline, comme d'ordinaire, outre le peigne ordinaire, le

tibia postérieur a deux éperons bruns, dont le plus grand est dentelé, empodium filiforme, avec quelques longs poils sur le dessous, un peu plus court que les crochets, pulvilles nuls. Abdomen grêle ; pince (Fig. 8) à article basal sans appendice, article terminal subglabre, à pubescence peu distincte, égal à la moitié de la longueur de l'article basal, graduellement et faiblement grossi de la base au sommet. Taille : 2, 5 mm.—Peradeniya, 14. VII. 1910.

2.—**Cardiocladius,** gen. nov. (*Thalassomyia*, Johanns. non Schin.).

Ce genre diffère de *Orthocladius* par la conformation du 4e article tarsal qui est court et subcordiforme, découpé a l'extrémité ; ce caractère le rapproche de *Thalassomyia*, Schin., qui diffère par la présence d'un empodium, par les ailes à ponctuation microscopique, et dont *Scopelodromus*, Chevr., n'est qu'un synonyme. Le type du nouveau genre est.

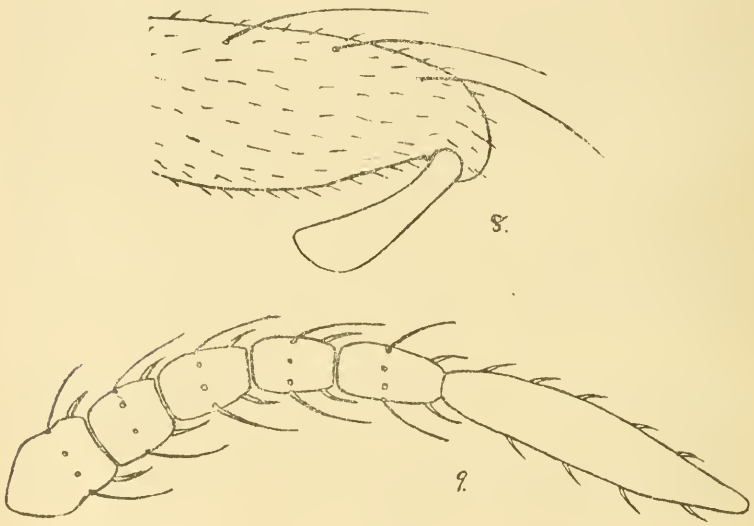


Fig. 8.—*Dactylocladius ceylanicus*, n. sp.—Moitié de la pince.

Fig. 9.—*Cardiocladius ceylanicus*, n. sp.—Flagellum de l'antenne.

Cardiocladius ceylanicus, n. sp.

Fig 9.

♀ Brun noir ; scape et pronotum jaunâtres, thorax brun roux, sauf le sternum, mesonotum pruineux, blanchâtre en avant, à trois larges bandes noires et mates, dont la médiane est raccourcie en arrière, les latérales en avant, metanotum noir, blanciers blanc jaunâtre, trochanters roux. Yeux largement séparés au vertex, à peine arqués, palpes plus longs que les antennes, composés de quatre articles. Antennes (Fig. 9) de 7 articles, 2–6 cylindriques, au moins de moitié plus longs que gros, serrés, avec un verticille de six poils pas plus longs que l'article et deux appendices subuliformes atteignant à peine la moitié de la longueur d'un article, 7e article

graduellement aminci distalement, un peu plus long que les trois articles précédents réunis, sans longues soies, à appendices subuliformes nombreux. Pronotum bilobé. Ailes hyalines, glabres, non ponctuées ; radius et cubitus à soies longues et espacées, base alaire rectangulaire, nervures antérieures jaunes, cubitus non dépassé par la costale, deux fois aussi long que le radius, presque aussi distant de la pointe alaire que le rameau supérieur de la posticale, 2e nervure non distincte, transversale perpendiculaire, bifurcation de la posticale située sous la transversale, les deux rameaux déviant peu de la direction de la tige. Tibia postérieur ayant, outre le peigne ordinaire, un long éperon, dont les deux tiers antérieurs sont élargis et dentelés, tibia antérieur d'un tiers plus long que le métatarse ; le 4e *article tarsal de toutes les pattes est subcordiforme*, prolongé ventralement à l'extrémité, à peine plus long que gros, tandis que le 3e est cylindrique et 4–5 fois aussi long que gros, le 5e mince, graduellement grossi distalement, de moitié plus long que le 4e ; crochets simples, empodium et pulvilles nuls ; pattes presque glabres. Abdomen très comprimé, mat, presque glabre, aussi long que le reste du corps. Taille : 2, 5 mm.—Peradeniya, 2. VI. 1910.

Remarque.—Ce nouveau genre trouvera place dans le Groupe Orthocladius d'après le tableau suivant :

1. Nervure costale ne dépassant pas le radius qui est épaissi, surtout à l'extrémité et n'atteint pas le milieu de l'aile ; cubitus faiblement marqué comme les nervures suivantes, sortant du radius et aboutissant près de la pointe alaire ; discoïdale non bifurquée, sa partie proximale semble former la base du cubitus, comme dans les genres *Tanytarsus* et *Metriocnemus*. . *Corynoneura*, Winn.

— Nervure costale atteignant ou dépassant l'extrémité du cubitus, qui est aussi fortement marqué que le radius. . 2.

2. Article 4e de tous les tarses cordiforme et beaucoup plus court que le 3e ou le 5e. . . 3.

— Article 4e de tous les tarses cylindrique, comme les autres, et ordinairement plus long que le 5e. . 4.

3. Ailes nues, tarses sans pulvilles ni empodium. . *Cardiocladius*, n.g.

— Ailes avec une ponctuation microscopique, tarses avec un empodium filiforme, pulvilles nuls. *Thalassomyia*, Schin. (*Scopelodromus*, Chevr).

4. Ailes glabres. . 5.

— Ailes velues. . 13.

5. Yeux densément velus. . 6.

— Yeux glabres. . 10.

6. Tarses sans pulvilles, avec un empodium filiforme. . 7.

— Tarses avec deux larges pulvilles et un empodium filiforme. . 8.

7. Palpes de 4 articles, pince ayant de chaque côté un article terminal unique. . *Trichocladius*, Kieff.

— Palpes de 3 articles, pince avec deux articles terminaux de chaque côté. . *Diplocladius*, Kieff.

8. Palpes de 4 articles. . 9.

— Palpes de 3 articles. . *Isocladius*, Kieff.

9. Article terminal des antennes du mâle en massue, pas plus long que les trois articles précédents réunis, pattes non annelées : femelle inconnue. . *Rhopalocladius*, Kieff.

— Article terminal des antennes du mâle non en massue, aussi long ou plus long que tous les précédents réunis, pattes ordinairement annelées de noir ou de blanc. . *Cricotopus*, V. d. Wulp.

10. Pulvilles bien developpés et larges..*Psectrocladius*, Kieff.
— Pulvilles nuls..11.
11. Rameau postérieur de la posticale brisé en angle ou sinueux en S, empodium filiforme..*Camptocladius*, V. d. Wulp.
— Rameau postérieur de la posticale droit ou très faiblement arqué..12.
12. Empodium nul..*Orthocladius*, V. d. Wulp.
— Empodium filiforme, à poils bifurqués ou trifurqués..*Dactylocladius*, Kieff.
13. " Thorax s'avançant en pointe conique par dessus la tête, pattes grosses, tibias postérieurs élargis et densément velus " (Ce genre m'est inconnu)..*Eurycnemus*, V. d. Wulp.
— Thorax en capuchon et faiblement proéminent au dessus de la tête, pattes grêles, tibias postérieurs non élargis..14.
14. Yeux glabres, crochets tarsaux simples, empodium filiforme, ailes non lobées à la base, antennes du mâle conformées comme d'ordinaire..*Metriocnemus*, V. d. Wulp.
— Yeux densément velus, crochets tarsaux bifides, empodium filiforme, antennes du mâle conformées comme chez les femelles mais de 12 articles, celles de la femelle de 6 articles..*Thienemannia*, Kieff.

CECIDOMYIES DE CEYLAN DECRITES.

Par J. J. Kieffer, Doct. phil. nat. (Bitsch).

(*Avec trois figures dans le texte.*)

L'Indian Museum de Calcutta renferme environ une trentaine de Cécidomyies recueillies dans l'ile de Ceylan. Ces insectes se rapportent à huit espèces nouvelles, dont deux deviennent le type d' un genre nouveau. Le présent travail, qui en donne la description, formera donc la première Contribution à la connaissance des Cécidomyies de l'ile de Ceylan. Il est regrettable qu' aucune de ces espèces n'aient été obtenue d'éclosion et que leur genre de vie demeure inconnu.

Hallomyia, g. n.

Ce genre, que je dédie à Monsieur le Major Hall, se rapproche du groupe des *Diplosariae*, par l'oviducte de la femelle, qui est muni de deux lamelles parallèles et allongées, mais en diffère par le nombre des articles antennaires qui est de 2 + 13. Bouche longue et pointue, atteignant les deux tiers de la hauteur de la tête (Fig. 1). Palpes de 4 articles. Bord antérieur de l'aile sans écailles, cubitus aboutissant en arrière de la pointe alaire. Crochets tarsaux bifides, empodium court, pulvilles nuls, premier article tarsal court, le second à peu près égal au tibia.

Hallomyia iris, sp. n.

Figs. 1 et 2.

♀ Roux jaune, deux premiers articles antennaires jaunâtres, flagellum brun noir, balanciers blanchâtres, pattes brun sombre. Bouche trois fois aussi longue que large à la base ; yeux largement confluents au vertex ; occiput avec de longs poils dressés. Articles

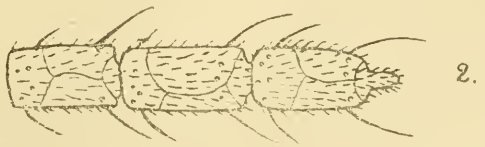


Fig. 1.—*Hallomyia iris*, g. et sp. n.—Tête vue de devant.

Fig. 2.—*Hallomyia iris*, g. et sp. n.—Trois derniers articles antennaires.

du flagellum (Fig. 2) cylindriques, deux fois aussi longs que gros, à col transversal et presque nul, verticilles de poils peu réguliers, très courts, plus courts que la longueur des articles, filets arqués conformés comme chez *Perrisia* ; dernier article avec un prolongement

en forme de stylet pubescent, cylindrique et égalant le tiers de la longueur de l'article. Thorax mat, mesonotum à peu près glabre, avec deux rangées de poils pâles. Ailes poilues, paraissant faiblement bleuâtres étant vues par transparence, avec des taches jaunâtres et arrondies ; vue d'un certain côté, la surface parait grise et les taches d'un bleu violacé intense et irrisé ; l'une de ces taches englobe le rameau inférieur de la nervure posticale ; une seconde est située entre la bifurcation de la posticale et le cubitus ; une troisième se trouve près de l'extrémité alaire, entre le cubitus et le rameau supérieur de la posticale ; en outre le lobe anal, et une fine bordure le long du radius, du cubitus et du rameau supérieur de la posticale sont de cette même couleur irrisée ; bord antérieur longuement poilu, interrompu à sa jonction avec le cubitus, qui est arqué, transversale bien marquée, oblique, située un peu distalement du milieu du radius, rameau supérieur de la posticale fortement relevé et arqué à sa base, l'inférieur presque perpendiculaire à la tige. Pattes grêles, couvertes de poils appliqués et presque en forme d'écaille, crochets grêles, le rameau inférieur d'un tiers plus court que le supérieur, empodium un peu plus court que la moitié des crochets. Oviducte non proéminent, lamelles deux fois aussi longues que larges, parsemées de soies. Taille : 1, 5 mm.—Peradeniya, le 17 mai (5 exemplaires).

CLINODIPLOSIS CEYLANICUS, s. p.

Fig. 3.

♀ Roux fauve uniforme, flagellum brun noir, mesonotum avec trois bandes brunes et presque confluentes, séparées par deux rangées de poils blanchâtres. Yeux largement confluents au vertex. Palpes de quatre articles courts. Antennes de 2 + 12 articles, le premier article du flagellum est soudé au 2e, plus long que lui et faiblement rétréci au milieu, avec un col guère plus long

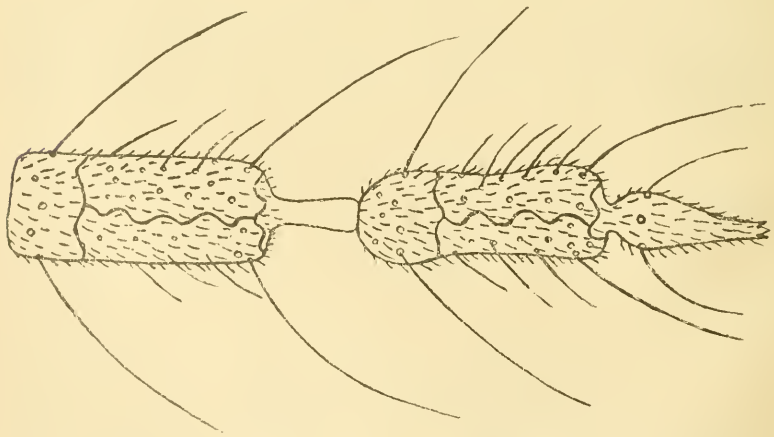


FIG. 3.—*Clinodiplosis ceylanicus*, sp. n.—Deux derniers articles antennaires.

que gros, les articles suivants sont cylindriques, presque trois fois aussi longs que gros, avec un col atteignant le tiers de leur longueur, d'abord $1\frac{1}{2}$, puis 2 et $2\frac{1}{2}$ fois aussi long que gros, à l'article terminal le col est remplacé par un appendice imitant un petit article en ovale pointue et muni d'un verticille de poils (Fig. 3) ; les articles du flagellum ont deux verticilles peu réguliers formés par des poils

aussi longs qu'un article, le reste de leur surface porte des poils plus courts et disposés sans ordre ; les deux verticilles de filets arqués forment chacun seulement un filament annuliforme et sinueux, ils sont reliés l'un à l'autre par deux ou trois filaments longitudinaux et sinueux. Ailes à cubitus arqué, aboutissant en arrière de la pointe alaire, costale interrompue à cet endroit ; transversale bien marquée, oblique, située un peu distalement du milieu du radius ; rameau supérieur de la posticale très pâle, relevé fortement à sa base, l'inférieur perpendiculaire à la tige ; bord antérieur de l'aile poilu Pattes poilues, crochets simples, un peu plus longs que l'empodium. Oviducte peu proéminent, pas plus long que gros, à lamelles parallèles, arrondies à l'extrémité, trois fois aussi longues que larges et parsemées de soies. Cette espèce est très voisine de *Clinodiplosis graminicola*, chez laquelle les deux rameaux de la posticale sont obliques dès leur origine. Taille : 3 mm.—Peradeniya (nombreux exemplaires).

Plutodiplosis, g. n.

Antennes du mâle comme chez *Bremia*. Ailes tachetées, cubitus aboutissant à la pointe alaire. Pattes couvertes d'écailles denses, premier article tarsal court, crochets simples, un peu plus longs que l'empodium, pulvilles nuls.

PLUTODIPLOSIS MAGNIFICUS, sp. n.

♂ Noir mat, avec des poils longs, dressés et d'un brun noir ; antennes blanches, les deux premiers articles et la nodosité inférieure des articles du flagellum d'un noir brillant ; balanciers d'un jaune d'or ; un large anneau situé un peu au-dessus du milieu des fémurs postérieurs, dont il occupe environ un tiers, tous les genoux, un anneau près de la base des quatre tibias antérieurs, les deux tibias postérieurs sauf le quart proximal, le 2e article tarsal des quatre pattes antérieures sauf la base et un anneau un peu après leur milieu, 2e article des tarses postérieurs sauf la base, et à toutes les pattes, les articles tarsaux 3 et 4 sauf leur base, d'un beaujaune d'or et couverts d'écailles de même couleur. Articles du flagellum composés de deux nodosités, dont l'inférieure est globuleuse et la supérieure ovoïdale, chacune est surmontée d'un col qui, aux premiers articles, est au moins aussi long que la nodosité et, aux articles suivants, plus long qu'elle ; chacune des deux nodosités est ornée d'un verticille de soies et d'un verticille de filets arqués et hyalins ; au côté interne, ces deux verticilles ont deux très longues soies et deux très longs filets arqués qui sont étalés à angle droit et 2–3 fois aussi longs que les soies ou filets du côté externe, lesquels sont dressés et non étalés, et atteignent le milieu de la nodosité suivante, entre les soies ou filets arqués internes et externes, les soies ou filets sont très courts ; la nodosité ovoïdale à en outre, à sa base, un verticille composé de filets arqués, réguliers, courts, ne dépassant pas l'extrémité de la nodosité. Ailes jaunes et couvertes de poils jaunes, avec sept taches noires couvertes de poils noirs ; la plus grande de ces taches a comme limite proximale la nervure transversale, comme limite supérieure le cubitus et atteint presque le bord inférieur de l'aile, à son extrémité distale, vis à vis de l'extrémité du radius, elle dépasse le cubitus et atteint le bord antérieur ; une 2e tache, très rapprochée de la grande, est perpendiculaire au pli alaire et va de là au bord inférieur de l'aile en traversant la bifurcation de la posticale ; une 3e tache, transversale, est située entre l'extrémité du radius et celle du cubitus et va

du bord antérieur au cubitus ; une 4e est située à l'extrémité de la cellule cubitale qu'elle ne dépasse pas ; deux autres se trouvent au bord postérieur, l'une, très petite, entre le cubitus et le rameau supérieur de la posticale, l'autre à l'extrémité du rameau supérieur de la posticale ; la 7e tache, un peu plus grande que la précédente, se trouve entre le cubitus et le milieu du rameau supérieur de la posticale ; bord antérieur de l'aile d'un jaune d'or, avec de longs poils jaunes et dressés, et trois taches noires correspondant à trois taches du disque, cubitus presque droit et aboutissant à la pointe alaire, transversale distante proximalement du milieu du radius, rameau supérieur de la posticale fortement relevé à sa base, l'inférieur perpendiculaire à la tige. Ecailles des pattes presque linéaires, brièvement pétiolées, pointues à l'extrémité, striées longitudinalement. Pince à articles terminaux longs, très minces et presque filiformes. Taille : 1, 8 mm.—Peradeniya.

Chrysodiplosis squamatipes, sp. n.

♂ Fauve ; mesonotum brun sombre et mat. Palpes assez longs. Flagellum brisé. Ailes densément velues et longuement ciliées, bord antérieur dépourvu de poils, mais couvert d'écailles noires, denses et appliquées jusqu'à sa jonction avec le cubitus, où il est interrompu ; cubitus un peu arqué, aboutissant à peine en arrière de la pointe alaire ; rameau antérieur de la posticale subdroit, continuant presque la direction de la tige, l'inférieur presque perpendiculaire à la tige ; transversale aboutissant au milieu du radius. Mesonotum avec deux rangées de poils clairs, lesquelles se touchent en arrière. Fémurs fauves, avec quelques longs poils dressés ; tibias, et tarses dépourvus de poils, couverts d'écailles noires, appliquées, denses, striées, brièvement pétiolées, arrondies à l'extrémité ; premier article tarsal court, crochets tarsaux assez gros, subdroits dans les deux tiers proximaux, arqués au tiers distal, simples, à peines plus longs que l'empodium. Abdomen à poils noirâtres et longs. Taille : 1, 5 mm.—Peradeniya, le 20 mai 1910. Chez le type de ce genre, qui habite les iles Séchelles, les crochets sont deux fois aussi longs que l'empodium.

Lestodiplosis ceylanicus, sp. n.

♀ D'un roux de chair ; flagellum brun, pattes brunâtres, base de l'abdomen avec une tache transparente noirâtre. Antennes de 2+12 articles, les articles du flagellum deux fois aussi longs que gros, rétrécis faiblement au milieu, à verticilles de poils étalés et un peu irréguliers, col au moins aussi long que l'article. Ailes subhyalines, avec des taches violacées et irrisées, dont une grande est située sur la bifurcation de la posticale et s'arrête un peu avant la discoïdale, une autre près de la pointe alaire, entre la discoïdale et le rameau supérieur de la posticale, deux entre le cubitus et le bord antérieur, dont la proximale est située vis-à-vis de la bifurcation de la posticale, en outre un trait le long du lobe alaire et le long des deux rameaux de la posticale ; costale jaune, avec trois taches noires correspondant aux taches du disque, interrompue à sa jonction avec le cubitus, celui-ci presque droit et aboutissant à la pointe alaire, rameau supérieur de la posticale relevé à sa base, fortement arqué sur toute son étendue, rameau inférieur oblique. Pattes à longs poils, surtout les postérieures dont les poils sont 3 à 4 fois aussi longs que la grosseur des pattes. Taille : 1, 5 mm.—Peradeniya, le 26 mai, 1910.

Coprodiplosis (?) inconspicuus, sp. n.

♀ Roux jaune ; flagellum brun, pattes pâles. Articles du flagellum cylindriques, deux fois aussi longs que gros, à col aussi long que l'article, verticilles de poils couvrant tout l'article, verticilles de filets arqués conformés comme chez les mâles, mais beaucoup plus courts, un filet arqué n'atteignant que le tiers de la longueur du col ; 12e article avec un stylet pubescent, mince, égalant la moitié de la longueur de l'article. Ailes longuement poilues, cubitus arqué, aboutissant en arrière de la pointe alaire, les deux rameaux de la posticale obliques. Pattes poilues, crochets petits, simples, sans empodium distinct. Oviducte non proéminent, lamelles allongées, un peu courbées en arc par en bas. Taille : 1, 2 mm.—Peradeniya, en mai (5 exemplaires).

Epidosis ceylanicus, sp. n.

♀ Roux jaune ; flagellum brun noir. Antennes composées de 2 + 11 articles, pas plus longues que la tête et le thorax réunis, premier article du flagellum plus de deux fois aussi long que gros, non soudé au 2e, qui est deux fois aussi long que gros, les suivants de moitié plus longs que gros, sans col distinct, le dernier presque cônique ; verticilles de poils courts, guère plus longs que l'article, verticilles de filaments conformés comme chez *Perrisia*. Ailes longuement poilues et longuement ciliées, cubitus bifurqué proximalement, les deux rameaux également écartés, l'inférieur un peu sinueux, atteignant la base de la posticale, le supérieur court, atteignant le radius, partie distale du cubitus très arquée, aboutissant en arrière de la pointe alaire, les deux rameaux de la posticale obliques, le supérieur deux fois aussi long que l'inférieur. Pattes poilues, crochets tarsaux grêles, simples, sans empodium distinct. Abdomen conique, aussi gros que le thorax, de moitié plus long que le reste du corps, sans longs poils ; segment anal petit, avec deux lamelles très petites. Taille : 2 mm.—Peradeniya.

Lestremia ceylanica, sp. n.

♀ Jaune rougeâtre ; flagellum brun noir. Antennes de 2 + 9 articles, les articles du flagellum sans col, cylindriques, de moitié plus longs que gros, le dernier un peu aminci distalement ; verticilles de poils peu distincts, pas plus longs que l' article. Ailes hyalines, poilues, cubitus rapproché du bord, dépassant notablement le milieu de l'aile, mais n'atteignant pas les deux tiers, 4 à 5 fois plus long que la partie distale du radius ; la discoïdale sort de la base de la posticale, est peu marquée sauf la partie proximale qui est aussi grosse que le cubitus, tige de la fourche sinueuse, bifurcation également distante de l'extrémité du radius et de l'extrémité du cubitus, ses deux rameaux peu divergents, formant une cellule 4 fois aussi longue que large ; transversale courte et oblique ; base du cubitus presque ponctiforme, posticale simple, faiblement marquée, à peu près droite ; anale arquée fortement, aussi grosse que le cubitus. Pattes peu longues, tibia postérieur deux fois aussi long que les deux premiers articles tarsaux, 4e article de tous les tarses non grossi, un peu plus court que le 5e. Abdomen faiblement poilu ; lamelles bi-articulées, 2e article subcirculaire ou en ovale courte. Taille : 1, 5 mm.—Oeuf blanc, allongé, subcylindrique.—Peradeniya, capturé la nuit, à la lumière, le 13 mai, 1910.

BIOLOGICAL SURVEY OF TRINCOMALEE HARBOUR.

By Joseph Pearson.

(With four Charts.)

IN January, 1911, I paid a visit to Trincomalee, where I spent some ten days in surveying the inner harbour with dredges and by means of divers. This work appeared to me necessary, seeing that so many suggestions have been made in recent years regarding the establishment of pearl oyster, sponge, and mother-of-pearl oyster fisheries at Trincomalee.

The harbour is admirably protected from both monsoons and possesses a rich fauna, but neither the pearl oyster nor the commercial sponge thrives. In 1857 Kelaart planted pearl oysters in the bay, but conditions do not appear to have been favourable. Herdman, in 1902, obtained several young oysters and under-sized adults. He noted the low salinity of the water and the small amount of plankton, and concluded that, "while experiments might be carried on at Trincomalee when impossible elsewhere because of weather, the conditions of water and food are probably not so favourable as in the Gulf of Mannar, and would probably not lead to such active growth and shell (including pearl) formation." During my visit I obtained very few pearl oysters, even in those parts of the harbour where conditions are most favourable, and where, therefore, one would naturally expect to find them. All the collected evidence appears to point to the fact that the conditions in Trincomalee harbour are unfavourable to the pearl oyster. On the pearl banks the oyster thrives best in depths between 5 and 8 fathoms, and a hard bottom is essential. The area in Trincomalee harbour in which both these conditions are fulfilled is very small. At the north-east end of the harbour there is a considerable area within the 5-fathom line having a hard bottom. This area is probably too shallow for the successful cultivation of adult oysters, but it is conceivable that an oyster nursery might meet with some success. But the idea of having a nursery so far from the pearl banks does not seem to be practicable, as oyster transplantation of any magnitude would probably be attended by great mortality.

Professor Herdman suggested the possibility of a future sponge fishery at Trincomalee. The commercial sponge is at present a rare member of the fauna of the harbour, and its present distribution very limited. Out of about sixty stations at which dredgings were taken in January the commercial sponge was only present at one or

two, and in the locality where Herdman found the sponge in abundance in 1902 I obtained one specimen.

The trepang, or *bêche-de-mer*, is extremely abundant throughout the bay. In five minutes a small dredge brought up forty-eight specimens of *Holothuria marmorata* at Station 12. This species is the most abundant trepang. Most of the specimens obtained were about 9 inches long and 4 inches broad. Other species well represented are *Holothuria atra* and *Holothuria scabra*. In September, 1911, I saw large numbers of *Holothuria atra* on the eastern shore of the Ostenberg peninsula. *Holothuria scabra* is interesting, because of its colour variation in different parts of the coast. In the Trincomalee and Galle specimens the dorsum is black, with well-defined transverse yellow stripes, and the ventral surface is yellow, with numerous gray mottlings. In the Jaffna specimens the back is gray in colour, and the yellow stripes are generally absent. The ventral surface is yellow, and does not possess the gray patches. The Jaffna variety resembles very closely specimens which I have examined from East Africa, and the "Challenger" specimens described by Théel; upon a superficial examination the two forms appear to be distinct species.

From time to time the trepang fishery at Trincomalee has given rise to a minor industry of no mean importance. In 1902 Herdman witnessed trepang diving operations at Trincomalee. He states that the divers obtained 75 cents per hundred for them. During my January visit I made inquiries, and learned to my surprise that the trepang fishery was no longer carried on. This cannot be due to scarcity of material.

The trepang at Trincomalee are obtained by diving in all depths up to 8 fathoms. This method differs from that practised at Jaffna, where the trepang (*Holothuria scabra*) occurs in the shallow water, which for miles does not exceed a depth of 1 or 2 fathoms. There the bottom is clearly visible from the boat, and when a trepang is seen, it is speared by means of a two-pronged fork attached to a long pole. This method cannot be practised at Trincomalee owing to the greater depths, and hence diving is resorted to.

The Trincomalee divers are much more efficient than those at Tamblegam. The latter do not care to dive at a greater depth than 3 fathoms, and never stay under water more than 8 seconds when working at a depth of 1 or 2 fathoms. The Trincomalee divers work in couples as a safeguard against sharks, and they will go to a depth of 8 fathoms without the aid of weights, which the divers in the Gulf of Mannar always use. I have known them to remain under water for a minute, although the average time is only about half that.

All my work at Trincomalee, with the exception of two shore collecting trips, was conducted from an unseaworthy old pilot boat

manned by a crew of six, one of whom filled the most necessary office of baler. The boat, however, was roomy, and in consequence was much more adapted to dredging work than the ordinary canoe.

Since the investigations were conducted by means of divers and with the dredge, the material collected did not include fishes and other rapidly moving animals. The fishes will be worked out in connection with a general survey of the marine and fresh-water fishes of Ceylon, which I hope to commence in a few months.

Generally speaking, the bottom fauna of the harbour is richest in sponges, corals, and Holothurians. The shore collecting is at present poor in the inner harbour, although it is exceedingly rich in the rock pools on the seaward side of the Ostenberg peninsula. Mollusca and sea anemones are extremely rare. The sponge fauna is surprisingly rich and varied. The specimens collected by me have not yet been worked out, but I have obtained about thirty species. The commercial sponge is rare. With the exception of Alpheids, which were extracted from the sponge masses, the crustaceans obtained were small in number, and consisted mainly of Callianassids and Stomatopods, which also frequent the cavities of sponges. Crustaceans are, however, a common feature of the fauna, although very few were caught in the dredge. In the shallow water at the north end of the harbour Peneids are very abundant, especially *Peneus indicus*.

Four charts of Trincomalee harbour are appended—

(1) Giving the positions of the fifty-nine stations at which dredging and diving operations were conducted.

(2) Giving the depths and nature of the bottom in various parts of the harbour.

(3) Giving the present distribution of the Holothurians (trepang). It will be seen from this that the trepang is more abundant in the northern half of the harbour, and that it is almost completely limited to that part of the harbour inside the 8-fathom line.

(4) Giving the distribution of sponges of all species. Practically no commercial sponges are present, but otherwise the sponge fauna is exceedingly rich and varied, and they occur within the 8-fathom line, on much the same ground as that occupied by the trepang.

I give below an account of the results of the dredging. Many of the specimens still await identification, but sufficient information is available regarding depth, nature of bottom, and general fauna to guide the biologist in questions relating to the possibilities of Trincomalee harbour in connection with the various schemes to which reference has been made above.

January 17, 1911.

Station 1.—Three-quarter mile west of Little Powder Islands. About 300 yards from shore, half a mile from smallpox hospital.

Depth, 3 fathoms. Bottom, sand and lot of *Halimeda*.

One *Holothuria marmorata*. Many *Synapta striata* living in sponges. Few Callianassids. Few *Gonodactylus glabrous*. Few *Alpheus audouini* living in sponges. Many sponges of different colours (*Megalopastas nigra*, *Acanthella carteri*, &c.). Few crabs and starfishes. Sipunculids in sponges.

Station 2.—Half a mile west of Little Powder Islands.

Depth, 4 fathoms. Bottom, sand and little *Halimeda*.

Few *Synapta striata* living in sponges. One specimen of *Metapeneus monoceros*. Many sponges (similar to Station 1). Few crabs.

Station 3.—250 yards east of Station 2.

Depth, 5 fathoms. Bottom, sand and few stones.

The dredge caught almost immediately in the sand. From a rowing boat it is sufficient to stop the boat if the dredge dip into the soft sand.

Several *Holothuria scabra*. Several *Holothuria marmorata*. Few sponges.

Station 4.—Quarter mile north-west of Little Powder Islands.

Depth, 5 fathoms. Bottom, sand.

Several *Holothuria marmorata*. One *Stichopus chloronotus*. Many sponges of various colours (similar to those at Station 1). Few crabs.

Station 5.—500 yards north-north-west of York Island.

Depth, 6 fathoms. Bottom, sand and coral.

Few *Holothuria marmorata* and sponges. Several Echinoids, among which one is deserving of special mention. It was as large as an orange, and was dark brown in colour, with the exception of the spines, which were lighter in colour, and varied from dark brown at the base of each to white at the tip. The test was remarkably soft. The spines were said to be poisonous by the boatmen. Living amongst the spines were two small shrimps, which afforded an excellent example of colour protection. They were brown in colour, with a white stripe along the rostrum and down the middle of the back. The legs were also white. So far as I have determined from a hasty inspection, the shrimps belong to the genus *Anchistus*.

January 18, 1911.

Station 6.—Opposite Admiralty House, 200 yards from shore and half a mile north-east of York Island.

Depth, 3 fathoms. Bottom, sand.

Large green sponge full of small Ophiuroids and Sipunculids. Numerous light violet sponges. Two specimens of *Conchodytes meleagrinæ* from *Pinna*. Some coral.

Station 7.—Half a mile west of York Island.

Depth, 6 furlongs. Bottom, sand.

Holothuria scabra. *Stichopus chloronotus* with living crab and a *Fierasfer* taken from cloaca. Large quantity of a weed-like sponge,

dichotamously branched, black in colour, having small bunches of spicules projecting from the surface. Probably an *Axinella*. Other sponges as in Station 6.

Station 8.—Quarter mile north-east of York Island.

Depth, 3 fathoms. Bottom, sand.

Branched sponge, probably *Plocamia manaarensis*. Dichotamous weed-like sponge (*Axinella*).

Station 9.—Opposite Dockyard, 200 yards from shore, half way between York Island and Ostenberg Point.

Depth, 8 fathoms. Bottom, mud and sand.

One *Holothuria scabra*.

Station 10.—South end of Dockyard, 200 yards north-east of Ostenberg Point.

Depth, 12 fathoms. Bottom, rock and sand.

Nothing.

Station 11.—In a line between the Naval Hospital and the south end of York Islands, half way across the channel.

Depth, 5 fathoms. Bottom, sand.

Nothing.

Station 12.—500 yards north-east of Station 6.

Depth, 3 fathoms. Bottom, sand.

Forty-eight large specimens of *Holothuria marmorata*. Purplish-gray sponge in abundance. Yellow sponge.

Stations 13 and 14.—Starting half way between York Island and Powder Rocks and steering for Powder Rocks.

Depth, 5 to 8 fathoms. Bottom, sand and coralline.

Nothing.

January 19, 1911.

Station 15.—Nicholson's Cove, half way down the bay.

Depth, 6 fathoms. Bottom, small stones and sand.

Madrepora scandens. Corals and sponges in abundance. A blue branched sponge (*Petrosia similis*) very abundant, attached to stones. One commercial sponge.

Station 16.—Nicholson's Cove. Nearer the head of the bay than Station 15.

Depth, 2 fathoms. Bottom, sand.

Few broken shells. Few Spatangoids. *Metapeneus mogiensis*. *Alpheus bucephalus*. Small specimen of *Holothuria marmorata*.

Station 17.—Quarter mile south-east of Powder Islands.

Depth, 2 fathoms. Bottom, sand.

Large number of *Holothuria marmorata*.

Station 18.—Quarter mile south-west of Station 17.

Depth, 3 fathoms. Bottom, sand and stones.

Several *Holothuria marmorata*. One *Holothuria scabra*. Yellow sponge, containing *Synapta striata*.

Station 19.—500 yards east-north-east of Powder Rocks.

Depth, 5 fathoms. Bottom, sand and stones.

Holothuria marmorata. Holothuria scabra. Stichopus chloronotus. Yellow sponge, containing *Synapta striata.* Numerous sponges, including *Megalopastas nigra, Acanthella carteri,* and *Siphonochalina* sponges.

Station 20.—Quarter mile north of Powder Rocks.

Depth, 5 fathoms. Bottom, sand and stones.

Large number of *Holothuria marmorata.* Numerous extremely young specimens of *Synapta striata.* Blue Ophiuroids.

January 20, 1911.

Station 21.—Yard Cove, 300 yards north of Plantain Point.

Depth, 2½ fathoms. Bottom, sand and stones.

Dredge full of sand. Yellow sponge, containing *Synapta striata.* One Spatangoid.

Station 22.—Yard Cove, 500 yards north-north-east of Plantain Point.

Depth, 2½ fathoms. Bottom, sand and lot of *Halimeda.*

Two *Holothuria marmorata.* Coral containing several shrimps, including *Periclimenes.* Black sponge (*Megalopastas nigra*), containing numerous Alpheids (*Alpheus bis-incisus*). *Saron gibberosus. Conchodytes meleagrinæ* from *Pinna.* Commercial sponge (*Euspongia officinalis*). Several other sponges. Yellow sponge, containing Sipunculids.

Station 23.—In narrow part of Yard Cove, about three-quarter mile north of Plantain Point.

Depth, 2½ fathoms. Bottom, sand.

One *Stichopus chloronotus.* Several *Holothuria marmorata.* Two large Echinoids. Several small fishes. Large number of sponges, including *Megalopastas nigra, Hippospongia clathrata,* and others. *Synapta striata* in yellow sponge. Sipunculids, Ophiuroids, and Polychæte worms in sponges.

Station 24.—Central channel of Yard Cove, 250 yards south-west of Station 23.

Depth, 2½ fathoms. Bottom, sand.

Several *Holothuria marmorata.* One *Holothuria scabra.* One large *Peneus semisulcatus.* Many sponges containing *Synapta striata,* Ophiuroids, Sipunculids, and Polychætes.

Station 25.—300 yards north-west of Plantain Point, in central channel of Yard Cove.

Depth, 5 fathoms. Bottom, sand.

Several *Holothuria marmorata. Alpheus audouini* and Sipunculids in sponge masses. Generally speaking, the southern half of Yard

Cove has rock and stones covered with sponges and *Halimeda* near the shore, and sand with abundance of sponges and Holothurians in the channel.

Station 26.—Cod Bay, 300 yards north of Middle Point.

Depth, 4 fathoms. Bottom, sand and stones.

Numerous *Holothuria marmorata*. Numerous sponges, including *Acanthella carteri*, *Megalopastas nigra*, *Phakellia donnani*, &c. Two large prawns, *Peneus monodon*. *Synapta striata* and various worms in yellow sponge.

Station 27.—Centre of Cod Bay, half a mile north-north-west of Middle Point.

Depth, 6 fathoms. Bottom, mud and sand.

Several *Holothuria marmorata*.

Station 28.—Cod Bay, 200 yards south-east of Mangrove Islands.

Depth, 4 fathoms. Bottom, mud and sand.

Several *Holothuria marmorata*. Small crab with two large lateral spines on carapace; large yellow sponge, containing worms, Alpheids, and Ophiuroids.

Station 29.—Cod Bay, 200 yards south-west of Mangrove Islands.

Depth, 3 fathoms. Bottom, mud and sand.

Several *Holothuria marmorata*. Several small Gastropods (*Pterocera*). General. The fauna of Cod Bay is similar to that of Yard Cove. In both localities there are great numbers of trepang.

January 21, 1911.

Station 30.—500 yards north-west of Powder Rocks.

Depth, 6 fathoms. Bottom, sand and stones.

Holothuria atra. *Megalopastas niger*, containing several crabs (*Dromia*). Few star fishes (*Astropecten zebra*).

Station 31.—In a line between Plantain Point and Powder Rocks, half a mile from the latter.

Depth, 8 fathoms. Bottom, sand.

The dredge ploughed immediately into soft sand and anchored the boat. Nothing.

Station 32.—Nearly half a mile east-south-east of Plantain Point.

Depth, 7 fathoms. Bottom, sand.

Holothuria marmorata. *Holothuria atra*. *Stichopus chloronotus*. Numerous young *Synapta striata* in sponge masses. Large *Rhizostomid medusa*. Various sponges, including *Acanthella carteri*, *Aulospongus tubulatus*, &c. Green colony of *Bugula* (?). *Saron gibberosus*. *Synalpheus minus* in large quantities in cavities of sponges.

January 23, 1911.

Station 33.—1,000 yards south-south-west of Powder Rocks.

Depth, 11 fathoms. Bottom, rock at beginning and sand further south.

At this and the next two stations the soft sand made dredging a very difficult operation. The dredge anchored the boat several times, and when brought up was full of sand. Hence representative hauls at Stations 33, 34, and 35 were not obtained. At Station 33 only a few small crabs and broken shells.

Stations 34 and 35.—Continuing the line of Station 33 and dredging towards Small Sober Island.

Depth, 13 to 18 fathoms. Bottom, sand.

At both stations the dredge stuck in the sand and nothing was obtained.

Station 36.—Along north end of Sober Island, near shore.

Depth, 8 to 10 fathoms. Bottom, rock, stones, and sand.

Many Echinoids of a deep peacock blue colour. Several *Astropecten zebra*. *Holothuria marmorata*. Many sponges, containing Alpheids (*Alpheus minus*, *Alpheus bis-incisus*), *Synapta striata*, *Dromia*, worms, brittle stars, and Callianassids. *Metapeneus mogiensis*. One specimen of a solitary coral. Many broken shells and *Halimeda*.

Station 37.—Malay Cove, nearly half a mile south-west of Round Point.

Depth, 7 fathoms. Bottom, gravel and stones.

One *Holothuria marmorata*. One *Cucumaria imbricata*. One *Parapeneus stylifera* (?). Several *Astropecten zebra*.

Station 38.—Malay Cove, half a mile south of Round Point, near the shore of Sober Island.

Depth, 5 fathoms. Bottom, gravel and stones.

Numerous sponges and *Halimeda*. Alpheids, worms, and brittle star fishes mixed with the sponges. Many blue Echinoids. *Holothuria marmorata*. This haul is very similar to the one at Station 36.

Station 39.—Centre of Malay Cove, 600 yards west of Station 38.

Depth, 4 fathoms. Bottom, sand.

Very similar to Stations 36 and 38, but no blue Echinoids present. Large Ophiuroids and several compound Ascidians. Numerous *Synapta striata* in the sponges.

Station 40.—In Orlando Cove, between the north-east side of Sober Island and Small Sober Island.

Depth, 7 fathoms. Bottom, sand.

Many shrimps (*Periclimenes spinigerus*), on a large dark purple sponge. This sponge was peculiar in having a sticky jam-like secretion, which stained the hands.

Station 41.—Off south-east side of Small Sober Island, about 300 yards from shore.

Depth, 9 fathoms. Bottom, sand and gravel.

Many sponges, including black, purple, and brick-red. *Alpheus bis-incisus* in crevices of yellow sponge. Several corals. Many Sipunculids and Polychætes from interior of the sponge.

Station 42.—Off south end of Small Sober Island, opposite channel between Sober Island and Small Sober Island.

Depth, 9 fathoms. Bottom, rock and stones.

Stichopus chloronotus. Several sandy Ascidians. Two sponges.

Station 43.—300 yards south-west of Station 42, off south end of Sober Island.

Depth, 9 fathoms. Bottom, stones.

Several blue Echinoids, similar to those obtained at Station 36. Several sponges, including dark purple sponge found at Station 41. A dark green sponge and a yellow sponge containing Alpheids and worms.

January 24, 1911.

Station 44.—300 yards south-east of Plantain Point.

Depth, 7 fathoms. Bottom, sand.

Stichopus chloronotus. Holothuria scabra. Synapta striata in yellow sponge. Many sponges, including *Megalopastas nigra*, *Siphonochalina*, *Acanthella carteri*, &c. *Synalpheus neomeris* from sponges.

Station 45.—Across the mouth of China Bay, half a mile south-south-west of Plantain Point.

Depth, 10 fathoms. Bottom, sand.

Several *Holothuria scabra*, some of which differ from the ordinary striped form found in Trincomalee and resemble the kind found at Jaffna. *Astropecten zebra.* A brick-red sponge.

Station 46.—China Bay, nearly half a mile north-west of Round Point.

Depth, 9 fathoms. Bottom, sand.

The dredge came up full of sand, and contained a few crabs and empty bivalves.

Station 47.—China Bay, about 600 yards west-north-west of Round Point, 200 yards from the shore opposite Mount Challenger.

Depth, 7 fathoms. Bottom, sand.

One *Holothuria nigra.* A few young specimens of *Astropecten zebra.*

Station 48.—China Bay, 200 yards north of Round Point.

Depth, 6 fathoms. Bottom, sand, stones, and coralline.

Masses of a dichotamous coral-coloured alga. Coral of various species. Many sponges of various colours. *Synapta striata* in yellow sponge. Few crabs.

Between this Station and Station 47 there is a coral reef with masses of coral and sponges. Numerous "coral fishes" were seen.

Station 49.—China Bay, nearly one mile north-west of Round Point. Similar distance south-west of Plantain Point.

Depth, 6 fathoms. Bottom, hard sand and *Halimeda.*

Nothing but *Halimeda* and a large mottled orange sponge.

Station 50.—China Bay, nearly one mile almost due east of Plantain Point.

Depth, 5 fathoms. Bottom, hard sand and *Halimeda*.

Two *Holothuria marmorata*. Yellow sponges with *Synapta striata*. *Acanthella carteri* and *Plocamia manaárensis* and other sponges. White Nudibranch with purple spots. Small Gastropod (*Pterocera*). *Halimeda*.

Station 51.—China Bay, quarter mile south-west of Middle Point.

Depth, 4 fathoms. Bottom, sand and stones.

Petrosia similis, a blue sponge. Several small crabs. Little *Halimeda*.

Station 52.—Opposite entrance to Yard Cove, 600 yards west of Plantain Point.

Depth, 7 fathoms. Bottom, sand.

Four *Holothuria marmorata*. A few common sponges.

Station 53.—600 yards west-south-west of Powder Rocks.

Depth, 8 fathoms. Bottom, sand and gravel.

Several flat Clypeastroids about 1½ inch across. Few *Holothuria marmorata*. Few *Holothuria scabra*. *Metapeneus mogiensis*. *Synapta striata* in sponge masses. Various common sponges.

Station 54.—Half a mile north-east of Round Point.

Depth, 10 fathoms. Bottom, sand and gravel.

Nothing but pieces of a *Virgularia*-like Alcyonarian.

Station 55.—500 yards east of Round Point.

Depth, 14 fathoms. Bottom, soft mud.

Nothing in dredge.

January 29, 1911.

Station 56.—Clappenberg Bay, south end of French Pass in mid-channel.

Depth, 10 fathoms. Bottom, sand.

Many blue Echinoids. *Holothuria marmorata*. *Saron gibberosus*. Sponges containing *Synalpheus minus*. Red dichotamous seaweed. *Halimeda*. Several small shrimps (*Periclimenes ?*). Large circular Foraminifera (*Orbitolites*). Black dichotamously branched sponge (*Axinella ?*). Several small Clypeastroids. Sandy Ascidians. Crabs, shells, &c.

Station 57.—Middle of French Pass.

Depth, 5 fathoms. Bottom, sand.

Few sponges and shells. *Metapeneus mogiensis*. Few Clypeastroids.

Station 58.—South end of French Pass.

Depth, 7 fathoms. Bottom, sand.

Three *Holothuria marmorata*. A few sponges.

Station 59.—Clappenberg Bay, half a mile west-north-west of Clappenberg Point.

Depth, 8 fathoms. Bottom, sand.

Several *Holothuria marmorata*. One small Clypeastroid. Many sponges, including *Megalopastas nigra*. *Phakellia donnani*, &c. *Gonodactylus glabrous*.

Shore collections were made on two occasions, once on the shore of Powder Islands and once near Admiralty House. In both places the conditions are much the same, and the shore consisted mainly of muddy sand, on which were scattered boulders of various sizes. On the whole, the shore fauna was very poor, and contrasted strongly with the rich and varied fauna found in the rock pools on the other side of the Ostenberg peninsula. The latter locality is probably one of the best places in the Island for shore collecting. At the two stations in Trincomalee harbour the predominant features were the masses of black sponges encrusting the stones and containing numerous Alpheids and Callianassids, Dromiids, Sipunculids, Ophiuroids, and Polychæte worms. So far as I can determine, the sponge is *Megalopastas nigra*. This sponge appears to have two predominant forms, the commonest being massive and rounded, and the other being digitate. The Alpheids all proved to be *Alpheus audouini* and *Alpheus bis-incisus*. A few specimens of *Saron gibberosus* were also obtained. Several large Turbellarians were obtained under stones. There was a complete absence of Anemones. Shore crabs and land crabs were also found, as well as *Periopthalmus*. A few rock oysters were found, and large numbers of a small Gastropod (*? Cerithium*).

Explanation of the Charts.

(Scale of all the Maps is 1 Nautical Mile = 2 Inches.)

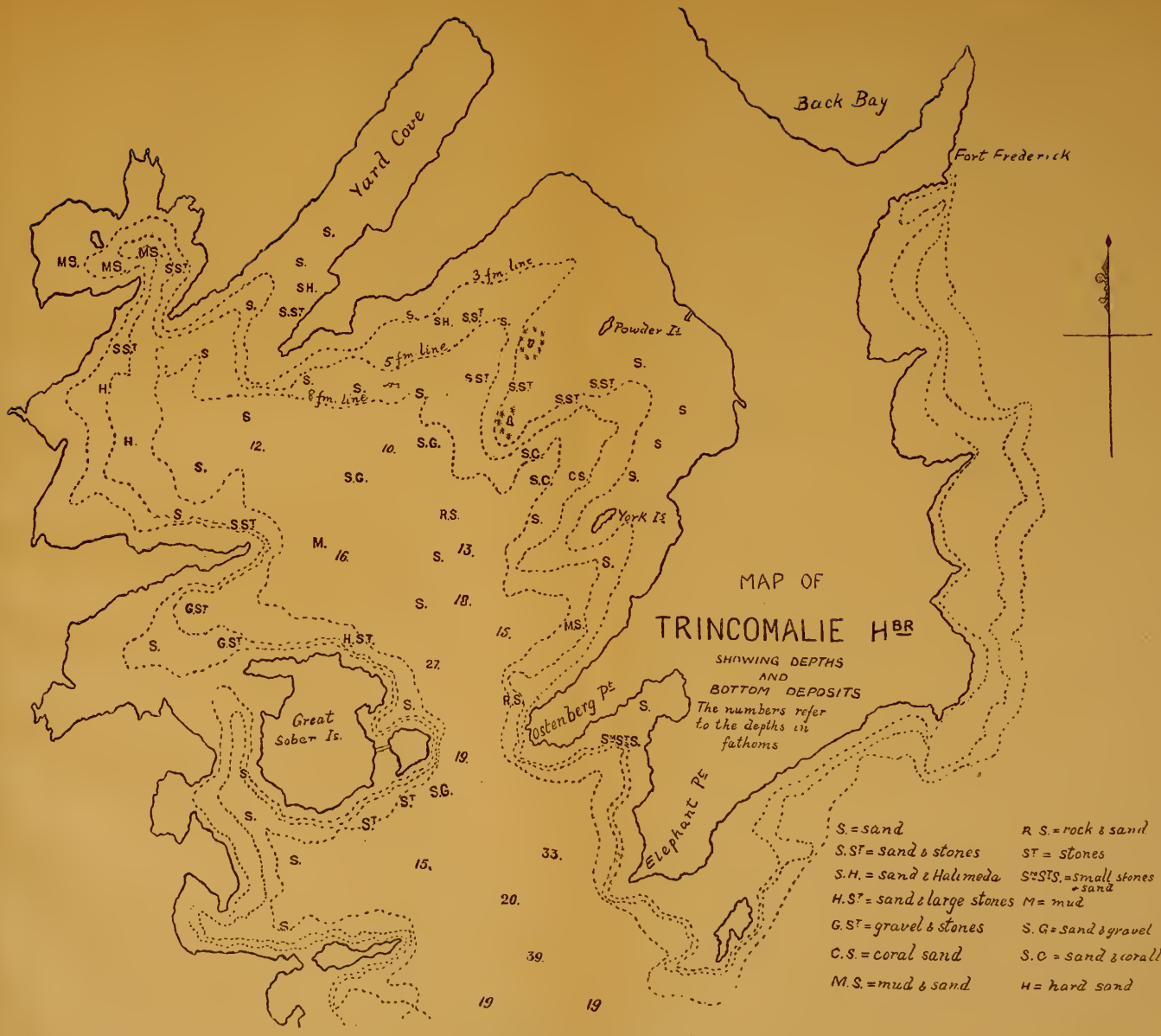
Chart 1.—Map of Trincomalee harbour, giving position of the stations referred to in the present report.

Chart 2.—Map of Trincomalee harbour, giving depths and bottom deposits.

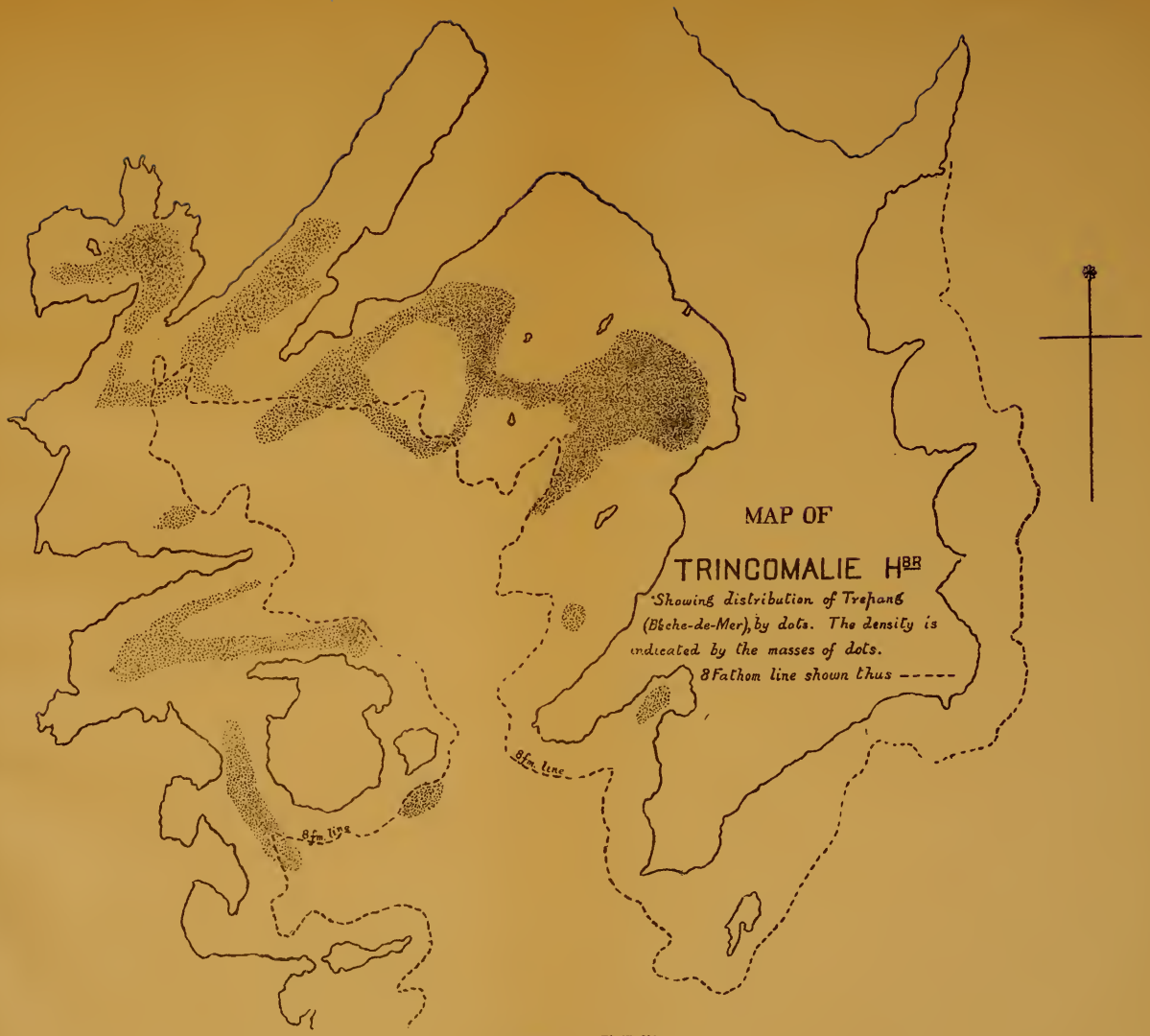
Chart 3.—Map of Trincomalee harbour, giving the distribution of trepang.

Chart 4.—Map of Trincomalee harbour, giving the distribution of sponges of all species.

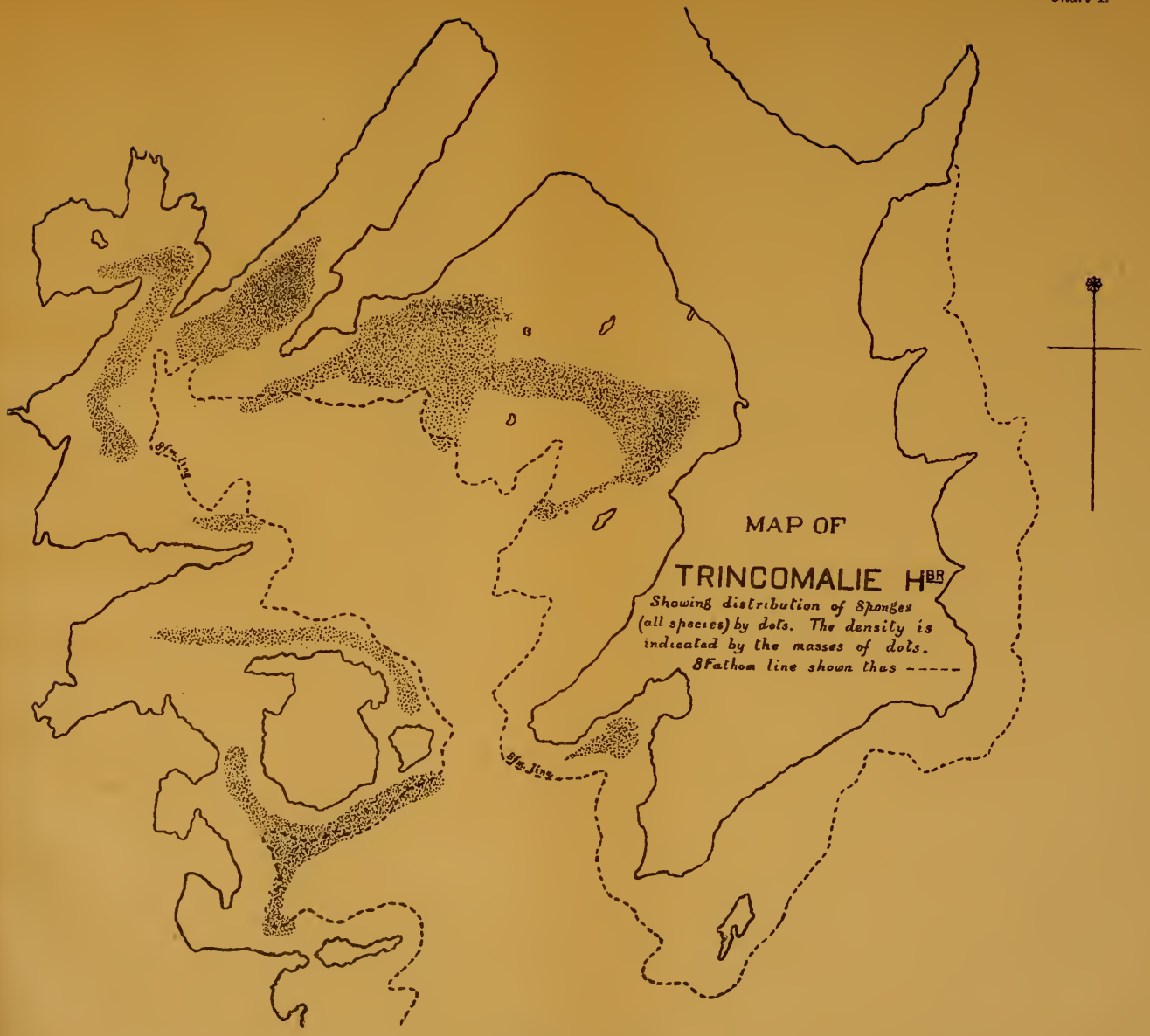
POSITION OF STATIONS.



DEPTHS AND BOTTOM DEPOSITS.



DISTRIBUTION OF TREPANG.



DISTRIBUTION OF SPONGES.

SURVEY OF LAKE TAMBLEGAM, SEPTEMBER, 1911.*

By Joseph Pearson.

(With seven Charts.)

LAKE TAMBLEGAM covers an area of about seven square miles, and is connected with the large outer bay of Trincomalee by a narrow channel some hundreds of yards across. The specific gravity of the water varies considerably with the season of the year, owing to the number of rivers flowing into the lake. In September, after months of dry weather, the specific gravity is about the same as in the open sea. The floor of the lake consists of a level stretch of soft gray mud brought down by the rivers, and over the greater part of the lake the depth does not exceed one fathom. It is upon these mud beds that the windowpane oyster (*Placuna placenta*) finds its natural habitat.

The main conditions under which this mollusc lives may be summarized as follows: (1) High temperature of the water owing to the shallowness. This high temperature is varied by inrushes of cold river water during the wet season. (2) Soft, slimy mud, upon which the oyster rests by means of its lower convex valve. According to Hornell, the shell sometimes is implanted in the mud in a vertical position, like a *Pinna*. The divers say that the young oysters rest on the top of the mud, while the adult oysters become almost imbedded in the mud. (3) The water is never clear, and always contains a lot of mud in suspension. This is particularly the case from May to January, when the rough sea churns up the soft mud. From October to December this is aggravated by an inrush of fresh water carrying a large amount of mud in suspension. This latter period is probably the most critical time of the year.

* The chief literature dealing with Lake Tamblegam is as follows :—

1857.—Kelaart. Report on the Tamblegam Pearl Oysters, 8vo., 6 pp. Trincomalee.

1906.—Hornell. Report on the *Placuna placenta* Pearl Fishery of Lake Tampalakamam. "Ceylon Marine Biological Reports," Part II., No. 2. Colombo.

1907.—Willey. Report on the Windowpane Oysters in the Backwaters of the Eastern Province. *Spolia Zeylanica*, Vol. V., Part XVII.

1908.——— Placuna Fishery. Inspection of March, 1908. *Spolia Zeylanica*, Vol. V., Part XIX.

1908.——— Ceylon Administration Reports (Marine Biology).

1909.——— Ceylon Administration Reports (Marine Biology).

The divers say that a great inrush of fresh water kills the oysters. It is impossible to say at present what truth there is in this statement, since the inrush of fresh water synchronizes with the presence of an abnormal amount of mud and gritty sand in suspension.

The windowpane oyster fishery formerly gave employment to a large number of divers, and added an annual sum of about Rs. 5,000 to the revenue of the Island. Since 1890, however, there has been no successful fishery, and the divers of Kiniyai and Tamblegam have had to look elsewhere for a means of living. The object of the recent work of Willey and Hornell has been to discover the reason of this decline and, if possible, to suggest remedies. Their work, therefore, has consisted of investigating the bionomics and life-history of *Placuna;* and the survey of Lake Tamblegam, which I have just completed, bears on these points.

The main object of the scientific work at Lake Tamblegam is to restore the windowpane oyster fishery to its former prosperous condition. As a starting point in such an investigation, it is necessary to determine the distribution, rate of growth, period of maturity, and frequency of spawning of *Placuna placenta*. At present we are in ignorance of all these points, with the exception of the distribution. Even our knowledge of this highly important item has rested mainly on the statements of the local fishermen and divers. It is only too true that they know exactly where oysters are to be found, but that information is not definite enough for purposes of exact record. A systematic survey of the lake should be made every year, as the information thus gained is of the utmost value in the solution of all the other problems. No such survey appears to have been made hitherto. Hornell's survey of 1905 consisted of a series of irregular lines of divings at various places in the lake, which, though of value, were not detailed enough. My visit to Tamblegam in September, 1911, was for the purpose of making a thorough survey of the lake. Two canoes were employed, one in charge of Mr. George Henry, my Assistant, and the other occupied by myself. A series of parallel lines of divings were made, which were sufficiently numerous to ensure that no large area of the lake escaped examination. In all 161 stations were examined, and at each station two divers made at least a dozen descents. The results of these operations are appended, and a series of charts compiled from those results are given, showing amongst other things the depth, nature of bottom, distribution of living oysters, and distribution of dead oysters.

Placuna placenta can live best on soft mud, in depths varying from $\frac{3}{4}$ fathom to about $1\frac{3}{4}$ fathom. From this information the potential area of the lake has been determined, *i.e.*, the area upon which the oysters can grow. This potential area is more than half the area of the lake, and includes practically the whole of the central part of the lake, together with a small patch near the head of Nachchikuda and scattered patches in the south-western corner. The large central

portion is bounded by lines drawn between Sinna Vellaikalmunai and Kodaipota on the east, and between Peyaddaimunai and Kakamunai on the west.

Hornell's Palamput bed should be farther west, in order to coincide with the potential area of that part of the bay as determined from my observations in September, 1911. The position of Kapalturai bed as defined by Hornell should be about half a mile farther south than what he has indicated, and it appears to be joined to the so-called Kakamunai bed of Hornell. This latter bed is made up of the following beds referred to in Willey's Administration Report (Marine Biology), 1909 :—

(1) *Sembianar Motuaram*, off the mouth of the Sembian-aar.
(2) *Kakamunai*, north-west of Kakamunai Point.
(3) *Polokarai-aru Motuaram*, between (1) and (2).
(4) *Sembianar Vilangu*, an offshore bed lying to the north of (2) and (3).

This division of the beds is recognized by the fishermen and divers, but so far as I can determine from the results of my survey there is practically one large bed covering the whole of the central part of the lake, which is especially productive in the southern portion of this area.

At present the northern half of this area (see Charts 5 and 6) is barren, and contains nothing but dead shells, which in some parts are very abundant. In the southern half there is a fairly large bed of young oysters, about 3½ inches in the greatest diameter. The age of these oysters is uncertain, but it is probable that they are at least twelve months old. It is interesting to note that in January, 1911, practically no oysters were reported from this area. Eight months later the divers reported the presence of a flourishing bed of young oysters. It is possible that these oysters were present in January as extremely small spat, which escaped the notice of the divers. I questioned both the Government watcher and the divers about this, and they were all confident that the oysters were not present during the January inspection. One is absolutely dependent upon the reports of the divers, as dredging in the soft mud would be quite impossible, and consequently there is no way of discovering errors.

I propose to return to Tamblegam in January, 1912, in order to transplant some of these young oysters to other parts of the lake which are barren at present. This new bed of young oysters will not be sufficient to justify a fishery in two years or so, but they will prove of the greatest value for the purposes of a transplantation experiment. I propose to enclose small areas of about 300 square yards upon the following beds :—Palamput, Kakamunai, Sembianar Vilangu, Nachchikuda, and Kapalturai. Young oysters will be planted in these areas, and it will then be possible to keep the oysters

under close and accurate observation, and spawning centres will be established in all parts of the lake.

The following is an indication of the main lines which future work at Lake Tamblegam should follow.

Distribution.—Yearly systematic inspections, similar to the one described in this report, should be made; and based upon the results of these inspections charts showing distribution of living oysters and dead shells should be drawn up. For purposes of comparison such charts would be extremely useful.

Age.—By having these regular annual surveys much information about the condition of the beds might be obtained. Thus a fall of spat could be detected and the subsequent development of the bed of oysters determined. From these records it would be an easy matter to compute the age of the oysters on any particular bed.

Rate of Growth.—By taking measurements of oysters recorded at the various stations it would be possible with successive inspections to determine the average rate of growth. After a sufficient number of observations had been made it will be possible to correlate age and size. This knowledge would be of great practical value.

Age of Maturity.—This could be determined by an examination of the reproductive organs, and correlating this with the age and size of the oyster.

Spawning Period.—The evidence with regard to this should be derived from three sources :—

(1) Frequent examinations, to determine the ripeness of the gonads.
(2) Frequent tow nettings, to find out the period of the year when the *Placuna* larvæ occur in the plankton.
(3) Determining the probable date of spatfalls.

In addition to the above, some protection of the oysters against the unreasonable rapacity of man must be ensured. This is particularly important in the case of adult oysters with ripe gonads. In an ordinary case the problem would be a comparatively simple one, and would merely require a knowledge of the spawning period of the oyster, and protection could be afforded by establishing a close season during that period, and also by the formation of a few reserve areas. In the case of the windowpane oyster at Tamblegam, however, the stress of weather from May to January practically makes diving during those months prohibitive, and fishing is necessarily confined to the first five months of the year. Hence there is a natural close season extending over more than half the year, so that Hornell's recommendation that the fishing season should be limited to the period between January 15 and May 15 is perfectly sound, although made without any knowledge of the spawning period of the oyster, but merely on the local conditions of weather. Even should it be shown upon further investigation that spawning takes

place during the fishing season no changes need be made, except to provide small reserves upon each bed.

It is very important that reserves should be laid down, upon which diving should not be allowed even in the season. These reserves need not be large, but they would be of great value as spawning centres after the main beds have been depleted. This is the only way of protecting the beds from being ruthlessly over-fished.

Further knowledge is required regarding the age and rate of growth of *Placuna*. Hornell agreed with Kelaart that the largest oysters, measuring 7 inches by 6 inches, are about three years old, and do not live to a greater age. On the other hand, Willey was of the opinion, after three years' work, that the mature pearl-bearing oyster is from three to six years old. Willey recognized seven stages, as follows :— *Spat*, the first sedentary stage, with a major diameter varying from $\frac{1}{2}$ inch to 2 inches ; *placunet*, from 2 to 3 inches ; *yearling*, from 3 to $4\frac{1}{2}$ inches ; *adolescent*, up to $5\frac{1}{2}$ inches ; *first adult*, up to $6\frac{1}{2}$ inches, about three years old ; *second and third adult*, up to 7 or 8 inches.

Hornell recommended a size limit of $5\frac{1}{2}$ inches in the shortest diameter. Willey has pointed out the difficulty of proposing a size limit, since most of the superficial growth takes place in the first two years, after which the growth is mainly concerned with the thickening of the shell. It is much more satisfactory to know the age of a bed of oysters, which can be ascertained by making frequent systematic inspections in the manner I have indicated. Willey has shown that the mature oysters in the lake are probably all of the same age. If this be the case, it is much safer to determine the age of the bed of oysters, and to prohibit its being fished until the proper time. In this way the need of a size limit is obviated. Willey suggested that the number of oysters obtained at a fishery should be limited, in order to prevent over-fishing. There appear to be difficulties in the way of such a proposal, and a much more satisfactory plan appears to be the establishment of reserves.

The diving at Tamblegam is done by Moormen. After witnessing the diving operations on the pearl banks or in Trincomalee harbour, one is not impressed by the attainments of the Tamblegam diver. They do not care to dive in more than 3 fathoms, and they can only stay down for about eight seconds, even when diving in a depth of 1 fathom. They do not, of course, use any rope or stone. They simply turn a somersault in the water, and the last one sees of them as they disappear is their feet. Owing to the abundance of soft mud the water is never clear enough to see the bottom, even when the depth is less than a fathom. In rough weather the water contains a large amount of mud in suspension, which renders the work of the divers very difficult, and they are reduced to feeling for the oysters. Whenever diving operations are in progress, the boat is anchored by a long pole being plunged into the mud from the bow of the boat.

This is a ready and effective method of anchoring the boat, even in the roughest weather. In those parts of the lake where sharks are supposed to abound, the boatmen scare away these dreaded creatures during diving operations by knocking a paddle against the side of the boat. The boats used are ordinary dugouts, which do not have outriggers. The type of paddle used is used in various parts of Ceylon, and consists of a long pole, to which is attached a circular piece of wood, which acts as the blade. No rowlocks are present, and the oar is attached to the side of the boat by means of a rough hemp rope.

The following are the results of the diving operations from September 4 to 8, 1911, giving the depths, nature of bottom, and the presence or absence of *Placuna* :—

Station 1.—$\frac{1}{2}$ fathom. Black mud. Nothing.

Station 2.—$\frac{1}{2}$ fathom. Black mud and weed. Dead *Placuna** shell (5 × 5 approx.).

Station 3.—$\frac{2}{3}$ fathom. Brown mud and weed. One dead cockle. Several dead *Placunæ* (5 × 5).

Station 4.—$\frac{2}{3}$ fathom. Brown mud and weed. Several small dead Gasteropods. One living *Placuna* ($4\frac{1}{2} \times 3\frac{1}{2}$). No pearls.

Station 5.—$\frac{1}{2}$ fathom. Black mud. Nothing.

Station 6.—1 fathom. Black mud and weed. Nothing.

Station 7.—$1\frac{1}{2}$ fathom. Black mud and weed. One dead shell (5 × 5 approx.). One living *Placuna* ($2\frac{1}{2} \times 2\frac{1}{2}$). No pearls.

Station 8.—1 fathom. Mud and weed. Nothing.

Station 9.—$\frac{3}{4}$ fathom. Mud. Dead *Placunæ* scanty.

Station 10.—$\frac{1}{2}$ fathom. Mud. Nothing.

Station 11.—$\frac{3}{4}$ fathom. Mud. Nothing.

Station 12.—$\frac{3}{4}$ fathom. Mud and sand. Nothing.

Station 13.—$\frac{3}{4}$ fathom. Sand. Nothing.

Station 14 (= Hornell's Station 14*a*). — $1\frac{1}{4}$ fathom. Mud. Nothing.

Station 15 (= Hornell's Station 17). — $1\frac{1}{2}$ fathom. Mud. Nothing.

Station 16 (= Hornell's Station 16). — $1\frac{1}{4}$ fathom. Mud. Nothing.

Station 17.—$1\frac{1}{2}$ fathom. Sand. Nothing.

Station 18 (= Hornell's Station 18*a*). — $1\frac{1}{2}$ fathom. Sand and mud. Nothing.

Station 19.—$1\frac{1}{4}$ fathom. Sand and mud. Nothing.

Station 20.—$1\frac{3}{4}$ fathom. Mud and shell débris. Dead *Placunæ* very plentiful ($4\frac{1}{2} \times 4\frac{1}{2}$).

Station 21 (= Hornell's Station 18*b*).—2 fathoms. Brown mud with shell fragments. Nothing.

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* NOTE.—"Dead *Placunæ*" means empty shells. The sizes of the shells are given in inches.

Station 22.—2 fathoms. Brown mud and shell fragments. Dead *Placunæ* ($4\frac{1}{2} \times 4\frac{1}{2}$).

Station 23 (= Hornell's Station 13*a*).—2 fathoms. Brown mud with fine shell fragments. Red Alcyonarian.

Station 24 (= Hornell's Station 12).—2 fathoms. Black mud. Red Alcyonarian. Dead *Placuna* ($4\frac{1}{2} \times 4\frac{1}{2}$).

Station 25.—$2\frac{1}{2}$ fathoms. Black mud. Red Alcyonarian. Dead *Placunæ*, several (5×5).

Station 26.—$1\frac{1}{2}$ fathom. Black mud. Dead *Placunæ*, several, broken (5×5).

Station 27.—$\frac{3}{4}$ fathom. Dead *Placunæ* very abundant.

Station 28. — $\frac{1}{2}$ fathom. Sand, shell débris, *Caulerpa*, sp. Nothing.

Station 29.—$\frac{3}{4}$ fathom. Sand, shell débris. Nothing.

Station 30.—$\frac{3}{4}$ fathom. Mud and weed. Nothing.

Station 31.—$1\frac{1}{2}$ fathom. Weed. Dead *Placunæ* very plentiful (5×5).

Station 32.—$1\frac{1}{2}$ fathom. Black mud. Dead *Placunæ* very plentiful (5×5).

Station 33.—$\frac{3}{4}$ fathom. Black mud and weed. Dead *Placunæ* very plentiful (5×5).

Station 34.—$\frac{1}{2}$ fathom. Black mud and weed. Dead *Placunæ* plentiful (5×5).

Station 35.—$\frac{1}{2}$ fathom. Black mud. Dead *Placuna* (5×5).

Station 36.—$\frac{2}{3}$ fathom. Mud. Dead *Placunæ*.

Station 37.—$\frac{3}{4}$ fathom. Mud. Dead *Placunæ* (several, full grown).

Station 38.—$1\frac{1}{4}$ fathom. Mud. Nothing.

Station 39.—$\frac{2}{3}$ fathom. Mud and weed. Nothing.

Station 40.—$\frac{3}{4}$ fathom. Mud and weed. Nothing.

Station 41.—$\frac{1}{2}$ fathom. Mud and weed. Nothing.

Station 42.—$\frac{1}{3}$ fathom. Mud and weed. Nothing.

Station 43.—1 fathom. Sand and broken shells. Nothing.

Station 44.—1 fathom. Mud. Six dead *Placunæ* ($4 \times 3\frac{3}{4}$ to $2 \times 1\frac{3}{4}$).

Station 45.—$\frac{3}{4}$ fathom. Mud. Five dead *Placunæ* (5×4 to $3\frac{1}{4} \times 3$).

Station 46.—$1\frac{1}{4}$ fathom. Mud. Red Alcyonarian. Four dead *Placunæ* ($5\frac{1}{2} \times 5$).

Station 47 (= Hornell's Station 11).—1 fathom. Sand and mud Dead *Placuna* ($4\frac{1}{2} \times 4\frac{1}{2}$).

Station 48.—1 fathom. Sand and mud. *Placunæ* scanty.

Station 49.—1 fathom. Sand and mud. Dead *Placunæ* very plentiful.

Station 50.—1 fathom. Soft mud. Dead *Placunæ* very plentiful ($5\frac{1}{2} \times 4\frac{3}{4}$ to $1\frac{3}{4} \times 1\frac{1}{2}$).

Station 51.—2 fathoms. Hard mud. Two dead *Placunæ*.

Station 52 (= Hornell's Station 18*c*).—2 fathoms. Hard mud. Nothing.

Station 53.—2 fathoms. Mud. Nothing.

Station 54.—2 fathoms. Brown mud with shell fragments. Nothing.

Station 55.—2 fathoms. Brown mud. Nothing.

Station 56.—2 fathoms. Brown mud. Nothing.

Station 57.—2¼ fathoms. Brown mud and shell débris. Dead *Placuna* scanty (4½ × 4½ approx.).

Station 58.—2 fathoms. Black mud. Dead *Placunæ* fairly plentiful.

Station 59.—2 fathoms. Living *Placunæ* plentiful (4¾ × 4½ to 3½ × 3½).

Station 60.—1 fathom. Living *Placunæ* very plentiful (4½ × 4½).

Station 61.—1 fathom. Living *Placunæ* very plentiful (4½ × 4½).

Station 62.—1 fathom. Living *Placunæ* plentiful (4½ × 4½).

Station 63.—1½ fathom. Living *Placunæ* plentiful (4 × 4).

Station 64.—⅔ fathom. Mud and weed. Nothing.

Station 65.—½ fathom. Black mud and weed. Nothing.

Station 66.—¾ fathom. Mud and weed. Nothing.

Station 67.—¾ fathom. Black mud, weed, and small Gasteropods. One dead *Placuna*.

Station 68.—1 fathom. Black mud and weed. Nothing.

Station 69.—¾ fathom. Mud and weed. Nothing.

Station 70.—¾ fathom. Gray mud and weed. Nothing.

Station 71.—½ fathom. Weed. One living *Placuna* (5½ × 5¼).

Station 72.—¾ fathom. Gray mud and weed. Nothing.

Station 73.—½ fathom. Black mud, one small Gasteropod. Nothing.

Station 74.—½ fathom. Black mud and weed. One living *Placuna* (5½ × 5¼).

Station 75.—½ fathom. Gray mud and weed. Nothing.

Station 76.—½ fathom. Black mud and weed. Nothing.

Station 77.—½ fathom. Weed. Nothing.

Station 78.—½ fathom. Black mud and thick weed. Nothing.

Station 79.—½ fathom. Weed. One dead *Placuna*.

Station 80.—⅓ fathom. Mud and much weed. Nothing.

Station 81.—½ fathom. Mud and weed. Nothing.

Station 82.—⅓ fathom. Mud and weed. Nothing.

Station 83.—½ fathom. Mud and weed. Old broken *Placuna* shells.

Station 84.—½ fathom. Mud and weed. Nothing.

Station 85.—½ fathom. Mud and weed. Five living *Placunæ* (6 × 5½ to 5½ × 5). (*a*) One small pearl; (*b*) nothing; (*c*) two parasites; (*d*) two large hinge pearls; (*e*) nothing.

Station 86.—½ fathom. Black mud and weed. Nothing.

Station 87.—½ fathom. Black mud. Dead *Placunæ*.

Station 88.—½ fathom. Mud. Several small living *Placunæ* (3 × 3).

Station 89.—¾ fathom. Mud and sand. Small living *Placunæ* abundant. A few big dead *Placunæ*.

Station 90.—¾ fathom. Mud and sand. A few small living *Placunæ*.

Station 91.—1 fathom. Mud. Small living *Placunæ* abundant (4 × 4).

Station 92.—1 fathom. Mud. Living *Placunæ* plentiful (4 × 4). Dead *Placuna* (7 × 6).

Station 93. — 1½ fathom. Mud. Living *Placunæ* abundant (3 × 3).

Station 94.—1½ fathom. Mud. Several living *Placunæ* (4 × 4). Many large dead *Placunæ*.

Station 95.—1½ fathom. Mud. Two dead *Placunæ* (5 × 5 to 2 × 2).

Station 96.—1½ fathom. Mud. Nothing.

Station 97.—1½ fathom. Mud. Nothing.

Station 98.—2½ fathoms. Hard sand and mud. Nothing.

Station 99.—¾ fathom. Mud. Nothing.

Station 100.—1½ fathom. Muddy sand and weed. Nothing.

Station 101.—1½ fathom. Fine muddy sand. Nothing.

Station 102.—1 fathom. Hard sand and weed. Nothing.

Station 103.—2 fathoms. Black mud with shell débris. Dead *Placunæ* plentiful.

Station 104.—2 fathoms. Black mud. Living *Placunæ* fairly plentiful (4 × 4). Many dead *Placunæ*.

Station 105.—1¼ fathom. Black mud. Living *Placunæ* plentiful (4 × 4 approx.).

Station 106.—1½ fathom. Black mud. Living *Placunæ* very plentiful (4 × 4 approx.).

Station 107.—1½ fathom. Black mud. Living *Placunæ* very plentiful (4 × 4 approx.).

Station 108.—1 fathom. Fine black muddy sand. Nothing.

Station 109.—¾ fathom. Fine black sand and weed. Nothing.

Station 110.—1 fathom. Soft mud. Living *Placunæ* plentiful (4 × 4).

Station 111.—⅔ fathom. Soft mud. One living *Placunæ* (6 × 6). No pearls or parasites.

Station 112.—⅓ fathom. Soft mud and weed. Nothing.

Station 113. — ⅔ fathom. Soft mud. Few small living *Placunæ*.

Station 114.—¾ fathom. Hard mud. Nothing.

Station 115.—1 fathom. Soft mud. Very few living *Placunæ* (4 × 3¾).

Station 116.—1¼ fathom. Soft mud. Small living *Placunæ* (4 × 3¾ to 3½ × 3).

Station 117. — 1 fathom. Soft mud. Many living *Placunæ* ($4\frac{1}{2} \times 4$ to 4×4).

Station 118.—1 fathom. Hard mud. One dead *Placuna* ($1\frac{1}{2} \times 1\frac{1}{4}$).

Station 119.—1 fathom. Hard mud. Nothing.

Station 120.—1 fathom. Hard sand and mud. Nothing.

Station 121.—1 fathom. Hard sand, mud, and weed. Nothing.

Station 122.—1 fathom. Hard sand and weed. Nothing.

Station 123.—1 fathom. Sand and mud. Nothing.

Station 124.—1 fathom. Sand. Nothing.

Station 125.—1 fathom. Muddy sand. Nothing.

Station 126.—$1\frac{1}{4}$ fathom. Sand. Nothing.

Station 127.—2 fathoms. Brown muddy sand and weed. Nothing.

Station 128.—1 fathom. Fine black sand. Nothing.

Station 129.—$\frac{1}{2}$ fathom. Black mud and weed. Nothing.

Station 130. — 1 fathom. Fine black muddy sand. Living *Placunæ* plentiful.

Station 131.—$\frac{1}{2}$ fathom. Hard mud and weed. Nothing.

Station 132.—$\frac{1}{2}$ fathom. Hard mud and weed. Nothing.

Station 133.—$\frac{3}{4}$ fathom. Hard mud and sand. Nothing.

Station 134.—$\frac{3}{4}$ fathom. Hard mud and sand. Nothing.

Station 135.—1 fathom. Hard sand and mud. Nothing.

Station 136.—$1\frac{1}{2}$ fathom. Sand. Nothing.

Station 137.—$1\frac{1}{2}$ fathom. Sand. Nothing.

Station 138.—$1\frac{1}{2}$ fathom. Mud and sand. Nothing.

Station 139.—$1\frac{1}{2}$ fathom. Mud and sand. Nothing.

Station 140.—$1\frac{1}{2}$ fathom. Mud and sand. Nothing.

Station 141.—1 fathom. Mud and shell débris. Few old dead *Placunæ* ($5\frac{1}{2} \times 5\frac{1}{2}$).

Station 142.—1 fathom. Mud and sand. One broken shell.

Station 143.—1 fathom. Mud. Several medusæ near bottom. Old dead *Placunæ*.

Station 144.—$\frac{1}{2}$ fathom. Mud. Several medusæ near bottom. Old dead *Placunæ*.

Station 145.—1 fathom. Black mud and weed. One old dead *Placuna*.

Station 146.—$\frac{3}{4}$ fathom. Mud. Few *Placunæ*.

Station 147.—1 fathom. Black mud. One small whelk. Nothing.

Station 148.—$1\frac{1}{2}$ fathom. Black mud and shell débris. Nothing.

Station 149. — 2 fathoms. Black mud. One dead *Placuna* ($5\frac{1}{4} \times 5$).

Station 150.—3 fathoms. Soft black mud with shell débris. Nothing.

Station 151.—3 fathoms. Soft black mud with minute shell débris. Nothing.

Station 152.—3 fathoms. Muddy sand with *Placuna* shell débris. Nothing.

Station 153.—2 fathoms. Mud. Nothing.

MAP OF LAKE TAMBLEGAM, GIVING THE "POTENTIAL AREA."

MAP OF LAKE TAMBLEGAM, GIVING DISTRIBUTION OF DEAD *Placunæ*.

MAP OF LAKE TAMBLEGAM, GIVING DISTRIBUTION OF LIVING *Placunæ*.

MAP OF LAKE TAMBLEGAM, GIVING THE NATURE OF BOTTOM.

A = mud.
B = mud and sand.
C = mud and weed.
D = mud and shell débris.
E = sand.
F = sand and shell débris.

MAP OF LAKE TAMBIEGAM, GIVING DEPTHS IN FATHOMS.

MAP OF LAKE TAMBLEGAM, WITH LIST OF STATIONS.

Map Of

Lake Tamblegam

Showing Placuna Beds in May, 1905. (After Hornell.)

Station 154.—1½ fathom. Sand and mud. Nothing.
Station 155.—1½ fathom. Sand, mud, and weed. Nothing.
Station 156.—2 fathoms. Mud. Nothing.
Station 157.—2 fathoms. Hard sand. Nothing.
Station 158.—½ fathom. Mud. Nothing.
Station 159.—½ fathom. Mud. Nothing.
Station 160.—½ fathom. Sand. Nothing.
Station 161.—½ fathom. Mud. Nothing.

Explanation of the Charts.

[Scale of all the Maps is 1 Nautical Mile = 1¾ Inch.]

1. Map of Lake Tamblegam, showing principal beds (after Hornell).

2. Map of Lake Tamblegam, giving the stations referred to in present report.

3. Map of Lake Tamblegam, giving the depths in fathoms.

4. Map of Lake Tamblegam, giving the nature of the bottom.

5. Map of Lake Tamblegam, giving the distribution of living oysters.

6. Map of Lake Tamblegam, giving the distribution of dead shells.

7. Map of Lake Tamblegam, giving the joint distribution of living oysters and dead shells, thus indicating roughly the "potential area."

WHALES WASHED ASHORE ON THE COAST OF CEYLON FROM 1889 TO 1910.

By H. F. Fernando,
Taxidermist, Colombo Museum.

A LARGE Sperm Whale, or cachalot (*Physeter macrocephalus*), was washed ashore on the north-west coast of Mannar, midway between Talaimannar and Mannar, in September, 1889. Mr. Haly, the then Director, having received a wire from the late Mr. de Hoedt, Head Clerk of the Kachcheri there, despatched me with a collector to secure as much of the skeleton as possible. I arrived at the spot accompanied by the headman of the district, and found the huge carcase in a highly decomposed state. It must have been dead probably a fortnight or more, and the carcase had drifted to the northern part of the Island.

I found the right side of the head and the right fin partly buried in the beach. The left paddle was much damaged, probably by some fishes, and the tail part was floating. The lower part of the right side of the skull had been cut away, and the crest attached to the right maxilla was entirely detached from the supraoccipital crest. It is impossible to account for this except on the supposition that the whale received a blow from some large vessel. Another less probable explanation is that it received its death at the hands of harpooners. The lower jaws were missing, and it is probable that they dropped into the sea whilst the carcase was drifting.

This was my first experience of this sort of work, and the task was a most difficult and trying one, but I tried my best to secure as much as possible of the skeleton. The coolies who were brought by the headman were a daring lot of men, and were a great help to me. Although provided with hatchets and katties, they were given a most difficult task, as they found much difficulty in cutting through the masses of skin and blubber. The hatchets brought into requisition rebounded without making any impression, and the waves broke over the carcase, so that the men had to cease work for the day. I then devised the following method of cutting away the flesh. I obtained a few large shark hooks, each one being attached to a long stick. A small opening was made in the skin and a hook was fixed into it. This hook was held tight by two men, whilst another went on chopping the skin. In this way all the men were engaged, and huge pieces of skin and blubber were separated. It took a gang of twenty men nearly three weeks to clean the bones. The bones were exposed in the sun for a week, and the heat was so severe that melted marrow issued from the bones, and the stench

was unbearable. The north-east wind carried the smell for a long distance, and the lumps of flesh that had been cut off drifted for a distance of nearly 10 miles and were cast ashore along the coast.

The skeleton was brought in a Jaffna sailing boat to Negombo, and thence by canal to Colombo lake, where it was loaded into a trolly cart and brought to the Colombo Museum. A cadjan shed was temporarily erected for the reception of the bones.

The skull, minus the lower jaw, has now been placed in the Mammalian Gallery.

I have taken a photograph showing a side view of the skull of this specimen. (Fig. 1.)

In appearance the Sperm Whale is ungainly and ugly in the extreme, this being chiefly due to the great height and abrupt truncation of the enormous muzzle. Inside the dome-shaped part of the skull is a huge cavity, which is not the brain cavity as one might suppose, and which is filled in the living animal with the substance known as spermaceti. The brain cavity of this beast is surprisingly small. The lower jaw is very long and slender, its two branches being united in the middle line for about half their total length; the teeth are implanted in the lower jaw in a long groove, partially divided into sockets by incomplete bony partitions. These teeth are of large size, and when unworn are pointed and recurved at their tips. They are composed solely of ivory, and the pulp cavity at their base remains open for a long period, although generally more or less completely closed in adult life.

The Sperm Whale is essentially an inhabitant of the open seas. The distribution of the species extends over all the warmer oceans, but does not include the Polar seas. It is in the habit of travelling immense distances, and specimens have been killed in the Atlantic bearing in their bodies spears that had been fixed there during a sojourn in the Pacific. Formerly this whale was much hunted in the Bay of Bengal and around Ceylon, but it is now comparatively rare in these regions, while its numbers have been greatly diminished in its favourite haunts in the South Pacific.

In September, 1894, another large whale was washed ashore at Ambalangoda, on the south-west coast, about 50 miles south of Colombo. This specimen was an adult of the Great Indian Fin Whale (*Balænoptera indica*). As soon as the information was received I was despatched to the spot to secure the skeleton. This monster was also in a decomposed state, and was being lifted by the waves against the rocks. This proved to be a work of great difficulty and of some danger, in consequence of the roughness of the sea and the presence of enormous sharks which swarmed around the carcase, and in consequence the men were afraid to take the risk. The first thing I did was to secure the whalebone and the paddles, but unfortunately I found the right paddle, which was lying underneath, a little damaged, but the left one was quite perfect. I

brought into requisition my first experience in cutting the masses of skin and blubber. At first the men found it very difficult to cut, but gradually they overcame the difficulty as the sea became calmer. I am glad to say that I was fortunate in securing the whole skeleton complete, including even the small rudiments of the hind leg.

The bones were conveyed by double bullock carts to Colombo, and were stored in the cadjan shed side by side with the Mannar whale.

Directly the new Director (Dr. Pearson) assumed duties here in September, 1910, he decided to have this skeleton mounted, and steps were taken to do so. The mounting of this skeleton has proved to be the biggest job undertaken at the Museum.

The preliminary work, which was done in the taxidermist's workshop, was carried out in the face of great difficulties owing to the limited amount of room. (Figure 2 shows a portion of the whale skeleton during the course of its preparation in the workroom.)

The skeleton of this whale, which measures about 65 feet in total length, is now suspended from the ceiling of the Mammalian Gallery. (Fig. 3.) Thus, after lying unmounted for seventeen years, it now ranks as one of the finest exhibits in the Museum.

In July, 1904, another carcase of a Sperm Whale (*Physeter macrocephalus*) was washed ashore at the village of Aturuwella, about 4 miles from Bentota, on the south-west coast. The skull and a few vertebræ had already been dragged out of the reach of the tide, and the rest of the body was in a high state of putrefaction.

Another whale of the same species was washed ashore near the Mount Lavinia Hotel in November, 1904. Dr. Willey and myself visited both these places, and found that the specimens were not in a fit state for the Museum.

In August, 1910, a Great Indian Fin Whale was stranded at Chilaw, on the west coast of Ceylon, drifted thither after the animal had apparently met with death at the hands of harpooners, as marks on the body seemed to indicate. The carcase was found near the mouth of the Deduru-oya in a highly decomposed state. Rough measurement gave the length as 66 feet, and a girth of 32 feet in the thickest part. The two bones of the lower jaw were found on the shore. They measured 19 feet length in each. The skeleton not being perfect, and as there was already one perfect skeleton in the Museum, it was decided not to secure this one.

FIG. 1.—Side view of skull (minus the lower jaws) of the Sperm Whale (*Physeter macrocephalus*) in the Colombo Museum.

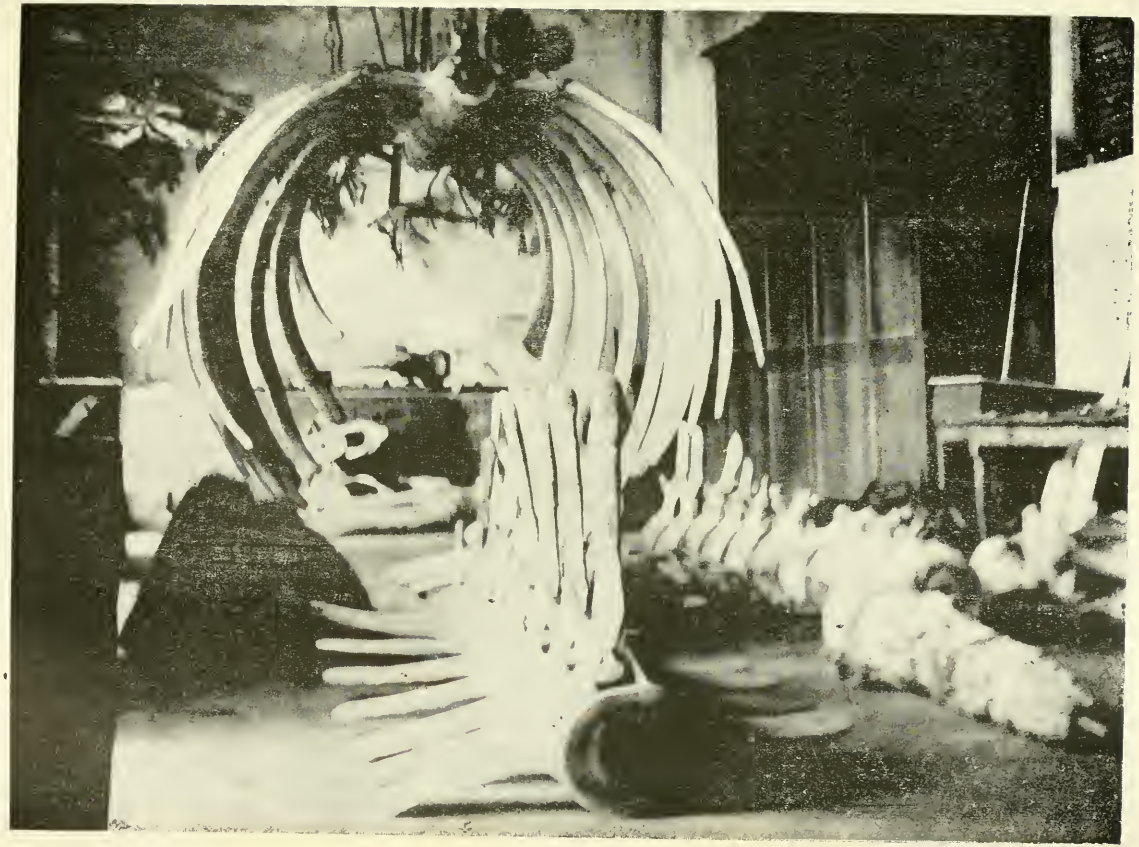

FIG. 2.—Skeleton of the Indian Fin Whale (*Balænoptera indica*) in process of re-construction at the Colombo Museum.

FIG. 3.—Skeleton of *Balænoptera indica*, mounted in the Mammalian Gallery, Colombo Museum.

ORNITHOLOGICAL NOTES.

By G. M. Henry,

Draughtsman and Laboratory Assistant, Colombo Museum.

THESE notes are intended to be a record of distribution, habits, and remarkable occurrences noted during a seven weeks' trip which I made in my capacity of Assistant to Dr. Pearson during the months of August and September, 1911. A short *resumé* of the trip may not be out of place here, as it will serve to explain some of my notes in regard to breeding, &c.

We left Colombo on August 16, travelling by the ss. Lady McCallum to Batticaloa. After a fortnight's stay, during which I had the opportunity of visiting Kaddukkamunai tank, 9 miles from Batticaloa, we again took steamer to Trincomalee, from whence we went to Niroddumunai to inspect the *Placuna* beds of Tamblegam lake. A week was spent here, and we returned to Trincomalee for the purpose of investigating the marine fauna, &c. After another week at Trincomalee, we again embarked for Kankesanturai and took train for Jaffna, where we spent another fortnight, returning to Colombo on October 2.

The outstanding characteristic of the birds shot was the disreputable condition of the plumage preceding moult. Very few of the specimens were in good plumage. It is probable that had the trip been made a couple of months later, this list would have been a considerably longer one. We were just too early to catch the stream of migrants, chiefly waders, which come over from India in numbers on the turn of the south-west monsoon. These migrants were just beginning to arrive when we left Jaffna, in the shape of numbers of Ringed Plover, Sandpipers of sorts, and Little Stints, also Wagtails. It will be seen that the notes are of a meagre nature, but this was unavoidable, as we were not long enough in any one place to correctly ascertain the precise distribution of species, and in spite of this I trust that they will not be altogether valueless or without interest.

Order ACCIPITRES.

Sub-order Falcones.

Family *Falconidæ*.

Sub-Family Accipitrinæ.

Astur badius (the Indian Goshawk).—One of these birds was shot at Niroddumunai, and another was shot about a mile down the Sambore river. Both were in immature plumage.

Sub-family Aquilinæ.

Haliætus leucogaster (the White-bellied Sea Eagle).—This species is common at Batticaloa. Specimens were also seen at Niroddumunai and Trincomalee (Fort Frederick).

Polioætus ichthyætus (the Bar-tailed Fish Eagle).—A specimen of this bird was shot at Kaddukkamunai (Batticaloa), and another at a small pond near Kottiar, which it was guarding in company with its mate.

Haliastur indus (the Brahminy Kite).—Very common everywhere. A pair flew out to the steamer on anchoring in Batticaloa roads, and gave a very pretty exhibition of clever flight in seizing offal thrown overboard.

Milvus govinda (the Pariah Kite).—Very common at Jaffna, but more shy and wary than the former species.

Sub-family Falconinæ.

Falco peregrinator (the Indian Peregrine or Shahin).—One of these fine birds was observed at Fort Frederick. It was evidently making its abode amongst the cliffs and rocks which guard the seaward face of the promontory, and we had a good view of it whilst we were rowing round the Saamy rock on a dredging expedition.

Sub-order Pandiones.

Pandion haliætus (the Osprey).—A hawk was observed at Kadukkamunai which had all the appearance of an osprey, but it would not permit a near-enough approach to make certain by shooting it.

Order PSITTACI.

Family *Psittacidæ*.

Sub-family Palæorninæ.

Palæornis eupatrius (the Alexandrine Parrakeet).—Large flocks of these birds were seen at Batticaloa. They flew in a south-easterly direction every evening, apparently coming from the head of the lagoon, and roosted in the palms of the more cultivated areas.

Order PICARIÆ.

Family *Picidæ*.

Sub-family Gecininæ.

Brachypternus ceylonus (the Common Red Woodpecker). — Several woodpeckers of this species were seen at Kottiar, and one was shot.

Family *Capitonidæ*.

Sub-family Megalæminæ.

Megalæma zeylanica (the Brown-headed Barbet).—Common at Tamblegam.

Xantholæma rubricapilla (the Ceylon Coppersmith). — Very common at Batticaloa in the neighbourhood of the resthouse.

Xantholæma hæmacephala (the Red-breasted Coppersmith).— One was shot at Kadukkamunai.

Family *Cuculidæ*.

Sub-family Phœnicophainæ.

Zanclostomus viridirostris (the Green-billed Malcoha).—A specimen was shot at Kalmunai (Jaffna). It is common about Trincomalee.

Centropus rufipennis (the Common Coucal).—Common at Tamblegam, Jaffna, and Kayts.

Family *Bucerotidæ*.

Tockus gingalensis (the Ceylon Hornbill).—Seen at Tamblegam.

Family *Coraciidæ*.

Sub-family Coraciinæ.

Coracias indica (the Indian Roller).—This species was seen at Tamblegam in the jungle, and at Jaffna in paddy fields.

Family *Alcedinidæ*.

Sub-family Alcedininæ.

Ceryle rudis (the Pied Kingfisher).—Very common at Batticaloa and Jaffna.

Alcedo bengalensis (the Little Indian Kingfisher).—Common at Batticaloa, Trincomalee, Kottiar, and Tamblegam.

Sub-family Halcyoninæ.

Pelargopsis gurial (the Stork-billed Kingfisher).—Fairly common at Batticaloa. Noticed at Kottiar and Tamblegam.

Halcyon smyrnensis (the White-breasted Kingfisher).—Common at Batticaloa and Kadukkamunai.

Family *Meropidæ*.

Merops viridis (the Common Indian Bee-eater).—Very common everywhere. All the specimens noticed were in very "dowdy" plumage. These birds are especially numerous on the Trincomalee-Anuradhapura road. Numbers were seen during a walk to Kanniya from Trincomalee.

Family *Cypselidæ*.

Cypselus batassiensis (the Palm Swift).—Very common everywhere, but most so at Batticaloa and Jaffna.

Family *Caprimulgidæ*.

Sub-family Caprimulginæ.

Caprimulgus asiaticus (the Common Indian Nightjar).—A pair were shot at dusk in a field 2 miles out of Trincomalee on the Anuradhapura road. They were sitting together on a bare patch of ground, and were killed with a single cartridge.

Order PASSERES.

Family *Oriolidæ*.

Oriolus melanocephalus (the Black-headed Oriole).—Common at Tamblegam. A single immature bird was seen at Batticaloa.

Family *Dicruridæ*.

Buchanga atra (the Black Drongo).—Common at Jaffna.

Dissemurus paradiseus (the Racket-tailed Drongo).—A specimen was obtained on the road to Anuradhapura, about 5 miles from Trincomalee.

Family *Muscicapidæ*.

Terpsiphone paradisi (the Paradise Flycatcher).—Several were seen at Kottiar, all in chestnut plumage.

Family *Saxicolidæ*.

Copsychus saularis (the Magpie Robin).—Common everywhere.

Cittocincla macrura (the Long-tailed Robin or Shama).—Common in the jungle round Trincomalee and Tamblegam.

Thamnobia fulicata (the Black Robin).—Common at Batticaloa and Trincomalee. At Batticaloa a nest containing two fledglings was found in a hole in the side of a rugged and decomposed block of cabook which lay on the bank of the Fort moat. In the dried-up state of the vegetation and the consequent scarcity of insect life it was difficult to understand how the parents could find food for their young.

Family *Brachypodidæ*.

Sub-family Pycnonotinæ.

Ixos luteolus (the White-eyebrowed Bulbul).—Common everywhere.

Pycnonotus hæmorrhous (the Madras Bulbul).—Common everywhere.

Family *Timaliidæ*.

Sub-family Timaliinæ.

Malacocercus striatus (the Common Babbler).—Very common everywhere.

Alcippe nigrifrons (the Quaker Thrush).—Common at Batticaloa and in the jungles round Trincomalee.

Pellorneum fuscicapillum (the Black-capped Quaker Thrush).—Observed at Tamblegam.

Family *Hirundinidæ*.

Hirundo rustica (the Common Swallow).—Was seen at Kayts, and two were shot at Jaffna.

Family *Montacillidæ*.

Limonidromus indicus (the Black-breasted Wagtail).—A pair were seen at Kayts.

Corydalla rufula (the Common Pipit).—Common everywhere.

Family *Alaudidæ*.

Pyrrhulauda grisea (the Indian Finch Lark).—Very common at Jaffna, and also observed at Trincomalee. A specimen was shot at Kalmunai (Jaffna).

Family *Artamidæ*.

Artamus fuscus (the Ashy Swallow Shrike).—Very common at Kaddukkamunai and Kottiar. Several were shot.

Family *Sturnidæ*.

Acridotheres melanosternus (the Common Mynah).—Very common at Batticaloa. They were evidently nesting, as several were noticed emerging from holes in trees.

Order COLUMBÆ.

Family *Columbidæ*.

Turtur suratensis.—Common at Kaddukkamunai, Kottiar, and Tamblegam.

Family *Gouridæ*.

Chalcophaps indica (the Bronze-winged Dove).—Very common at Tamblegam and the jungles round Trincomalee.

Order GALLINÆ.

Family *Phasianidæ*.

Gallus lafayettii (the Ceylon Jungle Fowl).—Common at Tamblegam. Two hens were observed at the turn-off to Kanniya, on the Trincomalee-Anuradhapura road, cackling most vigorously in the jungle. I succeeded in approaching within a few yards of them, but was not able to locate them exactly until they discovered my presence and dashed off. It almost seemed as though they had each laid an egg in nests within a couple of yards' radius and were proclaiming the fact in the usual way, but a rapid search failed to reveal any sign of a nest, and the cackling may have been due to alarm by a snake, or some such cause.

Family *Tetraonidæ*.

Ortygornis pondiceriana (the Gray Partridge).—A pair of these birds were observed at Kalmunai (Jaffna). They flew out of a clump of cacti near the seabeach, and one (a male) was shot.

Family *Tinamidæ*.

Turnix taigoor (the Bustard Quail).—A female specimen was shot in some low scrub near the sea at Kayts.

Order GRALLÆ.

Family *Scolopacidæ*.

Tringoides hypoleucus (the Common Sandpiper).—Several were shot at Batticaloa, where they were evidently just arriving from India on their migration south. One was wounded far out over the water, into which it fell. It promptly commenced swimming away from the shore against a moderate breeze at quite an appreciable speed. I gave it up as a lost bird and began to walk away, but as soon as I had gone a short distance I noticed that it was swimming back to land. It walked ashore, and I captured it.

Tringa minuta (the Little Stint).—A specimen was shot at Kadduk-kamunai, and several were obtained at Jaffna, where they were common, flying in small flocks. After they had been shot at once or twice they became very wary, and would not permit one to approach within gunshot.

Numenius lineatus (the Eastern Curlew).—Very common at Jaffna, where the shallow sandbanks and mud flats of the lagoon form a fine hunting ground for them and many other waders.

Family *Parridæ*.

Hydrophasianus chirurgus (the Water Pheasant).—Very common on Kaddukkamunai tank.

Family *Charadriidæ*.

Sub-family Himantopodinæ.

Himantopus candidus (the Stilt Plover).—Several of these birds were seen at Kaddukkamunai tank.

Sub-family Charadriinæ.

Charadrius fulvus (the Asiatic Golden Plover).—Seen in small flocks at Jaffna.

Ægialitis curonica (the Lesser Ringed Plover). — Common at Jaffna and Kayts. Several specimens were obtained.

Ægialitis jerdoni (Jerdon's Ringed Plover).—Very common at Jaffna and Kayts. Several specimens were shot.

Sub-family Vanellinæ.

Lobivanellus indicus (the Red-wattled Lapwing).—Very common at Kaddukkamunai and Kottiar. A few were seen on the green at Batticaloa.

Family *Œdicnemidæ*.

Sub-family Œdicneminæ.

Œdicnemus scolopax (the Stone Plover).—A single specimen of this species was seen at Kottiar.

Family *Glareolidæ*.

Glareola orientalis (the Eastern Swallow Plover).—A specimen of this species was shot at Kaddukkamunai. It was a female in a state of moult.

Order GAVIÆ.

Family *Laridæ*.

Sub-family Sterninæ.

Sterna media (the Lesser-crested Tern).—Three of these birds were shot at Trincomalee. The stomachs of two of them were distended with fish of the genus *Caranx* up to 3 or 4 inches in length. A number of cestodes were found in the gut of one of them.

On the voyage to Batticaloa, between the Great and Little Basses, we passed a number of these birds (or possibly the larger species, *Sterna bergii*). I noticed one of them settle on the water for a few moments and rest, notwithstanding the comparative choppiness of the sea.

Sterna anglica (the Gull-billed Tern).—Two of these birds were shot at Jaffna. One was in winter plumage, and the other was in semi-breeding plumage, having the black crown and nuchal crest.

Family *Procellariidæ*.

Oceanites oceanicus (*?*).—A number of Storm Petrels were observed while on the voyage to Batticaloa. They were black in colour, with a white band round the base of the tail. I had a good look at them with a telescope. They flew about astern of the ship, flitting close to the water and disappearing over the wave crests.

Order HERODIONES.

Family *Ardeidæ*.

Ardea purpurea (the Purple Heron).—Several were seen at Batticaloa and Kaddukkamunai.

Herodias alba (the Large White Egret).—Common at Batticaloa and Kaddukkamunai.

Herodias intermedia (the Lesser White Egret). — Common at Batticaloa and Tamblegam. Large colonies of this and the two preceding species live in the mangrove swamps on the western and south sides of Buffalo Island (Batticaloa), and also on other islands in the lagoon.

Ardeola grayi (the Pond Heron).—Very common everywhere.

Butorides javanica (the Little Green Heron).—Common at Batticaloa and Jaffna. A specimen in beautiful plumage was shot at Jaffna.

Order STEGANOPODES.

Family *Pelecanidæ*.

Phalacrocorax pygmæus (the Little Cormorant).—Very common at Batticaloa. One specimen was shot. Its stomach contained several small gobies and a number of prawns.

Plotus melanogaster (the Darter or Snakebird).—Very common on Kaddukkamunai tank. When disturbed they fly high in the air, and look just like some mythical winged snake.

FISHES OF BATTICALOA, TRINCOMALEE, AND JAFFNA.

By George M. Henry,
Draughtsman and Laboratory Assistant, Colombo Museum.

THE following fishes were collected at Batticaloa, Trincomalee, and Jaffna during a trip in August and September, 1911 :—

Trygon uarnak.—A specimen of this ray was obtained at Tamblegam and another at Kayts.

Torpedo marmorata.—A young specimen was captured in a rock pool at Trincomalee, and three mature specimens were obtained at Jaffna.

Plotosus arab.—Several specimens were taken at Jaffna.

Clupea kanagurta.—Specimens were obtained at Batticaloa.

Clupea fimbriata.—Obtained at Batticaloa.

Chatœssus nasus.—Common at Batticaloa.

Engraulis hamiltonii.—Obtained at Batticaloa.

Elops saurus.—One specimen was obtained at Batticaloa. This and the foregoing Clupeoid fishes were taken by the fishermen in the more saline water near the mouth of the lagoon. They appear to hold an important place among the food fishes of Batticaloa.

Belone choram.—A specimen was obtained at Kayts.

Serranus pantherinus.—A specimen was obtained from fishermen, who had caught it near the mouth of the lagoon.

Serranus fasciatus, var. *variolosus.*—One specimen was taken at Jaffna.

Lutjanus marginatus.—Obtained at Batticaloa.

Lutjanus bohar.—Obtained at Trincomalee.

Lutjanus fulvus.—Obtained at Trincomalee.

Lutjanus quinquelinearis.—Obtained at Trincomalee.

Apogon auritus.—Common in the Jaffna lagoon.

Apogon sangiensis.—A single specimen was taken in the Jaffna lagoon.

Therapon quadrilineatus.—Dredged in the Jaffna lagoon.

Scolopsis bimaculatus.—Obtained at Trincomalee.

Gerres filamentosus.—Common in the Batticaloa lagoon.

Gerres poeti.—Common at Batticaloa.

Chœtodon vagabundus, var. *pictus.*—One specimen was obtained at Batticaloa and another at Trincomalee.

Chœtodon auriga, var. *setifer.*—Obtained at Trincomalee.

Holacanthus xanthurus.—Obtained at Batticaloa.

Upeneus macronema.—Obtained at Trincomalee.

Lethrinus miniatus.—Obtained at Trincomalee.

Lethrinus ramak.—Obtained at Jaffna.

Lethrinus, sp. — Taken at Jaffna. Too young for satisfactory identification.

Chrysophrys berda.—A single specimen was obtained from fishermen at Batticaloa.

Amblyapistus macracanthus.—One specimen was taken in the dredge at Trincomalee.

Amblyapistus tænianotus.—A specimen was captured at Jaffna.

Pelor didactylum.—One specimen was dredged at Jaffna.

Teuthis java.—Very common at Batticaloa. Found at Jaffna.

Teuthis vermiculata.—Common at Batticaloa.

Teuthis oramin. — Common at Batticaloa and Jaffna. These Teuthidæ are among the chief food fishes at Batticaloa. Numbers are caught by means of ingenious wicker traps, the bait being a green flocculent seaweed, on which these fish feed. Various nets are also used to capture them.

Holocentrum caudimaculatum. — A specimen was obtained at Kayts.

Acanthurus matoides.—Found at Batticaloa.

Caranx jarra.—Obtained at Batticaloa.

Equula edentula.—Very common at Batticaloa. This species is captured in large numbers along with *Gerres*, spp., and other small silvery fish. A specimen which was taken at night was highly luminous in the region of the stomach and gills. This fact is probably accounted for by the fish having eaten luminous plankton organisms.

Batrachus grunniens.—A pair were dredged in Jaffna lagoon.

Platycephalus tuberculatus.—Common at Jaffna.

Pegasus natans.—A specimen of this species was captured at Jaffna. Day does not record this species from Indian waters.

Gobius criniger.—Obtained at Jaffna.

Gobius cyanomos.—Taken at Jaffna.

Periopthalmus schlosseri.—Common at Batticaloa.

Petroscirtes variabilis.—Very common at Jaffna.

Petroscirtes lienardi.—Found at Jaffna. These *Petroscirtes* live amongst the large-leafed Zostera, which grows abundantly in the lagoon.

Mugil cœur.—Common at Batticaloa near the mouth of the lagoon.

Fistularia serrata.—A specimen of this species was captured in a rock pool at Trincomalee. The peculiarity about it was that it had been seen by a party some evenings before its capture, when it was brilliantly luminous. The rock pool was quite closed against the sea, and depended for its water supply on occasional extra-heavy waves, so that there appears to be no doubt that *Fistularia* has the power of luminosity. The fish changed its colour repeatedly whilst being chased about, becoming either light greenish gray or dark

gray with distinct brown bands. It was quite a small specimen, being about 9 inches long.

Amphiprion sebæ.—A specimen of this fish was taken in the sea off Kalmunai, Jaffna.

Tetradrachmum trimaculatum.—Obtained at Trincomalee.

Glyphidodon cochinensis.—A fish was taken at Jaffna answering perfectly to Day's description of this species, except in the colour, which in our formalin specimen is yellowish gray and not purplish black.

Chilinus trilobatus.—A specimen was obtained at Trincomalee.

Pseudoscarus dussumieri.—Common at Trincomalee.

Pseudoscarus bataviensis.—Obtained at Trincomalee.

Etroplus suratensis.—Obtained at Batticaloa. Common at Jaffna.

Pseudorhombus arsius.—Taken at Jaffna.

Gastrotokeus biaculeatus.—Very common at Jaffna. Many of the males taken were ovigerous, and the eggs were in various stages of development, some being about to hatch.

Corythroichthys conspicillatus. — Common at Jaffna. Several ovigerous males were taken.

Syngnathus spicifer.—Several specimens were obtained at Jaffna. They appear to belong to the variety *Djarong*, Bleek.

Hippocampus, spp.—Several seahorses were captured at Jaffna. They apparently belong to two species.

Triacanthus brevirostris.—Common at Batticaloa. One or two were obtained at Jaffna.

Monacanthus chœrocephalus.—Very common at Jaffna.

Ostracion cornutus.—Young specimens about an inch long were very common at Jaffna. At this early stage the body is almost as broad and deep as it is long. The tail appears to be used for steering purposes only, propulsion being effected by means of the dorsal and pectoral fins.

Tetrodon hispidus.—The young of this species, from 2 to 3 inches long, were common in Jaffna lagoon.

Tetrodon immaculatus.—Young common in Jaffna lagoon.

Tropidichthys margaritatus. — A specimen of this species was captured in a rock pool at Trincomalee referred to in the note on *Fistularia serrata* on page 63.

NOTES.

1. *Tipulidæ from Ceylon.*—In the "Annals and Magazine of Natural History" for July,* Mr. F. W. Edwards has a small paper on the above group. The insects described in this paper belong to the three following collections :—

(1) Mr. E. E. Green's collection made between 1888 and 1897.

(2) Lieut.-Col. J. W. Yerbury's collection made in 1890–92.

(3) Mr. T. Bainbrigge Fletcher's collection made in 1907–8.

Sixteen species are described, of which eight are new :—

Thrypticomyia saltens, Dol. Madulsima.
Thrypticomyia longivena, sp. n. Dondra.
Geranomyia fletcheri, sp. n. Madulsima.
Libnotes pœciloptera, O.-S. Pundalu-oya.
Teucholabis cyanea, sp. n. Madulsima, Bentota.
Styringomyia ceylonica, sp. n. Weligama.
Trentepohlia trentepohlii, Wied. Galle, Weligama, Tamblegam.
Trentepohlia pennipes, O.-S. Trincomalee, Pundalu-oya.
Conosia irrorata, Wied. Dondra, Galle, Bentota.
Eriocera crystalloptera, O.-S. Madulsima, Pundalu-oya, Haputale.
Eriocera humberti, O.-S. Pundalu-oya.
Eriocera ctenophoroides, sp. n. Kandy, Kottawa, Pelmadulla.
Eriocera albonotata, Lw. Kandy, Passara, Pelmadulla, Trincomalee, Pundalu-oya, Diyatalawa.
Eriocera scutellata, sp. n. Pundalu-oya.
Eriocera tuberculifera, sp. n. Pundalu-oya.
Eriocera fusca, sp. n. Pundalu-oya.

[Ed.]

2. *Note on the Arboreal Habits of the Kabaragoya* ("*Varanus salvator*") *and the Talagoya* ("*V. bengalensis*").—In *Spolia Zeylanica*, Vol. VI., Part XXI., March, 1909, p. 49, Dr. Willey has a note to the effect that "old talagoyas (*V. bengalensis*) and young kabaragoyas (*V. salvator*) ascend trees only under exceptional circumstances." In the Notes of Vol. VI., Part XXIII., December, 1909, p. 131, Mr. E. E. Green records a case where a fairly large specimen of *V. salvator* was seen to run up a jak tree, and was captured at a height of 20 feet from the ground. This might also appear to be a case of exceptional circumstances. But a visit to Bentota lagoon by two friends and myself on July 2, 1911, appears to show that the full-grown kabaragoya is in the habit of basking on the branches of trees

* F. W. Edwards: "On some *Tipulidæ* (*Limoniinæ*) from Ceylon in the British Museum Collection, with Descriptions of Eight New Species."—Ann. Mag. Nat. Hist. (8), Vol. VIII., No. 43, July, 1911, pp. 58–67

overhanging water, and also that these animals are particularly tame when they are in the water. As we paddled in a canoe round the shores of the lagoon on the west side we were able to approach within 6 or 8 feet of several fair-sized specimens, which were resting on partially submerged stumps in the shallow water. They remained in most cases quite motionless, but keeping their eyes fixed on us as we passed or stopped to examine them. One large specimen was seen to be resting (possibly asleep) lengthwise along the branch of a tree overhanging the water, at a height of 10 or 12 feet. We tried to disturb it and see it move along the branch, but it was some time before we succeeded. With regard to talagoyas, there have been for some years in the Government Training College compound in Colombo several specimens, which I have observed from time to time during the last two years. When I first noticed them there were three, one large and two smaller. All these I have seen searching the trunks of trees (especially the "mére de cacao") to a height of 12 or 14 feet, and they probably went higher. When occasionally chased by the dogs, they moved rapidly along the ground with a very "waddling" gait and escaped up the nearest tree or into a drain.

C. T. SYMONS.

3. *Note on Arrival of Migrant Birds in Colombo.*—It may be of interest to those who are observers of bird life in Ceylon to have a list of observations of the first appearances in Colombo of migrant birds for a number of years. No pretence is made of stating that this list is in any way standard. It is probable that the birds arrived several days before they were observed by us, and it is very possible that other observers will be able to supply more accurate dates. But as we believe no list has yet been published, it seemed advisable to make a start and stimulate others to make any corrections necessary. As will be seen, the list is by no means complete; where no date is inserted no observation was made, sometimes owing to the absence of the observers from the Island:—

Name of Bird.	1906.	1907.	1908.	1909.	1910.	1911.	Remarks.
Common Swallow (*H. rustica*) ..	16/11	25/10	25/10	9/10	6/10	8/10	On Golf Links
Brown Flycatcher ..	—	—	—	—	11/10	16/10	In Cinnamon Gardens
Wagtail	12/10	10/10	12/10	14/10	9/10	30/9	On Golf Links
Asiatic Golden Plover	—	—	—	—	8/10	3/9	On Racecourse
Brown Shrike ..	—	9/10	—	—	23/10	8/10	—
Richard's Pipit ..	—	19/10	—	—	—	[5/2]	—
Banded Crake ..	—	—	18/11	—	—	—	—

It would be of considerable interest to have lists from other parts of the Island.

C. T. SYMONS.
W. A. CAVE.

4. *Vibration of the Tails of Snakes*—In a recent Note (*Spolia Zeylanica*, Vol. VII., Part XXVIII., p. 207) Mr. Abercromby calls attention to the habit of vibrating the tail indulged in by *Lachesis trigonocephalus*. In this it is not alone, and the action has often been noticed in the case of *L. gramineus;* amongst recent authors, I think that Gadow calls attention to it in his book on "Mexico," though the volume is not available here to verify the impression. Gunther (Rept. Brit. India, p. 384) also notes that "they are frequently not perceived until they prepare to dart, vibrating the tail and uttering a faint hissing sound." In this connection it is of interest to observe that the snakes of this genus usually have the tail modified in some special way, either brightly coloured or peculiarly shaped. *L. gramineus*, indeed, derives one of its synonyms (*erythrurus*) from the colour of its tail, the specimen figured by Fayrer (Thanat. Brit. India, Pl. XIV.) belonging to this form, whilst in the case of the American *L. mutus* the tail terminates in a long, thin spine, which, as Dittmars (Rept. of the World, p. 339) notes, suggests an ancestral relationship to the rattlesnakes.

It is however a fact, as Mr. Abercromby remarks, that other snakes, in nowise related to the Pit Vipers, share this peculiarity of vibrating the tail. Quite lately my *mali* brought in a specimen of *Dipsadomorphus trigonatus* which he had caught whilst clipping a hedge—a favourite haunt of this species; when placed on a bush in a vivarium, the snake struck out valiantly at anything that approached, at the same time vibrating its tail rapidly against a flat leaf and producing quite a sharp rattling noise. A few months ago I noticed the same thing in a specimen of *Lycodon aulicus* in one of my cages; when annoyed and on the defensive it repeatedly quivered its tail very rapidly, so as to produce a distinct rattling against the floor of its cage.

T. BAINBRIGGE FLETCHER.

5. *On "Megaderma lyra."*—Mr. Green's colony of *Megaderma lyra* (see *Spolia Zeylanica*, Vol. VII., Part XXVIII., p. 216) is possibly an abnormally blood-thirsty one. Last year I had frequent opportunities of observing this bat, as the bungalow in which I was living had several empty rooms, and the bats used to fly in through the open windows and suspend themselves from punkahs, &c., to eat their prey. It is noteworthy that each bat has what is presumably its own favourite perch, to which it brings all its larger prey to eat. Inspection of the remains after the bats had been feeding showed that their food had been almost entirely large Lepidoptera—mostly Sphingids and large Noctuids, amongst which *Ophideres fullonica* appeared a great favourite; I saw no remains whatever of any Vertebrates. The bats were quite bold, and often flew around the lamps in the verandah catching moths in the air or from off the

ceiling. I may add that I caught a good number of the bats and definitely identified them as *Megaderma lyra;* like Mr. Green's specimens, they were all swarming with small winged flies, some of which were sent to Europe for identification, but I have heard nothing further of them. Very similar, if not identical, winged flies were found by me on bats caught at Galle, but these latter bats were, I think, *Rhinolophus affinis.*

T. BAINBRIGGE FLETCHER.

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6. *The Bell at Kayman's Gate*—On a recent visit to Jayawardhana Kotte, the Cotta of to-day, I was informed that the bell at Kayman's Gate in the Pettah was removed from the site of the Portuguese Church close to where had once stood the palace of Dharmapala. A few mornings back I examined the bell in question, and from where I was in the street an inscription was visible. A ladder was obtained from the Municipal Office, and a Fiscal's peon, boldly daring, scaled the spiked enclosure and climbed as far as he could with the help of the shaky ladder up the side of the belfry. From the disjointed letters which he deciphered from his precarious position I make out the legend, which is in two lines, to be as follows :—

AVE GRATIA PLENA DOMINUS
TECUM BENEDICTA TU INMULIERS

My informant then was correct. The bell is a Portuguese one, and I hope some enthusiast of the Dutch Reformed Church of Wolvendahl, whose property I understand the bell now is, will examine it with care to ascertain if it bears any date.

P. E. PIERIS.

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7. *The Growth of Marine Organisms in Colombo Harbour.*—In a letter which I received in September, 1911, from Capt. J. A. Legge, Master Attendant, Colombo, the following interesting communication was made :—" When Dr. Chalmers was appointed to investigate the sanitary conditions of Colombo, he made a study of the harbour, and found that whilst the Teredo worm destroyed timber in most of the harbour area, it hardly touched the timber on the passenger jetty or south shore of the harbour. This he attributed to the want of scour or circulation of drainage matter at the south end of the harbour resulting in the destruction of marine life. The pilot launches, tugs, and other vessels of every department used to require cleaning about twice a year only. After the new arm of the Breakwater had been extended an appreciable distance, and particularly early this year, it was noticed that the current running out of the harbour at the south entrance had increased markedly in force, so much so that it used to sweep the divers off their work and make their work much more difficult. Synchronizing with this the harbour has become cleaner and cleaner during the last two years, and the marine growth on the craft lying off my boat-house has been

excessive. As much grows now in six weeks as grew in six months four years ago. The passenger jetty is no longer a guide, as the timbering has largely been replaced by ferro-concrete."

Along with Captain Legge I examined a pilot launch, which had been hauled up for cleaning on the Master Attendant's slip. The hull was thickly encrusted with countless numbers of barnacles and huge masses of white calcareous tubes containing Polychæte worms. I understand that this fouling represented a growth of about two months. [Ed.]

8. *Composition of Ancient Bronze from Polonnaruwa.* — I give below the result of an analysis of a fragment of a bronze begging-bowl, which was given to me for the purpose by the Director of the Colombo Museum early in 1911. The bowl was unearthed at Polonnaruwa some years ago, and is supposed to belong to the twelfth century. The analysis was made in conjunction with Mr. Wallace, Instructor in Analysis at the University of Pennsylvania.

Owing to the metal on the bowl being very thin, much corroded, and covered with a scale of oxide and carbonate copper, it was difficult to get a sample for trial *entirely* free from this coating. So that if the analysis does not foot up to 100, it is probably due to the oxygen and carbon and in the coating not being estimated. The result we have obtained is as follows :—

	Per Cent.
Copper	77·46
Tin	19·63
Lead	·19
Cobalt	·43
Traces of Iron and Zinc.	
	97·71

One would have looked for almost pure copper in a bowl which had to be hammered up from a sheet, which must be soft and yielding, not hard and brittle. Possibly this bowl was cast, a matter difficult to tell owing to the thinness of the metal and the deeply corroded surfaces. The amount of tin is rather larger than usual. Ten per cent. is the usual amount required to make a true bronze and give hardness to the metal. The large percentage of tin may be owing to the fact that that metal could be obtained in India more easily than in some countries like Egypt, where it was more sparingly used. Tin was doubtless used in this alloy to give hardness and to resist the wear and tear. The presence of cobalt is rather unusual, and may be due to its presence in the copper ore from which the bronze was made. The comparison of analyses of different bronzes of ancient races, used for making tools, ornaments, arms, and utensils, indicates to some extent their knowledge of alloys, and my investigations have this end in view. An analysis of bronze from Anuradhapura or from any other ancient site in Ceylon would be very interesting if a specimen could be obtained. — G. BRINTON PHILLIPS.

9. *Notes on the Food of the Jackal* ("*Canis aureus*") *and that of the Talagoya* ("*Varanus bengalensis*").—During the inspection of Lake Tamblegam in August last a jackal was shot in the jungle on the shore of the lake, about 2 miles from Niroddumunai, along the Trincomalee road. Its stomach was distended with what turned out to be a huge mass of winged termites. This mass was taken, at first, to be a quantity of weed, and was deposited in the compound as such, but on examining it when dry it was seen to be nothing but termites. There had been a lot of rain two or three days previously, and numbers of termites were to be seen flying about in consequence.

A specimen of *Varanus bengalensis* was captured and opened. Its stomach contained a large quantity of scorpion-spiders, termites, and a single black scorpion of rather small dimensions. There were a number of nematodes in the gut.

G. M. HENRY.

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10. *Spur Fowls breeding in Captivity.*—There appears to have been a little surprise among a few persons who are interested in keeping birds that I should have been able to keep a pair of spur fowls in captivity for over three years, and further, that they should breed in captivity. Some letters appeared in the "Ceylon Independent" about this, and I think the circumstances are of sufficient interest to be put on record in *Spolia Zeylanica*.

The birds were given to me by Mr. L. B. Goonatilleke of Wattala over three years ago (since the letters appeared in the papers I have seen Mr. Goonatilleke, and he tells me it is more than four years ago). As I had no exact dates I put three years, knowing I had had them over that time. The hen bird has laid three eggs in all—the first egg I took no notice of; the second egg I put under a bantam fowl to hatch, and this was killed by the hen when partly out of the shell; the third egg was laid about seven or eight days before the hen sat. This was hatched out, and the chicken lived five days, when it unfortunately got into a tin of water and was drowned. The birds have been caged up in a place 4 feet by 2 feet on sandy ground. I have never once cleaned them out, and I attribute this in some measure to the birds getting their natural food from under the garden weeds, mixed up as they are with mixed canary seed and paddy. I think the whole place must be alive with small insects.

H. STEVENTON.

Note.—I have made inquiries and find that no one seems to know of any instances of spur fowls breeding in captivity. Mr. Fernando, the Museum Taxidermist, says: "We had a pair of these birds in the Museum aviary for over two and a half years, and they were very tame. I have seen the pair courting, and very likely eggs would have been laid had it not been that a rusty spotted cat got in and killed the hen bird and three teal. The male bird died a few days later." This particular rusty spotted cat now helps to adorn the Mammalian Gallery of the Museum!—[Ed.]

11. *Note on the Habitat of "Ramcia inepta," Annandale.*—When I found the larvæ last year which have been described by Dr. Annandale as *Ramcia inepta*,* they were in the marsh, always associated with a red flocculent matter made up of vegetable débris, a few diatoms, and a closterium in large numbers. The larvæ were sluggish compared to those of *Culex*, but when they did move they moved with a quick jerking motion. The pupæ were markedly sluggish, and stayed at the surface of the water, and were to all appearances dead. From the numbers I found on the first occasion I should think the fly is not rare. I regret I did not at that time collect more material, but not being an entomologist I was not aware that the larvæ, though they struck me as unlike anything I knew, were unusual.

A. J. MacDOUGALL.

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12. *Note on a Web-spinning Psocid.*—Web- or silk-spinning by larval insects is of very common occurrence, and is employed by representatives of at least five of the nine main orders of insects. The cocoons of *Lepidoptera* and *Hymenoptera* are instances in point. But the power of producing silken webs is extremely rare amongst adult winged insects, and appears to be confined to certain species of the lower and more archaic families of the order *Neuroptera*. The *Embiidæ*, for instance, are provided with spinning organs on the front feet, and construct silken galleries in moss and under stones. Another family in which this phenomenon occurs is the *Psocidæ*—minute soft-bodied (often apterous) insects, certain species of which are known as "book-lice." Some species of *Psocidæ* construct silken coverings for their eggs, others live in colonies beneath a more or less elaborate web, which might easily be mistaken for the work of a spider. The accompanying photograph (for which I am indebted to Major C. H. Ward) represents part of an orange tree in the Royal Botanic Gardens, every branch of which has been profusely covered with a fine and intricate web of this nature. The character of the web is strongly suggestive of a snare, but I have been unable to find any proof of this in the form of captured insects upon which the Psocids might be feeding. It is more probably constructed for protection, though it does not appear to be completely effective for this purpose, as I have found the webs frequented by a small predatory Hemipteron (*Ploiariola polita*), which appears to be preying upon the Psocids.†

Mr. J. C. F. Fryer has been studying the habits of this insect, and finds that the silk is produced by individuals of all stages of growth.

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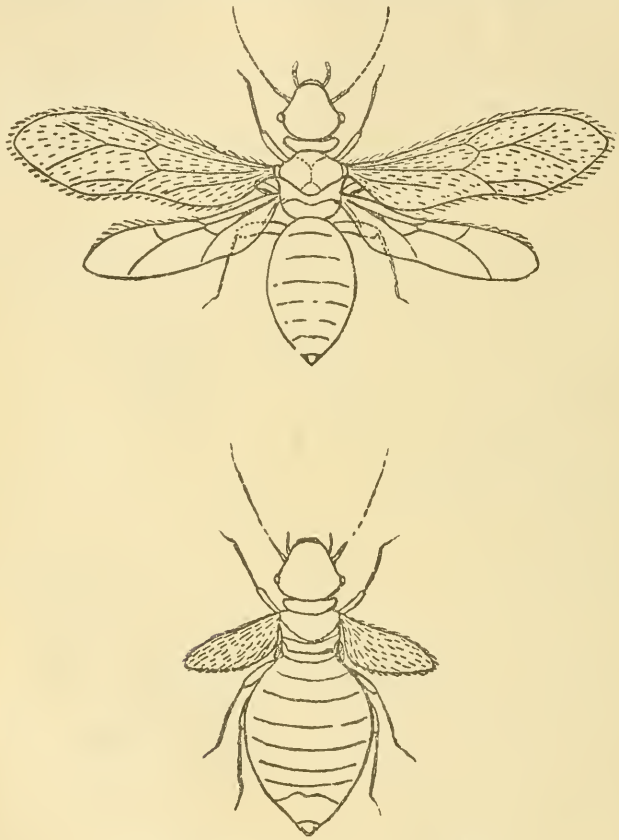
* N. Annandale: "A New Genus of Short-beaked Gnats from Ceylon."—*Spolia Zeylanica*, Vol. VII., Part XXVIII., p. 187.

† In addition to the Reduviid, the Psocus insects are attacked and preyed upon by the orange-red larvæ of a species of *Thrips*.

The orifice of the gland is apparently connected with the mouth parts, the filament being emitted from the mouth and carried back between the legs of the insect. There seems to be little or no method in their work. The insects wander about, leaving a trail of silk behind them. No definite galleries or runs are constructed, the web being apparently a shapeless tangle of fine threads, in the interstices of which the insects move about. In the daytime they are usually found resting upon the surface of the bark (beneath the web),



Web-spinning Psocid (*Archipsochus* sp.).
Upper figure—Winged female × 26.
Lower figure—Micropterous female × 26.

where they probably feed upon minute algæ and moulds. Both fully winged and micropterus forms of the adult female occur. In the accompanying illustration the upper figure shows the macropterous and the lower one the micropterous form.

Dr. Gunther Enderlein has recently published a description of an East African species of *Archipsocus* (*A. textor*) which has very similar habits. From his figure of the wing-venation it is probable that our Ceylonese insect is a representative of the same genus.

E. ERNEST GREEN.

Web of a Psocid on an Orange tree.

THE CEYLON NATURAL HISTORY SOCIETY.

By C. T. Symons, B.A. (Oxon.), F.R.G.S.

IN a country like Ceylon, where the prosperity of the inhabitants depends, not so much upon manufactures, as usually understood, but upon the natural products of the land in the way of vegetable produce and minerals, and where practically every person is brought closely in contact with striking natural objects and phenomena, the need for the study of Natural History is self-evident. This statement is meant to apply to the ordinary individual, and does not in any way refer to the organized staff of experts, which must naturally be attached to any properly-conducted industry which depends upon natural products. It is most probable that every one has at some time or other in his life come across some natural object or phenomenon which has puzzled him, and made him wish to know the why and the wherefore of the occurrence. Perhaps he has noticed the coming of some unusual bird into his compound, and would like to know why and whence it has come; perhaps he has been struck by the peculiar growth of plants in some particular district, or the occurrence of certain mineral deposits in certain definite places, and would like to trace them elsewhere or know why they occur in that particular way; perhaps he has been amazed at the extraordinary numbers of butterflies in particular spots, or at their concerted movements in hundreds and thousands in particular directions at certain times of the year, and would like to trace out the reason of the phenomenon. These and many other instances will probably have occurred to every reader. Nature appears to be always throwing questions in our way, and to be tempting us to find answers to them. Such answers for the individual must be gained in one of two ways. The one alternative is solitary study with the help of books, which, so far as Ceylon natural objects are concerned, are few and far between, and furthermore expensive. This method pre-supposes a very strong mind in the observer, who will persevere, in spite of the inevitable difficulties in the way of individual effort. The second alternative is the concerted working of those who have been trained to know, or of those who have been experienced, with those who are anxious to know, so that the accumulated knowledge of the few may be available for the many, and the observations of the many may add to the general stock of knowledge.

It is with this latter aim in view that the Ceylon Natural History Society has been inaugurated. Its headquarters are at the Colombo Museum. Its rules state that it has as its object the promotion of

the study of Natural History, more especially in the branches of Botany, Zoology, and Geology, and the accumulation of such observations as will lead to a more complete knowledge of the Natural History of the Island. Those who were instrumental in convening the inaugural meeting were of opinion that there was a real need for such a society in Ceylon, and that it would bring together a large number of individuals who were interested in the subject, and who had made valuable observations in their own fields, but who were perhaps diffident about approaching on the subject those whom they regarded as experts, and of bringing them in touch with those who were only too ready to give the results of their training and experience. The isolated individual is always at a disadvantage, more especially in such a subject as Natural History, where accumulated data are of such great value, and where an ounce of personal advice is worth a ton of information from such books as are available, or comprehensible to the untrained observer; and further the trained expert, who gives his life's work to the study, is also at a disadvantage, because he realizes the necessity for many observations and much work, more than can possibly be accomplished by the few.

In the past, the organized study of Natural History in Ceylon has been necessarily carried on by those who were definitely appointed by Government for special work, or by those who were sufficiently keen to surmount the initial difficulties of individual work. In the history of the subject it is undoubtedly true that much of the best work has been done by the amateur, who has had his interest aroused by some natural phenomenon and has been thus led on to the definite study of some branch of Natural History. But in many cases where the individual has not become pre-eminent, or where he has not been in touch with the other workers in the same branch, his observations have been lost to the world at large. In some cases the observer may be sufficiently aroused to write to the daily papers on the subject of some observation; but no permanent record is thereby made in scientific literature, and most probably the results of the work are lost, so far as future workers are concerned. The Ceylon Natural History Society will provide an instrument whereby such an occurrence is unlikely. Although at the outset it is not the intention of the Society to publish its own periodical, members will be able to lay their observations before the rest of the members of the Society, and, further, will be encouraged to record their work in the pages of *Spolia Zeylanica*, at present the only local publication dealing with the subject. As soon as the Society is in a position to do so, it will produce its own periodical, which it is hoped will take its place amongst the recognized literature of the subject.

At such an early stage any Society must be in the position of an infant, and must not attempt anything which is liable to impair its strength in the future. But, with such encouragement as the

Society has had by the acceptance of the position of Patron by His Excellency Sir Henry McCallum, and of President by Sir Hugh Clifford, and by the readiness with which the experts have come forward with offers of service, it is only reasonable to expect that the period of infancy will be a very short one so far as actual power is concerned. There are most probably a very large number of persons who, if they are not actually active in the study of Natural History, are ready to join and to have their interest aroused. There is also a large number of persons who hesitate because of the usual expense involved in joining any Society, and because they feel that, though keen, they have no expert knowledge. These may be relieved to know that the subscription to the Society has been fixed at a very low figure, which will hold good until a magazine is published, or even after then, if sufficient funds are available, and which will enable all who are interested to join, and, further, to know that it is one of the objects of the Society to publish, as soon as possible, a series of booklets dealing with natural objects in a simple way such as will enable the beginner to gain a grasp of the subject and to identify his specimens.

Membership is open to anyone who is *interested* in the study of Natural History. A communication addressed to the Honorary Secretaries will procure further information on the subject, if necessary. In Ceylon there must be a very large number of persons who are qualified for admission, and the work which can be done by the Society will largely depend upon the number, and also the activity, of its members.

It is proposed to hold meetings at convenient intervals in Colombo or in some other suitable centre, at which members will be able to make communications or exhibit specimens, and at which lectures will be given by members from time to time. These meetings will enable workers in particular branches of Natural History to get in touch individually with others who are working in the same branches.

Nature lies around us in this Island in some of its most pleasant aspects, and must impress itself even upon the most unobservant. With the seashore, the low-lying land around the coast, the central range of uplands, the jungle of various types, and the drier districts in the north, we have in Ceylon plenty of variety in a small compass, plenty to keep the worker busy wherever he may be. And the more general diffusion of the knowledge of Natural History must lead to a sounder outlook on life, and indirectly to the greater prosperity of the Island.

THE PIONEERS OF CEYLON NATURAL HISTORY.*

By E. Ernest Green.

AT this first meeting since the inauguration of our Society, it would seem appropriate to give a short account of the progress of Natural History, in connection with Ceylon, since the European occupation of the Island, and of the persons who have done most to further our knowledge of the subject.

In the earlier days, when scientific literature was neither so abundant nor so far reaching as it now is, all knowledge of the Natural History of the country had, perforce, to be gained entirely at first hand. At the present day, although a vast amount of original work still remains to be done, we have the very great advantage of solid stepping-stones laid down by former workers, and it should be the aim of this Society to add further landmarks for the benefit of future students.

In the present Paper I propose to review very briefly some of those workers and their work, as far as possible, in chronological order. I am conscious that there must be many omissions in my roll of names ; but it has been impossible, in the short time available for the preparation of this account, to make an exhaustive search amongst the old records, which alone can supply the necessary information. It is not my intention to refer to the writings of scientists who have never been resident in or even visited Ceylon, useful and important though they are. I shall confine my remarks as much as possible to the work of those lovers of nature who, in the midst of other and widely different occupations, have found pleasure in studying the natural objects that have surrounded them. It has always been a matter of wonder to me that such a large percentage of the inhabitants of this country—or even of the world—can go through life without any interest in or desire for a more intimate knowledge of the teeming life around them. Up till quite recent times a Naturalist was regarded as somewhat of a freak, and was too generally represented as an amiable lunatic without any business capacity. Even the most trivial observation often proves, ultimately, to have a bearing, the importance of which was not recognized at the time.

* A Paper read at the First General Meeting of the Ceylon Natural History Society, March 26, 1912.

Sir Emerson Tennent, in the introduction to his "Natural History of Ceylon," remarks that, "with the exception of Kelaart, Layard, Knox, and Davy, the subject of Natural History was (at that time) almost untouched in works relating to the Colony. Of these names, the earliest is that of **Robert Knox,** who was captured by the Singalese in 1657 and held a prisoner by the King of Kandy for twenty years before effecting his escape." He published the well known narrative of his adventures in 1681, and devotes three chapters of his book to a consideration of "their Roots, Plants, Herbs, Flowers; of their Beasts, Tame and Wild Insects; and of their Birds, Fish, Serpents." His observations, though aiming at no scientific value, are extremely interesting, and many of the species that come under his notice are easily recognizable at the present day. When dealing with the animals, Knox includes some close observations of the appearance and habits of the bees and ants, curiously interpolated between his account of the larger mammals and the monkeys and carnivora. He describes the bird that we recognize as the "Paradise Flycatcher," with its streaming tail feathers, and he notices the difference in colour between the two sexes. After reviewing the various serpents, he gives a fearsome description of "a Spider called Democulo, very long, black, and hairy, speckled and glistering. Its body is as big as a man's fist, with feet proportionable. These are very poisonous, and they keep in hollow trees and holes. Men bitten with them will not die, but the pain will for some time put them out of their senses."

Some ten years later, **Sir John Fryer,** when on an embassy to Persia, travelled in India and the neighbouring Islands, apparently visiting Ceylon, which was then in the hands of the Dutch. On his return to England, in 1682, he published a description of his travels. Sir John appears to have devoted much attention to the Natural History of the countries which he visited, and his book contains descriptions and figures of many animals and plants that had attracted his attention. I have not seen the work in question, and am uncertain to what extent Ceylon figures in his account; but his name is worthy of record as that of the first British naturalist to set foot in Ceylon.

An interval of about thirty years occurs before we find another name connected with the Natural History of this country. Legge, in the introduction to his well-known book on our birds, mentions that "during the latter half of the eighteenth century **Gideon Loten** was nominated Governor of Ceylon by the Dutch, and, happening to be a great lover of birds, collected and employed people to procure specimens of species which attracted his notice; and from his labours we first learn something of the peculiar birds of the Island. He had drawings prepared of many species, which he lent to an English naturalist named Peter Brown, who published in

London, in 1776, a quarto work styled 'Illustrations of Zoology.'" Legge remarks that "some of the drawings are fairly accurate; but others are grotesque and unnatural, showing the poor state of perfection to which the illustration of books had up to that time been brought."

We now come to the time of the British occupation. In 1817 **Alexander Moon** was appointed Superintendent of the Botanic Gardens, then situated at Kalutara. Six years later, after the conquest of the Kandyan kingdom, the gardens were removed to their present site at Peradeniya. There had been other Superintendents before him, but Moon appears to have been the first of them to leave any written work behind him. He published a "Catalogue of Indigenous and Exotic Plants of Ceylon," in the year 1824, which must have been of great assistance to the local botanists of the period. Such names as *Moonia heterophylla* and *Capparis moonii*, in our list of Ceylon Flora, are indications of his reputation as a botanist.

John Davy, mentioned by Tennent as one of the few students of Ceylon Natural History before his day, was contemporary with Moon. He paid special attention to Reptilia and described several species of snakes. He also published a note on the "Analysis of the Snake Stone." Tennent notes that "Dr. Davy, brother to the illustrious Sir Humphrey Davy, published in 1821 his 'Account of the Interior of Ceylon and its Inhabitants,' which contains the earliest notice of the Natural History of the Island, and especially of its Ophidian Reptiles."

Dr. George Gardner, who was Superintendent of the Peradeniya Gardens from 1844 to 1849, besides publishing various contributions to the Flora, paid some attention to Geology, and is responsible for a "Sketch of the Geology of Ceylon." Tennent acknowledges his assistance in his "Account of the Botany of the Island." *Acrotrema gardneri*, *Goniothalamus gardneri*, *Aberia gardneri*, and many other Ceylon plants retain his name. Dr. Gardner also published a memoir on the Coffee Bug.

Of **Dr. Templeton,** who was contemporary with Gardner, I find several records in Tennent's volumes. It appears that, at a meeting of the Entomological Society, in 1842, Dr. Templeton introduced thin slices of the rhizomes of *Sonneratia acida*, as a substitute for cork, for lining butterfly boxes. Again, in 1844, Dr. Templeton forwarded to the Zoological Society a description accompanied by drawings of the Wanderoo of the western maritime districts. A rare moth (*Œceticus templetonii*) testifies to his interest in entomology.

To this same period belongs **Major Champion,** who published some "Remarks on the Flora of Ceylon" in the Ceylon Almanac for 1844.

A few years later, I find in the Journal of the Asiatic Society for 1849 "An Outline of the Tamil System of Natural History," by **Simon Casie Chitty.** This is a gratifying record of early interest in such subjects by the native community.

The period from 1850 to 1880 shows a sudden and marked increase of local interest in Natural History. Such well-known names as Kelaart, Layard, Tennent, Thwaites, Ferguson, Wall, and Nietner, appear upon the scene.

Dr. Kelaart, according to Legge, was "a native of Ceylon, who went out from England in 1849 as Staff Surgeon to the Forces. He appears to have interested himself in all branches of Natural History, and must be regarded as in the front rank of Ceylon Naturalists. In 1849 he published 'Notes on the Geology of Ceylon,' and 1852 saw the appearance of his 'Prodromus Faunæ Zeylanicæ,' the earliest attempt at a systematic arrangement of the fauna of the country. We find him publishing 'Descriptions of New Reptiles' in 1855, and a 'Report upon the Pearl Oyster' three years later—a report which is considered, by competent authorities, to contain a theory of pearl formation which was very near the truth. Kelaart was more particularly interested in marine biology, and the volumes of the Journal of the Asiatic Society contain numerous contributions on this subject from his pen." It is interesting to note that Sir Willian Twynam, till now resident in Jaffna, was contemporary with Kelaart, and visited the Pearl Banks with him in 1857.

Edgar L. Layard, of the Ceylon Civil Service, was a born naturalist. Tennent drew much of his information—for his "Natural History of Ceylon"—from this source, as witnessed by the constant recurrence of Layard's name in that work. He published numerous Papers in the Journal of the Ceylon Asiatic Society, between the years 1849 and 1857, and in the "Annals and Magazine of Natural History" for 1852 and 1853. His influence must have been considerable in popularizing an interest in Natural History amongst his contemporaries in Ceylon. One of his earliest Papers was "On the Formation of a Collection of Lepidoptera in Ceylon," which supplied useful hints to beginners and describes methods of collecting and rearing caterpillars and of setting and preserving the adult insects. His relative and contemporary in the same service—the first **Sir Charles Peter Layard**—was a conchologist of some repute. He made an extensive collection of Ceylon shells which was consulted by various writers on Conchology.

The name of **Sir Emerson Tennent** is too well known to require much comment. His volumes on Ceylon (published in 1859) and on the "Natural History of Ceylon" (1851) were standard works of the time, and now have a classical reputation. Tennent himself was not a systematic zoologist, and relied upon specialists for the systematic part of his work; but he must have been an acute

observer of nature, and his book has the merit of bringing together, in a convenient form, all that was then known of the animal life of the country.

Dr. G. H. K. Thwaites, F.R.S., before assuming the reins of the Royal Botanic Gardens in 1850, was already famous in the scientific world by his discovery of the true nature of the minute aquatic organisms known as Diatoms. The old microscope with which he carried out his classical researches is still preserved at Peradeniya. He directed the Botanic Gardens for a period of thirty years, retiring in 1880, after which he resided in Kandy for two years before his death. He made extensive collections of plants, which now form the mass of the rich herbarium at Peradeniya. His "Enumeratio Plantarum Zeylaniæ" was compiled for the use of scientific botanists; but the writing of a popular Flora of Ceylon, which he had in view, was prevented by the onerous duties of his Directorship. In addition to his labours in the botanical world, Dr. Thwaites was an entomologist of some standing. Under his supervision a series of beautiful coloured drawings of the caterpillars, of a large number of local butterflies and moths, was prepared. These drawings, together with Thwaites's own collection of Lepidoptera, were utilized in Moore's fine monograph of the Lepidoptera of Ceylon—a work which is unfortunately too costly to be generally available.

Amongst Ceylon naturalists of the last generation, the name of **William Ferguson** can never be forgotten. His sympathy and ever-ready assistance were at the disposal of every budding naturalist or earnest inquirer. He had a very complete knowledge of the botany of the Island and supplied Tennent with copious communications on the subject. He was more particularly interested in Ferns and Selaginellas, and also studied the grasses of the country. But his interest in Natural History was by no means confined to plant life. Indeed, it would be difficult to mention any branch in which he was *not* interested. He gathered together much information about the reptiles of Ceylon and published several papers on the subject. One of our tree frogs (*Rhacophorus fergusonii*) bears his name. He also made notes on the structure and habits of Fireflies and Glow-worms, which, however, were never published and—owing to the unfortunate loss of his collections of these insects—cannot now be utilized.

George Wall was another well-known personality of the same period. He was an enthusiastic collector and student of ferns, and has left us "A Catalogue of the Ferns Indigenous to Ceylon" (1873) and a "Check List of Ceylon Ferns" (1879).

Any entomologist who may carry his researches into other branches than that of Lepidoptera will be familiar with the name of **J. Neitner.** He was a prominent planter in the coffee days, and was

the author of a booklet on the "Enemies of the Coffee Tree," published at the *Times of Ceylon* office in 1861. His more serious Papers appeared in continental publications; but he contributed "Descriptions of New Ceylon Coleoptera" to the Journals of both the Bengal and Ceylon branches of the Asiatic Society.

Capt. W. V. Legge's "History of the Birds of Ceylon" is perhaps the most complete monograph of any order of animals connected with the Island. Published in 1880, it remains practically complete at the present day. Not half a dozen species of birds have been added to Legge's list since the date of its publication; but much still remains to be done in the study of their habits, nidification, and distribution. In the pages of his work, the author acknowledges the assistance of many local observers, amongst which the names of Nevill, Bligh, Parker, MacVicar, Forbes Lawrie, Wickham, Holden, Cobbold, and Wade-Dalton are prominent. To show how useful such assistance may be, I will quote Legge's own words, where, in speaking of his book, he says: "In conclusion, I am constrained to remark that had others among my subscribers corresponded as vigorously with me, during the progress of the work, as Messrs. Bligh, Parker, and MacVicar, much more local information would have been contained in it."

S. Bligh, mentioned by Legge, published some "Notes on Rare Birds," in 1874, in the Journal of the Ceylon Asiatic Society. His name has been attached to "Bligh's Whistling Thrush" (*Myiophonus blighi*).

There is another name in Legge's list of contributors that deserves more special mention. **Hugh Nevill,** a Member of the Ceylon Civil Service from 1869 to 1897, was a most versatile naturalist and ethnologist, and possessed a fund of information in every branch of those subjects. He was equally at home in the Botany and the Zoology of the Island, but paid most attention to Conchology, upon which subject he contributed many Papers to the Journal of the Asiatic Society. To provide an outlet for his various studies, he founded the "Taprobanian: A Dravidian Journal of Oriental Studies in and around Ceylon, its Natural History, Archæology, Philology, History, &c.," of which he was both editor and almost sole contributor. Started in 1885, this Journal ran through three volumes and ceased to exist in 1887.

Sir William Gregory deserves recognition as the founder of the Museum in which we meet to-night. He showed great interest in the advancement of a knowledge of Natural History, and was instrumental in the production of Moore's "Lepidoptera of Ceylon."

Staniforth Green, a part contemporary and close friend of Ferguson, Wall, and Nietner, was locally renowned for his skill in mounting minute insects and other objects for the microscope. He was a

patient and careful observer, and a valued correspondent of Prof. Westwood, the famous entomologist.

A search through the Journals of the Ceylon Asiatic Society of the period reveals several other local contributors. Thus, the **Rev. B. Boake** is responsible for Papers "On the Air-breathing Fish of Ceylon" and "On the Crocodiles of Ceylon" (1865–6). **W. C. Ondaatje** writes "On the Poisonous Properties of Callotropis" (1865), and contributes Papers on Corals and Zoophytes. **E. W. Holdsworth** publishes a report on the Pearl Oyster Banks in 1867, and contributed a Paper on Ceylon Birds to the Zoological Society in 1872.

The remaining period—from 1880 to the present day—has produced numerous students and lovers of Natural History, many of whom, happily, still remain with us; but others have retired or joined the great majority. Of the latter, **Dr. Henry Trimen, F.R.S.,** was as distinguished for his loveable nature as for his scientific knowledge. While Director of the Botanical Gardens at Peradeniya from 1880 to 1896, he brought out the first four volumes of his "Handbook of the Flora of Ceylon," and left notes for the concluding volume which were put into form—after his death—by the late Sir Joseph Hooker. His able successor, **Dr. J. C. Willis**, did good service to Ceylon botany by his critical studies on the *Podostomaceæ*, of which he published a memoir in the "Annals of the Royal Botanic Gardens, Peradeniya."

When referring to the establishment of the Colombo Museum, mention should have been made of its first Director, **Amyrald Haly,** who occupied that position for approximately a quarter of a century —from 1877 to 1901, during which he amassed the enormous collections which still form the bulk of the contents of the museum. When one remembers that he had to start with an empty building and—single handed—to furnish it appropriately in every department, the magnitude of his task appears prodigious. He invented a method of preserving fish for exhibition, by which their natural colours are retained. The success of this method can be seen in the fish gallery of our Museum at the present day.

It may be taken as an axiom that one of the principal duties of the Director of a Natural History Museum is to advance and popularize the study of Natural History. Haly's successor in this office—**Dr. Arthur Willey, F.R.S.**—did much to achieve this object by the foundation of the Journal *Spolia Zeylanica* which aims at the collection and record of all observations of local interest appropriate to our subject. As the editor remarks, in the preface to the first volume: "In a progressive Colony like Ceylon, where the aspect of the country is undergoing rapid change, records of apparently trivial observations often acquire a cumulative importance in the course of years, and it should be considered an

advantage to have the means of rendering permanent and available for future reference, notes on the habits of creatures which become more shy and difficult to procure as time goes on and the new order of things replaces the old." But Dr. Willey's claim for inclusion amongst the pioneers of Ceylon Natural History does not rest solely upon his connection with *Spolia Zeylanica*. Though by training a marine biologist, he rapidly acquired a working knowledge of all the branches of zoology in the Island, and so was in a position to give valuable assistance to specialists in various groups of animal life.

Of his worthy successor I must say nothing, as I fear to outrage his modesty; but his action in initiating this Society is a pleasing foretaste of the assistance that we may confidently expect from him.

Any account of the Pioneers of Ceylon Natural History would be incomplete without mention of **Oliver Collett,** a planter whose abounding love of nature, coupled with a genial personality, could not fail to excite, amongst others, a reflected interest in the studies that were so dear to him. His knowledge of the land shells of Ceylon was unique, and he was recognized as an authority on the subject far beyond the boundaries of our Island. The fine collection that he amassed between the years of 1890 and 1901 is now lodged in the Colombo Museum. His death, in the prime of life, was a real loss to science, and it is a matter for regret that no one in Ceylon has arisen to carry on and complete his work. Collett published many Papers in the Journals of the Malacological and Royal Microscopial Societies.

Another planter, of similar tastes, was **F. Brooke Armstrong,** who was resident in Ceylon between 1880 and 1893. He added several new species to the list of our Ceylon moths; but was more specially attracted to the study of bird life. Spending all his spare time in the jungle, he acquired an intimate knowledge of the habits of the rarer and more retiring birds. Not only did he know all their notes, but displayed extraordinary skill in imitating them. He provided material and copious notes for Murray's book on the Birds of Ceylon.

Major (now Colonel) Yerbury, R.A., while stationed at Trincomalee some time in the eighteen-eighties, studied the entomology of the East Coast of the Island, paying special attention to the Diptera, or two-winged flies, and added much to our knowledge of this generally neglected order of insects.

Though not strictly residents of Ceylon, the **Drs. Sarasin** made a prolonged visit to the Island in 1883, and conducted an exhaustive study of the development of the curious eel-like animal *Ichthyophis glutinosa*, thereby solving its systematic position amongst the Batrachia. On their return to Europe they published, in 1886, some magnificently illustrated memoirs entitled "Scientific

Researches in Ceylon," dealing with this animal and with the biology of various marine organisms.

Amongst those who have left Ceylon more recently must be mentioned **John F. Jowitt,** an enthusiastic botanist and specialist on grasses ; **Col. N. Manders, R.A.M.C.,** whose studies on the butterflies of Ceylon have been of the greatest assistance to other workers on the subject ; and **Major A. J. Macdougall,** of the same service, whose labours were more particularly devoted to the life history of mosquitoes.

Though I have purposely avoided reference to the useful work of the many students of Natural History who are still with us, I cannot refrain from mentioning the name of one who, by reason of his long residence in this Island, can justly claim to rank as a pioneer. I believe that our Vice-Chairman, **Mr. F. M. Mackwood** (he is not with us to-night, so I can speak freely), is one of the oldest residents of Ceylon. He is certainly the *doyen* of our present-day collectors, and I can personally testify to his unremitting readiness to assist and encourage his fellow-workers in every way.

It is this spirit—of mutual help and encouragement—that we hope to see adopted by every member of our new Society. Let us try to remember that there is no room for petty jealousies in our work ; that discoveries made by one should be at the service of all and welcomed by all ; and that we should work, not for personal aggrandizement, but for the advancement of knowledge.

DESCRIPTION OF A MICROPTEROUS FLY OF THE FAMILY PHORIDÆ ASSOCIATED WITH ANTS.

By N. Annandale, D.Sc., Indian Museum.

IN August, 1911, Mr. E. E. Green found at Peradeniya, associated with predaceous ants of the genus *Lobopelta*, a minute micropterous insect, which he recognized as belonging to the Dipterous family Phoridæ. He has been kind enough to entrust me with its description in *Spolia Zeylanica*.

The Phoridæ* are a family as yet little known so far as the Oriental forms are concerned, but Brues† has described several species from India, and others will shortly be described by Brunetti, probably in the "Records of the Indian Museum." Although the majority of the species are provided with ample wings and lead an active life, as a rule feeding on rotting animal and vegetable matter, a considerable number have the wings degenerate or altogether absent. Some of these forms feed on carrion or the slime of snails, while others live as parasites or guests in the nests of ants or termites. The apterous and micropterous forms are very unlike ordinary flies in appearance, rather resembling fleas or minute cockroaches. Certain genera, indeed, have been separated off from the Phoridæ by Wandolleck,‡ who regards them as a distinct family (Stethopathidæ) related to the fleas. In the case of one of these genera, however, namely *Chonocephalus*, Becker§ has associated a winged and not very remarkable male with a wingless and otherwise degenerate female, while in several other genera only the female is known.

In general appearance Mr. Green's specimen resembles a female of *Chonocephalus*, a species of which (only the male) has been found in the Bombay Presidency, and is described by Brues; but in structure it is more closely allied to *Psyllomyia*, an African genus, of which the only known species (*P. testacea*) was described by Loew‖ many years ago, and has not apparently been re-discovered. It was taken in the nest of ants belonging to the genus *Dorylus*.

It seems probable that the micropterous and apterous species of Phoridæ will utimately be found to fall naturally into several

* See Brues in *Genera Insectorum*: Diptera, Fam. Phoridæ, fasc. 44 (1906).
† *Ann. Nat. Mus. Hungarici*, III., p. 539 (1905).
‡ *Zool. Jahrb.* (Syst. Abth.), XI., p. 412 (1898).
§ "Die Phoriden," *Abh. k. k. zool.-bot. Gesch. Wien*, p. 86 (1901).
‖ *Wien ent. Monatschr.*, I., p. 54, plate I., figs. 22–25 (1857).

sub-families or groups of genera, when sufficient material has been examined for a proper consideration of their taxonomy. *Psyllomyia* and the new genus which it is necessary to found for Mr. Green's species, would probably form one such group ; *Stethopathus*, *Wandolleckia*, and *Chonocephalus* a second ; *Platyphora*, *Aenigmaticus* (probably the female of *Platyphora*), and *Ænigmatistes** a third, while other genera (*e.g.*, *Termitoxenia*) appear to stand by themselves. Most of these genera are, however, known only from females, and from very few specimens at that, and it is possible that the discovery of males would in several cases completely upset a classification based solely on degenerate females, among which the phenomenon of convergence has possibly been manifested. It is even possible that the males of some of these genera are already known under other generic names. The new genus here described must, therefore, be regarded as a provisional one, until the corresponding male has been discovered, Mr. Green's specimen, its type, being clearly a female.

RHYNCHOMICROPTERON, gen. nov.

♀ Minute Phoridæ with degenerate, almost linear wings, degenerate eyes, no ocelli, an elongate elbowed proboscis, a swollen abdomen, of which all the segments are transverse and nearly all the integument soft, three large forwardly directed bristles on each side of the head and none on any part of the thorax.

♂ unknown.

The new genus appears, so far as can be judged from Loew's description and figures, to differ from *Psyllomyia* chiefly in the following points :—

(1) The abdomen is soft.
(2) The wings are much narrower.
(3) The legs are entirely covered with hairs.
(4) There are no chætæ on the thorax.
(5) The cheeks bear no downwardly directed bristles.

The two genera agree in the general form of the proboscis, although in *Rhynchomicropteron* the bend is further from the base than in *Psyllomyia ;* but it is not possible with the material at my disposal to investigate the minute structure of this organ.

R. PULICIFORME, sp. nov.

♀ The habit is stout but moderately compressed, the insect having a certain external resemblance to a flea. The head, thorax, and legs are deep brown, the abdomen white tinged with brown, the antennæ and palpi yellow ; all the larger bristles are black ; the length is about 1 mm.

* This genus is not described in the *Genera Insectorum ;* see Shelford in the *Journ. Linn. Soc.* (Zool.), XXX., p. 150, plate XXII. (1908).

Head.—The head is large and broad, depressed as a whole, but with both the dorsal and the ventral surfaces convex; no lateral surface can be distinguished. As viewed from above, the outline is rounded in front and truncated posteriorly, the sides being nearly straight. The anterior third, as seen from the side, is deeply concave, and is occupied by the antenna, the third joint of which is of great relative size and spherical in form, entirely concealing the first and second joints; near its apex it bears a very long and slender minutely pilose arista. The lower margin of the antennal cavity forms a sharp ridge which is produced forwards just in front of the eye into a triangular projection. The eye is small and appears to be pigmented very little if at all more deeply than the surrounding integument; it consists of about twelve facettes, which are by no means prominent, and is situated laterally but below the margin of the head, being narrowly oval in outline and horizontal in position. The palpi are large and conspicuous, somewhat irregularly club-shaped in form and armed with four large bristles on the inner margin and at the tip, being also sparsely clothed with minute recumbent hairs. The proboscis is very long and slender, and, except at the base, has a cylindrical form throughout its length. It is divided into three unequal regions: (1) A short flat triangular region lying on the ventral surface of the head between the palpi; (2) a proximal cylindrical portion which is the longest, running parallel to the base of the sternum nearly as far as the coxæ of the intermediate legs: it is separated from the third region by a distinct band. The third region (3) points downwards and backwards between the legs. There are a few minute and apparently soft hairs at the tip, but only very small and ill-developed fleshy expansions; no trace of any organ that could be used for stabbing or cutting is apparent.

The whole of the dorsal surface of the head is covered sparsely with minute recumbent hairs, all of which point backwards. There are about twelve small forwardly directed bristles on each side of the ventral surface below and behind the eye. On each side of the head there are three much larger bristles, all of which are directed forwards. One is situated just in front of the eye, another outside each palpus, and the third near the posterior end of the ventral surface of the head beside the proboscis. The direction of the two latter is somewhat oblique.

The integument of the head is minutely and regularly punctured, but that of the proboscis is smooth.

Thorax.—As seen from above, the pronotum, which conceals the other segments, is longer than the head, but distinctly transverse. It is divided longitudinally by a deep mid-dorsal groove, and near the anterior border on each side there is a small circular pit. A comparatively large chitinous plate on the dorsal surface of the abdomen, narrowly separated from the posterior margin of the

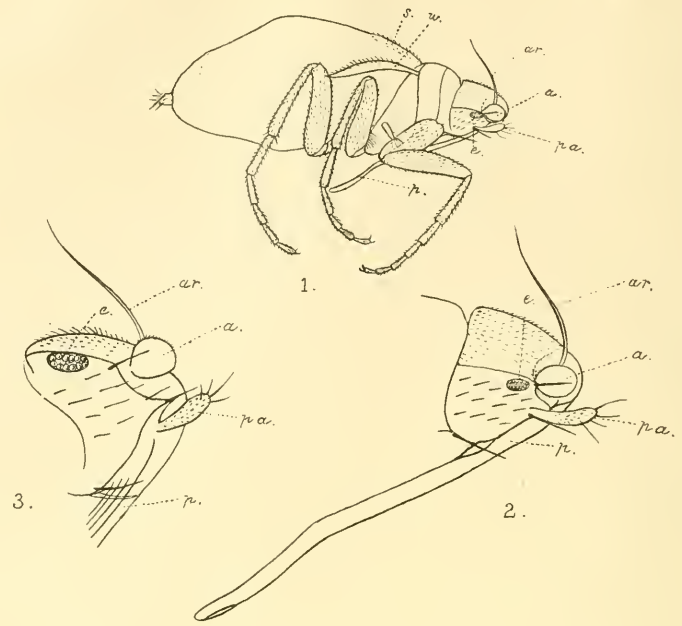
pronotum, represents the scutellum. It is broadly triangular in form, except that the apex is rounded, and has a smooth surface sparsely covered with minute recumbent hairs. Similar hairs occur on the dorsal surface of the thorax proper, the integument of which is sculptured in the same manner as that of the head. In lateral view the thorax is distinctly divided into three segments; the metathorax extends backwards for some distance on the sides of the abdomen, forming an acute triangle with the two long sides somewhat curved; the bases of the posterior legs are situated at about one-third of the length of the whole insect, if the measurement is taken from in front backwards.

Wings.—The wings, although very narrow, are distinctly spindle-shaped and acutely pointed. They lie parallel to the sides of the body with the tips pointing obliquely downwards and reaching a point some little distance behind the level of the third coxæ. No veins are apparent, but there are three distinct rows of minute bristles running along the surface. The halteres are almost cylindrical; they are situated on the lateral surface of the metathorax.

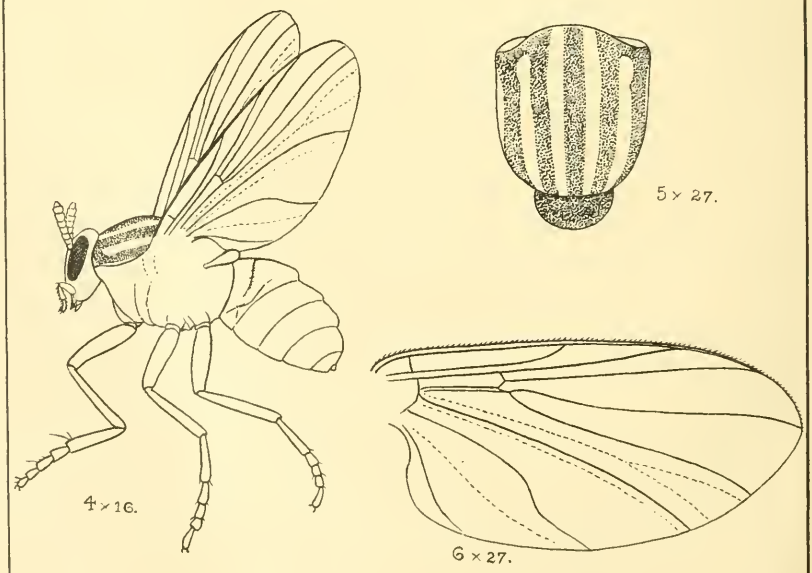
Legs.—The legs are short and stout. In all the femora are dilated, but only compressed to a moderate extent; they are longer as well as much broader than the tibiæ, the latter being cylindrical and much shorter than the tarsi, the first joint of which is the longest; the tarsi are longer than either the tibiæ or the femora. The coxæ of the first pair of legs are almost as long as the femora, which they resemble in form; those of the intermediate and posterior legs are short, but they are rendered conspicuous in the case of the intermediate pair by bearing a bunch of stout but almost recumbent black bristles on the anterior face. Similar, but much shorter, bristles also occur on the posterior coxæ. The whole of the surface of the limbs is clothed with short recumbent hairs, and the intermediate and posterior tibiæ bear several short bristles disposed in a semicircle at the tip; the posterior tibiæ also bear in the same position a single stout bristle or spur. There are two slender, strongly curved, smooth-edged claws on each foot; the pulvillus consists of a slender longitudinal process bearing a number of elongate downwardly-directed branch-like projections, and the empodium is bristle-like.

Abdomen.—The abdomen is considerably swollen, but tapers towards the tip and is much longer than broad or deep; its segmentation is obscure. The whole of the integument (with the exception of the scutellum) is soft, almost colourless and naked. The external genitalia form a short projecting tube, the dorsal surface of which is divided into two short lobes bearing long curved bristles; similar bristles also project from the ventral part of the tube.

Habitat.—Peradeniya, Kandy District, Ceylon; altitude about 1,500 ft.



Rhynchomicropteron puliciforme, Annandale.



Simulium striatum, Brunetti.

A. Chowdhary, del. et. lith.

Type.—Mr. Green has generously presented the type specimen to the Indian Museum, in which a large proportion of the type specimens of the Indian and Ceylon species of Diptera are now preserved.

Biology.—Unfortunately it is possible to say very little about the biology of *R. puliciforme*. Mr. Green found the only known individual of the species running in and out of a foraging-party of the common predaceous ant *Lobepelta ocellifera* in his garden at Peradeniya. The point at which he took it was over a hundred yards distant from the nest, whence the ants had emerged. It would be interesting to know the functions of the long elbowed proboscis of this species and of its ally the African *Psyllomyia testacea*. It does not appear to be adapted either for piercing solid bodies, or for licking or sucking nourishment from their surface, and the tip is devoid of sensory structures to an unusual extent. Possibly it may prove useful in the transmission of liquid food from the mouths of the ants to that of their guest, but this is, of course, no more than a conjecture, for we know nothing of the social relations that may exist between the two insects.

Plate I., Figs 1 to 3.

RHYNCHOMICROPTERON PULICIFORME, gen. et sp. nov.

Fig. 1.—Lateral view of the whole insect, × about 22.

Fig. 2.—Head and proboscis in profile, more highly magnified.

Fig. 3.—Oblique lateral view of the head.

a. = third joint of the antenna; *ar.* = arista; *e.* = eye; *p.* = proboscis; *pa.* = palpus; *h.* = halter; *w.* = wing; *s.* = scutellum.

A NEW SPECIES OF BLOOD-SUCKING FLY (SIMULIUM) FROM CEYLON.

By E. Brunetti.

NO species of *Simulium* appears to have been recorded from Ceylon, so I have pleasure in offering a description of one recently taken there by Mr. E. E. Green and Mr. F. H. Gravely.

Simulium striatum. sp. nov.

♀ Ceylon. Long. 2 mm.

Head.—Frons shining leaden gray, with a few pale hairs, face of similar colour. Back of head light gray, with sparse short pale hairs. Antennæ blackish, with light gray pubescence, the basal segments distinctly yellowish for some little distance, the whole antennæ appearing in certain lights tinged with reddish-yellow. Proboscis shining reddish-yellow, with large oval gray hairy labella placed at the base. Palpi long, slender, blackish, the first joint not much thickened.

Thorax.—Dorsum ash-gray, with scattered short bright yellow hairs, and three moderately narrow black stripes beginning just behind the anterior margin, but not continued to the posterior one. Viewed from a low angle in front the dorsum appears blackish, with four ash-gray stripes, of which the two outer ones are emarginate in the middle on their outer edges. Sides of thorax blackish-gray, with ash-gray reflections on the pleuræ.

Abdomen.—Dull black (apparently denuded of pubescence).

Legs.—Coxæ and femora yellowish or brownish-yellow, the latter more or less brown towards the tips, especially the posterior legs. Fore tibiæ dark brown, posterior tibiæ pale yellowish on basal half, brownish or dark brown on apical half, the proportions being variable. Fore tarsi black, the metatarsus, second and third joints large; middle tarsi brownish-yellow at the base, the joints very narrowly black tipped, the last two or three joints wholly black; no undue dilatation of any of the joints. Hind metatarsus considerably incrassated, pale whitish-yellow, with black tip; the next joint pale, narrowly black tipped; the remainder black; the joints, except the apical one, dilated.

Wings.—Colourless, venation normal; halteres lemon-yellow.

Described from five specimens taken by Mr. E. E. Green and Mr. Gravely at Peradeniya, Ceylon, VII., 1911 (*type*), XII., 10 and 2, VI., 10 (alt. 1,500–1,600 ft.).

Type in Indian Museum.

N.B.—In one specimen the frons is of equal width throughout, in the others of triangular form, broad at the vertæ, and narrowing gradually to just above the antennæ. This is the case with the other species previously described by me, and it may be a question of shrinkage, the eyes in most females being much sunken in dried specimens. The striped thorax will distinguish this species at once from all other Oriental ones. The thoracic stripes are by no means as distinct as shown in the figure.

It may be opportune to mention here that in my description of *Simulium rufithorax** an error has crept in. It is said there that the last joint of the palpi is the largest. It should be the first joint.

See Plate following Dr. Annandale's Paper.

Figs. 4–6.—*Simulium striatum*, sp. nov.

Fig. 4.—Lateral view of the fly from the left side, × 16.

Fig. 5.—Thorax and scutellum from above, × 27.

Fig. 6.—Outline of wing, × 27.

N.B.—In my "Notes on Ceylon Diptera" (Spol. Zeyl., Vol. VI., p. 170), referring to Pycnosoma flavipes Mcg., I stated it caused an outbreak of smallpox. This was a *lapsus* for cholera.

* Rec. Ind. Mus., IV., 282.

ON A REMARKABLE MIMETIC SPIDER.

By E. E. Green.

(With one Plate.)

INSTANCES of protective mimicry are by no means confined to the true (*i.e.*, hexapod) insects. We find the same phenomenon strongly developed amongst spiders. There is, in Ceylon, a well-marked group of hunting spiders (*Attidæ*) that have acquired an extraordinary resemblance to ants. This is not merely a general resemblance, but the form and colour pattern of each spider can be closely matched by particular species of ants. At first sight it might be supposed that the mimicry was of an aggressive nature, and that such spiders would habitually prey upon the ants, utilizing their resemblance to approach the insects without alarming them. But such is not the case ; and it is improbable that the closest superficial similarity would deceive an ant which recognizes its friends and foes by some other sense than that of sight. Though these spiders may catch and eat an occasional ant, it is probable that the chief value of the resemblance is of a protective nature. The particular ants that are the subjects of the imitation are all of species that have either formidable jaws and an aggressive habit (*e.g.*, *Œcophylla*), or species that are armed with a powerful sting, such as *Odontognathus*, *Lobopelta*, *Sima*, &c. One of these soft-bodied Attid spiders would stand a poor chance in a contest with ants of the species which they most resemble.

But the object of this Note is to draw attention to a different kind of spider (though also one of the *Attidæ*) which bears the most remarkable likeness, not to an ant, but to the apterous forms of wasps of the family *Mutillidæ*.

The accompanying plate shows this similarity very clearly. The spider (Figs. 5 and 6) is *Cœnoptychus pulchellus* of Simon, who has already recorded its resemblance to a *Mutilla*. This resemblance is so real that I was completely deceived by the first example that I found. Believing it to be a *Mutilla*—an insect whose painful sting I have personally experienced—I picked it up very carefully with a pair of forceps. It was only after it had been subjected to the killing bottle that I recognized its true character. Mr. Oswin Wickwar tells me that he was similarly deceived by a specimen of the same spider that he found at Anuradhapura, together with a number of the Mutillids. He writes : " I caught one spider thinking it to be a Mutillid, as it ran over the ground just like one."

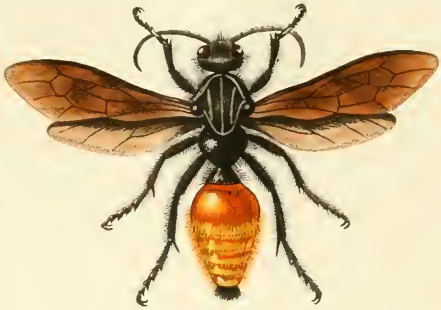


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Fig. 1 Mutilla humbertiana ♂ × 1½ Fig. 2 Spilomutilla eltola ♂ × 3
Fig. 3 Spilomutilla eltola ♀ × 3 Fig. 4 Mutilla subintrans ♀ × 3
Fig. 5 Cœnoptichus pulchellus ♂ × 3 Fig. 6 Cœnoptichus pulchellus ♀ × 3

Mr. F. H. Gravely, of the Indian Museum, tells me that he has found similar spiders associating with Mutillas in Calcutta.

The two sexes of the spider are differently coloured; the male (Fig. 5) having conspicuous white spots on the abdomen, while the female (Fig. 6) is spotted and banded with golden yellow. Both of these colour patterns occur commonly amongst Ceylon *Mutillidæ*.

Figures 2 and 3 represent the two sexes of *Spilomutilla eltola*, Cam., and present very good models for the male spider, while Fig. 4 (*Mutilla subintrans*, Rad. and Sich.) is an equally good model for the female.

It must not, however, be supposed that these spiders mimic any particular species of *Mutilla*. Such close resemblance is unnecessary. For protective purposes it is sufficient that the animal should bear a general likeness to insects of the genus *Mutilla*, just as many harmless flies have a general resemblance to wasps.

The males of the *Mutillidæ* usually bear little or no resemblance to their respective females. With a few exceptions, they are winged, have a very different colour scheme, and are much larger and more powerful. They may often be seen carrying their small mates about with them on the wing, and are said to fly with them from flower to flower; but I have not personally observed this last part of the programme. *Spilomutilla* is an exception, both sexes of this species being apterous.

It can hardly be supposed that the mutilloid appearance of the spider can be so complete as to deceive the *Mutilla* itself. Be that as it may, it is a fact that a male *Mutilla* (Fig. 1, *M. humbertiana*, Sauss.) was recently taken on the wing, and—when the capture was examined—the net was found to contain an apparently uninjured specimen of this spider, in addition to the male *Mutilla*. The presumption is that the wasp was carrying it off, but whether as food, or in mistaken identity, must remain open to conjecture.

Explanation of Plate.

(From coloured drawings by Mr. G. Henry.)

Fig. 1.—*Mutilla humbertiana*, male, × 1½.
Fig. 2.—*Spilomutilla eltola*, male, × 3.
Fig. 3.—*Spilomutilla eltola*, female, × 3.
Fig. 4.—*Mutilla subintrans*, female, × 3.
Fig. 5.—*Cœnoptychus pulchellus*, male, × 3.
Fig. 6.—*Cœnoptychus pulchellus*, female, × 3.

Erratum.

On the accompanying plate *Cœnoptichus* should be *Cœnoptychus*.

THE BIRDS OF COLOMBO.

By Walter A. Cave.

(With five Plates.)

THE following list is intended for those who have only a slight knowledge of the study of birds, to enable them to identify a species without having to refer to scientific works on the subject.

The list is by no means complete, but it has been compiled with the idea of encouraging others to make similar lists of birds in their districts. The writer will welcome notes from any one who can record the occurrence of birds in Colombo other than those listed.

The scientific nomenclature and arrangement of the Fuana of British India Series (Birds) have been followed, but in the case of the familiar names, I have sometimes adopted those used by Blandford and Oates, and at others those used by Legge, whichever I considered would be the most helpful to a beginner in identifying the bird. The numbers given in brackets in front of each species refer to the number of the species in Blandford's volume of Birds in the Fauna of British India.

No attempt has been made to describe the plumage accurately or in detail, for a description of the bird as it appears to a casual observer is, to my mind, more useful in a list of this kind. Only two references have been given, Blandford and Oates and Legge. These two works contain ample references for the scientific ornithologist, and furthermore they will give the beginner all the details he may require.

The term " Resident " is used to indicate that the bird is resident in Ceylon. In some cases there is a local migration of resident birds, and such have been mentioned. There is, however, much work still needed on the movements of some species at certain times of the year. For instance, it may be noted that Bee-eaters, Orioles, and Richard's Pipits are more frequently seen in February and March in Colombo than at any other time of the year.

The daily migration of crows is a well-known feature. It is noticeable that during the last three or four years large numbers have taken to roosting in the trees in York street and the clump of trees surrounding the fountain by the Racquet Court. In the latter vicinity the air is black with crows, in the evening, struggling and quarrelling to secure their places for the night. The trees in the Fort offer innumerable coigns of advantage from which the crows

descend during the day to secure any garbage thrown out from boutiques, &c.; in fact, so large is the crow community becoming that it is already a positive nuisance.

With very few exceptions, I have personally observed all the birds mentioned in the list. My thanks are due to Dr. Pearson, F.L.S., the Director of the Colombo Museum, for the use of specimens from which the accompanying illustrations have been reproduced.

Family *CORVIDÆ*.

Sub-family CORVINÆ.

(4) **Corvus macrorhyncus** (the Black Crow). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 17 : Legge, Birds of Ceylon, p. 346.

Plumage entirely black. More frequently seen on the outskirts.

(7) **Corvus splendens** (the Common Gray-necked Crow). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 20; Legge, Birds of Ceylon, p. 349.

Smaller than the foregoing species, and the commonest bird of Colombo. It can be distinguished from the larger bird by its gray neck and size.

Sub-family PARINÆ.

(31) **Parus atriceps** (the Gray-backed Titmouse). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 46 ; Legge, Birds of Ceylon, p. 557.

The occurrence of this bird in Colombo is rare, but it has recently been reported. It is a familiar bird in the hills, particularly in Nuwara Eliya, where its similarity to the English Tom-tit lends additional effect to the home-like appearance of our sanitorium. The plumage above is bluish ashy and darker beneath, the white cheeks being conspicuous against the black of the head.

Family *CRATEROPODIDÆ*.

Sub-family CRATEROPODINÆ.

(112) **Crateropus striatus** (the Seven Sisters, or Common Babbler). Resident.

Oates, Fauna Br. Ind. (Birds). I., p. 112; Legge, Birds of Ceylon, p. 494.

The parties of seven sisters seen at the sides of all the roads in Colombo are amongst the commonest of our feathered denizens. The plumage generally is a dowdy brownish hue, round the eye "dirty fleshy white," and "legs sickly yellow."

(119) **Pomatorhinus melanurus** (the Ceylonese Scimitar Babbler). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 118; Legge, Birds of Ceylon, p. 501.

Legge records having procured a specimen at Borella. I am inclined to think this bird, which is peculiar to the Island, has been driven inland; I have never seen it, or heard its note, which is so characteristic in Colombo or the neighbourhood. The plumage above is dark brown; conspicuous white streak over the eye; under parts white; bill yellow, 1·23 in. in length and curved.

Sub-family Sibiinæ.

(226) **Zosterops palpebrosa** (the Common White-eye). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 214; Legge, Birds of Ceylon, p. 582.

The occurrence of this bird in Colombo is not as common as its name seems to indicate. It frequents gardens, and moves about in parties of six or more. It is a small dark-green bird, lighter underneath, with a conspicuous circle of white feathers round the eye.

Sub-family Liotrichinæ.

(243) **Ægithina tiphia** (the Common Bush Bulbul, or Iora). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 230; Legge, Birds of Ceylon, p. 490.

This elegant little bird is frequently seen in the gardens of Colombo. Its brilliant plumage and clear flute-like note, chee-too, must be familiar to residents. The plumage above, including the wings, is black, a white band across the wing, and under surface yellow. The female is dark green above.

Sub-family Brachypodinæ.

(278) **Molpastes hæmorrhous** (the Madras Red-vented Bulbul). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 268; Legge, Birds of Ceylon, p. 482.

The familiar Bulbul, with its smoky-brown plumage, its black head surmounted by a tuft of feathers, and the bright red patch under the tail, is probably as well known as any bird we have. Its appearance in the compound, with its sprightly manners and cheerful series of notes, is always a source of pleasure to an observer.

(305) **Pycnonotus luteolus** (the White eye-browed Bulbul). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 290; Legge, Birds of Ceylon, p. 475.

Owing to its partiality for thick bushy trees this bird is not frequently seen, but for all that it is quite as common as the foregoing species. The series of notes is uttered more precipitately

than the Madras Bulbul. The plumage above is "olivaceous brown," with a conspicuous white stripe over the eye, and lighter brown under the body.

Family *DICRURIDÆ*.

(331) **Dicrurus leucopygialis** (the White-bellied Drongo). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 316; Legge, Birds of Ceylon, p. 392.

The "King Crow" of Colombo is so called because it is the only bird that will fearlessly attack the crow. It is distinguished by its steel blue colouring and racquet-shaped tail. It is an insect feeder, and its sallies from its perching branch into the open are performed with wonderful grace and agility. It has a variety of pleasing notes.

Family *SYLVIIDÆ*.

(374) **Orthotomus sutorius** (the Indian Tailor-bird). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 366; Legge, Birds of Ceylon, p. 517.

Very common. Its note "to-whit to-whit" or "te-wicke te-wicke" may be heard at all times of the day. Builds a nest by sewing together one or two leaves with cotton thread and lining it with fibre and cotton. Incidentally it may be mentioned that the Tailor-bird is found from the sea-coast to the summit of Pidurutalagala (8,200 feet). Top of head is rufous, upper plumage olive-green, under parts whitish, tail long. The dark patches on either side of the neck are conspicuous when the bird utters its familiar note.

(381) **Cisticola cursitans** (the Common Grass Warbler). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 374; Legge, Birds of Ceylon, p. 531.

Found in nearly all grass fields. Its note is a sharp "chick-chick," and when uttered is often difficult to locate when the bird is on the wing. There are other Warblers in Colombo, which I have been unable to identify. It is very difficult to distinguish the differences between the different kinds of this species, as they are so much alike, even when one handles specimens. The study of the Warblers still requires a lot more work, for our knowledge of them is by no means complete.

Family *LANIIDÆ*.

Sub-family LANIINÆ.

(481) **Lanius cristatus** (the Brown Shrike). Migrant.

Oates, Fauna Br. Ind. (Birds), I., p. 468; Legge, Birds of Ceylon, p. 377.

One of the earliest migrants, arriving at the end of September. Distinguished by its harsh rattling scream. The black eye-stripe is very conspicuous.

(488) **Tephrodornis pondicerianus** (the Common Wood Shrike). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 475; Legge, Birds of Ceylon, p. 372.

Above slaty-gray, blackish stripe through eye, supercilium white, rump white, tail black, breast pale ashy, under parts white.

(500) **Pericrocotus peregrinus,** Linn. (the Little Minivet). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 487; Legge, Birds of Ceylon, p. 366.

I have on several occasions seen this bird in Colombo, but its occurrence is rare. It is one of our most brilliantly coloured birds, the plumage of the male being black, scarlet, and orange, contrasting with that of the four or five sombrely clad females which generally accompany him. These latter are without the scarlet. I observed it in March and November in Colombo, and am inclined to think it is a local migrant.

(508) **Campophaga sykesi** (the Black-headed Cuckoo Shrike).

Oates, Fauna Br. Ind. (Birds), I., p. 493; Legge, Birds of Ceylon, p. 369.

Bill, legs and feet, head, tail and wings black. Upper surface slate-gray. Breast pale gray, below white. Females have the head gray, some white on the rump, and the breast white, barred.

(512) **Artamus fuscus** (the Ashy Wood Swallow, or Swallow Shrike). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 498; Legge, Birds of Ceylon, p. 666.

Resident in the outskirts all the year round. During the last two years I have seen it on the Ridgeway golf links in large numbers. General colouration gray or ashy, and the tail short and square. Spends most of its time on the wing catching insects, in company with swallows and swifts.

(521) **Oriolus melanocephalus** (the Indian Black-headed Oriole). Resident.

Oates, Fauna Br. Ind. (Birds), I., p. 506; Legge, Birds of Ceylon, p. 357.

The occurrence of this bird in Colombo is somewhat rare, but it is widely distributed throughout the low-country and hills, and, according to Legge, ascends to Nuwara Eliya. Plumage "shining jet-black and rich yellow." Known as the "Mango-bird" from the resemblance of its colour to the yellow variety of the fruit. A pair of these birds was reported from the Cinnamon Gardens last February.

(550) **Acridotheres melanosternus** (the Common Ceylon Myna). Resident.

Oates, Fuana Br. Ind. (Birds), I., p. 538; Legge, Birds of Ceylon, p. 670.

Peculiar to Ceylon. Found on the outskirts of Colombo, and very common in the low-country. Takes the place of *A. tristis*, the common Myna of India, and only varies slightly from it in colouration. The Ceylon species is too well known as a cage bird to need description.

Family *MUSCICAPIDÆ*.

(588) **Alseonax latirostris** (the Brown Fly-catcher). Migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 35; Legge, Birds of Ceylon, p. 415.

An early migrant, arriving at the beginning of October. A small insignificant brown bird, with a ring of white feathers round the eye which are scarcely perceptible, but tend to make the eyes conspicuous. One came on board a steamer I was on, about 250 miles due west of Colombo, in January, 1907.

(598) **Terpsiphone paradisi** (the Paradise Fly-catcher). Partial migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 45; Legge, Birds of Ceylon, p. 404.

As far as my observations go, this bird is not common in Colombo, but whenever seen it is bound to attract attention by the elegance of its plumage. During its life the male undergoes three changes, but in each stage the black head and tuft of feathers are retained. This tuft and the size of the bird in the short-tailed stage remind one of a Bulbul.

Female and Young Male.

The whole head black, throat brown, plumage above chestnut, below whitish. This plumage is retained by the female for life.

Second Year (Male).

Plumage as above, but the feathers of the tail grow to a foot or more in length.

Third Year.

Plumage as above, but under parts pure white, throat black.

Fourth Year.

Plumage, except the head which is black, entirely white, including the elongated feathers of the tail, which vary from 13 in. to 17 in. in length. This white plumage after this age is permanently retained. The first time I saw a bird in this stage it flew a short distance from one tree to another and I scarcely had time to recognize it, but it seemed as though it were carrying a long piece of white thread. The Sinhalese name, *Redi hora* (Cotton Thief), by which this

bird is known to the natives, occurred to me, and following up the bird I had no difficulty in identifying it as the Paradise Fly-catcher. When in the full chestnut plumage with the long tail feathers it is called by the Sinhalese *Ginni kora* (Fire Thief).

Sub-family RUTICILLINÆ.

(662) **Thamnobia fulicata** (the Black Robin). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 115; Legge, Birds of Ceylon, p. 440.

This familiar black robin inhabits almost every garden. The plumage of the male is glossy black, with some white in the wings and a chestnut patch under the tail. The female is a brownish black. Frequently seen together, when the difference in sexes can easily be distinguished.

(663) **Copsychus saularis** (the Magpie Robin). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 116; Legge, Birds of Ceylon, p. 433.

This robin is the "black and white bird" which is found in nearly every compound. The name "Magpie" is descriptive enough for identification. The female has the breast dark gray, which in the male is black. It is our best songster, and during March it pours forth a volume of beautiful notes in the early mornings and late in the evenings.

Family *PLOCEIDÆ*.

Sub-family VIDUINÆ.

(735) **Uroloncha punctulata** (the Spotted Munia). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 189; Legge, Birds of Ceylon, p. 656.

A common cage bird. Found in the Cinnamon Gardens and more outlying parts. General appearance dull chocolate colour, chest white, spotted with dark brown.

Munia oryzivora (the Java Sparrow). Partial migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 182; Legge, Birds of Ceylon, p. 646.

This familiar cage bird is not admitted to the Natural History of either India or Ceylon, because the specimens seen in a mild state are descended from imported stock. I have frequently seen flocks of as many as twenty Java Sparrows at a time on the Galle Face, feeding on the grass. My records show that they were observed in August and February. The plumage above is a "delicate dove-gray" (*Legge*), conspicuous white cheeks; head, chin, and throat black; under surface gray; breast "isabelline red"; bill red.

Family *FRINGILLIDÆ*.

Sub-family FRINGILLINÆ.

(776) **Passer domesticus** (the Common House Sparrow). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 236; Legge, Birds of Ceylon, p. 600.

Family *HIRUNDINIDÆ*.

(813) **Hirundo rustica** (the Swallow). Migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 277; Legge, Birds of Ceylon, p. 587.

This familiar bird is a migrant, arriving at the end of September, and later on is found in large numbers over open spaces, such as the Galle Face, racecourse, golf links, &c. Many people have been surprised to hear that the English Swallow occurs in Ceylon.

(825) **Hirundo hyperythra** (the Ceylon Swallow).

Oates, Fauna Br. Ind. (Birds), II., p. 284; Legge, Birds of Ceylon, p. 592.

Peculiar to the Island. I think a partial migrant, for I have only noticed it at certain times. Very much like the common Swallow, except that there is a large amount of chestnut on the under parts and rump. Its flight is feeble, and thus makes identification an easy matter.

Family *MOTACILLIDÆ*.

(833) **Motacilla borealis** (the Gray-headed Wagtail). Migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 294; Legge, Birds of Ceylon, p. 617.

This familiar winter visitor arrives at the beginning of October, and within a fortnight large numbers are to be seen on the Galle Face and other open spaces. The variety of plumage in which this bird appears at first is often bewildering. Some birds could easily be mistaken for common Pipits, whereas the yellow breast is prominent in others. It is, however, not easy to mistake a Wagtail, and although the plumage may vary to such an extent as to suggest the possibility of there being two or more different kinds of birds, I believe all the Wagtails seen in Colombo belong to this species. I have heard residents remark, in March, that when the small yellow birds appear it is a true sign that the hot weather has set in. They little suspect these birds have been here during the cool season, and that they don their yellow waistcoats preparatory to their departure in April. I have recorded an albino of this species (*Spolia Zeylanica*, Vol. VI., Part XXIV., p. 173).

(845) **Anthus richardi** (Richard's Pipit). Migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 307; Legge, Birds of Ceylon, p. 621.

A migrant, but I have never seen it before the month of February. It is suggested that it does not stop in Colombo on its migration south, but halts here for a month or so on the return journey. This fine Pipit is by no means common. I have only seen a few specimens each season, in February, March, and April. It can be readily recognized from the following species by its size. Its note is deeper than *A. rufulus*.

(847) **Anthus rufulus** (the Common Pipit). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 308; Legge, Birds of Ceylon, p. 625.

Oates says: "An exact miniature of *A. richardi*, from which this species differs in nothing but size." This Pipit is one of the commonest birds of Colombo, being found all the year round, and at all times of the day, on open stretches of grass.

Family *ALAUDIDÆ*.

(872) **Mirafra affinis** (the Madras Bush Lark). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 335; Legge, Birds of Ceylon, p. 634.

This Lark is almost as common as the foregoing Pipit, with which it consorts on all open grass lands. It is remarkably like the common Pipit; in fact, so much so that it is extremely difficult to distinguish one from the other. There are three points by which it can be recognized, but it is necessary to know both birds very well before these differences can be appreciated :—

(1) It generally sings whilst soaring.
(2) It frequently perches on branches, whereas I have never seen the common Pipit do so.
(3) The beak is larger and "leavier" than the Pipit's.

Furthermore, the hinder part of the tarsus is scutellated, whereas in the Pipit it is smooth, but this point, of course, cannot be recognized unless a specimen is handled. The easiest way to recognize these birds is by observing their habits.

A minute description of *A. rufulus* and *M. affinis* would convey little at first; it is sufficient to say they are the common brown birds seen on all grass lands.

(879) **Pyrrhulauda grisea** (the Black-bellied Finch Lark). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 341; Legge, Birds of Ceylon, p. 637.

Mr. Symons and I found a flock of about a dozen on the racecourse, which we believe is the first record of this bird in Colombo.

Family *NECTARINIIDÆ*.

Sub-family NECTARINIINÆ.

The Sun Birds.

(894) Arachnechthra lotenia (Loten's Sun Bird). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 358; Legge, Birds of Ceylon, p. 563.

The largest of the three Sun Birds found in Colombo. It is named after Loten, a Governor of Ceylon, who first recorded it.

(895) Arachnechthra asiatica (the Purple Sun Bird). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 359; Legge, Birds of Ceylon, p. 566.

In general appearance similar to Loten's, but smaller. Commoner than the foregoing species.

During the non-breeding season, November and December, both the foregoing species assume the plumage of the female, except for a dark metallic stripe down the fore-neck. At this period specimens are frequently seen in a mixture of the breeding and non-breeding plumage.

The plumage of the females is roughly as follows :—

A. lotenia.—Above, olive-brown ; wings, darker brown.

A. asiatica.—Above, mouse-gray ; wings, black.

The tail in both species is black, and the under parts yellow.

(901) Arachnechthra zeylonica (the Ceylonese Sun Bird). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 364 ; Legge, Birds of Ceylon, p. 569.

Same size as *A. asiatica*, and much the same in appearance, except that the breast and lower parts are yellow. It is the commonest of the three in Colombo. The female has similar colouring to the first two Sun Birds mentioned. It is difficult to give a short description of these beautiful birds without going into details of their wonderful metallic plumage. I will, therefore, endeavour to give a key which may help in identification :—

Upper plumage uniformly of one colour ; lower plumage dark coloured ; length 5·5 in. ; bill 1·2 in. .. .. .. *A. lotenia* ♂

Upper and lower plumage as above ; length 4·5 in. ; bill ·8 in. .. .. *A. asiatica* ♂

Upper plumage, including chin and throat, uniformly one colour ; breast and under parts bright yellow ; length 4·5 in. ; bill ·8 in. .. *A. zeylonica* ♂

Family *DICÆIDÆ*.

(919) **Dicæum erythrorhynchus** (Tickell's Flower-pecker). Resident.

Oates, Fauna Br. Ind. (Birds), II., p. 381 ; Legge, Birds of Ceylon, p. 574.

The smallest bird we have in Ceylon. Frequents the tops of tall trees, and, in spite of being a common bird, is apt to be passed over on account of its inconspicuous plumage. The colour generally is ashy-olive, paler underneath.

Family *PITTIDÆ*.

(933) **Pitta brachyura** (the Indian Pitta). Migrant.

Oates, Fauna Br. Ind. (Birds), II., p. 393 ; Legge, Birds of Ceylon, p. 687.

A migrant, arriving in October. Owing to its partiality for thick bushes, is not often seen. It is by no means common in Colombo. I have only two records. It is known as the " Painted Thrush," from the variety of brilliant colours in its plumage, or the " Six o'clock Bird," from its peculiar note.

Family *CAPITONIDÆ*.

(1008) **Thereiceryx zeylonicus** (the Brown-headed Barbet). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 86 ; Legge, Birds of Ceylon, p. 208, plate X.

One of the commonest birds of the low-country. Its cry, commencing with a low gurgle and ending with notes which resemble " kottoruwa-kottoruwa " (which, by the way, is its Sinhalese name), is familiar to everyone. Occasionally seen in well-wooded gardens in Colombo, but on the outskirts of the town its note can be heard at any time of the day.

(1015) **Cyanops flavifrons** (the Yellow-fronted Barbet). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 94 ; Legge, Birds of Ceylon, p. 212, plate X.

Peculiar to Ceylon. It is reported from Colombo.

(1019) **Xantholæma hæmatocephala** (the Crimson-breasted Barbet, or Coppersmith). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 98 ; Legge, Birds of Ceylon, p. 218.

This bird is reported from Colombo, but so far I have not observed it. I have thought at times that I have heard its note, *wonk-wonk-wonk*, which sounds like blows on a hollow vessel, but am inclined to believe I have mistaken it for the following bird, which, although

it utters its note, a decided *wok-wok-wok*, in a more rapid series, it does at times repeat it slowly like the Coppersmith. I have noticed that the voice, if I may apply the term, of the Coppersmith sometimes "cracks" on a note, when a harsh sound is produced. This never occurs with the next species.

X. *hæmatolephala*, according to Legge, is confined to the drier parts of the Island, chiefly on "the lower portions of the Kandyan country towards the east." It does not appear to come further west than Peradeniya.

(1021) Xantholæma rubricapilla (the Little Ceylon Barbet). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 100; Legge, Birds of Ceylon, p. 215, plate XI.

This Little Barbet is peculiar to Ceylon, and abundant in Colombo. It frequents tall leafy trees, and, on account of its green plumage, is not often seen. Although its note, *wok-wok-wok*, is very distinct, it does not assist one in tracing the bird, for it has a habit of turning its head from side to side, and it is difficult to decide from which direction the sound really comes.

Key to the Barbets.

General plumage uniformly green.

A.—Length, 8·5 in. and over.

(*a*) Head, neck, and breast brown, yellow patch round edge .. .. *T. zeylonicus.*

(*b*) Cheeks blue, yellow patch on forehead *C. flavifrons.*

B.—Length more than 6 in.

(*a*) Top of head *black;* cheeks *yellow*, red patch on forehead; *broad red band* below the yellow breast; plumage below whitish, feathers with broad dark green centres, giving a mottled appearance .. .. *X. hæmatocephala.*

(*b*) Top of head *bluish-green*; cheeks *blue*, red patch on forehead; *crimson spot* on the yellow breast; plumage below uniformly green .. .. *X. rubricapilla.*

Family *CORACIADÆ.*

(1022) Coracias indica (the Indian Roller). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 103; Legge, Birds of Ceylon, p. 281.

I have only once seen this bird in Colombo. It is usually confined to the drier parts of the Island. Plumage generally is a mixture of

bright, dark, and light blue, brownish on the back, and vinous beneath. It reminds one of a large Kingfisher at first sight, with a large amount of vinaceous brown.

Family *MEROPIDÆ*.

(1026) **Merops viridis** (the Green Bee-eater). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 110 ; Legge, Birds of Ceylon, p. 309.

Found usually in the drier parts of Ceylon. I have, however, seen this species in Colombo.

(1027) **Merops philippinus** (the Blue-tailed Bee-eater). Migrant.

Blandford, Fauna Br. Ind. (Birds), III., p. 111 ; Legge, Birds of Ceylon, p. 306.

This handsome Bee-eater, which is larger than the foregoing species, is a migrant, arriving in Colombo in October, leaving it almost at once, and returning in February, when it can frequently be seen. It spends most of its time on the wing, much like a Swallow ; its graceful flight and the elongated centre tail feathers proclaim its identity at once. Its note is not unlike that of the Golden Plover.

Key to the Bee-eaters.

Plumage uniformly green, length about 9·5 in. ; black band across throat edged yellowish-green ; centre tail feathers elongated .. *M. viridis*.

Plumage generally " brownish-green," length about 12 in. ; black eye-stripe ; centre tail feathers elongated 2½ in. beyond others .. *M. philippinus*.

Family *ALCEDINIDÆ*.

(1033) **Ceryle varia** (the Pied Kingfisher). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 119 ; Legge, Birds of Ceylon, p. 288.

This beautiful Kingfisher is frequently met with on the outskirts of Colombo, fishing over the swamps. It has a habit of hovering like a hawk, and dropping like a stone to seize its prey. The plumage, as its name implies, is black and white.

(1035) **Alcedo ispida** (the Little Indian Kingfisher). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 122 ; Legge, Birds of Ceylon, p. 292.

Common on the swamps on the outskirts. Differs only in a few details from the Kingfisher which livens the streams in England. The beauty of its plumage surpasses that of the following species, and it can be identified at once by its small size.

(1044) **Halcyon smyrnensis** (the White-breasted Kingfisher). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 132 ; Legge, Birds of Ceylon, p. 298.

One of the commonest birds of Colombo, being found in almost every garden. Its harsh scream as it wings its way through the air, contrasted with the plaintive note it utters when perched on a branch, must be familiar to every resident.

Key to the Kingfishers.

Plumage entirely pied, black and white	.. *C. varia.*
Plumage generally bright blue ; chin, throat, eye-stripe white ; under plumage " orange rufous "	.. *A. ispida.*
Plumage generally bright " torquoise blue " ; breast white ; head and lower parts below breast rich " chestnut-brown "	.. *H. smyrnensis.*

Family *CYPSELIDÆ.*

Sub-family CYPSELINÆ.

(1073) **Cypselus affinis** (the Common Indian Swift). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 168 ; Legge, Birds of Ceylon, p. 319.

Fairly common. May be distinguished from other Swifts by its vigorous flight, the conspicuous white rump in contrast to its black plumage, and its short square tail. The white rump can be distinguished even when looking up at the bird, for the white patch extends to the sides of the rump.

(1075) **Tachornis batassiensis** (the Palm Swift). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 170 ; Legge, Birds of Ceylon, p. 322.

Much more common than the foregoing species. This small Swift is found all over the low-country and on the lower hills. The general colour of the plumage is smoky-brown ; the tail is deeply forked, but this can only be noticed when the bird opens it whilst on the wing. The flight, though fluttering, is fast, and its note, which can frequently be heard, " is likened by Blyth to the sound *titèeya* " (Legge). Frequently seen flying about at dusk after insects.

(1086) **Macropteryx coronata** (the Indian Crested Swift). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 180 ; Legge, Birds of Ceylon, p. 328.

The largest Swift seen in Colombo. Its crest is scarcely, if ever, raised when on the wing, but conspicuous when perched. The plumage above is " bluish ashy," grayish underneath, paling into the white of the under tail-coverts. The tail is long and deeply forked.

In the following key I give the length of each bird, to assist the beginner in identifying each species :—

Plumage entirely black, rump and sides of rump white; tail short and square; length about 5 to 5½ in. .. ..*C. affinis.*

Plumage smoky brown, tail long and deeply forked; length about 5 in. ..*T. batassiensis.*

Plumage above "bluish ashy," gray below, white under tail-coverts; tail long, attenuated, and deeply forked; crested; length about 9·5 in. .. .. ..*M. coronata.*

NOTE.—I have on one or two occasions seen another Swift in Colombo, which I have been unable to identify. It is entirely blackish-brown, has a very vigorous flight, and is not at all unlike *C. apus* (the European Swift) in size. This species so far has only been recorded in the north of India, and one specimen was shot in the Andaman Islands. It was in November that I saw the bird mentioned.

Family *CAPRIMULGIDÆ.*

(1091) **Caprimulgus asiaticus** (the Common Indian Nightjar). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 186; Legge, Birds of Ceylon, p. 343.

Common about open spaces in Colombo. The plumage is beautifully mottled, but the bird can more readily be noticed by its note. I do not think ornithologists have emphasized how remarkable this note really is. Jerdon says: "Its usual note is like the sound of a stone scudding over the ice." Legge reiterates this, and adds: "This peculiar note has given rise to its name 'Ice-bird'; and not unappropriate it is, too, notwithstanding that the idea does not assimilate well with a temperature of 84° Fahr.!" However extraordinary the resemblance may be, to my mind the most remarkable thing is that not only is the scudding of the stone exactly true, but one can even hear the ring of the ice. I have frequently pointed this out on hearing the note, and all agree that the ring of the ice is most faithfully reproduced.

Family *CUCULIDÆ.*

Sub-family PHŒNICOPHAINÆ.

(1120) **Eudynamis honorata** (the Indian Koel). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 228; Legge, Birds of Ceylon, p. 251.

Common during certain months of the year. Most frequently heard at the commencement of the hot weather, the monotony of its oft-repeated note, *ku-il ku-il*, having earned for it the title of

the "Brain-fever Bird." The male is jet black all over, and the female spotted brown and white. Frequents thick leafy trees and is not often seen. The male bird is not unlike a crow, but can be distinguished from it by its feeble flight, smaller size, and longer tail. The Koel is a parasitic cuckoo, and lays its eggs in the nests of crows.

Family *PSITTACIDÆ.*

(1138) Palæornis torquatus (the Rose-ringed Parrakeet). Resident.
Blandford, Fauna Br. Ind. (Birds), III., p. 250; Legge, Birds of Ceylon, p. 171.

Frequently seen in small flocks of three, six, or even more. Their flight is very rapid, and they easily attract attention by the frequent utterance of their screaming note, both on the wing and when perching. The plumage is bright green, a collar of pale red on the neck with black edge at the sides. A common cage pet. A larger Parrakeet with red patches on the wings is frequently caged too, but I have not seen this species (*Palæornis eupatrius*, the Alexandrine Parrakeet) in its wild state in Colombo.

The Tamil name of *P. torquatus* is "Killi," which resembles the note it utters.

Family *ASIONIDÆ.*

Sub-family ASIONINÆ.

(1160) Syrnium indrani (the Brown Wood Owl). Resident.
Blandford, Fauna Br. Ind. (Birds), III., p. 275; Legge, Birds of Ceylon, p. 155, plate V.

This fine Owl is reported from Colombo, and its weird and horrible cries, which has earned for it the name of Devil-bird, have been heard at night. A specimen was caught in a Fort store last February. Mr. F. Lewis gives a good account of the cry of this Owl in *The Ibis*, Vol. IV., No. 15, 1898.

Sub-family BUBONINÆ.

(1178) Scops bakkamœna (Forster's Scops Owl). Resident.
Blandford, Fauna Br. Ind. (Birds), III., p. 297; Legge, Birds of Ceylon, p. 135.

This little Owl can be heard every night on the roads of Colombo, and its hoot from a tree in the compound must be familiar to every one.

Family *FALCONIDÆ.*

Sub-family FALCONINÆ.

(1228) Haliastur indus (the Brahminy Kite). Resident.
Blandford, Fauna Br. Ind. (Birds), III., p. 372; Legge, Birds of Ceylon, p. 76.

This bird seems to have only come to Colombo within the last thirty years, for Legge remarks that he has never observed it here.

It is frequently seen in the harbour feeding on garbage from the ships, and is common in most parts of the Island on the coast. The plumage of the adult bird is maroon-red, except the head, neck, and breast, which are white. Young birds are totally different, lacking the maroon and white, and being mottled, more or less, all over. Legge's note on the way this bird devours its food whilst on the wing is very interesting. I have frequently seen it performing the operation.

(1234) **Circus cineraceus** (Montagu's Harrier). Migrant.

Blandford, Fauna Br. Ind. (Birds), III., p. 383 ; Legge, Birds of Ceylon, p. 12.

Only one specimen, which was caught in Colombo in October, has come under my notice. It is a migrant, and comes over at the beginning of the cool season.

(1248) **Accipiter virgatus** (the Besra, or Jungle Sparrow Hawk). Resident.

Blandford, Fauna Br. Ind. (Birds), III., p. 404 ; Legge, Birds of Ceylon, p. 26.

Reported by Mr. Symons.

I have seen several other species of hawks in Colombo, but so far have been unable to identify them.

Family *COLUMBIDÆ*.

Sub-family COLUMBINÆ.

(1307) **Turtur suratensis** (the Spotted Dove). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 43 ; Legge, Birds of Ceylon, p. 705.

Seen occasionally on the outskirts of Colombo, but abundant throughout the low-country. The head is gray, a band of black feathers with white spots round hind neck. Above brown, the white tips of the tail feathers conspicuous when on the wing. Under parts vinous. A common cage bird.

Family *PHASIANIDÆ*.

(1354) **Excalfactoria chinensis** (the Blue-breasted or Chinese Quail). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 112 ; Legge, Birds of Ceylon, p. 755.

With the disappearance of the grass fields in Colombo, this Quail is not so frequently met with as it used to be. They are, however, still to be found, and I have put them up in the evenings near the racecourse.

Family *RALLIDÆ*.

(1395) Rallina superciliaris (the Banded Crake). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 167 ; Legge, Birds of Ceylon, p. 772.

A migrant arriving in October, when numbers are caught in Colombo in an exhausted state. It appears to stay only a few days, and then goes up to the hills. On their arrival they are frequently found in compounds and even in bungalows, where they are easily caught. The head and neck are chestnut, the remainder of the plumage olive-green, except the breast and under parts, which are spotted or banded black and white. They thrive well in captivity.

(1401) Amaurornis phœnicurus (the White-breasted Water Hen). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 173 ; Legge, Birds of Ceylon, p. 786.

Frequents Colombo lake, but I think its numbers are dwindling, owing to encroachment on the shores. Head, neck, and breast white, upper parts slaty-gray and olive-green. Rump brown, under parts chestnut. It is a very noisy bird. The extraordinary notes it produces are unequalled by any other wader. E. H. Aitken (known as E. H. A., author of "Tribes on my Frontier," "Behind the Bungalow," &c.) says : "Anything more unearthly proceeding from the throat of a bird I never heard. It began with loud harsh roars, which might have been elicited from a bear by roasting it slowly over a large fire, then suddenly changed to a clear note, repeated like the coo of a dove."

Family *CHARADRIIDÆ*.

Sub-family CHARADRIINÆ.

(1430) Strepsilas interpres (the Turnstone).

Blandford, Fauna Br. Ind. (Birds), IV., p. 223 ; Legge, Birds of Ceylon, p. 900.

I have only met with this bird once on the Galle Face sands, in October.

(1437) Chettusia gregaria (the Sociable Lapwing). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 231 ; Legge, Birds of Ceylon, p. 959.

I observed this bird for the first time during the cool season of 1906–7, when a flock of seven took up their quarters on the race-course. Since then I have only seen a solitary example at the same place in January of last year. The flock of seven were extraordinarily tame, allowing even equestrians to come up close to them before taking flight. This typical Plover can readily be distinguished by the large amount of white in the wings, which is very conspicuous when the bird flies.

(1439) **Charadrius fulvus** (the Eastern Golden Plover). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 234; Legge, Birds of Ceylon, p. 934.

This Plover is, strictly speaking, a migrant, and arrives earlier than any of the other birds which come to us for the winter. I have seen them as early as September 3 in Colombo. The plumage of these particular birds was then changing from the breeding to the winter dress, the under parts being blotched black and white. Frequently seen in large flocks on the racecourse, in company with the two following Plovers.

(1446) **Ægialitis alexandrina** (the Kentish Plover). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 240; Legge, Birds of Ceylon, p. 947.

(1447) **Ægialitis dubia** (the Little Ringed Plover). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 241; Legge, Birds of Ceylon, p. 952.

Key to the Plovers.

(*a*) Plumage above generally stone-gray; breast black; wings black, with broad white patch; under parts black. Length about 12 in. .. .. .. *C. gregaria.*

(*b*) Plumage above generally blackish-brown with golden yellow markings; breast and under parts white, with dark centres to feathers. Length about 9 in. to 10 in. .. *C. fulvus.*

(*c*) Plumage above generally ashy brown; white ring round neck; *no black or brown band across breast.* Length about 6 in. .. *Æ. alexandrina.*

(*d*) Plumage above generally brownish; white ring round neck; *black or brown band across breast.* Length about 6 in. .. *Æ. dubia.*

Sub-family Totaninæ.

(1460) **Totanus hypoleucus** (the Common Sandpiper). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 260; Legge, Birds of Ceylon, p. 867.

Common on the seashore and borders of the lake. Its shrill piping note and peculiar flight close to the surface of the water, "holding its wings bent like a bow," proclaim its identity. When it settles it wags the hinder part of its body like a Wagtail. The plumage above is grayish-brown and the under parts a very pale gray, almost white.

Sub-family SCOLOPACINÆ.

(1484) Gallinago cœlestis (the Common Snipe). Migrant.

Blandford, Fauna Br. Ind. (Birds), IV., p. 286; Legge, Birds of Ceylon, pp. 821, 1218.

The familiar snipe of sportsmen takes its place in this list, as it undoubtedly was formerly found in good numbers in the swampy lands round Colombo, and has within the last month or so been reported from the Ladies' golf links. I have heard of it being put up in the grounds of the new Royal College and the racecourse.

Family *LARIDÆ*.

Sub-family STERNINÆ.

(1496) Hydrochelidon hybrida (the Black-bellied Marsh Tern). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 307; Legge, Birds of Ceylon, p. 996.

The commonest bird seen on the lake, and abundant on the inland waters round the coast, and on the big tanks. The top of the head is black; upper plumage dark gray; underneath white; abdomen "gray-black." In breeding plumage, the under parts from breast downwards are very dark.

(1501) Sterna media (the Smaller-crested Tern). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 313; Legge, Birds of Ceylon, p. 1030.

Common in the harbour and on the coast. Top of head black; upper plumage dark gray; under parts white; legs and feet black; *bill orange red*. Length about 15 in.

(1502) Sterna bergii (the Large-crested Tern). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 314; Legge, Birds of Ceylon, p. 1026.

Plumage the same as the foregoing species, except that there is a *white spot on forehead; bill "musky yellow tinged with green."* Length 20 in.

Family *FREGATIDÆ*.

(1525) Fregata ariel (the Lesser Frigate Bird).

Blandford, Fauna Br. Ind. (Birds), IV., p. 338; Legge, Birds of Ceylon, p. 1203.

I have on several occasions seen this bird over the Galle Face. Its powerful flight forms a subject about which much has been written. I have noticed it flying about casually at a fair height, and in a moment or so, with a very few strokes of its wings, it has gone away quite out of sight. When descending it has a curious way of folding its wings, it seemed to me, over its head, and swooping down.

Nicholl (*Ibis*, Oct., 1906, p. 692) says he saw the larger species "close one wing and plunge downwards."

The plumage above is black, and below dark brown. Immature birds are lighter underneath, with chest and abdomen white. Tail long and deeply forked.

Family *PHAËTHONIDÆ*.

(1534) **Phæthon flavirostris** (the White Tropic Bird).

Blandford, Fauna Br. Ind. (Birds), IV.; Legge, Birds of Ceylon, p. 1172.

A rare visitor to the coasts of Ceylon.

Family *ARDEIDÆ*.

(1562) **Bubulcus coromandus** (the Cattle Egret). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 389; Legge, Birds of Ceylon, p. 1147.

Seen occasionally in the swamps on the outskirts of Colombo.

(1565) **Ardeola grayi** (the Pond Heron). Resident.

Blandford, Fauna Br. Ind. (Birds), IV., p. 393; Legge, Birds of Ceylon, p. 1150.

The most familiar bird on any piece of water in or near Colombo. In flight the large white wings are most conspicuous, but when once it settles it tucks them away so that they are not seen, and as the plumage generally resembles the greenish-yellowish grass of the swamps, the bird to all intents and purposes disappears from sight.

Family *PODICIPEDIDÆ*.

(1617) **Podicipes albipennis** (the Little Indian Grebe, or Dabchick). Resident.

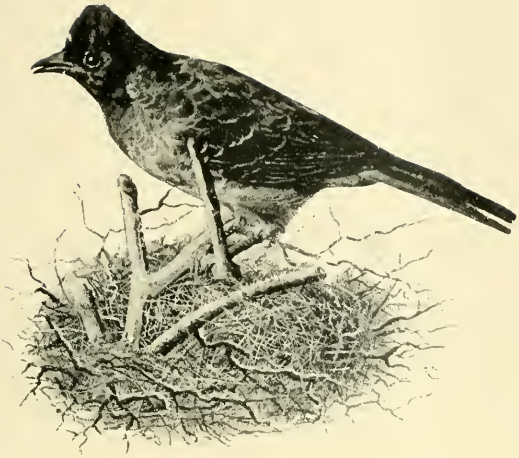
Blandford, Fauna Br. Ind. (Birds), IV., p. 475; Legge, Birds of Ceylon, p. 1059.

Except for a very slight difference in colour this bird is the same as the familiar Dabchick found on the ponds in England. It frequents the Colombo lake in large numbers at certain times of the year, and a small colony can generally be seen on the water off the Fort railway station.

The following is a list of common birds seen round Colombo, which scarcely, if ever, come within the confines of the city :—

(252) **Chloropsis jerdoni** (the Green Bulbul). Resident.

Blandford, Fauna Br. Ind. (Birds), I., p. 238; Legge, Birds of Ceylon, p. 485.



THE MADRAS RED-VENTED BULBUL.

(*Molpastes hæmorrhous*).

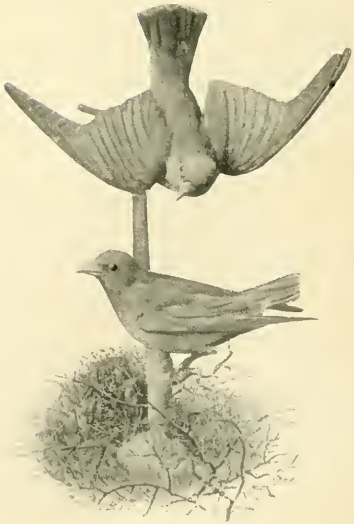
THE WHITE-BELLIED DRONGO

OR KING CROW.

(*Dicrurus leucopygialis*).

THE BROWN SHRIKE.

(*Lanius cristatus*).



THE ASHY WOOD-SWALLOW

OR SWALLOW SHRIKE.

(*Artamus fuscus*).

THE PARADISE FLYCATCHER.

(*Terpsiphone paradisi*)

LOTEN'S SUN-BIRD
Female.

(*Arachnechthra lotenia*).

LOTEN'S SUN-BIRD
Male.

(*Arachnechthra lotenia*).

THE INDIAN PITTA.

(*Pitta brachyura*).

THE PIED KINGFISHER

(*Ceryle varia*).

THE LITTLE INDIAN KINGFISHER.

(*Alcedo ispida*).

THE WHITE-BREASTED KINGFISHER.

(*Halcyon smyrnensis*).

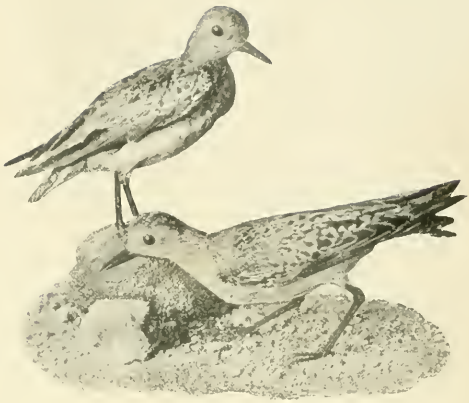
FORSTER'S SCOPS OWL.
(*Scops bakkamœna*).

THE BANDED CRAKE.
(*Rallina superciliaris*).

THE BRAHMINY KITE.
(*Haliastur indus*).

THE SOCIABLE LAPWING.

(*Chettusia gregaria*).



THE EASTERN GOLDEN PLOVER.

(*Charadrius fulvus*).

THE LARGE CRESTED TERN.

(*Sterna bergii*).

(720) **Ploceus baya** (the Common Weaver Bird). Resident.
Blandford, Fauna Br. Ind. (Birds), II., p. 175 ; Legge, Birds of Ceylon, p. 641.

(725) **Munia malacca** (the Black-headed Munia). Resident.
Blandford, Fauna Br. Ind. (Birds), II., p. 182 ; Legge, Birds of Ceylon, p. 652.

(985) **Micropternus gularis** (Madras Rufous Woodpecker). Resident.
Blandford, Fauna Br. Ind. (Birds), III., p. 57 ; Legge, Birds of Ceylon, p. 200.

(1237) **Circus æruginosus** (the Marsh Harrier). Migrant.
Blandford, Fauna Br. Ind. (Birds), III., p. 387 ; Legge, Birds of Ceylon, p. 5.

(1291) **Chalcophaps indica** (the Bronze-wing Dove). Resident.
Blandford, Fauna Br. Ind. (Birds), IV., p. 26 ; Legge, Birds of Ceylon, p. 714.

(1573) **Ardetta cinnamomea** (the Chestnut Bittern). Resident.
Blandford, Fauna Br. Ind. (Birds), IV., p. 402 ; Legge, Birds of Ceylon, p. 1162.

Plate I.

(i.) *Molpastes hæmorrhous* (the Madras Red-vented Bulbul).
(ii.) *Dicrurus leucopygialis* (the White-bellied Drongo).
(iii.) *Lanius cristatus* (the Brown Shrike).
(iv.) *Artamus fuscus* (the Ashy Wood Swallow, or Swallow Shrike).

Plate II.

(i.) *Terpsiphone paradisi* (the Paradise Fly-catcher).
(ii.) *Arachnechthra lotenia* (Loten's Sun Bird). ♂
(iii.) *Arachnechthra lotenia* (Loten's Sun Bird). ♀

Plate III.

(i.) *Pitta brachyura* (the Indian Pitta).
(ii.) *Ceryle varia* (the Pied Kingfisher).
(iii.) *Alcedo ispida* (the Little Indian Kingfisher).
(iv.) *Halcyon smyrnensis* (the White-breasted Kingfisher).

Plate IV.

(i.) *Scops bakkamœna* (Forster's Scops Owl).
(ii.) *Rallina superciliaris* (the Banded Crake).
(iii.) *Haliastur indus* (the Brahminy Kite).

Plate V.

(i.) *Chettusia gregaria* (the Sociable Lapwing).
(ii.) *Charadrius fulvus* (the Eastern Golden Plover).
(iii.) *Sterna bergii* (the Large-crested Tern).

THE VENOM OF SNAKES.

By Dr. G. Bobeau,

Preparateur in Histology to the Faculty of Medicine, Paris.

THIS article makes no pretence of containing anything new concerning venoms and their physiological action. It is merely a general review of the knowledge acquired on the subject up to the present day. Later on I intend to give the histological results obtained by me from the material (poison glands and organs of animals bitten by snakes) that I brought back from my recent travels in Ceylon and India. I here take the opportunity of offering my best thanks to Dr. J. Pearson, Director of the Colombo Museum, for his kind reception.

Setting apart for future studies the anatomical and histological structure of the poison gland, I will briefly indicate the physical and physiological characters of venoms. Afterwards I will examine the symptoms which result from the bites of venomous serpents (Viperidæ and Colubridæ), and indicate what lesions they determine in the principal organs. Lastly, I will consider the question of the treatment of snake bites.

Physical Characters and Physiological Properties of Venoms.

It is possible to obtain fresh venom either by compressing the poison glands dissected from a freshly-killed serpent, or by inciting a living snake, which is securely fixed, to eject the contents of its glands into a vessel placed under the poison fangs.

The liquid obtained in this way is of oily consistency; its colour is light yellow and its taste is very bitter. When rapidly dried, it concretes into glittering lamellæ of a colour varying between gold-yellow and light brown. In this state it may be preserved for some time, provided it is sheltered from light and moisture.

When wanted for physiological experiments, dry venom has to be dissolved in about four times its weight of normal saline solution. In fact, the dry residuum is from 20 to 38 per cent. (Calmette). Its abundance is proportionate to the period which has elapsed since the animal had last partaken of food or had used its poison-fangs. The approximate quantity of liquid venom that can be gathered (for the two glands) is as follows:—A large sized cobra (1·60 mètre) gives about 1·10 gramme; a Russell's viper, 1·80 mètre long, furnished 1·40 gramme.

I give here Calmette's table concerning the toxicity of dry venom :—

One gramme of dry cobra's venom kills approximately*—

1,250	kilogrammes of	dog.
1,430	do.	rat.
2,000	do.	rabbit.
2,500	do.	guineapig.
8,333	do.	mouse.
10,000	do.	man (or 165 persons of about 10 stones each).
20,000	do.	horse.

Although cold has no action on the toxic properties of liquid venoms, heat coagulates and modifies their chemical composition. The action is different on liquids obtained from Colubridæ from those obtained from Viperidæ. According to Calmette, in the first case (Colubridæ) venoms retain their toxicity with temperature of about 100° C. ; this toxicity is completely destroyed at 120° C. only. In the second case (Viperidæ) toxicity disappears between 65° C. and 85° C. Therefore it is not possible to give a general rule as to the resistance of venoms against heat, especially as there are large differences in this resistance between closely related species of the same genus.

Venom presents most of the chemical reactions which characterize proteic matter, viz., precipitation by absolute alcohol ; reaction of biuret ; xantho-proteic reaction ; precipitation by picric acid, with disappearance of the precipitate by heating, &c.

Such, in brief, are some of the most important physical and chemical properties of venom. Concerning the physiological properties, I will indicate only their two chief functions. It must be borne in mind that if venoms are an offensive and defensive secretion, they are also an indispensable secretion for the digestion of aliments. In fact, the non-venomous snakes (*Tropidonotus natrix*) possess parotid and supra-labial glands which secrete venomous saliva (works of Leydig, Reichel, Blanchard, Physalix, Bertrand, &c.), but they are deprived of the special channelled teeth which enable venomous snakes to inoculate their poison.

Symptoms resulting from the biting of Venomous Snakes.

Calmette has proved that all venoms contain at the same time a neurotoxin and a hemorragin, but in various proportions. That in Colubridæ and Hydrophidæ, neurotoxin predominates, whereas with Viperidæ there is predominance of hemorragin. Therefore, in case

* The toxicity of venom varies a great deal according to the physiological state of the animal ; it is much greater (about ten times) after the moulting or after a long fast.

of a cobra bite, the local symptoms will be little marked, but some signs of intoxication of the bulb will rapidly appear. On the contrary, in the case of a bite from a Russell's viper, the local symptoms, extremely intense, will predominate at first.

Having had the unfortunate experience of being bitten twice by snakes—in 1904 by a cobra (Colubridæ), in 1910 by a *Cerastus vipera* (Viperidæ)—it may be of interest if I give an account of my personal observations.

(1) *Bite of Cobra.*—On June 10, 1904, at 1 P.M., I was bitten on the right thumb by a cobra, 1·20 mètre in length, which I was preparing to dissect in the belief that the animal was dead. Nine days before I had emptied its poison glands, and since that time it had completely fasted. At first the pain was very slight. At 1·15 there was a sensation of numbness in the whole right arm, in spite of the ligatures made immediately after the bite at the base of the thumb and in the middle of the forearm. At 1·35 I attempted to make an injection of 20 cc. Calmette's serum into my side, but a slight fainting fit in the middle of the operation stopped me. Upon reviving, I finished the injection, and, in spite of my extreme weariness, I prepared a second syringe of 10 cc. of Calmette's serum. At 2.30 by struggling against an insurmountable sleepiness, I made the second injection. It was more difficult to perform than the first, because of the numbness of my right arm. A second fainting fit followed the injection. At 5 P.M., feeling increased weariness and experiencing some nausea, I again injected 20 cc. of serum. The operation was long and laborious and provoked another fainting fit, this time of much longer duration. But soon after I felt much better; the sensation of violent thirst had diminished and the sleepiness was not so overpowering; I could stand up and walk about without tottering. During the night I was not much troubled, except by a peculiar and distinct sensation of torpor which remained during my sleep. On awakening there was a slight dizziness, but not bad enough to prevent my walking about. On the following day my condition gradually assumed normality; there were no secondary effects produced locally by the venomous fangs. However, the albuminuria (1·20 gramme the first day) observed from the date of the bite gradually decreased during the following forty days. I impute the rapidity of the phenomenon of intoxication to a direct penetration of the venom into a small vein.

(2) *Bite of Cerastus vipera.*—On October 6, 1910, at 3 P.M., a viper 30 cm. in length, escaped from my hands just as I had collected its venom. In trying to secure the animal on the table, I pressed it against my side, and I was bitten on the front part of the left thigh, a hand's breadth above the knee. I experienced an immediate sensation of lancinating pain along the lower limb. I quickly made a tight ligature at the top of the thigh, and squeezing the wound as hard as possible, I applied a 1/60th solution of hypochlorite of lime.

Since the snake had just ejected most of its venom, and fearing anaphylactia on account of previous injections of Calmette's serum, I did not use serotherapy. At 5 P.M. the pain became unbearable; the whole limb was swollen and œdematous, with a sensation as though it were in imminent danger of bursting; the inguinal ganglia began to ache and were sensitive to the touch. I renewed the hypochlorite dressing every ten minutes. At 7 P.M. a few steps that I was obliged to make increased the suffering. In the evening at 9.30 my temperature was 98° F. The following morning at 8 A.M., 97·7° F. During the night I had slight delirium. Walking was impossible for two days, because of the ganglionic swelling. The urine contained traces of albumin for eight days. Then everything was restored to natural condition, except that for a fortnight after the inguinal ganglia were still slightly painful.

We will now describe the lesions traced in the principal organs during the autopsy of men and animals killed by snake-bite.

When autopsy is performed on an individual killed by the bite of a cobra or a Russell's viper, provided in the latter case that death ensues slowly, the blood remains fluid. In case of rapid death due to the bite of Russell's viper, the blood is coagulated. This fact is due to the presence in venoms of numerous substances (such as proteolytic and hemolytic substances) to which Flexuer and Noguchi have especially drawn notice.

The liver of the subject is very much congested; it is friable, and the knife mangles it rather than cuts it. The microscope shows that many cells are undergoing fatty degeneration.

The kidney is affected with hyperhemia and is full of interstitial hemorragic centres. The necrosed cells of the tubuli contorti leave their basal membrane and obstruct the canal.

The lungs display numerous small congestions; it is noticeable also that the pulmonary vesicles appear to have contracted.

The nervous centres seem affected with hyperhemia, but their microscopic aspect does not permit one to infer that there are important lesions. The histological examination shows the disappearance or modification of the corpuscles of Nissl and the opacity of the nucleus.

The Anti-venomous Serotherapy is entirely due to the researches of Calmette. To obtain his serum, which must be only considered as curative (and never as preventive, because of the anaphylactic accidents that would follow), Calmette injected into a horse progressively increasing doses of venom. He commences by injecting infinitesimal doses of venom whose toxicity has been destroyed by heating. The serum of the animal may be used when the latter can withstand an injection of 2 grammes of cobra's dry venom (that is, 80 times as great as what would ordinarily kill a horse). It takes on an average sixteen months to obtain this result.

The serum obtained in this way possesses a curative power against the venom of the same kind of snake which served to inject the horse.

But the Viperidæ and the Colubridæ having venoms whose physiological actions differ, the serum must, to be efficient in all cases, be obtained from a horse which has received injections of both kinds of venoms. This is why Calmette has obtained a polyvalent serum which is at the same time antineurotoxic (Colubridæ) and anti-hemorragic (Viperidæ).

An anti-ophidian serum is specific only against the kind of snake which supplied the venom for inoculation, and these kinds vary obviously according to the country. For this reason curative serums are now prepared in different countries against the local species. Thus in India, at the Central Research Institute of Kasauli, a polyvalent serum is obtained by inoculation of a mixture of cobra and Russell's viper venom. At Saô-Paulo (Brazil) three sorts of serum are prepared: two are specific (anti-crotalian and anti-bothropian); the third variety is polyvalent.

The description of the proceedings used in the various institutes of anti-venomous serotherapy would extend beyond the limits of this rapid and general review. I will consequently not discuss this question, nor describe the manner of collecting the serum and of computing its anti-toxic powers.

What to do in a case of Snake-bite.

(1) The first thing to do is to stop as quickly as possible the return circulation in the wounded limb, by establishing at its base a very tight ligature (with the help of braces, or a handkerchief, or a string, if nothing more suitable is at hand).

(2) Press out the greatest part of the venom, either by applying cupping-glasses on an incision as deep as that of the poison fangs, or by simply sucking the wound in urgent cases. This latter operation is dangerous for the operator, if the latter suffers from buccal ulcerations, but in any case immediately after each suction it is necessary to rinse out one's mouth with water as soon as the exhausted liquid has been ejected from the mouth.

(3) Neutralize the venom in the wound. Several proceedings have been recommended, but the following have given the best results:—

(*a*) Solution of 1/50 or 1/100 of permanganate of potash, or packing the wound with crystals of permanganate. When the solution of permanganate is employed the liquid must be syringed into the tissues surrounding the bite; a dressing soaked in the same solution is then applied on the latter. This dressing has to be renewed every hour.

(*b*) Solution of 1/60th hypochlorite of lime. The technique is the same. A few injections around the wound—afterwards dress as in case (*a*).

(*c*) 1/80th solution of hypochlorite of soda, 1/100 of chromic acid, 1/100 of gold chloride. These have the disadvantage of being caustic, and may sometimes give rise to ulcers.

(4) Make an injection of anti-ophidian serum. The right dose varies with the serum employed. With Calmette's serum it is necessary to inject at the outset *at least 40 cc.* (and not 10 or 20, as the author advises). The general technique remains the same. A sterilized syringe (of 20 cc. capacity) is filled asepticly with the serum chosen and the liquid is injected into the sub-cutaneous cellular tissue in the side of the patient. It is naturally indispensable (as for every hypodermic injection) to wash carefully with alcohol the skin of the region where the puncture has to be made. The place is then touched with a plug of aseptic padding dipped in tincture of iodine. When all the liquid has penetrated, the needle is pulled out with a jerk and a small piece of sterilized padding is applied and kept in place with collodion.

(5) Remove the ligature. Give warm tea or coffee, and prevent the sensation of cold by wrapping up the patient in warm blankets.

THE GALLE TRILINGUAL STONE.

By Edward W. Perera,
Barrister-at-law, Middle Temple; Advocate, Ceylon.

(With two Plates.)

A CARVED stone, inscribed in Chinese, Persian, and Tamil, was discovered by Mr. H. F. Tomalin, Provincial Engineer, Southern Province, early in 1911, near the turn of Cripps road, within the Town of Galle.* The tablet was used as a cover stone of a culvert with the inscribed face downwards. The history of the "find" is given in a note by Mr. G. A. Joseph, Honorary Secretary, Ceylon Branch of the Royal Asiatic Society, in the Journal of the Society for 1911. With commendable care, Mr. Tomalin had the tablet safely removed. It has proved to be a unique historical find, with an interest more than purely local. Dr. H. A. Giles, Professor of Chinese at Cambridge, thus speaks of it:—

"The day of doubt in regard to the general accuracy of Chinese annals has gone by; were it otherwise, a recent (1911) discovery in Ceylon would tend to dispel suspicion on one point. A tablet has just been unearthed at Galle, bearing an inscription in Arabic (?), Chinese, and Tamil. The Arabic (?) is beyond decipherment, but enough is left of the Chinese to show that the tablet was erected in 1409 to commemorate a visit by the Chinese eunuch Chêng-Ho, who passed several times backwards and forwards over that route. In 1411 the same eunuch was sent as envoy to Japan and narrowly escaped with his life."†

Several experts were consulted in regard to the decipherment of the trilingual inscription, which was greatly defaced. The Tamil and Persian portions were found to be quite indistinct, but a complete translation of the Chinese inscription, which baffled more than one scholar, was ultimately secured through the courtesy of Mr. Jordan, the British Ambassador at Pekin. Mr. Backhouse of Pekin furnished a translation of the Chinese, which is given in Appendix I.

Mr. Backhouse's note contains a few errors, due to his insufficient acquaintance with Ceylon history.‡ Kandy was not founded in

* It is significant that, according to the Chinese authorities quoted by Tennent (ed. 4, Vol. I., p. 614), Galle (Lo-le) was the port at which Chinese vessels anchored.

† H. A. Giles, "The Civilization of China." Home University Library of Modern Knowledge, p. 200.

‡ See, however, Appendix VIII., which came to hand after this Paper was written.

the fifteenth century, and the reference in the Chinese chronicles is clearly to the older capital Jayawardhanapura (modern Kotte), on the sea-board, the seat of Government from *circa* 1391–1565. The Sinhalese annals relating to this period are very scanty, and the true account of the Chinese missions and the events which ultimately led to the capture and deportation of the Sinhalese monarch by the Chinese can only be gathered by a careful comparison of the Chinese histories with the Sinhalese historical fragments. For this a complete translation of all the passages in the Chinese chronicles referring to Ceylon is necessary. From the references Tennent gives in the passages quoted in Appendix IX. and Appendix X., it is clear that the Chinese historians refer to the transaction recorded in the stone.

From the above it would appear that the tablet commemorates the second visit of Chêng-Ho to Ceylon, referred to in the Chinese texts. Probably it was engraved in China by the order of the Great Ming Emperor Yung-Lo, and transported with gifts for the Sacred Tooth of Buddha then deposited at Kotte. It would seem that an attempt made by Chêng-Ho to seize for his master the most venerated relic of the Buddhist world culminated in the struggle in which the Sinhalese monarch fell a victim to Chinese strategy. But, as previously noted, nothing definite can be arrived at till the Chinese chronicles are carefully analysed in the light of Ceylon history. Perhaps the Ceylon Government, which has displayed a practical interest in the discovery by securing the tablet for the Museum, getting it photographed, and having a proper translation made, will take steps to obtain this information.

The *Saddharmaratnakara*, a Buddhist work, contains the only contemporary allusion to the event yet discovered in the Sinhalese books :—

" From that time forward religious harmony prevailed among the priesthood up to the 15th year of Bhuvaneka Bahu V. Up to the fourth year of Bhuvaneka Bahu there was fulfilled 1,929 years after the death of our Sage (1382 A.D.). Thereafter there was the own son of Alakeswara Prabhuraja, Kumara Alakeswara, his* father's nephew Vira Alakeswara, the latter's younger brother Vira Bahu Epana, his son Vijaya Epa, his younger brother Tunayesa, whose father's elder brother Vira Alakeswara, having been defeated by his younger brother Vira Bahu Epa, fled the country. Thereafter he returned and reigned twelve years.

" *Afterwards, in consequence of the sins of a former birth, he fell into a snare of the Chinese and went away ;* thereupon Parakrama Bahu Epa, the grandson of Lanka Senevirat, who had been previously mentioned, ascended the throne in the month of Poson in the year of Buddha 1958 and 1722nd year from the establishment of the

* " His " refers throughout to the name immediately preceding.

religion in the Island (1415 A.D.), after the demise of the said seven."—*Saddharmaratnakara*, Colombo Museum, MS. C 12, p. ෙෙෙ, MS. V., p. ඕඃ.

The *Rajavaliya*, or "A historical narrative of Sinhalese kings," though later, contains a more circumstantial account :—

" During the reign of king Vijaya Bahu, Dosraja, king of Great China, landed in Lanka, with an immense army ; and under pretext of bringing presents and curiosities, craftily carried away king Vijaya Bahu, who fell into his hands, foolishly thinking that he also brought presents as other foreign princes had done in the time of king Parakrama Bahu. His (Vijaya Bahu's) four younger brothers were killed. Taking many captives, Dosraja returned to Great China.

* * * * * * * *

" Here it must be observed that it was in the 1958 of the illustrious Buddhist era (1415 A.D.), on Thursday, the seventh day of the bright half of the month Wesak, and under the asterism Phusa, that king Vijaya Bahu was taken captive. Whereupon his queen Sunctra Devi left the city, and went to Visidagama, taking his son with her."—The *Rajavaliya* (Gunasekara), p. 67.

De Couto, the Portuguese historian of the East Indies (1543–1616), who based his narrative on ancient Sinhalese chronicles (probably a variant of the *Rajavaliya*, now lost), also refers to the event. I quote from Mr. Donald Ferguson's translation and append his valuable notes :—

" And as the Chins continued to carry on trade with this island, and are wicked (as we have said), there put in there an armada of theirs, when Dambadine Pandar* was king, whom we have mentioned above ; and those of the country not being afraid of them, the day that they intended to embark they captured the king, and sacked his city ; and carrying off from it great treasures they departed for China, and presented the captive king to theirs. The latter was very angry at the treachery that his vassals had practised on a king who had received them into his country ; and he forthwith commanded them under pain of death to take him back again to his kingdom, for which purpose he ordered an armada to be got ready in which he embarked him with every honour."†—Journal R.A.S., C.B., Vol. XX., No. 60, pp. 66, 67.

* This statement proves that the copy of the *Rajavaliya* in the possession of the Sinhalese princes who supplied Couto with his information, had the usual hiatus, after the reign of Parakrama Bahu II. (see *Rajavaliya*, p. 66). In reality the reigning king was Vira Bahu, or Vijaya Bahu VI. (?1391–1412), and he it was whom the Chinese General Ching Ho in 1410 carried off captive to China (see Bell's Report on Kegalla District, 91–3 ; Sylvani Lévi in *Journal Asiatique*, 430, 440).—D. F.

† It is noteworthy that this statement regarding the remission of Vijaya Bahu, which finds no place in the *Rajavaliya*, is confirmed by the Chinese historians (see Tennent, Vol. I. pp. 416, 624).—D. F.

All the available evidence points to the conclusion that the Tamil and Persian inscriptions are merely translations of the Chinese: the enumeration of the gifts sent by the Chinese Emperor evidently misled Dr. Harowitz in concluding that a mercantile transaction was described in the imperfect Persian inscription. The only translation of the Tamil available, that made by a Galle student, would confirm this view.

For a detailed consideration of the Chinese invasion of Ceylon in the fifteenth century *vide* Bell's Report of the Kegalla District (Ceylon Archæological Survey), pp. 91–93; and my Papers Alakeswara, Appendices A and B (Journal R.A.S., C.B., Vol. XVIII., No. 55, p. 281); and Sri Parakrama Bahu VI. (Journal R.A.S., C.B., Vol. XXII., No. 63, p. 2).

A summary of the correspondence relating to the decipherment of the tablet is subjoined.

[NOTE.—Although satisfactory readings of the Tamil and Persian inscriptions have not yet been obtained, it is thought advisable to publish the opinion of the various experts obtained up to the present. Epigraphists are invited to assist in deciphering the Tamil and Persian.—Ed.]

Appendix I.

Translation of the Chinese Inscription.

His Majesty the Emperor of the Great Ming dynasty has despatched the eunuchs Ching-Ho, Wang Ch'ing-Lien, and others to set forth his utterance before Buddha, the World Honoured One, as follows:

"Deeply do we reverence you, Merciful and Honoured One, whose bright perfection is wide-embracing, and whose way of virtue passes all understanding, whose law enters into all human relations, and the years of whose great Kalpa (period) are like the sand of the river in number, you whose controlling influence ennobles and converts, whose kindness quickens, and whose strength discerns, whose mysterious efficacy is beyond compare!

"Whereas Ceylon's mountainous isle lies in the south of the ocean, and its Buddhist temples are sanctuaries of your gospel, where your miraculous responsive power imbues and enlightens. Of late, We have despatched missions to announce our mandates to foreign nations, and during their journey over the ocean they have been favoured with the blessing of your beneficent protection. They escaped disaster or misfortune, and journeyed in safety to and fro. In everlasting recognition of your supreme virtue, We, therefore, bestow offerings in recompense, and do now reverently present before Buddha, the Honoured One, oblations of gold and silver, gold embroidered jewelled banners of variegated silk, incense burners, and flower vases, silks of many colours in lining and exterior, lamps and candles with other gifts, in order to manifest the high honour of our worship. Do you, Lord Buddha, bestow on them your regard!"

List of Alms bestowed at the Shrine of the Buddhist Temple in the Mountain of Ceylon as offerings.

1,000 pieces of gold: 5,000 pieces of silver: 50 rolls of embroidered silk in many colours: 50 rolls of silk taffeta, in many colours: 4 pairs of jewelled banners, gold embroidered, and of variegated silk: 2 pairs of the same picked in red: one pair of the same in yellow: one pair in black: 5 antique brass incense burners: 5 pairs of antique brass flower vases picked in gold on lacquer, with gold stands: 5 pairs of yellow brass candlesticks picked in gold on lacquer, with gold stands: 5 yellow brass lamps picked in gold on lacquer with gold stands: 5 incense vessels in vermilion red, lacquered gold picked on lacquer, with gold stands: 6 pairs of golden lotus flowers: 2,500 catties of scented oil: 10 pairs of wax candles: 10 sticks of fragrant incense.

The date being the seventh year of Yung-Lo (1410 A.D.) marked Chi ch'ou in the sixty years' cycle, on the Chia Hsu day of the sixty days cycle in the second moon, being the 1st day of the month.

A reverent oblation.

EDMUND BACKHOUSE.

Pekin, March 31, 1911.

Appendix II.

A Note on Ching-Ho.

The eunuch Ching-Ho was one of the greatest figures in the great reign of Yung Lo. He attracted the attention of that monarch, when prince of Yen, by his knowledge of strategy, and was his chief assistant in the long campaign he successfully carried out against his nephew, the second emperor of the Ming dynasty and grandson of Chu Yuan-chang, its founder. It is needless to recapitulate the events of that four years' war, with which the reader will be familiar: marching from Pekin southwards the prince of Yen won city after city from the imperialists, and entered Nanking in 1403. The young Emperor Hui Ti fled into Yunnan and thence to Burma; and the first of the expeditions which Ching-Ho undertook to a foreign country was to ascertain, if possible, his whereabouts. In 1405 he went as far as Tongking, Siam, and Java, from all of which countries tribute was received and the accession of Yung Lo duly acknowledged.

Encouraged by his success, his master sent him with a larger fleet in the year 1407 to visit more remote lands: he collected tribute in Borneo, Sumatra, Straits Settlements, visited Assam and Chittagong, and cruised down the Bay of Bengal to Ceylon, where the King of Kandy is recorded as having recognized the Emperor Yung Lo as his suzerain. A Cingalese envoy returned with him to China and was received at court. This is the visit referred to in the inscription now translated. Apparently he followed it up by a second journey to Sumatra in 1411. The year after his return to Pekin (*i.e.* 1415) he went on a fourth mission and opened up trade with all the countries and islands in the southern archipelago. After a second stay at Kandy, where he sojourned in the well-known Buddhist temple near the lake, he went on to Calicut, Socotra, Aden, entered the straits of Babel-Mandeb and appears to have gone up the Red Sea as far as Suakim. The Sultan (?) of Yemen sent representatives to forward tribute to Yung Lo, and the ruler of Aden hospitably received his mission, which lingered there several weeks.

His life was spent in journeys abroad, and after the death of Yung Lo, that Emperor's grandson Hsuan Tsung (reign title Hsuan Te) despatched him on yet another excursion, in the course of which he passed up the Persian Gulf and received tribute from the rulers of Bunder Abbas, Bushire, and what we may perhaps identify as Koweyt. In all he opened trade relations with forty-three States. He died at an extreme old age about 1444, during the troublous reign of Ying Tsung.

EDMUND BACKHOUSE.

Pekin, March 31, 1911.

Appendix III.

Translation of the Tamil Inscription.

Mr. F. H. de Vos of Galle was able to procure an imperfect translation of the Tamil inscription from a "Young Tamil Schoolmaster of Galle." This is given below :—

Year [very indistinct]..... Treaty ..... This island ..... conquerors ..... therefore ..... this ..... to the enemy ..... this rough messengers ..... China ..... up to this time ..... sent ..... demanding in all this land ..... peacock feathers [?] ..... firstly ..... these conditions ..... tribute ..... the Turks who conquered yesterday ..... description of the tribute ..... beautiful ..... fifty different kinds of silk ..... pearls ..... if not given ..... safety ..... ten ..... ten lamps (brass) .....

* * * * * *

Appendix IV.

Copy of Letter from Professor Giles to Director, Colombo Museum.

Selwyn Gardens,
Cambridge, March 2, 1911.

SIR,—In reply to your letter No. 49 of February 7, the Chinese inscription is mostly obliterated, but enough remains for me to tell you roughly that the tablet bears date the seventh year of the Emperor Yung Lo of the Ming dynasty = 1409 A.D. The name of Buddha occurs more than once ; also such items as five copper censers, five golden boxes for incense, and five receptacles for perfumed oil.

In 1405 the eunuch Chêng-Ho was sent to Ceylon to acquire a tooth of Buddha ; and Chinese history tells us that, after a fight, he succeeded in carrying off the relic. This tablet is probably connected in some way with that event.

H. A. GILES.

Appendix V.

The Archæological Commissioner wrote to M. R. Ry. H. Krishna Sastri Avargal, the Assistant Archæological Superintendent for Epigraphy, Southern India, asking for assistance, and the followign two letters were received :—

From M. R. Ry. H. Krishna Sastri Avargal, B.A., Assistant Archæological Superintendent for Epigraphy, Southern Circle, to H. C. P. Bell, Esq., Archæological Commissioner for Ceylon.

Office of the Assistant Archæological Superintendent for Epigraphy, Ootacamund, Camp Chickbakapur,

No. 57. February 6, 1911.

Sir,—With reference to your letter No. 58 dated January 30, 1911, I have the honour to inform you that the impressions of the trilingual inscription from Galle are not so perfect as I would desire them to be. I can only gather from a rough examination that the Tamil record deals with a mercantile transaction. I shall, however, find time to study them more closely after I return to headquarters about the middle of March. The results of my study will be communicated to you about the end of that month.

I suggest that the Arabic inscription may be sent for examination to Dr. J. Horovitz, Ph.D., of Aligarh, who is the Editor of *Epigraphia Moslemica*.

H. Kristna Sastri.

From M. R. Ry. H. Kristna Sastri Avargal, B.A., Assistant Archæological Superintendent for Epigraphy, Southern Circle, to H. C. P. Bell, Esq., Archæological Commissioner for Ceylon, Anuradhapura.

Office of the Assistant Archæological Superintendent for Epigraphy, Ootacamund.

No. 146. March 20, 1911.

Sir,—In continuation of my letter No. 57 of the 6th instant, I have the honour to enclose my very tentative transcript of the Tamil portion of the trilingual record from Galle. The letters in this are so small and smashed that it is often difficult to distinguish *ka* and *cha*, *na* and *ta*, &c., which look so much alike in Tamil. I have not on this account attempted to send you a practically meaningless translation. It, however, appears to me from certain phrases underlined on the transcript that the inscription deals with a mercantile transaction in which the weavers and other merchants (often bearing the honorifics *nayanars* and *Settis*) agreed among themselves, or with the ruling authorities, to levy some specified taxes amounting to about 2,500 (*pon ?*) on articles such as gold, silver, silk, *tulukki*, sandal, beeswax, thread, &c. The purpose for which this tax was levied is not clear from the inscription, whether it was for the benefit of a temple, the guild, or the royal treasury. The ink impressions and the photograph of the trilingual record have been forwarded to Dr. Horovitz, Ph.D., the editor of the *Epigraphia Moslemica*, Aligarh, for decipherment of the Arabic portion thereof and their direct despatch to you after (they are) done with, with his text and translation.

H. Kristna Sastri.

Appendix VI.

Copy of Letter from Dr. J. Horovitz, Epigraphist for Moslem Inscriptions in India, to the Archæological Commissioner, Ceylon.

From Dr. J. Horovitz, Epigraphist for Moslem Inscriptions in India, to H. C. P. Bell, Esq., Archæological Commissioner, Ceylon.

Aligarh, June 20, 1911.

Inscribed Slab, Galle.

Sir,— I beg to enclose herewith a transcript of the *Persian* text of the trilingual inscription—very incomplete I am afraid—impressions and photograph of which were sent to me by the Assistant Archæological Superintendent for Epigraphy in Southern Circle. I am sorry to say that I have been able to make out a word here and there only, and am not in a position even to say what the inscription refers to. This much only is clear: that in the beginning one Adilshoh is mentioned, and also that the language of the inscription is Persian. It seems to be some legal document referring to some territory, the boundaries of which perhaps are given; possibly it refers to a wagf made with regard to that territory, or its sale.

I beg to return under separate cover the impressions and photograph.

J. Horovitz.

Appendix VII.

Note obtained through Mr. N. S. Fernando of Colombo.

A portion of the Tamil inscription is indistinct, but it is evident that the tablet was erected to commemorate the visit of a Chinese mission, which, voyaging *viâ* Hai-nan, reached Ceylon about the seventh year of the Emperor Yung Lo, *i.e.*, in 1410 A.D.

Out of veneration for Buddha, the members of the mission made offerings to various temples, and caused a list thereof to be engraved on the tablet by way of recording their visit to Buddha land.

The offerings were as follows :—

1,000 gold coins.*
5,000 silver coins.*
10 pieces assorted silk.
50 pieces assorted pongee.
4 pairs gold embroidered silk banners (2 pairs red, 1 yellow, 1 blue).
5 brass incense burners.
5 pairs flower vases (inlaid gold).
5 pairs candlesticks (inlaid gold).
5 gold lacquered incense boxes.
6 pairs golden lotus flowers.
2,500 catties aromatic oil (sandal wood).
10 pairs votive candles.
10 sticks incense.

* More probable *mace* weights of gold and silver, and not coins.

Appendix VIII.

Part of Letter from Mr. Edmund Backhouse of Pekin to the Director, Colombo Museum (February 23, 1912).

In regard to my notes on the visit of the Chinese eunuch to Ceylon, I understand that the temple at which the Chinese record speaks of their having lodged, and having been hospitably treated by the bonzes, cannot have been the famous shrine at Kandy, as in my ignorance I had supposed, owing to the fact that the artificial lake was not then in existence. The Chinese text speaks of the envoys residing at a temple close to a body of water and surrounded by hills: this seemed to me to answer the description of Kandy, and I therefore hazarded the conjecture that this was the place referred to. It is evident that one must seek elsewhere for the site: possibly there may be some old shrine near Galle answering to the Chinese description ? *

EDMUND BACKHOUSE.

Appendix IX.†

The beginning of the fifteenth century was, however, signalized by an occurrence, the details of which throw light over the internal condition of the Island, at a period regarding which the native historians are more than usually obscure. At this time the glory of Buddhism had declined, and the political ascendency of the Tamils had enabled the Brahmans to taint the national worship by an infusion of Hindu observances. The *Se-yih-ke foo-choo*, or "Description of Western Countries," says that in 1405 A.D., the reigning king, A-lee-koo-nae-wurh (Wijaya Bahu VI.), a native of Sollee, and "an adherent of the heterodox faith, so far from honouring Buddha, tyrannized over his followers." He maltreated strangers resorting to the Island, and plundered their vessels, "so that the envoys from other lands, in passing to and fro, were much annoyed by him."

In that year a mission from China, sent with incense and offerings to the shrine of the Tooth, was insulted and waylaid, and with difficulty effected an escape from Ceylon. According to the *Ming-she*, or History of the Ming Dynasty, "the Emperor *Ching-tsoo*, indignant at this outrage on his people, and apprehensive lest the influence of China in other countries besides Ceylon had declined during the reign of his predecessors, sent *Ching-Ho*, a soldier of distinction, with a fleet of sixty-two ships and a large military escort, on an expedition to visit the western kingdoms, furnished with proper credentials and rich presents of silk and gold. Ching-Ho touched at Cochin-China, Sumatra, Java, Cambodia, Siam, and other places, "proclaiming at each the Imperial edict, and conferring Imperial gifts." If any of the princes refused submission, they were subdued by force; and the expedition returned to China in 1407 A.D., accompanied by envoys from the several nations, who came to pay court to the Emperor.

In the following year Ching-Ho, having been despatched on a similar mission to Ceylon, the king, A-lee-ko-nae-wah, decoyed his party into

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* Probably this temple was at one of the older capitals, Gampola or Kotte. The former stands on the banks of the Mahaveli-ganga, and is "surrounded by hills."

† Tennent's "Ceylon," ed. 4, Vol. I., pp. 622–625.

the interior, threw up stockades with a view to their capture, in the hope of a ransom, and ordered soldiers to the coast to plunder the Chinese junks. But Ching-Ho, by a dexterous movement, avoided the attack, and invested the capital, made a prisoner of the king, succeeded in conveying him on board his fleet, and carried him captive to China, together with his queen, his children, his officers of state, and his attendants. He brought away with him spoils, which were long afterwards exhibited in the Tsinghae monastery at Nankin, and one of the commentaries on the *Si-yu-ke* of Hiouen Thseng states that amongst the articles carried away was the sacred tooth of Buddha. "In the sixth month of the year 1411," says the author of the *Ming-she*, "the prisoners were presented at court. The Chinese ministers pressed for their execution, but the Emperor, in pity for their ignorance, set them at liberty, but commanded them to select a virtuous man from the same family to occupy the throne. All the captives declared in favour of Seay-pa-nae-na, whereupon an envoy was sent with a seal to invest him with the royal dignity, as a vassal of the empire," and in that capacity he was restored to Ceylon, the former king being at the same time sent back to the Island. It would be difficult to identify the names in this story with the kings of the period, were it not stated in another chronicle, the *Woo-heo-peen*, or Record of the Ming Dynasty, that Seay-pa-nae-na was afterwards named *Pu-la-ko-ma Ba-zae La-cha*, in which it is not difficult to recognize "Sri Prakrama Bahu Raja," the sixth of his name, who transferred the seat of Government from Gampola to Cotta, and reigned from 1410–1462 A.D.

For fifty years after this untoward event the subjection of Ceylon to China appears to have been humbly and periodically acknowledged; tribute was punctually paid to the Emperor, and on two occasions, in 1416 A.D. and 1421 A.D., the kings of Ceylon were the bearers of it in person. In 1430 A.D., at a period of intestine commotion, "Ching-Ho issued a proclamation for the pacification of Ceylon," and, at a somewhat later period, edicts were promulgated by the Emperor of China for the Government of the Island. In 1459 A.D., however, the series of humiliations appears to have come abruptly to a close; for, "in that year," says the *Ming-she*, "the King of Ceylon for the last time sent an envoy with tribute, and after that none ever came again."

Appendix X.*

It was during this period that an event occurred, which is obscurely alluded to in some of the Sinhalese chronicles, but is recorded with such minute details in several of the Chinese historical works, as to afford a reliable illustration of the condition of the Island and its monarchy in the fifteenth century. Prior to that time the community of religion between Ceylon and China, and the eagerness of the latter country to extend its commerce, led to the establishment of an intercourse which has been elsewhere described; missions were constantly despatched charged with an interchange of courtesies between their sovereigns; theologians and officers of State arrived in Ceylon empowered to collect information regarding the doctrines of Buddha; and envoys were sent in return bearing royal donations of relics and sacred books. The Sinhalese monarchs, overawed by the magnitude of the Imperial power, were inuced to avow towards China a sense of dependency approaching

* Tennent's "Ceylon," ed. 4, Vol. I., pp. 416, 417.

to homage ; and the gifts which they offered are all recorded in the Chinese annals as so many " payments of tribute." At length, in the year 1405 A.D.,* during the reign of the Emperor Yung-Lo of the Ming dynasty, a celebrated Chinese commander, Chingo-Ho, having visited Ceylon as the bearer of incense and offerings, to be deposited at the shrine of Buddha, was waylaid, together with his followers, by the Sinhalese king, Wijayo Bahu VI., and with difficulty effected an escape to his ships. To revenge this treacherous affront Ching-Ho was despatched a few years afterwards with a considerable fleet and a formidable military force, which the king (whom the Chinese historian calls A-lee-ko-nae-wih) prepared to resist ; but by a vigorous effort Ho and his followers succeeded in seizing the capital, and bore off the sovereign, together with his family, as prisoners to China. He presented them to the Emperor, who, out of compassion, ordered them to be sent back to their country on the condition that " the wisest of the family should be chosen king." " Seay-pa-nea-na " was accordingly elected, and this choice being confirmed, he was sent to his native country, duly provided with a seal of investiture, as a vassal of the empire, under the style of Sri Prakrama Bahu VI., and from that period till the reign of Teen-shun, 1434–1448 A.D., Ceylon continued to pay an annual tribute to China.

Illustrations.

Plate 1.—Photograph of the stone bearing the trilingual inscription.

Plate 2.—Copy of the Chinese inscription made by Mr. Edward Backhouse, Pekin.

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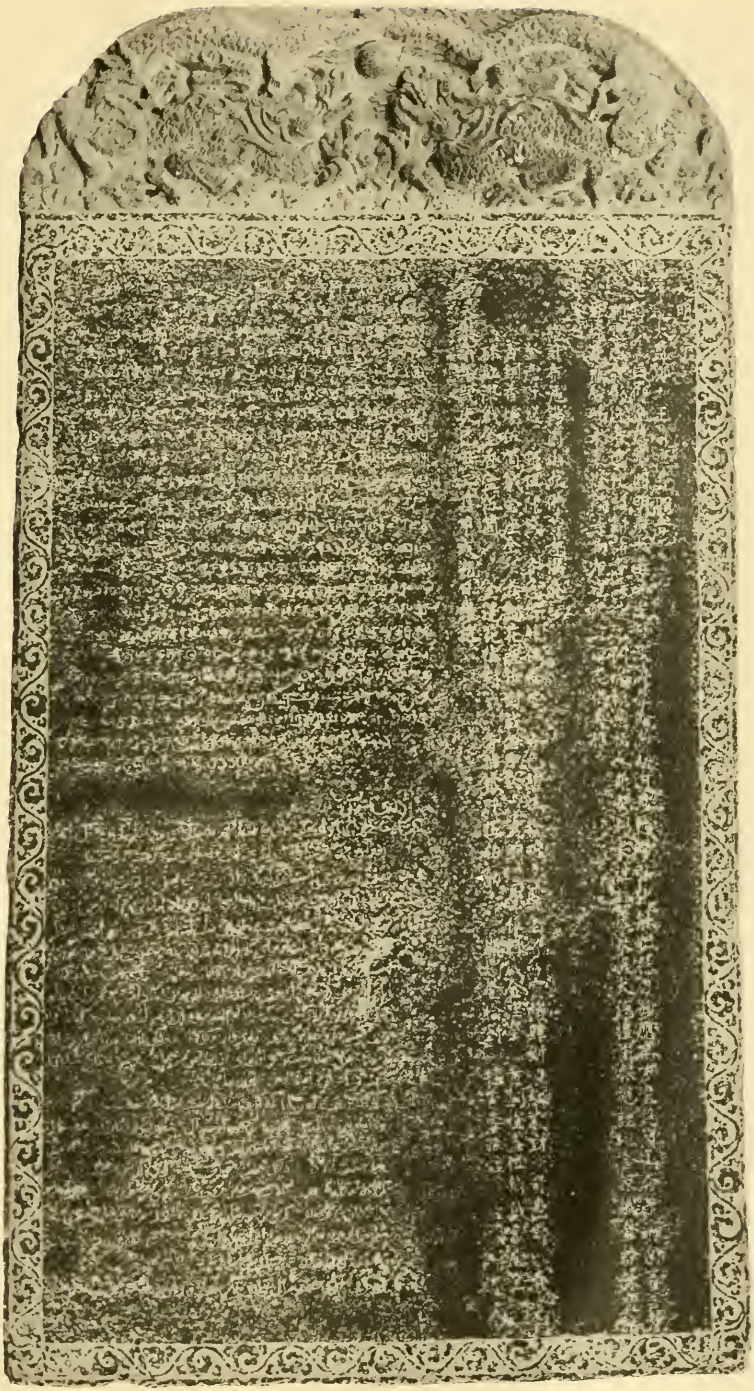
* The narrative in the text is extracted from the Ta-tsing-yi-tung, a " Topographical Account of the Manchoo Empire," written in the seventeenth century, to a copy of which, in the British Museum, my attention was directed by the erudite Chinese scholar, Mr. Meadows, author of " The Chinese and their Rebellions." The story of this Chinese expedition to Ceylon will also be found in the Se-yih-ke-foo-choo, " A Description of Western Countries," 1450 A.D. ; the Woo heo-pecu, " A Record of the Ming Dynasty," 1522 A.D., b. LVIII., p. 3, and in the Ming-she, " A History of the Ming Dynasty," 1739 A.D., CCCXXVI., p. 2. For a further account of this event see Part V. of this work, Chapter III.



大明

皇帝遣太監鄭和王清濂等昭告于

佛世尊 曰仰維慈尊圓明廣大道德玄妙法濟群倫魔劫河沙約歸弘化能仁慧力妙應無方惟錫蘭山介乎海南信言梵

刹靈應翕彰比者遣使詔諭諸番海道日開鴻頤慈祐無窮秉往無虞永惟大德禮用報施謹以金銀織金絲綵寶幡

香爐花瓶綵絲表裏燈燭等物布施佛尊以光供奉惟

世尊鑒之

總計布施錫蘭山立佛等座供養

金壹阡錢 銀伍阡錢 各色綿絲伍拾疋 各色絹伍拾疋 織金綵絲寶幡肆對 納紅貳對 黃壹對 青壹對

古銅香爐伍個 戧金座金 古銅花瓶伍對 戧金座金 黃銅燭臺伍對 戧金座金 黃銅燈盞伍個 戧金座金

硃紅漆戧金香盒伍個 金蓮花陸對 香油貳阡伍佰觔 爐燭壹拾對 檀香壹拾炷

告永樂柒年歲次己丑二月甲戌朔日謹施

PLATE 2.—THE GALLE TRILINGUAL STONE: THE CHINESE INSCRIPTION.

NOTES.

13. *Stray Notes on Ceylon Animals.*—The following notes were made during and subsequent to a holiday trip in Ceylon in October, 1911. Disconnected and trivial as they are, they may perhaps be useful if only as indicating points in the habits and distribution of certain animals that would repay further investigation.

(1) Freshwater Sponges and Polyzoa.

In my volume on the Freshwater Sponges, Hydroids, and Polyzoa, in the "Fauna of British India," I pointed out how little was known of these animals so far as Ceylon was concerned,* and I hoped that a personal investigation of some of the lakes and tanks of the Island would enable me to add to our knowledge of these groups. In this, however, I was to a large extent disappointed, partly perhaps because my visit was not made at a favourable season, but also partly, I have no doubt, because freshwater sponges and polyzoa are much scarcer in Ceylon than in some districts of India. The only sponge obtained was *Spongilla carteri*, which was found growing in the Kandy lake on a masonry dam. The only freshwater polyzoon that I saw was an immature colony of *Plumatella*, probably *P. javanica*, Kræpelin, which was attached to the lower surface of a stone in a small stream above Peradeniya, at an altitude of about 1,700 feet. A careful search round the edge of the lake at Nuwara Eliya (alt. *ca.* 6,000 feet) was absolutely unproductive, and the profuse growth of a slimy dark green alga which covered every stone and every twig rendered it improbable that either sponge or polyzoon could live. Mr. S. W. Kemp's recent investigation of lakes at altitudes of from 3,500 to 6,500 feet in the Western Himalayas proves that several species of these groups grow luxuriantly in them, so that the question of altitudes does not enter the case. Neither at Colombo, nor at Anuradhapura, nor in the hill-country did I find either sponge gemmules or polyzoon statoblasts floating free on the surface of the water. There were no gemmules in the specimen of *S. carteri* I obtained at Kandy in October.

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* The list of records for Ceylon stands as follows :—

Freshwater Sponges.	Freshwater Polyzoa.
Spongilla proliferens.	*Plumatella (?) javanica.*
—— *carteri.*	—— "*princeps.*"
	Pectinatella burmanica.

(2) A Leech Parasitic on the Hard-Shelled Pond-Tortoise of Ceylon (*Nicoria* trijuga* subsp. *thermalis*).

In the course of her work on the blood-parasites of Ceylon reptiles Miss Muriel Robertson discovered on the soft parts of pond-tortoises a peculiar little leech which she at first assigned to the genus *Branchellion* ("Spolia Zeylanica," Vol. V., p. 178, 1908). Mr. W. A. Harding, however, later described it under the name *Ozobranchus shipleyi* (Proc. Cambridge Phil. Soc., XV., p. 233, 1909), and it is by this name that it is referred to in Miss Robertson's fuller paper in Vol. LV. of the Quart. Journ. Micro. Sci., in which she gives some interesting information about the habits both of the parasite and of its host, as well as a detailed description of the Hæmatozoon (*Hæmogregarina nicoriæ*), apparently conveyed by the leech from tortoise to tortoise. So far as is known, the leech is only found on the one form of tortoise, the blood of which it sucks; it was very abundant on that form in the lake at Kandy in October, 1911. In life the anterior part of the leech is narrow and pointed, the single pair of minute black eyes being easily detected near the extremity of the body. The posterior part, which is distinctly broader, bears the tufted lateral gills that are a characteristic feature of the genus. The whole animal is translucent and appears at first sight to be colourless, except for a dark brownish tinge due to blood contained in the alimentary canal. Examination with a pocket-lens shows, however, that, in spite of the translucency of the tissues, the dorsal surface is of a dull yellow delicately veined, especially at the sides of the body, with dark green. The posterior sucker, which is very large and maintains an extremely tight grip, is minutely speckled with the same shade; the gills are quite colourless and almost transparent. Miss Robertson states that the gills are kept in constant motion. This was not the case with individuals which were attempting to escape from a tube of clear water in which they had been placed after being removed from the leech. All that I could observe, apart from the movements of the body as a whole, was an occasional faint trembling of the gills in nowise rhythmical or concerted.

(3) A Rare Ceylon Lizard (*Lepidodactylus ceylonensis*).

This lizard is recorded in the "Fauna" and the British Museum "Catalogue" only from Gampola, which is situated in the hill-country not very far from Kandy (alt. 1,600–1,700 feet). A specimen was taken by Mr. Green and myself at Peradeniya. *L. ceylonensis* is not, however, peculiar to Ceylon, for the Indian Museum possesses specimens from Lower Burma; Mr. Boulenger records it from Java, Engano Island, and Pegu (—— Am. Mus. Genova, XIII. (XXXIII.), p. 316), and it also occurs in the Malay

* Siebenrock, in his recent revision of the Chelonia (Zool. Jahrb., 1909, Supplement), calls this genus *Geoemyda*, on grounds that are technically correct.

Peninsula. It is very closely related to *L. crepuscularis* from New Caledonia. At first sight I mistook the living lizard for *Gonatodes kandianus*, to which it bears a close superficial resemblance; but the tail is prehensile and the pupil vertical, and there is considerable difference in the structure of the feet. I am not aware that the prehensile character of the tail has hitherto been noticed in this species.

(4) Eggs and Young of the Lizard *Calotes nigrilabris*.

Calotes nigrilabris is a large green lizard with conspicuous black markings on the side of the head and on the throat. It is only found in the mountains of Ceylon at considerable altitudes, and is common in the neighbourhood of Nuwara Eliya. Dr. Willey* in his note on the viviparity of another lizard (*Cophotis ceylanica*) common in the same district rather implies that *Calotes nigrilabris* is oviparous, but no particulars appear to have been published about its eggs, which differ considerably from those of the common and widely distributed *Calotes versicolor* of the plains and lower hill-slopes of India and Ceylon.

On October 14 I found near Pattipola (alt. 6,000 feet) a clutch of four eggs, three of which survived the vicissitudes of a journey to Calcutta and finally produced (on November 1 and 2) young lizards agreeing in all essential characters with adult specimens of *Calotes nigrilabris*. Two were sacrificed, in order that they might become specimens. The four eggs lay in a small depression in sandy soil beside a footpath leading, at the spot, through open country. They had probably been covered with earth which had been washed away by heavy rain, and were still partly embedded, without exhibiting any definite arrangement. In shape they differed from the eggs of *C. versicolor* in being proportionately much broader and in having a regularly oval, instead of an almost spindle-shaped, outline. The shell, although probably it contained a certain amount of calcareous matter, was tough, leathery, and flexible, and the external surface was ornamented by an almost microscopic network of fine furrows. The eggs varied slightly in size; one of them measures (in spirit) 17 × 11 mm.

One of the eggs was opened the same day and found to contain a well advanced embryo already complete in all its parts, but enclosed in the usual embryonic membranes, which were exceedingly transparent, and still with a large yolk-sack attached. The yolk-sack was twisted over the back of the embryo, to which it formed a kind of cloak. The fore legs were bent up in front of the face in such a way that the claws projected towards the shell of the egg. A faint pigmentation was already apparent in the skin of the embryo, and the position of the pineal body was marked by a conspicuous black spot on the surface of the head.

* "Spolia Zeylanica," Vol. III., p. 235 (1906).

The other three eggs reached Calcutta safely, and on the evening of November 1, I noticed that one of them had burst and that its sides had collapsed owing to an escape of liquid. No movement was, however, apparent in the egg, which was found to be in exactly the same condition two hours later. It was then removed for closer examination and the handling it received forced the young lizard's head out of the aperture. It seemed to be impossible, however, for it to get any further, and the mouth was opened as if it were suffocating. I therefore slit the egg shell down one side with a pair of scissors. Much to my surprise the young lizard thereupon leapt out of its shell and began running and jumping about so vigorously in my hand that I had some difficulty in preventing it from escaping altogether.

The remaining two eggs were found to be, early the next morning, in the same condition as that just described, and one of them was killed and preserved intact. The young lizard escaped from the other by its own efforts about midday.

The method by which the egg-shell had been ruptured was easily seen on an examination of the egg that had been preserved. The aperture had been produced by several oblique parallel slits on each side, which had evidently been brought about by the action of the claws of the fore limbs. They had torn a roughly triangular flap in the egg-shell near the anterior end.

The young lizards measured nearly $3\frac{1}{2}$ inches in total length on hatching. They differed from the adult of the species in their relatively larger heads, and in the total absence of the dark markings on the side of the head and on the throat. Their dorsal surface was grass-green, varying in intensity from time to time and sometimes becoming much darker ; the ventral surface and the sides of the head were much paler green and less changeable ; there was a dark streak running from over the eye to over the ear. Food in the shape of small moths and grasshoppers was taken regularly from the day of hatching, and great activity was fully maintained until the end of November, notwithstanding the fact that the weather was becoming cool.

N. ANNANDALE.

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14. *Notes on Ceylon Butterflies.*—Col. N. Manders, who did much useful work in the study of our butterflies during his residence in Ceylon, has been frequenting the British Museum (Natural History) for the same purpose, since his arrival in England. A letter recently received from him contains several particulars of interest to us.

Catochrysops lithargyria, Moore.—This very distinctly marked insect was included by Bingham (Fauna B. I., " Butterflies,' Vol. II., pp. 411, 412) amongst the varietal forms of *C. strabo*. But Swinhoe, who is completing the " Lepidoptera Indica " commenced

by the late F. Moore, now admits it to specific rank. He describes the female of *lithargyria* as having the same colouring as the male, but with a broadish black border. Local collectors do not appear to have met with the female of this species. Even the male is a scarce insect in Ceylon. It is difficult to understand how the species could ever be confused with *strabo*. Apart from its characteristic colour, the heavy and very distinct markings of the under side separate it completely from every other species of *Catochrysops*.

Nacaduba ardates, Moore.—This smallest of the *Nacaduba* group was originally described by Moore, presumably from Indian examples, in P. Z. S., 1874, p. 574. He subsequently recorded the same species from Ceylon. We have either two forms or two closely-related species in Ceylon, one with, and the other without, tails on the hind wings. De Niceville and Manders, in their "List of the Butterflies of Ceylon," unite both these forms under the name *noreia* of Felder. Bingham (*loc. cit.*, pp. 391, 393) describes both *ardates* and *noreia*, and credits Ceylon with the two species. I understand from Col. Manders that Swinhoe now refers the tailed form to *nora* (also of Felder), and the tailless one to *noreia*. Apart from the presence or absence of this tiny appendage, the two forms are practically indistinguishable. They frequent the same localities and are on the wing at the same time. The larva of the tailed form has been bred by Mr. J. C. F. Fryer, from the flowers of *Allophyllus cobbe*. Manders submitted examples of both forms to Dr. Chapman for a critical study of the genitalia, but the results of the examination were purely negative, no appreciable difference being observable.

Terias.—The number and names of the species of this genus occurring in Ceylon have always been a matter of dispute. Moore, in his "Lepidoptera of Ceylon," enumerates nine species, viz., *hacabe*, *simulata*, *hecabeoides*, *citrina*, *rotundalis*, *uniformis*, *drona*, *cingala*, and *rama*. These fall easily into two groups, which we may call the "hecabeoid" group (containing the first six names), and the "drona" group (containing the other three). De Niceville and Manders reduced this number to five, namely, *libythea* (= *drona*, of Moore), *venata* (= *cingala* and *rama*, of Moore), *hecabe* (= *Simulata*, *hecabeoides*, and *citrina*, of Moore), *silhetana* (= *rotundalis* and *uniformis*, of Moore), and *sari*. Bingham credits Ceylon with four species only, omitting *silhetana* from our list, but it is evident, from his description and figures, that he has included under the name *hecabe* several varieties of *silhetana*, as it is recognized in Ceylon. It is probable that typical *sari* does not occur in this Island; but whether the local form that we know by that name is distinct from *hecabe* or not, can be proved only by breeding. Personally, I am inclined to believe that we have only two species of the hecabeoid group here, which I recognize—for the present—as *hecabe* and *silhetana*, whatever their correct names may be. They are both

very variable insects, and the presence or absence of one or more spots in the basal half of the discoidal cell (on under side) is a character of no specific value. There is, however, one constant character by which they may be distinguished. In the so-called *hecabe*, the black border of the fore wing involves that portion of the inner margin, while, in our *silhetana*, a thin yellow line is continued along the inner margin, below the black border, towards the outer angle. In the males of *silhetana*, the black border is often very narrow and without any appreciable expansion at its lower end. I have never observed this restricted border in any of the forms of our *hecabe*. A chocolate patch—of varying dimensions—may occur at or near the apex on the under surface of the fore wing in females of both species.

In the hecabeoid group we find two distinct types of larvæ: one gregarious, with a black head, which produces what we—in Ceylon—regard as *silhetana;* the other non-gregarious, with a green head, from which results our supposed *hecabe*.

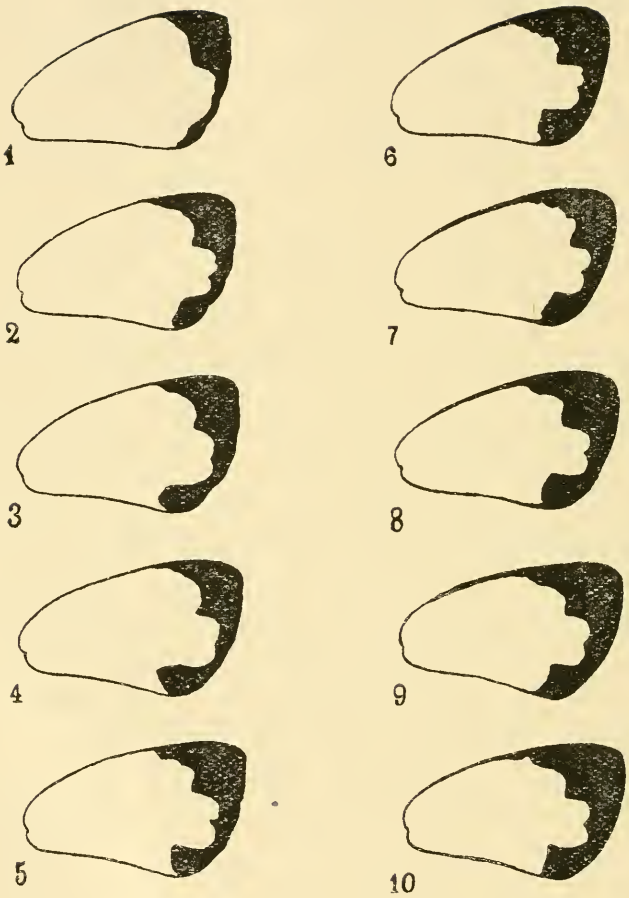
The nomenclature of these species is still in great confusion, and every fresh authority maintains a different opinion to that of the last. Piepers, in his "Rhopalocera of Java," describes the larva of *hecabe* as having a black head. According to the same author, the larvæ of *sari* are gregarious, but have green heads. Moreover, he does not recognize *silhetana* as distinct from *hecabe;* but his *hecabe* is probably not the same as ours. The British Museum authorities again assert that *hecabe* does not occur in India or Ceylon, but is confined to the Chinese region. They recognize our Ceylon insect as *T. suava*. Col. Manders remarks of the typical examples of *hecabe* and *suava* displayed in the British Museum collection: "If the labels were removed, I would defy any one to differentiate between them." Swinhoe, I understand, is describing all the innumerable forms of *hecabe* as distinct species. These many conflicting opinions do not tend to make matters clearer for us. Who is to be the final authority?

E. ERNEST GREEN.

Supplementary Note.—When preparing the drawings shown on the accompanying plate, illustrating the colour pattern in different forms of Terias *silhetana* and *hecabe*, I noticed two other distinguishing characters which appear to be constant for the two species (as represented in Ceylon).

In *silhetana* the outer margin is distinctly crenulate, while in *hecabe* the same margin is practically entire. By this character alone I have been able to separate—with certainty—the two species by examination with transmitted light without removing them from their paper envelopes.

In *hecabe* the black border is continued along the costal margin, gradually thinning out before reaching the base of the wing. In



FRONT WINGS OF TERIAS:

Figs. 1–5, *silhetana*; Figs. 6–10, *hecabe*.

silhetana the black border ends almost abruptly on the *costa*, leaving the costal area of the remainder of the wing pale.

With regard to what I consider the principal distinguishing character, namely, the termination of the lower extremity of the black border of the fore wing, the difference will be appreciated more clearly by examination of the accompanying figures. There is, normally, a strongly marked inward extension of the black border below vein 2, its inner edge dipping sharply down to the inner margin. In *hecabe* this edge meets the inner margin either squarely (figs. 9, 10), or turns inwards along the margin towards the base of the wing (figs. 6 to 8). There may be, and very frequently is, a small yellow point projecting into the black, simulating the condition characteristic of *silhetana*, but this incursion of yellow is always above the actual margin, and is followed by a distinct though slender tongue of black running inwards along the extreme margin. In *silhetana* (figs. 1 to 5), on the other hand, the lower extremity of the black border invariably turns outwards, and is subtended by a distinct marginal extension of the yellow area. This is independent of the cilia of the inner margin, which are always yellow, in both species. This character may seem trivial, but is constant in long series of bred specimens that I have examined. It may be unappreciable to the naked eye, but is readily distinguishable with a lens, and—in any case of doubt—may be corroborated by the other characters mentioned above. The distinguishing characters may be indicated, synoptically, as follows:—

Terias hecabe.—Outer margin of fore wing entire. Marginal area of costa distinctly black. Lower extremity of black border not subtended by yellow.

Terias silhetana.—Outer margin of fore wing distinctly crenulate. Marginal area of costa yellow. Lower extremity of black border partially subtended by yellow.

E. ERNEST GREEN.

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15. *Large Parasitic Thread-worm in a Butterfly.*—In January, 1912, I received from Mr. F. M. Mackwood a specimen of *Danais chrysippus*, from which a thread-worm had emerged after Mr. Mackwood had prepared the butterfly for exhibition. The worm was $5\frac{1}{4}$ inches (130 mm.) long and ·6 mm. in thickness. As the worm was in a shrivelling up condition when I received it, I could not identify it with any certainty. It has the appearance of an ordinary nematode worm, but larval nematodes and larval gordiids, which differ very little in appearance from the adult nematode, are also found parasitic in insects.

[Ed.]

16. *A Curious Tree.*—About 2½ miles from Maho railway station, along the road leading to Buttala and Nikaweratiya, stands a tree—about a hundred yards from the roadside—bearing on its trunk what appears to be the figure of a human being, thought to be a woman. Looking at it from the roadside it suggests an image carved in stone. The tree, which is a *Strychnos nux vomica* (common enough in the locality), is near a tank known by the village name of Attawarali. One is naturally led to think that the figure was carved on the tree trunk, but a close inspection makes it clear that the outline of the human form is the result of an irregular development of bark which has produced a sort of embossed surface. At close quarters the semblance disappears, and is only brought into relief by a distant view. As a peculiarity the tree is well known to the people about the place, and is said to be an old landmark. Strange to say there is no legend associated with the tree, though there is one connected with a stone image in the same neighbourhood which is said to represent a petrified woman.

I inspected the tree on the 3rd instant.

C. DRIEBERG.

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17. *The Ceylon Natural History Society.*—In connection with the founding of the Ceylon Natural History Society one is reminded of the fact that no Ceylonese except Dr. Kelaart* of the Army has ever seriously taken up the study of Natural History in any way. This lack of study by the people of the country is partly responsible for the most vague and incorreet statements which are accepted and repeated. If nothing else, this formation of a Ceylon Natural History Society will tend to first-hand observation and accurate statement of fact. Animals figure largely in sacred and legendary lore in Ceylon, and there is a literary harvest in this connection for anybody to write about; though such a compilation may have "no root in actual life," it would help the present and the future by explaining many things un-understandable except when considered with Ceylon mythology and folklore.

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* Kelaart, E.F., M.D., F.L.S., F.G.S., author of Notes on the Geology of Ceylon: Laterite Formation; Fluviatile Deposit of Nuwara Eliya—in Journal, R.A.S. (C.B.), 1850, p. 87. List of Mammalia of Ceylon Observed or Collected, ditto, p. 201. Description of New Species and Varieties of Mammals found in Ceylon, ditto, p. 207. Prodromus Faunæ Zeylanicæ, being contributions to the Zoology of Ceylon, Vol. I., 8vo., Colombo, 1852. Catalogue of Ceylon Birds by (and Edgar Layard), in Journal, R.A.S. (C.B.), 1853, pp. 54 and 57. Notes of Cultivation of Cotton in Ceylon, in Ceylon Calendar for 1854, appendix. Report on the Pearl Oyster, in Ceylon Calendar, 1858, appendix. Description of New or Little-known Species of Reptiles found in Ceylon, in Journal, R.A.S. (C.B.), 1855, p. 102. Ceylon Ornithology, ditto, p. 143. Ditto of Nudibranchiate Mollusca and Zoophytes, ditto, 1856–58, p. 84. Contributions to Marine Zoology, being Descriptions of Ceylon Nudibranchiate Molluscs, Sea Anemones, and Entozoa, Vol. I., 8vo., Colombo, 1859.—G.A.J.

The Brahminy Lizard (*Mabuia carinata*) is alleged to have poisonous properties. There is a strong local belief in regard to this, and deaths of persons from the bite or scratch of this lizard have been registered in the Vital Statistics of Ceylon. The learned A. Mendis Gunasekara, Mudaliyar, made mention of a girl thirteen years old in the Galle District, whose death was caused " by poison caused by a 'hikanala' (Brahminy Lizard) licking one of her toes."

" It is stated in Sinhalese medical works dealing with snakes and their poisons that hikanalas are often hatched from the eggs of cobras, polongas, and mapilas, all highly venomous snakes." As pointed out by Dr. Willey in *Spolia Zeylanica*, equivocal generation is impossible in the animal kingdom. Tamil and Hindu writers on snake poison also point out that the bite, scratch, or a touch of the saliva of the Brahminy Lizard is highly poisonous.

The Brahminy Lizard in reality is harmless, though it is believed both here and in South India to inflict a poisonous bite.

The name " karawala " is indiscriminately applied both to harmless snakes such as *Lycodon aulicus* and also to the poisonous snakes belonging to the genus *Bungarus*. Dr. Willey recorded a case of a woman having been bitten by the harmless *Lycodon aulicus* who died from fright, in the belief that she had been bitten by a poisonous " karawala."

In India Lockwood Kipling mentions that even in the country a fly-catcher, a sparrow, and a shrike are all spoken of as " chiriyas," birds merely. He attributes this lack of observation to be peculiar to Orientals. Science teaching and special societies and institutions taking up branches of study like the Ceylon Natural History Society can help to dispel much ignorance that exists.

GERARD A. JOSEPH.

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18. *The Elephant Stylobate in the Colombo Museum.*—An elephant stylobate was dug up late in 1894 in a private land, a mile from the town of Anuradhapura, close to the Anuradhapura-Kurunegala road, by the Archæological Commissioner. The parts of the structure were kept together loosely in the grounds of the office of the Archæological Commissioner at Anuradhapura. With other " finds " handed over by the Archæological Commissioner to the Colombo Museum was the elephant stylobate, which Dr. Pearson, the Director, has had erected on the lawn near the library. An illustration is given here of the structure as it now stands. It is 20 feet square and 4 feet high. When new it must have been a very striking object, and even now it arrests attention, and is a fine specimen of work of the days of the Sinhalese monarchy. Mr. Bell says that along with the stylobate were found two pieces of Buddhist railing, which he thinks belong to the top and went round as a wall. These pieces he has promised to send to the Museum to be placed on

the top of the stylobate. Most of the platforms in the great Buddhist dagobas in Ceylon have elephants in high relief or standing out as if supporting the platform. The elephant plays an important part in Indian and Ceylon history. The use of elephants in war dates from early times. The *Mahawansa* mentions the king at Anuradhapura in the fifth century possessing a white elephant—a rare, lucky, and sacred thing to own. In India, in the earliest myths, the elephant was said to take the place of thunder and lightning, and is one of the steeds of Indra. The elephant in ancient Hindu history is mentioned as supporting the four corners of the earth—the elephant supports the world. The elephant's place at the base is a post of honour, but he is sometimes shown with uplifted trunk in sacrificial vases, of which a splendid old specimen in bronze is shown in the Colombo Museum, being a loan exhibit belonging to Mr. P. E. Pieris, M.A., C.C.S.

There are many legends about the elephant in Ceylon, but in Buddhism the elephant takes the place of the dove in the annunciation of Maya Devi (mother of Buddha), of the coming of the Bodhisat. She lies asleep, and the elephant appears to her as depicted in many sculptures at Amravati and Southern India. Another legend is that Devamitta, the envious schismatic, was sent to meet and murder Buddha and took a frenzied elephant to do the work, but when the creature beheld Buddha it stood still and worshipped. There is a later story of an elephant's body being hurled an immense distance by the Lord Buddha.

Mr. Lockwood Kipling observes that the elephant is the only animal on the Buddhist sculptures "carved with true knowledge and unvarying truth of action."

It is conjectured that on the top of the elephant stylobate was placed a shrine or canopy with an image of Buddha.

GERARD A. JOSEPH.

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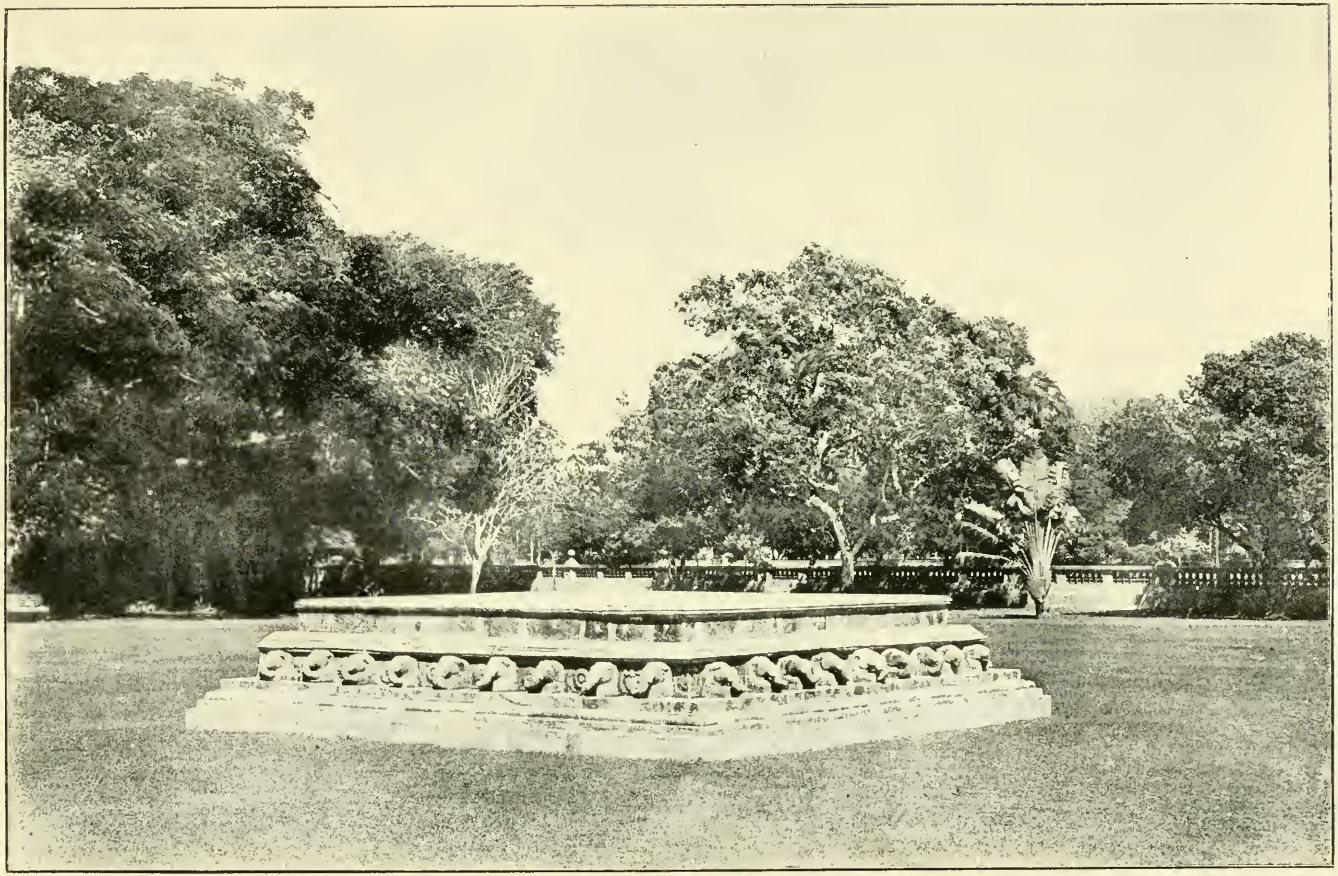
19. *Flints, &c., from a Cave at Urumutta.*—Copy of letter received by the Director, Colombo Museum, from Mr. Frederick Lewis of the Land Settlement Office :—

SIR,—I HAVE the honour to forward by hand the following :—

(1) A parcel of stones that I venture to believe are arrowheads of a very ancient period.
(2) Some fragments of pottery.
(3) Some bones, possibly of a "mouse deer."
(4) A clay mould, that I take to be for the purpose of moulding coins.

This last was given to me by my friend Mr. N. B. Faviell of the Survey Department, who found it in the bed of the Menikganga.

The "finds" 1, 2, and 3 come from a cave situated in the village of Urumutta in the Gangaboda pattu of the Matara District, and it



ELEPHANT STYLOBATE, COLOMBO MUSEUM.

may be of interest to describe the nature of the same, and the ground where the fragments were obtained.

I received information that there was a cave in a precipitous mass of rocks below the trigonometrical station at Urumutta, and that there was an inscription on the rock itself. I accordingly visited the spot with Lieut. Lindstroom, and after some very difficult climbing we at length reached the mouth of the cave itself. It is situated among a mass of rocks both above and below it, and faces the south.

In section, taken vertically, it is shaped like the letter F. The wall, or back of the F, is nearly vertical for 20 feet, and the " roof " is nearly horizontal, projecting about 14 feet.

The cave may be said to form two parts, one to the east and the other to the west, divided by a fallen mass of stone. The western section had an inscription in the old characters such as I have found at Nuwaragalla and elsewhere. It is cut into the wall of the " F " about 18 feet from the ground. I copied it, but owing to my not having a ladder to get close to the lettering, I defer sending the copy to you till I am more satisfied than I am at present with the figure, as I took it. One or two of the letters appear in my copy to be incomplete.

My attention was next drawn to the floor of the cave, which, in consideration of the enormously rough and broken character of its surroundings, appeared to me to be artificially flat. I found on sweeping away a mass of fallen leaves that had been blown in from some trees immediately above and round the cave's mouth, that the floor appeared to be of mud. On scraping the surface (in the eastern section) with a twig, I discovered the quartz fragments, that I venture to believe are arrowheads. Nearly side by side with these I found the pottery, and less than a yard away were the bones.

I would draw special attention to the fragment I have marked " A," which you will observe is enormously hard, and shows a coppery tinge when scraped with a knife. It is, moreover, very light in weight. It was lying among the fragments of quartz.

I venture to believe the quartz objects are paleolithic, and I draw my deductions from the fact that they are of a stone *not found within miles of this cave*. Secondly, they indicate in outline a generally definite arrowhead shape. They bear traces of being chipped into shape, and particularly in one instance, where the natural line of fracture is opposed to the edge formed.

All the objects—" arrowheads," pottery, and bone—were dug up within an area less than a yard square, and within a few inches of the surface of the " floor."

Among the " arrowheads " I found the small nodular piece of red material, which may or may not have been a colouring pigment, for by damping it it will make a dull red mark on paper.

The pottery is, I think, unquestionable.

The point is its antiquity. I may here state that the cave has the reputation of being haunted. It is in forest, and nowhere within a reasonable distance of a road or path that would lead one to suppose that travellers came there and cooked food by the way and left their broken utensils behind. The nature of the country and the situation of the spot completely hides the cave, while it requires considerable agility to climb into its mouth. Lastly, it is a good long way from water, so is not likely to be a place for a growing population to settle upon.

I leave it to experts to say if the stone objects are or are not paleolithic, or if they are or are not of value as pointing to an age when stone implements were made here. The fact that the cave has an inscription may or may not be coupled with the incident of the stone and bone fragments, and it may be open to question whether the inscription is of an earlier date than the pottery and other remains, or the contrary.

I venture to express no opinion till the "find" as a whole is submitted to experts.

The clay disc found by Mr. Faviell also requires elucidation, but appears to be a mould, and corresponds to the size of one of the coins figured as marked with a Swastika in Mr. Parker's "Ancient Ceylon." Its locality, moreover, must not be lost sight of.

I am much indebted to Lieut. Lindstroom for assisting me in finding this cave, and for helping me in copying the inscription, which, though still imperfect, would have been more so but for his aid.

I shall be much obliged to you if you will kindly favour me with your opinion as to the scientific value or otherwise of the "finds," and if they are worthy of a place in the Colombo Museum.

FREDERICK LEWIS.

The flints were submitted to Mr. C. Hartley of the Royal College, who reported as follows :—

"I have carefully examined the quartz fragments. Knowing nothing of the circumstances under which they were collected, I should say that the bulk of them were casual fragments of bad material unsuitable for making implements, and showing no signs of human work. Among them are a small proportion of splinters which look as if they had been chipped off and thrown away. I have selected and numbered eight pieces, of which I judge as follows :—

1. Crystal, chip, probably human.
2. Quartz, do.
3. Crystal, do.
4. Crystal, do.
5. Crystal, do. (shows old waterworm crust).

Fig. 1.

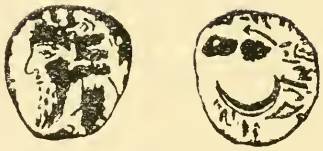


Fig. 2.

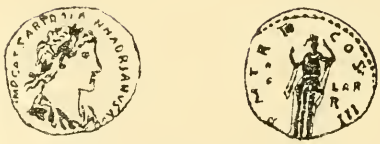


Fig. 3.

THREE RARE COINS.

6. Crystal, chip, or conceivably fragment of a blade or spall.
7. Quartz, almost certainly a worked flake. The rounded end seems to show abrasion by use, possibly a scraper.
8. Quartz, conceivably a rough arrowhead, more probably a chip.

At a later date Mr. Hartley wrote :—

Since I wrote my opinion there is nothing to alter. The description given by Mr. Lewis makes almost certain that many of the chips of white and clear quartz are of human manufacture.

[Ed.]

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20. *Three Rare Coins.*—The coins figured here are from my cabinet, and I am sending you this note in the hope that some one with more knowledge than I can pretend to will be able to identify them. The plates give the correct size.

Fig. 1.

This thick silver coin, weighing 8·03 grammes, was brought to me when I was District Judge at Ratnapura, by a silversmith to whom it had been given by a villager to be converted into jewellery. It was said to have been found in the Bintenna. Both sides of the coin are slightly concave. The figure on the reverse is a snake, and the coin appears to be Oriental.

Fig. 2.

This coin is roughly circular, of silver, and weighs 3·52 grammes. On the obverse appears a head of Dionysos facing left, with long pointed beard, the long hair being done in three rolls, and with what seems a wreath of ivy on the head. The reverse is worn, and bears no trace of an inscription. The coin seems to me to be of the Naxos issue, and if so would date back to about 500 B.C. There are certain wavy lines on the reverse, which may represent the vine leaves and bunch of grapes which are usually found on such coins. This specimen was purchased by me in Colombo from a shop where it is said to have been sold by a villager.

Fig. 3.

This is a beautiful silver medallion of Hadrianus (117–138 A.D.), and weighs 3·44 grammes. The obverse shows the laureate bust of the emperor facing right, with the legend IMP CAESAR TRAJAN HADRIANUS AUG. On the reverse appears the legend HILAR P R P M TR P COS III, and a female figure standing. There is no specimen of this in the Museum collection. I believe mine was purchased in Colombo.

P. E. PIERIS.

21. *A Dutch Gold Medal.*—The accompanying illustration shows the reverse of the medal, the obverse of which bears the following inscription :—

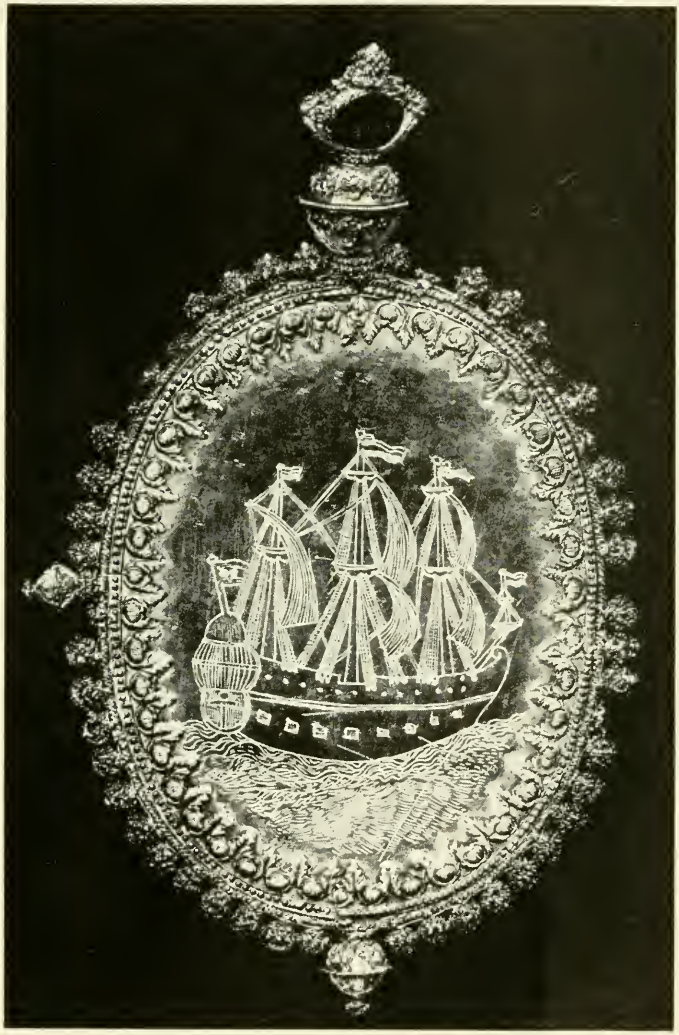
DOOR DEN WEL EDELE
GROOT AGTBARE HEER JULIUS
VALENTYN STYN VAN
GOLLENESSE, RAAD ORDINARIS
VAN NEDERLANTS INDIA
GOUVERNEUR EN DIRECTEUR VAN
T EYLANT CYLON MET DEN RESORTE
VAN DIEN WERD BY DESEN GEHONOREERT
EN VERGUNT AAN DON DIOGO WIDJE
SINGA DISANAIKE MODLIAAR VAN
MATURE, CORAAL DER MORUAC KORLE
JAAG EN SAAYMEESTER MITSGADERS
MAHAVIBADDA VIDAAN VAN
GIRWAYS VOOR SYN BETHOONDE
MANHASTE IVER EN TROUWE
DIENSTEN AAN DE COMP:
IN DEN MALLEBAARSE
OORLOG ALS ANDERS GEGEVEN
IN HET CASTEEL COLOMBO
DEN, 1: JUNY 1749—

The extreme length of this handsome gold medal is eight inches, and its extreme width would be five and a quarter but for the loss of one of the ornamental bosses on the side. The large boss on the top, which supports the ring with its beautiful flower-buds in filigree work, is bent to a side owing to careless handling.

In view of the illustration a minute description of the workmanship of the medal is unnecessary.

The translation of the inscription is as follows :—With this was honoured, by the Honourable Julius Valentyn Styn van Gollenesse, Ordinary Councillor of Netherlands India, Governor and Director of the Island of Ceylon and the Dependencies thereof, and the same was presented to Don Diogo Wijesinha Dissanayaka, Mudaliyar of Matara, Korala of the Morawak korale, Master of the Hunt and of the Sowing, and also Maha Wihadda Vidane of the Giruwas, for his valiant zeal and faithful service towards the Honourable Company in the Malabar war, as at other times. Given at the Castle of Colombo, 1st June, 1749.

Van Gollenesse assumed duties as Governor on May 11, 1743, and left for Batavia on March 6, 1751, on being appointed Director-General of the Dutch East Indies. I have no information regarding the Malabar war referred to in the medal, but another medal was given to the same Mudaliyar on April 10, 1747, also for distinguished



A DUTCH GOLD MEDAL.

service in the Malabar war. It was very rarely indeed that Sinhalese soldiers were employed by the Dutch in service outside the Island.

The grantee was a member of a distinguished family in the south. Dissanayake *Moetjaer* of *Dondure* (Mohottiyar of Devundara) is mentioned in the Thombo of the *Heerlykheyt* (Manor) of Dondure as living about the year 1630, and when Galle was captured from the Portuguese in 1640 Dissanaike Mudaliyar resided within the Fort as the chief representative of King Raja Sinha the Second. In 1752 another member of the family, Don Pauloe, was living in banishment in Tuticorin, while strangely enough his nephew, Don Simon Mudaliyar, was seven years later given a gold medal by Governor Schreuder for his eminent services to the Dutch.

To-day the mention of Sinhalese in connection with military service raises a smile; indeed, there is a rumour that the application of a Sinhalese for military employment during the Boer war was referred to the Superintendent of the Lunatic Asylum for report. It is, therefore, of interest to note the will of Don Simon, dated December 2, 1764, when he was about to accompany Governor van Eck on his disastrous Kandyan expedition, in command of the Galle and Matara Lascarins. From this will we learn that he was a Christian and residing at Hittetiya at the time, and that he had three sons, all minors; to the eldest he bequeathed his best silver mounted sword; to the second a similar sword and belt, which he was wearing for the war; and to the youngest a gold chain which he had received from the King of Kandy.

P. E. PIERIS.

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22. *A Sinhalese Toy.*—There is a toy in Ceylon corresponding to the "bull roarer," used by boys to keep the cattle away from the paddy fields. It is made of a thin oblong piece of wood or bamboo, attached to a stick by a string or a kitul fibre and swung rapidly round; its humming sound is said to resemble a cheetah's growl. The toy is called "helibambara" (හෙළිබම්බර), and the piece of bamboo "kotipetta" (කොටිපත්ත), koti = cheetah, and petta = thin piece of wood.

ARTHUR A. PERERA.

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23. *Sinhalese Iron and Steel.**—The use of iron—and included in this term is steel produced by the fusion or cementation process—dates back to a very early period in the world's history.

In a paper read before the Royal Society, Sir Robert Hadfield has described some specimens of ancient iron obtained from the buried cities of Ceylon. These include a steel chisel of the fifth century, an ancient nail, probably of the same date, and a bill-hook.

* Reprinted from *The Times* of November 28, 1911.

The exhaustive examination made of these specimens by the author suggested that a comparatively high degree of metallurgical knowledge must have prevailed more than a thousand years ago, and the research was claimed to have yielded knowledge not previously available on the subject of iron and steel specimens of ancient origin. The collection of these ancient tools and instruments in the Colombo Museum was the most complete of the kind in the world. The investigation made suggested that the specimens represented wrought iron rather than steel. The percentage of carbon was generally low, but the edge of the chisel was shown to have been cemented or carbonized—a fact which suggested that a knowledge of hardening the cutting edge of tools was possessed by ancient workers in metals. It would seem that the crucible process of steel manufacture has long been known and practised in the East.

A consideration of the origin of these specimens of ancient iron led to the conclusion that the methods of making steel practised in Ceylon probably reached that island from India at a very early date, and there was strong evidence that the iron age preceded that of bronze. Mr. J. M. Heath, in papers contributed to the Royal Asiatic Society in 1837 and 1839, had expressed the opinion that the tools with which the Egyptians covered their obelisks and temples with hieroglyphics were made of Indian steel. There was no evidence he claimed, that any of the nations of antiquity besides the Hindus were acquainted with the art of making steel, and the claims of India to a discovery which had exercised more influence upon the arts conducing to civilization and the manufacturing industries than any within the whole range of human invention was altogether unquestioned.

The Huntsman process of steel manufacture was probably, Sir Robert Hadfield stated, only a development, although an independent development, of methods long employed in India. The manufacture of crucible cast steel in Ceylon was now almost an extinct industry, a fact due to the operation of economic laws, as steel can now be imported more cheaply from Europe than it can be manufactured locally. One of the most notable ancient specimens of iron was, of course, the famous pillar of Delhi, which was a solid shaft of wrought iron welded together, and represented work carried out at least 1,600 years ago. The Dhar iron monument, 42 feet in length, probably belonged to the year 321 A.D., and, owing to its greater mass, was an even more remarkable tribute to the skill of forgotten craftsmen in metals.

THE CEYLON NATURAL HISTORY SOCIETY.

First Business Meeting.*

THE first business meeting of the newly-formed Ceylon Natural History Society was held in the Colombo Museum Library at 9 P.M. on Tuesday, March 26, 1912. The Hon. Sir Hugh Clifford, K.C.M.G., Colonial Secretary, presided, and there was a good attendance of members and visitors.

The President's Address.

After the Minutes of the Inaugural Meeting had been read, the President addressed the Society as follows :—

Ladies and Gentlemen : The agenda tells me that the next item on the programme this evening is an address from the President. At the invitation of the Committee I very gratefully accepted the post of President of this Society, though I ventured to point out to them that the many calls upon my time, and the peculiar nature of my own individual studies, somewhat precluded me from examining as closely into insect life as might be appropriate for the President of a Natural History Society. I suggested the name of another officer senior to myself, but was informed that on the whole, I had better continue, at any rate, for the moment. So I trust that the members of this Society—which has just been inaugurated so successfully, mainly through the efforts and the initiative of Dr. Pearson—will pardon any shortcomings on the part of its present President. And I can only assure you that I will always do my best to serve the Society to the utmost of my ability. The Society which has just been formed is, to some extent, a new institution in this Colony. But this morning I had my attention drawn to the prospectus of a Society which was established on December 11, 1820. I noticed that the opening paragraph of the prospectus said that " to a country nearly unprovided with manufactures and dependent almost entirely upon its natural productions the investigation of its Natural History must be of the highest importance "—a sentiment which, I feel sure, every member of this Society will endorse. Yet, though I tried to carry further my investigations into the history of that Society, its records proved quite elusive. It seems to have carried on a number of literary and anthropological discussions and to have left Natural History severely alone, in spite of the bright promise contained in the first words of its prospectus. I feel sure this Society—considering the short time that has elapsed since its inauguration, and considering the comparatively slight amount of advertising which it at present is receiving—has obtained a degree of encouragement. The numbers read out to you by the Secretary are of a most encouraging character. Already we have 107 members of this Society, and my earnest hope is that all persons whose occupations take them into the wilder parts of the country will hasten to join the Society and will assist it by contributing notes of interest to the publications of the Society. It has been said that the proper study of mankind is man. We all study mankind with sympathy in our own persons and with a certain amount, frequently,

* This account is taken partly from the newspaper reports of the meeting.

of criticism and disapproval in our neighbours, and we carry later those studies all through our lives, consciously or unconsciously. But I do not think Pope's line need trouble this Society, because, if the proper study of mankind is man, unquestionably that is not an exclusive sentence ; and the study of the natural life around us must always appeal very strongly to the intelligence of all. I recently heard a discussion between a lady and a medical man of great repute, who assured the lady on her arrival in Ceylon that this was one of the most interesting Colonies that the British Empire contained, and the lady said she felt quite sure that that was so. And all of us who know and admire the Island will agree with her. But the doctor I am speaking about added that there was a greater variety of tropical diseases in this Island than in any other place of its size in the world. And some measure of the lack of enthusiasm which his words called forth from the lady was noticed by him. Now, we all know that disease is very largely the result of organisms of various kinds ; and we know that numerous insects in this Colony and out of it carry disease in an extraordinary manner, and have the impertinence to inoculate us with the disease from time to time. That branch of study is rapidly becoming more and widely appreciated, not only by scientific men, but by the general public. But this Society, I take it, will probably leave pathological questions of that sort more or less alone, and will devote itself to the perhaps less utilitarian but more attractive form of study of Natural History, and especially of the beautiful insects, butterflies, birds, and animals, which abound throughout the Island. And it is because the Government of this Colony employs a very large number of people in all sorts of places— Civil Servants living at distant outstations, Irrigation Officers, Public Works Officers, and members of all the big departments scattered throughout the Colony—that I very much hope that all the services which I have the honour to represent will very quickly and promptly support this Society, and do their best to carry out the work of it and to perpetuate its existence. The great danger in a Society of this kind is that it begins with a good deal of interest and enthusiasm, which is apt all too soon to cool off and become apathetic. I trust that the members of this Society—every one of them—will do their best, as far as it lies with them, to prevent that being the record of the newly-formed Society. We all owe a debt of gratitude to Dr. Pearson for having started the Society in our midst, and I look forward to the time when the study of Natural History will spread widely throughout the Colony, and in the years to come people will look back with gratitude upon the efforts of Dr. Pearson who started the Society for which we are all met this evening to wish success and long life.

Pioneers of Natural History in Ceylon.

Mr. E. E. Green then read a Paper on "The Pioneers of Natural History in Ceylon."*

The Singing Fish of Batticaloa.

Dr. Joseph Pearson said he had one or two notes to which he wished to call the attention of members.

He had a letter the other day from Mr. E. L. Mack, the Private Secretary to Mr. Justice Middleton, who reported that while on a recent visit to Batticaloa he noticed that certain fishes when taken out of the water produced precisely the same notes as made by the "singing fish." Mr. Mack followed up his observations and kept some of the fishes in a bucket of water. No sounds were heard when the fish were kept in water, but musical notes were omitted when the animals

* Printed in full on p. 76 of the present number of *Spolia Zeylanica*.—Ed.

were removed from the water. It was Mr. Mack's conviction that he had discovered the singing fish. As Dr. Pearson had spent some days in the Batticaloa District in August of last year he was able to criticise Mr. Mack's conclusions. The speaker then went on to describe the conditions of the Batticaloa lake, which was a shallow backwater stretching for many miles to the south of Batticaloa town. The famous singing fish was only heard in a comparatively small area of the lake, between the fort and the entrance to the lake, and the sounds were only heard at night, most favourably at full moon. Sir Emerson Tennent's theory that the sounds were produced by the mollusc *Cerithium*—a theory which is based upon the traditions of the fishermen—does not appear to offer a satisfactory explanation. Dr. Pearson was convinced, after investigating the question, that the sound was produced by some animal in the water, and not, for example, by frogs on the banks of the lake. That animal may be either a fish or a crustacean. It is well known that both fishes and crustaceans can produce sounds. Since Mr. Mack's observations showed that the fish he wrote about only made a noise when removed from the water, the problem does not appear to be any nearer solution. The fact is that many fish when removed from the water make musical sounds. This may be due to the bubbles of air mixed with the water making a gurgling sound as the air and water are drawn through the gill chamber. Dr. Pearson had noticed this not only in Batticaloa but also in various places along the coast. The fact that the singing fish is only heard in a few scattered localities—Batticaloa, Kayts, and Puttalam—and that in each of these localities the distribution of the sounds is extremely limited, rather disproves the suggestion that the singing fish is a true fish (using the term zoologically), since fishes are generally active swimmers. It is probable that a comparatively sedentary animal, such as a crab, may give rise to the sounds which have made Batticaloa so famous. At any rate for the present the problem may be regarded as unsolved.

The CHAIRMAN : Might I ask you how many noises the fish produced ? Was the sound like sawing ?

Dr. PEARSON : Quite different sounds.

The CHAIRMAN : Any cadence ; or was it a croaking sound ?

Dr. PEARSON : Quite irregular. It seemed as if each one had its own note. You have about half a dozen sounds going on at once. Sometimes it was like the croaking of a frog, and sometimes there was a deep note like that of a cello. But none of them were musical.

Window Pane Oysters in the Colombo Lake.

Dr. Pearson stated that he had recently received a consignment of shells from Mr. Bakewell, the Assistant Construction Engineer of Railways, who, during operations in the Colombo lake between Captain's gardens and the Royal College, discovered the shells embedded in the mud five feet below the bed of the lake. The shells proved to be of three kinds—*Placuna placenta* (the window pane oyster), *Arca* sp., and *Tapes rotundata*. Since the first discovery Mr. Bakewell has reported the presence of similar shells in other parts of the lake. When Dr. Pearson first received the shells it occurred to him that this was evidence in favour of supposing that at one time the lake was connected with the sea, leaving aside the former connection of the lake with the sea by means of the old Dutch canal. If such connection had existed, the conditions would have been an ideal habitat for the window pane oyster. An examination of the shells, however, proved that, so far as *Placuna* was concerned, the evidence did not give much strength to such a theory, since the edges of all these shells proved to have been artificially trimmed. It is probable that the shells had been thrown into the lake many years ago.

Crustacea and Fish in the Sewage Tanks at Madampitiya.

Dr. Pearson also submitted a note on the presence of aquatic animals in the tanks of the treatment works at Madampitiya. Healthy fish were found in the septic tanks where the sewage material was undergoing treatment. It was not possible for the fish to have entered with the sewage matter, since the latter had to pass through a series of clashing blades which made it impossible for any large body to pass through intact. The only explanation appeared to be that fish eggs were able to pass through and that certain species found the conditions of the septic tanks favourable. Crustacea belonging to the genera *Palæmon* and *Caridina* were found in the effluent tanks after the sewage water had been passed through finely divided sprinklers and had flowed through the filter beds. The river is about 100 feet below where the Crustacea were found, and as the ascent is extremely steep it does not appear likely that the shrimps made their way up from the river.

The Chairman proposed a vote of thanks to Mr. Green and Dr. Pearson.

Mr. V. A. Julius proposed, and Dr. Andreas Nell seconded, a vote of thanks to the Chairman.

COLOMBO MUSEUM, FROM THE SOUTH-EAST

GUIDE

TO THE COLLECTIONS

OF

THE COLOMBO MUSEUM,

CEYLON.

PART I.

ARCHÆOLOGY AND ETHNOLOGY.

Illustrated.

COLOMBO:
H. C. COTTLE, GOVERNMENT PRINTER, CEYLON.

1912.

CONTENTS.

PREFACE.

THE first Guide to the Colombo Museum for the use of visitors was compiled by Mr. Amyrald Haly in 1886 ; a second abridged edition of it was printed in 1895 ; and Dr. Arthur Willey, F.R.S., issued an enlarged third edition, containing illustrations, in 1905.

The present account corresponds to a fourth edition, but the addition of a new wing and the rapid growth of the collections in the last seven years have made it impossible to adequately describe the collections in the limits of a small handbook. It has been thought advisable therefore to issue two separate guide books, one dealing with the archæological and ethnological exhibits on the ground floor, and another describing the natural history collections and the geological exhibits which occupy the upper floor of the Museum. The present guide is concerned with the former, and it is hoped to issue the second part, dealing with the natural history galleries, in the course of a few months.

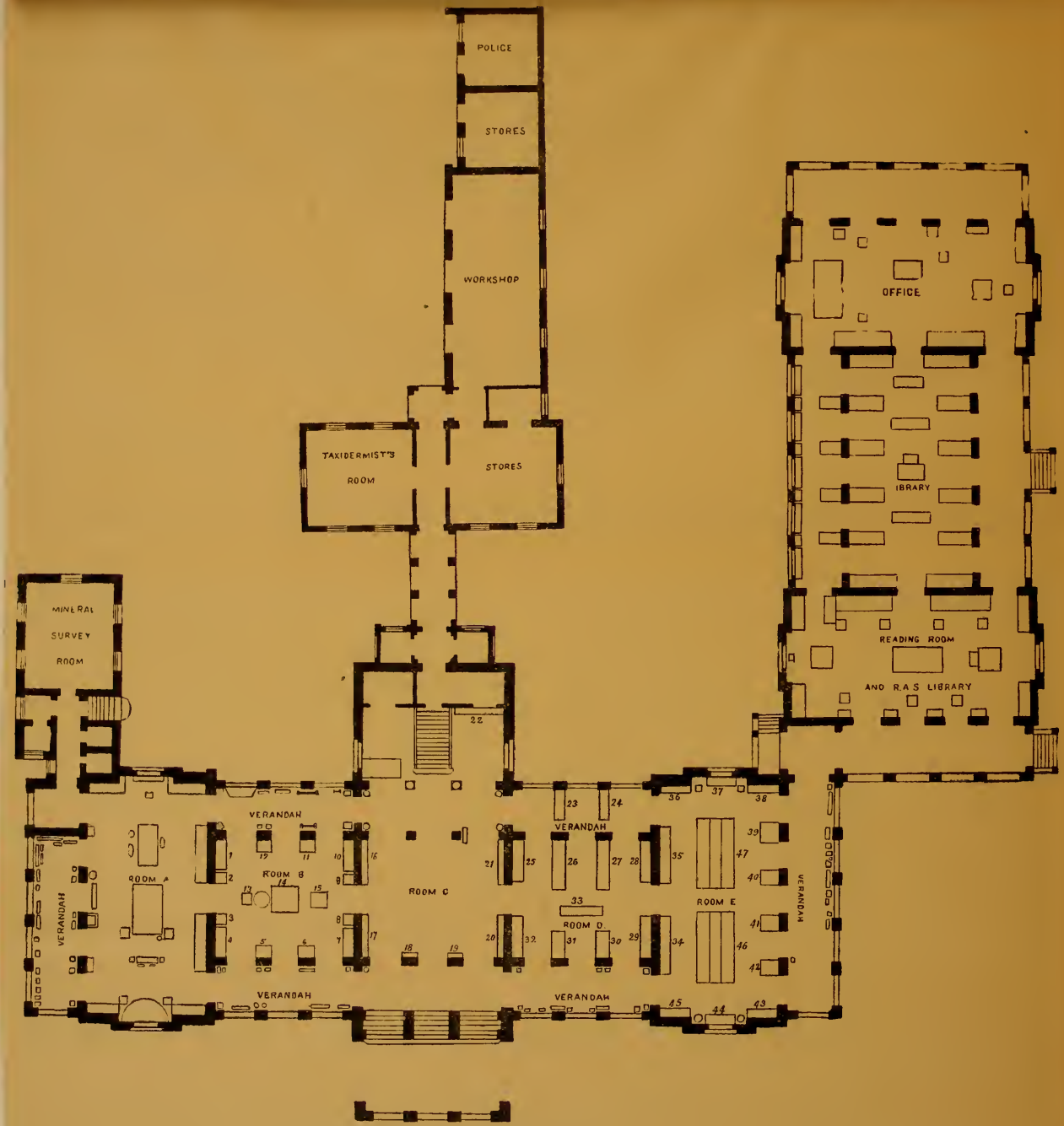
The present Guide is more profusely illustrated than the third edition. Most of the blocks are new, and have been made from photographs taken by Dr. Andreas Nell.

As a necessary preliminary to the production of this Guide the entire collections have been re-arranged. It is hoped that with the advent of the west wing the overcrowding, which is inevitable at present, will be obviated.

The production of this Guide has been rendered possible by the generous co-operation of the following gentlemen : Mr. PAUL PIERIS, M.A., LL.M., C.C.S., who has contributed articles on ivories, arms, Maldivian exhibits, jewellery, coins, betel boxes, and domestic appliances ; Mr. ARTHUR DE SILVA, who made himself responsible for the collections of charms, masks, and the instruments used in ceremonies ; Mr. A. M. GUNASEKARA, Mudaliyar, who has written on the ola manuscripts ; Mr. E. W. PERERA, who has described the Sinhalese banners ; Mr. GERARD A. JOSEPH, Secretary and Librarian of the Museum, who has written on archæological stone remains, bronzes, economic products of the coconut and palmyra palms, ancient and modern pottery, fishing appliances, games, and some of the domestic appliances ; and Dr. ANDREAS NELL, to whom I am indebted for a large series of photographs from which the illustrations of this Guide have been selected.

JOSEPH PEARSON,
Director.

November, 1912.



COLOMBO MUSEUM: PLAN OF GROUND FLOOR.

(The numbers refer to the Cases which are described in the text.)

Scale: 1 inch = 25 feet.

THE COLOMBO MUSEUM.

A GUIDE TO THE ARCHÆOLOGICAL AND ETHNOLOGICAL COLLECTIONS.

INTRODUCTION.

With the exception of articles from the Maldive Islands, the scope of the collections of the Colombo Museum has been wisely limited so as to deal only with things which are connected with Ceylon. The exhibits on the ground floor are illustrative of the customs, arts, and handicrafts of the inhabitants of the Island, and in this historical review place has been given not only to examples of Sinhalese and Tamil art and ethnology, but also to objects in which we may trace the influence of the Portuguese, Dutch, and English periods of occupation.

The Colombo Museum is the national museum of the country, and its position as such is fully appreciated, as may be gathered from the fact that about two hundred thousand natives visit the institution during the course of the year. If the Museum is primarily a storehouse of national treasures, it has none the less played an important part as an educative institution.

The collections described in the present Guide occupy the ground floor of the Museum. The archæological and ethnological exhibits are confined to the main block, while on the ground floor of the new east wing are found the Museum Offices and Library.

The Library has a double origin, and two distinct portions are still recognized. First, there is the Museum Library proper, which at present contains about twelve thousand volumes, and which in its present form dates from the foundation of the Museum. The nucleus of the small library then brought together was formed by the Government Oriental Library, which was founded in 1870, during the administration of Sir Hercules Robinson, for the purpose of rescuing the ancient literature of Ceylon. In addition to a valuable collection of ola manuscripts the Museum Library contains a representative collection of books dealing with the various phases of the history of the Island and its inhabitants. It is particularly rich in zoological monographs and journals and works on natural history.

The Library of the Ceylon Branch of the Royal Asiatic Society, which dates as far back as 1845, is also housed in the Museum. This valuable collection, consisting of about eight thousand volumes, forms a useful supplement to the Museum Library. Just as the latter has specialized to some extent on zoological works, so the Asiatic Society Library has very appropriately concerned itself more with archæology, ethnology, and history.

The combined collections thus provide a representative, though small, reference library, of which full advantage is taken by members of the Ceylon Branch of the Royal Asiatic Society in the case of the Society's Library, and by approved readers in the case of the Museum Library.

The main entrance of the Museum opens into the Central Hall, the contents of which will be described later. In the meantime we turn to the left, and reach the Stone Gallery either by way of the verandah or through the Bronze Gallery.

THE STONE GALLERY (Room A).

The Stone Gallery occupies the extreme western portion of the ground floor, and contains many fine examples of ancient Sinhalese stonework obtained chiefly from Anuradhapura (437 B.C.–769 A.D.), Polonnaruwa (769 A.D.–1319 A.D.), and Sigiriya (479 A.D.).

Long before the dawn of civilization in Britain the Sinhalese had stately palaces and cities. Anuradhapura, the greatest and most ancient of the cities of Ceylon, was the capital of the Island 400 years B.C.

Polonnaruwa (modern name, Topavewa) was made the capital after Anuradhapura. "At the present day it is said to be by far the most remarkable assemblage of ruins in Ceylon, not alone from the number and dimensions, but from the architectural superiority of its buildings." Polonnaruwa was plundered by those insatiable marauders, the Malabars, several times, until finally abandoned in 1204 A.D.

Sigiriya, which is considered to be one of the most remarkable fortresses in the world, rises from the plain with perpendicular sides to an estimated height of 500 feet. It was built in 477 A.D. by King Kasyappa, the Parricide, who, after dethroning his father, Dhatu Sena, stripped him naked, loaded him with chains, and caused him to be built in a wall. The Parricide, oppressed with the fear that this unnatural crime would be avenged, and haunted by its remembrance, sought security by constructing this "rock of refuge and making it the capital of his kingdom."

The exhibits in this room are chiefly carved out of gneiss, and some of them are entirely of crystalline limestone. Among the more notable archæological treasures are the Stone Lion from Polonnaruwa, the Yapahuwa Stone Window, the Medagoda Stone Pillar behind the lion, the Lotus Stem Capital and Pillars, the cast of the gigantic statue of Parakrama Bahu the Great of Polonnaruwa, the mystic square stone called a Yogi Stone or Yantragala, Naga or Cobra Stones portraying the seven-headed cobra in high relief, friezes and capitals from the ruined cities, statues of Buddha, a cast of a Processional Moonstone, and Lotus Moonstones.

The Stone Lion, called the Lion of Polonnaruwa, formed part of the great lion-throne, and stood in the Council or Audience Hall of the King at Polonnaruwa, whence it was removed to the Colombo Museum thirty years ago. From the base of the forefoot to the crown of the head the lion stands six feet. This relic of the past is specially interesting and a valuable historical monument. There is a Sinhalese inscription on each side near the base giving the date and purport of the monument. Upon it was placed the throne of King Nissanka Malla, a Chakrawarti or Emperor of Kalinga lineage, who was the Lankeswara or Overlord of Lanka (Ceylon) in 1187–1196 A.D. There is a fracture on the head, said to have been perpetrated by burglars expecting to find hidden treasure within. The inscription on the left side of the lion is terminated by the figure of a fish, a symbol of good omen. (See Plate I.)

Behind the great stone lion is the Medagoda Pillar, which formerly stood in the Pattini Dewale at Medagoda, six miles from Ruanwella, in the Province of Sabaragamuwa. (See Plate II.)

"The pillar rises octagonally from the back of a broad-faced couchant lion of conventional type, with frilled mane and raised tail; the shaft slides gradually into the rectangular by a semi-expanded calyx moulding. Half way up relief is given by a bordered fillet two inches in breadth, slightly projecting, carved with a single flower pattern repeated round the pillar. From the fillet depend on each a pearl-bead string (*muktá-dáma*). A few inches above this band stand out from alternate faces full-blown lotus knops, five inches in circumference, with ornamentation resembling much the 'Tudor flower' upon the intervening sides. Where the pillar becomes square there are further loops of pearls, three on each side separated by single vertical strings. A lower capital of ogee moulding, separated by narrow horizontal fillets, and finished with ovolos and a rectangular band, is surmounted by a four-faced *makara* and a low abacus. From the centre of the roundlet moulding on all four sides drops the garlanded *chakra* symbol noticeable on the sculptures of Bharhut."*

Facing the south window at the front end of the Gallery is a perforated carved slab, 4 ft. 8 in. high, 2 ft. 10 in. wide, and 7 in. deep, known as the Yapahu Window, from Yapahu or Yapahuwa, a village in the North-Western Province, about twenty miles north of Kurunegala. It consists of a single block of gneiss cut into the semblance of a frame, which surrounds a composite hieroglyph consisting of forty-five circles in five vertical rows joined together in a moniliform pattern, each circle containing an emblematic figure repeated on both sides of the stone. The matrix of the slab between the carved portions was removed by the artist who designed and executed this unique triumph of stone tracery. In the thirteenth and fourteenth centuries there was a royal palace at Yapahu, and the hall of the palace was lighted by two of these tracery windows of exquisite workmanship. (See Plate III.)

The human figures in the lowest circles represent grotesque manikins, above these are nautch girls, then animals, some of which are provided with a trunk and appear to represent the fabulous *gaja-sinha* or elephant-lion. The star-shaped radiating emblems are the *dharma chakra* symbols, the wheel or circle of the laws and teaching of Buddha. The birds in the top row are the *hansa* or

* Archæological Survey of Ceylon: Report on Kegalla District, 1892, p. 58.

sacred birds, usually represented by geese, sometimes by conventional representations of birds.

Near the stone window placed on the floor is a *Yantra-gala*. When such stones were first discovered they were the subject of much speculation, and by some were called Yogi or Meditation Stones. It was supposed that priests gazed at them until they fell into a deep state of meditation. It is probable that this suggestion is incorrect, and that such stones did not serve as *kasinas* for ascetic meditation, but were essentially used as talismans against demoniac influence. They are intended to rout the demons of disease, danger, and death. These partitioned stones are closely connected with the innate dread of "the powers of evil," and faith in the efficacy of propitiating them by mystical rites. These stones were laid down within shrines, below the floor, and were covered with a slab upon which rested the *ásanaya*, or pedestal, of the image or other object of worship. These square "mystic stones" with twenty-five partitions have been found at vihares and other ruins in Anuradhapura and elsewhere.

Against the West Wall is a cast of the gigantic statue said to be that of Parakrama Bahu the Great at Polonnaruwa. Some believe this colossal figure to be a Tamil saint. This is said to be proved by the absence of jewellery, the simple dress, and the matted locks. There is no reason to suppose that Parakrama Bahu ever became a monk. The original figure stands overlooking the great Topavewa tank at Polonnaruwa. If the figure does not represent the Great Parakrama it must have been done during his time (twelfth century). It is considered a very noble work. Very simply clad, the great sage stands easily, as it were against the rock of which the figure is still a part, reading from a palm-leaf manuscript.

It is not possible to describe the many exhibits in the Stone Gallery, but, besides those already mentioned, the visitor's attention is invited to the cast of a Processional Moonstone from Anuradhapura below the south window, the lotus-stem Capitals and Pillars, the figure of the Goddess Kali, the Guard Stones (janitors), and the Naga or Cobra Stones. "Moonstones" are found at the base of the steps at the entrance to temples. They are generally of beautiful design and execution, and are characteristic of Sinhalese Buddhist architecture. In the cast in the Stone Gallery there is a central lotus flower surrounded by concentric processions of *hansas* and other animals. The animals shown on "moonstones" are representative of the four points of the compass. Mr. H. C. P. Bell has inferred that these moonstones are equivalent of the old formula of dedication to the priests of the four quarters.

"The lotus is to Oriental art all that the rose was to mediæval English art." The illustrations of the lotus pillars will draw attention to the beautiful specimens exhibited. (See Plates III. and IV.)

The Guardian Deities (or *dwarpal*) are always in high relief and generally have grotesque supporters at the feet. These janitors are erected on each side of the steps at the entrance of Buddhist buildings. (See Plate IV.)

Several *Naga-gal* (cobra stones) will be seen in this room. They are supposed to have been guards, whose function it was to prevent the approach of evil spirits. (See Plate IV.)

In order more especially to draw attention to the age of some of the exhibits not here gone into in detail, the pillar from Thuparama

Dagaba should be mentioned, and the friezes from Ruwanweli Dagaba. Perhaps it would be necessary to the visitor to the Island to explain what a dagaba really is—specimens of which in gold, glass, bronze, crystal, and silver are found in the Museum. They are relic shrines, and in many cases in the old capitals are gigantic masses of solid brickwork built in the form of a half-egg or a bell, and crowned with a sort of spire, called a tee, which symbolizes the honorific umbrella. In these huge piles a secret chamber or chambers were constructed wherein offerings were deposited, and in the older dagabas some worshipful fragments of Buddha or one of his saints were enshrined. Round these dagabas are to be found many tall monoliths of stone or granite beautifully carved, which in some cases must have supported a roof or a building. The platforms on which the dagabas rise are paved with stone slabs, and have small buildings on the platform with beautiful ornamental stone work. (See Plate V.)

Jetawanarama, from where some stone *karanduwas* or relic boxes are exhibited in the Gallery, was built by Maha Sen about 275 A.D.—was originally 316 and is now 249 feet high—the summit being 600 feet above sea level. The diameter is 360 feet, and Sir Emerson Tennent estimated the contents of the whole at twenty millions of cubic feet. He says :—

" Even with the facilities which modern invention supplies for economizing labour, the building of such a mass would at present occupy 500 bricklayers from six to seven years, and would involve an expenditure of at least a million sterling. The materials are sufficient to raise 8,000 houses each with 20 feet frontage, and these would form thirty streets, half a mile in length. They would construct a town the size of Ipswich or Coventry ; they would line an ordinary railway tunnel 20 miles long, or form a wall 1 foot thick and 10 feet high reaching from London to Edinburgh."

There are several exhibits from Mihintale. The different incarnations of Kali, such as the Durga, Maha Mari, and Kaw Mari, come from Mihintale. Eight miles from Anuradhapura the sacred mountain of Mihintale rises from the plain ; it " is undoubtedly the most ancient scene of mountain worship in Ceylon." (See Plate V.)

The specimens in the Stone Gallery are sufficient in themselves to convey to the mind the fallen greatness of the Sinhalese, but taken together with the ancient ruined cities and their marvellous buildings the stupendous grandeur of the ancient capitals, during the palmy days of militant Buddhism, can well be understood.

WEST VERANDAH (Room A).

Opening out of the Stone Gallery on the extreme western side is the West Verandah, in which a number of inscribed stones will be found. The work of collecting and collating the numerous ancient inscriptions scattered over the Island was properly organized during the Governorship of Sir William Gregory, when Dr. P. Goldschmidt was appointed Archæological Commissioner to the Government of Ceylon in 1874. His reports were published as Sessional Papers from 1875 until his death in 1877. Dr. Goldschmidt was followed by Dr. Edward Müller, who compiled a valuable manual on " Ancient Inscriptions in Ceylon " (London, 1883), illustrated by a separate quarto book of plates. Dr. Müller left Ceylon in 1881, and was

succeeded, after an interval, as Archæological Commissioner by Mr. H. C. P. Bell, C.C.S., under whose direction the work of excavation, discovery, and transcription has been continued from 1890 to the present time.

The great slabs to be found here are of interest on account of their antiquity and the characters employed. One propped up lengthwise on the ground is the oldest inscription that has been discovered at Anuradhapura, from the Ruwanweli Dagaba.* It relates to the restoration of certain temples during the reign of King Gaja Bahu (113–125 A.D.).

An upright slab, known as the Tissamaharama Slab, from Tissamaharama, near Hambantota, in the Southern Province. It is almost completely preserved, and according to Dr. Müller "is the finest specimen we have of an inscription of the fourth century A.D."†

Adjoining this slab is a narrow flattened stone with an inscription on both faces. The inscription is headed on the obverse side by a symbol of the sun and on the reverse by a crescent representing the moon, the sun and moon being the usual royal signs. It is a grant of land to a temple, and concludes (on the reverse side) with a life-size figure of a crow in sunk relief. This is the Petigammana Pillar, found half buried in a garden within a few miles of Gampola.‡ (See Plate VI.)

Many of these inscribed pillars dating from the tenth century bear, at the top, engravings of the sun and moon as symbols of royalty [Rhys Davids] or eternity, and, at the bottom, the dog and crow as symbols of instability [Müller] or meanness; any one violating the property of the priesthood renders himself liable to the penalty of being re-born in the low condition of one of these animals [Goldschmidt]. The translation of the Petigammana inscription, according to Mr. Bell, ends with the usual curse: "Any one who disputes this [grant will be born] a crow."

In the middle of the outer side of the verandah there is a large slab, the Dondra Slab,§ recording the grant of land to the Temple of Vishnu at Dondra Head in the fourteenth century. This slab and the Dondra Pillar‖ at the front outer corner of the verandah are of particular interest on account of their association with Dondra Head, near Matara, in the Southern Province, the most southerly point of Ceylon. "Like Cape Comorin on the Continent of India," says Professor Rhys Davids (Indian Antiquary, I., 1872, p. 329), "Dondra Head has always been a place of pilgrimage, and seems to have derived its sanctity from its being the extreme southerly point of land, where the known and firm earth ceases, and man looks out upon the ocean—the ever-moving, the impassable, the infinite."

Opposite to the Dondra Slab is the Mahakalattewa Pillar, from the bund of a tank of that name six miles from Anuradhapura on the road to Galkulam. It is remarkable for its perfect preservation, not a single letter missing; the inscription is on all four sides.¶

Occasionally other symbols besides those mentioned above are engraved upon the pillars, such as a cobra or a priest's fan. The

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* Müller's Inscriptions, No. 5, p. 27, and Plate 5.

† Müller's Inscriptions, No. 67, p. 43, and Plate 67.

‡ H. C. P. Bell, Report on the Kegalla District, 1892, p. 79, with Plate.

§ Müller's Inscriptions, No. 163, p. 71. First translated by Rhys Davids, Journ. Ceylon R. Asiat. Soc., vol. V., 1870–1871, p. 25.

‖ Müller's Inscriptions, No. 159, p. 69. Rhys Davids, *loc. cit.*, 1872, p. 57.

¶ Müller's Inscriptions, No. 110, p. 55, with Plates 110 A–110 D.

latter occurs, for example, on the Kongollewa Pillar* (placed near to the Dondra Slab).

Another slab in a corner of the verandah bearing a short Sinhalese inscription, with representations of the sun (an orb) and moon (a crescent), is called the Ehunugalla Slab ;† it records a benefaction to a monastery.

The Kotagama Tamil Slab must be mentioned. It is of "dressed stone," with a Tamil inscription of the fifteenth century, from the Kotagama Vihare. Mr. Bell, who discovered the inscription, mentions the singularity of discovering a Tamil inscription in the heart of a Sinhalese district.

In this verandah will also be found the oldest "foreign" inscription found in Ceylon. It is an inscribed stone in Chinese, Tamil, and Arabic, dated 1409 A.D., in the reign of Emperor Young Lo of the Ming Dynasty, found at Cripps road, Galle, 1911.

THE BRONZE GALLERY (Room B).

Opening out from the Stone Gallery is the Bronze Gallery, which should next engage the visitor's attention.

The bronzes in this room, which were excavated by the Archæological Survey of Ceylon at Polonnaruwa and elsewhere, have been much admired by connoisseurs and experts, and some of them have been figured and described by such leading authorities on Indian art as E. B. Havell, Vincent Smith, and Dr. A. K. Coomaraswamy. Most noteworthy is the collection of Hindu bronzes from Polonnaruwa, which closely resemble in workmanship and design the numerous bronzes which are scattered throughout Southern India. Whether the Polonnaruwa bronzes were made by Indian workmen in Ceylon or were imported from India is not clear. Indubitably they belong strictly speaking to Indian art, and they have little in common with contemporary Sinhalese art. This collection, which is one of the best of its kind, has attracted experts from all parts of the world. In regard to these bronze figures two features must be recognized and considered if one is to properly appreciate them, namely, "the fine sense of nervous pose and the persistent idealism."

Case 1.

This case contains, besides a heterogeneous collection of bronze stands, finials, basins, bowls, &c., a large bronze *kotale*, or drinking goblet, with the spout fashioned after the manner of an elephant's head and trunk, which calls for special notice. This goblet, which was obtained from Ratnapura, has been lent by Mr. P. E. Pieris, C.C.S. A three-branched candelabrum from Munnessaram, presented by the late Sir F. R. Saunders, and a handsome bronze amphylla from Anuradhapura, are also noteworthy. (See Plate VII.)

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* Müller's Inscriptions, No. 112, p. 55. Kongollewa lies about two miles north of Madawachchi, in the North-Central Province.

† H. C. P. Bell, Report on the Kegalla District, 1892, p. 76, with figure on Plate facing p. 72.

Cases 2 and 3.

These cases contain figures of Siva-Kami or Parvati, Consort of Siva. (See Plate XIII.)

Case 4.

Here are displayed bronze spoons, round bronze dishes, bronze lions, bronze bangles, ornaments, "Hindu emblems," the Svastika—a symbol of pre-Buddhist origin and worldwide distribution. A richly embossed heavy bronze panel from Anuradhapura is also shown in this case, and at the bottom a six-headed image of Kataragam Deviyo standing under a *makara* and on a peacock from a Devale.

Case 5.

A collection of Buddhas in bronze, copper, brass, gold, and other metals. There are eight thin gold images of Buddha, filled with clay, from Panduwasnuwara, a gold figure from Tissamaharama, and gold and crystal dagabas from Anuradhapura. There are also bronze Buddhas on thrones backed by an arch called the *makara torana*. On the top of the case there is a large bronze sedent Buddha of unique design in the attitude of teaching, holding a flower (?) in the left hand. This was discovered twelve miles from Badulla along the new road to Batticaloa, and was presented by Mr. G. F. K. Horsfall in 1876. (See Plate VIII.)

There is a fine recumbent Buddha in the middle of the case, from Nilgama, in the Matale District. It represents the attitude of Buddha's *Maha Pari Nirvana* on his last death, after innumerable previous deaths in previous births: the entire cessation of re-births with the extinction of all the elements of bodily existence.

Case 6.

This case contains among other things bronze tripods from Polonnaruwa, bronze homunculi, a figure of Siva-Kami or Parvati on the top shelf, and a figure of Tiru-Navukarasu or Appar Swami (*circa* 500 A.D.), apostle and psalmist of the religion of Siva, on the second shelf. (See Plate XI.)

On the same shelf there is a bronze of Bodhisatva Maittreya (the loving one) in the attitude of a teacher. It is said to be one of the best bronzes in the collection. As it comes from Anuradhapura it represents a much earlier period than the Polonnaruwa bronzes. The treatment of the drapery is full of grace. The expression of the face is severe and exalted. This figure belongs to a type called by modern Sinhalese craftsmen *tri-vanka*, "three bent," the head, trunk, and lower limbs having a different inclination. The pose of such figures reminds us of the "sway" characteristic of so many mediæval European ivory Madonnas. The weight of the body is thrown on the right leg, the left hip being raised. In this case will also be found a figure of Tiru-gnânâ Sambandha Svâmi (*circa* 500 A.D.), apostle and psalmist of the religion of Siva. His psalms are in daily use in the temples. He is said to have been called to be an apostle while still a child (at Stickali, in Tanjore District) and to have died a child. Hence he is represented as a child, nude, save for anklets and a child's waist-string of beads, and having a child's tuft of hair on the front of the head. He holds in his hands the golden cymbals which he received from Siva and with which he went about singing Siva's praise. (See Plate XI.)

Case 7.

This case contains bronze finial stands, ancient bronze boxes, a contemplation box, bells, stirrups (one with rectangular base), cymbals, cobras (some seven-headed), bronze lamp stands, pounder and pestle. A temple bell 11½ inches high is seen, having the figure of a bull in relief, from the Siva Dewale. (See Plate IX.)

Case 8.

Contains a figure of Parvati, Consort of Siva, in the manifestation called Vira-Sakti, from Siva Dewale No. 1, Polonnaruwa.

Case 9.

This figure represents Chandeswara, an apotheosized devotee of Siva. He is holding a garland of flowers. On the base there is an inscription in a dialect which is said to be composed of mixed Grantha and Sinhalese. The inference drawn from what can be made of the inscription and from the attitude of the figure is that it represents a Lord Chief or King.

Case 10.

Here is a miscellaneous collection of bronze lamp covers, incense vessels, bracket lamps, sacred geese used as tops of lamps, ornaments, finials, &c. (See Plates IX. and XXIII.)

Case 11.

This case contains bronzes of Ganesha, Krishna, Kataragam Deviyo, guardian gods, horses, crabs, elephants, tortoises, shells, fishes, oxen, lions, bronze of Siva ; Kami or Parvati, Consort of Siva ; Siva standing with his Consort Parvati and embracing her (*alinga*), surrounded by a halo. On the bottom shelf will be seen a bronze bull from Polonnaruwa, a favourite charger of Siva in his manifestation of *Risha-bharuda* or *Pasu-palis*—the bull representing the human soul (*pasu*), of which he is lord (*pati*).

A noteworthy and uncommon type is *Suriya*, the Sun-god, with a halo round the head and a lotus bud in either hand. Tiru-na-Vukkarasa Swami or Appar Swami is shown in this case in a different form to the one in Case 6. He is here shown with shaven head, clad only in a breech-clout ; the end of the grass-cutter has been broken off. (See Plate XI.)

Case 12.

Several figures are shown here, such as guardian gods from Anuradhapura, demi-gods from Polonnaruwa, a small Nataraja and goddess Parvati from Polonnaruwa; a seated goddess from Polonnaruwa, and two images of Sundara Murti Swami (*circa* 700 A.D.), apostle and psalmist of the religion of Siva. He was a native of Tiruvarur, near Negapatam, in the Madras Presidency, called to be an apostle on his wedding day, hence dressed in the clothes and ornaments of a bridegroom. A figure of Manikka—Vachaka Swami, the greatest of Siva's apostles and psalmists, about 100 A.D.—is also in the case. He was prime minister of the Pandyan King of Madura in the Madras Presidency before he was called to be an apostle. He holds in his hand a palm-leaf manuscript of his psalms. (See Plate XII.)

Case 13.

This case contains a bronze finial from the top of a dagaba at Polonnaruwa. Near this case is a large bronze cauldron from Anuradhapura, which was possibly used for dyeing priests' robes.

Case 14.

This case contains two figures of Siva as Nataraja. Both bronzes are without the halo, and one of them without the whirling braids. There is also a figure of a Devi or goddess standing, from Polonnaruwa. Another figure of Siva is seen seated at ease (*sukhasana*), with his Consort Parvati or Siva-Kami. On Siva's crown are the sun, moon, and the Ganges. In one of his hands he holds a deer, in another a battle-axe; in other respects the ornaments are as in Case 15. Parvati holds a lotus bud in her hand. Both figures are seated upon the lotus throne or *padmasana*. Next is a figure of Siva in one of his dances called *Sandyanirtta*. Under the case is a copper *patra* or begging bowl from Polonnaruwa, excavated by the Archæological Survey in 1908. (See Plates XIV. and XV.)

Case 15.

This figure, which is perhaps the most noteworthy bronze in the collection, is of Siva as Nataraja, the lord of the universe. The whole figure symbolizes the activity of the lord in the universe, his five acts—Creation, Preservation, Destruction, Embodiment, and Release. "Our lord," says a Tamil text, "is the Dancer who, like the heat latent in firewood, diffuses his power in mind and matter and makes them dance in their turn"—a poet's intuitive perception of an idea of the nature of matter not far removed from the conceptions of modern science. Of concrete symbols, the drum in one right hand signifies creative sound, the vibratory movement initiating evolution; the flame in one left hand symbolizes the converse, activity, destruction, involution. The hand upraised says to the worshipper, "Fear not," and the other points to his foot, the refuge of the soul. The right foot tramples on a demon, representing the cosmic illusion of empirical reality. The Ganges, in the form of a mermaid, and the crescent moon are set in his streaming hair. One cobra wreathes itself about his arm, another is twisted in his locks. Upon his brow blazes the third eye of spiritual wisdom. (See Plate X.)

SOUTH VERANDAH (Room B).

A heavy large Portuguese cannon in copper, with the Portuguese coat-of-arms on it, will be found here. It was dredged by the "Merak" in 1888. This cannon most probably belonged to the Portuguese warship commanded by Francisco Perera, which was wrecked in the Colombo harbour in 1613.

Almost opposite will be found a stone slab bearing the royal arms of Portugal, found at Menikkadawara in the Kegalla District.

In this verandah will also be found a pillar and inscription (dated 1550) which were unearthed at the Chartered Bank premises in Colombo, in 1906. The pillar is elaborately carved, the design being peculiar and unlike those hitherto found in the Island. It seems Dravidian in style, and somewhat like the lion pillar

from Berendi Kovil (Sitawaka) figured in the Archæological Commissioner's Report on the Kegalla District, 1890–1893.

Near this pillar is exhibited a polished pillar of Ceylon gneiss from the Mahara quarries, employed in the construction of the Colombo Breakwater, presented by Mr. John Kyle.

NORTH VERANDAH (Room B).

Here will be found some Dutch and Portuguese tombstones—all labelled with text and translations. A couple of carved Maldivian tombstones in coralline limestone are also kept in this verandah, and also capitals, guardstones, and other stone carvings from Anuradhapura and elsewhere. There is a fine old carved Kandyan door frame from Kumbukgama, presented by Mr. F. H. Price, and also another ancient carved wooden door from Dewanagala in the Kegalla District. The solid wings of this door and the left jamb of its frame were found among the lumber underneath the vihare. There are ten plain panels enclosed by framework in high relief carved in a foliage scroll. The carving of the jamb is described as follows: "Between an outer beading and inner splayed edge of lotus petals runs a long narrow panel with gracefully intertwined double scroll of creeper, separating four figures all different from each other. A space half moulded, half panelled, in flower design, intervenes between it and the base panel, in which is placed beside a tree an elephant with head and right forefoot raised and curled trunk."* (See Plate XVI.)

CENTRAL HALL (Room C).

The Central Hall, by which the visitor enters the Museum, contains four cases of arms near the entrance and two cases ivories. In the far right hand corner is a case containing a miscellaneous set of things lent by Mr. Leslie de Saram. Suspended from the roof are specimens of old Sinhalese flags.

Arms (Cases 17, 18, 19, and 20).

When the first Portuguese ships arrived off Colombo in 1505, it is very probable that firearms, though known to a limited extent in the Indian continent, were not in use among the Sinhalese. Their arms were similar to those of most of the Indian races, and consisted of short swords, spears and javelins, bows and arrows, and clubs. The spears are well represented in the Museum, and are either hung on the walls or occupy stands in the Central Hall. The heads are as a rule richly inlaid with gold, silver, or copper, and the shafts elaborately lacquered. The short javelins were especially used for fighting with amidst forests and mountains, for the warfare of the Sinhalese was largely guerilla. Their bows were six feet in length, and were made of *dunumadala*, and were, like the spear shafts, heavily lacquered. The bow strings were manufactured locally from the tough fibre of the *niyanda* (*Sanseviera zeylanica*), and the arrows of arecanut wood, frequently without any metal head. But it was

* H. C. P. Bell, Report on the Kegalla District, 1892, p. 49.

in the sword and the spear that the artistic instinct of the smith developed itself. A dagger has always been a part of the everyday dress of the Sinhalese, and to-day every villager carries his knife at his waist. The collection in Case 17 shows some of these of the most elaborate description. The handles are of ivory, horn, crystal, or bronze, and the style of decoration followed resolves itself into three or four broad classes. In the better specimens more than one-half of the blade is covered with exquisite metal work, whether silver or bronze inlaid with silver; the scabbards are usually of wood and sometimes of horn, and as in the case of the blade they are also adorned with silver work. Some of the scabbards are fitted with the steel silver-mounted stylus which was used for inscribing on the palm leaves which served the Sinhalese instead of paper; these daggers were used by the officials whose duty necessitated the frequent entering of records. (See Plates XVII. and XLI.)

The swords are chiefly distinguished by the shortness of the blades and by the smallness of the handles. Those worn by the higher military officers were invariably covered with a profusion of gold and silver ornament, in which seven lion heads are prominent. With the development of firearms the sword fell more and more into disuse, and is to-day represented by the highly ornamental but utterly unpractical weapon which is worn with Sinhalese uniform. The visitor should notice in Case 17 the tortoiseshell scabbard richly carved which used to be worn in mourning. Two ancient straight swords at the bottom of Case 17, with long inscriptions, are among the most interesting objects of this collection. It will be noted that inlaid in brass on some of the blades are certain figures, whether of animals like the lion, horse, and dog, or conventional designs of flowers, &c. These are remnants of the Sinhalese system of heraldry, and served to differentiate between the various castes which used the weapons. A variety of Indian and Malay swords, daggers, and krises are shown in Cases 18 and 19. The Moorish thrust dagger in Case 19 should be particularly noted; this is the device which is still used by these Indo-Arabs in branding cattle. (See Plate XVII.)

The weapons which were introduced into the country by the Europeans can be easily distinguished by their appearance. The Portuguese sword shown in Case 19, which was found at the site of the ancient capital of Cotta, where for sixty years Portuguese influence made itself felt, bears an interesting inscription.* The weapons of the Dutch East India Company, which invariably bear the Company's mark  with the date, are collected in Case 18.

Their blades were greatly in demand among the Sinhalese, and their swords-sticks or *kala bonde* were fashionable amongst the noblemen of the Sinhalese Court towards the end of the seventeenth century.

The Portuguese writers again and again express their admiration of the skill of the Sinhalese in the manufacture of firearms. As usual the best of these were heavily ornamented with silver, and a beautiful specimen of such a gun may be seen in Case 20. A large number of small cannon or *kodi tuwakku*—foot-muskets, as the Portuguese called them, or "grasshoppers," according to the Dutch

* "No me embaines sin honor. No me saines sin razon."

—were used by the Sinhalese in their wars. These were very similar to the cannon manufactured by the Filippinos a few years back during their wars with the United States. These guns could be carried by two men, and were most efficacious in guerilla war. A handsome brass-mounted specimen is seen on the floor of the Central Hall. The powder horns in Case 20 should also be noted. They are of ivory or horn, and among the prettiest are some formed from the coconut shell. (See Plate XVII.)

One specimen of a Sinhalese shield of buffalo hide appears in Case 20. It is interesting to note that a white shield was one of the Sinhalese insignia of royalty, and that it was adopted as such by the Portuguese Captains-General, as representing their king.

Some specimens of stone " cannon-balls " will be seen on a stand at the foot of the stairs. These come from Medamahanuwara, the city of refuge which the Sinhalese kings maintained during their wars with the Portuguese during the first half of the seventeenth century. It is however doubtful if the Sinhalese possessed guns of sufficient calibre to discharge such projectiles, and it is much more probable that they were used with one of the species of catapults which were known in the East.

Ivories (Cases 16 and 21).

Whether the Court of Solomon was supplied with its ivory from Ceylon or not, this country has from the earliest dawn of history been renowned for the quality of its ivory, gems, and pearls ; and out of the exhibits to be seen at the Museum, the instinct of the Sinhalese workman for what is beautiful is probably best shown in the ivory carving. The smith caste has always been a favoured one with the Sinhalese kings ; among its nine classes were allotted works so different as the hewing of stones, the lacquering of spear handles, the carving of ivory, and the making of ornaments of gold. Several colonies of these people were imported from time to time from South India, bringing over with them the traditions of their own country. An elaborate organization of their caste existed round the Sinhalese Court till the extinction of the Kandyan Kingdom, and valuable information on the subject can be obtained from an article by Mr. H. W. Codrington, C.C.S., on the Kandyan Navandanno, in the 21st volume of the Journal of the Ceylon Branch of the Royal Asiatic Society.

Ivory and gems entered largely into the decoration of temples and palaces, the king's throne in the earliest times being wrought of ivory. Plaques of ivory were used to cover the wooden doorposts of sacred edifices, and specimens of these may be seen at the Museum, the depth of their carving, the elegance of the design, and the finish of the work making them particularly striking. The fragment of an ivory door frame carved out of a slab 1½ inch in thickness, which is shown in the illustration, is a specimen of the finest kind of Sinhalese work. These panels not only display the conventional designs of leaf and flower, but elaborate figures of deities and heraldic devices like the elephant and the two-headed eagle. The two carved panels from the Treasury of the last king, which occupy the central place in the case on the left, though lacking in the vigour of the oldest specimens, are of special interest from their historical associations. (See Plate XVIII.)

Akin to these panels are the ivory book covers which were used to protect the palm-leaf books of the Sinhalese. A long string

secured to a jewelled button and passed through a perforation in the leaves is employed to hold the book together.

The large ivory fan handles are among the most treasured possessions of the Buddhist priests, with whom a fan held in front of their faces is an essential portion of the priestly costume at all religious functions. An ivory fan was the insignia of the Sangha Raja, or Buddhist Pope, under the Sinhalese kings. The effective decoration of these handles by conventional designs in dots and circles of red and black is specially noteworthy. The design is incised on the object to be decorated, and the hollows filled in with colouring matter. The intertwined parrot heads shown in the illustration comes from the Balangoda District, and is probably a fragment from the back of a chair. Above this exhibit is another fragment of particularly excellent carving, though the use of the article is unknown. A variety of small cases, &c., turned on the lathe occupies the lower shelf. These were used as jewel cases, pill boxes, &c., and are all decorated with inlaid lac. Among them may be noticed the medicinal staff of King Raja Sinha II., which consists of a series of pill boxes screwed together in the form of a staff. Each compartment would be filled with a separate variety of medical preparation, and the warmth of the hand was considered to attract the virtues of these drugs within the system of the person who carried the staff. This rare curiosity was presented by the King to the French Count de Lanarolle, who was detained at his Court for many years, till he finally married and settled down among the Sinhalese, and has been lent to the Museum by one of his descendants.

As might be expected, ivory was largely utilized for making images of the Buddha, and several specimens of these, together with models of figures in various costumes, are shown in the case on the right. It will be noted that, as often done by the Greeks in the case of their marbles, the Sinhalese artist frequently coloured the background of his ivory for the purpose of throwing the delicate carving into prominent relief. Traces of this colouring can be seen in the most ancient plaques already referred to. The large collection of ivory combs display some fine specimens of art. These combs are carved on both faces, and the attention of the visitor is specially drawn to the delicacy of the workmanship in the one with the large lotus flower in the centre ; some of the perforated work and the reproduction of conventional designs are worthy of careful study. The carpicks are done with the same taste and minute care as the combs. An effective specimen of decoration in red lacquer is shown in the large shuttle, which was the insignia of the head of the weavers under the Sinhalese kings. (See Plate XIX.)

Among the greatest curiosities in Sinhalese ivory work rank the scent sprays or *sividi*. The manufacture of these was confined to a few families, and the knowledge is now almost extinct. The material is prepared in such a fashion that the ivory is compressible, and by a little pressure of the fingers will eject its liquid contents. The ivory drum on the lower shelf comes from the musical establishment of the last king of Kandy ; by its side are various ivory flutes and horns such as are still in use in temples.

Among the other articles of domestic utility in ivory are drinking cups, medicine flasks, mortars, cotton reels, spectacle cases and frames, syringes, &c. The early Portuguese fully appreciated the beauty of Sinhalese work, and the high officials employed considerable

numbers of silversmiths in preparing such work for them. It is recorded that a crucifix sent from Ceylon to the Archbishop of Goa in the sixteenth century was considered such a work of beauty that it was forwarded by that Prelate to Philip II. of Spain, to be preserved among the royal treasures. One specimen of Portuguese carving is shown in the Museum, representing, characteristically enough, Adam and Eve under an apple tree. The Dutch influence is shown in a series of jewel and betel boxes in Case 16.

De Saram Loan Collection (Case 22).*

This case contains various articles of beauty and value, including bronzes which probably came from the ancient temple of Mantota. This collection contains two ivory boxes of unusual beauty, one being book-shaped and the other being noteworthy on account of its fine perforated work. These boxes, as well as practically all those in Case 16, are probably of Indian workmanship. As a rule Sinhalese work is on solid planks of ivory, while the Indian is veneered on sandalwood or some other white wood. The hinges and nails employed in Indian boxes are generally of inferior metal. (See Plate XXVIII.)

Sinhalese Flags.

From the most remote times the Sinhalese had their standards and badges. The lions on the gateway at Sanchi (*circa* 320 B.C.) have been identified as the national symbol of Ceylon. Suspended from the roof of the Central Hall may be seen copies of the royal standard of Kandy and the flags of the different Provinces belonging to the ancient Kingdom of Kandy. Although the dimensions and the colouring of the originals are not shown in the copies hanging in the Gallery, they represent fairly accurately the symbols on the old flags, and have been worked by Sinhalese in red and white in the spirit of the old designs. The flag of Kandy represents the old Sinhalese banner of a red lion holding a sword, with a ray of the sun or gold finial issuing from the four corners. It is symbolical of the lion (*sinha*) race and the Solar dynasty of Ceylon. The others are flags of Provinces. (See Plate XX.)

The flag of the Seven Korales (Hat Korale) represents a lion. The flag of Udapalata, a red lotus on a white field within a border, with the usual Sinhalese design of stars to fill in a vacant space. The flag of Bintenna displays a red parrot, and the flag of Nuwara-kalawiya the mythical elephant-lion (*gaja sinha*) in red within a border, with the star decoration. The flag of Uva bears a red swan (*hansa*) and the flag of Tamankaduwa a red bear (*valaha*), while on the banners of Wellassa and Walapane appear respectively a red leopard (*kotiya*) and a red peacock. The banner of the Four Korales (Hatara Korale) led the van in war, and at the annual Buddhist procession, the Dalada Perahera, at Kandy it bore the sacred and royal symbols of the sun and moon. A representation of the standard of the Four Korales, beautifully worked, which the unfortunate chieftain Lewke bore against the British in 1803, is given in Bell's Report of the Kegalla District, page 126 (Ceylon

* In Ceylon there are numerous private collections of interesting antiques, the value of which would be largely increased by their display in their proper surroundings in the Museum. It is to be hoped that Mr. de Saram's example in lending the best specimens in his collection to the Museum will find numerous imitators.

Archæological Survey). The flag of the Three Korales (Tun Korale) contains the double-headed eagle (*bherundaya*). A plain white field within a red border is the banner of Matale. The flag of Sabaragamuwa represents a net, shown by intersecting red lines on a gold field within a blue border. Tradition says that one of the Kandyan monarchs, through persistent rebellions in that Province, declared that he would not trust the people of Sabaragamuwa out of his sight, and gave them the "net" flag so that he might see through them, even with the covering of a banner. The older ensign appears to be a plain yellow silk banner, on which the net is shown in the flag in the Museum. Besides the flags already mentioned, there is a copy of a flag said to be of the Udunuwara Dissavoni. It has a floral border and a large central figure blowing a trumpet, human forebody upon a bird's hindquarters (*kindura*), painted equally on both sides.

The drawings on the ceiling covering the top of the staircase must not be taken for flags. These are Kandyan ceiling drawings done by Kandyan workmen. Among other drawings there is the *hansa-puttuwa*. The *hansa* is the "sacred goose," which is regarded as beautiful and auspicious. In Sinhalese as in Hindu decorative art the *hansa* is seen frequently. The double or more swans with entwined necks is the typical Sinhalese (Kandyan) form of the *hansa*. The other drawings are merely decorative drawings. The one with the monster on the top with the figures supporting it is the *makara torana*. The *makara* is supposed to be a fabulous amphibious monster, usually taken to be the shark or crocodile, but depicted in the signs of the zodiac with the head and forelegs of an antelope and the body and tail of a fish. In the middle of the *makara* is the Maitriya Buddha.

ROOM D.

The visitor next comes to Room D, which opens off the east side of the Central Hall.

Here are found two cases displaying samples of Maldivian arts and handicrafts; two cases of models of boats, fishing appliances, and houses; two cases of masks, musical instruments, and other articles associated with various ceremonies; one case of modern pottery; and one case of ancient pottery and other remains disinterred at Anuradhapura and Polonnaruwa. There is also a small case in the centre of the room containing painted clay models illustrative of the different types of inhabitants of the Colony and their distinctive kinds of dress.

In the North Verandah are shown some of the economic products of the coconut and palmyra palms. In the South Verandah are various stone remains.

Maldivian Exhibits (Cases 25 and 32).

The Maldive Islands are situated 380 miles west of Ceylon, and form a dependency of the Government of this Island. The archipelago consists of several hundreds of islands grouped together in clusters, called atolls; they are of coral formation, and produce excellent coconuts, the fibre of which has been for centuries largely utilized as cordage for the shipping in the Indian waters. The country is governed by a Sultan, who sends a yearly Embassy, with

his tribute of cowries, ambergris, mats, &c., to the Ceylon Government. The people appear to have a considerable amount of Arab blood in their veins, and the produce of the coconut, dried fish, and tortoiseshell are important articles of export. The models of the various ships in use are of great interest as preserving the outline of the vessels in which no doubt the earliest Arab navigators crossed the Indian seas; the sails of some of these vessels are made of coconut leaves, and the flaming star shown on the others is the device of the Sultan. The fishing ladles are ingeniously constructed from the spathe of the coconut flower. Shark-fishing is an important industry, the animals being captured by means of large iron hooks. The chief interest in the exhibit centres round the beautiful specimens of Maldivian lacquer work; this is superior in finish to anything of the kind produced in Ceylon, and easily rivals the famous golden lacquer of Pagan. Among the best specimens are the lace stand, flower holder, and plate box as shown in the illustration. The curious high wooden sandal with a metal nail to pass between the first two toes is to be found in use in Ceylon; the shell spoons and the various games should also be noted, as well as the specimens of the costumes of the inhabitants. A considerable portion of the articles on view has been presented by the Sultan Ibrahim Noorudin Iskander. (See Plates XXI. and XXII.)

Ancient Pottery and Earthenware (Case 26).

The case containing ancient earthenware contains chiefly "finds" of the Archæological Survey of Ceylon—Anuradhapura 437 B.C. to 769 A.D., Polonnaruwa 769–1319 A.D., and Sigiriya 479 A.D. There are some ancient eaves tiles from Panduwasnuwara. Eaves or

hanging tiles are used on dewala and vihare roofs to fringe the eaves. These tiles have a plain flat upper portion which passes under the last row of tiles at the edge of the roof. The visible down-hanging portions, which frequently have the shape of conventionalized bo-leaves, give an artistic finish to the roof. Animal figures are embossed on the outer (and sometimes in the inner) surface of

the hanging tile, and frequently the lion (*sinha*) and the goose (*hansa*) are shown particularly. Attention is drawn to the bo-leaf shape, heraldic lion, lotus blossoms, and palmettes, and the Kandyan eaves tile from Pelenda, Kukul Korale, with face, from the palace of King Vidiye Bandara, father of King Dharmapala, and also the base of a clay lamp with elephants in relief. At the Dalada Maligawa and the Old Palace at Kandy tiles are let into the wall, with lions or geese, and painted, with very good effect as wall decoration.

There is in this case a fragment of a beautiful ornamental brick from Sigiriya. The other noteworthy things in the case are the old tile and ornamental clay top (*kota*) of a Maligawa, found at Maligatenna in Deraniyagala, said to come from the site of the palace built by King Rajasinha I. in Sitawaka, 1581–1592.

Pottery and Sinhalese Earthenware (Case 27).

This case has some excellent examples of painted pottery of much excellence, as well as some grotesque pottery. Sinhalese potters are found all over the country, but often in greater numbers in places where there is a good supply of suitable clay. In the days of the Sinhalese Monarchy, at the Court one of the household departments was that of the potters. Potters held land on service tenures often directly from the king. The potter is generally found at work in the verandah of his house, and sometimes in a separate shed. Dr. A. K. Coomaraswamy thus describes the potters' appliances and the process of working :—

" The potter's appliances are, as may be supposed, simple enough. His wheel (*poruwa*) is a circular board about 2½ ft. in diameter mounted on a stone pivot which fits into a large stone socket embedded in the ground, the horizontal surface of the wheel itself standing not more than six inches above the ground. The wheel is turned by a boy who squats on the ground opposite the potter and keeps it going with his hands. A lump of clay is dumped on the wheel, enough for half a dozen or more pots, and they are moulded one by one under the potter's hands, cut off, and set aside to dry. To finish off the rims, a strip of wet cotton is used ; with this the potter smooths off the edges as the wheel turns, and pressing through it with his nail he makes the little mouldings at the top. As removed from the wheel the pots are bottomless, and have to dry for a few hours or a day or two before they can be finished ; when they are ready the potter takes a smooth stone in his left hand and a sort of wooden bat (*walantalana lella*) in his right hand, and holding the stone inside the vessel he beats and pats its sides till finally they meet across the bottom ; the vessel is rubbed smooth with the bat. Occasionally the surface is polished by rubbing with a smooth seed. Any ornament required is now added and the pot is ready for the fire. Firing is done in a low kiln with stone sides and a dome covering of wet clay and sticks. The kiln is square in plan, and has three or four openings along one side for the insertion of fuel, and on the other sides smaller openings for the escape of air. Long sticks are used for fuel, pushed through the openings by degrees as they burn away. The kiln is usually protected from the weather by a rough shed."

Some fine examples of painted Kandy pottery are exhibited. These are painted with oil colours after the pots are fired. The

only colours properly used in painting pottery are red, yellow, white, and black—the ordinary pigments of the Kandyan painter. Some plain, well-made clay pots are also shown in this case. (See Plate XXIV.)

Demons and Devil Ceremonies (Cases 28 and 29).

The beliefs regarding the existence of evil and low spirits, and their various characters, are many and elaborate. The *yaksa* and *preta* are believed to cause many diseases, and are exorcised in various ways.

Among those to whom disease is attributed the Sanni Yaka takes eighteen forms, and to him are attributed eighteen forms of diseases. He is sometimes represented in a large mask with eighteen different figures, and more often by eighteen different masks. (See Plate XXV.)

For each *yaksa* there is a different ceremony for its propitiation, which includes offerings of food, dances, music, lights, &c. In Case 29 are shown the masks representing the attitudes of various demons and a large Sanni Yaka. This case also contains the dress of a devil dancer and various types of head-dresses used in devil dancing. (See Plates XXVI. and XXVII.)

There is a general ceremony for warding off evil influences known as *Suniyan-kepima* (the severing of bindings). The decorations for this ceremony and the dance connected therewith are very elaborate. A throne room is built in the shape of *atamagala*, the eight-sided figure, with green leaves, flowers, and plantain stalks, lit with hundreds of torches dipped in oil. In front of this are placed seven floral steps. The patient is made to wear a crown, anklets, armlets, bracelets, belts, &c., made of stems of tender creepers. The ceremony is concluded by the cutting down of all decorations, and lime fruit and various other fruits, after the repetition of invocations, charms, verses, and songs. The performers dress themselves in ornamental vari-coloured hats, bodices, and skirts. (See Plate XXVII.)

Giri Devi is a she-demon who is propitiated also in a dance. Her ornaments are represented in an elaborate dress, part of which is shown in Case 28. The story of Giri Devi is that she was a handsome young princess, who, through shame of an intrigue with her own brother, committed suicide, and afterwards was converted into a demoness through the power of the King of Demons.

Musical Instruments, &c. (Case 28).

In Case 28 the following instruments used in magical ceremonies are displayed :—

Drums.

Udekkiya.—A small drum used for keeping time to dancers ; specially used in ceremonies connected with temples of *devas*.

Bummediya.—A drum made of an earthenware spherical pot with two openings, one smaller than the other. The top opening is covered with the prepared skin of a lizard (Water Monitor). This is used in ceremonies connected with the reaping of crops, &c.

Demala Bere.—A Tamil drum is made of a large hollowed piece of wood tapering at the two ends. Both ends are covered with prepared skin, and one of the skins is coated with a cement. The

skin is kept stretched by an arrangement of strings drawn with double loops arranged on the drum cylinder. This drum is used for keeping time for songs connected with ceremonies of *devas*.

Yak Bere.—A drum used in devil ceremonies. This is a loud-toned drum, for beating with the fingers and palms of both hands. It consists of a long cylindrical regular-shaped hollowed wood, covered at both ends with prepared skins, which are tightened and arranged by looped strings running across the cylinder from side to side.

The *Davul Bere* contains a larger sized cylinder, arranged similarly to the *Yak Bere*, but is played with a stick and the palms and fingers.

Tammettan.—A double drum, both facing the player and attached together in a line. It is played with two bent sticks.

Wind Instruments.

Sak Gedi (chank shell).—This is prepared of shell. When blown from one end it produces a loud sound. It is used in Hindu temples and in processions and ceremonies connected with *devas*.

Was Dandu.—A whistle made of a piece of bamboo ; when played it emits a long and shrill note of call. It is used in demon ceremonies.

Horanewa.—A long flute-shaped wind instrument.

Bells, Anklets, &c.

The hand-bell is used in ceremonies connected with temples of *devas*.

Cymbals are used in connection with some of the demon ceremonies.

Gejji.—Small jingles, a number of which are strung together and tied round the ankles of a dancer.

Armlets.—Hollowed armlets with sounding pebbles; worn on the arm and wrist.

Anklets.—Sounding rings worn on the ankles.

Salamba.—Oblong sounding rings worn on the thumbs. (See Plate XXVII.)

Bali Ceremonies.

There are numerous coloured pictures representing various images used in different *bali* ceremonies. These pictures are above some of the cases in Rooms D and E, and also on the walls of the North Verandah of Room D.

Bali ceremonies are concerned in the invocation of the powers of planetary gods. Various clay images are mounted on frames and are coloured and decorated. Each one is intended for a special purpose, and its details are elaborately described. Offerings of food, flowers, lights, &c., are made before the figure, accompanied by incantations, songs, and dancing.

Case 30.

This case contains models of Low-country huts, a paddy barn, Jaffna bungalow, rattan bridge, of a gateway and gate in Jaffna District, brick kiln with bricks, tiles, moulds, and accessories, child's cot, palanquin, a well at Jaffna, and a bed used in the Jaffna District.

There is also a model of a *chekku* (native oil mill) shown. This is used by the natives for extracting coconut oil from copra (the dried kernel of the coconut). It is a simple and inexpensive method, and although not so effective as the steam machinery introduced by Europeans for the same purpose, it has held its ground against steam crushes and hydraulic presses, and notwithstanding the erection of large steam oil mills, the *chekku* or bullock mill still continues to exist in Ceylon.

Boats and Fishery Appliances (Case 31).

The objects under this head are not well represented for want of room. Among boats will be found the "dhoney" (a native sailing craft), "kattumarams," a Negombo canal "padda" boat, outrigger boat, passenger boats, a double canoe, a river raft, and a model of a boat used in the pearl fisheries, with crew and divers. On a side of the pearl fishery boat model will be found a diver's sinking stone and pearl diver's coir basket, which were used in the 1904 fishery.

Among the boats the "kattumarams" are the rudest and most primitive of any description of craft. They are extremely safe, and cannot be sunk when turned by the breakers. The dhoney with ballam is the craft which performs the coast carrying trade of the Island, and is built on the south coast. The square-rigged country craft are built in the small ports of the north. They vary in size from twenty to seventy tons burthen; the square-rigged vessels are owned by Moormen chiefly and the dhonies by Sinhalese, who work in shares with the crew. The owner receives one-third of the vessel's earnings, the remaining two-thirds being divided between tindal or commander and crew, the former's share being twice that of each of the others. Eight to fifteen men compose the crew of a dhoney. A considerable coasting trade during the fine weather of the north-east monsoon is done in these crafts. They carry coral from the northern districts of the Island to the south-west coast of India, returning with Indian commodities. The rigging is made of country-made coir rope, their sails of home-grown, home-spun cotton, their hulls of a light but durable wood, the planks and keel containing no metal nails, everything being held together by means of wooden pegs and coir yarn.

Various fishing appliances are shown, but this collection is not a representative one.

Case 33.

This case, which stands in the centre of the room, contains small painted models of the various types of inhabitants of the Island.

NORTH VERANDAH (Room D).

Products of the Coconut Palm (Case 23).

The coconut palm is the most valuable of the trees of the Island of Ceylon. Case 23 is assigned to the products of the "King of Palms" (*Cocos nucifera*). The uses of the coconut are endless

and enter into every part of the daily life of the Sinhalese, as food, drink, light, fuel, household utensils, and building materials. It is an article of foreign commerce, the chief source of Sinhalese wealth, and an important field of industry in the Island. The coconut flourishes best in the wetter coast regions. Almost every Sinhalese hut has a few of these palms near it, and many very large coconut estates are cultivated by wealthy Ceylonese. The fruit, when green, supplies food and drink ; when ripe it yields oil. The juice of the unopened flower gives toddy and arrack. Arrack is a delicate, wholesome spirit obtained by double distillation from the sap of the coconut. The fibrous husk of the fruit when woven makes ropes, nets, and matting. The nut shell forms drinking vessels, spoons, &c. The plaited leaves serve as plates and dishes and as thatch for the hut. The dried frond of the palm is twisted into a bundle and used as a torch. These torches, known as *chulu* light, are often employed for the purposes of illumination on festival occasions and ordinarily used by villagers at night to light their way. The midribs of the leaflets are tied into bundles and make very good brooms for sweeping ; the large leaf stalks as garden fences. The trunk of the tree sawn up is employed for every possible purpose, from knife handles to doorposts and rafters. The fruits while young contain a pint or more of a sweet watery fluid, which affords a most refreshing drink. As the nut ripens the water decreases and the kernel hardens. The nuts are gathered at about ten months old. Their kernels are eaten raw, in curries, and in other ways. The kernel when used in cookery is grated very fine by an instrument called a coconut scraper (to be seen in Case 34), after which milk is squeezed out of it. When dried the coconut is known as *copra*. From this oil is extracted, and the residue is used as poultry and cattle food, known as "poonac," which is considered a valuable fattening food. The oil is used for lighting, but its great use in Europe is for soap making. It also forms a hair dressing, and is used for the manufacture of candles. There is also a large industry in desiccated coconut in connection with confectionery. The outer husk of the coconut contains a large number of large stout fibres running lengthwise. The husks removed from the nuts are thrown into water to soak and rot, and then by beating out the soft tissues from the fibres coir yarn is obtained. There are large mills where special machinery is used for preparing coir fibre, which is exported from the Island.

At the bottom of the case will be seen a model of an arrack still. Arrack is obtained by "preparing the flowers"—a process which consists of beating once a day with a short but heavy wooden instrument the long spathe or sheath in which the immature flowers of the coconut are enfolded. Such treatment under an experienced hand has the effect in about seven days of reducing the whole flower to a pulp without breaking the sheath or envelope in which it is contained, and when this result has been obtained, and the pointed end of the spathe cut off, the juice produced by this bruising of the flowers will trickle out slowly into a small earthen pot which is fastened to the end ; the juice which falls is sweet toddy, which ferments and becomes arrack. Every morning and evening when the toddy-drawer collects his toddy he must again cut off a thin slice from the open end of the inflorescence, which by exposure to the atmosphere would rapidly dry up or heal and so obstruct the passage of the juice.

Products of the Palmyra Palm (Case 24).

The model of the palmyra palm and other articles in Case 24 were presented by Sir W. C. Twynam, K.C.M.G. The palmyra is another invaluable palm and a most beautiful one. It grows in great profusion in the north of Ceylon and especially in the Peninsula of Jaffna. The timber is used chiefly for rafters of houses, as its strength and durability and the quality of resisting the attack of white ants eminently fit it for this purpose. To the inhabitants of the northern provinces this invaluable tree ranks the same in importance as the coconut palm to the natives of the south. Its fruits yield them food and oil ; its juice palm wine and sugar ; its stem is the chief material of their buildings ; and its leaves, besides serving as roofs to their dwellings and fences to their farms, supply them with matting and baskets, with head-dresses and fans, and serve as a substitute for paper for their deeds and writings, and for the sacred books which contain the traditions of their faith. It has been said with truth that a native of Jaffna, if he be contented with ordinary doors and mud walls, may build an entire house (as he wants neither nails nor ironwork), with walls, roof, and covering, from the palmyra palm. From this same tree he may draw his wine, make his oil, kindle his fire, carry his water, store his food, cook his repast, and sweeten it, if he pleases ; in fact, live from day to day dependent on his palmyra alone. Multitudes so live, and it may be safely asserted that this tree alone furnishes one-fourth the means of sustenance for the population of the northern provinces.

So multifarious are the uses of the palmyra and its products to the natives of the countries favoured by its growth that the Hindus dedicated it to Ganesa, and celebrate it as the "Kalpa tree," or "Tree of life," of their paradise. They say that there are "eight hundred and one" uses to which the tree is applied.

In the model of a palmyra tree will be noticed the toddy climber. He climbs by the assistance of a loop of flexible jungle vine, sufficiently wide to admit both his ankles and leave a space between them, thus enabling him to grasp the trunk of the tree with his feet and support himself as he ascends.

SOUTH VERANDAH (Room D).

Here will be found several carved figures in stone from Polonnaruwa.

ROOM E.

This room contains a miscellaneous series of exhibits ranging from domestic appliances to charms and horoscopes. As we enter from Room D the wall cases on each side (Cases 34 and 35) are devoted mainly to domestic appliances, games, and wooden boxes. The two large central cases (46 and 47) display brass tobacco boxes, kettles, and drinking vessels ; the ritualistic accessories of the temple ; and the horoscope and *yantra* which play such an important part in the superstitions of the villager. The table cases contain jewellery and coins, and the four smaller wall cases are given up to betel boxes and life-sized models of the *Veddas*, Buddhist Priest, Kandyan Chief, Mudaliyar, and his Wife. This medley is unavoidable owing to lack of room, and the visitor is warned not to

omit examining some of the things which have been delegated through insufficient space to the lower part of the two central cases. Most noteworthy is the collection of ancient Sinhalese iron implements lying in the base of Case 46. Typical examples of these, however, are also shown in Case 44.

Domestic Appliances (Case 34).

The domestic economy of a Sinhalese household is well illustrated by the contents of Cases 34 and 35. In Case 34 it will be noted how the artistic feeling of the people manifests itself in the simplest article of household use. Note, for instance, the labour expended in adorning the wooden mortar, which is found in every household to-day. The block of granite on which the villager's curry stuffs are ground is prepared with like care. His *katti* or large knife, prepared from excellent steel of local manufacture, is richly carved or inlaid with precious metals. An elaborate design appears in the rattan basket in which his food is carried, while the mould into which his jaggery (the sugar of the palm tree) is run is as well carved as a piece of drawing-room furniture. The spoons used in every Sinhalese kitchen are invariably made from the coconut shell, with long wooden handles; and, hidden by the dingy smoke of his kitchen fire, the Sinhalese man hangs an exquisitely formed rack to contain the spoons. The villager draws his water from his shallow well with another spoon—often a dream of beauty in outline and general design. The coconut, the essential ingredient of his curry, has to be scraped on a small serrated circular scraper of steel, secured to a wooden body on which the person sits. (See Plate XXIX.) The beautiful moulds shown in Plate XXX. are used in the preparation of dainties of rice flour: a small ball of the dough is laid on the selected design and pressed flat with the thumb; it is rolled up lightly and dropped into the boiling oil. It is another characteristic of the Sinhalese that a thing is made beautiful for the delight in its beauty, and not for purposes of ostentation; for example, notice the elaborate treatment of the under-surface of the circular stone on which sandalwood used to be ground for the ceremonial of some temple. One incident of the dangers of forest life is illustrated by the short battle axes, which are carried by the villagers while travelling through forests as a means of protection from the dreaded bears. (See Plates XXIX. and XXX.)

Games and Domestic Appliances (Case 35).

The left half of Case 35 contains games and some domestic appliances. The sports and games of the Sinhalese consist of (1) religious games, (2) outdoor sports, (3) games of skill, and (4) games of chance. With a few exceptions the games and sports of the Sinhalese appear to have been borrowed from India, and some from the Portuguese, Dutch, and English. The games serve as a sort of index of the character of the people—they "reflect the tame and undemonstrative nature of the national temperament." The Sinhalese by nature takes no delight in outdoor sports, although he has very successfully adopted most of the English outdoor sports. At the top of the case there are *chonka* or *olinda* boards, some of which are beautifully carved. *Chonka* may be called the national

game of the Sinhalese; but the game is of peculiar distribution, and has "served for ages to divert the inhabitants of nearly half of the inhabited area of the Globe."

It obtained the name which it bears in the interior of Ceylon from the small red seeds of the *olinda* creeper (*Abrus precatorius*) which are used for playing it. *Olinda* or any other suitable seeds or shells are placed in two depressions at the ends, and the players have to make the circuit of the board from pit to pit along the sides without occupying the same hole at one time. The player who gets the seeds home first wins. The game is undoubtedly of wide distribution. The game is said to have had its original home in Central Africa, but it appears to be found wherever Arabian influence is felt. The wide diffusion of the game may be due to its having been carried by returning pilgrims to the various parts of the Muhammadan world.

Special attention is directed to two *chonka* boards, one with three birds in high relief and one, similar to boards in the British Museum, in the shape of a fish, consisting of two halves joined by hinges.

It is surprising to find that almost every country where the game is known has its special mode of playing it, an additional proof of its antiquity. Ceylon is no exception to this rule, and among the Sinhalese there are no less than five different methods, four of which are found in the interior among the Kandyans, and one on the western coast. (See Plate XXXI.)

The games are especially played at the season of the New Year, with which they appear to have some connection. At that season *olinda* boards that have never seen the light during the previous twelve months are invariably brought out of their hiding place on some dark dust-covered and smoke-begrimed shelf, and hour after hour is devoted to the game for several nights in succession. It is almost a monopoly of the women. The boards are then put away carefully, and often are not used again for another year, though there is no feeling of any prohibition against playing it at other times, and occasional games are sometimes indulged in.

There are four religious games played by the Sinhalese, namely, *An-keliya*, "the horn-pulling game;" *Dodan-keliya*, "the orange (striking) game;" *Pol-keliya*, "the coconut (breaking) game;" and *Mal-keliya*, "the flower game." All these games are intimately connected with the worship of Pattini, the goddess of chastity and controller of epidemics.

An-keliya is customary only at the time when a district is threatened with infectious disease, especially smallpox. Pattini is also considered an incarnation of the goddess Durga, the wife of Siva.

An-keliya, or the "pulling of horns," is the idea of the merry-thought of European superstition developed on a gigantic scale. The game, though seldom witnessed now, was formerly the one great national game of the Sinhalese, and was performed in many places on a scale of great magnificence and in the presence of thousands of spectators. As mentioned before, it is purely a religious game sacred to the goddess Pattini, and is usually performed on the occasion of some epidemic ascribed to her interference.

Usually, on a propitious day chosen by an astrologer, a large body of people accompanied by a *kapurala*, or devil-priest, repair to the foot of a selected tree surrounded by open ground, and there, at the distance of a few yards from the tree, a narrow hole about six feet long and four or five feet deep is dug, in which a substantial coconut

stump, called *henakanda* is loosely inserted, with the root end upwards. The toughest jungle creepers are looped round the lower part of the sheltering tree, and a loop of them is placed round the stump ; to these are tied ropes that have been attached to the *an-molas*, which are placed between the tree and the stump. Other strong ropes of considerable length are fastened to the upper part of the *henakanda*, and these are now pulled by the united force of the villagers, or in some places only by the section of them who form the party of Palanga, until one of the horns gives way.

Membership of these two sides is hereditary, and so strong is the party feeling or jealousy between them that those of one side usually avoid marriage with the members of the families belonging to the other side, and in fact never have much intercourse or friendly relations with them. In places where the *udupila* men alone do the pulling, the *yatipila* men stand as on-lookers under the tree. For managing the whole ceremony each party elects a temporary leader.

At the beginning of the ceremony the two bars—the *an-mola*—and the ropes to be attached to the horns are first dedicated to the goddess.

After a trial pulling at the respective ropes by the two parties, the *yatipila* rope is tied to the loops round the tree, and the *udupila* rope to the *henakanda*, which is inclined towards the tree for the purpose. Where it is the custom of the *yatipila* men to join in the final pulling, both parties then unite in tugging at ropes attached to the top of the *henakanda*, or passed though a hole in it, and fastened to the *udupila* log, until one horn is broken.

The leaders then examine the horns and ascertain whether the *yatipila* or *udupila* one has given way. The victorious horn is removed, wrapped in white cloth, and carried under a white canopy round the *henakanda* in a procession, accompanied by the music, and is again placed in the *dewala*, or the temporary shed erected for it.*

The other things in the same half of this case are domestic articles used formerly, and in some cases used at the present time. Of the former, special attention is directed to the water clocks. The Sinhalese water clock is a clepsydra, consisting of a copper bowl, of larger and smaller sizes, with a small pinhole in the bottom, and with or without silver datum marks let in at the sides. The bowl is set floating in a clay water chatty, the water gradually entering through the pinhole aperture until a datum level is reached, and eventually the bowl sinks. In the larger of the clocks shown with graduations the water reaches the level of the highest datum mark in exactly forty-eight minutes. The Sinhalese hour or *peya* consists of twenty-four minutes, and the day and night are divided into thirty *peyas* each. The water clock is called *pe-tetiya*.

The other articles consist of opium and mat weavers' knives, comb-making implements, *velliya* for weighing gold with, ivory rod in wooden case, a wooden club called *kitul-mal-telma* for beating the flower of the kitul to make the toddy run out, jewellers' mould, bronze moulds used by silversmiths, jewellers' scales with pagoda weights and touchstone, *dat-kapana-gal* (fine grained sandstone for grinding down the teeth), articles used in the preparation of native medicines, and cattle branding and castrating implements.

* For further information about these games see Parker's "Ancient Ceylon."

Special attention is directed to the stool beautifully carved with the *hansa-puttuwa*—the double-headed goose pattern. The *hansa* is the well known sacred goose of Hinduism. The name stands also for beautiful gait; it is regarded as beautiful and auspicious. In Sinhalese as well as in Hindu decorative art the *hansa-puttuwa* is seen everywhere.

In the right half of this case is seen a variety of wooden boxes. Many of the boxes are very finely carved, and others are handsomely bound in silver. Perhaps the two most noteworthy specimens are at the bottom of the case. One is a Kandyan *pot-pettiya* (book box) with copper fittings, and the other is a *rattaran-pettiya* (a box for storing valuables) with a finely carved *makara torana*. (See Plate XXXI.)

Case 36.

Life-size models of a Low-country Chief or Mudaliyar, and of a Sinhalese bride of the eighteenth century.

A collection of Dutch chatelaines and other Dutch silverware, as well as some Kandyan silver waist chains and a series of Tamil anklets, toe-rings, and other ornaments for decorating the feet.

Case 38.

Life-size models of a Kandyan Chief or Ratemahatmaya, and a Buddhist Priest with begging-bowl.

Jewellery (Cases 39, 40, and 41).

Case 39 and half of Case 40 are devoted to Sinhalese jewellery. The other half of Case 40 displays samples of jewellery of the Jaffna Tamils. Case 41 contains the handsome jewellery of the Chetties.

With the Indian races, jewellery forms not only an important but even a necessary portion of the costume of the female, and very often of the male as well. A glance at the copies of the Sigiriya frescoes on either side of the main staircase reveals the fact that in the fifth century of the Christian era the upper portion of the female was as a rule only covered with jewels, and this continued to be very largely the practice in India as well as in Ceylon till the arrival of the Portuguese. These frescoes prove that not only were the jewels massive and numerous, but that they were at the same time beautiful in design, and artistic in conception. The large stones with which the jewels are mounted are specially noticeable.

Till the arrival of Europeans the jewellery of Ceylon cannot be differentiated from that of India; to-day, however, the European influence is almost exclusively shown in the articles which are exposed for sale in the Colombo shops. The collection of the Museum displays a varied assortment, some of the exhibits dating from pre-Christian times. (See Plate XXXII.)

Case 39.

The gold bangles which have been unearthed at Anuradhapura are among the earliest. These are made in the Indian fashion, of very pure gold beaten thin, and the interior space filled with a preparation of wax, just as is done to-day. The more modern bracelets include some artistic specimens set with ivory and crystal,

some of the latter being cut out of a single piece. An earring of gold found at Halloluwa is among the most beautiful in the collection; the gems with which this had been originally set—white and purple and green in colour—have fortunately been preserved, and give us a clear idea of the best style of mediæval jewellery; but it is impossible to characterize the work as Sinhalese. These heavy earrings were worn, not only by women, but also by the men, as may be seen from the plaster cast of the statue of Parakrama Bahu the Great in the Stone Gallery. The custom among men fell into disuse towards the end of the seventeenth century.

The variety of ear ornaments still in use among the Sinhalese in the inland districts is very great, the ear being bored at half a dozen different points to receive the various articles. The large bamboo-shaped *todu*, of filigree or jewelled, serve to enlarge the perforated lobe of the ear. *Koppu* are thrust through the cartilage, and some charming specimens of these set with rubies and pearls are shown in the collection. But the details of the ear ornaments are essentially Tamil. The same remark applies to the richly chased armlets. The large rings, usually worn by chiefs on the middle finger of the left hand, appear to be a peculiarity of the Sinhalese; they are in some cases over $2\frac{1}{2}$ inches across. The smaller ones are either of silver or copper gilt, and do not display much artistic merit. In necklaces, which were worn both by men and women, the silversmith had to exert himself to economize the precious metal; the Museum collection of these is not extensive. The large coral beads should be noted; these have been popular with the Sinhalese since the time of their early introduction by Arab traders.

Case 40.

The purely Tamil ornaments are well represented in Case 40. The queue-shaped headdress, which is attached to the knot of hair and hangs down the back till it terminates in three black tassels fitted into golden cups, is an excellent specimen of Tamil work. The necklaces set with cabochon rubies, usually imported from India, are also in use among the Sinhalese; though not the belts of silver, a handsome specimen of which appears in the same case. The Jaffna silversmith is well spoken of for the beauty of his filigree work, but the art is purely South-Indian.

The massive anklets and other silver foot ornaments are as a rule worn by Moorish women. As all through the world, these rejoice in the weight of metal which they carry about their person, as can be well judged from the gold neck ornament described as a *tali* in Case 41.

Case 41.

Before leaving the purely Oriental jewellery the visitor's attention is also drawn to the photograph on the side of Case 45 of a chain belonging to the Sinhalese king in the middle of the eighteenth century, and which is now preserved at the shrine of the Sacred Tooth at Kandy. Sixty-four ornaments and the crown were necessary items of royal attire. The Sinhalese loved colour and abhorred glitter. His rubies and his sapphires were always cut cabochon and set on coloured wax so as to secure evenness. Strange tales have been preserved by the European and Chinese writers of the

fifteenth and sixteenth centuries regarding the amazing size of the jewels possessed by the Sinhalese kings. The Ceylon stones and the Ceylon pearls have been always considered superior to others in point of lustre.

A brief word may be said with regard to the jewellery produced under European influence, which is entirely distinctive from the purely Eastern type which has so far been described. A curiously distorted taste which prevailed among the ladies of the Iberian Peninsula in the sixteenth and seventeenth centuries has left its mark on the heavy and inartistic silver work mounted with tourmalines, of which there is a large collection on view. Size and quantity was in estimation among them, rather than beauty or rarity; the figure of the low-country Sinhalese woman in Case 36 shows the effect of Portuguese influence till the middle of the nineteenth century. The jet ornaments were employed exclusively for mourning purposes, and fashionable ladies attending a funeral would have two joints of every finger covered with these rings, as they pressed a dainty handkerchief to their streaming eyes. Under Dutch influence a good deal of very beautiful diamond jewellery was made in the country, though there are no specimens of it in the Museum. The *Coronchiya*—a name derived direct from the Portuguese—is still used in crowning a bride—a custom also prevalent in various parts of Europe, and which has been largely adopted among those classes of the Sinhalese who came most under European influence.

The visitor should notice the golden *pata tahaduwa* which is in Case 39. Under the Sinhalese kings high officials were invested by securing this band round the forehead with a silken ribbon, an honorific name being at the same time conferred upon the recipient.

Coins (Case 42).

The collection shown in the Museum can be divided into two classes, the first consisting of coins struck in the country itself by native or foreign Governments, and the second of those which were introduced by foreign traders. To the first class belong those struck by the Sinhalese, Portuguese, Dutch, and English; to the second the Roman, and a large variety of Indian coins. (See Plate XXXIII.)

The oldest of the series are represented by the *Karshapana*, which go back to a period considerably anterior to the birth of the Buddha. They are oblong, square, and circular in shape, without any legend, and distinguished by punch marks of various Buddhist symbols. These appear to have been current in the Island till about the eleventh century of the Christian era, but it is not possible to say definitely whether they were struck in the Island or imported from India, or both.* These coins are chiefly of silver.

After the commencement of the Christian era an improved issue of these coins seems to have been made in copper, of a circular shape and about $1\frac{1}{2}$ in. across. These coins are extremely rare, and also display no legend, the two faces being fully occupied by various symbols, among which the *swastika*, the elephant, and the *trisula* are prominent. Contemporaneously with these there appears to

* For further information see a paper on "Notes on a find of Eldlings made in Anuradhapura," by John Still. Journal, R. A. S., 1907, Vol. XIX., p. 191.

have been in circulation the copper coinage of Imperial Rome. The effigies of no less than twenty-two of the Emperors have been identified in the specimens which from time to time have been found in this country. The most modern of these coins is that of Honorius (395–433 A.D.). The Portuguese historians have recorded the fact that similar coins were discovered as long ago as 1574, and comparatively recently one find in the neighbourhood of Kandy yielded no less than 1,500 oboli. It is interesting to note that these coins appear to have been locally imitated, and the imitation can be easily distinguished from the genuine article by the fact of the head being turned in the wrong direction.*

The sea-borne trade of Ceylon for the first thousand years of the Christian era, though very extensive—Ibn Batuta, the Moor traveller, saw one hundred of the Sinhalese king's trading ships riding at anchor at one time off the Coromandel coast so late as 1344—was almost entirely one of barter. But the local demand for some convenient medium of exchange necessitated the existence of a currency, and this was satisfied by the issue of *massas* by the Sinhalese kings in the twelfth and thirteenth centuries. Compared with the Ceylon mintage of the Dutch towards the end of the eighteenth century, these show a considerable degree of finish, though the conception of the human figure is of the crudest. On the obverse appears the standing figure of the king, a conical hat on his head, a sceptre in his right hand and a lotus in his left; two lines represent the drapery wrapped round his waist. On the reverse is the same figure seated, with the legend in the *Nagara* character, in which Sanskrit was usually written. This coin, which served as the type for several Indian issues, is still found in astonishing profusion, as well as the half and quarter *massas*, with gold and silver issues of the same type. They were struck by Parakrama Bahu (1153–1186 A.D.), Wijaya Bahu (1186–1187), Nissanka Malla (1187–1196), Chodaganga Deva (1196–1197), Queen Raja Lilavati (1197–1200), Sahasa Malla (1200–1202), Dharmasoka Deva (1208–1209), and Bhuvaneka Bahu (1296). Of these, the rarest are the coins of Chodaganga Deva and Nissanka Malla and the lion coins of Parakrama Bahu.

At the time of the arrival of the Portuguese the *massas* formed the ordinary currency, along with gold *fanams* of low value and silver *larins* shaped like a fish hook and probably introduced from Persia. All these were in ordinary use till the end of the eighteenth century. In 1697 a *larin* would purchase about 300 coconuts, so that its purchasing power at the time was equivalent to that of a sovereign to-day.

The Portuguese struck a few coins during the first half of the seventeenth century, and their mint is said to have been within the Fort of Galle. These coins are distinguished by the letters C.–L.°, standing for Ceylão, but the majority of the coins in use under them were imported from Goa and Malacca. Their issues were found in gold, silver, copper, and lead.

The Portuguese Settlements on the coast were occupied by the Dutch in 1646–1656; the earliest of their coins is the Batavian copper half-stuiver of 1644. Except for an issue of thick copper stuivers, and its fractions stamped "ST" within a wreath, the early

* See Mr. Still's article on Roman Coins, Journal, R. A. S., 1907, Vol. XIX., p. 161.

currency of the Dutch was minted in Europe. They consist of a few gold ducats, ducatoons, half-ducatoons, ten-, six-, two-, and one-stuiver pieces in silver, and duits and half-duits in copper. These last show on the obverse the monogram "V. O. C." (Vereenighte Oost Indische Compagnie—United East India Company), and on the reverse the arms of the State by which they were issued, namely, Holland, Zealand, Finland, Gelderland, Utrecht, &c. A series of coarsely executed two-stuiver and one-stuiver copper pieces and a few leaden duits were issued locally, the handiwork of the native smiths; the metal was greatly debased, and the currency in a state of confusion. A paper currency of six denominations, the highest being ten rix-dollars, was issued in 1796, in which year the Dutch Settlements were ceded to the British.

Perhaps the most curious of their coins was the heavy ingot, weighing 913·75 grains, and stamped at either end, which is shown in the illustration. The local issue usually bears the initial letter of the place of issue, viz., Colombo, Galle, Trincomalee, and Jaffna.

The first issue of the English coins, which was in silver and copper, was a slight improvement on the thick Dutch coins, and showed an elephant on the obverse and the legend "Ceylon Government" with the value on the reverse. Fresh types on the European model were issued in 1802 and 1815, both issues being struck in England; a silver *fanam*, $\frac{3}{8}$ inch in diameter, was issued in 1820 and a silver rix-dollar in 1821.

The present currency consists of the silver rupee and its decimal fractions, the cent being in copper and the five-cent piece in nickel. There is a paper currency, of which the highest denomination is Rs. 1,000. The sovereign is also legal currency at Rs. 15.

Among the foreign coins found in the country are the Chinese, and, as might be expected, a vast variety of Indian issues. Among the rarest are those bearing the fish device of the Pandiyans, the tiger of the Cholians, the lion of the Cheras, or the bull of the Setu Pathis of Ramnad. The beautiful Venetian sequins are still met with, but as they are in great demand among silversmiths for the high quality of the gold, their number is rapidly decreasing. Along with the coins are exhibited some oblong copper plaques of great antiquity, showing the figure of a man (see Plate XXXIII.). Their use is still a matter of conjecture.

For further information on Ceylon coins see Professor Rhys Davids in the Numismata Orientalia, Van der Chijs de Munten van der Nederlandsche Indie, and Descripçao Geral e Historica das Moedas Cunhadas, por A. C. Teixeira de Aragao.

Case 43.

Man in all ages and in all countries has ever craved for a stimulant or a sedative, and with the Sinhalese the stimulant took the form of the leaf of the *betel* vine; this is chewed with a few slices of the arecanut and a little lime. Case 43 contains an exhibit of the various articles used in connection with this dainty. Perhaps the most striking of these are the large bags of handsome embroidery, almost a lost art among the Sinhalese, which used to be carried filled with the leaf and slung over the back of an attendant when on long journeys. Then follow the metal chunam boxes for holding the lime, varying in size from the copper box ten inches across to the

silver trifle half an inch wide. Some of them are works of considerable beauty, showing great skill and taste in their ornamentation of silver and bronze, and in their variety of shape and outline. Attached to them in every case by a short chain is an ornamental metal rod, flattened at the end, and which is used for extracting the lime. Below are the nut slicers of steel, inlaid with silver or brass and of every variety of fanciful shapes. Even toothless old age is not debarred from the joys of this stimulant, and every old man carries at his waist a small mortar with an ivory-handled pestle to assist in the mastication of the hard nut. The first act of courtesy to be shown to a villager at a Sinhalese house is to place before him the betel leaf, neatly arranged with the other necessary ingredients on a stand of lacquered wood or metal. (See Plate XXXIV.)

Case 44.

In this small table case are shown a few ancient Sinhalese iron implements obtained from the buried cities of Ceylon. Most of these implements are shown at the bottom of Case 46. Sir Robert Hadfield, who has investigated these instruments, is of the opinion that the Sinhalese must have possessed a comparatively high degree of metallurgical knowledge more than a thousand years ago, and he has stated that this collection of ancient tools and instruments is the most complete of its kind in the world.

Case 45.

A man and woman of the Veddas, the aboriginal hunting caste or hill tribe of Ceylon. The bark-cloth bag hanging against the side of the case is made from the bark of the upas tree, *Antiaris toxicaria*, called *riti* in Sinhalese, *metavil* in Tamil, belonging to the same natural order (*Urticaceæ*) as the breadfruit and jakfruit trees.

The Veddas used to be an interesting race of forest haunting nomads, but they are rapidly falling victims to civilization, exchanging their ancient skill as bowmen and woodmen for a more sordid if less precarious existence dwindling towards extinction.

They are chiefly to be found in the Province of Uva, but it is possible to tramp through the Province from top to bottom without seeing a sign of a Vedda. Occasionally persons are paraded as Veddas, but when seen away from their natural environment the effect must be pitiful rather than picturesque.

Case 46.

This case is mainly devoted to brassware. On top are spittoons and kettles. Inside are drinking vessels and other domestic utensils of various kinds. In the table cases there is a fine collection of Dutch and Kandyan tobacco boxes, articles of native dress, and embroidered and painted cloths. There is also a small collection of articles made from tortoiseshell. In the base of the case is a set of elephant bells and a large series of ancient implements, the best of which are represented in Case 44.

Spittoons formed an important portion of the domestic economy of the betel-chewing Sinhalese. They vary in size from the tall brass article four feet in height, which is used by the rich man as he lies in his bed, to the tiny silver vessel, a few inches high, which is

depicted on the table of the Council Chamber of the Dutch Governor at the reception of the Sinhalese Ambassadors in 1772. It is interesting to note that among the articles plundered from the Sinhalese palace at Cotta in 1551 by the Portuguese Viceroy Don, are enumerated spittoons of gold. The large kettles which are placed by the side of these on the show case are chiefly in use at gatherings of Buddhist priests. A brass pot ranks amidst the most cherished possessions of the Tamil inhabitants. According to Oriental custom, the Sinhalese used to take their food seated on the ground on a mat, the plate of food being, in the case of the wealthy, placed on an ornamental brass stand a foot in height. Water is the sole drink of the Buddhist, and according to custom this was drunk by pouring the water into the mouth without allowing the vessel to come into contact with the lips. A large variety of brass pots, chiefly of modern Kandyan workmanship, are shown in Case 46.

Most of the tobacco boxes have been made from Dutch designs, and some of them have been actually manufactured in Holland, whence they were brought during the Dutch administration. The Kandyan tobacco boxes are copied from the Dutch boxes, but the ornamental design is generally pure Kandyan. (See Plates XXXV., XXXVI., and XXXVII.)

Case 47.

The upper part of the case contains a variety of articles used in Buddhist religious ceremonies, such as temple oil vessels, ceremonial goblets, begging bowls. A beautiful ceremonial mango is worthy of special mention. This mango is made of pale alloy crowned by a mounting of yellow brass, bedecked with crystals, and terminated by a high knob carrying a hook. On each side there is a figure of a mythical bird called *garuda*, and below these an incised bo-leaf design. The mango ends in a lotus flower with a crystal centre. It is hollow, and contains loose pellets which rattle when carried about. Along the lower concave border there is a cleft, as in the *pattini* bangles and anklets, through which the pellets can be seen. This mango is said to have come from the Seven Korales, where it was carried in procession at the Pattini dewalas.

The table cases are mainly devoted to the accessories of ancient superstitious and magic ceremonies, charms, and horoscopes.

Magic ceremonies, including astrology and divination, charms and amulets, and the propitiation of devas, evil spirits, and planetary gods were common at one time among the Sinhalese. The Sinhalese, it appears, acquired a knowledge of some of the primitive ceremonies from the aboriginal inhabitants of the Island, and cultivated magic as a branch of study, supplementing the original forms with those derived from the people of the neighbouring countries. Sinhalese magic in time developed a distinctive character. The forms of ceremonies derived from various sources appear to have been kept fairly distinct. Buddhism distinctly discouraged the practice of magic, but at times, when the religious ideals of the people had deteriorated, magic ceremonies became popular. Charms and ceremonies are performed for various purposes, such as (*a*) for curing diseases, (*b*) warding off disease and ill-luck, (*c*) promoting health and success, (*d*) counteracting evil influence directed by others, (*e*) causing evil to others, (*f*) foretelling events, and generally for the purpose of divination.

Pancanga Lita (Chart of Heavens).—This gives the position of the planets and certain of the stars on each day of the year. It is consulted by people before undertaking any serious work, such as sowing, planting, and agricultural operations, starting on journeys, building houses, commencing studies, &c. The charts were calculated and written on ola leaves. Since the introduction of printing these are printed.

Avurudu Sittuwa (Memoranda on New Year Ceremonies).—The New Year is observed with much ceremony; a special chart is calculated, giving the time of the commencement of the New Year and various hours for bathing, cooking, receiving visitors, travelling, transacting business, for religious ceremonies, viewing the moon, &c. Among other things the chart details the prospects of the ensuing twelve months in the affairs of the Island and the world in general. These memoranda, too, were inscribed in ola leaves. The ola is now displaced by the printed sheet.

Velápatkade (the piece of leaf with the chronicle of time).—This is a record of the time of the birth of a person, with a few particulars as to the prospects of the sun, moon, and planets at the time of birth.

Handahanpata (the recorded leaf).—This practically is the horoscope, which records the time of birth and the position of planets at the time of birth and the details as to their various aspects. The horoscope is usually inscribed carefully on a prepared leaf of the talipot palm. It is neatly written, with ornamental diagrams giving the disposition of the planets.

Yantra are usually diagrams, figures, and letters drawn on sheets of metal, leaf, or paper, used for various purposes of magic. A *yantra* after it is drawn is charmed with an appropriate invocation repeated many times. This process is known as *jivama*, or the giving of animation, power, or life to the object to serve the purpose for which it is intended. Each *yantra* has its own diagram and symbols and its own appropriate *mantara*. (See Plate XXXVIII.)

The *yantra* may be inscribed on metal, palm leaf, or paper, and these may be enclosed in a *yantra* case, which is attached to the waist or wrist. When a *yantra* is intended to produce evil influences it is necessarily charmed in private, but when it is for a good influence or curative purpose the repetition of the charm or *jivama* is done openly, and is frequently attended with some ceremony.

Sivali Yantra is an adaptation of an incident in Buddhist lore for the purpose of magic ceremonies, and this *yantra* is supposed to bring prosperity and luck to the person possessing it.

Ratana Yantra.—The *Ra'ana Sutta* of the *Sutta Pitaka* is in great repute among the Sinhalese Buddhists as one the repetition of which brings them protection from evil. A *yantra* is made by inscribing this on metal leaf or paper with suitable ornamentation.

A second series of *yantra* are those containing the figures of Brahma, Vishnu, Siva Kali, Indra, Visvakarma, Laksmi, Mahikanta, &c., with appropriate letters and charms. *Yantra* with the figures of Kali and with those of a large number of *yaksa* are also met with in the ola-leaf *yantra* books. A very numerous series of *yantra* are those dealing with the figures and symbols of the planetary gods. There are other *yantras* which contain only geometrical figures.

Amulets are made from a variety of materials, and are worn as a protection from evil influences, and for warding off disease, and also as a protection from wild animals, evil spirits, &c.

The following are shown in the middle section of the east side of Case 47 :—

Leopard claws, made into a pendant, usually worn around the neck as a protection against evil spirits. (See Plate XXXVIII.)

Wild-boar tusk.—The wild boar is supposed to be an abode of evil spirits. The tusk is worn as a charm against evil spirits.

Rings made in the shape of snakes are worn as a protection from the evil eye.

Dedications.—Various forms of votive offerings are made at the temples of gods (devala). The offerings of food, clothes, banners, lights, and lamps are quite common. Gold and silver chains and ornaments are offered on special occasions. There is also a class of offerings made to redeem vows, either when starting on agricultural or industrial pursuits or for curing diseases : ploughs, knives, hoes, and grain stacks made of silver are promised and offered if success results. Models in silver of houses, carpenters' tools, boats, are also met with. Images, and models of eyes, ears, nose, arms, legs, feet, fingers, toes, &c., made of silver are offered in redeeming vows, which are usually made when a person suffers from any illness of body or any part of the body.

There are also offerings made of ornaments appertaining to the different devas in special thank-offerings, such as armlets, bracelets, swords, tridents, anklets, &c. Each deva has his own set of ornaments.

Pattini worship is found both in the Kandyan districts and the Low-country of Ceylon, and also in the Tamil districts. The ornaments devoted to the goddess are the anklet, the mango fruit, and the silk shawl.

Vishnu is believed to be the special guardian deva of Ceylon, and many offerings and vows are made to this deva ; the temples and images dedicated to Vishnu are held in esteem. The principal temple for Vishnu worship was at Devundara (Dondra Head). The ornaments of Vishnu deva consist of vari-coloured garments and the five weapons *pancayudha :* the chank, the wheel, the sword, the dagger, and the *chatra*.

Skanda.—The temple of Skanda Deva is situated in Kataragama, which is a place of pilgrimage. He is described as possessing six heads and twelve arms, and his ornaments and weapons are as follows : (1) golden sword, (2) golden bow, (3) arrow, (4) short axe, (5) shield, (6) hook, (7) wheel, (8) lance, (9) trident, (10) serpent, (11) banner, with the figure of a cock, (12) pearl umbrella.

Sumana.—The deva of Samanala (Adam's Peak) is believed to be the special guardian of Sabaragamuwa. His ornaments consist of a white elephant and a golden bow and arrow.

In the left hand part of Case 47 (east side) the following votive offerings are shown :—

Clay votive tablets, model of bo tree, silver images, coils of silver wire representing the height of the persons on whose behalf they were offered, and an outrigger canoe.

Lamps.

A fine collection of hanging lamps is seen suspended from the ceiling of Room E, and several standard lamps are found on the top of Case 47.

Prior to the introduction of petroleum, oils extracted from the coconut and some other wild products of the country formed the sole illuminant in use among the Sinhalese. Their lamps were almost exclusively made of brass, and could either be suspended or placed on a stand ; both these kinds are well represented. It is of interest to note that in the case of the hanging lamps the container is placed above the level of the wick, the oil trickling down through a small opening which communicates with the latter. That these lamps have been largely influenced in their design by the Arabs and Portuguese seems apparent. For instance, the dove shown in the illustration is such as one would expect to find in a Christian church ; several hundred Portuguese prisoners were employed as artisans under the Sinhalese kings at the beginning of the seventeenth century.

The tall standards are usually employed in temples, and frequently bear the device of the god to which they are dedicated, *e.g.*, the peacock. These lamps consist of two tiers of wicks with a receptacle at the bottom for any oil which might overflow ; some are made adjustable by a simple screw device, and others can be suspended by means of a massive and ornamental chain, crowned with a small canopy. Some of these lamps are of considerable beauty, the wick holders resting upon well-wrought branches. Among the lamps are shown specimens of the kind used in the ceremonial of the Hindu temple. These are meant to contain a large number of wicks in shallow receptacles, and the whole, when lit, is waved before the sacred image and the oil poured on the ground. (See Plates XXXIX. and XL.)

EAST VERANDAH (Room E).

The stone carvings here were excavated from Maligawatta, Cotta. Kotte Jayawardhanapura was built *circa* 1356–71, and became the seat of Government 1391–1581.

There is also a stone carved pillar (1410–15 A.D.) from the king's palace at Gampola, presented by Mr. T. B. Yatawara, Ratemahatmaya of Udapalata.

STAIRCASE.

On the landing of the main staircase in the Central Hall there are two cases containing china. Most of the contents of these cases have been lent by Mrs. Meaden, Mr. E. B. Denham, C.C.S., Mr. Paul Pieris, C.C.S., Mr. H. P. Beling, and Dr. C. T. van Geyzel. No porcelain of any value has been made in Ceylon. During the Dutch period vast quantities of Chinese porcelain were introduced. At present the valuable pieces that still remain in the country are mainly of Chinese manufacture. Since the British occupation many of the best kinds of English china have been introduced. In order to make this collection as educative as possible it has been thought advisable to display specimens of all the well known kinds of china and porcelain, even though they have no historic connection with Ceylon.

A painted Hindu cloth is shown at the head of the main staircase.

Sigiriya Frescoes.

On the walls flanking the main staircase will be found copies of the celebrated frescoes discovered in a cave or pocket of the ancient rock fortress of Sigiriya near Dambulla. Sigiriya, the lion rock, rises abruptly from the plains of the North-Central Province to a height of about four hundred feet, with an area of little more than an acre at the summit. It is said to have been fortified by the Sinhalese parricide King Kasyapa, who ascended the throne 475 A.D., and fled to the rock after having immured his father King Dhatu Sen, whose capital was Anuradhapura. Kasyapa made Sigiriya his capital, and took refuge there for eighteen years.

On the western face of the rock chambers have been scooped out, and in one of these, 160 feet from the ground, protected from sun and rain, frescoes were painted upon stucco plastered upon the smooth surface, and still remain in an excellent state

of preservation. The ancient approaches to the summit and to the chambers having fallen into decay, the rock once more became nearly inaccessible and, according to local tradition, the haunt of *yakku* or demons. It was however tackled by more than one adventurous climber during the latter half of last century, and in June, 1889, Mr. A. Murray, of the Public Works Department, succeeded in reaching the pocket containing the frescoes, and in making the tracings of them, which he coloured as nearly as possible like the originals. He has left it upon record that the work of copying took him from sunrise to sunset every day for a week, lying at full length on his back. A Buddhist priest who visited the chamber gave it as his opinion that the pictures must be the portraits of some of King Kasyapa's queens. The portraits are arranged singly and in couples, the latter representing a maid offering the sacred lotus on a tray to her mistress.

During the last fifteen years excavations have been carried on at Sigiriya under the direction of the Archæological Commissioner, and fresh copies of the frescoes have been made under his supervision in oil colours, and these are now exhibited in the Museum alongside the copies referred to above.

LIBRARY.

Ola Manuscripts.

The art of writing was known to the Sinhalese as early as 543 B.C., when, according to the *Mahavansa*, their ancient historical work, they colonized Ceylon and became known by the name "Sinhala;" for, it is stated in that chronicle that their first king, Vijaya (543–505 B.C.), sent a letter to his father Sinhabahu, who was reigning at Sinhapura in Lata (Larike of Ptolemy, a country comprising Kandesh and a part of Gujarat), requesting him that he would send his brother Sumitta to succeed him in his kingdom. The material upon which this letter was written was probably an ola (Tamil, *olai*, "palm-leaf"), *i.e.*, leaf of the palmyra (Sinhalese, *tal*) or talipot (Sinhalese, *tala*), which existed in Ceylon from the earliest times, and the use of the ola for writing on was very probably introduced to Ceylon by Vijaya and his men.

The olas used by the Tamils are prepared from the dried young leaves of the palmyra tree, which abounds in the northern part of Ceylon, and are narrower and less durable than talipot leaves.

Palmyra leaves are never used by the Sinhalese for books of any importance.

The olas used by the Sinhalese are the leaves of the talipot tree, which grows abundantly in the up-country, whence the supply required for the low-country is obtained. This was probably the material employed when the text and commentaries of the Buddhist scriptures were committed to writing in 81 B.C. at Aluvihare, in Matale, Ceylon, and it was also probably the material used by the Venerable Mahinda when he wrote his commentaries on the *Tripitaka* in Sinhalese (307–258 B.C.), and by Buddhaghosa Thera when he translated them into *Pali* (410–432 A.D.).

These olas are prepared from the tender leaves by boiling them in water, and afterwards drying them slowly in the sun and shade. Before boiling, the central ribs of the leaves are removed, separating each leaf into two strips, and these strips are made up into rolls. When sufficiently boiled, the strips are unfolded and put in the sun for a day or two, then exposed to dew for a night, then rolled up again and kept for some time, after which they are re-opened, washed, and dried again in the sun. These operations are repeated until they attain the standard thickness and quality, when they are rolled up and kept in a dry place, such as a loft over a fireplace. These prepared leaves, called *puskola* (*lit.* "blank leaves"), are sold at about a rupee a hundred. Before they are utilized for books they are polished by drawing them backwards and forwards over a clean smooth trunk of the arecanut tree, or *valla* tree (*Gyrinops valla*), which is specially prepared for the purpose, the leaves being damped during the operation. Two such trunks, one over the other,

are also used when it is desired to have both sides of the leaves polished at the same time. The leaves are finally dried in the sun and cut to pieces of required lengths. These pieces, called *pat-iru* (*lit.* "leaves sections"), are each provided with two equidistant round holes, one towards each end, and after pressing them together by means of two side boards provided with corresponding holes and passing an iron nail or a piece of stick through each set of holes, they are trimmed to bring them to equal size, and their sides are then slightly singed with a red hot iron to remove fibres and coarseness, and besmeared with a dye to remove the charred appearance. This block of leaves, called *puhu-potgediya* (*lit.* "blank book block"), is kept in a dry place, and leaves are taken from it by the copyist as he requires them.

The leaves are written upon with an iron style* (16 inches long), called *ulkatuva* (*lit.* "pointed instrument"), or *panhinda* (*lit.* "leaf needle"), the writing point being made of good steel. The student of Sinhalese, who is taught to write almost at the commencement of his studies, writes first on a sand board, then on palmyra leaves, then on dried ripe talipot leaves called *karakola*, and lastly on prepared talipot leaves (*puskola*). In copying a book a set of sixteen leaves, called *pat-kattuva* (*lit.* "collection of leaves"), which is the number of leaves a clever copyist is able to write in a day, is held by the left hand of the copyist, the leaves being loosely strung by the two sets of holes, and letters are cut or scratched upon the surface of the leaf with the style held with the thumb, fore finger, middle finger, and ring finger of the right hand (somewhat in the fashion of holding a pen), and supported by a nick cut at the tip of the left hand thumb nail to keep the style in position. The set of leaves is moved to the left by means of the thumb of the left hand as the writer proceeds. An English writer has remarked: "Singhalese writing is very neat and small, and it is wonderful to see what straight lines are produced by writers who have no support for the strip except their own left hand." Copyists are paid at the rate of about fifteen cents a leaf, twenty inches long, with seven or eight lines to a page.

The writing is blackened with a pigment composed of resin oil and powdered charcoal of *gedumba* wood (*Trema orientalis*), or burnt rags, the pages being afterwards well cleaned with rice bran and a piece of cloth. The book is then protected on the two sides by painted boards, of the size of the pages, provided with holes corresponding with those of the pages, and a long thread, generally of different colours, is passed through the set of holes on the left hand side of the leaves and the board and tightly wound round, the end of the thread on the side of the beginning of the book being attached to a button (called *kasiya*), generally made of metal. It is then wrapped in one or two large handkerchiefs or pieces of good cloth and kept in a box or almirah.

The consecutive order, as well as the number of each leaf, is indicated by a consonant written on the left hand margin of the first page of the leaf. When all the consonants combined with vowels have been used in their consecutive order, they are repeated with a Sinhalese figure affixed to them, indicating the number of times the same consonant has been used.

* Styles are made of other metals also, and some are highly ornamental and set with gems. (See Plate XLI.)

Marks of punctuation are very few, and *kundali* ( ), the principal of them, is used generally at the end of a paragraph, and at the commencement and close of a quotation or a stanza. The words are not separated.

For the most important books, such as the text and commentaries of the Buddhist scriptures, and other voluminous religious works, leaves of the largest dimensions are used, the longest used being generally two feet three inches and the broadest three inches; nine or ten lines are generally written on a page. Shorter and narrower leaves are employed for scientific and poetical works, and the small pieces which are not suitable for books are utilized for writing short notes and letters.

A book written on well-prepared talipot olas will last more than a thousand years. The age of the oldest books now extant in Ceylon is about 500 years, absence of older manuscripts being due to the destruction which the Sinhalese literature has suffered from time to time. The oldest manuscript found in India is one on talipot leaves (with the writing in ink), and is dated in 1132 A.D.

The Sinhalese ola manuscripts are some of the best in the world, and rank next to Burmese manuscripts (which are also on talipot leaves) in point of durability. The following observation has been made by Dr. A. C. Burnell :—

" The meanness which is so characteristic of S. India displays itself conspicuously in the MSS. written there. It is very seldom that the least attempt is made (except in Malabar) to trim the leaves and to provide proper covers for them. In Ceylon, Burma, and Indo-China, on the other hand, the palm-leaf MSS. are always beautifully written, and are often real works of art. In S. India, MSS. are hung up in the kitchen chimney; in the Ceylon monasteries I observed that each one of importance is preserved carefully in a box made for the purpose and to fit the MS."

All the manuscripts of this library, with a few exceptions, are written on talipot olas, the exceptions being a few palmyra ola books, such as the *Hilekammitiya* (a register of paddy fields in Uva, 123 leaves) and the Dutch, Sinhalese, and Tamil Vocabulary (words of each language being written in its own characters, 83 leaves); one paper manuscript of the *Diyasevul Sandesaya* ("Water cocks' message," a Sinhalese poem), and a copy of the *Satipatthana* (a discourse of Buddha) on twenty-four copper leaves with wooden side boards covered with brass.

Most of the manuscripts are in Sinhalese characters and are locally made; the largest portion of the rest, consisting of books of the *Tripitaka*, the *Milinda Panha* (questions on Buddhism of King Milinda—identified with Menander—and replies thereto by Nagasena Thera), and the *Mahavansa* and *Dipavansa* (two histories of Ceylon composed in Ceylon), the *Mahavansa Tika* (a commentary on the *Mahavansa*, also composed in Ceylon),* and a few other religious works, are in Burmese characters; the remainder, consisting of the *Mahavansa* and the *Mahavansa Tika*, presented by Her late Majesty Queen Victoria's Consul at Bankok, and the *Mangalatthattha Dipani* (a commentary on *Mangala Sutta*, a discourse of Buddha), are in Cambodian characters.

* All these, which are with gilt edges, were presented by His late Majesty the King of Burma.

There are a few Tamil ola manuscripts recently presented to the Library. No attempt to collect Tamil manuscripts has been made, as the Tamil language belongs to Southern India, and all the important works in that language are those composed there.

The manuscripts locally made consist of works in the Sinhalese, Pali, and Sanskrit languages. Those in Pali relate mostly to Buddhism and grammar, and predominate the rest in bulk owing to the Buddhist text, the commentaries (*Atthakathas*) thereon, and the scholia (*Tikas*) on the *Atthakathas*.

The *Atthakathas* (Sinhalese, *atuva*) are the voluminous translations made by Buddhaghosa Thera, the Indian Buddhist monk (410–432 A.D.), from the Sinhalese commentaries by Mahinda Maha Thera (307–258 B.C.), who introduced Buddhism to Ceylon, and the *Tikas* are works subsequently composed by erudite monks of Ceylon, India, and Burma. Of grammatical works, some were composed in India and Burma.

The Sinhalese works consist of prose translations of religious works in Pali, a few historical prose works, all of which are based on the *Mahavansa* and *Dipavansa*, and poems, most of which embody *Jataka* stories.

The works in Sanskrit, the least in number, are mostly on medicine, astrology, grammar, and other scientific subjects, and are generally provided with Sinhalese paraphrases, as most of the Pali works are. They are books mostly composed in India. The larger number of books of the series of ancient Sinhalese readers, including the *Amarakosha* (composed in India), are in Sanskrit and with Sinhalese paraphrases.

The authors of these works were mostly Buddhist monks, who were generally teachers of the laymen, both in religion and letters. The Sinhalese kings, who were generally proficient in Sinhalese, Pali, and Sanskrit, as well as in the sixty-four Oriental arts and sciences, were also authors of several important works.

The most voluminous work in Pali is the *Jatakatthakatha* (*i.e.*, the commentary on the *Jatakas*), and in Sinhalese its translation, commonly known as the *Jatakapota*.

MUSEUM COMPOUND.

Stone Antiquities.

Owing to lack of room in the Stone Gallery, several stone antiquities have been temporarily housed in a palm-thatched shed at the back of the Museum. Chief among these is the large sedent Toluwela Buddha from Nuwarawewa tank at Anuradhapura. Writing about this fine specimen, Mr. H. C. P. Bell, the Archæological Commissioner of Ceylon, says :—

"This Buddha is admittedly the finest yet brought to light at Anuradhapura. In mere size it yields to the seated Buddha of the outer circle, which measures 7 feet 6 inches in height by 7 feet across the knees. But in other respects it surpasses all three statues near the Jetawanarama. The wonderful sharpness and depth of the features, the softness of expression, the symmetry and repose of the

body, give the image a *tout ensemble* which contrasts markedly with the stolid "figure-head" appearance so characteristic of these Buddhas in stone. The eyelids, under-lips, and ears are carved with a life-like reality not reached in the case of the other Buddhas already known. The nose is chipped, but so slightly as to be practically unnoticeable from the front. The fingers are somewhat worn, and there are a few cracks. A peculiarity of the head is a rectangular block, 10 inches by $4\frac{1}{2}$ inches, at the back. One would be tempted to dub this a *konde*, or hair-knot, but for the curly hair, close cut as usual. Possibly it may have connected the statue with the back wall. The *sirespota*, not improbably of gold, is, as might be expected, missing. (See Plate XLII.)

In front of the Buddha is a unique floral moonstone from Hanguranketa of admirable design, embossed with wreaths, festoons, and garlands, and a pair of fabulous creatures (*makaras*) at the sides, and a pair of two-fold representatives of the *sripatula* or sacred footprints of Buddha near the base. This moonstone is unique, and differs from the conventional type found in the ancient cities of Ceylon.

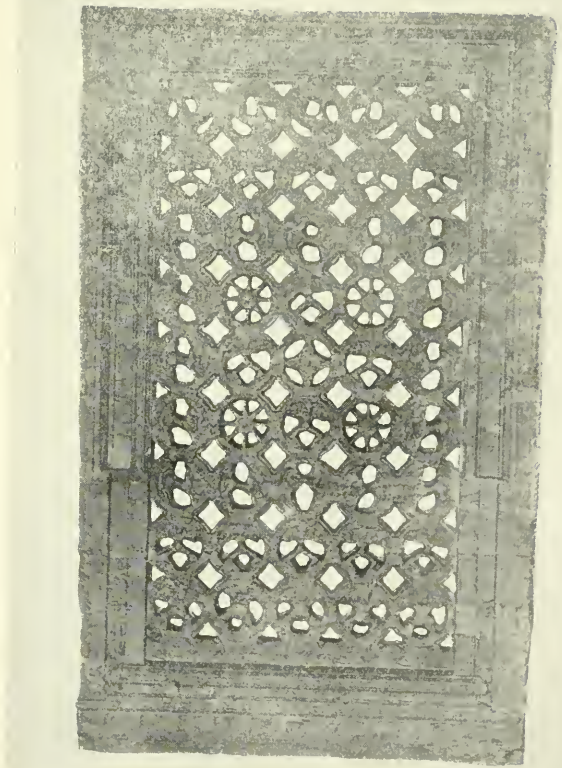
There is also a collection of stones from Anuradhapura near the Buddha shed.

On the lawn near the Library is seen a square-based stylobate, each side of which is ornamented by several elephant heads. This handsome structure was discovered near Anuradhapura by the Archæological Commissioner in 1894. It was erected in the grounds of the office of the Archæological Commissioner in Anuradhapura, and in 1911 transferred to the Colombo Museum. Originally a Buddhist rail probably surmounted the four sides of the base. It is not known what rested on the top. (See Plate XLIII.)

PLATE I. — LION OF POLONNARUWA (ROOM A).

PLATE II. — MEDAGODA PILLAR (STONE GALLERY).

PLATE III. — LOTUS PILLAR (ROOM A).



YÁPAHU STONE WINDOW (ROOM A).

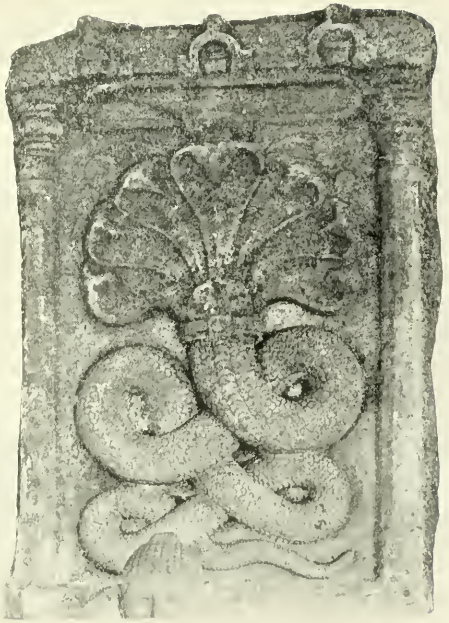


PLATE IV. — JANITOR, LOTUS STONE PILLAR.

NÁGA-GALA (COBRA STONE).

(ALL IN ROOM A.)

PLATE V. — THE GODDESS KÁLI (ROOM A).

CAPITAL OF PILLAR FROM THÚPÁRÁMA (ROOM A).

PLATE VI. — PEṬIGAMMANA PILLAR (ROOM A, WEST VERANDAH).

PLATE VII. — BRONZE AMPHYLLA. THREE-BRANCHED CANDELABRUM. BRONZE DRINKING GOBLET.

(ALL IN CASE 1.)

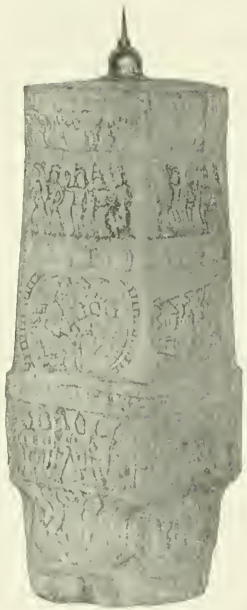


PLATE VIII. — BRONZE SEDENT BUDDHA (CASE 5).

MAHA MÉRU GALA (CASE 47).

PLATE IX. — MISCELLANEOUS BRONZES (CASE 7).

PLATE X. — SIVA AS NAṬA-RÁJÁ (CASE 15).

PLATE XI. — TIRU-GÁNNA-SAMBANDHA SWÁMI ; SÚRIYA, THE SUN-GOD ; AND TWO FIGURES OF APPARSWÁMI (CASES 6 AND 11).

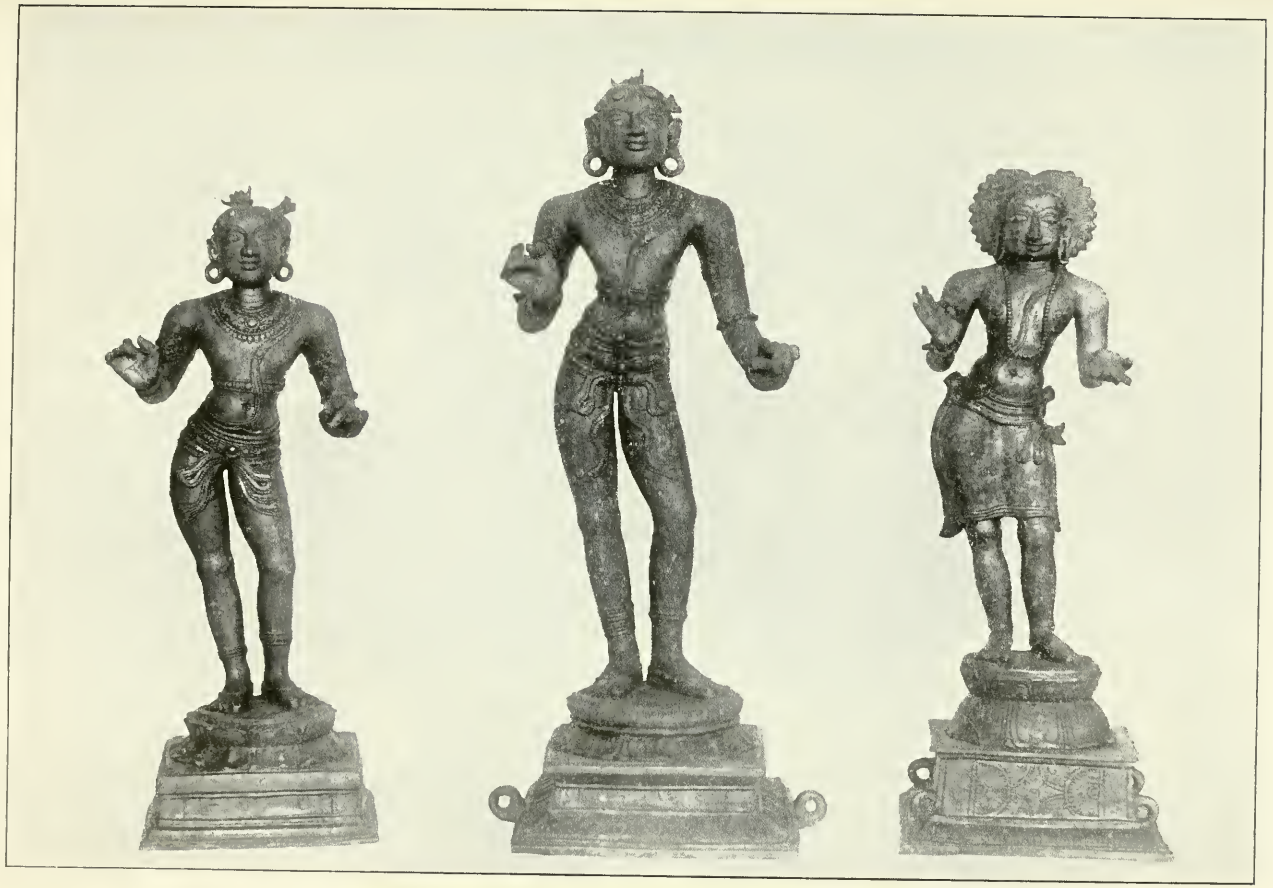


PLATE XII. — TWO FIGURES OF SUNDARA MÚRTI SWÁMI (CASE 12). MANIKKA-VACHAKA SWÁMI (CASE 12).

PLATE XIII. — TWO FIGURES OF PARVATI, CONSORT OF SIVA (CASES 2 AND 3).

PLATE XIV. — SIVA AS NAṬA-RÁJÁ (CASE 14).

PLATE XV. —SIVA WITH HIS CONSORT PÁRVATI (CASE 11).

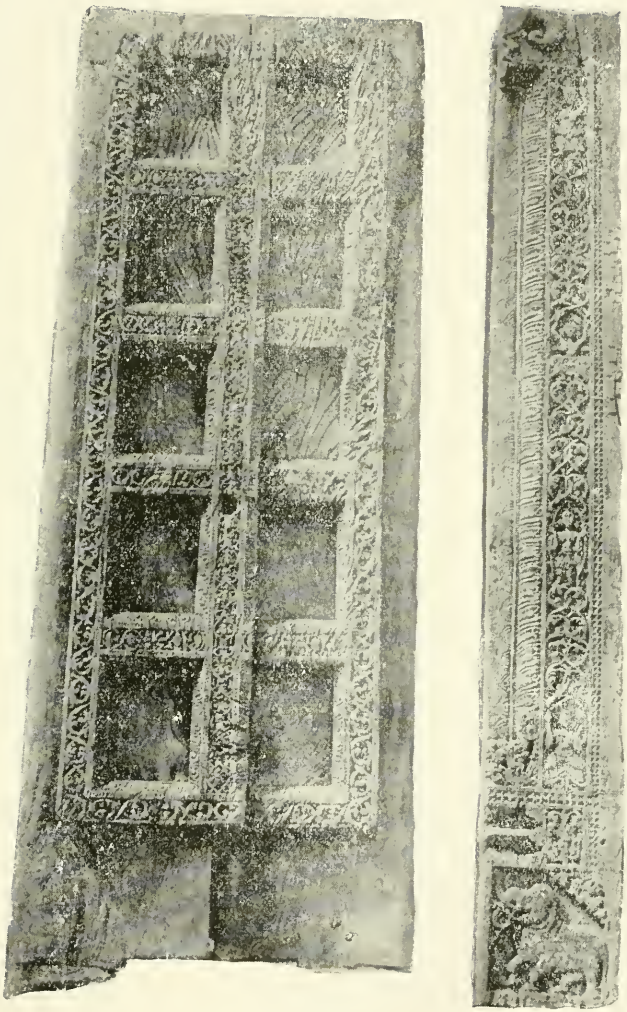


PLATE XVI. — WOODEN DOOR AND JAMB FROM DEVANÁGALA VIHÁRÉ (ROOM B, NORTH VERANDAH).

PLATE XVII. — SWORDS, DAGGERS, AND POWDER HORNS (ROOM C).

PLATE XVIII. — CARVED IVORIES (CASE 16).

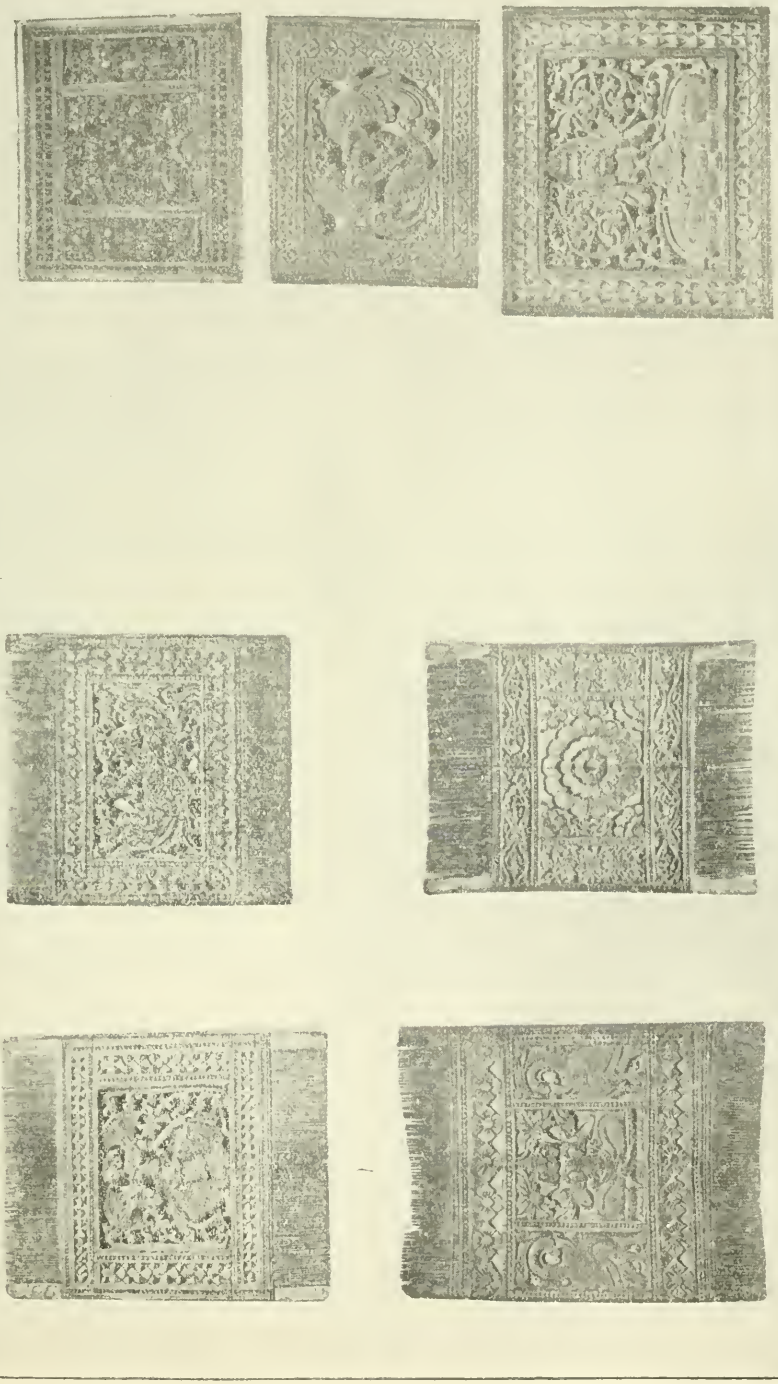


PLATE XIX. — IVORY COMBS AND PANELS (CASE 21).

PLATE XX. — FLAG OF KANDY.

PLATE XXI. — MALDIVIAN LACQUERED LACE STAND (CASE 32).

PLATE XXII. — EXAMPLES OF MALDIVIAN LACQUER WORK (CASE 32).

PLATE XXIII. — BRONZE LAMP (CASE 10).

BASE OF EARTHENWARE LAMP (CASE 26).

PLATE XXIV — EXAMPLES OF NATIVE POTTERY (CASE 27).

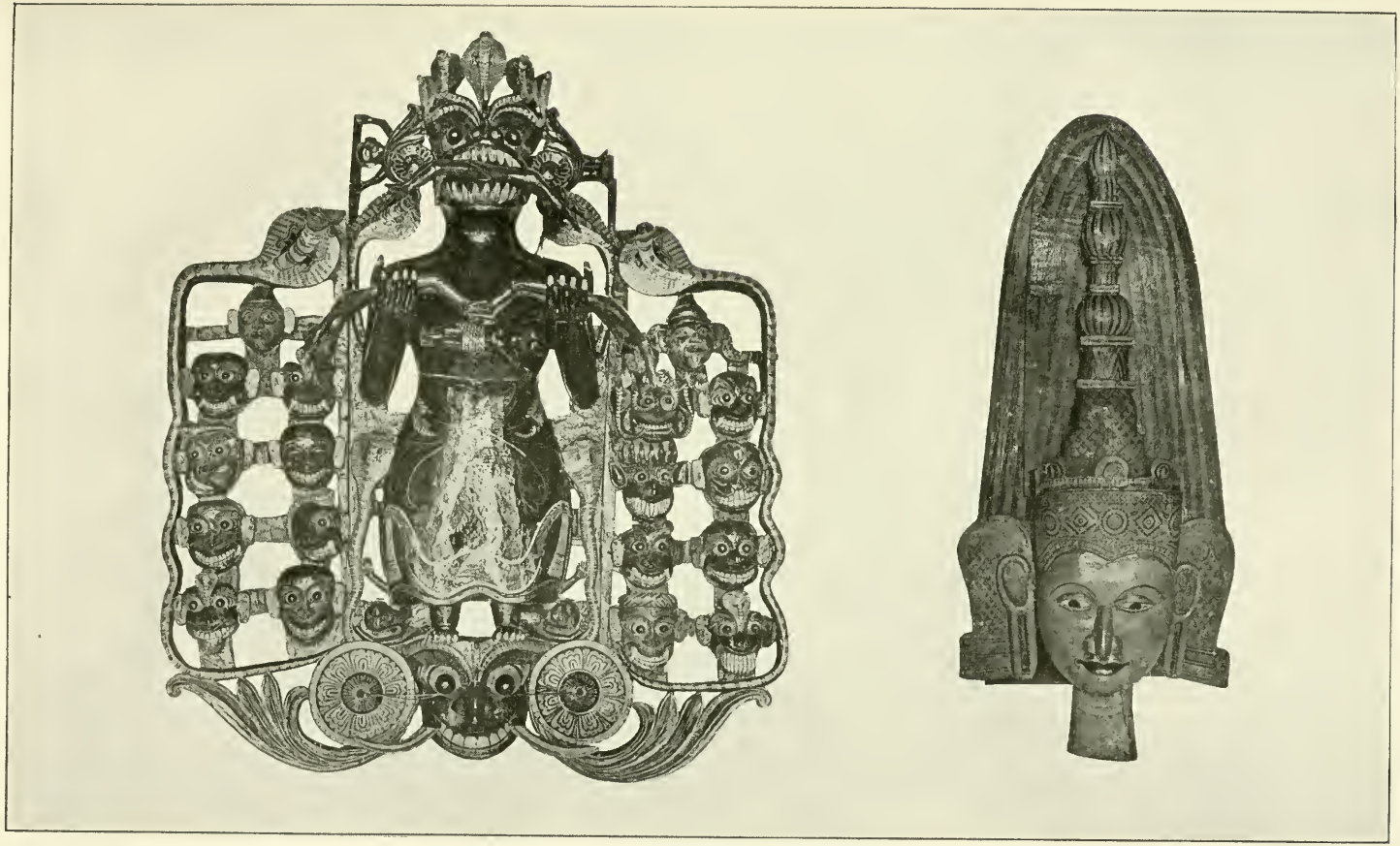


PLATE XXV. — SANNIYAN YAKSA (CASE 29).

MASK WORN AT MASKED PANTOMIME (CASE 28).

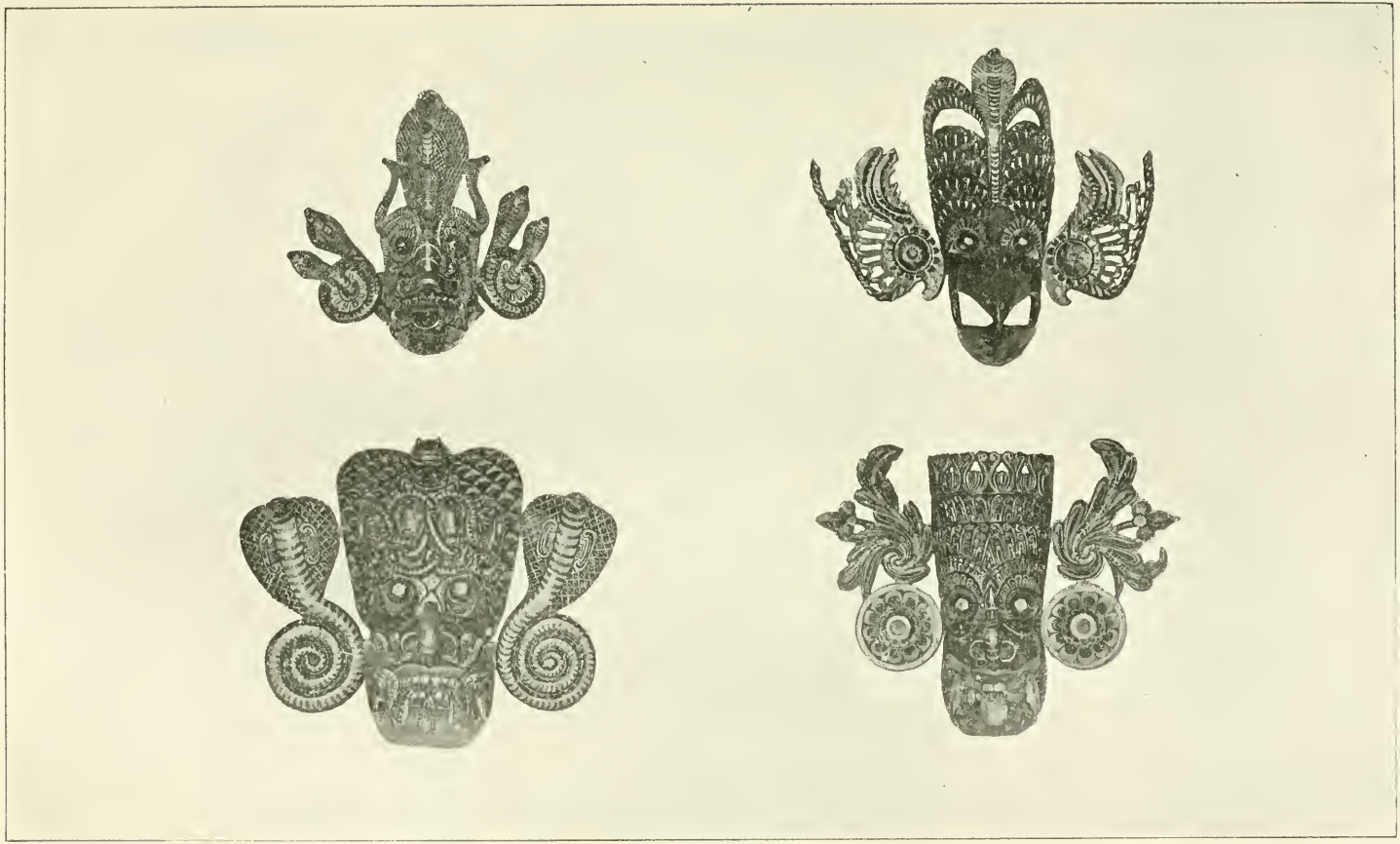


PLATE XXVI. — MASKS WORN BY DEVIL DANCERS (CASE 28).

PLATE XXVII. — HEAD DRESS, MASKS, AND ORNAMENTS WORN IN NATIVE DANCES (CASES 28 AND 29).

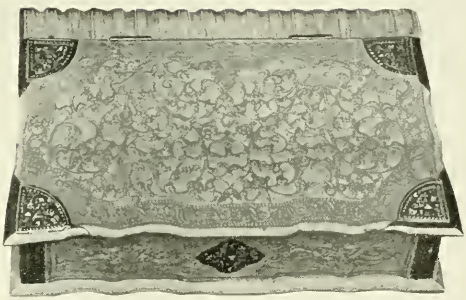


PLATE XXVIII.—SILVER SCENT SPRINKLER AND CUP (CASE 42); CARVED IVORY BOX (CASE 22); AND VARIOUS ARTICLES USED IN DEMON CEREMONIES (CASE 28).

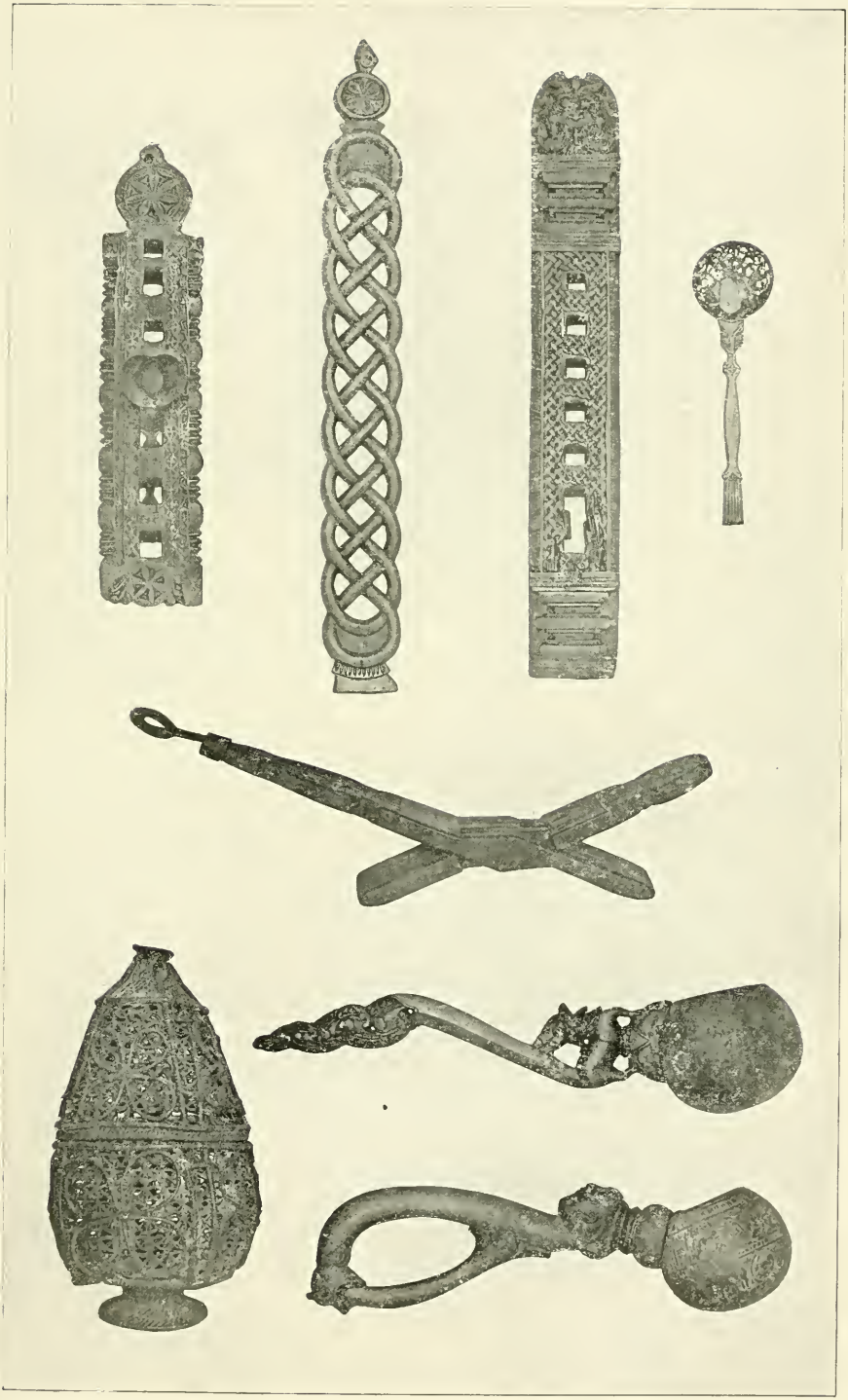
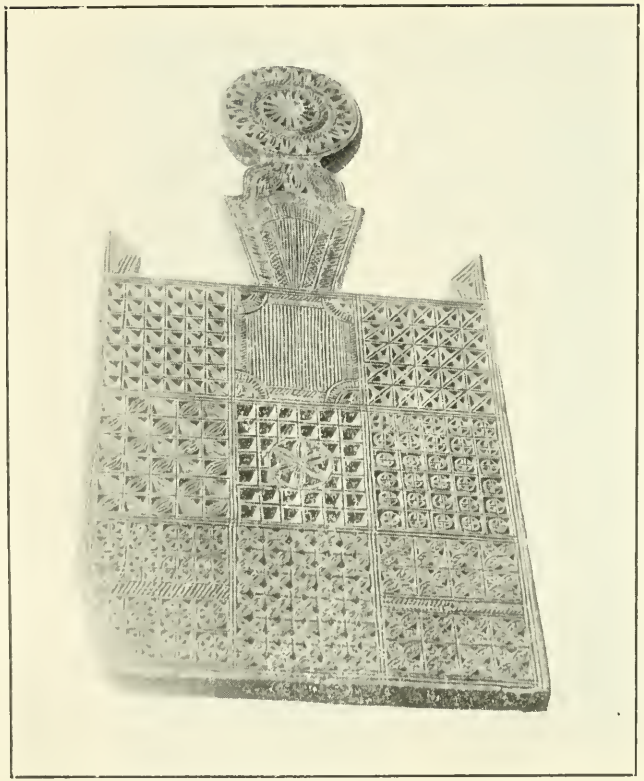


PLATE XXIX. — SPOONS AND SPOON RACKS, COCONUT SCRAPER, AND RATTAN BASKET (CASE 34).



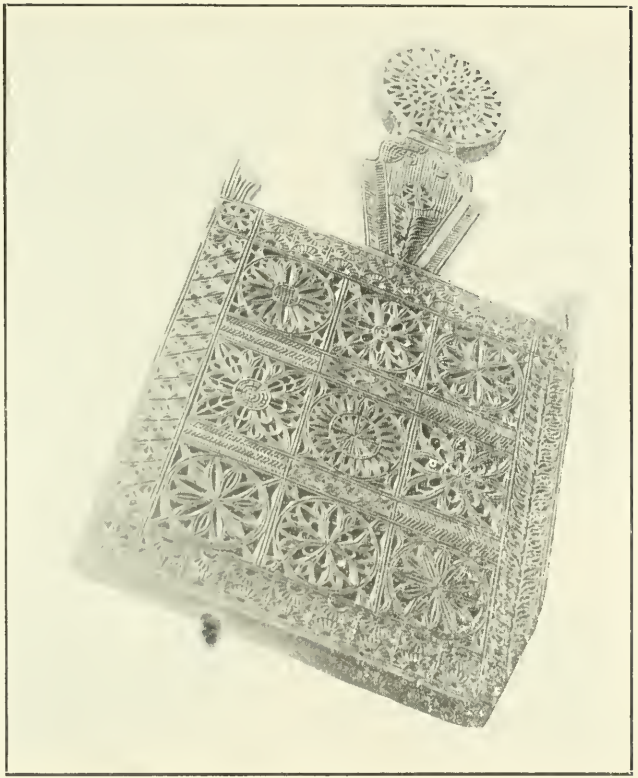
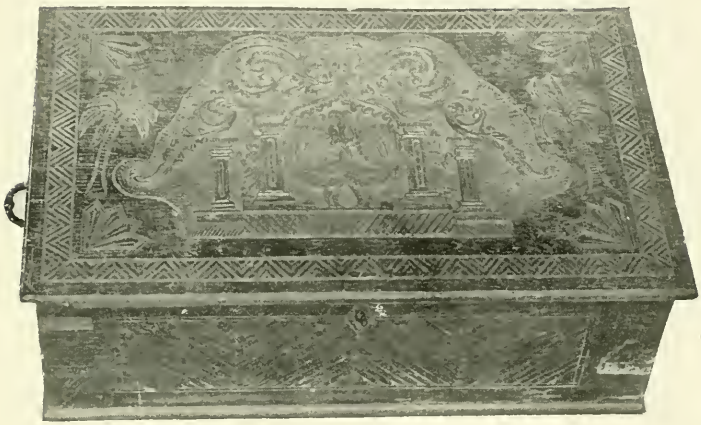
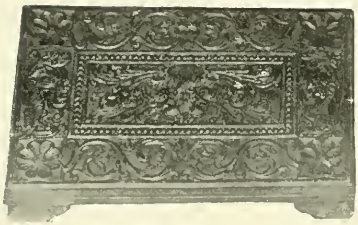


PLATE XXX. — SWEETMEAT MOULDS (CASE 34).





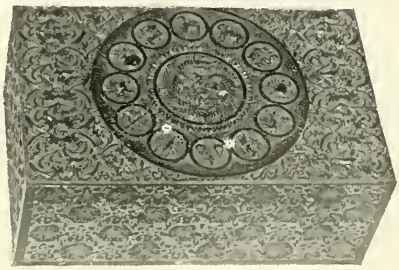


PLATE XXXI. — CHONKA BOARD, JAGGERY MOULD, AND CARVED BOXES AND STOOL (CASE 35).

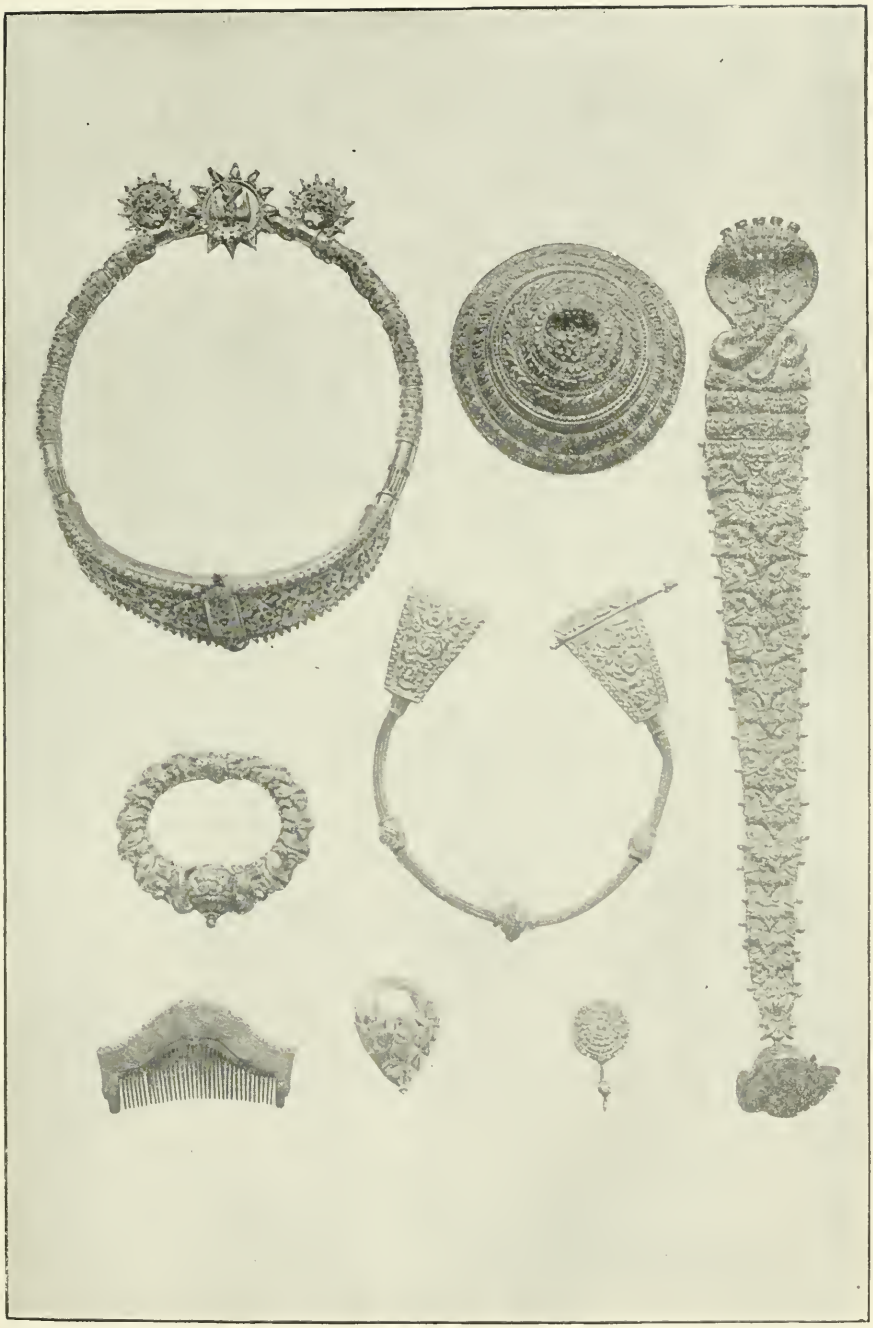


PLATE XXXII. — SINHALESE, TAMIL, AND MOORISH ORNAMENTS (ROOM E).

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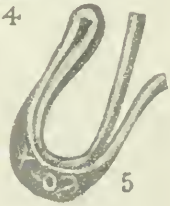

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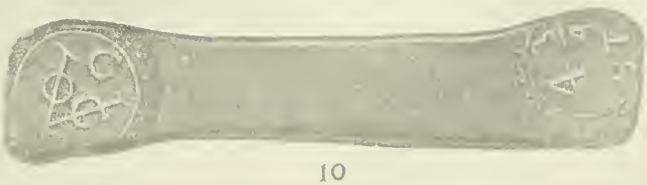

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PLATE XXXIII.—COINS (CASE 42).

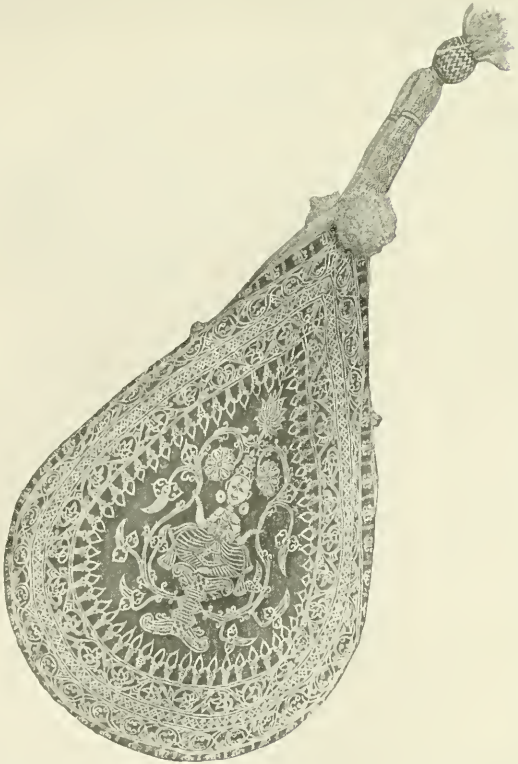


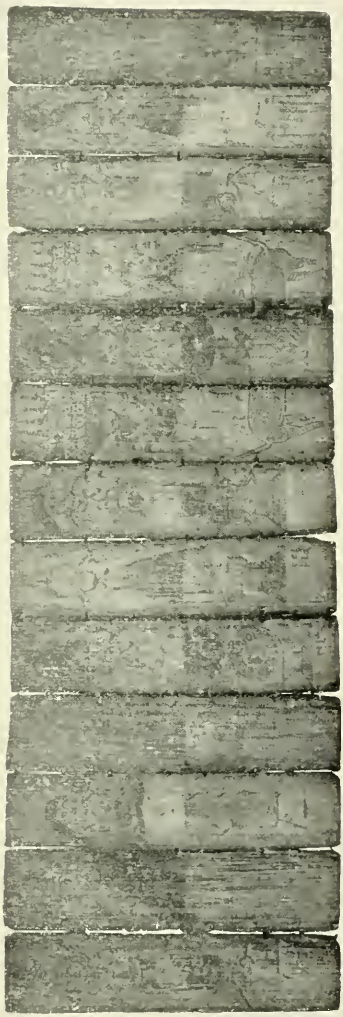
PLATE XXXIV. — EMBROIDERED BETEL BAG (CASE 43).

CHUNAM BOXES (CASE 43).

PLATE XXXV. — KETTLE, INCENSE BURNERS, AND DRINKING VESSEL (ROOM E).

PLATE XXXVI. — BRASS BOXES AND POTS (CASE 46).

PLATE XXXVII. — BRASS RICE STANDS AND SPITTOON ; BRONZE CEREMONIAL MANGO (ROOM E).



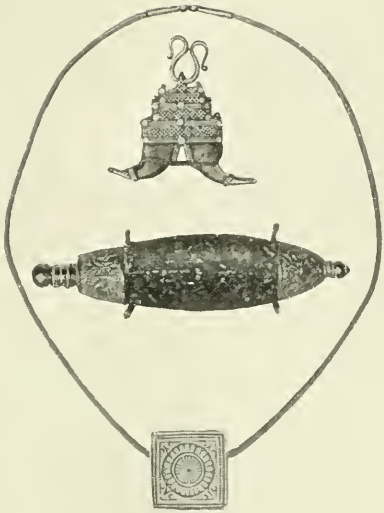


PLATE XXXVIII. — CHARMS (CASE 47).

PLATE XXXIX. — HANGING LAMP (ROOM E).

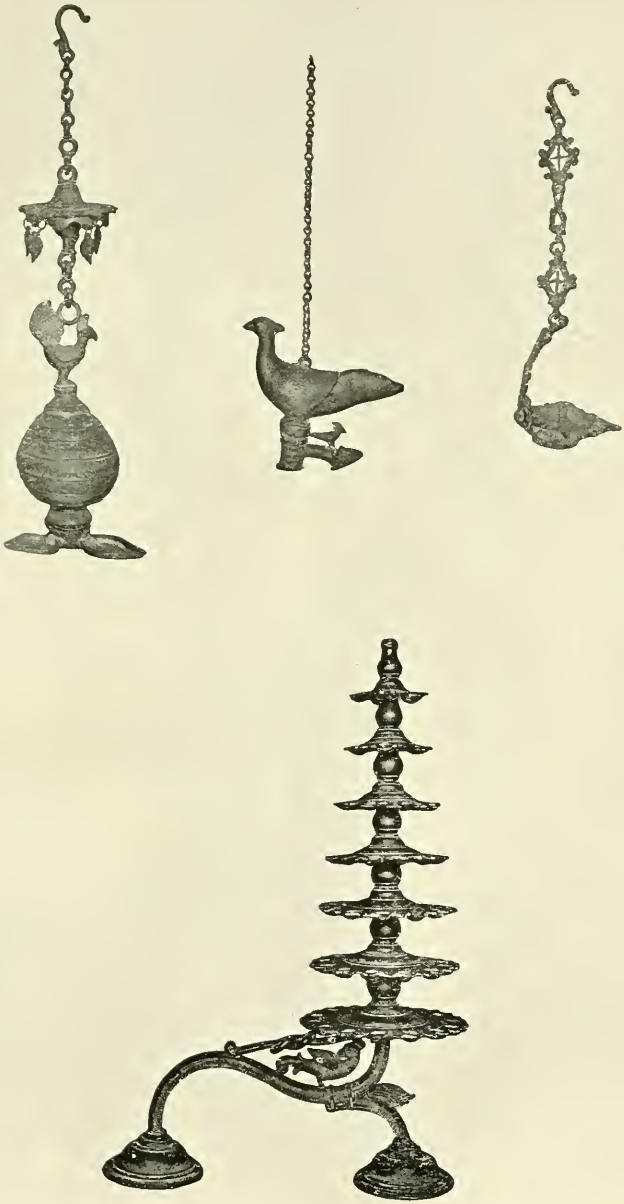


PLATE XL. — LAMPS (ROOM E).

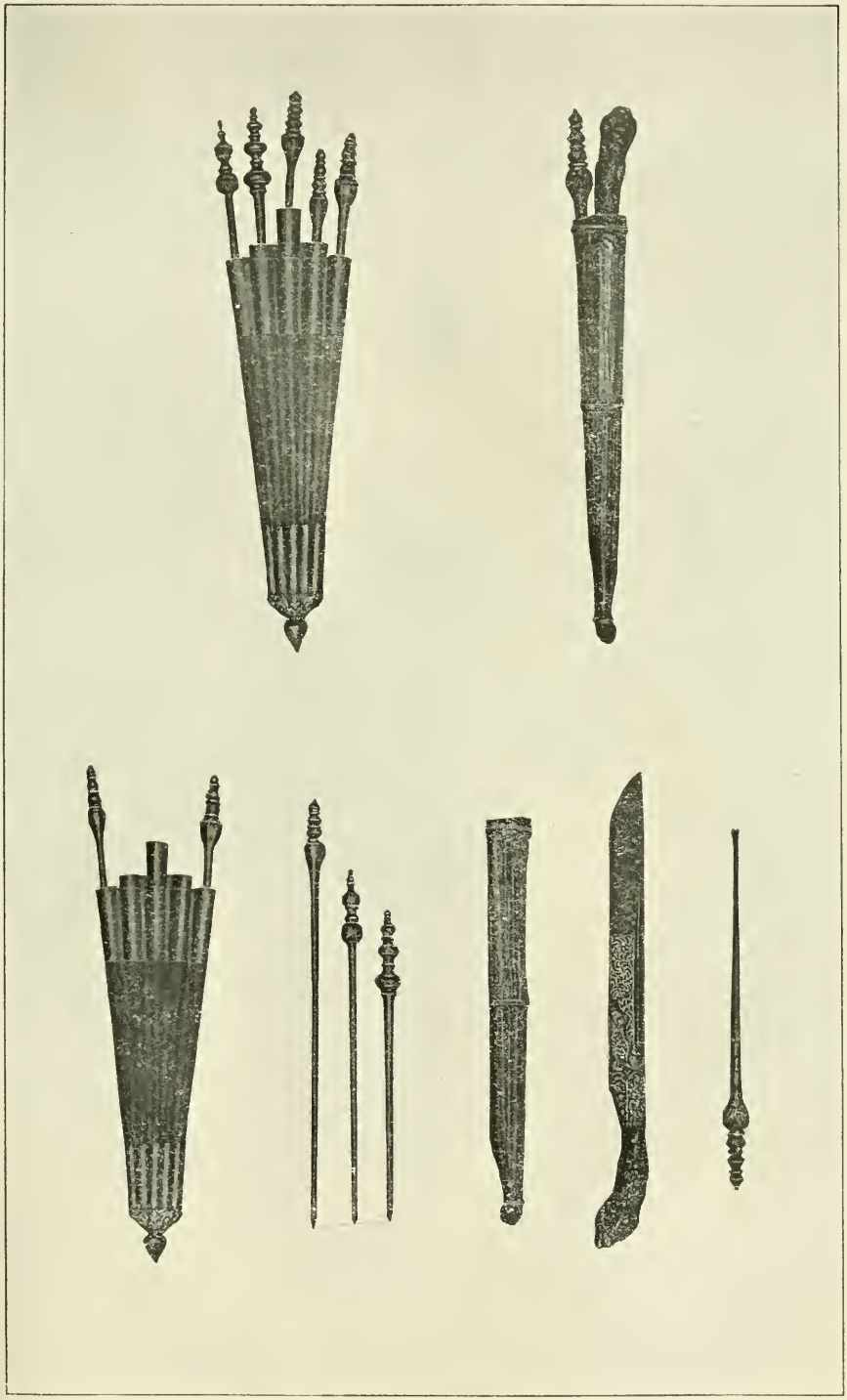


PLATE XLI. — OLA STYLI AND CASE; DAGGER, STYLUS, AND SHEATH (CASE 47).

PLATE XLII. — TOLUWELA BUDDHA (MUSEUM COMPOUND).

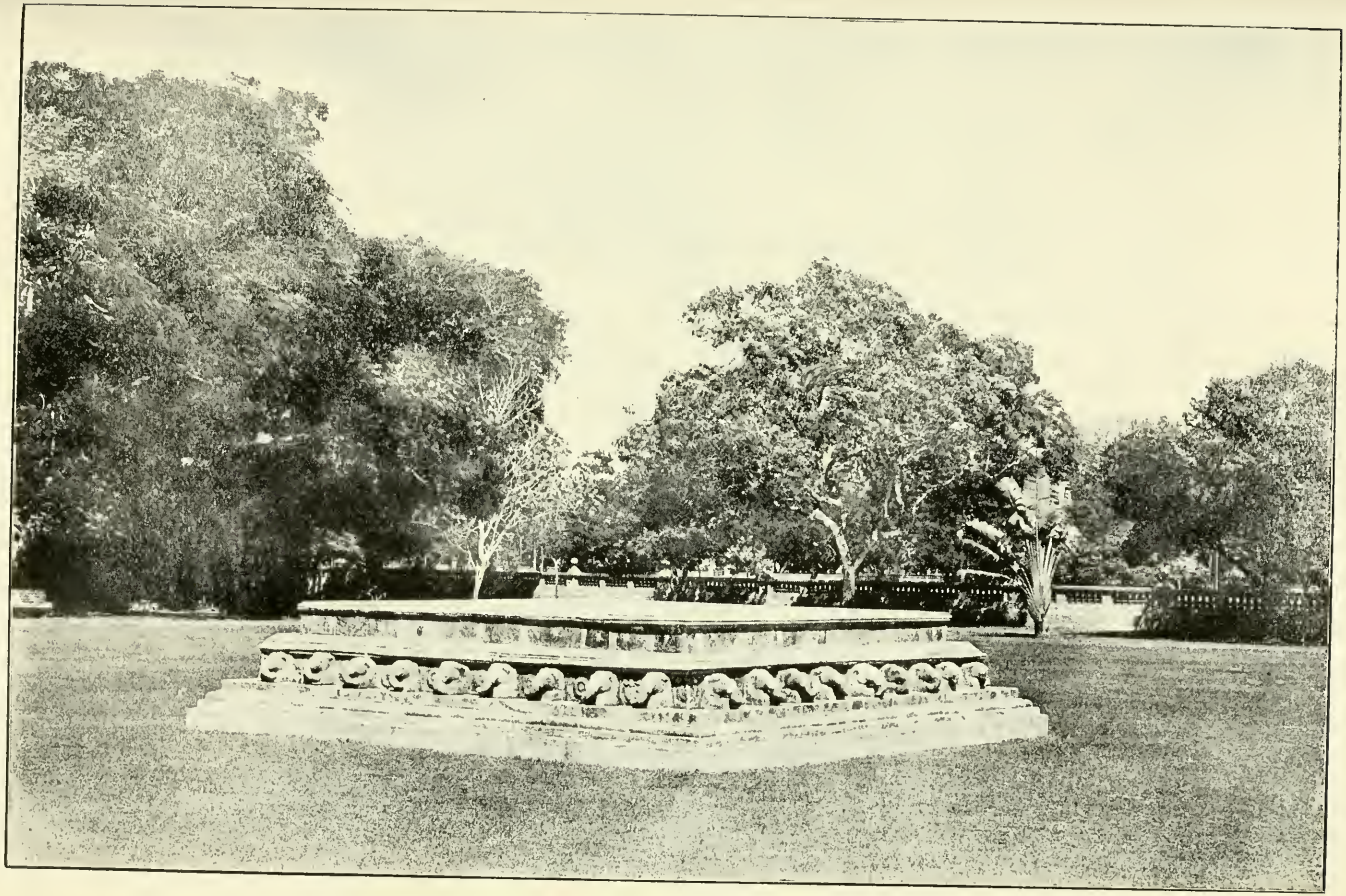


PLATE XLIII. — ELEPHANT STYLOBATE (MUSEUM COMPOUND).

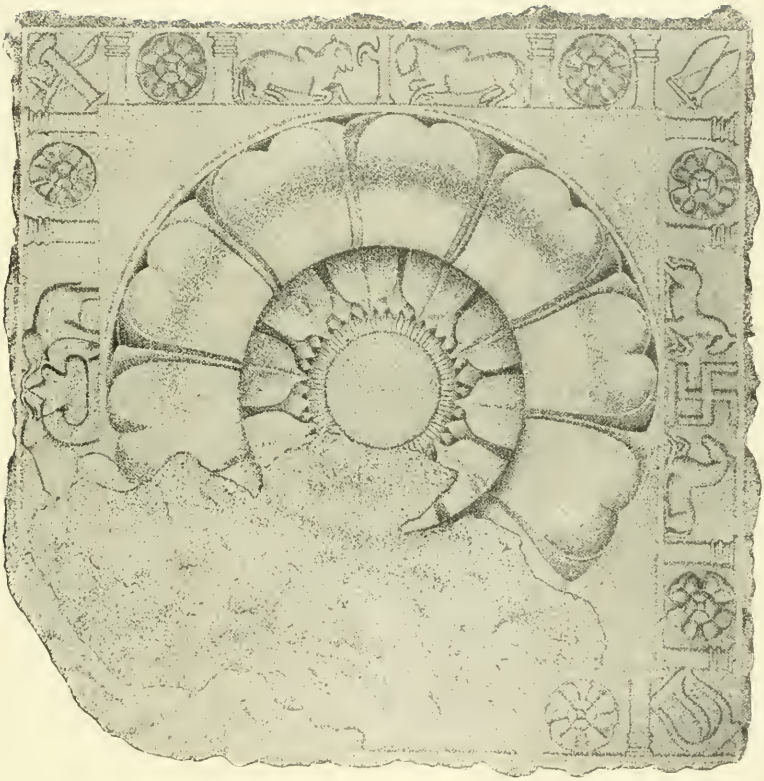


PLATE XLIV. — CARVED LOTUS FLOWER SLAB (MUSEUM COMPOUND).

THE CEYLON PEARL OYSTER FISHERIES.*

By Captain John A. Legge, F.R.G.S., A.R.I.N.A.,

Master Attendant and Joint Police Magistrate, Colombo, and Inspector of the Ceylon Pearl Banks.

THE paper which I am about to read you to-night is on the very interesting subject of the Pearl Oyster Fisheries of this Island, a subject that, besides a scientific interest, has a sporting and a romantic interest as well.

To begin with, the Ceylon pearl oyster is not an oyster at all, but a member of the family *Aviculidæ:* it is not confined to the waters of Ceylon, but is found in both the Persian Gulf and the seas of Japan, and in both places it is fished with profit.

I am neither competent, nor do I desire to talk highly, scientifically, or use the classic names of the shellfish about which we are talking to-night, but I will just explain the difference, as I understand it, between the edible oyster and the pearl oyster. The edible oyster adheres to rock or stone by means of a natural hard cement, whilst the pearl oyster attaches itself by means of a green string-like substance and is easily detached ; this substance is called its byssus, and as a matter of fact it would be impossible to fish up any quantity of edible oysters by the methods in vogue at a Ceylon pearl fishery. If any of you desire to confirm this you have only to walk to the end of the South-west Breakwater, of course in the north-east monsoon, if you do not desire to get wet, when you will see the edible oyster in large numbers adhering to the structure.

Tradition has it that King Solomon obtained some of his pearls from our fishing grounds, whilst Phœnicians are credited with adventuring as far as Ceylon to obtain its pearls; this, anyone who has seen the traces left by them on the Cornish moors in their search for copper and their lines of defences and fortified camps, all of pre-Roman period, can well believe would not have been beyond their adventurous disposition. Again, the pearls Cleopatra dissolved and drank are credited with a Ceylonese origin.

Tradition has it that in the times of the Tamil power in Ceylon the fisheries were of frequent occurrence ; and it is stated that they were watched over, to prevent robbery by the divers, by a Tamil princess, who was carried to the end of the Karaittivu Point and there enthroned to remain until the fishery was over.

* A Paper read before the Ceylon Natural History Society on Wednesday, October 9, 1912.

The Karaittivu Point ends in a long sandspit now nearly all submerged, but in those days doubtless it was high and dry, in which case it ran right up to the largest of our present-day pearl banks and lends somewhat to the support of the tale of our princess's business capacity and her doubts as to the honesty of the divers she employed.

We now come to the Portuguese control of the pearl banks, but they left little record, if any, of their fisheries ; they seem to have fished more banks than we are able to now, and it is reported they held a fishery off Mount Lavinia.

Apropos of the Portuguese fishery off Mount Lavinia, the following is an experience of my own when searching for pearl oysters.

In March, 1905, some fishermen dredging for prawns off Mount Lavinia brought up two oysters, in one of which was a pearl ; this was sold for Rs. 10, but finding that the purchaser had disposed of the pearl almost at once for Rs. 60, the fisherman complained to the Government Agent, Mr. Fowler. He gave the oyster shells and the story to the Principal Collector of Customs, Mr. Jackson, who told me. I took a launch and diving apparatus one morning and proceeded to the spot, as near as the fisher headman could indicate it ; I then proceeded to descend, but in a short time I found I was getting no air. I found also that I could not reach the life line to signal to be pulled up, and I had ascertained before descending that the depth was over 75 feet. Well, I reached the bottom, and was just able to make out that it was all soft sand and no oysters to be seen, when I made a great gasp for breath, and the whole of my chest frame seemed to cave right in. I felt furiously angry, and rather like taking gas at the dentist's, and then I became unconscious. I recovered consciousness on being pulled to the surface, and on examining the air pump—which, by the way, was twenty-three years old—we found that after a certain depth, when the pressure increased beyond a certain amount, the air instead of going down the rubber air pipe escaped into the atmosphere through the valves of the pump ; that was a narrow but not such a very unpleasant squeak as it sounds.

Following the Portuguese we have the Dutch, who left many of their terms, specially in the valuation of the samples taken to ascertain if a fishery would prove lucrative.

After the Dutch we come to our own domination of Ceylon and its pearl fisheries. In the British time, the Master Attendant of Colombo has been until 1903, and is now again, the Inspector of the Pearl Banks, whilst the Government Agent of the Northern Province was the Superintendent of Pearl Fisheries.

Until recent years a good deal of mystery was purposely allowed to enshroud the pearl banks practically ; no beacons or marks were erected on the shore, and the difficulties of locating any banks were increased wherever possible, whether to prevent poaching or not

I am unable to say; but it certainly added to the romance of the work, and the public were undoubtedly disposed to regard the advent of a pearl fishery much as we regard the Derby sweep. It, however, always brings a rich harvest to the poor but hardworking inhabitants of the Northern Province.

In the early part of the last century fisheries appear to have been few and far between, one interval being as long as, I think, thirty-seven years. James Steuart, Master Attendant of Colombo and Inspector of Pearl Banks, and a brother of George Steuart, the founder of the Colombo firm of that name, gives us the first coherent accounts of the pearl banks and fisheries, and published a handbook upon them; but as in those days they were dependent on the wind entirely, and no steam vessels at first were available, you will readily understand that the annual inspections, if they were annual in those days, were long and arduous, and certainly entailed the loss of many a good bed of oysters.

One of the early British Governors built himself a residence on a convenient site, both to enable him to be present at the fisheries and to act as a beacon. This was called the Doric, after its style of architecture, but it has been long since condemned as unsafe by the Public Works Department and more or less demolished, only enough being left to act as a beacon, and a very good one it makes.

During the time of my predecessor, Captain Donnan, who was connected with the pearl banks for some forty-three years, there were periodical fisheries at varying intervals, but I can only find record of one pearl of very great value. This was a black pearl, which I believe was bought by Tiffany of New York for a sum of £5,000, but I am not quite sure of the figure.

I came out here at the time Professor Herdman had been imported to investigate the whole subject of the Ceylon pearl oyster. During his investigations he discovered many new species of marine life, one of which he did me the honour to name after me. It is a repulsive looking creature, like a cross between a nightmare and a lobster, and in such ways are our names handed down to posterity!

During that year's investigations we had the services of a European diver from the Colombo Harbour Works, and I seized the opportunity to personally descend in his dress and examine the sea bottom for myself; in fact, on one occasion I walked for four hours on the bottom with the boat drifting over the surface above me, and covered four miles in a more or less straight line.

The sensation in a diving dress is not unpleasant when you get over the feeling of helplessness and nervousness; whilst up on the pearl banks on a sunny day, where the water is always at that season of the year beautifully clear, the effects on the bottom are very beautiful. The weeds wave with a gentle languorous motion; everything is coloured a soft greenish hue; the fish show little, if any, fear of you, more, in fact, curiosity than fear.

The potential paars, or oyster beds, are formed by an amalgam of coarse granite sand and old oyster shells cemented together with coral lime; on these paars there is little, if any, movement of sand, and were it not for the fish that prey upon them the oysters would thrive. Immediately I walked off the paar I was upon very loose sand, in waves like giant furrows in a ploughed field; whilst for quite two feet high above the ground there was sand in suspension. Here oysters are covered up, buried, and destroyed immediately.

The coral is, as may be expected, varied and very beautiful; some are lovely white branches of the most delicate tracery; other coral I have seen with what looks like the tiniest small blue flower of a particularly beautiful deep blue; but, alas, with the death of this coral the colour fades away to white; then there is a rocky spot called by the Tamils *Ani-verlundun Paar*, or elephant's ear rock. Here the coral is enormously large, and shaped like an elephant's ear, or a large leaf, or, even better, the paper holder that a bouquet of flowers is contained in; these pieces of coral growth are frequently two or three feet across, and are very hard and difficult to break off the rock, to which they are attached anyhow, without injuring the delicate knife-like edge of the leaf. Tradition has it that this coral is the result of an elephant falling down on this spot.

The life of a Ceylon pearl oyster is not more than eight years, and from about its third year it seems to be more productive both in numbers and size of pearls. As a matter of fact, very few three-year old oysters contain pearls, or anyhow only pearls of minute size; whilst if a bed of oysters could be fished just as they were dying off with old age, the pearls obtained would be many and large. The oyster attains its largest size in circumference in its third or fourth year, due principally to its having a soft rough edge. This wears off very soon, whilst the oyster thickens in a marked degree and also increases in weight. True pearls, which are the result of a disease, and not due to the admission of foreign matter into the shell—though this does cause a form of misshapen pearl of no particular value—are formed in the intestines of the oyster, and when they reach such a size as to cause great discomfort to the oyster, the oyster either dies or, as I have observed, forces the pearl towards the opening between its valves, where the pearl is retained by an absolutely transparent substance or skin, and they have the appearance of being loose; but this is not so, as it is by no means easy to extract them with a match. I have a theory that, if the pearl continues to grow in this position, it eventually prevents the oyster from closing, and thus renders him an easy prey to his enemies, in which case either the oyster dies or expels the pearl into the sea. In either case the largest pearls would be lost. Very large pearls are rarely found on these Ceylon banks. A dead pearl is a curious thing to see; it loses its weight and becomes a dull brown. I saw one of a very large size.

In the year 1902 I obtained two pearls out of a common mussel attached to a buoy in this harbour, and it is curious that I have never found any mussels since here. These pearls were of a very delicate slatey blue colour and were of considerable size ; one was without a flaw and perfectly round, and the other, which was the larger, had a considerable flaw on its surface.

When a fishery is established, and the divers, &c., have arrived, they are divided into two parties and fish on alternate days. They are allotted one-third of their catch in payment, whilst Government auctions the remainder the same evening.

The oysters are then placed in private kottus, or enclosures, by their purchasers and allowed to rot for eight to ten days by merely placing them in a receptacle (generally a canoe, which is covered over to shade it from the rays of the sun and the light, but enables the flies to obtain free access), after which the contents are washed with a copious supply of clean water, and the shells, stones, and byssus, &c., picked out. The residue is then spread on a clean cloth to dry, during which operation it is carefully scrutinized and picked over again and again many times. I always used a length of black calico, on which pearls are much more easily distinguished than in the older method with a white cloth, and I also used a galvanized iron bath for the rotting process in preference to a wooden canoe. I tried brass tea sifters of various meshes, but found the old white muslin method the best and cheapest for sifting and straining.

The apparatus used for classing, &c., the pearls is a series of brass cullenders, about the size of tobacco ash trays, which are called baskets. They have holes in the bottom of each, each hole being of equal size in its own basket, thus making various meshed sieves ; the sieve with the largest-sized holes has twenty holes only, whilst that with the smallest holes has several hundreds ; there are generally ten or twelve of these sieves or baskets.

Pearls, as you know, vary in size from the almost indistinguishable minute seed pearl to the size of a large pea, and sometimes larger. The result of this is that whilst the larger pearls are all found in the course of sifting, the tiniest seed pearls are left in large numbers in the sand near the oyster-washing places, and for months after a fishery is over and the camp abandoned to desolation and jungle, men and women—mostly women—are met with searching the sands for these minute treasures ; and that they find these infinitesimal pearls cannot be doubted, as I doubt such patient perseverance without some adequate reward.

Seed pearls, namely, these minute specimens, are largely used by Indian princes, pounded up to powder to form the chunam for their betel-chewing, whilst, as the ladies present all know, what pretty embroidery and cluster necklaces they make.

Before a fishery is settled upon, the Inspector has in the previous November to lift a sample of about 20,000 oysters, extract the pearls in the manner I have explained, and have them valued. This is done by native Moormen jewellers, by secret hand-clasps under a cloth. After sifting and weighing the pearls through these brass sieves and on delicate scales, the value is fixed on the old Portuguese or Dutch coinage, and, finally, when the amount is estimated in the current coin of the realm, it is determined whether a fishery will pay.

As a matter of fact, the valuation come to is in very little relationship to the market value of the sample.

The examination and inspection of the pearl banks is carried out by native divers under the superintendence of the Inspector of Pearl Banks, who also checks and verifies the native divers' reports as to the nature of the bottom, number of oysters present, &c., and sometimes inspects himself in the diving dress.

The inspection boats, six-oared whalers, start from the windward side of the area to be inspected and work across the wind east and west, between the buoys, which a reference to the accompanying chart* will show, are laid down north and south, east and west, in such a manner as to direct the boats on their east and west course and prevent their getting out of position. Each coxswain is provided with a chart, on which the result of each dive is recorded with the soundings, the signs shown on the chart being used to represent the nature of the bottom, &c.

The smaller charts, known as "coxswain charts," are filled in by each coxswain as each dive is made, and they are transferred by the Inspector to the larger chart.

The Ceylon oyster is different from the Australian or Burma varieties, which are very large, and have beautiful nacre or mother-of-pearl, which is most valuable, and for which they are fished quite apart from the finding of pearls, whilst the Ceylon pearl oyster has little mother-of-pearl, and what it has is of small value commercially.

It is only possible to fish the Ceylon oyster from early in March until late in April.

All the facts collected during recent years serve to show that a spatfall on the Ceylon banks is dependent upon exotic larvæ which have been carried over from the Tuticorin side of the Gulf of Mannar. In a continuously strong monsoon such as we have been favoured with this year, but particularly during the months of July and August, a drift current of sufficient power and velocity may carry the pelagic larvæ, which float for about six days, from the Tuticorin banks to the banks on our side of the Gulf. In a weak monsoon, however, the larvæ never reach the Ceylon banks, since they are carried northwards and may be deposited on the other side of the Paumben Pass.

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*Not reproduced.

As regards predatory fish, the large ray or skate would seem among the worst. At the inspection in November, 1902, I decided that a certain bed was quite the gem of those to be fished in March, 1903; the oysters were larger and older than any others I had inspected, and were very plentiful; however, as I was passing over this spot on my way back at the end of the inspection, I observed a very large shoal of rays in the vicinity. In the following March, about the second week of the fishery, I moved to this my pet bed of oysters, only, however, to be told by the divers that there were no living oysters there. I at once descended in the diving dress and found the bottom of the sea strewn with empty oyster shells, each valve turned nacre upwards and shining, giving a very curious effect, whilst each shell or valve was broken obviously by external pressure into three pieces. This could only have been done by the powerful jaws and teeth of the ray.

The method employed by the native diver is this. At a fishery each boat contains ten divers, who work five at a time, and each pair has one attendant, called a manduck (as he does not enter the water it seems a misnomer to describe him as "man duck"); he also rows or sails the boat. In addition there is a tindal, a representative of the owner of the boat, and a peon or individual representing Government interests.

Each boat has five stone sinkers, sometimes rather shapely, having a hole at the upper end, to which the rope is attached; a second rope is attached to a small circular frame or hoop, which has a coir netting across it. This is called the basket. The local basket is shallow, but that of the Arab divers of the Persian Gulf has a small circumference but a deep net.

When the divers are ready, they get over the side, place one foot on the stone, which is held clear of the side of the boat by two poles fastened at right angles over the side of the boat and a third pole lashed to each end of them parallel to the boat. Grasping the rope to which the stone is fastened, and hitching the loop of the rope attached to the basket over his arm, the diver, closing his nostrils with his free hand, takes a deep breath, and slightly raising himself to add impetus to his descent, gives the signal to the manduck to let go the rope fastened to the stone, and down he goes. The instant he reaches the bottom he lets go the stone, which is hauled up preparatory to the next descent, whilst the diver swimming on the bottom with his eyes open grasps all the oysters within reach in the limited time at his disposal. I do not think I have seen anything more graceful than when I was on the bottom of the sea in the diving dress I watched these men at work. They seem to float much as a person is drawn in an imaginary picture as flying; their backs gracefully arched and their heels above their heads, whilst their generally long hair waves gracefully behind them supported by the water. Occasionally men either from avarice or over-estimation of

their strength collapse at the bottom and are brought up dead. There were several such cases in March, 1903, which, as I was the only European on the banks, I had to deal with as best I could with the "Shipmaster's Medical Guide" as my authority for the action to be taken.

One day a man came to me with a fearful sting from a jellyfish. He was in great pain, and the whole of the left side of his body was discoloured where the fish had stung him. I seized a bottle of castor oil, the only thing I could think of, and painted the spot with a copious covering of oil, and much was my pleasure when not only did it instantly relieve him, but he was even able to go on with his work.

Arab divers use a sort of horn clip with which to close their nostrils when under water, but the local and Indian diver holds his nostrils with his hand only until such time as he reaches the sea bottom.

I have timed many native divers, and the average time that a Tamil remains below is between fifty and sixty seconds, whilst an Arab remains under water between eighty and ninety seconds.

The diver signals to his attendant when he wishes to ascend, and is partially pulled up with his basket and rises partially by his own initiative. Diving bells were imported for the pearl fishery by Sir Edward Barnes in 1825, but neither they or a European diver in a diving dress can compete with the naked native.

The first fishery that we have any record of is I believe that of 1661, but no record of what the fishery brought in is to be found.

A fishery in 1808 appears to have resulted in £90,000, and one in 1804 in £75,000.

A table that I looked up in Steuart's book gives the amount of oysters fished in one boat in seven consecutive days as : the first day 25,000 oysters, second 23,000, third 55,000, fourth 10,500, fifth 19,000, sixth 20,500, and the seventh 25,200.

Of course, there was a certain amount of theft and rascality at the washing. To get the pearls, one favoured method was for one man, when he found a valuable pearl, to secrete it, whilst another man in the know would secrete an inferior pearl ; when the first man would inform against the second, who would be beaten, whilst in the commotion the other man would safely secure the good pearl.

The pearl oyster apparently selects, if he has any power of selection, the most suitable banks off the mouths of rivers. For this predilection there may be several causes, but I personally am inclined to the view that the oyster has no control over his movements in his buoyancy stage, and just drifts as the current wills ; in this stage there is probably an enormous loss of young oysters. The more fortunate survivors at the period when they lose their buoyancy are in the vicinity of suitable banks, and in any case those that sink on sand, or where there is no food, perish ; now it is usual for a bank to form from principally flood materials off the mouths of rivers, and here oysters settle free of sand and other dangers, whilst

their food is or may be supplied by the outflow of the river bringing it to them. Anyhow, if this, the food theory, is incorrect, there is no doubt that oysters, both edible and pearl-bearing, do congregate off the mouths of fresh water rivers round the coast of this Island.

Fish are not, according to my experience, plentiful on the pearl banks, and an indication of this is the small number of fishermen ; sharks are rare there, whilst on the south and east coast of Ceylon they exist in great numbers. I remember being becalmed in a sailing ship about twenty-five years ago, and seeing and catching them by the score for one whole twenty-four hours in the lower part of the Bay of Bengal ; there was one ancient gentleman, however, who swam lazily up to our stern and spent the four hours, from midnight to 4 A.M., sucking in the bait of succulent fat salt pork and just letting it slide out of his mouth whenever I endeavoured to hook him. The supposed origin of the seaman's mermaid is a rare form of marine mammal occasionally seen on the pearl banks, called the dugong. Looking at the specimen mounted in this building, it is difficult to believe that the romantic old sailor, however long he had been at sea without coming in contact with the opposite sex, could ever insult them by mistaking the dugong for a charmer of the fair sex, no, not even for a suffragette. We all know how marine artists have idealized into the loveliest of women the mermaid. Like the whale, these fish suckle their young at the breast, where their food glands are situated, and perhaps this is the origin of the mermaid myth. Another fish, also seen on the pearl banks, is the globe fish. It is a big-headed slow-swimming fish, which, when disturbed, blows itself out into a globe covered with spikes, and at the same time becomes quite helpless.

It is said that a Venetian visited the pearl banks between 1563 and 1588, named Cæsar Frederick, but nothing is known of his objects or their results. The Dutch, during the whole of their occupation of Ceylon, only had four good fisheries, namely, in the year 1732 ; in 1747, when they made £21,400 ; in 1748, when they made £38,580 ; and in 1749, when they made £68,000. This in a period of 140 years does not seem very good. There is a record in the Royal Asiatic Society's Journal, No. 456, III., of a fishery at Trincomalee of Ceylon pearl oysters in the year 1750.

The pearl necklace captured from Raja Jaipat by Mahmud in the year 1001 A.D. was valued at £100,000, but whether of Ceylon origin I cannot say, though it is quite likely to have been.

Servilia, the mother of Brutus, received a pearl from Cæsar worth £50,000, and Cleopatra's earrings were valued at £161,000.

The most perfect pearl ever discovered was bought in the year 1633 by the Shah of Persia for about £10,266 from an Arab, who brought it from Catifa, a fishery opposite Bhareen in the Persian Gulf.

Another Bhareen pearl of 12 carats weight belonged to the Prince of Muscat, who was offered 40,000 crowns, equal to £10,000, for it.

Bhareen pearls are credited with being the finest pearls in the world.

The earliest mention of a pearl fishery in Ceylon is found in the *Rajavali* chronicle, 306 B.C., as being near Colombo, and being destroyed by an inundation of the sea.

Mention of the Ceylon pearl fisheries occurs in Pliny, and of the Tuticorin fisheries in the "Vishnu Purana."

During the Dutch occupation the best fisheries took place off Chilaw, but there is no actual record of any fisheries during the Portuguese occupation. The Dutch made about £200,000 from their fisheries in 140 years.

Albyrouni, who lived in the eleventh century, mentions that in his times the Ceylon pearl fisheries suddenly became exhausted.

I will just quote the final paragraph of a report by Captain Kerkham, the Superintendent to the defunct Ceylon Company of Pearl Fishers, who says that it is highly desirable that all the rocky areas north of Colombo should be annually inspected, as it would appear from the immense quantities of oyster shell found in these places that beds of oysters have occurred, matured, and died of old age without even being discovered or fished.

The question has been raised in recent years as to our claim to the sole right of fishing the Ceylon pearl banks, seeing that they are outside the three-mile limit, but this has been satisfactorily settled, and as a matter of fact the three-mile limit is in itself obsolete, as it referred in the past to that area within the range of the guns then in use in shore batteries, for it may be said what you can defend is yours. Nowadays a fourteen-mile limit would not be excessive with modern artillery.

In all stages of the pearl oyster wastage is enormous ; when young they crowd together and only the fittest survive, and by the time they become fishable they are scattered about over fairly large areas in bunches of twos and threes.

By the present methods of fishing it is impossible so to deplete the banks as to leave no oysters for breeding purposes ; quite a quarter of the stock is left on the banks by the divers ; so it is not true, as has been frequently stated, that our blank years are due to overfishing ; and some other reason must be found, and that is, I think, that oysters when spawned on our banks are all carried away by the current and probably lost, whilst we benefit for the same reason from the Tuticorin oyster banks.

The pearl oysters apparently are continuously present on the Persian Gulf and Somali beds, and fishing is always in progress there.

That oysters cannot be cultivated on our banks seems pretty certain, as the currents that bring us the Tuticorin spat carry away the local spawn into deep or unsuitable places, where it is lost, and nothing that science can do will ever guarantee annual fisheries or prevent this.

Our banks are too circumscribed, and the currents too constant, to allow of locally-produced spat setting on the parental oyster beds.

A REVIEW OF THE SCIENTIFIC WORK ON THE CEYLON PEARL BANKS FROM 1902 TO 1912.

By Joseph Pearson,
Government Marine Biologist.

Introduction.

THE intermittent nature of the pearl fisheries in the Gulf of Mannar is well known. Cycles of barren years occur irregularly, but none the less consistently. This lack of continuity is unfortunate, and at the same time remarkable—unfortunate, in that the value of the pearl banks as an important source of revenue to the Colony is somewhat discounted; and remarkable, since it presents to the economic scientist points of supreme interest. Although the spasmodic nature of the pearl fisheries must have caused serious misgivings in the past, no organized attempt appears to have been made to discover a cause and a remedy until the year 1902. With the advent of Professor Herdman, who brought to the problem an unrivalled experience of marine biological science, the fortunes of the pearl banks may be said to have entered upon a new phase, and one has no hesitation in affirming that the last decade has proved the most eventful in the history of the Ceylon pearl fisheries. In addition to the fact that the methods of biological science were introduced into the enterprise for the first time* the period in question was rendered noteworthy by the formation of a Syndicate in 1906 to take over from Government the control of the pearl banks for a term of twenty years. The Ceylon Company of Pearl Fishers commenced its career under the most happy auspices, and as the result of two successful fisheries in the first years placed itself in an extremely sound condition. After the fishery of 1907, however, the yield of pearl oysters failed, and since that date the banks have been in a condition of absolute barrenness. The result was that after an

* It must not be forgotten, however, that scientific operations were conducted on a small scale by Dr. Kelaart in the fifties and by Mr. Houldsworth in the sixties.

eventful career extending over six years the Company found its affairs to be in such a hopeless condition that in 1912 it asked Government to terminate the lease. This has now been done, and the fishing rights on the pearl banks have reverted to the Ceylon Government.

In view of the somewhat sensational history of the Syndicate, and of the inevitable publicity which has been given to Ceylon pearl fisheries in recent years, it is not surprising to find that the economic Marine Biologist has loomed rather large in the reports of the Company. The result has been that both the expectations and the possibilities of the scientific work have been grossly misunderstood. Thus, the commonly accepted notion appears to be that marine biology as applied to the pearl banks must stand or fall upon the result of the last ten years' work, and many are satisfied that the failure of the Pearl Fishery Company to make the enterprise a financial success is directly consequent upon the failure of economic science to offer a solution of the main problem.

One does not feel inclined to accept the conclusions of those who are sceptical of the ultimate success of the work of applied science, and who talk vaguely about "leaving Mother Nature to her own devices." The principle involved is of universal application, and the answer does not rest upon a few years' work on one particular problem, but is closely concerned with all the activities of the human race in so far as they affect the products of Nature. Man's enterprise has long since shown the fallacy of leaving Nature to her own devices, whether it be in agriculture or pisciculture.

Certain it is that the main point of the problem which science set out to solve on the Ceylon pearl banks has baffled all inquiry, and it may appear at first sight that the history of the last ten years spells failure of scientific methods. The writer has been prompted to write this paper because of certain misunderstandings which undoubtedly exist, and in order to present a summary of the biological position, with a view of determining how far the scientific investigations have progressed towards the attainment of their chief object.

Further than that one cannot go, for it would be idle at the present juncture to profess that any ripe judgment can yet be given on the merits of economic marine biology as applied to the problems of the Ceylon pearl oyster.

Brief Resumé of the Scientific Work.

After a period of eleven years, during which there had been no fishery, Professor Herdman was invited to institute an inquiry and to present a report. In consequence he spent the early part of the year 1902 in Ceylon, and in company with his assistant, Mr. Hornell, made a thorough examination of the conditions of the pearl banks. On Professor Herdman's return to England, Mr. Hornell was left in charge of the investigations. The researches were thus continued

until 1905, and the results are to be found in the five volumes published by the Royal Society. The commencement of these operations happened to coincide with the appearance of large deposits of spat on the banks, so that from the beginning of their work Herdman and Hornell had material at hand, and they were able to follow the oyster through all the later stages of its development. Every branch of the investigations was prosecuted with great vigour, and the researches of these four years were very fruitful.

In addition to the arduous duties of inspections and the distractions of the two largest fisheries on record, the two main lines of inquiry may be said to have been, first, the examination of the pearl oyster from every point of view, including structure, life-history, and bionomics. In Volume V. of his reports, Herdman summarizes the work done and makes a series of recommendations. These will be discussed later. The second important piece of work was concerned with pearl formation and the pearl-inducing parasite.

A second phase was entered upon in 1906, when the Ceylon Company of Pearl Fishers obtained a lease of the beds. Mr. Hornell's services were retained for both the biological and surveying work, and Professor Herdman was appointed scientific adviser to the Company.

There is no published record of any scientific work done during the years 1906 and 1907. Doubtless the two fisheries which took place in these years occupied all the time of Mr. Hornell in his double rôle, but the Company were not perhaps serving their own interests best by practising economy at the expense of the scientific investigations, upon the result of which, as recent events have shown, they believed so much to depend. The biological position was sufficiently difficult to demand the whole time and energy of the Marine Biologist, without saddling him with navigating and surveying work, which ought properly to have been assigned to a man of proved nautical experience, which Mr. Hornell admittedly was not. When he left the services of the Company in 1908, this defect was remedied by two appointments being made in respect of the duties previously performed by Mr. Hornell alone. Mr. Southwell, who had been Hornell's assistant, was placed in charge of the biological work, and Captain Kerkham was made responsible for the navigations and surveying.

The reports of the Company show that the Chairman and Directors pinned their faith upon the anticipated results of the scientific investigations. Therefore, it is surprising to find that since the fortunes of the Company were regarded as being so dependent upon the scientific efforts, no results of the scientific operation on the Company's banks were published for nearly four years. The first scientific report which dealt with the operations on the banks under lease did not appear till May, 1910. Possibly during this blank period the Directors received reports upon the progress of operations

from their experts, but scientists who are interested in the problem are in absolute ignorance of what transpired during that period, except for scattered references in Southwell's reports. In attacking a series of problems such as the Ceylon pearl fisheries present, it is absolutely essential that the large mass of data collected should be put on record, irrespective of whether they may appear to have any bearing upon the main problem at the time. For this reason it is regrettable that information concerning the scientific operations conducted during the first part of the Company's tenure should not be available for those who will now be called upon to continue the work, and there is not much consolation to be gained from Mr. Southwell's statement that the investigations recorded in the Ceylon Marine Biological Reports "represent a mere fraction of the work done by the Company." There is another cause for regret, in that these blank years synchronized with the time when the banks became barren. It would be interesting to know what occurred during this critical period. Did the Company realize what would probably happen, and did they take all possible precautions? Were breeding reserves established in the fishery of 1907, and were any oysters that were left over carefully preserved? On these points no information is forthcoming. Professor Herdman emphasized the danger of overfishing. Did the Company accept this view? We are anxious to know what relation, if any, exists between the practice of overfishing and the periodic failure of the pearl fishery. To the solution of this problem the years 1906–1908 offer no contribution.

The results of the Southwell-Kerkham régime are naturally of a somewhat meagre nature, since these gentlemen were in the unfortunate position of having to take charge of the operations during a period when the banks were barren. The most noteworthy results of their term of office were Southwell's work on the pearl-inducing worm, the current investigations prosecuted by Southwell and Kerkham by means of drift bottles, the compilation of a new chart of the banks, and the inauguration of a new system of inspection by Kerkham. The researches on the pearl-inducing worm and the current investigations will be referred to later. Not the least important of the benefits which accrue to Government are the new method of inspection and the chart of the banks, for which Captain Kerkham is responsible. A discussion of these achievements is beyond the scope of the present paper, but since a very important part of the annual survey is dependent upon an efficient system of inspection, and none the less upon a reliable chart of the banks, Captain Kerkham's work in these matters cannot be dismissed without a word of appreciation.

Those whose lot it will be to continue the scientific work commenced ten years ago are under heavy obligations to Professor Herdman and the other biologists who have hitherto been concerned

with the work. But although the ten years' work has made the task much lighter, the main problem is still unsolved, as the present barren conditions of the banks only too plainly testifies. Moreover, the combined results of the ten years' operations are not convincing enough to induce the writer to agree with Mr. Southwell that, "given a spatfall, only thorough inspection, care, and normal foresight in isolating breeding stocks, &c., are required to make the banks perennially productive." Mr. Southwell is too optimistic when he thinks the future presents such an easy task, and he is perhaps too sanguine when he records his belief that a spatfall is almost certain to take place at an early date.

Herdman's Summary and Recommendations.

Herdman considered that the principal causes of mortality were (1) silting sand, (2) predaceous fish, (3) overcrowding, (4) overfishing, (5) various other causes, such as disease and attacks of invertebrates.

Amongst other things, he recommended transplanting, cultching of sandy areas, the institution of drift-bottle experiments.

It is instructive to determine how far the various practices advocated by Herdman have been seriously tested.

The question of silting sand on the banks is discussed elsewhere. If this danger is a real one, it would appear difficult to overcome, except by transplanting the oysters from places where large sandy stretches predominate. Southwell and Kerkham have not fully appreciated Herdman's point in regard to the dangers of silting sand. They have written a great deal to show that the movement of the bottom water is vertical and not horizontal, but one is not convinced that this vertical movement, if admitted, may not give rise to silting. So long as silting takes place, from whatsoever cause, the precautions suggested by Herdman must be practised.

There appears to be universal agreement that predatory fish are an important source of danger, but our knowledge on this subject is not a little vague since the published information is extremely meagre. It would have been helpful if exact records had been kept of the thousands of trawling operations which have been conducted throughout the course of the ten years' inquiry. One may be forgiven for emphasizing once more the importance of a detailed and systematic collection of data in the course of a big investigation extending over many years, such as the one under discussion. It is by such methods that results of permanent value may best be attained. In regard to the natural enemies of the oyster, the problem would have been a much simpler one for future workers if detailed records of the gut-contents of fishes had been available. It would also have been of interest to have had a comparison of the fish fauna of the banks during fishery years and non-fishery years, to have determined whether the fish which feed on oysters disappear when the

oyster beds are rendered barren, or whether they merely change their diet. The scattered evidence on these points, which one discovers only after much trouble in the published reports, is insufficient and unconvincing. Doubtless Messrs. Hornell and Southwell obtained an intimate knowledge of such details, but if they had put it on record they would have saved their successors much trouble, and the "legacy" which the Ceylon Company of Pearl Fishers left to Government would have been incomparably richer.

Mr. Southwell repeatedly states that the collection of data regarding predatory fish has been carried on extensively and persistently. He says further: "Almost every fish caught has been carefully examined in order to determine the nature of the stomach contents, and in this way thousands of fish ..... have been repeatedly under observation."* Why was this information not published? It may make uninteresting reading, but it is the sort of information to which future workers on the subject should have the means of access. It is not sufficient to discuss the question in a brief summary such as Mr. Southwell contributes in the Ceylon Marine Biological Reports (Part IV., page 175).

There is no ground for Dr. Jameson's supposition that Professor Herdman and his successors have refrained from a campaign of extermination of these predatory fishes on the ground that they play an important part in the life cycle of the supposed pearl-inducing parasite. As a point of academic interest, Herdman has drawn attention to the fact that though an excess of predaceous fish would destroy the oysters, the other extreme would be equally disastrous from the point of pearl production. But as a matter of practice no mercy has been shown to those fish which have proved inimical to the oysters. It is true that no active measures have been taken to reduce the numbers of predatory fishes, but the reason of this is not to be found in any desire to protect the fish because of their probable importance in pearl production, but in the peculiar local conditions. Apart from the trawling operations of the "Violet," which do not extend over more than three months of the year, there is practically no fishing pursued on the banks. The pearl banks happen to lie off one of the most thinly populated parts of the Ceylon coast, and in consequence there is practically no fishing industry of any importance. If, for example, the banks had happened to lie off the coast between Colombo and Galle, where sea fishing is practised extensively, it would have been an easy matter to keep down the numbers of predatory fish. In such a case, however, a rigid system of police supervision would have to be enforced in order to prevent poaching of pearls.

The danger of overcrowding is one which has been fully recognized, and the obvious remedy is to transplant some of the oysters to new ground. Transplanting has not yet been carried out in a thorough

* Ceylon Marine Biological Reports, Part IV., p. 177.

manner. As Jameson has pointed out, Hornell transplanted a batch of 10,000,000 oysters, but no subsequent report indicates whether the experiment was a success or failure. Southwell also transplanted 9,000,000 oysters, but they all died in the following year. One has every reason to believe that transplantation operations, if carried out on a sufficiently large scale, will prove an important factor in the improvement of the banks, and in consequence it will be of interest to follow the results of future transplantation experiments.

Transplanting is not only necessary to relieve overcrowding, but also in cases where a spatfall takes place on unsuitable ground. For example, Periya Paar frequently receives large deposits of spat which rarely reach maturity. In such a case, whenever a spatfall occurs, the young oysters should be dredged up and deposited on more suitable ground.

It is questionable whether the dangers of overfishing are so serious as would appear at first sight. Professor Herdman strongly emphasized the evils of overfishing in his reports, but it is significant that in his final recommendations no mention is made of any provision against overfishing. It is probable that the pearl oyster matures at least two years before it is "fishable," and so far as one can determine it does not live long after the fishable age. It has been suggested that overfishing may be prevented by marking off certain "spawning reserves" during a fishery. This will ensure that a few compact beds of oysters are left at the conclusion of fishing operations. But since these oysters have already been spawning for at least two years, and since so far as one can determine their fertility wanes after they reach a "fishable" age, the advantage of establishing these reserves is probably overrated.* At any rate, so long as other beds of young oysters are known to be on the banks there appears to be no need for establishing breeding areas on any particular paar. If this be so, it would seem that the only time when the establishment of breeding reserves would be necessary would be when whole banks showed signs of approaching barrenness. But as a matter of practice it would be unwise in the immediate future not to take every conceivable precaution, and it would be regrettable not to test the value of the breeding reserves as a means of arriving at some solution of the main problem, namely, the recurrence of barren years. So far as I am aware, no such measures have yet been taken.†

Both Herdman and Hornell were strongly of opinion that cultching should be carried out, but so far as one is able to judge, Southwell's criticism of this suggestion is a sound one. If Southwell's figures

* Since so little is known of the spawning periods and the life-history of the oyster, such a conclusion as this may have to be modified as our knowledge of the subject increases.

† It is pointed out later that the breeding reserves will be valueless if spawn produced is carried off the banks.

be accepted, extensive cultching in the pearl banks is not a feasible scheme, and in the later years the Ceylon Company of Pearl Fishers, who were bound under their agreement to deposit at least 500 tons of cultch each year, were able to induce Government to forego that stipulation.

The work subsequent to Herdman's reports gives very little evidence that his recommendations have been carried out seriously: With the exception of cultching, which appears to be impracticable on a large scale, there is little evidence to show that efforts were made to seriously guard against the alleged evils of overfishing and overcrowding. We have yet to learn the importance of these two factors in regard to the problems which are awaiting solution.

Pearl Production.

In addition to their investigations upon the main problem, Messrs. Herdman, Hornell, and Southwell have considerably extended our knowledge of the supposed pearl-inducing parasite. Herdman and Hornell determined the Ceylon pearl to be formed around the larva of a tapeworm, *Tetrarhynchus unionifactor*. Herdman was of opinion that three hosts are probably concerned in the life-history of the parasite, namely, the pearl oyster, a large ray, and *Balistes*. While Southwell agreed as to the nature of the parasite, he did not believe that three hosts were concerned; and he made two series of experiments, with the object of showing that the life-cycle of the tapeworm could be completed within the pearl oyster and ray without the intervention of a bony fish. This conviction apparently was not shaken when the experiments produced only negative results.

A small area of the sea bottom was enclosed by expanding metal and stocked with oysters. In the 1909 experiment some 36,000 oysters were deposited in the enclosure, and four fish, after being treated with male fern extract and castor oil, were introduced, viz., *Tetrodon unimaculatus*, *Tetrodon stellatus*, *Ginglymostoma concolor*, and *Tæniura melanospilos*.

At the end of twenty-eight days the fish were killed, and an examination of the gut-contents revealed the absence of any adult cestodes from the two species of *Tetrodon*. In *Ging. concolor* there were 51 *T. unionifactor* and 48 *Tetr. herdmani*, and in *Tæniura melanospilos* there were 150 *Tetr. herdmani*.

In 1910 a second experiment was tried. 12,000 oysters were placed in the enclosure, together with the following fish :—*Serranus undulosus*, *Ginglymostoma concolor*, and *Trygon walga*. In about seven weeks' time the fish were killed, and only *Ginglymostoma concolor* proved to have any adult cestodes. Three species were represented : 38 specimens of *T. unionifactor*, 140 specimens of *Phyllobothroides hutsoni*, and 9 specimens of *Phyllobothroides kerkhami*.

Since these experiments were made, with the object of proving that a bony fish did not enter into the life-cycle of the pearl-inducing parasite, but that only the pearl oyster and a ray were concerned, two conditions were necessary :—

(1) That the alimentary canal of each fish should have been quite free from cestodes at the beginning of the experiment. Southwell attempted to arrive at this condition of things by treating the fishes with extract of male fern and castor oil.

(2) That the fishes and oysters should have been absolutely isolated from other organisms, such as bony fishes. Southwell believed this had been achieved by surrounding the enclosure with expanding metal having a four-inch mesh.

With regard to the first condition, the only test made to prove the efficacy of the purgative used—namely, by killing a fish three days after treatment and examining the intestinal contents—revealed the presence of a few cestodes. Furthermore, in explaining the presence of the large number of specimens of *Phyllobothroides* in his second experiment, Southwell says, "it would seem probable that these cestodes were present when the fish were placed in the enclosure." If this possibility be admitted, the value of the whole experiment is nullified.

The second condition was not strictly observed. Southwell admits this, and says, "the food supply consisted entirely of oysters, save possibly such small fish as were able to pass through the expanded metal." After seeing the nursery in question, the writer was of the opinion that the enclosure was not proof against the inroads of other fishes.

Mr. Southwell admits the unsatisfactory results of the experiments, but still adheres to his view that there are only two hosts, a view which may probably prove correct.

The conclusion that one is forced to is that further investigations are required before the question of pearl production may said to be satisfactorily solved.* If Southwell's experiments are reliable, it would appear that the pearl oyster has larvæ of at least four kinds of tapeworms, viz., *Tetrarhynchus unionifactor*, *Tetr. herdmani*, *Phyllobothroides hutsoni*, and *Phyllobothroides kerkhami*. This is not inconceivable, but, if true, it would raise the interesting question if the cestode origin of pearls be accepted, of the formation of pearls from the larvæ of all these different cestodes, and not only from *Tetr. unionifactor*.

* Dr. Jameson's Paper on pearl production had not been received when this was written. Dr. Jameson's examination of a large number of pearls failed to detect the presence of a larval tapeworm in the nucleus, and on these grounds he rejects Herdman's theory. The Paper produces only negative evidence, and Dr. Jameson is not in a position to offer an alternative explanation. The whole question will need re-investigating.

Currents.

According to Herdman and Hornell, the surroundings of the oysters are influenced in some degree by the presence of bottom currents, and they were of opinion that one of the causes of mortality among young oysters was the silting of sand over the oysters through the agency of these bottom currents. In fact, they regarded the shifting sand as a more serious cause of disaster than even the depredations of voracious fish.

In their discussion of the bottom currents, Southwell and Kerkham assumed that the danger of a bottom current to a bed of oysters is that the oysters will be swept away, and apparently on those grounds they appear to ignore the more probable explanation suggested by Herdman, that any movement of the bottom layers of water is dangerous, in that the sand becomes silted and buries the oysters.

Southwell and Kerkham contend that there is no longitudinal motion of the bottom layers of water, and base their conclusions upon three series of observations. Experiments were made with a piece of apparatus which was too faulty to be treated seriously, and they themselves admit that the results of these experiments were "of too crude a nature to count for anything." Their second ground for adopting this view was based upon the scanty information obtained from the divers. But the main reason for their opinion is founded upon the observation made by Captain Kerkham himself on the numerous occasions when he descended in diving dress. It is significant, however, that none of these descents were made in the height of the south-west monsoon, when the banks are swept by strong winds and the water is in a continual state of disturbance.* Whether even in the roughest weather the water six fathoms below the surface is affected in any considerable degree by the action of the wind is a doubtful point, but that some serious disturbance of the bottom layers does take place during the south-west monsoon is actually admitted by Southwell and Kerkham when they state that "at such a time (late in October, before the south-west monsoon has subsided) the bottom layer of water is turbid. The cause of this turbidity has been microscopically examined, and has been repeatedly proved to be due to the disintegrated remains of seaweed and caulerpas. The turbidity renders it almost impossible for divers to see, but it subsides as the north-east monsoon begins." They admit, moreover, that the sandy bottom becomes ridged during the south-west monsoon. This ridging is caused, they assert, by the action of surface agitation, which is transmitted as a vertical and not as a horizontal movement. This evidence may quite well be claimed by Herdman as support for his case. It seems clear that *any* movement, be it horizontal or vertical, which can produce well-defined

* Dress diving is impossible during the south-west monsoon owing to bad weather, but this is the period of the year when silting will take place, if ever

ridges of sand may possibly be sufficient to cause silting, and it is still more likely that the movement of water, which is sufficient to disintegrate seaweed growing on the bottom to such an extent as to make it difficult for the divers to see, is quite enough to disturb the sand and produce silting.

It is obvious then that Southwell's and Kerkham's opinion that there are no bottom currents, even if true, does not dispose of Herdman's suggestion that silting of sand takes place to such an extent as to be an important cause of mortality. So long as there is movement in the bottom layers of water, whether caused by a definite current or by the transmission of the surface waves, it is probable that silting takes place.

In support of this view, I am able to publish, through the kindness of Captain J. A. Legge, Master Attendant, Colombo, an extract from his report to Government in December, 1903, in his capacity as Inspector of Pearl Banks :—

" From November 19 until my return I used a diving dress and air pump and dived personally daily..... What impressed me most was that the spots I dived on last March, which were then level rock, with a coating of 3 or 4 inches of sand, had now as much as a foot of sand in places. All over the sand was in fairly deep ridges, not so deep as the ridges off the paar proper, but quite distinct from the appearance of the sea bottom last March. Now this was not the case on the South-east Cheval, and the impression I have formed from this is that the shoal running up from the Karativu Islands arrests the sand and shelters this part of the Cheval and also the North and South Modragam Paars. One of my reasons for this impression is that after a protracted search for the old tanks sunk by Captain Donnan in four fathoms on the extreme north end of this shoal I was quite unsuccessful, though these tanks are seen from quite a little way off by their shadow on the surface of the water when the water is clear, and I have never experienced clearer water than when I made this search last month. I am informed that Captain Donnan on only one occasion found these tanks in November, and I was unsuccessful last year. The soundings on or about the position of these tanks showed a shallowing of the water. I have, therefore, come to the conclusion that the south-west monsoon washes up the sand and covers these tanks, and the north-east scours them clear again of sand. If this opinion is confirmed, it will explain the absence of sand ridging on the South-east Cheval, and the marked ridging and increase in quantity of sand on the parts of the Cheval not sheltered by this shoal."

The information collected by Southwell and Kerkham regarding currents is interesting, since much of it was obtained from personal observation in the diving dress, but these conclusions can hardly be regarded as convincing. More work is needed on this important point.

Drift-bottle Experiments.

Southwell and Kerkham have rendered valuable service by their drift-bottle experiments. Previous workers had realized the possible importance of oceanic currents in relation to the dispersal of the pelagic stages of the oyster, and Herdman recommended the use of drift bottles in order to extend our knowledge of the currents in the neighbourhood of the Gulf of Mannar. I believe I am right in saying that Hornell first started the drift-bottle experiments, but the results have never been published. Hence the result of Southwell's and Kerkham's drift-bottle experiments in the Gulf of Mannar are the first which have been published, and they disclose an interesting state of affairs.

In the north-east monsoon an oceanic current makes a northward sweep up the west coast of Ceylon, becomes deflected at Tallaivillu Point, and from westwards towards Cape Comorin. Hence this current does not reach the pearl banks. On the banks there is a steady wind from the north which sets up a surface drift, which when the monsoon is strongest, from November to January, is sufficient to carry floating objects from the pearl banks as far as the westward oceanic current flowing towards Cape Comorin.

The drift experiments have revealed two phases during the south-west monsoon : (*a*) When the monsoon is strong the water at the head of the Gulf becomes piled up, and an easterly oceanic current striking Cape Comorin is partly deflected across the mouth of the Gulf of Mannar ; when it reaches Tallaivillu Point the current takes a southerly course. The stronger the monsoon the higher up the Gulf is this current forced, and may reach as far as north as the Tuticorin banks, whence it is deflected eastwards over the Ceylon pearl banks.

(*b*) When the monsoon is weak quite a different state of affairs exists, though the real significance of the conditions during this phase is not rendered quite clear by Southwell and Kerkham. They say that " during a weak or moderate monsoon this current never penetrates the Gulf at all."

In view of this statement, it is difficult to explain the northerly flow along the Indian side of the Gulf of Mannar, which they show in chart B, and to which they refer in the text as finding an outlet through the Paumben Channel.

Two alternative explanations of the conditions prevailing in a weak south-west monsoon suggest themselves to the writer. The first is, that the oceanic current, after striking Cape Comorin, is not deflected eastwards across the mouth of the Gulf, but owing to the lightness of the wind is able to take a much more southerly course, and thus may miss the Ceylon coast altogether, or only strike it at the southern extremity. In such a case a large triangular area lying to the north of this current is unaffected by it. In this area a light surface drift is set up by the south-westerly wind—a drift which is

recognizable on the Tuticorin banks and on the Ceylon banks, and which finds an exit through the Paumben Channel. Such a surface drift would be sufficient to produce the results which the drift experiments have shown.

The second explanation is, that when the current strikes Cape Comorin a small portion of it is deflected up the Indian side of the Gulf. If the main stream strikes the Ceylon coast near Colombo it will flow southwards, but a small portion may be deflected northwards into the Gulf of Mannar.

Messrs. Southwell and Kerkham have very properly confined themselves to the results of their drift-bottle experiments, but in so doing they have not fully discussed the causes which produced those results. For instance, they speak constantly of "currents," and have evidently not realized that the drift experiments do not assist them in discriminating between oceanic currents and the ordinary surface drift caused by the wind, except in cases where the current and wind are in opposition. In a weak south-west monsoon, for instance, they speak of the northerly currents flowing along the Ceylon and Indian sides of the Gulf of Mannar. It is just as likely that at that phase of the monsoon the Gulf is only affected by surface drift. Drift-bottle experiments, however, cannot discriminate between the one and the other, and before we have any right to speak of oceanic currents affecting the surface waters of the Gulf of Mannar, we must supplement the very valuable results obtained from Southwell's and Kerkham's drift-bottle experiments by the chemical examination of a large series of water samples from the area under discussion. Only by this means will it be possible to solve the current questions in the Gulf of Mannar.

Bearing of Drift-bottle Experiments.

The bearing which these drift-bottle experiments have upon the main question is probably a very intimate one. In the Gulf of Mannar there are two series of pearl banks: those on the Indian side at Tuticorin, and those on the Ceylon side; the two are separated by a distance of nearly one hundred miles and by a considerable depth of water. It is highly probable that after a series of barren years, as we are passing through at present, the Ceylon banks are replenished through the agency of the Tuticorin beds.

As we have already seen, during a very strong south-west monsoon the oceanic current sweeps up as far as the Tuticorin beds, and then takes an eastward course as far as the pearl banks. One of the spawning maxima coincides with the early part of the south-west monsoon, so that it is possible that the floating larvæ liberated on the Tuticorin banks may be carried over to the Ceylon side if they happen to be in the way of the oceanic current. According to Hornell the pelagic stage lasts at least five days. Southwell and Kerkham have shown how in the case of a strong monsoon the

larvæ from Tuticorin may be carried over to the Ceylon pearl bank in six days.

If the monsoon be weak the larvæ are carried up northwards, and may even pass through the Paumben Channel.

According to Southwell and Kerkham, then, if the spawning period synchronizes with a strong south-west monsoon, a spatfall may take place on the Ceylon pearl banks.

But there is another point of equal interest which Southwell and Kerkham do not appear to have realized. This is dependent upon Hornell's statement that there are *two* spawning maxima in the year, namely, June to August and December to February.*

If the current work done by Southwell and Kerkham may be relied upon, and if there are two spawning maxima, it follows that not only may the Ceylon pearl banks be repleted in the manner described above, but the Tuticorin banks in their turn receive exotic spat from the Ceylon banks during the spawning period at the end of the year. One has only to look at Kerkham's and Southwell's chart C† in order to see that if the oysters on the Ceylon pearl banks spawn in December the pelagic larvæ may be carried over to Tuticorin. In other words, we have a reciprocal arrangement of the highest importance between the two pearl banks.

If Southwell and Kerkham had only realized the possibility of a December spawning maximum, they would not have penned the following :—

"It follows from the nature of the currents that the Tuticorin banks receive no exotic spat, for as far as we are aware no oyster beds exist around Cape Comorin. Moreover, their own resources are being continually drained, and it is not to be wondered at that they are unprofitable."

It is true that if there were only the July spawning maximum any exotic spat deposited in the Tuticorin beds must needs have come from some place around Cape Comorin, but the presence of another spawning season in December renders it possible for Ceylon spat to be deposited on the Tuticorin beds.

The continual drainage of the resources of the Tuticorin beds referred to by Southwell and Kerkham would soon render the beds barren if no exotic spat were received. These fresh supplies probably come from the Ceylon bed, and we must seek another reason for the comparative failure of the Tuticorin beds as a pearling centre.

The information which may be obtained from the current investigations cannot be fully utilized so long as our knowledge of the life-history and spawning habits of the pearl oyster is so imperfect, and it is therefore imperative that these problems should be attacked

* Southwell only recognizes the first of these.

† Ceylon Marine Biological Reports Part VI., 1911.

anew when next the opportunity presents itself. The question of the currents is one of more than academic interest, and it is not improbable that when our knowledge of both the currents of the Gulf of Mannar and the life-history of the pearl oyster is more complete than at present, the way will be cleared for the elucidation of some of the problems which have hitherto baffled inquiry. It may be claimed that the knowledge gained by these current investigations has no practical value. It is true that man cannot attempt to control the numerous factors which together effect a spatfall. A lull in the monsoon, a slackening of the current, or any one of a hundred other causes may be sufficient to prevent the larvæ reaching favourable ground. But there is another aspect of the current investigations which would appear to hold out some promise, and it is an aspect which hitherto does not appear to have been considered very seriously.

In view of the proposals which have been put forward from time to time to establish breeding reserves, it is necessary to make an intensive investigation of the comparatively small area of the banks in order to determine the nature of the currents and surface drift. To establish breeding reserves will be futile, unless we know that spawning will be followed by a spatfall on the banks themselves. The only object of the breeding reserves is to maintain the productivity of the banks, hence this object fails if owing to currents or surface drift the pelagic larvæ are carried off the banks.

If drift-bottle experiments show that the drift over the banks during, say, the July spawning maximum is very slight, then there would be reason to hope that any larvæ liberated on the banks would not be carried away, and this would prove of great value on subsequent efforts to maintain the productivity of the beds.

I have already hinted that in the December spawning maximum spawn from the Ceylon pearl banks may be carried over to Tuticorin, but this would not be the case in the July maximum.

Altogether the question of breeding reserves raises many points of great interest, and before we can be convinced of success in this matter, we must first of all know more about spawning periods of the pearl oyster, the duration of the larvæ stage, and the disposition of the tides, currents, and surface drift on the banks.

Summary of the Position.

The present position of the question appears to show that so long as the banks are barren the part played by man must be a passive one. He is entirely dependent upon Nature for the re-population of the banks, and so far as one can see nothing can be done to hasten a spatfall in such circumstances. Dr. Jameson's suggested importation of a " few thousands of young spat " presents many difficulties. For the experiment to be of any value many millions of young spat would have to be imported. The cost and trouble of transport from

the Persian Gulf, and the large mortality which would be inevitable, probably renders such a scheme impracticable.

Even after the spatfall has taken place, the young oysters are to a great extent at the mercy of the elements and predatory fish. All that the Marine Biologist can do is to " thin out " the beds which are overcrowded, and to transplant the spat from unfavourable ground to the paars where good attachment is assured and where the probable dangers of silting may be minimised.

Admitting that predatory fish are one of the chief sources of danger to the beds, it is difficult to know how their depredations may be best arrested. Either vigorous and continued warfare must be waged against these enemies of the pearl oyster, or the pearl oyster itself must be protected. The difficulties in the way of the first of these propositions have already been dealt with. To prosecute a sufficient vigorous and effective campaign against these predaceous fish over an area of many hundreds of square miles does not appear to be practicable in the special circumstances of the case.

The other alternative presents even greater difficulties than the first. Nevertheless Mr. Southwell made provision for an experiment of this nature, and following his suggestion the Company purchased at a cost of £3,500 sufficient wire netting to cover one-sixth of a square mile. It was proposed to lay this wire netting over a bed of spat, and thus protect the oysters at the most critical period of their life from the ravages of the natural enemies. Unfortunately Mr. Southwell was not able to test the value of this experiment as no spatfall occurred. The wire netting is now the property of Government, and the experiment devised by Mr. Southwell will be carried out when the first spatfall occurs. But it is quite obvious, as Mr. Southwell himself pointed out, that the cost of such a means of protection is prohibitive, and the objection which Mr. Southwell himself made in regard to Herdman's cultching proposals may be made with equal force to the wire-netting experiment.

In view of these difficulties, it is fortunate that when a spatfall does take place it is usually so abundant that, on suitable ground, a sufficient number of oysters survive for the requirements of a fishery. On Periya Paar it is true that an excessive mortality of the spat occurs, but this is probably not due so much to the attacks of fishes as to other obscure causes. Since Periya Paar is so unsuitable, the difficulties may be partly averted by extensive transplantation as soon as a spatfall on this paar is discovered. For the reasons which have already been stated, it is difficult to say whether the establishment of breeding reserves is necessary, but as the question involved is of too vital an importance to be dismissed by a mere expression of personal opinion, the value of such reserves will be tested when next the opportunity presents itself.

For obvious reasons the question of artificial hatching of the Ceylon pearl oyster has not yet been seriously considered. Artificial

hatching of marine organisms is fraught with so many difficulties, which would be intensified in a tropical climate, and the ultimate advantage of successful hatching is so problematic that one would hesitate at this stage in the operations to advocate such a course. It would seem that the small experimental tanks which the Company erected at Marichchukkaddi have been taken too seriously. For the purpose for which they were built they are of little value, but it is hoped that in future they will prove useful in following out the problems of the life-history of the pearl oyster.

In addition to the inherent difficulties of this problem—admittedly one of the most formidable within the whole range of Marine Biological Science—two additional factors were introduced, which placed those concerned in a most unenviable position. First, the pearl bank became exhausted when the scientific work had only been in operation five years. It is not difficult to realize the irony of the position thus created, both for the scientist, to whom the presence of oysters was necessary for the prosecution of the investigations, and for the shareholder, whose visions of yearly fisheries were so soon falsified. Mr. Southwell's position was an unfortunate one, as his tenure of office represented a succession of barren years. Thus it follows, that though it is undoubtedly true that there has been a relatively small advance in our knowledge of the pearl oyster during the last five years, this is due, not so much to "an insufficiency of 'directive' business control of the scientific side of the enterprise," as Dr. Jameson would have it, but to a much simpler reason, namely, that there have been no pearl oysters on the banks.

There was a second factor which, in the writer's opinion, has probably added to the difficulties of the situation, and has certainly rendered the position of the scientific expert a somewhat anomalous one.

This was the exploitation of the pearl banks by a commercial syndicate in the early days of the scientific investigation. This statement of an opinion may be liable to misconception. The Directors of the Ceylon Company of Pearl Fishers took a very liberal view of the scientific investigations, the prosecution of which they were bound to continue according to the terms of their agreement, and their attitude towards their scientific staff was distinctly sympathetic and deserving of the highest praise. The fault did not lie here, but in the fact that the shareholders, who apparently knew little or nothing of the problems at issue, put extraordinary faith in the scientific work and expected that science with the wave of the magician's wand would be able to produce a plentiful supply of oysters where hitherto there had been barrenness. It is regrettable that the scientific work, and the results which were expected from it, were given such undue prominence in the affairs of the Syndicate, and were open to so much misinterpretation.

It is not surprising, therefore, to find that when the affairs of the Company became so critical, the misfortunes which were gathering fast were directly attributed to the failure of the scientific work.

The non-expert may be pardoned for taking this most amazing view of the situation when Dr. Lyster Jameson, himself a biologist and a competent authority on pearl-fishing matters, discusses what he terms the " failure of the biological work on Ceylon pearl fisheries."* Both the title and the context of this Paper reveals Dr. Jameson's opinion that the scientific work has proved a failure, although certain passages in his Paper show that, unlike his fellow-shareholders, he does not believe that this " failure " is responsible for the misfortune which attended the Company's enterprises. On page 15 of his Paper, in discussing the terms of agreement between Government and the Company, he says " the Company was pledged to pay in annual expenses on the minimum scale more than twice, and on the maximum scale about three times, the probable average return," and further on he continues : " Applied Biology had a colossal task placed before it to make up this difference, and in addition to pay dividends on a capital of £165,000." In concluding his Paper, he writes as follows : " Let me say here that I do not think any scientific man who has seriously studied the pearl and mother-of-pearl fisheries question from an economic standpoint could dare to hope that a Company which started loaded with the heavy obligations which the Ceylon Company of Pearl Fishers accepted could within a few years have been made with a paying concern by biological science."

The Company were perfectly aware of the risk they ran in taking the lease, and it is astonishing that men of acute business acumen should have taken such a sanguine view of scientific operations which had only been in progress four years as to convince themselves that the intermittent fisheries, which had characterized the banks for thousands of years, should give place so soon to yearly fisheries. If the Chairman of the Company had placed the blame for the unenviable outcome of their schemes at the doors of those business men who negotiated the lease and accepted such heavy responsibilities, instead of ascribing the failure to the scientific experts, whose greatest misfortune was that they had to conduct their operations in connection with a heavily burdened commercial enterprise, he would have placed the matter in a more reasonable light.

* Journal of Economic Biology, Volume VII., Part 1., February, 1912.

REPORT ON THE WINDOW-PANE OYSTER INVESTIGATIONS, 1912.

By Joseph Pearson,
Government Marine Biologist.

(With nine Plates.)

Introduction.

THE progress of my preliminary investigations at Tamblegam during 1911 was published in *Spolia Zeylanica*, Volume VIII., Part XXIX. Two inspections were made last year—a short visit in January, which revealed the presence of a few 2- or 3-year old oysters; and one in the following September, when a bed of young oysters was discovered. This bed was not sufficiently large to hold out any hopes of a fishery, and my design was to keep these oysters as a breeding reserve for future fisheries. In my report on the survey, I expressed the belief that these oysters had been deposited subsequent to the January inspection, since no small oysters had been found early in the year.

In January, 1912, Mr. G. M. Henry, who has assisted me throughout the course of these investigations, visited Tamblegam in order to make an inspection and to erect an oyster enclosure in Nachchikkuda. He discovered that most of the oysters which were present in the previous September had died. This may be directly attributed to the excessive rainfall which took place in the concluding months of 1911. On Plate 3 a comparison is given of the distribution of the oysters before and after the rains of 1911, which will convey some idea of the havoc which was wrought. A sufficient number of oysters, however, were left to enable measurements to be taken in order to follow up the work on the growth-rate of *Placuna*, which was commenced in the previous September. In May, 1912, I made a further inspection, and then discovered a large bed of young oysters extending over an area of nearly three square miles and consisting of over fifty million individuals. A spatfall had evidently taken place since the January inspection, and this occurrence agreed

with my conclusions regarding the age of the oysters discovered in the previous September. It was also found that the oysters transplanted to the Nachchikkuda enclosure in January had all been eaten by fish. Another visit was made in June, mainly for the purpose of making transplantations from the southern part of the main bed, where the oysters were extraordinarily abundant. A brief survey of the progress of the beds was then made, and the enclosure at Nachchikkuda was again stocked with oysters after it had been strengthened. The work in June was rendered difficult owing to the strong winds and rough seas. In September ten days were occupied in making a thorough survey of the lake. The oysters proved to be thriving, and were present in large numbers. Once more the Nachchikkuda enclosure had been raided by fish and every oyster had been eaten. Transplantations from the southern portion of the main bed were effected and seven hundred oysters were placed on the Kapalturai bed, and a similar number in Nachchikkuda, outside the enclosure.

The survey of September, 1912, was made in great detail and with much thoroughness. Two boats were requisitioned—the one in which the writer worked was kindly lent by Mr. Hodson, the Assistant Government Agent at Trincomalee, and the other in charge of Mr. Henry was a hired canoe. Both boats were ordinary dugouts, without outriggers. The weather was favourable on the whole. The series of divings were made along parallel lines running S. 60° W., and in all 217 stations were investigated. At each station two divers worked for not more than 5 minutes, and made about ten descents each. It was found very difficult to take satisfactory bearings owing to the low coast line, and in consequence a series of landmarks are being erected at various points along the shore. These are as follows :—Coconut tree trunks to carry a white flag at Kodaipota, Kakkaimunai, mouth of the Tamblegam-aar, Peyaddimunai, Sallaimunai, Pataiaddimunai near Kumladdimaddam ; a cairn of whitewashed stones at Sinna Vellai Kalmunai ; whitewashed rocks at Periya Vellai Kalmunai, Maulankarai, and Semmalai.

Generally speaking, it may be said that the oysters on the beds are healthy, and given normal conditions a fishery in three years should be assured.

It is hoped that in a short time all the main points regarding the bionomics of *Placuna* will be made clear. The result of 2 years' systematic work by the present writer, together with the previous information which had been obtained, have enabled us to solve many problems which have a direct bearing on the question of the improvement of the fishery.

It is admitted that there are now three main difficulties which stand in the way of the present attempt to improve the window-pane oyster fishery at Tamblegam. I refer to the danger due to an inflow of an excessive amount of fresh water; to the ravages of

predaceous fish ; and to the illicit diving and poaching practised by the Kinniyai villagers.

The first of these dangers is a serious one. It is unfortunate that the part of the oyster bed which is richest in oysters lies off the mouths of the Sembian-aar and the Polokarai-aru, and hence is most affected by inrushes of fresh water. Transplantation would appear to be the only remedy for this very serious danger. It is nevertheless a fact that the oysters are more abundant in the southern half of the main bed, which is close to the rivers, than in the northern half, which is more remote from the mouths of the rivers. One reason of this is undoubtedly because the soft ooze upon which the oysters flourish best is carried down by the rivers, and is therefore more abundant opposite the mouth of the rivers. It is also certain than *Placuna* flourishes best in water of low density. The actual relation between the distribution of the oyster and the salinity of the water has not yet been determined. It is proposed to carry out this work for the first time in the January inspection.

If the transplantation experiments show that the oysters thrive best on the soft mud off the mouths of the rivers, as is highly probable, then we are presented with the paradox of the rivers proving both beneficial and harmful. To determine the resultant of these opposing factors will offer a nice problem to the marine biologist.

The ravages of predaceous fish are indisputable, and it is probable, as pointed out by Dr. Willey, that the young oysters are particularly in danger from this source. I have recently had this fact brought home to me very plainly. In January of this year an enclosure was made in Nachchikkuda and oysters were transplanted from area H. In May these had all disappeared, and broken shells gave unmistakable signs of fish having been the depredators. The enclosure was surrounded by wire netting supported by strong stakes and railway rails, and the fish had buried under the netting and thus gained entrance. In June the enclosure was further strengthened by the addition of numerous upright stakes about 3 inches apart, and the enclosure was again stocked. In the September examination nothing but broken shells were found in the enclosure, and the nature of the bites showed that a *Tetrodon* had probably been the culprit.

These experiments, although they failed in their main point, proved indisputably how important a factor predatory fish are in the bionomics of the window-pane oyster.

The question of poaching is one which demands serious consideration. The Moormen of the Kinniyai district are born thieves and marauders. They have a not unnatural desire to investigate the wealth of oysters which lies so conveniently near. The presence of the two watchers but feebly reminds the Kinniyai villager of those remote and shadowy things—law and order—and perhaps add just

the necessary spice to their poaching expeditions. If these villagers could be induced to believe that they stand to gain most by allowing the oyster to remain on the beds until they are in full bearing, a great improvement in the state of affairs would immediately result. I am in full agreement with Dr. Willey in regarding the revenue which accrues from the Tamblegam fisheries as of purely secondary importance. The Tamblegam window-pane oyster fishery should be looked upon primarily as a local industry worthy of encouragement. If, as the result of the investigations now being carried on at Tamblegam, the fishery can be brought back to its former prosperous condition, Government will be justified in incurring the small expenditure which the work annually entails. The present oyster bed comprises about three square miles. If only one oyster per square yard is present, the bed contains about ten million oysters. The actual number present must be nearly fifty millions. If half this number survive the two-fold dangers of weather and predatory fish, the fishery should produce a sum of Rs. 150,000, computing the oysters at the very low rate of Rs. 6 per thousand. Half this amount goes to the divers and boatmen. It may be readily seen then, that when the oysters have successfully withstood the stress of weather and have survived the inroads of predatory fish, it is of the utmost importance that some real protection against poaching should be afforded. It may be said that no fishery at Tamblegam has ever produced so large a return as Rs. 150,000. This is undoubtedly due to the continual thefts. The writer had an interview with Mr. Hodson, the Assistant Government Agent at Trincomalee, who has shown much practical sympathy with the investigations at Tamblegam. He was obliged to confess the impracticability of providing adequate protection for the oyster beds. If that be so, the scientific work can only have a partial success, and the consequence will be that instead of the fishery in 2 or 3 years' time being valued at Rs. 150,000, it will not be worth a quarter of that amount. Since the Kinniyai divers get half share of the proceeds, one would think they would not be so foolish and shortsighted as to dive for immature oysters, as they have been in the custom of doing, when by allowing the oysters to remain until rich in pearls a valuable harvest could be reaped. Added to this, there is a certain amount of resentment against the claim by Government of exclusive rights of oyster-fishing in Tamblegam. The difficulties of the position are admittedly great, and to protect Lake Tamblegam from the raids of poachers would require a staff of watchers five times as efficient as the two men employed at present. There are several hundreds of men living in the shores of Tamblegam who are experienced divers, and it may be taken for granted that two watchers, however zealous they may be, are insufficient for the purposes of supervision.

There has not been a successful fishery since 1890, but it is hard to believe that this is altogether due to an absence of sufficient

oysters on the beds for over 20 years. It is much more likely that poaching has been so extensively and continuously practised, both upon young oysters and pearl-bearing oysters, that the actual results of the meagre fisheries which have taken place have given a highly erroneous idea of the potential value of the beds.

Division into Areas, and Results of Year's Work.

It has been found convenient for the purposes of the work to divide into twenty-two parts that portion of Lake Tamblegam which contains the pearl beds. These parts are lettered A to W. With the exception of the southern boundary of A and the eastern boundary of B, these areas are separated from each other by two series of lines running at right angles to each other. One series of lines are set W. 60° N., and the other at S. 60° W. (see Plate 2).

There are five lines running W. 60° N., starting from the south-western end of the lake. These have the following position, which may be followed on the chart shown on Plate 2:—

(1) A line running E. 60° S. from Peyaddimunai (not Hornell's Peyaddimunai, which is incorrectly placed). This meets the opposite shore at the Sinna Palamput-aar (not Hornell's river of that name; he has interchanged the Sinna and Periya Palamput rivers), and separates areas U, V, and W from R, S, and T.

(2) A line taken on the shore 350 yards N. E. of the Periya Palamput-aar and running E. 60° S., separating areas R, S, and T from O, P, and Q.

(3) A line running W. 60° N. from Kakkaimunai, separating areas O, P, and Q from K, L, M, and N.

(4) A line running W. 60° N. from the mouth of the Polokarai-aru, separating areas K, L, M, and N from F, G, H. and J.

(5) A line running W. 60° N. from Kodaipota (Hornell's Kanna-munai), separating areas F, G, H, and J from B, C, D, and E.

There are three lines running S. 60° W. as follows:—

(1) A line running S. 60° W. from Periya Vellai Kalmunai, separating areas B, J, K, Q, R, and W from C, H, L, P, S, and V.

(2) A line running S. 60° W. from Sinna Vellai Kalmunai, separating areas C, H, L, P, S, and V from D, G, M, O, T, and U.

(3) A line running S. 60° W. from Korrinjavat, separating areas D, G, M, O, T, and U from E, F, and N.

Area B is bounded on the eastern side by a line running due S. from Periya Vellai Kalmunai, and area A is bounded on the southern side by a line running due E. from the same point.

As will be seen from the chart on Plate 2, the four areas, B, C, D, E, on the north side of the main bed contain but few oysters. There are also barren patches on the north-western side of the main bed (sections M and W), and in the south-western corner (sections U, V, and W).

The depth and nature of the bottom in the various sections may be made out clearly from the charts published by me in *Spolia Zeylanica*, Volume VIII., Part XXIX.

During the examination of the oysters in January, May, June, and September of this year a large number of measurements have been taken, which are given in the Appendices and are shown by means of curves on Plates 4 to 9.

Area A, Nachchikkuda.—This bed was only surveyed in September, 1912. Dived at 22 stations, but oysters found only in the four most northerly stations. Altogether 44 oysters were examined, having an average size of 3·36 × 3·70 inches. These oysters have the smallest average size in the whole lake.

The enclosure erected in Nachchikkuda in January last has been twice stocked with oysters, which have been eaten by predatory fish. In September, 1912, 500 oysters from area J were placed in this area, just south of the enclosure.

Previous writers have regarded the position of Nachchikkuda as highly favourable for oyster cultivation, lying as it does at a considerable distance from any of the rivers opening into Lake Tamblegam. The only point in its favour, to my mind, is the fact that there is not the same chance of extermination in the event of very heavy rains, but apart from this very important point, the evidence tends to show that the oysters are usually more abundant at the mouths of rivers. The evidence of the last two years shows that the Nachchikkuda bed is inferior to the main bed.

Area B.—Comprising the whole width of the lake between Periya Vellai Kalmunai and Kodaipota, it is characterized by the presence of a sandspit which stretches half-way across from Periatmunai. This area is evidently unsuitable for oysters, mainly because of the presence of too much sand.

Area C.—The north-eastern half of this area does not appear to be potentially suitable for *Placuna*, as no oysters have been found here during the last two years. The south-eastern half marks the beginning of the main central bed, and there are a fair number of this year's oysters present. In May, 9 specimens had an average size of 1·59 × 1·69 inches, an extremely low average. In June no records were taken, but in September 20 specimens showed an average size of 3·89 × 4·11 inches, which is slightly less than the average for the whole bed. Since the oysters present in this area form the fringe of the main bed, it is not surprising that they are rather small.

Area D.—No oysters have been found in this area during the last two years.

Area E.—The northerly part of this area contains the upper end of the Kapalturai bed. In the hurried inspections of May and June this area was not examined, but the September inspection revealed the presence of numerous well-grown oysters, 8 specimens of which had an average size of 4·39 × 4·87 inches.

Area F.—This contains the southerly portion of the Kapalturai bed, and here again the oysters were well grown, and 16 specimens had an average size of 4·59 × 4·65 inches in the September inspection.

Area G.—In this area the Kapalturai bed is connected with the north-western portion of the main bed. Here the oysters are abundant, but have proved throughout the year rather below the average size of the whole area.

In May, 17 specimens had an average size of 2·16 × 2·32 inches. In June, 1 specimen measured 3·25 × 3·5 inches, and in September 61 oysters showed an average of 3·85 × 4·11 inches.

Area H.—This area contains a large supply of oysters, which in the early part of the year were above the average size, but which are now slightly below the average size. In this area there are some of last year's oysters, the remnants of the bed which was destroyed by the rains of 1911.

In May, 45 specimens showed an average of 2·20 × 2·39 inches. In June, 2 oysters measured had an average of 3·12 × 3·25 inches, and the September average of 100 specimens was 3·78 × 3·99 inches.

Area J.—This area receives the water from the Sembian-aar and the Polokarai-aru, and it may be looked upon as a point of danger in the lake, as in the event of excessive floods these oysters will probably be the first to succumb. Nevertheless the young oysters are exceedingly abundant in this area. In May, 4 specimens showed an average of 1·96 × 2·15 inches. In June, 237 specimens averaged 2·90 × 3·21 inches, and in September 52 specimens had an average size of 3·96 × 4·28 inches. So that in spite of the proximity to the rivers the young oysters in this area are of good average size. 500 oysters were taken from here in June, 1912, and deposited in area T. 1,307 oysters were transplanted from this area in September to Kapalturai and Nachchikkuda, and 130 specimens were transplanted to Nachchikkuda in June, but were all eaten by fish.

Area K.—This corresponds very closely to the area J. The oysters are very abundant, but very unequal in size. Dr. Willey's statement that the oysters in this area are dwarfed is partly borne out by the results of this year's work, but the low average rate of growth is probably due to overcrowding, and not to the inherent nature of the locality.

In May, 7 specimens measured 2·57 × 2·79 inches, and in September 123 specimens averaged 3·74 × 4·02 inches.

Area L.—Here, although not so thickly disposed as in J and K, the oysters are abundant and are of average size.

In May, 8 oysters had an average size of 2·14 × 2·28 inches. In June, 2 specimens had an average of 3·25 × 3·38 inches, and in September 54 specimens averaged 3·73 × 4·02 inches.

Area M.—There are very few oysters here owing to the presence of shoal water covering the Muttikallam.

The May measurements gave an average of 2·55 × 2·85 inches for 5 oysters. In June, 1 oyster measured 3·5 × 3·75 inches, and the September average for 27 specimens was 3·91 × 4·19 inches.

Area N.—An inshore area with no oysters.

Area O.—The oysters in this area are fairly abundant, and are above the average size. Many of them, however, are rather undersized, and have reddish-brown stains on the shells.

This area was examined in September only, when 136 oysters had an average size of 4·04 × 4·41 inches.

Area P.—Oysters fairly abundant and well above the average size.

In May, 19 specimens averaged 2·27 × 2·46 inches. In June, 9 specimens measured 3·24 × 3·60 inches, and in September 115 specimens averaged 4·12 × 4·66 inches.

Area Q.—Oysters only present on the line bounding areas P and Q, and these have been included in area P. The main part of the area contains a weed which is evidently harmful to the oyster, as no *Placunæ* were found.

Area R.—Contains few oysters, but all of good size. The oysters in this area have greatly increased in growth since the first inspection in May, when they were only of average size. Now they are well above the average.

In May, 3 specimens averaged 2·04 × 2·16 inches, and in June, 1 oyster measured 3·5 × 4 inches. The September average, 4·43 × 4·94 inches, for 52 specimens, was very high.

Area S.—Few oysters of very large size are present in this area.

In May, 1 specimen measured 2·87 × 3·25 inches, and in June a single specimen measured 3·50 × 4 inches. In September the average of 12 specimens was very high, viz., 4·52 × 5·08 inches.

Area T.—Areas R, S, and T resemble each other in having extremely large oysters, which however are not very abundant. 500 oysters were placed here in June from area J.

In September the oysters in area T had an average size of 4·38 × 4·87 inches for 13 specimens.

Areas U, V, and W.—No oysters.

The nearer we approach to the south-western shore of the lake the deposit of mud increases in thickness. This is doubtless due to the large deposition of mud, which is brought down by the various rivers which open into this part. In this portion of the lake the tide is evidently not very strong. Hence the mud does not get sufficiently scattered, but forms a thick deposit opposite the mouths of the rivers. This will account for the absence of oysters in areas U, V, and W.

Rate of Growth.

The investigations of the last 12 months have enabled us to ascertain the rate of growth in the earlier stages of the oyster. Measurements of large series of oysters have been made at every inspection, and by taking the average of a sufficiently large series the approximate rate of growth has been determined.

This investigation has demonstrated the extraordinarily rapid superficial growth of the oyster in the first year. In the September inspection many oysters were found having a measurement of over 5 inches in the short diameter, although the average for the whole lake was slightly less than 4 inches.

Hornell's recommendation of a size limit of 5½ inches in short diameter for fishable oysters is shown to be unsound, as they attain this size at the age of 2 years, and so far as my experience goes no 2-year old oysters are pearl-bearers. In fact, it will be impossible to impose a size limit, as superficial growth is no criterion of pearl production. For the first 18 months the increase in size is mainly superficial. After that the increase is mainly in thickness. The only reliable method is to know the age of the oysters on the bed by having determined the date of the spatfall. After that it will be merely a matter of calculation to determine, when they will be ready for fishing.

In Appendix 3 a table is given showing the measurements from which I have determined the growth-rate, and on Plate 5 a curve of the growth-rate is given. In compiling the table and curve I was not able to use measurements from the same series of oysters. The first three sets of measurements are taken from the same batches of oysters—those which were deposited this year. The fourth, fifth, and sixth sets of measurements belong to the series of oysters which appeared in 1911. The measurements were taken this year. The last three measurements are compiled from Dr. Willey's report of the 1908 inspection.

Appendix 3 and Plate 5 show quite clearly what we should have expected, namely, that the rate of increase of growth is highest in the younger stages, and that it gradually becomes less as the oyster grows older.

In Appendix 4 and Plate 4 I have tried to show the rate of growth of first-year oysters for each area of the bed during 1912. Unfortunately these figures do not help us much in determining which are the best parts of the bed, but so far as they go they lend support to Dr. Willey's statement that the oysters on the Kakkaimunai bed (area K) are dwarfed. At any rate, their rate of increase was less than one-third of that in area C.

It is interesting to compare the relative abundance of the oysters with the growth-rate. This is shown in Appendix 4, and it is seen that with the exception of areas J, S, and M, and to a smaller extent area G, a large growth ratio is found where the oysters are scarce, and

a small growth ratio where they are abundant. That overcrowding is harmful is what one would expect, and the results tabulated in Appendix 4 support this view. If we place the areas in order of rate of increase—(1) (beginning at the largest rate of increase and finishing with the smallest) and compare this with the areas placed in order with regard to the density of the oysters on the beds (2) (commencing with the areas of low density and finishing with those of high density)—we see there is much similarity of order, and that the areas C, R P, L, H, and K support the rule that the more thickly the oysters are disposed the less quickly do they grow. The two statements show as follows :— *

(1) C, R, J, P, G, L, H, S, M, K, growth-rate.
(2) C, R, S, M, P, L, H, G, J, K, density.

With the information now collected it is possible to correct some of the conclusions regarding the age of oysters which were made by Dr. Willey in the earlier stages of the investigation, and in other places to determine the age of the oysters where this was not possible previously.

In his report of the inspection of March, 1908, Dr. Willey gives a series of measurements, which I will reproduce. To these I have added my computation of the ages of the oysters (placed in italics).

Table I.—Nachchikkuda.

May, 1905 (Hornell).—" Very young individuals," size $1\frac{3}{4}$ to 2 inches.

These were about 2 months old.

June, 1907.—44 specimens. Average 147 × 159 mm. (5·88 × 6·36 inches).

These were about 28 months old.

October, 1907.—66 specimens. Average 156 × 168 mm. (6·16 × 6·72 inches).

These were about 32 months old.

March, 1908.—24 specimens averaged about 162 × 171 mm. (6·48 × 6·84 inches).

These were about 37 months old.

Table II.—Kapalturai.

May, 1905.—The oysters had an average size of 2·92 × 3·33 inches. Hornell believed these to be 3 months older than those at Nachchikkuda of the same date. Willey states that "they may be estimated at not less than 1 year old."

We have every reason to believe that spawning takes place early in the year. Whether there would be a difference of 3 months between the

* In (1) the areas which show the highest growth-rate are placed first, and so on, in order of growth rate : in (2) the areas are arranged so that those with a low density of oysters are placed first.

earliest and latest spawnings is impossible to say. My opinion is that there would not be such a difference, and I believe these Kapalturai oysters to be only slightly older than those of Nachchikkuda, namely, about 3 months. The locality has much to do with the size of the oysters, and the last 2 years' work has shown that Kapalturai oysters are healthier and larger than those from Nachchikkuda.

June, 1907.—Average of 16 specimens 6·1 × 6·6 inches. Willey computes their age at 3 years.

I believe they would be about 28 months, that is, in their third year.

October, 1907.—Average of 15 oysters, 153 × 169 mm. (6·12 × 6·76 inches). Willey considers them about 3½ years old.

My calculation would place them at 32 months, or about 2½ years.

March, 1908.—Average of 22 oysters, 165 × 181 mm. (6·60 × 7·24 inches).

These would be 37 months.

Table III.—Kakkaimunai.

May, 1905 (Hornell).—Two samples, one estimated by Hornell at 1½ year old gave average size of 102 × 111·4 mm. (4·08 × 4·45 inches); the other estimated at 1¾ year old gave an average of 114·96 × 125·2 mm. (4·59 × 5 inches).

There may be a difference of a month or so in the ages of these two batches. The smaller ones are about 15 months old.

June, 1907.—Average of 12 specimens 111 × 119·3 mm. (4·44 × 4·76 inches). *I cannot agree with Dr. Willey's conclusion that these belong to the same generation as Hornell's 1905 oysters. If stunted growth is characteristic of the Kakkaimunai oysters, the influences at work are not sufficiently powerful to keep half-grown oysters at the same size for 2 years, between their fifteenth and thirty-ninth months. I believe that these oysters were deposited early in 1906, that is 1 year younger than Hornell's oysters.*

October, 1907.—60 oysters, having an average size of 123·87 × 133·25 mm. (4·95 × 5·33 inches).

These were undoubtedly oysters of the second year, about 20 months old; that is to say, they were probably the same batch of oysters that were measured in June.

79 oysters were measured, the smallest being 92·75 × 106·25 mm. (3·71 × 4·25 inches), and the largest 146·9 × 159·4 mm. (5·87 × 6·37 inches).

These 79 samples evidently contain oysters of three different years. The smallest ones are undoubtedly 8 months old, and the largest are probably 32 months old. We would gather from this that the majority of them would be second-year oysters, about 20 months old, deposited in 1906.

March, 1908.—Average of 16 "topotypes," 122·1 × 129·2 mm. (4·88 × 5·61 inches). *These appear to be second-year oysters, about 14 months old, and belong therefore to a 1907 brood.*

Average of 16 oysters, which were transplanted to Nachchikkuda in October, 1907, 130·1 × 141·8 mm. (5·20 × 5·67 inches).

These are evidently oysters deposited in 1906, about 26 months old.

Table IV.—Sembian-aar.

May, 1905 (Hornell).—Numerous oysters. Average size 142·25 × 155 mm. (5·69 × 6·20 inches). Hornell states that these are "probably over 2 years old."

In my opinion they are about 27 months old.

June, 1907.—Average of 12 oysters, 142·5 × 150·5 mm. (5·70 × 6·02 inches). Willey believed that these were the same brood examined by Hornell in 1905, and that growth was suspended for over 2 years. This is difficult to believe, especially as the same batch of oysters showed an increase in growth 4 months later, and a further increase 9 months later. In fact, the oysters measured in June and October, 1907, and March, 1908, appear to me to be slightly undersized oysters of the 1905 brood, and are hence 2 years younger than those measured by Hornell in 1905.

In June, 1907, they were probably 28 months old.

October, 1907.—Average of 20 oysters, 149 × 154 mm. (5·76 × 6·16 inches).

These are the same batch as those examined in June, and are probably 32 months old.

March, 1908.—Average of 20 oysters, 154·75 × 166·4 mm. (6·19 × 6·65 inches).

Probably 37 months old.

Table V.—Polokarai-aru.

October, 1907.—Average of 18 oysters, 149·6 × 154·7 mm. (5·98 × 6·18 inches).

These are some of 1905 brood, and are about 32 months old.

Transplanting.

Transplantation experiments have been in progress for some time. In the 1911 inspections full-grown pearl-bearing oysters were found in Nachchikkuda, which were the remnants of the oysters transplanted by Dr. Willey. His experience led him to believe that transplantation was not successful in the case of oysters a few months old. But this is the period when transplantation is most necessary. I have found 3-months and 6-months oysters in great profusion near the shore along the southern boundary of the main bed. So abundant were they in May of this year that the divers were able to bring up about twenty or more in a few seconds at a station a few hundred yards west of Kodaipota. In areas K and J the oysters were overcrowded during the May inspection, and to a less extent in September. Owing to the rapid growth of the young oysters there must be a great mortality through overcrowding in the first

few months, and if the oysters during this period will bear transplanting much good may be done. But transplantation at Tamblegam is a slow method, since dredging is rendered impossible by reason of the soft ooze. Diving must be resorted to, and I compute that one diver cannot bring up more than 500 oysters per hour under favourable conditions. In September, 1912, four divers brought up about 1,400 oysters in less than two hours. The total expense of transplanting is about Rs. 2·50 per thousand. Owing to the expense and slowness of the method it would seem that transplantation of large quantities with the object of improving an impending fishery is not feasible. For example, the areas J and K must have contained several million young oysters in May, 1912. It would have taken twenty divers one month to transplant one million of these to a new bed. Nevertheless, if transplanting on a large scale prove impracticable, it must not be forgotten that comparatively small numbers may be transplanted with advantage with the object of making breeding reserves.

The transplantation experiments which have been made during 1912 have in two cases ended in failure, and the result of the third have still to be determined.

The first transplantation was made in January, 1912, when 110 oysters were moved from area H to Nachchikkuda and placed in an enclosure ; unfortunately the enclosure, which was made of wire netting supported by railway rails, was not proof against the inroads of fish, as all the oysters had disappeared in May, and broken shells only too plainly indicated the manner of the extermination.

In June* the enclosure was strengthened, and 102 oysters from areas H and J were placed in it, but these again had disappeared by September. It is now proposed to surround the enclosure with a fish tat, such as is used in fish kraals in various parts of the Island. This will be erected in January next. In the meantime, in September, about 1,400 oysters were taken from section K; half were placed in area F on the Kapalturai bed and the other half in Nachchikkuda. These transplanted oysters have been measured, and their average size is similar to that of the whole area. The Kapalturai bed at the present time contains the healthiest oysters in the lake, and the Nachchikkuda oysters are the smallest, and only have an average of 3·36 × 3·70 inches, compared with 3·94 × 4·30 inches, which is the average size for the whole lake. Hence this transplantation experiment is of more than ordinary interest. We shall be able to determine whether 8-months oysters are too young for transplantation, if they are not wiped out by predatory fish, and we shall also be able to compare the effect of transplanting normal oysters to a particularly good locality and to Nachchikkuda, where the conditions at present prove to be unsatisfactory.

* In addition to this, 500 oysters were taken from area J in June and placed in area T. These are still living.

Spawning Period.

Although direct information regarding the spawning period of the window-pane oyster has not yet been obtained, all the evidence points to its occurring between January and March. This much is certain, and it is hoped that in the early months of 1913 confirmation of this point will present itself. In the chart on Plate 5, which shows the rate of growth, I have assumed that the spatfall takes place in February. The exact date may be expected to show some variations in different years, according to the weather and other influences. Large 2-year oysters were found to have ripe gonads in January. Very few 2-year oysters were present in the lake in January of this year, and yet a very large spatfall took place some time between January and May. It is just possible that oysters are sexually mature at the age of 12 months. If this be so the large spatfall of this year could be accounted for by the presence of a considerable number of 12-months oysters on the beds at the time when spawning must have taken place. After the 1911 oysters had been decimated by the rains, there was still a sufficient number left to repopulate the bed if these oysters were ripe. It is proposed to examine all these points in January next. The floating larvæ have not yet been found in the surface water.

In September the first-year oysters had small pale-yellow gonads, and were in an extremely immature condition. The second-year oysters had much larger gonads of an orange colour. It is almost certain that these will spawn in January or February next.

It may be stated confidently that *Placuna* spawns only at one period of the year, namely, in January or February. Willey expressed the opinion more than once that all the oysters existing on the bed at the same time were of the same age, and that fisheries could not follow one another year after year as the oysters of different ages came into full bearing. It may be true, as a matter of practice, that after a fishery in any particular year insufficient oysters are left for a fishery the following year, but this, I take it, is not due to the absence of oysters of different generations, but to the reckless methods of fishing, by which a bed is depopulated during one fishing, irrespective of age. The fact is, that oysters of different ages do occur at the same time on the beds. This is proved conclusively by the investigations of 1911 and 1912. The practical difficulty still remains how to preserve the non-bearing oysters during a fishery. Oysters of different ages will be lying side by side, and as we have seen a size limit is of little value. Nevertheless, experienced divers can tell at a glance the different ages of the oysters. In the event of oysters of two ages being present together on the beds during a fishery, it would be necessary to instruct the divers to return all the younger oysters to the water. Supervision

of all the boats coming ashore would be necessary, and in the event of young oysters occurring in the "catch," the boatmen concerned would be required to return the oysters to the water.

Establishment of a Close Season.

On further consideration of the question of a close season I feel obliged to modify the opinion I expressed in *Spolia Zeylanica* Volume VIII., Part XXIX. I then agreed with Mr. Hornell that without knowing the spawning period of the oyster the local conditions at Tamblegam rendered it easy to establish an effective close season from May to January, since during these months the water is too rough for successful diving. Weather conditions render diving possible only from January to May, but if January or February prove to be the spawning months, as I believe likely, it will be unwise to allow fishing until spawning has actually taken place. I, therefore, think that the window-pane oyster fishery should only be prosecuted from March 1 to the end of May in any one year. This period of 3 months gives ample time to complete the fishery.

Effect of Excessive Rainfall.

As Dr. Willey has pointed out, the rainfall plays a very important part in the bionomics of the window-pane oysters. I have expressed the view elsewhere in this report, that though too much fresh water is harmful a certain proportion mixed with the sea water is necessary. The rain has a further use in carrying down the mud, which when deposited in Lake Tamblegam forms a suitable habitat for the window-pane oyster. The continuity of my observations on the window-pane oyster were rather abruptly interrupted at the end of 1911, when, as the result of the abnormal rains, the greater portion of a young bed of oysters was wiped out. Chart 3 shows the comparison between this bed before and after the rains, and in Appendix 2, through the kindness of Mr. A. J. Bamford of the Colombo Observatory, I am able to give the rainfall in various parts of the Tamblegam district for the months of October, November, and December.

Pearl Production.

During the last two years the oysters present on the beds have been too young for pearl production. In consequence little progress has been made with the question of the best age for fishing the oysters for pearls. This branch of the work will be steadily prosecuted as the oysters get older. At present it may be said that oysters in the first and second years do not bear pearls of any size and in any quantity. From the results of previous work it would seem that oysters of less than three years do not contain many pearls. The fourth year appears to be the critical time.

Appendix 1.—Summary of Measurements, 1912.

(First-year Oysters.)

Area.	May. Numbers examined.	May. Average Size in inches.	June. Numbers examined.	June. Average Size in inches.	September. Numbers examined.	September. Average Size in inches.
A	Not examined	—	Not examined	—	44	3·36 × 3·70
B	—	—	—	—	—	—
C	9	1·59 × 1·69	—	—	20	3·89 × 4·11
D	—	—	—	—	—	—
E	Not examined	—	Not examined	—	8	4·39 × 4·87
F	Not examined	—	Not examined	—	16	4·59 × 4·65
G	17	2·16 × 2·32	1	3·25 × 3·5	61	3·85 × 4·11
H	45	2·20 × 2·39	2	3·12 × 3·25	100	3·78 × 3·99
J	4	1·96 × 2·15	237	2·90 × 3·21	52	3·96 × 4·28
K	7	2·57 × 2·79	Not examined	—	123	3·74 × 4·02
L	8	2·14 × 2·28	2	3·25 × 3·38	54	3·73 × 4·02
M	5	2·55 × 2·85	1	3·5 × 3·75	27	3·91 × 4·19
N	Not examined	—	Not examined	—	Not examined	
O	Not examined	—	Not examined	—	136	4·04 × 4·41
P	19	2·27 × 2·46	9	3·24 × 3·60	115	4·12 × 4·66
Q	Not examined		Not examined	—	—	—
R	3	2·04 × 2·16	1	3·50 × 4·00	52	4·43 × 4·94
S	1	2·87 × 3·25	1	3·5 × 4·00	12	4·52 × 5·08
T	Not examined	—	Not examined	—	13	4·38 × 4·87
U	Not examined	—	Not examined	—	—	—
V	Not examined	—	Not examined	—	—	—
W	Not examined	—	Not examined	—	—	—
Total	118	2·22 × 2·40	254	2·94 × 3·22	833	3·94 × 4·30

Appendix 2.—Rainfall of Tamblegam District.

	October.		November.		December.	
	Inches.	Days.	Inches.	Days.	Inches.	Days.
Trincomalee, 1911	8·42	19	12·74	21	24·76	23
Average for 42 years	8·03	16	14·00	19	14·51	19
Minneriya, 1911	23·83	23	37·88	23	53·52	21
Average for 13 years	12·65	16	13·27	16	15·12	15
Topawewa, 1911	15·30	13	25·43	17	51·00	16
Average for 21 years	9·23	12	10·98	12	15·45	14
Kanthali, 1911	12·59	21	14·26	19	25·03	22
Average for 36 years	8·99	11	12·68	13	15·79	14
Andankulam, 1911	9·19	18	18·58	19	30·37	18
Average for 21 years	5·88	11	13·27	14	15·74	14
Allai, 1911	11·03	15	28·50	21	28·67	23
Average for 36 years	9·25	11	13·73	14	20·11	15
Periyakulam, 1911	11·69	16	13·84	18	25·61	15
Average for 36 years	6·54	9	12·19	13	15·72	13

Appendix 3.—Growth-rate of Oysters.

Year.	Month.	Probable Age.	Size in Inches.*	Number of Oysters measured.	Average Growth per Month since last Measurement.*	Growth Ratio per Month since last Measurement.†
First year	May	3 months	2·22 × 2·40	118	·74 inches	—
	June	4½ months	2·94 × 3·22	254	·48 inches	·215
	September	7 months	3·94 × 4·30	833	·40 inches	·135
	January	11 months	4·40 × 4·91	63	·115 inches	·029
Second year	June	16½ months	4·68 × 4·82	56	·050 inches	·011
	September	19 months	4·95 × 5·25	31	·108 inches	·023
Third year	June	28 months	5·94 × 6·42	60	·110 inches	·022
	October	32 months	6·16 × 6·72	66	·055 inches	·009
Fourth year	March	37 months	6·55 × 7·07	39	·078 inches	·012

N.B.—The last three sets of measurements are taken from Dr. Willey's Paper in *Spolia Zeylanica*, Volume V., Part XIX., pp. 130–138.

* Using measurements of short diameter only.

† *i.e.*, increase in size compared with total size.

Appendix 4.—Growth-rate of First-year Oysters in various parts of the Beds during 1912.

(The areas are given in order of rate of increase. In some areas measurements were taken in September only, and in these no rate of growth can be given.)

Area.	Size of Hinge Diameter in May.	Rate of Increase in June.	Rate of Increase in September.	Relative Abundance of Oysters (Approximate).
C	1·59 inches	Not measured	1·44	Very scarce
R	2·04 inches	·71	1·17	Very scarce
J	1·96 inches	·48	1·02	Very abundant
P	2·27 inches	·42	·86	Scarce
G	2·16 inches	·50	·77	Abundant
L	2·14 inches	·51	·74	Abundant
H	2·20 inches	·41	·71	Abundant
S	2·87 inches	·32	·57	Very scarce
M	2·55 inches	·37	·53	Very scarce
K	2·57 inches	Not measured	·45	Very abundant
Whole Area	2·22 inches	·32	·77	Fairly abundant

Appendix 5.—Measurements of First-year Oysters, May, 1912.

(See also Plate 6.)

Size (Hinge Diameter). Inches.	No. of Specimens.	Size (Hinge Diameter). Inches.	No. of Specimens.
$1\frac{1}{8}$	2	$2\frac{3}{8}$	5
$1\frac{1}{4}$	1	$2\frac{1}{2}$	20
$1\frac{3}{8}$	3	$2\frac{5}{8}$	11
$1\frac{1}{2}$	7	$2\frac{3}{4}$	10
$1\frac{5}{8}$	10	$2\frac{7}{8}$	4
$1\frac{3}{4}$	4	3	3
$1\frac{7}{8}$	8		
2	16	Total oysters	122
$2\frac{1}{8}$	10		
$2\frac{1}{4}$	8		

Appendix 6.—Measurements of First-year Oysters, June, 1912.

(See also Plate 7.)

Size (Hinge Diameter). Inches.	No. of Specimens.	Size (Hinge Diameter). Inches.	No. of Specimens.
$2\frac{1}{4}$	4	$3\frac{3}{8}$	15
$2\frac{3}{8}$	4	$3\frac{1}{2}$	25
$2\frac{1}{2}$	19	$3\frac{5}{8}$	4
$2\frac{5}{8}$	24	$3\frac{3}{4}$	10
$2\frac{3}{4}$	33	$3\frac{7}{8}$	2
$2\frac{7}{8}$	31	4	6
3	44		
$3\frac{1}{8}$	24	Total oysters	287
$3\frac{1}{4}$	42		

Appendix 7.—Measurements of First-year Old Oysters, September, 1912.

(See also Plate 8.)

Size (Hinge Measurements). Inches.	No. of Specimens.	Size (Hinge Measurements). Inches.	No. of Specimens.
$2\frac{1}{2}$	2	$4\frac{3}{8}$	52
$2\frac{5}{8}$	3	$4\frac{1}{2}$	75
$2\frac{3}{4}$	3	$4\frac{5}{8}$	23
$2\frac{7}{8}$	1	$4\frac{3}{4}$	21
3	18	$4\frac{7}{8}$	10
$3\frac{1}{8}$	20	5	9
$3\frac{1}{4}$	33	$5\frac{1}{8}$	1
$3\frac{3}{8}$	37	$5\frac{1}{4}$	—
$3\frac{1}{2}$	64	$5\frac{3}{8}$	—
$3\frac{5}{8}$	57	$5\frac{1}{2}$	—
$3\frac{3}{4}$	82	$5\frac{5}{8}$	2
$3\frac{7}{8}$	51		
4	140	Total oysters	864
$4\frac{1}{4}$,$4\frac{1}{8}$	71		
$4\frac{1}{4}$	89		

Appendix 8.—Measurements of Second-year Oysters, January, 1912.

(See also Plate 9.)

Size (Hinge Diameter). Inches.	No. of Specimens.	Size (Hinge Diameter). Inches.	No. of Specimens.
4	4	5	4
$4\frac{1}{8}$	2	$5\frac{1}{8}$	2
$4\frac{1}{4}$	2	$5\frac{1}{4}$	1
$4\frac{3}{8}$	7	$5\frac{3}{8}$	—
$4\frac{1}{2}$	24	$5\frac{1}{2}$	1
$4\frac{5}{8}$	2		
$4\frac{3}{4}$	8	Total specimens	63
$4\frac{7}{8}$	6		

Appendix 9.—Measurements of Second-year Oysters, June, 1912.

(See also Plate 9.)

Size (Hinge Diameter). Inches.	No. of Specimens.	Size (Hinge Diameter). Inches.	No. of Specimens.
$4\frac{1}{4}$	3	$5\frac{1}{8}$	3
$4\frac{3}{8}$	5	$5\frac{1}{4}$	7
$4\frac{1}{2}$	3	$5\frac{3}{4}$	—
$4\frac{5}{8}$	4	$5\frac{1}{2}$	2
$4\frac{3}{4}$	10		
$4\frac{7}{8}$	7	Total specimens	56
5	12		

Appendix 10.—Measurements of Second-year Oysters, September, 1912.

(See also Plate 9.)

Size (Hinge Diameter). Inches.	No. of Specimens.	Size (Hinge Diameter). Inches.	No. of Specimens.
$4\frac{1}{4}$ ..	1	$5\frac{1}{4}$ ..	4
$4\frac{3}{8}$ ..	—	$5\frac{3}{8}$ ..	4
$4\frac{1}{2}$ ..	3	$5\frac{1}{2}$ ..	1
$4\frac{5}{8}$ ..	3	$5\frac{5}{8}$ ..	1
$4\frac{3}{4}$ ..	4		
$4\frac{7}{8}$ ..	5	Total specimens..	45
5 ..	14		
$5\frac{1}{8}$ ..	5		

Explanation of Plates.

1. *Placuna* shells showing evidence of having been bitten by fishes $\times \frac{1}{2}$.
2. Map of Lake Tamblegam, showing the distribution of oysters in September, 1912, and also the division of the lake into areas. Scale $1\frac{1}{8}$ inch to 1 mile.
3*a*. Map of Lake Tamblegam, showing the distribution of the 1911 oysters before the rains.
3*b*. Map of Lake Tamblegam, showing the distribution of the 1911 oysters after the rains. Scale $\frac{7}{8}$ inch to 1 mile.
4. Comparison of the sizes of 1912 oysters in each area for May, June, and September, 1912.
5. Curve showing rate of growth of *Placuna* during 3 years.
6. Curve showing sizes of 1912 oysters in May, 1912.
7. Curve showing sizes of 1912 oysters in June, 1912.
8. Curve showing sizes of 1912 oysters in September, 1912.
9. Three curves showing sizes of 1911 oysters in January, June, and September, 1912.

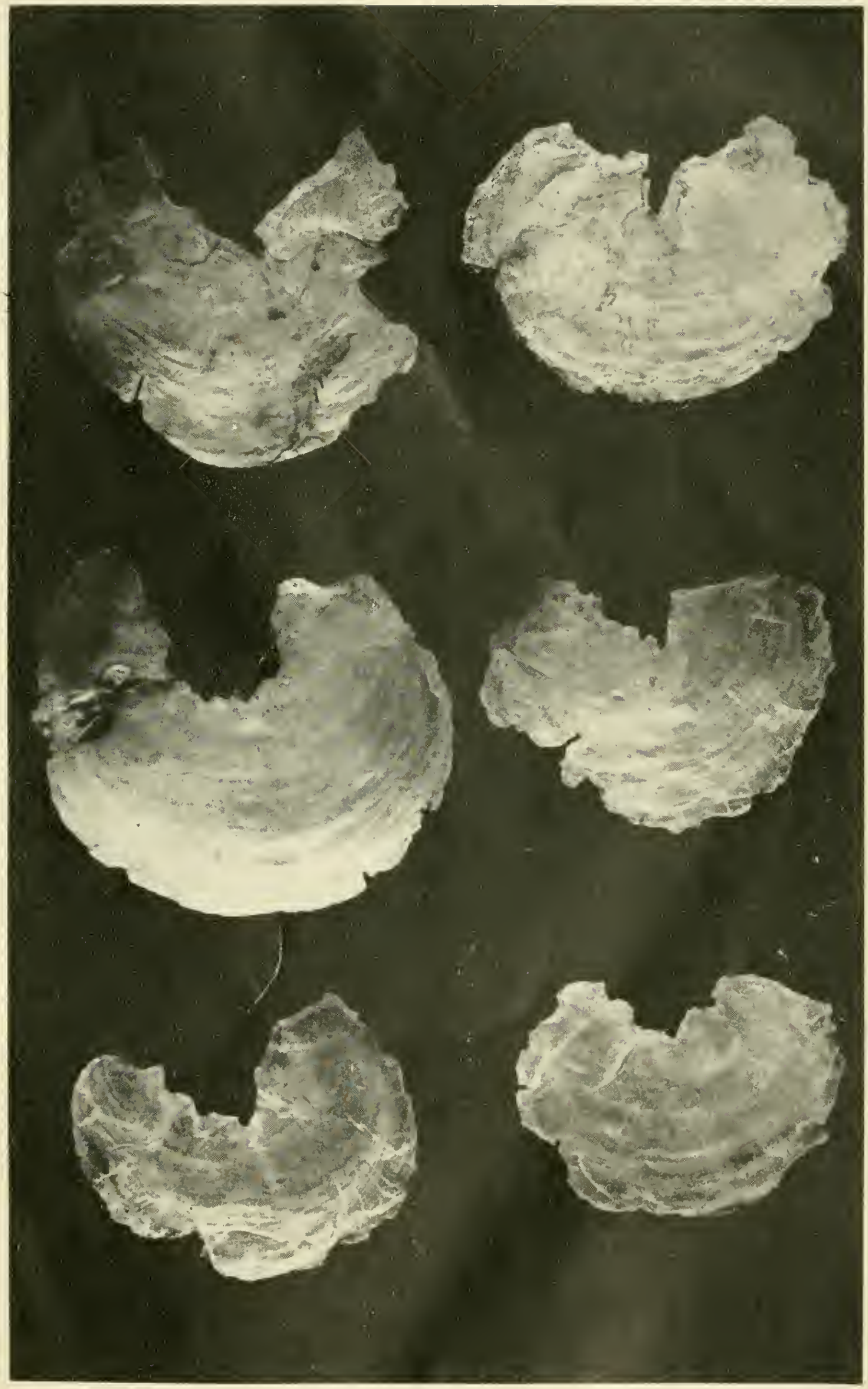


PLATE I. — *Placuna* shells after having been bitten by fishes.

PLATE II. — Map of Lake Tamblegam showing the distribution of Oysters in September, 1912, and also the division of the lake into areas. (Scale $1\frac{1}{6}$ inch to 1 mile.)

PLATE III. — A: Map of Lake Tamblegam showing distribution of the 1911 Oysters before the rains.
B: Distribution of 1911 Oysters after the rains. (Scale $\frac{7}{8}$ inch to 1 mile.)

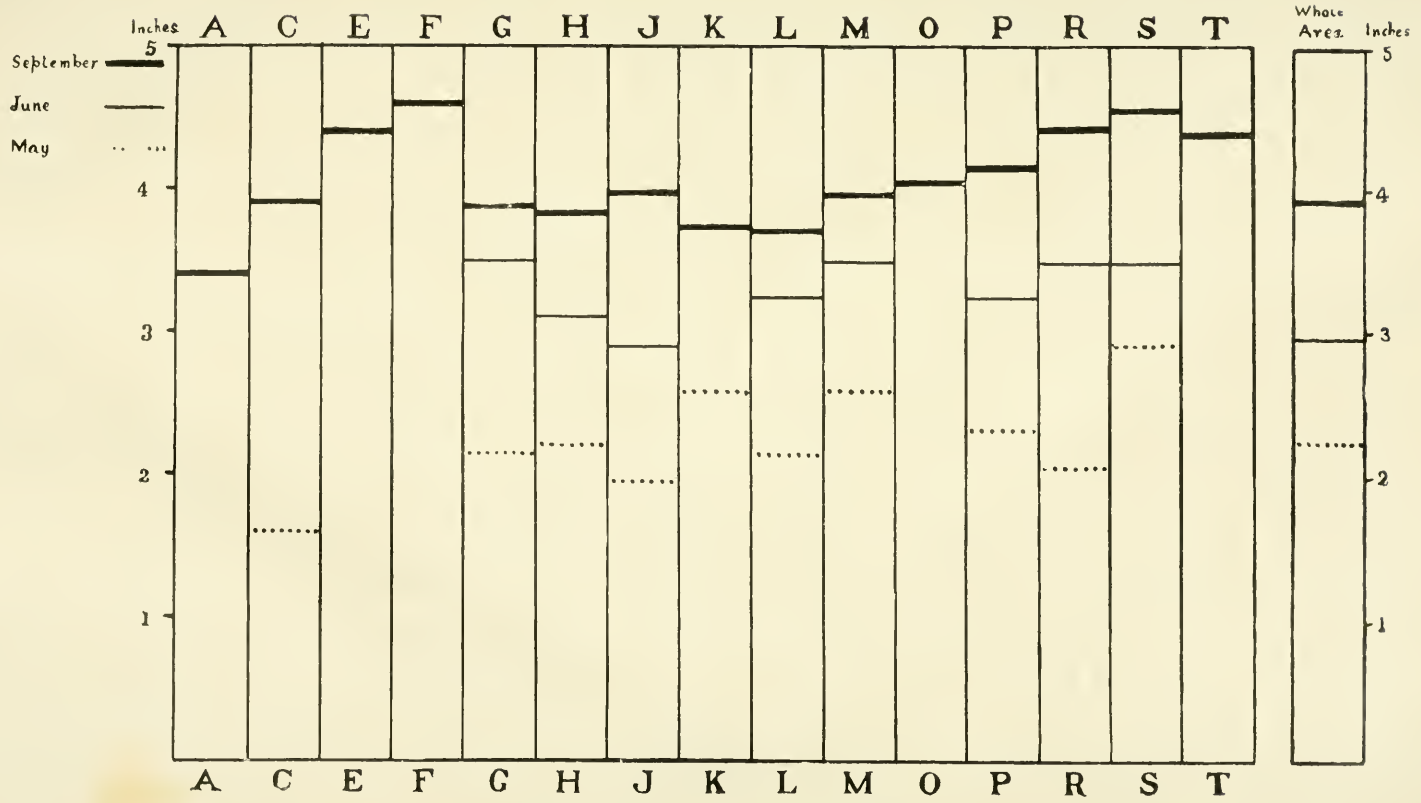


PLATE IV. — Comparison of the sizes of 1912 Oysters in each area for May, June, and September, 1912.

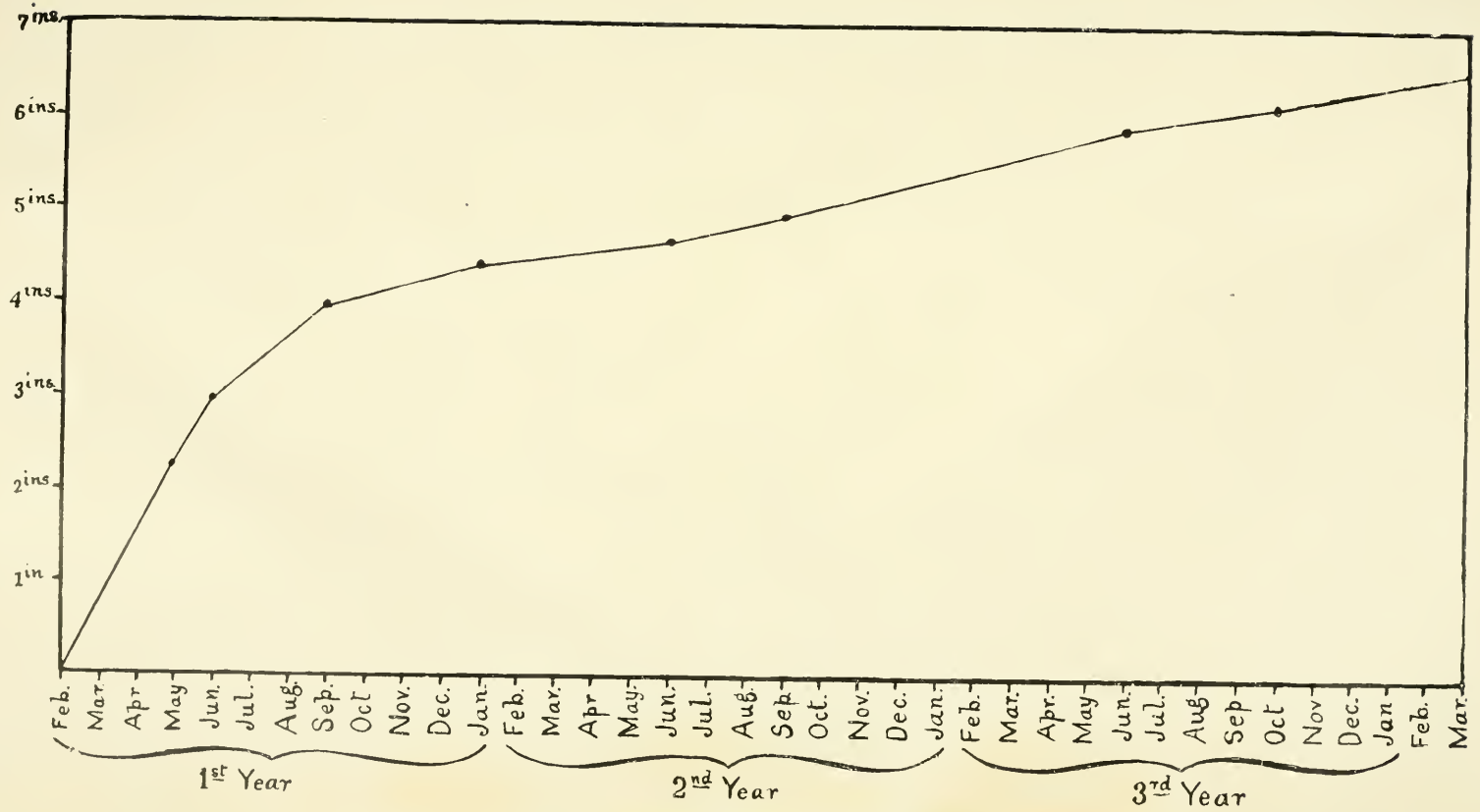


PLATE V. — Curve showing rate of growth of *Placuna* during three years.

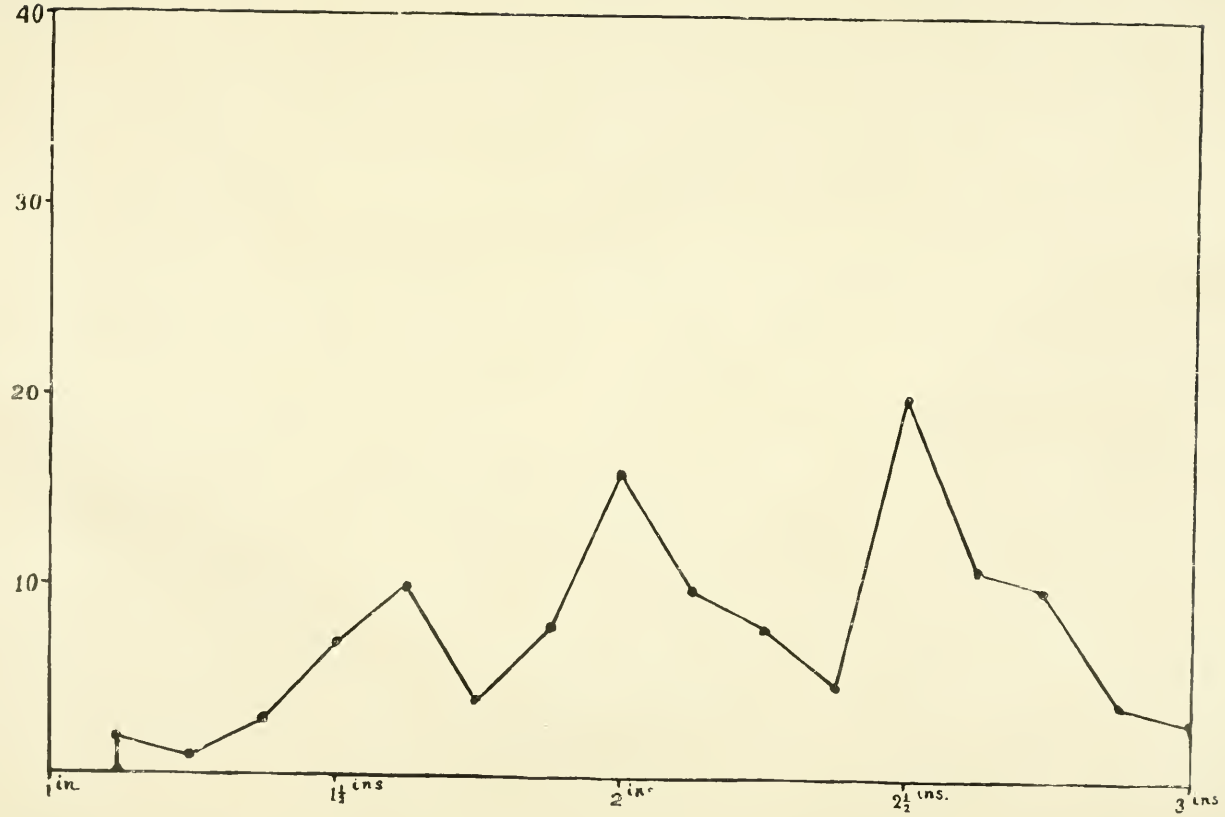


PLATE VI. — Curve showing sizes of 1912 Oysters in May, 1912.

PLATE VII. — Curve showing sizes of 1912 Oysters in June, 1912.

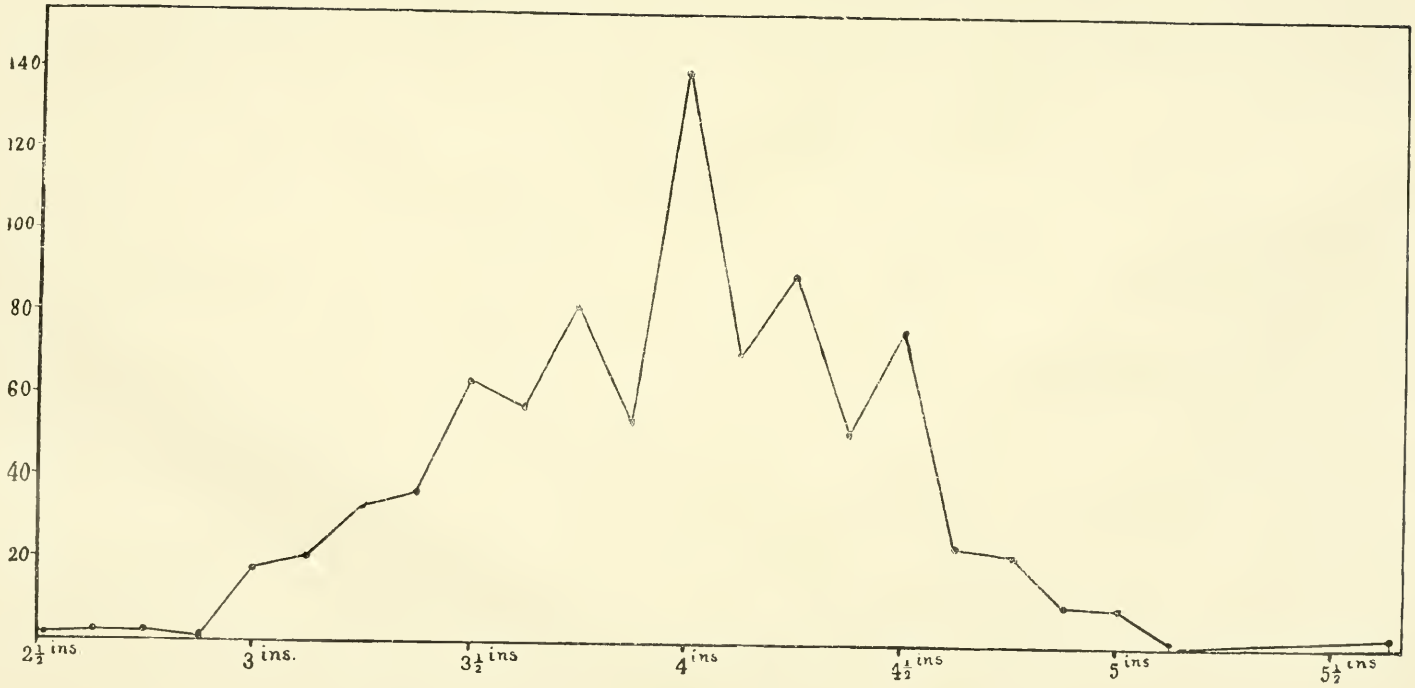
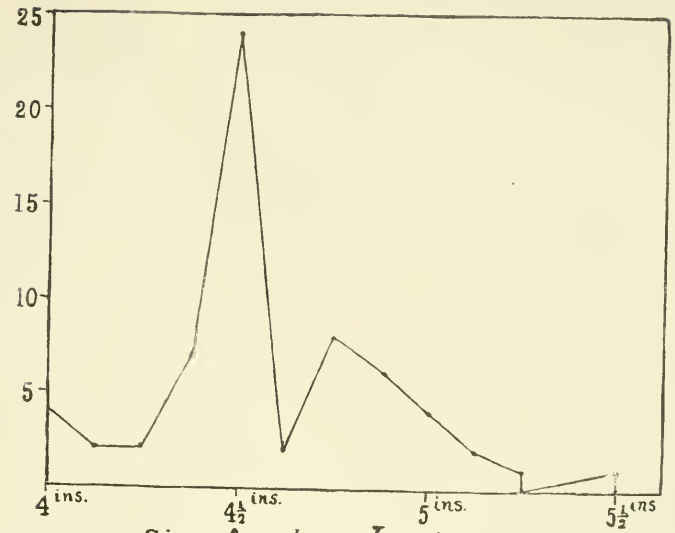
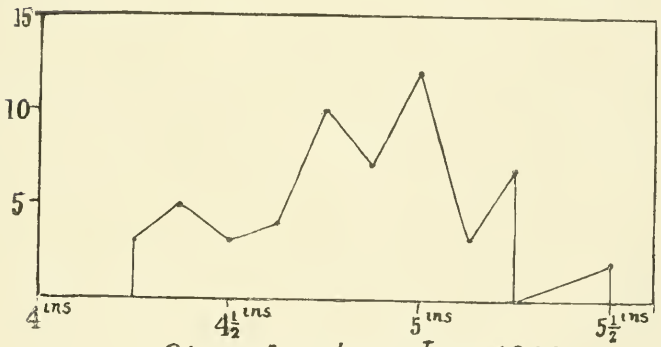


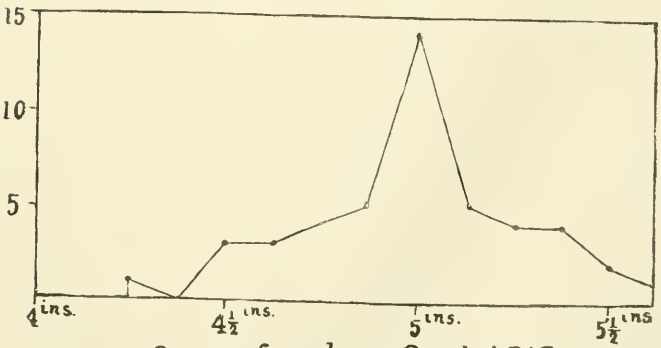
PLATE VIII. — Curve showing sizes of 1912 Oysters in September, 1912.



Size of oysters Jan. 1912
11 months old.



Size of oysters June 1912
16 months old.



Size of oysters Sept 1912
19 months old

PLATE IX. — Curves showing sizes of 1911 Oysters in January, June, and September, 1912.

NOTES ON THE FRESH-WATER FISHES OF CEYLON.*

By A. H. Pertwee.

THE following notes, dealing with some of the better known varieties of our fresh-water fishes, do not claim to be either strictly original or of a highly scientific nature; rather I shall endeavour, by calling attention to certain interesting features of fish life, to stimulate and foster an interest in what is, to my mind, one of the most absorbing branches of Natural Science.

It is a curious and regrettable fact that while other branches of Nature Study have been exploited to a large and increasing extent, very little progress—in this country at all events—has been made in that branch devoted to the life-history of our fishes.

In histories of the past century we find the names of scientific giants like Dr. Day, Emerson, Jerdon, Buchanan, and others who devoted many years of strenuous work to the study of fish life, but, alas, the results of their labour remain buried in volumes seldom consulted, except for purpose of reference by the small band of disciples who are trying to carry on the good work they began.

As I have already said, the study of fish life is a most fascinating one, and to those members of this Society who have not yet identified themselves with any particular subject, I very strongly commend the study of our fresh-water fish. Here, almost at your doors, you will find revealed some of the most wonderful of Nature's mysteries, some of the greatest of the Creator's works, and it is a most astonishing thing that such apathy as now exists regarding this subject should continue.

One of the objects of this Paper is to destroy that apathy.

The first specimen to which I desire to call your attention is *Ophiocephalus striatus*. Those of you who have already made his acquaintance at table will doubtless recognize him as the *loola* (once described as "cotton wool stuffed with pins"), and those who have met him at the end of a line will know him for the low-down rascal he is. Yet, apart from epicurean or sporting considerations, there are few fish whose domestic life is so full of interest. The majority of fish deposit their eggs, varying in number from a few hundreds to many thousands, according to species and conditions, and in localities suitable for incubation by natural heat, and, so far as

* Read before the Ceylon Natural History Society on Friday, June 7, 1912.

they are concerned, the matter ends there. Not so the *loola*, which appear to have a highly developed sense of parental duty, and not only remain in the vicinity of their ova until the fry appear, but will fight with extraordinary ferocity any intruder approaching their eggs.

I once watched a pair of *loola*, each about a foot long and probably two or three years of age, guarding a spawn cast in one of the Anuradhapura tanks. The feeble movements of the female fish and the usual tameness of both in quite shallow water surprised me considerably at first, until I saw moving toward them a large fresh-water tortoise, evidently intent on a meal of fish roe. Pisciculturalstudents know, and doubtless most fish share our knowledge, that of all enemies to fish culture the water tortoise (*Testudo*) is one of the most deadly. Should any other fish approach the *loola* nest, two well-armed, widespread jaws, backed by ferocious jealousy and dauntless courage, will promptly "attend to his case," and lucky the intruder that gets away alive. But what of this armour-clad robber, protected from helm to heel, who deliberately waddles up to the precious spawn, and in three minutes devours what might in a few months have been several hundredweight of fish. The parents are utterly and entirely helpless. On this particular occasion, however, the enemy received a rude shock in the shape of a rifle bullet, which put an abrupt period to his depredations, and incidentally no doubt frightened the parents out of their wits. But so strongly attached are the *loola* to their ova and fry, that in a very few minutes both were back again, watching with evident satisfaction the dying kicks of the would-be robber. I am unable to say if they eventually saw their labour through to a satisfactory issue, but one cannot help hoping that they did so.

There are nine Indian species of *ophiocephalus*, all of which are remarkable for the fact that they exhibit a strong parental affection for their offspring. As I have already mentioned, they stoutly resist any marauder that may approach their spawn, but this is not by any means the sum of their care. For several days after spawning they remain on guard, until the warmth of the sun and the mysterious processes of Nature convert the mass of jelly-like spawn into myriads of fry, each one thin as a pin and shorter than a grain of rice.

In human families twins are (I understand) considered rather an alarming eventuality, while triplets are a matter calculated to make both parents do a lot of hard thinking, but even quadruplets are a mere nothing compared with a healthy *loola* family, which may easily run to five thousand or more. Nothing daunted, however, Mr. and Mrs. Loola, far from deserting their helpless family, as more aristocratic fish are apt to do, now become more assiduous than ever, and proceed to round up and swim off with their interesting progeny

in search of suitable feeding ground. Just exactly how long this happy state of things lasts seems to depend on various circumstances, and very little is definitely known on that point. What we *do* know however—and I sorrowfully record so sad an end to so happy a beginning—is that as soon as the fry get big enough to be worth eating both parents proceed to make a hearty meal on those members of the family who have not developed sufficient sense to get under adequate cover.

Before we part with our cannibal friend, I wish to call your attention to another peculiarity of his, namely, that of breathing the air, much as human beings breathe. According to Thomas, this is the way of it: "The murral (or *loola*) lives a long time without water, and the reason for this is that, unlike most fish which breathe only the oxygen contained in solution in the water, the *Ophiocephalidæ* inhale the atmospheric air direct. They may be seen coming up to the surface continually, exhaling a bubble and taking in a mouthful of fresh air, and they have an air cavity for the storage of fresh air. If confined in a globe or other vessel, with a net stretched across a little below the surface of the water, so as to prevent them breathing the atmospheric air direct, they will die from not being able to oxygenate their blood, however fully supplied with oxygen the water may be. Being thus able to breathe our air, and being commonly dependent on it, they do not suffer like other fish on being transferred to it. Indeed, they travel on land of their own accord, and one allowed to jump out of your can or tub will soon be seen to wriggle a considerable distance on land, and to keep it up long after any of the carps would be dead."

The foregoing references to *loola* spawn suggest a brief word or two on the important subject of reproduction generally, and more particularly with regard to the peculiar conditions existing in this country. You will all be aware that in most countries legislation has been brought to bear on this subject, and, very properly, stringent laws have been enacted for the protection of fish during their breeding season. In England coarse fish enjoy a close season from March 15 to June 15 or 30, and trout from October 2 to February 1, while in certain districts the dates are varied slightly to meet peculiar local conditions.

In Ceylon, however, little or nothing has been done in this direction, and although official inquiries into an alleged depletion of our fresh-water fish supply are now in progress, it seems likely to be some years before we arrive at anything adequate in the shape of protection.

To the uninitiated this would appear to be an excellent opportunity to cast another stone at an apathetic Government, but the results of many years of close observation has taught us that there is hardly a month in the year in which one or more varieties of our fresh-water fishes are not propagating their species, and that several

varieties are known to produce as many as three or four families in the course of twelve months—in other words, breeding all the year round. The difficulty therefore would appear to lie, not so much in when to restrict fishing, as to ascertain the period that will afford the greatest protection to the greatest variety of valuable fish, recognizing that in any case a certain amount of sacrifice has to be faced. We now know that, unfortunately, another difficulty has to be overcome in the fact that certain fish vary their time of spawning from year to year, and so upset all ordinary calculations. From my notes I find that the *moda* (*Lates calcarifer*) in Negombo lagoon were spawning freely in December and January, 1909, and that out of eighteen specimens I examined at Christmas fourteen were full of ova. This year, however (at the same place), I found no indication of spawn in January, and was informed by reliable fishermen that no fry had been observed for several months. In March (last) I caught two specimens there, and examined them with several others, all of which had the appearance of having recently spawned, and were in the worst possible condition. But my own opinion in this matter of protection is that, to be of any real value, protection will have to come rather from greater restriction in the use of small-meshed nets than from prohibition during any set season. The abolition of nets capable of taking fry, and the suppression of river kraals, combined with the bi-annual floods most of our rivers are subject to during the two monsoons, would, I believe, do more in the way of protection than a three months close season. This, however, is a matter which, as I have already said, is now receiving the attention of Government, and to those who care to look further into what has already been done, I commend a perusal of the Administrative Reports dealing with the subject. I may add, however, that in some parts of the Southern Province river kraals have been officially recognized as an unnecessary evil and abolished accordingly.

Before leaving the subject of reproduction, I should like to make brief reference to a well known fresh-water fish common throughout the East, and found in practically every river, tank, and pond in Ceylon. I refer to *Arius falcarius* or the *anguluwa*, to give its Sinhalese name. A more repulsive-looking creature it would be difficult to imagine, but nevertheless he has several redeeming features, not the least of which is that he is uncommonly good to eat if freshly caught. But *Arius*, in common with one or two other varieties of the Siluridæ family, has a more important claim on our attention than the flavour of his flesh, for he has developed the extraordinary habit, not only of hatching his family in his mouth, but of permitting his offspring to take shelter therein when pursued by enemies.

Thomas, the distinguished Indian Civilian, who devoted many years to the study of fresh-water fish, says, referring to the Siluroids

generally : " Some bring forth their young alive, who flee for refuge into their mouths. Some of them I have observed hatch their ova in their mouth, and keep them there even after being hatched. Dr. Day and I examined over 500 of these fish in company on one occasion, besides the observations we had each made separately. The conclusions we came to were, that the female seemingly holds the eggs (which are about half an inch in diameter) in her two large cup-like ventral fins, whence they are taken by the male, who thenceforward keeps them in his mouth, never eating, till they are hatched." It has been suggested that the suffragette idea is not quite so new as we thought it.

The *anguluwa*, in common with *Mastacembelus*, *Ophiocephalus*, and (I think) *Saccobranchus*, are included in a group of fish peculiar for the fact that they are able to hibernate through lengthy periods in sun-dried clay, which peculiarity extends also to the eggs of these species.

In India, where it frequently happens that protracted drought results in dried-up rivers and tanks, it is a common experience to find, after a few hours' rain, practically every little pond and wayside pool teeming with tiny fish, though the nearest water prior to the rain was miles distant. This phenomena, perhaps naturally, has given rise to a widespread belief, which, by the way, is not confined to natives of the country, that a beneficent Providence occasionally showers down fish to replenish barren water, but the believer usually fails to explain the absence of any fish whatever in that portion of the downpour which may be caught in buckets or other receptacles.

The mention of small tanks and restricted areas of water suggests another point of interest to students of fish life, namely, the effect of confined space on the fish themselves. This curious effect is very marked in the case of *Barbus tor*, the famous sporting fish, better known as Mahaseer or Leyla.

Colonel Gordon Reeves, who has probably had a more extensive acquaintance with this fish in Ceylon than any other recent observer, mentions a specimen caught in the Mahaweli-ganga which weighed 23½ lb., and, so far as I know, this constitutes the record weight for this country. Now, in the large Indian waterways, like the Ganges and Jumna, 23 or 24 lb. would be considered a comparatively small Mahaseer, and numerous specimens have been caught which weighed well over 100 lb., my own bags having included several verging on 60 lb. In the Bangalore Museum there used to be, and no doubt still is, the head of a specimen caught by Colonel Sanderson, the authenticated weight of which was 150 lb., and the same authority speaks of others weighing from 200 to 250 lb.

Nor is this curious effect confined to the members of the carp family, as may readily be seen by comparing other varieties common to Ceylon with specimens of the same from the adjoining continent.

And speaking of India, I should like, in passing, to point out that there are no fresh-water fishes found in Ceylon which do not occur in Southern India, which fact would seem to furnish further evidence in support of the theory that in remote ages this Island was part of the adjacent peninsula. There are, of course, other ways of accounting for the coincidence, but a land connection intersected by a river (or perhaps several rivers) appears to me the most probable explanation.

In a small country like Ceylon, entirely surrounded by the ocean and traversed by numerous large rivers, it is quite natural that marine and estuarial fish comprise a very large proportion of the total annual catch, and although my remarks are supposed to deal exclusively with fresh-water fish, it is of interest to note that under certain conditions the scaly inhabitants of our estuaries readily accommodate themselves to fresh or slightly brackish water, and *vice versâ*. The gray mullet and *Chanos salmoneus* are notorious for this adaptability, and *Etroplus suratensis* provides another instance. There are numerous lagoons all round our coasts, such as Kalutara and Negombo (to mention only two out of many), divided by quite a narrow sand strip from the sea, in which the water is fresh, or practically so, and yet they contain several species of fish usually found only in the sea, or at any rate in salt water. Moreover, these fish have lived and reproduced their kind there for many years, and apparently suffer no inconvenience. The salmon in European waters has been quoted as a similar instance of adaptability, but as a matter of fact this fish only returns to fresh water for a specific purpose, namely, to deposit its eggs and hatch the young, so the cases are not analagous.

In conclusion, I wish to draw your attention for a few minutes to a fish which I imagine very few of you have ever seen before, either alive or dead. I refer to *Osphromenus olfax*, the *gourami* of the Far East, to acclimatize which in Ceylon several attempts have been made during the past twenty years. As stated in a recent number of *Spolia Zeylanica* Mr. G. M. Fowler, C.C.S., procured a number of these fish some dozen years ago and distributed them amongst certain tanks, the localities of which, unfortunately, have not been preserved. A few weeks ago, however, I was fortunate enough to discover six of them in an ornamental piece of water, and a photograph of one secured therefrom, with the help of Dr. Pearson and his staff, is now displayed on the screen. This timely find has established beyond doubt that the *gourami* will live in Ceylon, but it also makes evident the fact that they will not necessarily reproduce themselves. So far as I am able to judge, all six of the specimens in question belong to the same batch and are of the same age—roughly, twelve years—but as none of them are over 8 or 9 lb. in weight, they cannot be said to have thriven in their present surroundings. On the other hand, it has to be conceded that they

have been kept in unnatural surroundings, that is to say, in a cement tank, the water in which is shallow, hot, and entirely devoid of all vegetation, and as *gourami* are almost, if not entirely, herbivorous in their habits, it cannot be said they have had much encouragement to produce and rear families. As an instance of the importance attaching to ample aqueous vegetation where these fishes are concerned, I may say that two young specimens were turned into a small tank (well supplied with water lilies and grasses) by Dr. Willey as recently as two and a half years ago, and although the space is very restricted, they have at least quadrupled in weight during that time. That they have not produced young may easily be explained by the fact that they are probably of the same sex. Now that we know *gourami* will thrive in Ceylon, no doubt a more ambitious attempt will be made to introduce them into our rivers and tanks, and if this is done a most important step will have been taken in the direction of improving and supplementing our somewhat meagre fresh-water fish supply. I have already called attention elsewhere* to the suitability of Kandy reservoir for purpose of further experiment with *gourami*. and take this opportunity of again pressing the claims of that ideal locality as a breeding ground and nursery for *Osphromenus olfax*.

But to return to the great family of the carps, numerous representatives of which are to be found in our inland waters.

Barbus tor we have already noticed, and although this fine fish cannot vie with his Indian brother in point of size, he is none the less far and away the best fresh-water fish—from the sportsman's point of view—we have. Near relations of his found in most of our fresh-water streams, and taking them in order of importance, are : *Barbus chrysopoma*, *Cirrhina cirrhosa*, *Barbus filamentosus*, *B. mahecola*, *Labeo calbasu*, *Barbus innominatus*, *dorsalis*, *porcellus and Rasbora daniconius;* all of them edible, and most of them of great economic value.

The *moda* (*Lates calcarifer*), of which I spoke just now as being an erratic breeder, is one of those curious fish that would appear to be equally at home in either salt or fresh water, and is a most valuable though somewhat neglected food fish.

In Bengal, where it is known as Beckti, the *moda* stands in very high repute, not only amongst the people of the country, but with Europeans also, and commands about the highest price of any fish in the market. In appearance the flesh is firm, white, and comparatively free of bones, while if not too old the flavour is distinctly delicate. In the north of Ceylon, and more particularly at Elephant Pass, this fish (known there by its Tamil name of *kodawa*) is extraordinarily plentiful at certain times of the year—generally in November and December—and annually attracts a number of

* *Spolia Zeylanica*, Vol. VII., Part XXVIII.

European sportsmen, some of whom have written glowing accounts of the great bags to be made. I regret I cannot speak of it at first hand, but I am sufficiently well acquainted with *Lates calcarifer* to recommend the pursuit of him to any one desiring to get rid of superfluous fishing tackle.

It has been suggested to me that since the rainbow trout has now done his duty in the shape of perpetuating his species in Ceylon, and seems likely to continue doing so, he should be considered one of our fresh-water fish, and that any lecture or paper on this subject that ignored him would be incomplete. Well, I am very sorry if this is so, but in any case I have omitted quite a large number of other important species, so our lively little friends at Nuwara Eliya and the Hortons need not take offence; they are not the only uninvited guests.

Possibly at some future date the benevolent Council of this Society will invite me again to discourse on the subject of Ceylon fresh-water fishes, and then the speckled beauties shall have half an hour all to themselves.

ON A COLLECTION OF OLIGOCHÆTA, MAINLY FROM CEYLON.

By Major J. Stephenson, D.Sc., I.M.S.,
Professor of Biology, Government College, Lahore.

(With two Plates.)

Introduction.

In November of last year (1911) I received from Dr. Annandale of the Indian Museum, Calcutta, an interesting collection of Oligochæta made by him in Ceylon during the preceding month, with one tube, containing the single specimen of *Drawida annandalei*, from Tanjore in South India. The species belong to both of the large subdivisions of the Order, the Microdrili and Megadrili; a peculiarity about the habitat of the specimens is that they were all taken either in water or in rotten wood; none of them, therefore, are "earthworms" in the literal sense of the word.

In 1909 Michaelsen (8) wrote, at the beginning of a communication describing a new *Megascolex* from Ceylon: "As the earthworm fauna of Ceylon belongs to the best known of the tropics, I was surprised at seeing that these worms represented a new species. This circumstance gives a new indication of the richness of the Oligochæt fauna of Ceylon, and of our being far from a complete knowledge of the latter."

The same facts are more forcibly exemplified by the results of the examination of the present collection. Fourteen species were represented (excluding one specimen which was unidentifiable) in the six tubes; of the fourteen, nine are new, while another is sufficiently distinct to rank as a new variety. One tube was a miniature museum in itself; besides an example of *Pheretima hawayana*, it contained, represented mostly by single specimens, six species of *Megascolex*, all new. A partial explanation of the extremely large proportion of new species is perhaps to be found in the peculiar habitat from which they were drawn.

Of the four species which are already known, we are acquainted with one (*Aulophorus palustris*) only through a short diagnosis previously published by Michaelsen. Another (*Limnodrilus socialis*), first described a short time ago by myself, is interesting as being one of the very few Tubificids known to occur in the Indian region. The remaining two (*Pheretima hawayana* and *Dichogaster affinis*) have been known for some time.

The type specimens of the new species are to be kept in the Indian Museum, duplicates being sent to Colombo where possible.

I wish here to express my thanks to the authorities of the Natural History Museum, South Kensington, for very kindly affording me all possible facilities in the use of their library during the writing of this Paper.

Dero zeylanica, sp. nov.

(Plate I., Figs. 1–4.)

Four specimens, one incomplete ; in the same tube as *Limnodrilus socialis* and *Aulophorus palustris*. Hill country, Kandy, Ceylon, 1,600 feet.

The *length* of a complete single animal was 7·5 mm. ; none of the specimens were preparing for asexual division ; when this occurs the length of the chains would probably be greater. *Breadth*, maximum ·35 mm. *Segments* 43–60. *Prostomium* short, rounded. There are no *eyes*.

The *posterior end* of the animal is expanded, and in the preserved specimens this expansion may either have the form of an approximately circular sucker-like disc, facing upwards, with a definite margin, or of a deep and narrow cup, opening dorsally, and compressed from side to side ; the latter was the case in the specimen chosen for sectioning (figs. 1–3). A number of ridges can be indistinctly seen on the inside of the cup, or on the face of the disc ; some of these are more distinct than others, and in the case where the posterior end of the animal is flattened they radiate towards the periphery of the disc.

A series of transverse sections is necessary in order fully to elucidate the structure of this region ; the following description begins anteriorly, from a point in front of the opening out of the intestine into the branchial fossa or branchial funnel, and proceeds posteriorly to the hinder end of the animal.

In the specimen taken for sectioning, the whole posterior end of the animal appears to have been laterally compressed. The first peculiarity to be mentioned is the occurrence, dorsal to the end of the intestine, of a pocket, or forward diverticulum from the branchial fossa ; at the anterior blind end of this pocket a pair of gills originate, which further back lie free within the cavity of the diverticulum (fig. 1).

Proceeding backward, the diverticulum and gut shortly unite, and we may now speak of the cavity as the branchial fossa. The first

pair of gills, already mentioned, here fuse along one of their sides with the dorsal wall of the fossa, and thus constitute longitudinal ridges of the wall. Here also another gill arises, ventral to the first pair, from the lateral wall of the funnel; its fellow however springs (in this particular specimen at least) from the right gill of the first pair. These two, constituting the second pair, lie at first free in the cavity of the fossa; but on proceeding backwards they soon fuse with its walls, and appear, like the first pair, as ridges (fig. 2).

The third pair of gills now appear; in these, unlike the first two pairs, the anterior ends, which are first encountered, are free. The branchial chamber now opens out dorsally; the first pair of gills appear in a transverse section as projections just within the margin; the second pair are similar, and more ventrally situated; the third pair are free in the cavity at a still lower level.

The first pair of gills now flatten out and disappear; the third pair fuse with the wall of the funnel; and a fourth pair appear ventrally, at first free within the cavity (fig. 3), but soon fusing with the wall of the funnel. A section of the funnel therefore now shows three projections of the wall on each side, corresponding to three ridges.

The second pair of gills now flatten out and disappear; the third does the same; and lastly the fourth also. All have disappeared some little distance in front of the posterior end of the funnel.

The free gills and gill ridges are ciliated; they are covered in part by a characteristic pyriform epithelium (fig. 3); the diameter of the gills, or of the ridges, is from 50 to 70 μ.

The relative lengths of the several portions of the branchial fossa may be estimated from the number of sections which go to each. The sections being of a thickness of 8 μ, it is found that the anteriorly pointing diverticulum dorsal to the end of the gut is 40 μ in length; from the mouth of the diverticulum (which coincides with the end of the gut) to where the branchial fossa opens out dorsally is 96 μ; and from this point to the posterior end of the animal is 272 μ. The whole length of the fossa is therefore less than half a millimetre.

The *dorsal setæ* begin in segment VI., and are of two kinds, capillary and needle setæ. In the anterior segments there are three capillary and three needle setæ per bundle, arranged in pairs of one of each kind; further back the bundles consist of two capillary and two needle setæ; and behind this again of a single pair only. The capillary setæ vary in length from 240 to 320 μ; thus they do not exceed the diameter of the body. The needle setæ (fig. 4) are nearly straight, with however a slight sickle-shaped curve; the point is bifid, but the forking is so fine as to be only just visible with the ordinary high power of the microscope. Their length varies considerably, from 82 to 102 μ. The very slight nodulus is distal to the middle of the shaft.

The *ventral setæ* of segments II.–V., differ somewhat from the rest. The shaft is only very slightly curved in the usual S-shape ; the distal prong of the forked end is nearly twice as long as the proximal ; the prongs are about equal in thickness at their base, or the proximal is perhaps a little thinner ; the angle between the prongs is narrower than in the setæ of the posterior bundles. The nodulus is either exactly at or slightly proximal to the middle of the shaft. In length they are from 123 to 128 μ. The number per bundle is four or five.

In the segments from the sixth onwards, the distal prong is slightly longer than the proximal, and only one-half or two-thirds as thick at its base ; the nodulus is either slightly or very markedly distal to the middle of the shaft (distal : proximal : : 41 : 46 or 41 : 57). In length they are from 87 to 98 μ. Towards the anterior end of the animal there are four, or occasionally five, setæ per bundle ; further back the number sinks to three, and then to two.

The alimentary canal shows but little differentiation throughout its extent. The *pharynx* is ciliated ; its floor is lined by long columnar cells, while the cells which form its roof are shorter ; sections show a pair of small recesses dorsolaterally in this region. There are no definite *septal glands ;* but a few large deeply staining gland cells occur in connection with the alimentary tract in segments III., IV., and V. *Chloragogen cells* begin in segment VI. There is no *stomach.*

The *dorsal vessel*, covered with chloragogen cells, courses along the ventral side of the intestine, a little to the right of the middle line. The ventral vessel is situated in a corresponding position on the left.

The *cerebral ganglion* is widely indented in front, but is not indented behind.

Sexual organs were not present, nor was *asexual reproduction* in progress in any of the specimens.

The present form would seem to be one of the best marked species of the genus, and the characters of the posterior end appear to be quite distinctive. It is of course true, as has been pointed out by Michaelsen (6), that the gill-bearing hinder end of species of *Dero* (including *Aulophorus*) is liable to vary considerably according to whether it has or has not been completely developed after the process of fission ; and Bousfield (4) had previously drawn attention to the great differences which exist between the conditions of contraction and full expansion.

In the present case however the distinctive features of the hinder end are due to a characteristic difference of type ; and it is impossible to refer the peculiarities of the species to difference in degree of development or to differences of contraction or expansion. The chief peculiarities are, that for the greater part of their extent the gills are long ridges only ; and that while in the case of the posterior gills the ridges dissociate themselves from the wall of the fossa so as

to end freely within the latter, these freely ending processes are anterior, and directed forwards within the fossa, instead of pointing backwards as in other species.

Aulophorus palustris, Mchlsn.

(Plate I., Fig. 5.)

Several specimens, in the same tube as *Limnodrilus socialis* and *Dero zeylanica*. Hill country, Kandy, Ceylon, 1,600 feet.

The *length* varied from 3 to 4·5 mm.; but these were all single animals, no chains of two or more being met with; it appeared however that chains of two animals had existed in the material, but had broken asunder at the budding zone. *Breadth*, maximum ·3 mm. *Segments*, maximum 52; several of 35 segments; the anterior of two zooids which had broken apart at the budding zone showed 22 segments.

The *prostomium* is short and rounded; the anterior end of the animal is gently swollen, and is thickest at the level of segment IV.; the thinnest part of the animal is at segments VI.–VII., so that this region has somewhat the appearance of a neck. There are no *eyes*.

The hinder end of the animal bears the gills and palps. The *palps* are a pair of long slender projections from the posterior lip of the branchial funnel; in length they appear to be about equal to the longest gills; in breadth they taper gently from a diameter of 60 μ at their base to 16 μ at their tip; the tip is not expanded; their cavity is not, as is that of the gills, crossed by strands or stellate cells. The *gills* are inserted within the margin of the funnel, which has a complete dorsal lip. There are four pairs of gills, each gill being a sausage- or finger-shaped process, of the same diameter throughout. In breadth they are about 60 μ; the length varies, the longest being about ·4 mm.; the most dorsally placed are the shortest, about ·08 mm., and arise furthest forward, within the dorsal (anterior) lip of the branchial funnel. The cavity of each gill is crossed by numerous very regularly arranged strands or partitions, which give it a segmented appearance, as if it were made up of a series of separate chambers; a nucleus is easily visible in the middle of each strand. The same appearance is seen in sections of a gill cut longitudinally; in transverse sections however the partition appears as a large single stellate cell.

The *dorsal setæ* begin on segment V.; each bundle consists regularly of one capillary and one needle seta. The capillary seta does not exceed the diameter of the body in length; the needle seta is about 51–55 μ long, sickle-shaped, forked at the free extremity, with a slight nodulus at the junction of the curved with the straight portion of the shaft (fig. 5*a*).

The *ventral setæ* of segments II.–IV. (fig. 5*b*) differ somewhat from those behind; they are four or five per bundle, 76–84 μ in length, with the usual double curve and forked extremity; the

distal prong of the fork is twice as long as the proximal, but only two-thirds as broad at its base ; the nodulus is markedly proximal to the middle of the length of the shaft (proximal : distal : : 34 : 50 or 34 : 42). Behind segment V. the ventral setæ (fig. 5*c*) are four per bundle, except posteriorly, where bundles of three and then of two setæ occur ; the prongs of the fork are equal in length, the distal prong however is only half as thick as the proximal ; the nodulus is markedly distal to the middle of the shaft (proximal : distal : : 40 : 28 or 42 : 26). In length they are shorter than the setæ of the most anterior segments (68 μ) ; the proximal curve of the shaft is ample, and better marked than in the anterior setæ ; but I could not discover any considerable difference in thickness between the two groups.

The *buccal cavity* is tubular, and extends through segments I. and II. ; the *pharynx*, in segments III.–IV., is lined by elongated columnar ciliated epithelium, the cells being specially long in the dorsal wall ; the musculature of the pharynx is weak, and there is nothing to suggest that the pharynx is protrusible, or that it can act as a sucker, as in *A. tonkinensis* (9, 10). *Septal glands* are present in segments IV. and V., situated laterally and dorsolaterally on the alimentary canal ; they are attached to the front faces of septa 4/5 and 5/6, and consist of aggregates of large ovoid or pyriform cells ; a few such cells are also seen in segment VI. The *œsophagus* extends through segments V.–VIII., when the tube dilates to become the *intestine ;* there is thus no stomach. *Chloragogen cells* begin in segment VI.

The *dorsal vessel* has a ventro-lateral position to the left of the middle line throughout the greater part of its extent. It becomes lateral in segment VII., and dorsal in VI., according to the evidence of sections. The lateral commissures could not be made out.

In *asexual reproduction* $n = 22$ (three instances). None of the specimens showed any trace of sexual organs.

In 1905 Michaelsen (7) published the following provisional diagnosis of a species of *Aulophorus* collected by Stuhlmann in 1888 in Zanzibar, reserving all description of the animal till later : " Länge etwa 9 mm., Dicke max. ·3 mm., Segmentzahl etwa 50. Dorsale Borstenbündel am 5 Segment beginnend, mit Haarborsten und gabelspitzigen Hakenborsten. Kiemennapf mit 4 (5 ?) Paar fingerförmigen Kiemen. Palpen schlank, am Hinter- (Unter-) Rande entspringend."

No further account has however appeared ; and it must therefore remain somewhat doubtful whether my identification of the present species with it is correct. The agreement is fairly close ; I do not regard the difference in length as of great importance. I might add that I saw no reason, from an examination of the limited number of specimens at my disposal, to suppose that more than four pairs of gills were ever present ; and that I am in some doubt as to how far

the term " Hakenborsten," which Michaelsen applies to the shorter dorsal setæ of *A. palustris*, can be used for those of the present form. The definition of a " Hakenborste " is " eine verhältnismässig kurze .....S-förmig gebogene Borste.....," (Michaelsen, 5) ; and it is evident that the dorsal setæ of the present form are not, as are the ventral setæ (to which the term " Hakenborsten " is properly applied), curved like the letter S. The dorsal setæ of the form here described are more properly termed needle-setæ, since " eine Nadelborste entsteht aus der Hakenborste, wenn diese ihre S-förmige Krümmung aufgiebt " (ib. id.). The point is of some importance, as owing to the degree of variability in the development and possibly in the number of the gills in this and the allied genus *Dero*, the setæ may probably be found to afford a more reliable means of discrimination of the several species (*cf.* Michaelsen, 6).

Hesperodrilus zeylanicus, sp. nov.

(Plate I., Fig. 6.)

A single specimen, found crawling on the under surface of a stone aken from a streamlet running down the bank of the lake in very marshy ground, Nuwara Eliya, Ceylon, 6,000 feet.

The specimen was curled up, and damaged (nearly severed) at one place near the posterior end ; many of the dorsal setæ had also been broken off. The *length* was estimated at 8 mm. ; *breadth*, maximum ·6 mm. ; *segments* 34 with a small undifferentiated region posteriorly. *Prostomium* short, bluntly conical ; the length from tip of prostomium to mouth is about equal to the length of a body-segment. *Clittellum* 1/5 XII.–XIII. = 1 1/5.

The *dorsal setæ* begin in segment III., and are all capillary ; they vary in thickness, some being much stouter than others ; this difference exists in many cases between the setæ of the same bundle. The largest number in a bundle was five ; four were counted not infrequently. In length, the longest (·58 mm.) are about equal to the diameter of the body.

The *ventral setæ* are as a rule two per bundle ; of the two, one is a simple hook, while the other is forked at its free end (fig. 6) ; both have the usual double curve. The forked setæ are 118–123 μ long ; the prong on the outside of the curve is much the smaller, being only about half as long, and one-third as thick at its base, as the other ; the nodulus is slight, and is markedly distal to the middle of the shaft (distal : proximal : : 45 : 73 or 47 : 76) ; the shaft is stout—6·3 μ broad—considerably stouter than that of the singly pointed setæ.

The singly pointed setæ are about the same length as the forked setæ ; the curves of the shaft are slightly less pronounced ; there is no nodulus ; and the shaft, though varying in thickness in different bundles, is considerably thinner (*e.g.*, 3·4 μ) than that of the doubly pointed setæ.

As stated, the rule is that a ventral bundle is constituted by one seta of each kind; in segment VII., however, and again in XIV., there were two such pairs on each side. In segment XII., on which are situated the openings of the male ducts, there are no ventral setæ.

With regard to the *alimentary canal*, the following features may be briefly noted. The epithelium of the buccal cavity is flat, as is also that of the floor of the pharynx; the roof of the pharynx is lined by columnar, richly ciliated cells. The pharynx passes into the œsophagus without any sharp line of demarcation, and this latter becomes the intestine in segment VIII. There is no stomach. A number of large, deeply staining cells are attached to both sides of septa 4/5, 5/6, 6/7, and there are a few also on 7/8.

The *cerebral ganglion* is very intimately attached to the roof of the pharynx. The *ventral nerve cord* is closely united with the ventral body-wall, which in transverse sections shows a median ventral groove externally, corresponding to the line of the nerve cord; there are three giant fibres dorsally in the cord, the middle one being the largest.

The *testes* are in segment XI.; sperm morulæ were found in segments X. and XI., dorsal to the alimentary canal, and not enclosed in sperm-sacs. The *sperm funnels* are situated on the anterior face of septum 11/12; the *vas deferens* is seen ventral to the intestine in XII.; as is explained below, I did not follow it throughout its course; it appears however finally as a thin tube, 12–15 μ in diameter, running forwards from the level of septum 13/14 and arching dorsally to join the proximal (upper) end of the *atrium*. This latter is a conspicuous glandular-looking mass, vertically elongated, situated in the anterior part of segment XIII.; it narrows towards its lower end and is prolonged obliquely forwards to the male aperture on segment XII.

The *spermathecæ* are ovoid sacs, 80 × 70 μ and 120 × 95 μ respectively, situated dorsally, one in segment XIV., the other in XVI. The first, in XIV., was provided with a long narrow duct, 20 μ in diameter, leading directly ventralwards. The second, in XVI. (slightly the larger of the two), possessed a duct which, wider at first than in the previous case, narrowed gradually and led first downwards, and then forwards ventral to the intestine in segment XV., to open externally behind the ventral setæ of XIV., in or near the intersegmental furrow 14/15.

I very much regret that owing to an unfortunate accident my series of sections of this unique specimen was so damaged as to be of little use in working out its anatomy. Fortunately the worm was of small size, and consequently was transparent enough to allow of a more or less complete account of its anatomy being written from observations made while it was in cedar oil, before embedding. The chief points of interest which have escaped me are the nephridia,

the female organs, and a portion of the course of the vas deferens. The location of the various organs was definitely determined in the entire specimen, and I was able to confirm this in the sections ; the characters of the spermathecæ and their ducts, and the fact of the entry of the vas deferens into the proximal end of the atrium, were also made out by both methods.

Of the four species of *Hesperodrilus* recorded by Beddard (1, 2) from South America (where alone, so far, the genus has been found), two (*H. albus* and *H. pellucidus*) showed the same form of " cephalization " which occurs commonly among the Naididæ, that is, the dorsal setæ began at a level posterior to the beginning of the ventral setæ. The present species shows the same peculiarity, the dorsal setæ beginning in the third, the ventral as usual in the second segment. It is immediately distinguished, however, from both *H. albus* and *H. pellucidus* by the much shorter prostomium and the ventral position of the spermathecal apertures.

The present species displays, in addition, a number of other peculiarities, which, though striking, have possibly not the same morphological value. Thus the atrium is in segment XIII. instead of XII., and the spermathecal apertures in the posterior part of XIV. instead of in XIII. ; in other words, while in the genus *Hesperodrilus* as a whole the genital organs are displaced one segment backwards as compared with most Tubificidæ, in the present specimen the posterior half of the genital organs show a backward displacement of *two* segments.

Among the specimens of *H. albus* examined by Beddard was one which showed the genital organs in the usual Tubificid position, *i.e.*, displaced one segment *forwards* as compared with the rest of the genus. Since therefore the position of the genital organs is variable in at least one species of *Hesperodrilus*, it may be so in the present case also, and it is possible that the peculiar disposition here recorded is merely an individual variation.

My failure to detect the female apparatus may have been due to the fact that the specimen was only in an early stage of sexual development ; and the absence of sperm-sacs may perhaps also be due to the same cause. It is however unlikely that the entry of the vas deferens into the proximal portion (instead of the distal, as in other species of *Hesperodrilus*) of the atrium can be similarly explained.

The following diagnosis, I believe, omits all doubtful points, of both the kinds exemplified above :—

Hesperodrilus zeylanicus, sp. nov. Length 8 mm., breadth ·6 mm., segments 34 ; prostomium about the length of an ordinary body-segment ; clitellum 1/5 XII.–XIII. = 1 1/5. Dorsal setæ begin in III., up to 5 per bundle, capilliform, longest equal to diameter of body. Ventral setæ in pairs of one forked and one singly pointed seta ; one, or occasionally two, such pairs on each

side in each segment (except I. and XII.); the singly pointed seta thinner than the forked one, and without nodulus; the outer prong of the forked seta much smaller than the inner, the nodulus markedly distal. Vas deferens enters atrium at the proximal end of the latter. Spermathecæ ovoid, with long narrow ducts; spermathecal apertures ventral

Ceylon (Nuwara Eliya).

Limnodrilus socialis, Stephenson.

This worm occurs twice in the present collection, both batches of specimens having been taken at Kandy (hill country, 1,600 feet). In one case Dr. Annandale notes that "these worms were very numerous in the mud at the bottom of a pool of very dirty water in a disused tunnel frequented by bats." The other tube contained also the specimens of *Dero zeylanica* and *Aulophorus palustris* (v. ant.); these "were taken in the mud left in a small depression in the bed of a bathing-pool formed by the overflow of the Kandy lake. The pool had just been emptied in order that it might be cleaned, and the worms must originally have been in 5 or 6 feet of water."

The rarity of Tubificidæ throughout the whole of the Indian region (only three species having been so far recorded), and the striking similarity in behaviour, has caused me to suspect that this species may be that referred to by Willey in his recent book on "Convergence in Evolution" (13). Writing of the similarity in appearance and habits between the larvæ of *Chironomus* and the Tubificidæ, he says of the latter (with special reference to an unnamed species of *Limnodrilus* from Ceylon):—"They keep the head and fore-body buried in the mud, whilst the hinder portion of the body, through which respiration is effected, is kept constantly waving as near the surface of the shallow water as possible. When alarmed, an entire colony will instantly withdraw out of sight into the mud as with one consent ..... *Limnodrilus*, as observed by me in Ceylon, forms dense aggregates of individuals surrounded by mud, but does not form definite tubes which can be isolated from the clumps."

The above has such a striking resemblance to my original description of the habits of the worm as observed at Lahore (11), that, with these specimens, also from Ceylon, before one, it is difficult to believe that the species are not the same.

This worm is apparently widely distributed in the East; I have received specimens from Calcutta also. When in Kashmir last summer I saw, in a pool at Baramula, a colony of what I believe to have been this species; though, as I had of set purpose omitted to take any apparatus with me, this remains for the present a conjecture only.

DRAWIDA ANNANDALEI, sp. nov.

(Plate I., Fig. 7.)

A single specimen.

Tanjore, South India; from the river Caveri, in the mud below the water; October, 1911.

EXTERNAL CHARACTERS.—*Length* 35 mm.; *width*, max. 1·75 mm.; *Colour* olive. *Segments* 137.

Prostomium prolobous.

Clitellum 2/3 X.–2/3 XIII. = approximately 3 1/3, but not well marked.

Male and *female pores*, and *spermathecal apertures*, not seen externally.

A *genital area* is present on segments X. and XI. This is a slightly darker oval patch, with its longer diameter transverse, along the line of furrow 10/11; the patch lies between the ventral setæ of X. and those of XI.; within it, a smaller oval area is marked out by a slight ridge, as shown in the figure (fig. 7).

The *setæ* are closely paired. The interval *aa* is less than *bc*; and *dd* is equal to about half the circumference.

INTERNAL ANATOMY.—*Septa* 5/6–8/9 are much thickened.

The *pharynx* exhibits a dorsal pouch, which, according to the evidence of sections, opens into the pharynx by a narrow longitudinal slit, while expanding laterally in the pharyngeal wall above this. Three *gizzards* are present in segments XII., XIII., and XIV.

Hearts are present in segments VI.–IX.

Male Organs.—The large *testicular vesicles* are suspended by septum 9/10, and project forwards into IX. and backwards into X. The *funnel* is a part of the wall of the sac, the mouth of the funnel being but little dilated, and situated at about the level of the septum (9/10). From this the *vas deferens* proceeds; this is a coiled tube, situated in segments IX. and X., penetrating the prostatic cells to open into the inner (proximal) end of the atrium. The *atrium* of the one side is a tube, vertically placed in segment X., lined with high columnar epithelium, outside which is a muscular layer; outside the muscular layer again is a thick covering of *prostatic gland cells*; the whole organ (atrium + prostatic investment) is somewhat longer in the vertical direction than it is thick; it occupies the segment from the dorsal body-wall above to the ventral below; ventrally the lumen penetrates the body-wall to open at the *male aperture* in furrow 10/11, in the line of the ventral setæ. There is no *copulatory pouch*.

On the other side of the body the atrium with its glandular investment is pressed down, in the sections, against the ventral body-wall, in such a way that the vas deferens enters it anteriorly.

Female Organs.—The *ovary* is in segment XI., as is also the *funnel*; the *female aperture* is in furrow 11/12. The large *ovisacs*

extend backwards through several segments from septum 11/12, as far as segment XVI. ; they are dilated in their posterior portions.

The *spermathecæ* are in segment VIII. ; they are comparatively small spherical sacs, with a much-coiled duct in the same segment. This duct comes forwards into VII., where it joins the posterior face of the muscular spermathecal atrium near its base. This muscular sac is of moderate size ; narrowing at its base, it becomes a tube which runs for a short distance in a lateral direction to open externally in furrow 7/8.

Remarks.—This species is on the whole not unlike *D. ramnadana*, Mchlsn. (9), from which however it is distinguished by two important features : (1) the presence of a characteristic copulatory area ; (2) the fact that the vas deferens enters the prostatic mass at the proximal (inner) end of the latter, not at its basal front, in the thickness of the body-wall.

LAMPITO MAURITII, Kinb., var. ZEYLANICA, var. nov.

Two specimens, one not fully mature.

In rotten wood, in the hotel compound, Anuradhapura (low country), Ceylon. October, 1911. In a tube along with a specimen of *Dichogaster affinis*.

EXTERNAL CHARACTERS.—*Length* 4 inches ; *breadth* 3 1/2 mm. *Colour* gray. *Segments* 147.

Prostomium prolobous.

First *dorsal pore* in intersegmental furrow 12/13.

The *clitellum* extends over segments XIV.–XVII. = 4 ; it does not obliterate the limits of the segments ; setæ are present on the clitellar segments.

The *male apertures* are situated in large round sucker-like depressions, with raised and swollen margins, on segment XVIII. The interval between the apertures is equal to 1/4 of the circumference ; there are no setæ in this interval.

The *female aperture* is not very conspicuous, median, on the anterior part of segment XIV.

I failed to see the *spermathecal apertures ;* and there are no other genital marks of any kind.

The *setæ* are in a chain, which is interrupted both ventrally and dorsally. Ventrally *aa* = 3 1/2 *ab* (in front of the clitellum = 3 *ab*) ; and dorsally *zz* = 2–2 1/2 *yz*. There is no regular difference between the setal intervals in different parts of the chain ; no setæ are specially enlarged. The numbers of setæ are as follows :—36/VI., *ca.* 45/IX., 33/XIX., 33/XXV., and 34 in the middle of the body.

INTERNAL ANATOMY.—Septa 6/7 and 7/8 are somewhat thickened, 8/9–12/13 much thickened, and 13/14 again somewhat thickened.

The *gizzard* is in segment VI. There are yellow bulgings of *the œsophagus* in XI. and XII., but no calciferous glands. The

intestine begins in XV., and there are no diverticula (as far back as segment XXXIV. at least).

The last *heart* is in segment XIII.

There is one pair of *meganephridia* per segment behind the male apertures, as well as *micronephridia*.

Male Organs.—The *testes* and *seminal funnels*, the latter white and glancing, are free in segments X. and XI. The *vesiculæ seminales* are paired, and much cut up into small lobules, in segments IX. and XII. The *prostates* are comparatively small, the prostatic duct thick and S-shaped. Separate from the prostate, and close to the terminal portion of its duct, is a small gland attached by a short stalk to the inner surface of the body-wall; it is of the same opaque whiteness and the same texture as the prostate; on the one side this accessory gland was situated some little distance anterior, on the other side posterior, to the end of the prostatic duct. The *penial setæ* are ·83 mm. in length, 22–27 μ in breadth, curved, and then very slightly recurved again, distally; the free end appears bifid, the two limbs resembling the limbs of a horseshoe; above the free end are a number of prominent spines, arranged in irregular circles round the distal portion of the shaft, with which they make an acute angle.

Female Organs.—The *ovaries* and *ovarian funnels* are in XIII. The *spermathecæ* open in the furrows 6/7, 7/8, and 8/9; there are thus three pairs. The ampulla of each is bent on itself; when straightened it is fusiform, narrowing distally to the external aperture, without separate duct. From its base arise one or two minute club-shaped diverticula, from 1/8 to 1/4 as long as the ampulla; on the left side, only the posterior of the three spermathecæ had two diverticula; on the right side, the two hinder spermathecæ had two diverticula, the anterior only one.

Remarks.—The features wherein the present form appears to differ from the typical form, as described, for example, in Michaelsen's "Oligochæta" in the Tierreich, are the following:—The head is prolobous; the chain of setæ is very distinctly interrupted, both dorsally and ventrally (*aa* = 3 1/2 *ab*); no setæ are noticeably enlarged; the setal intervals *ab*, *bc*, *cd*, &c., do not undergo a regular diminution dorsalwards; the first dorsal pore is in 12/13. Less important, perhaps, are the small size of the prostates, the smaller penial setæ, the variability of the spermathecal diverticula; the large round papillæ, on which, in the typical form, the male pores are situated, are here represented by sucker-like areas with a prominent circular rim.

Megascolex annandalei, sp. nov.

One sexually mature specimen.

Pattipola, Ceylon, hill country, 6,000 feet. In rotten wood of dead tree stumps and logs in jungle.

External Characters.—*Length* 2 1/2 inches; *breadth*, maximum 3 mm.; *segments* 120. *Colour* pale olive.

Prostomium small, prolobous. First *dorsal pore* in furrow 9/10; dorsal pores extremely distinct in some regions.

Clitellum not distinct, apparently XIV.–XVI. = 3.

Male pores on XVIII., on papillæ, in a common slightly elevated transversely extended glandular area; the pores in line of setæ *b*, separated by an interval equal to 1/5 circumference.

Copulatory areas as single ventral oval patches on segments XI., XII., and XV.; the one on XV. encroaching slightly on XIV.; the outlines of the other two flattened where they touch, along the furrow 11/12. The area on XI. was not precisely in the middle of the ventral surface, being displaced a little to the right.

Setæ in each segment numerous. A definitely limited mid-ventral tract is without setæ, as also a more indefinite mid-dorsal tract. The lines of setæ *a* and *b* are distinct and regular on each side; but the rest of the setæ are much less regularly arranged. The lines of the ventralmost setæ (*a* and *b*) converge inwards a little about the region of the male aperture, which is in line *b*. The setæ are small and difficult to count; the number per segment varies considerably, but is roughly 24–32 in the anterior part of the body. In the anterior part of the body $ab = 2/7\ aa$, more posteriorly $= 1/3\ aa$.

Internal Anatomy.—The *gizzard* is in VI.; in XV. the *œsophagus* appears as a rounded white mass; in XIX. the *intestine* begins.

The *nephridial system* is micronephridial. There is a large tuft of nephridial tubes on each side of the alimentary canal at the anterior end of the gizzard, a smaller one behind this on septum 6/7, and another on 7/8.

The first definite *septum* is 6/7, which is very thin; septum 7/8 is somewhat thickened.

The *male funnels* are one pair in X. and one pair in XI.; the *seminal vesicles* are in XI. and XII., and the lobular *prostates*, of moderate size, in XVIII.

The *spermathecæ* are one pair only, lying in segment IX. and opening at the level of furrow 8/9. The spermathecal sac is of an elongated ovoid shape, the duct being very short. A long tubular diverticulum springs from the base of the spermatheca; it is between three and four times as long as the spermathecal sac itself; this diverticulum may be somewhat coiled, and may extend for some distance across the middle line.

The *genital setæ* have a length of 4/5 mm., and a breadth of 24 μ. They are gently curved, the terminal portion being armed with small triangular teeth, distributed all round the circumference and not arranged in rows; the distal end tapers somewhat, and the extreme point is recurved and flattened.

MEGASCOLEX PATTIPOLENSIS, sp. nov.
(Plate II., Fig. 8.)

A single specimen. From the same locality as the last.

EXTERNAL CHARACTERS.—*Length* 2 inches; *breadth* 2 1/2 mm.; *segments* 129.

Prostomium prolobous, with in addition a pair of small grooves, leading backwards from the hinder limit of the prostomium through 1/3 of segment (combination of pro- and epilobous characters).

First *dorsal pore* in intersegmental furrow 5/6.

Clitellum absent (or not yet developed).

Male apertures on papillæ, in segment XVIII., in line of setæ *b*; interval between male apertures = 1/3 circumference; the papillæ of the two sides connected by a narrow transverse ridge (fig. 8). *Female aperture* not observed.

Spermathecal apertures not very conspicuous, in furrow 8/9, in line of setæ *b*.

Genital papillæ (fig. 8) on segment XIX., transversely oval, their centre in line of setæ *b*; while abutting on furrow 18/19 they do not occupy the whole length of the segment antero-posteriorly; in a transverse direction they extend from about the line of setæ *a* to an equal distance on the other side of *b*. Another pair of small, transversely elongated papillæ is situated in furrow 17/18, in front of and bordering on the anterior edge of the papilla of the male aperture on each side.

The *setæ* are sometimes difficult to see. Ventrally the setal ring is broken in each segment; *aa* = 2 *ab* (segment XVII.) or 2 1/2 *ab* (XX. and further back); *ab* = *bc*, *bc* is slightly greater than *cd*; *cd* = *de* approximately; but though *a* and *b* are in regular longitudinal lines throughout the body, *c*, *d*, and *e* are placed somewhat irregularly posteriorly.

Dorsally to *e* are a few (*e.g.*, in the middle of the body, 4) more setæ, irregularly placed. Anteriorly *zz* = about 3 *yz* on the average; in segment XIII. *zz* = 2 *yz.*, at the junction of middle and posterior thirds of the body = 1 1/2 *yz.*, and at the posterior end *zz* = *yz*. Thus the line *z* is irregular.

Number of setæ: 20/XIII.; in middle of body 20; at junction of middle and posterior thirds 24 (12 on each side) or 25 (12 and 13 on each side respectively).

INTERNAL ANATOMY.—*Septum* 6/7 is (?) slightly thickened; septa 7/8 and 8/9 are moderately, 9/10 and 10/11 considerably strengthened.

There is a large *gizzard* in segment VI. *Calciferous glands* are present in XV. and XVI., appearing as lateral swellings on the œsophagus, which narrows again in XVII., and dilates to form the intestine in XVIII. There are no intestinal diverticula (at least as far back as XL.) A *typhlosole* is present.

The last *heart* is in segment XIII.

Numbers of small separate *micronephridia* are present.

The male *funnels* are free, in segments X. and XI. The *vesiculæ seminales*, in XI. and XII., are lobulated masses surrounding the alimentary canal. The *prostates* are of moderate size, simple rounded masses, not lobulated, with stout white ducts; the whole resembling a mushroom. No *penial setæ* observed.

The *spermathecæ* are one pair, opening between VIII. and IX.; spindle-shaped, with a short thick duct, and a finger-shaped diverticulum as long as the ampulla, attached to the duct at the base of the ampulla.

Megascolex bifoveatus, sp. nov.

(Plate II., Fig. 9.)

Two specimens. From the same locality as the last.

External Characters.—The specimen examined was incomplete at its hinder end; in *length* it measured 1 2/3 inch; *breadth*, max. 3 mm., but narrower in front of the clitellum; the anterior end (first few segments) tapering. *Colour* light gray, with a pinkish tinge on dorsal surface anteriorly. *Segments* > 85 (after dissecting the incomplete specimen I unfortunately, on subsequently meeting with a complete specimen, omitted to count the segments of the latter).

Prostomium epilobous 3/5–3/4.

First *dorsal pore* in intersegmental furrow 5/6.

Clitellum embracing segments XIV.–XVI. = 3; setæ present as regular rings on clitellar segments.

Male apertures on segment XVIII. as small pits, surrounded by small oval areas which however are not elevated. The apertures are 1/7 of the circumference apart, approximately in the line of seta *d*; but no setæ are present in the interval between the apertures.

Female aperture indistinct, apparently mid-ventral on segment XIV.

Spermathecal apertures in furrows 7/8 and 8/9.

Genital marks are present as a pair of conspicuous oval pits, with the long axis transversely placed in furrow 19/20, the centre of each situated slightly internal to the line of the male apertures.

The *setæ* form a ring in each segment, which is almost closed both dorsally and ventrally. Dorsally the interval is irregular; $zz = 2\,yz$ approximately. Ventrally $aa = 2\,ab$ regularly. The setæ on the ventral side are placed somewhat closer together, in the anterior part of the body at least, than on the dorsal side. Number of setæ 39/V., 40/IX., *ca.* 41/XIX., 42/XXVIII.

Internal Anatomy.—The first distinguishable *septum* is 5/6; 6/7–8/9 are somewhat thickened, 9/10–13/14 considerably so, 14/15 and 15/16 moderately.

The *gizzard*, situated in segment VII., is not large nor very hard. There are no *calciferous glands*. The *intestine* begins in XV.

The last *heart* is in segment XIII.

Very numerous small *micronephridia* are present in each segment.

Male Organs.—Testes were not distinguished. The male *funnels* are free in segments X. and XI. *Vesiculæ seminales* are situated in XI. and XII., paired, of large size, much lobulated, the lobules forming grape-like masses. The *prostates* are of moderate size, occupying segments XVIII., XIX., and XX.; they are also much lobulated; the duct is straight and stout, arising from the gland in XVIII.

The *ovaries*, in segment XIII., are comparatively large, and fan-shaped, folded longitudinally. The female *funnels* are small.

The *spermathecæ* are two pairs, opening in furrows 7/8 and 8/9; the ampulla of each is circular, flattened between the gizzard and the body-wall; the duct is short and fairly thick; a small diverticulum, of an elongated ovoid shape, and one-quarter as long as the ampulla, arises from the duct.

On opening the ampulla, the upper end of the duct is seen to be invaginated into the cavity of the ampulla.

The *genital setæ* (fig. 9) are ·72–·75 mm. long, and 14–16 μ thick. They are almost straight, except at the distal end, which is curved to form the quadrant of a circle. The distal end (except the extreme point) is ornamented with finely sculptured dots, which are arranged in four circles one above the other.

Megascolex curtus, sp. nov

(Plate II., Fig. 10.)

A single specimen, incomplete at its posterior end. From the same locality as the preceding.

External Characters.—*Length* of the fragment 1 1/2 inch; *breadth* 3 mm.; *colour* light gray; *segments* present 90.

Prostomium epilobous 1/3.

First *dorsal pore* in intersegmental furrow 13/14.

The *clitellum* embraces segments XIV.–XVII., = 4; it extends all round the circumference, but is less well marked ventrally in XVII. Setæ are present on the clitellar segments.

The *male apertures* are on small papillæ on segment XVIII., in the line of setæ *b*, 1/7 of the circumference apart. The surrounding and intervening parts of the body-wall are thickened, wrinkled, with irregular depressions just anterior and internal to the male apertures, and an elevation in the mid-ventral line.

The *female aperture* was not distinguishable.

The *spermathecal apertures* are one pair, in furrow 8/9, apparently between the lines of setæ *b* and *c*; but these apertures were very inconspicuous.

Genital papillæ are present as two median ventral large flat oval elevations. Of these, one is situated on segment XX., occupying the whole length of the segment and encroaching forwards on XIX. as far as the middle of this segment; transversely it extends from the line of setæ *a* on one side to the same line on the other side

(the lines of the setæ converge inwards somewhat at this region). The other papilla is slightly larger than the first; it is situated on segment XII., encroaching however on the neighbouring segments (for about half the length of XIII. and one-third the length of XI.); it has a very faint circular elevation at its centre; transversely it extends from a point between the setal lines *a* and *b* on one side to a corresponding point on the other side.

The *setal rings* are broken both dorsally and ventrally. Dorsally $zz = 2\ yz$ in the anterior, $= 4\ yz$ in the posterior part of the body; ventrally $aa = 3\ ab$ in front of clitellum, $= 4\ ab$ nearly behind clitellum. In front of the clitellum all the setæ are arranged in regular longitudinal lines, in 6 pairs on each side, or 24 setæ per segment; $ab < bc$; $cd = ab$. In the hinder part of the specimen the setæ were frequently difficult of observation; while *a* and *b*, *y* and *z*, were throughout arranged in definite longitudinal lines, the more laterally placed setæ appeared to be more irregularly distributed; the number of setæ per segment was, at least approximately, the same (24). The setæ of segments II.–VII. were moderately enlarged.

Internal Anatomy. *Septa* 8/9–10/11 are moderately thickened.

The *gizzard* is in segment VI. There are no *intestinal cæca* (as far back as segment XL).

The *nephridial system* consists of micronephridia.

The *male funnels* are free, in segments X. and XI.

The *vesiculæ seminales*, in XI. and XII., are much lobulated, and extend unbroken across the middle line dorsally. The *prostates* are small and compact, the duct thin and straight.

The *spermathecæ* lie in segment IX., with their apertures in furrow 8/9. The ampulla has an inverted pyriform shape; the duct is moderately thick, and nearly as long as the ampulla. The diverticulum is very long, and extends inwards as far as the middle line; it is bent on itself at the junction of its inner and middle thirds, the inner third thus lying alongside the rest; the diverticulum is of equal thickness throughout, being about as wide as the duct; its length, when straightened, is about three times that of ampulla and duct together (fig. 10).

Genital setæ are present, in length 7·25 mm., in breadth ·022 mm. The distal extremity is slightly broadened and flattened, and tapers to a blunt point. The last ·6–·7 mm. of its length is ornamented with small triangular teeth, irregularly distributed all round the circumference of the shaft.

Megascolex quintus, sp. nov.

(Plate II., Figs. 11 and 12.)

A single specimen. From the same locality as the last.

External Characters.—*Length* 2 1/2 inches: *breadth* 2 1/2 mm. *colour* light gray; *segments* 139. The specimen was contracted at the clitellar region.

Prostomium epilobous 1/2.

First *dorsal pore* in intersegmental furrow 6/7.

Clitellum not developed.

Male apertures on segment XVIII., in line of setæ *b*, 1/6 of the circumference apart, on very small inconspicuous whitish papillæ. The male apertures are included in a slightly raised *genital field* (fig. 11), of somewhat oval shape, which embraces the ventral portions of segment XVIII., half of XVII., and two-thirds of XIX. Also situated in the genital field are a pair of flat circular areas, each with a dark dot in the middle, occupying the anterior part of XVIII. and encroaching on XVII.; these areas are thus situated between and in front of the male apertures. The intersegmental furrow 17/18 is obliterated ventrally.

The *spermathecal apertures* are very inconspicuous, one pair, in furrow 8/9, just external to the line of setæ *b*.

The *setæ* form a ring, interrupted both dorsally and ventrally. Ventrally, $aa = 3\ ab$ nearly; dorsally, *zz* is quite an irregular interval. The more ventrally situated setæ (*ab*, *cd*, *ef*) form a series of regular longitudinal lines. Behind the clitellum, $ab = bc = cd = de = ef$, but the differences are slight only. Seta *e* is about at the lateral line of the body; dorsal to *f* are two or occasionally three more setæ on each side, irregularly placed; thus there are usually 16 setæ per segment. In front of the clitellum the setæ are fewer, 6 only on each side. The setæ of segments II.–VI. are enlarged, especially *a* and *b*. Numbers of setæ: 12/V., 12/IX., 12/XIII., and 16 behind the clitellum.

Internal Anatomy.—*Septum* 7/8 is moderately thickened, septa 8/9–13/14 considerably, 14/15–17/18 again moderately.

The *gizzard* is in segment VI. *Calciferous glands* are present in XV. and XVI. as considerable dilatations of the œsophagus, very vascular, with a lamellated structure internally. The *intestine* begins in XVIII. No intestinal diverticula were seen.

The last *heart* is in segment XIII.

The excretory system consists of *micronephridia*.

Testes and *male funnels* are free in segments X. and XI. The *vesiculæ seminales*, paired, in XI. and XII. are racemose in form. The *prostates* are small, confined to segment XVIII.; the duct is thick, and straight except for a bend at its inner (proximal) end.

No *penial setæ* were discovered.

Ovaries were present in segment XIII., but the ovarian funnels were not seen.

The *spermathecæ* lie in segment IX., and open in furrow 8/9. The ampulla is elongated, and somewhat dilated proximally; there is no distinctly marked-off duct. The diverticulum is finger like, and joins the base of the ampulla. On the left side (fig. 12)

the ampulla was bent on itself, and the diverticulum was about 2/5 as long as the ampulla ; on the right side the ampulla was smaller and straight, and the diverticulum was almost as long as the ampulla.

Megascolex sextus, sp. nov.

(Plate II., Figs. 13 and 14.)

A single specimen. From the same locality as the last.

External Characters.—*Length* 4 inches ; *breadth* 2 mm. ; *colour* brown dorsally, with transverse segmentally repeated whitish markings along the lines of the setæ, light gray ventrally, the anterior end darker. *Segments* 114.

Prostomium epilobous 2/3 limited posteriorly however by a faint transverse marking between the hinder ends of the longitudinal grooves. The *first segment* is cleft in the middle line ventrally.

The first *dorsal pore* is situated in segment V., near the intersegmental furrow 5/6 ; and all the dorsal pores in the anterior part of the body are in front of the furrows.

The *clitellum* extends from 1/2 XIV.–XVI. = 2 1/2 ; the body is slightly swollen here, but otherwise there is no notable change in the character of the skin ; the setæ are quite obvious on all the clitellar segments.

The *male apertures* are on papillæ on segment XVIII., 1/4 of the circumference apart from each other ; no setæ occur in the interval between the apertures.

The *spermathecal apertures* are in the furrows 6/7 and 7/8, and are nearly half the circumference apart.

There are two pairs of *genital papillæ*. One pair, in furrow 17/18, are small whitish elevations, slightly internal to the line of the male apertures. The others, in furrow 9/10, are a pair of conspicuous oval papillæ, their long axis transversely placed, with eye-like markings in the centre ; they are situated internal to the line of the spermathecal apertures, a little more than 1/5 of the circumference apart.

The *setæ* are disposed in rings, which dorsally are almost closed ; ventrally *aa* = 2 *ab* posteriorly, or in front of the clitellum often = 2 1/2 *ab*. The setæ are at approximately the same distance apart at all parts of the chain. Number of setæ : *ca.* 36/V., *ca.* 40/IX., 36/XV., 50/XIX., and posteriorly 50.

Internal Anatomy.—*Septa* 9/10–13/14 are slightly thickened.

The *gizzard* is in segment VII. The *intestine* begins in XIV. The last *heart* is in XIII. The excretory system consists of *micronephridia*.

The *testes* and *seminal funnels* are in segments X. and XI., enclosed in testicular sacs which are connected dorsally over the œsophagus in each segment. The funnels are large, brilliantly glancing, and iridescent.

The *vesiculæ seminales* are paired, in segments XI. and XII., comparatively small in size, not lobulated. The *prostates* are lobulated, and occupy four segments, XVIII.–XXI.; the duct is stout, originates in XIX., and runs obliquely forwards to open in XVIII.

The *ovaries* are large, and are situated, with the *ovarian funnels*, in segment XIII.

The *spermathecæ* (fig. 13) are two pairs, in segments VII. and VIII., opening in the furrows 6/7 and 7/8. The ampulla is somewhat flattened, irregularly circular and sac-like; the duct is very broad, and nearly as long as the ampulla, from which it is not sharply marked off. The diverticulum is very small, club-shaped, and arises from the junction of ampulla and duct.

The *genital setæ* (fig. 14) are in length ·94 mm., in breadth 16–18 μ. The distal end is curved through about the quadrant of a circle, is tapering and pointed, and is ornamented by a single circle of minute sculpturings at the commencement of the terminal curve.

Pheretima hawayana, (Rosa).

For reasons to be subsequently assigned, I give an account of some of the anatomical features of the single specimen of this species in the present collection. It was found, along with the six species of *Megascolex*, in the rotten wood of dead tree stumps and logs in the jungle, at Pattipola (hill country), Ceylon, 6,000 feet.

External Characters.—*Length* 2 inches; *breadth* 2 1/2 mm. *Colour* yellowish brown. *Segments* 91.

Prostomium epilobous 1/2.

First *dorsal pore* in intersegmental furrow 10/11.

The *clitellum* comprises segments XIV.–XVI. = 3; it is annular in form, and has a few small setæ ventrally on segment XVI. only.

The *male apertures* are on segment XVIII., widely separated, and not elevated. There are twelve setæ intervening between the apertures; these setæ however do not approach very near to the inner margins of the apertures themselves.

The *female aperture* is presumably situated in a small, mid-ventral, somewhat transversely extended depression on segment XIV.

The *spermathecal apertures* were invisible from the exterior.

Genital markings were present in the form of a number of spots to the inner side of the male apertures. These were of a dark colour, and were, I think, somewhat depressed, certainly not elevated. There were four such spots on the left, and two on the right side, in a transverse line slightly behind the level of the male apertures, and therefore behind the level of the setæ. A minute darkish spot was also visible ventrolaterally on the left side of segment VIII., just in front of furrow 8/9.

The *setæ* form a ring in each segment, which behind the clitellum is almost closed dorsally ($zz = 2\ yz$ or less); in the first few segments of the body, zz is a wide interval, and yz is also much wider than posteriorly. Ventrally the ring is quite, or almost, closed; if not quite closed, the line of setæ a, and the interval aa, is irregular. As far back as segment IX., the setæ on the ventral surface are arranged at very irregular, and in some segments very wide, intervals. The ventral setæ of segments III.–IX. are enlarged; those of X. are quite small.

Internal Anatomy.—The lower margin of the *intestinal diverticula* has a crenated appearance.

The *prostates* are large, occupying six segments; the duct forms a single loop. On the right side there were four *accessory glands;* and on the left side two only, somewhat larger than those of the right; there is thus no direct relation to the number of dark spots seen externally, the numbers for each side, four and two, being reversed.

The *spermathecæ* open between segments 5/6, 6/7, and 7/8; there are thus three pairs. The ampulla is circular in shape, and flattened; the duct is narrow, and nearly as long as the ampulla; the diverticulum, in most cases directed inwards towards the middle line, is narrow, nearly as long as ampulla and duct together, and dilated at its inner extremity.

Remarks.—In a recent Paper on some earthworms from Yunnan and the Shan States (12), I have described some specimens of *P. hawayana* which very much resemble the above. The interest lies in the fact that they are in some respects intermediate between the typical form of *P. hawayana* and the sub-species *barbadensis*.

These two forms were previously described as separate species, and are so considered by Michaelsen in the Tierreich (5). Beddard however (3, p. 645) considered that they should be united; and this Michaelsen (9, p. 187) accepts, with however the following proviso: "I am not yet quite convinced that this view is correct. Till now I have not seen a specimen—and I have examined many—which aroused any doubt as to whether it should be placed in the typical form or in the sub-species."

We may take as a basis of comparison (i.) the diagnosis of *P. hawayana* and *P. barbadensis* in the Tierreich, and (ii.) the following passage from Michaelsen's Paper just referred to:—"In the generally more robust typical form with stronger setæ in the anterior part of the body the papillæ near the male pores are always united at each side, occupying an oblong oval area medial from the male pores and mostly somewhat oblique. In the sub-species *barbadensis*, the papillæ near the male pores are scattered, partly very near the male pores, partly near the median ventral line."

In the present specimen we find no papillæ, but darkish spots (= " Fleckchen " of *P. hawayana*, in Tierreich) ; which however were not confluent but separate (= *barbadensis*), and near and on the inner side of the male aperture (= *hawayana*). The setæ of the anterior segments were strengthened (= *hawayana*) ; the setal chains were not quite closed (= *hawayana*), but on the other hand the dorsal interval was the more marked (the contrary is characteristic of *P. hawayana*, *cf.* Tierreich). The clitellum occupied the whole of three segments (= *barbadensis*) ; the intestinal cæca showed a series of secondary diverticula, and the prostatic duct was curved (= *hawayana*).

Most of the characters of the present specimen were found also in the examples from the Shan States. The present specimen from Ceylon differs from them however in having a few clitellar setæ, in the fact that the setal rings are not quite closed, and in having circular rather than ovoid, spermathecal ampullæ.

Dichogaster affinis, (Mchlsn.).

A single specimen, in a tube along with the *Lampito* previously described. In rotten wood in the hotel compound, Anuradhapura (low country), Ceylon.

This species is already known from Ceylon ; I subjoin a few notes on the single specimen submitted to me, since it shows a few peculiarities, mostly however in all probability of an individual nature only.

Length 30 mm. ; *breadth*, max. 1·5 mm. ; *segments* 125. *Colour* brownish red (due to contents of gut), with white specks (nephridia) behind the clitellum. The chief of the peculiarities referred to above was in the segmentation ; the two pairs of *prostatic pores* were on segments XVI. and XVIII., instead of XVII. and XIX., and internally also the organs, from the pharynx backwards, were one segment in front of their normal position.

The *clitellum* was incomplete ventrally, and extended from XIII. to 1/2 XX. = 7 1/2. The *body-wall* was elsewhere very thin, and the red woody material could be plainly seen filling out the gut in its whole extent behind the clitellum.

The *nephridia* were very conspicuous externally, appearing as three white spots on each side in each segment behind the clitellum ; in some of the anterior segments there were four such spots. They were of an opaque flocculent appearance, each in linear series with the corresponding organ in preceding and succeeding segments, the whole of them thus being arranged for the most part in regular longitudinal lines along the body. They become much smaller towards the posterior end, and in the middle and posterior thirds of the body the dorsal row is somewhat widely separated from the other more ventrally situated rows.

The *prostatic pores*, as mentioned above, are on segments XVI. and XVIII.; those of the same side are connected by an almost straight longitudinal groove, and the two apertures and connecting groove of each side have raised margins. Since the ridges bordering the grooves on their inner side approach each other closely in the mid-ventral line, the appearance of the whole is that of a raised square with rounded corners.

The *genital "papillæ"* do not appear to be raised. Each is a small inconspicuous circular area, mid-ventrally situated in the course of furrows 7/8 and 8/9, with a smaller circular marking in its centre. There was a similar very small area between and behind the posterior prostatic apertures mid-ventrally in furrow 18/19.

The *setæ* had the normal relations for the species. The length of the ordinary setæ was 115–125, in shape they were of the "*Enchytræus* type," with a hooked proximal and almost straight, tapering, and pointed distal end.

The anterior portion of the animal was sectioned longitudinally; the woody material in the intestine and gizzards proved very damaging to these parts of the sections, so that unfortunately the spermathecæ, in the region of the gizzards, were almost unrecognizable. The following points may be briefly noted.

Septum 7/8 was moderately thickened, septa 8/9–10/11 considerably, 11/12 and 12/13 moderately; allowing for the difference in the numbering of the segments, this is practically the condition given in the diagnosis of the species by Michaelsen (5). There was a well-marked *typhlosole*. The first *dorsal pore* was in the furrow 4/5 (this would correspond to 5/6 in a normal specimen).

The *nephridia* presented a curious appearance in sections. They were mainly composed of circular aggregates, up to 22 μ in diameter, of small white spherical non-staining granules; and it is presumably to this material that the opaque white appearance of the nephridia in the entire animal was due. Nuclei and strands of tissue were present between the granular aggregations; substituting these white grains for oil, the appearance of a nephridium in section was not unlike that of a group of fat cells.

The *seminal funnels*, *vesiculæ seminales*, *male apertures*, *prostates*, *gizzards*, *spermathecal apertures*, and *calciferous glands* agreed in structure and position (making the necessary allowance) with what has been previously described for the species.

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Description of Figures.

Plate I.

Fig. 1.—*Dero zeylanica*; transverse section through posterior end, cutting both intestine and dorsal diverticulum of branchial fossa, the latter containing the first pair of gills; × 155, Abbe's drawing apparatus.

Fig. 2.—The same; transverse section at a more posterior level; intestine has opened into the branchial fossa, which is still closed dorsally; the first and second pairs of gills as ridges on the walls of the fossa; × 155, Abbe's drawing apparatus.

Fig. 3.—The same, more posteriorly still; the branchial fossa has opened out dorsally; the first pair of gills has disappeared; the second, third, and fourth pairs are seen; × 155, Abbe's drawing apparatus.

Br. f., branchial fossa; *d. d.*, dorsal diverticulum of fossa; g^1–g^4, first to fourth pairs of gills; *int.*, intestine; *marg.*, margin of fossa; *sp. c.*, nerve cord; *x.*, pear-shaped epithelial cells of gills.

Fig. 4.—Dorsal needle-seta of *Dero zeylanica*.

Fig. 5.—Setæ of *Aulophorus palustris*; *a*, dorsal needle; *b*, ventral seta of segments II.–IV.; *c*, ventral seta of segments behind IV. (*b* and *c* more highly magnified than *a*).

Fig. 6.—Ventral setæ of *Hesperodrilus zeylanicus ;* the distal end of the single-pointed seta is uppermost ; × 600.

Fig. 7.—Genital area of *Drawida annandalei.*

Plate II.

Fig. 8.—Genital area of *Megascolex pattipolensis.*

Fig. 9.—Distal end of genital seta of *Megascolex bifovcatus.*

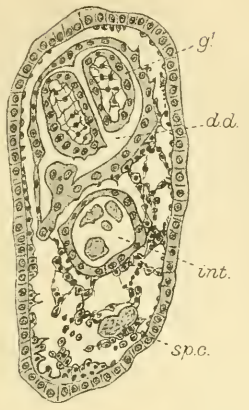
Fig. 10.—Distal end of genital seta of *Megascolex curtus.*

Fig. 11. – Genital area of *Megascolex quintus.*

Fig. 12.—Spermatheca of *Megascolex quintus.*

Fig. 13.—Spermatheca of *Megascolex sextus.*

Fig. 14.—Distal end of genital seta of *Megascolex sextus.*



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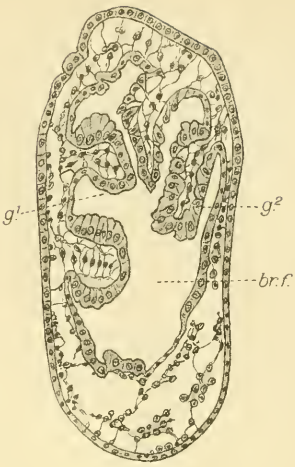

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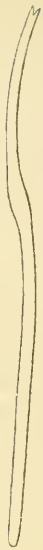

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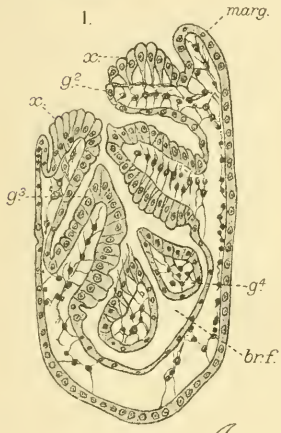

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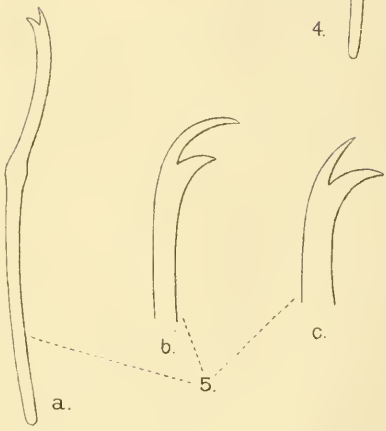

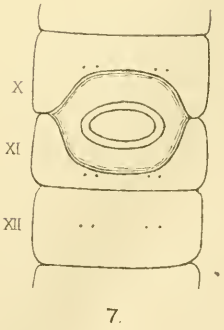

7.

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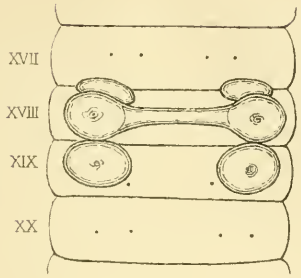
1-4. Dero zeylanica. 5. Aulophorus palustris.
6. Hesperodrilus zeylanicus. 7. Drawida annandalei.



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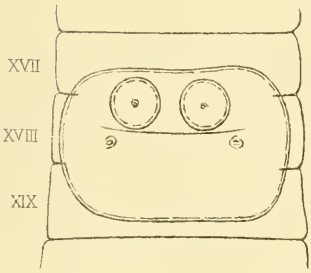

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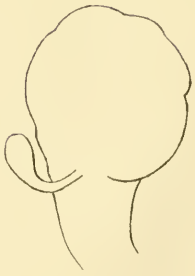

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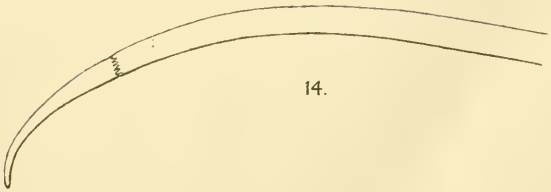

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8 Megascolex pattipolensis. 9. Megascolex bifoveatus.
10. Megascolex curtus. 11 & 12. Megascolex quintus
13 & 14. Megascolex sextus.

ON SOME TERMITES COLLECTED BY MR. GREEN IN CEYLON.*

By Dr. Nils Holmgren, Stockholm.

I HAVE, on several occasions, received termites for determination from Mr. E. E. Green, of Peradeniya.

These very valuable collections contained several new species in addition to others that were already well known, but of which our knowledge has been amplified by the discovery of hitherto unknown castes.

Hereunder I will deal with the following species and castes that are new to Ceylon or to Science :—

Calotermes (*Neotermes*) *militaris*, Desn. Imago.
Calotermes (*Glyptotermes*) *dilatatus*, Bung. Imago.
Calotermes (*Glyptotermes*) *ceylonicus*, Holmgr. Imago and soldier.
Termes estheræ, Desn. New to Ceylon.
Odontotermes horni, Wasm. Imago.
Odontotermes ceylonicus, Wasm. Imago.
Odontotermes obscuriceps, Wasm. Imago.
Eutermes lacustris, Bugn. Soldier and worker.
Eutermes longicornis, n. sp. Soldier and worker.
Microcerotermes bugnioni, Holmgr. Imago.
Microcerotermes greeni, n. sp. Soldier and worker.

Calotermes (Neotermes) militaris, Desneux.

Imago :—Reddish brown, with lighter coloured antennæ, pleuræ, coxæ, femora, and abdominal sternites. Tibiæ and tarsi reddish brown. Wings (rust coloured) yellow brown, smooth, sparsely covered with hair.

Head broadly oval, thick when looked at from the side, moderately arched, with somewhat impressed forehead. Compound eyes rather small, ocelli small, almost touching the eyes. Basal portion of clypeus very short, of the same colour as the forehead, quite flat. Apical portion of clypeus trapezoidal, white. Upper lip somewhat broader than long. Mandible armed as in *Hodotermes*. Antennæ with eighteen or nineteen joints. In the case of those with eighteen, the second, third, and fourth are of equal length. When there are nineteen joints, second and third are equal and the fourth shorter.

Pronotum much broader than the head ; anterior border strongly concave, distinctly shorter than the hinder border. Posterior angles more strongly rounded than the anterior angles. Mesonotum

* Translated from the German.

and metanotum straight behind, hardly rounded. Basal pads ("Schuppen") of the fore wings very large, with rather convex costal margin and bowed hinder margin; ribs prominent. Wing membrane thickly covered with minute prominences. Subcosta and radius of fore wing fairly well developed. Radius-sector with from six to seven branches to the front edge of the wing; the first branch proceeding from the inner third of the wing. Mediana free from the base of the wing, with from six to eight radius-sector connections, often with a backwardly directed branch at the extremity. Interspace between the mediana and the cubitus reticulated. The five to seven inner branches of the cubitus well defined; the remainder (ten to twelve*) weaker.

The mediana of the hind wing extends almost from the base of the radius-sector.

All the tibiæ with three apical teeth; the middle tibiæ with one or two additional lateral teeth. Onychium small.

Length, with wings, 17 mm.
Length, without wings, 10 to 12 mm.
Length of head, 2·5 to 2·7 mm.
Breadth of head, 2 mm.
Width of pronotum, 3 mm.
Locality, Peradeniya. (Coll. Green, No. 2,452.)

Calotermes (Glyptotermes) dilatatus, Bugn.

(nec *Calotermes ceylonicus*, Holmgr.)

Imago (apterous form):—Brownish yellow; head and pronotum somewhat darker; lower parts whitish yellow. Hair very scanty.

Head broadly oval, somewhat longer than broad. Head sutures hardly visible. Compound eyes rather small, slightly protuberant. Ocelli almost touching the eyes. Mandibular condyle large. Basal portion of clypeus short. Upper lip small, strongly bent. Antennæ ?-jointed, third joint somewhat smaller than second and as long as fourth.

Pronotum with somewhat widely rounded fore-angles, and with unindented anterior margin. Mesonotum and metanotum obscurely excavate.

Length, without wings, 6 mm.
Length of head, 1·44 mm.
Width of head, 1·26 mm.
Width of pronotum, 1·07 mm.
Length of pronotum, 0·59 mm.
Locality, Peradeniya.

Remarks.—The imago described as *Calotermes ceylonicus*, Holmgren (Escherich, "Termitenleben auf Ceylon"), does not belong to *C. dilatatus*, Bugnion, as I once supposed (Zool. Anz., 1911).

* There are about eleven principal branches to the cubitus, but these are much subdivided, especially on the distal part of the wing.

CALOTERMES (GLYPTOTERMES) CEYLONICUS, Holmgr.

Calotermes ceylonicus, Holmgren (Escherich, " Termitenleben auf Ceylon ").

Imago :—Yellowish brown to brown. Below, straw-yellow. Wings hyaline with brown veins. Pronotum with a T-shaped yellow mark.

Hair very scanty.

Head quadrate-oval, longer than broad, very thick, sloping somewhat towards the forehead. Sagittal suture very distinct. Compound eyes small, somewhat protuberant. Ocelli of medium size, almost touching the eyes, placed somewhat awry. Basal portion of clypeus very short; upper lip small, sharply bent. Antennæ 13-jointed, third about as long as second and a trifle longer than the fourth. Pronotum rather smaller than the head, with acutely rounded angles in front (" Vorderecken beinahe spitzwinkelig abgerundet "). Metanotum somewhat rounded behind. Wing membrane verrucose (" hockerig "). Subcosta of the fore wing rudimentary. Radius short. Cubitus very feebly defined, with from ten to twelve branches :—

	Smaller Form.	Larger Form.
Length, with wings ..	8·5 mm.	—
Length, without wings ..	4·7 mm.	6 mm.
Length of fore wing ..	7·3 mm.	—
Length of head ..	1·33 mm.	1·48 mm.
Width of head ..	1·15 mm.	1·26 mm.
Width of pronotum ..	0·96 mm.	1·18 mm.
Length of pronotum ..	0·52 mm.	0·7 mm.

Soldier :—Head yellowish red, brown towards the front ; mandible brown at base ; body straw-yellow. Hair very scanty.

Head approximately cylindrical, much longer than broad. Forehead sharply receding, medially impressed, bilobed, rounded at the sides. Basal portion of clypeus short. Upper lip reaching beyond the middle of the closed mandibles, longer than broad. Mandible very short and broad, strongly toothed. Antennæ 12-jointed, short ; third joint very short.

Pronotum smaller than the head, half-moon shaped ; anterior margin concave, posterior margin slightly excavated in the middle. Abdomen somewhat extended.

Length of body, 6·5 to 7 mm.
Head, with mandibles, 3·22 mm.
Head, without mandibles, 2·55 mm.
Width of head, 1·52 mm.
Width of pronotum, 1·39 mm.
Length of pronotum, 0·63 mm.
The collection contains many larvæ and nymphs.
Locality, Peradeniya.

Remarks.—The imagines of *C. ceylonicus* and *dilatatus* are very similar to each other, but may be distinguished by the following characters :—

(1) Pronotum with almost rectangular slightly rounded angles in front. Sagittal suture of head very well defined ; darker.—*C. ceylonicus*, Holmgr.

(2) Pronotum with broadly rounded angles in front. Sagittal suture of head ill-defined ; paler.—*C. dilatatus*, Bugn.

Termes estheræ, Desn.

Soldiers and workers present.

Locality, Hambantota (A. J. MacDougall).

Remarks.—This species is now recorded from Ceylon for the first time. Desneux described it from the Bijapur District (Bombay Presidency).

Odontotermes horni, Wasm.

Syn. *Termes peradeniyæ*, Holmgren. " Termitenleben auf Ceylon," K. Escherich, p. 197.

Syn. (?) *Termes taprobanes*, Hag. According to Ceylon examples of Hagen, Wasmann.

The imago of this species, which is common at Peradeniya, has been hitherto unknown. Mr. Green has now obtained imagines. They are identical with specimens from the collections of the Vienna Hof-Museum, which I have described as *T. peradeniyæ*.

Probably *T. taprobanes*, from Ceylon, is also identical with *O. horni*.

Locality, Peradeniya ; Koslanda. In branches of *Croton tiglium*.

Odontotermes ceylonicus, Wasm.

Imago :—Head bright castaneous : area surrounding the fontanelle, anterior angles of the "transverse band," basal portion of clypeus, antennæ, and mouth parts reddish yellow. Pronotum of the same colour as the head, with a T-shaped mark, shoulder spots, and two posterior spots yellow. Front part of the meso- and metanotum paler than the hinder parts. Wings brownish. Abdomen brown above, rusty yellow below. Legs rusty yellow.

Hair rather dense, yellowish.

Head large, broadly oval. Fontanelle small, elevated. Compound eyes of medium size, decidedly prominent. Ocelli large, distant from the eyes by about their greater diameter. " Transverse band " medially excavated, narrow, uneven. Basal portion of clypeus large, rather shorter than half its own width, strongly swollen, convex behind, straight in front. Antennæ 19-jointed, second longer than third, fourth somewhat longer than third but shorter than second.

Pronotum wide, with broadly rounded anterior angles, lateral margins converging strongly behind, posterior margin slightly excavated in the middle. Mesonotum more broadly excised behind than the metanotum. Wing membrane minutely punctate, sparsely hairy at the extremity, with a yellow subcostal streak. Radius-sector with some short backwardly directed branches. Mediana extending from the cubitus, with one, two, four, or six apical branches, and often with some slender branches united to the radius-sector. Cubitus with about sixteen branches, of which about the seven innermost are thickened. Cerci present in the male.

Length, with wings, 27 mm.
Length, without wings, 12 to 13 mm.
Length of fore wing, 12·5 mm.
Length of head, 2·7 mm.
Width of head, 2·59 mm.
Length of pronotum, 1·29 mm.
Breadth of pronotum, 2·52 mm.

Locality, Peradeniya.

Remarks.—O. ceylonicus is readily distinguishable from other Ceylon species by the extensive yellow area surrounding the fontanelle.

ODONTOTERMES OBSCURICEPS, Wasm.

Imago :—Head dark castaneous. Fontanelle, two spots, and the anterior angles of the front margin of the " transverse band " rusty yellow. Basal portion of clypeus brownish. Antennæ brownish ; mouth parts rusty yellow. A T-shaped mark and two shoulder spots on the pronotum yellow. Fore parts of the meso- and metanotum paler than the hind parts. Dorsal surface of abdomen brown ; ventral surface, especially in the middle, much paler. Tibiæ brownish. Wings yellowish brown, with brown veins. A yellow subcostal line is present.

Hair " fairly plentiful." The head partly with short hairs and partly with longer bristles.

Head broadly oval, narrowed in front. Area surrounding the fontanelle strongly impressed. Fontanelle small, punctiform, with a small longitudinal elevation in front of it. Compound eyes of medium size, decidedly prominent. Ocelli fairly large, with a raised inner edge : distant from the eyes by about their longer diameter. Basal portion of clypeus large, distended, rather shorter than half its width, convex behind, straight in front. Antennæ 19-jointed ; third shorter than second ; fourth rather longer than third, but shorter than second ; fifth as long as third.

Pronotum moderately broad, with broadly rounded fore-angles ; a slight median notch in front, widely excavated behind. Mesonotum more broadly notched than the metanotum. Wings moderately broad : membrane, finely punctate, sparsely hairy towards the tip. Radius-sector sometimes with a " hind rib " ; also with short

backwardly directed branches. Mediana, even before the middle, divided into about eight branches. Cubitus with from twelve to sixteen branches, of which about the seven innermost are thicker than the others.

Length, with wings, 26 to 27 mm.
Length, without wings, 10 to 12 mm.
Length of fore wing, 22, 23, or 24 mm.
Length of head, 24 mm.
Width of head, 2·22 mm.
Length of pronotum, 1·04 mm.
Width of pronotum, 2·07 mm.

Locality, Peradeniya.

Remarks.—It is curious that in the literature dealing with Termites a complete description of *Odontotermes obscuriceps*, Wasm., appears to be wanting, in spite of the fact that this is one of the commonest of Ceylon species.

Eutermes lacustris,* Bugn.

Soldier :—Head dark brown ; antennæ, thoracic plates, and abdominal tergites paler brown ; legs and abdominal sternites straw yellow.

Head with only a few scattered setæ. Abdominal tergites minutely hairy, with a feebly developed row of setæ behind. Sternites with longer hair and setæ.

Head (without the process) seen from above circular ; profile of forehead almost completely straight, or almost imperceptibly concave. Process conical, of medium length. Antennæ 13-jointed ; second as long as third ; fourth smallest.

Pronotum short, with short strongly elevated anterior lobes ; entire. Mesonotum somewhat narrower than the metanotum, the latter slightly excavated behind. Fourth joint of tarsus produced in the form of a spine.

Length of body, 3 to 3·5 mm.
Length of head, 1·63 mm.
Width of head, 1·05 mm.

Worker :—Head brown, body tergites slightly brown ; sutures of head, anterior edge of the " transverse band," clypeus, sides of head and the remaining parts of the body whitish straw-coloured. Head with only scanty short hair. Abdominal tergites with fine short hair and a feebly developed row of setæ behind. Head approximately quadrate, with strongly rounded angles, longer than broad. Sutures of head very distinct, moderately wide. Clypeus with a

* This was originally described by Dr. Holmgren as a new species, *Eutermes greeni ;* but, since the submittal of his manuscript, a description of the same species has been published by Dr. Bugnion, under the name of *Eutermes lacustris.* Dr. Bugnion's name, therefore, takes precedence. The correction has been authorized by Dr. Holmgren.—E. E. G.

short base, which scarcely touches the mandibular condyles. Mandibular condyles rather large. Apex of clypeus hyaline. Upper lip rather small, broader than long. Antennae 14-jointed; second slightly longer than third; fourth smallest. Pronotum strongly convex; anterior lobes as long as the hinder part, very slightly excavated (or entire).

Length of body, 4 mm. | Width of head, 1·03 mm.
Length of head, 1·3 mm. | Width of pronotum, 0·61 mm.

Locality, Peradeniya.

Eutermes longicornis, n. sp.

Soldier :—Head brownish yellow, frontal process more decidedly brown; antennæ rusty yellow; abdominal tergites brown; body, in other respects, yellowish white. Smooth, with a few setæ on the hinder margins of the abdominal tergites. Head pear-shaped, not constricted ("eingeschniirt"). Frontal process slender, about as long as the rest of the head. Profile of forehead concave, the frontal process and the crown of the head not lying in the same plane. Antennæ long, 13-jointed; third at least twice as long as second and distinctly longer than fourth. Pronotum saddle-shaped, not excavated in front.

Length of body, 2·75 mm.
Length of head, 1·66 mm.
Length of frontal process, 0·74 mm.
Width of head, 0·92 mm.
Width of pronotum, 0·44 mm.

Worker :—Head light brown, with white sutures and fontanelle. Basal portion of clypeus and anterior border of "transverse band" yellowish. Tergites brown: remainder of body yellowish white. Head with a few setæ. Hair, in other respects, as in the soldiers.

Head broadly oval. Sutures clearly defined. Fontanelle triangular, situated in the sagittal suture. Base of clypeus short, rather narrow, somewhat arched. Antennæ rather long, slender, 15-jointed; third joint as long as second and fourth together; fifth as long as fourth; other joints gradually increasing in length. Pronotum saddle-shaped, not excavated in front.

Length of body, 4·25 mm. | Width of head, 1·29 mm.
Length of head, 1·63 mm. | Width of pronotum, 0·67 mm.

Locality, Peradeniya, on stem of "Giant Bamboo."

Remarks.—Nearest to *Eutermes escherichi* of Ceylon.

Microcerotermes bugnioni, Holmgren.

Imago :—Dark brown, lighter beneath. Clypeus, antennæ, mouth parts and legs rusty yellow; wings dark. Hair short and fine.

Head oval, longer than broad, approximately parallel-sided, thick. Compound eyes small and prominent. Ocelli rather small but not punctiform; scarcely less distant from the eyes than their

diameter. Fontanelle imperceptible, but actually present. Basal portion of the clypeus large, almost triangular behind, straight in front, somewhat distended. Antennæ 14-jointed, third very small.

Pronotum small, straight in front, anterior corners angularly rounded, lateral margin strongly convergent; posterior margin relatively short, obscurely excavated in the middle. Mesonotum distinct. Metanotum very slightly excised. Front wing-pads distinctly longer than the hinder ones, but not reaching the base of same. The mediana of the fore wing arises free from the pad, and runs nearer to the cubitus than to the radius-sector. Mediana simple or furcate, or with two or three branches. Cubitus with eight or nine branches, of which most are furcate. Six or seven stout inner nervures. The mediana of hind wing starts from the radius-sector.

Length, with wings, 7·5 mm.	Width of head, 0·84 mm.
Length, without wings, 4 mm.	Length of pronotum, 0·43 mm.
Length of head, 0·91 mm.	Width of pronotum, 0·65 mm.

Locality, Ambalangoda.

Microcerotermes greeni, n. sp.

Soldier :—Head yellowish brown ; body straw-yellow, whitish ; head very sparsely hairy.

Head elongated, parallel-sided. Forehead somewhat truncated, " rinderformig "-shaped, impressed. Basal portion of clypeus distinctly convex behind, with straight anterior border. Upper lip roundly pentagonal. Fontanelle small. Transverse sutures distinct. Mandible decidedly concave externally at the base. Mandibles relatively short, with very distinctly serrate teeth, the tips falcate. Antennæ 13-jointed ; second as long as third and fourth together ; third very short. Pronotum small, saddle-shaped, not excised in front.

Length of body, 4·20 to 4·25 mm.
Length of head, with mandibles, 1·85 mm.
Length of head, without mandibles, 1·37 mm.
Width of head, 0·81 mm.
Width of pronotum, 0·52 mm.

Worker (two forms):—Head yellow ; body yellowish white. Hair scanty. Head broadly oval. Fontanelle not visible. Basal portion of clypeus large, arched in front, fleshy, rather longer than half its breadth, distinctly convex behind, straight in front. Antennæ 13-jointed ; second as long as third and fourth together ; third very short. Pronotum saddle-shaped, not excised in front.

	Small Form.	Large Form.
Length of body ..	2·5 mm. ..	3 mm.
Length of head ..	0·78 mm. ..	0·81 mm.
Width of head ..	0·67 mm. ..	0·7 mm.
Width of pronotum ..	0·44 mm. ..	0·48 mm.

Locality, Ambalangoda.

SOME SUGGESTIONS FOR MEMBERS OF THE CEYLON NATURAL HISTORY SOCIETY.*

By E. Ernest Green, F.E.S., F.Z.S.,
Government Entomologist.

OUR Natural History Society, which was inaugurated just eight months ago, now numbers 157 members.

This is our third meeting, and we have already listened to several interesting Papers on various subjects. We look forward to many other meetings; but the object at which such a Society as ours should aim is not merely to meet at stated intervals and listen to the reading of Papers by a small number of our members. The actual meetings are the least important part of the programme. The life of the Society depends upon the endeavours of each individual member to add (if only a few grains) to the general stock of knowledge. The source of such knowledge is to be looked for, not at the meetings—though fresh ideas and inspiration may possibly be gathered on those occasions—but in the intelligent observation of Nature day by day.

Let no one, even the veriest beginner, be alarmed or discouraged by this dictum, or imagine that no valuable discoveries can be made without special training; nor must it be supposed that little remains to be discovered. Far from such being the case, endless problems, in every branch of Natural History, in Ceylon, await solution.

Speaking as an entomologist, I can confidently affirm that little is known about the life-histories and habits of our Ceylon insects. As soon as we get outside one or two conspicuous families—such as the butterflies and moths—it is probable that not one-tenth of the existing number of species has even been recognized, much less determined or classified, and our ignorance of their habits is discouragingly profound. Even amongst the butterflies, which have been collected assiduously ever since the British occupation of the Island, new species are still occasionally brought to light, and of many well-known species the early stages are yet unknown. The blank spots in our knowledge of the moths are still more numerous; and when we come to the other groups of insects, we seem to have scarcely touched the fringe of the subject.

* Read before the Ceylon Natural History Society on Wednesday, October 9, 1912.

To show you what interesting facts may turn up unexpectedly, I may mention that, only a few months ago, one of my valued up-country correspondents sent me a very common beetle, and asked me if I knew that it was luminous in the dark. He had captured a specimen, one night, believing it to be an ordinary firefly, and was surprised to find that it was of quite a different form. Although I had been acquainted with this beetle—which is quite a common one—for many years, and had handled and examined many specimens of it, I was quite unaware of its phosphorescent properties. Systematic entomologists in Europe were apparently equally ignorant of the fact. Even when my attention had been drawn to the matter, I was unable, for some time, to corroborate the observation. I captured specimen after specimen and examined them in a dark room, without any result, except that my faith in my friend's accuracy began to wane. But I continued my investigations, and was rewarded one night in observing a very distinct phosphorescence emanating from a specimen captured on that afternoon. Moreover, I was still further interested to find that the light did not proceed only from the hinder extremity of the body, as is the case in common fireflies and glowworms, but was emitted from a definite series of points distributed along each side of the beetle. In fact, the insect displayed what looked like a row of illuminated portholes on each side of it. It would seem that this beetle is only occasionally luminous, though the conditions that govern its display are still obscure.

I have since discovered another beetle, hitherto unsuspected of producing light, that exhibits a similar series of phosphorescent points upon different parts of its body. The inference to be drawn from these interesting discoveries is that every unusual occurrence, or what appears to be unusual to the observer, should be duly reported and investigated. It may be already known ; it may lead to nothing. On the other hand, it may be a clue to some discovery of considerable scientific importance.

There must be countless unsuspected facts to reward the careful observer. There are many problems and undecided questions that any of you may be the means of solving. Let me mention a few.

Have we an indigenous hedgehog in Ceylon ? I fully believe that we have. There are five species recorded from the Indian continent, one of which—*Erinaceus micropus*—is common in the plains of Southern India ; but not a single species has been recorded from Ceylon. Yet I have been assured by competent observers that they have seen true hedgehogs in Ceylon. I have had a most circumstantial account from one man of how they were found in shallow burrows or runs beneath bushes, with the *débris* of insects upon which they had been feeding strewn round the entrance to their retreats. He had found them, more particularly, in the Eastern Province. I would appeal to our outstation members to settle this

disputed question by submitting a living example of the animal, with full particulars of the circumstances of its capture.

Similarly, while the continent of India produces nine distinct species of "short-tailed field mice," or voles, not a single species is credited to Ceylon. As I pointed out in a recent number of *Spolia Zeylanica*, I am confident that we have at least one species of vole in the Island. I have myself seen what I believe to be one of these animals on the Horton Plains, and other competent observers have assured me that they have seen mice answering to this description. Not realizing the interest attaching to this matter, they have not troubled to capture and examine the animals. Who will acquire the credit of sending to the Colombo Museum the first specimen of a true Ceylon vole ?

For those who are interested in bird life, I would draw attention to the probable occurrence of an unsuspected bird in the hilly parts of Ceylon. I refer to one of the smallest of the hawk tribe, a falconet, three species of which are found in India. The first suggestion of the presence of such a bird came to me through a planter in Hewaheta, who described to me how he had seen two blackbirds fighting, and how one of them had killed the other and had flown away with it. I had, later, the good fortune to witness a similar occurrence myself. In this case the victim was a common "bulbul." I was attracted by its cries of distress, and came upon the scene just in time to see it disappearing over the trees in the clutches of a tiny dark-coloured hawk that looked no bigger than itself. Naturally, I had no gun with me, and so was unable to verify my observation. If our falconet is identical with one of the Indian species, it will probably prove to be *Microhierax fringillarius*, the smallest of the three, which ranges through the southern portion of Tenasserim, Malay Peninsula, Sumatra, Borneo, and Java. This species is said to feed more exclusively upon birds.

There is in Ceylon a carnivorous bat, the *Megaderma* (of which we have two species). When I say "carnivorous," I mean that it is not content with the insect fare of ordinary bats, but has a craving for real meat. Such animals as mice, small birds, lizards, and frogs are amongst its victims, and their remains can often be seen in the verandahs of our bungalows, below the spot where one of these bats has hung itself up to consume its prey. I have watched *Megaderma* flying low over the grass, in the dusk, evidently searching for lizards and frogs ; but it is difficult to understand how they effect the capture of the small birds that, to judge by their remains, form such a large part of the diet of this bloodthirsty vampire. Such birds usually roost in the depths of a bush, where—it might be thought—they would be well out of the reach of a bat, which requires open spaces for the employment of its wings. Does it scent out its sleeping prey, creep into the bush, and pounce upon it there ?

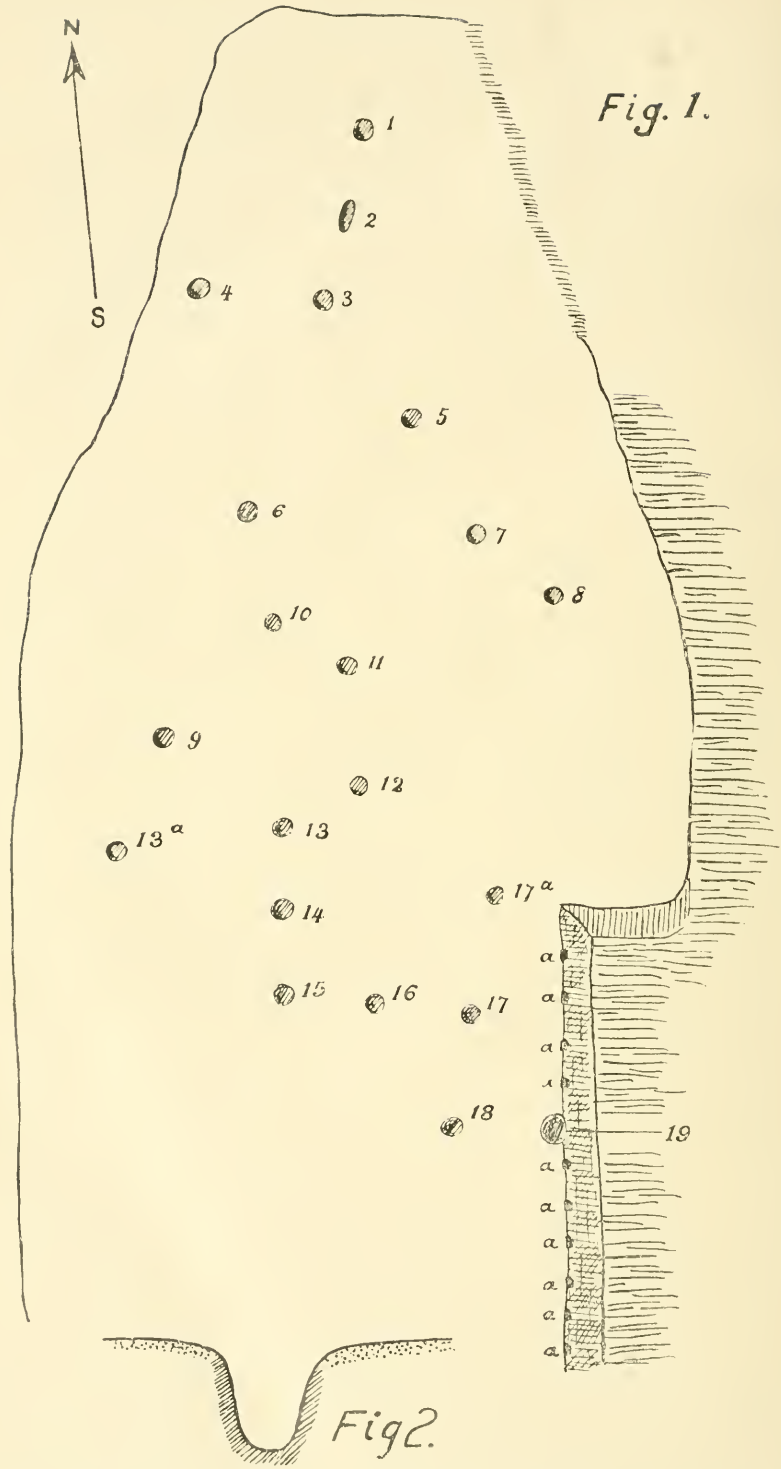
Who can tell us what is the normal food of the common land leech ? Only a few of the myriads of these little pests can ever have the opportunity of tasting warm blood.

The actual destination of the periodical migratory flights of butterflies that are so conspicuous at certain seasons in Ceylon has never been properly worked out, and the object of this movement can only be guessed at. The solution of this problem would require an army of observers, stationed along the route of the migration.

What is the food of the common firefly ? It has been suggested that they take no nourishment after attaining the adult winged stage. But if that is really the case, why are they provided with well-formed mouth-parts and jaws of a distinctly carnivorous type ? In other insects, such as certain moths, that are known to take no food in the perfect state, the mouth-parts are rudimentary or completely atrophied. We know that the larvæ of fireflies and glowworms are carnivorous, subsisting upon slugs, snails, worms, and soft-bodied insects. But the firefly, in captivity, refuses such food. They may sometimes be seen congregated in thousands upon the foliage of some tree, but I have equally failed to tempt them with leaves or fruit, as might be expected from the structure of their mouths.

My endeavours to discover the breeding place of that unmitigated nuisance, the "eyefly," have, so far, been unavailing. I have been assured that they must breed in fruit, as they can frequently be seen swarming upon overripe plantains. But this assertion is due to an error of observation. The tiny flies that so constantly frequent such situations belong to quite a different family and species, whose life-history is well known to entomologists.

I could put endless other problems before you, but I have already said enough to show you that the possibilities of useful discovery that lie within your reach are by no means limited. We cannot have too many careful observers. There are so many problems to be solved, and so few to solve them.



Cup-marked rock found at Kudagama, in the Kende korale, North-Central Province :—

Fig. 1.—Plan of the rock.

Fig. 2.—Section across one of the cups.

NOTES.

24. *Note on a Cup-marked Rock found at Kudagama, in the Kende Korale, North-Central Province.*—While inspecting the village of Kudagama during August of this year, I noticed a large mass of slab rock situated in the close vicinity of a tank. Below the tank bund was an abandoned "gangoda," where scattered about were the fragments of stone door frames. On the inner side of the tank bund was a well-carved three-headed cobra stone in a good state of preservation.

The carving was bold in outline, as well as graceful in pattern, the folds and convolutions being specially well cut.

On examining the slab first mentioned, I found that a large fragment had been wedged out, evidently for the purpose of supplying pillars. The wedge marks are quite distinct, and arranged along the line of natural fracture. A little to the north-west of this line of wedge marks I noticed what appeared to be a circular hollow in the stone, filled with dirty water. I next explored the rock and found another slight depression, also full of water, which on being swept out disclosed a cup-shaped hole, while another had been completely split across in the removal of the stone by wedging. A little further examination of the rock showed altogether twenty-one of these cup-like drill holes, the sizes of which ranged from 2 inches to 10 inches in depth by 5 inches to 6½ inches in width from "lip" to "lip." The rough sketch attached is copied from an eye-survey of the rock itself, from which it will be observed that there is no particular order as to the distribution of the cup holes, except that holes 13, 14, and 15 form a row nearly at right angles to the row 15, 16, and 17, but as the distances are so close—generally less than 18 inches—it is difficult to suppose that these holes were drilled for the purpose of letting in posts for a building, as the rest of the marks are quite without any order of arrangement, but they all agreed in sectional outline, though variable in depth.

The holes themselves are invariably circular in shape a few inches below the "lip," and concave at the bottom. They could be produced by spinning on its axis a stone of torpedo shape, this serving as a drill, the motion being imparted by a rubbing action of the hands, just as one might spin a ruler while keeping it erect at the same time. The "drill" stone was doubtless aided in its action by the addition of water, and possibly percussion at the start.

The question now arises as to the object or purpose of those cups as it appears impossible to believe that they were of use for building

upon, and certainly they could not have been for levering out the stone to be used later as pillars, as neither the depth, nor shape of the holes, would admit of sufficient "purchase" for the action of levers inserted into them.

On page 588 of "Ancient Ceylon," Mr. H. Parker gives some sketches of "Olinda (Mancala) boards," and a photo print on page 591 of the Mancala Holes at the third Pyramid at Gizeh, but it will be observed that these are in a distinct order of arrangement, leaving little room for doubt, in the latter illustration, that they were for a game.

Earlier in the same work Mr. Parker devotes a chapter to Ancient Rock Cup-marks, with an excellent plate of sections of these holes. in addition to full details as to sizes and localities of these singular objects, but he does not appear to find a satisfactory explanation of their object and purpose.

I noticed, in nearly all cases, the surface of the rock, where the holes I am describing are cut, is slightly more "weathered" away than the rest of the slab, and I am inclined to believe that in this is the explanation of the purpose of these cups. I would suggest that they were crucibles, for making or tempering the iron wedges used for splitting off fragments of stone for pillars and the like.

The metal, possibly in a crude state, was first placed in the "cup," and firewood heaped above it and lighted till the flames raised the stone and its enclosed iron fragments to a sufficient heat to render the metal of suitable temper for its ultimate purpose.

The fact that side by side with these cup holes are the wedge marks, showing where a block of stone had been removed, is in itsel highly suggestive, and more so when coupled with fact that the greater number of cup marks are situated within a more "crumbled" area of rock, the "crumbling" being explained on the theory of fire action.

The shape and smoothness of the holes can be easily explained on the hypothesis of their being formed by spinning an acute-shaped stone on its longitudinal axis, adding water as the drilling stone continued to cut its way into the softer material. This also obviously explains the reason for the holes being invariably tapered and rounded at the bottom.

My rough sketch shows the general plan of the slab rock only as far as where it is cup-marked, but I might mention that to the south the rock slopes down at a gradual inclination, and then becomes covered with a thin crust of soil. (See Plate.)

The scanty population in the neighbourhood are Sinhalese, but they are quite unable to give any explanation for these marks, and dismiss the subject by saying that it is a "Yoda-weda." I might add that my cleaning out and measuring each hole caused some amused astonishment.

In submitting these notes I venture to offer my theory for criticism as to the origin or purpose of these cup holes; that appear, so far, not to have been thoroughly investigated in connection with stone quarries of ancient times.

September, 1912. FREDERICK LEWIS.

Appendix.—Measurements of Cup Holes.

No.	Depth. In.	Width. In.	No.	Depth. In.	Width. In.	No.	Depth. In.	Width. In.
1	3¼	5	8	4	5	15	9½	6½
2	4¾	6	9	6	6	16	9½	6
3	3¾	5	10	4	5	17	7	6
4	3¼	5	11	6	6	17*a*	2½	5
5	2½	5	12	8	6	13*a*	2	5
6	2¾	5	13	10	7	19*	6½	6
7	5	6	14	7½	6			

* Split across showing complete section.

25. *The Mathematical Boy, Arumuyam.*—This remarkable boy was born at Sirivilliputturu, a village not far from Madura. His parents were very poor, and belong to the Weaver caste. At the age of eight his father died, and the boy was left in great poverty. He had absolutely no form of education, and to the present moment appears to be uncomfortable in the clothes that have been given to him.

At about the age of eight or nine he went to the temple of Superamuniam Swamy, in the village of Tiruparankundan near Madura, probably to beg. There was a festival on at the time, which lasted to about 1 o'clock in the morning. When the festival was over he fell asleep, and while sleeping he dreamed that a "Pandaran" came and touched his tongue with his finger. This awoke him, but finding nobody he went to sleep again till 9 o'clock in the morning. When he awoke he felt that he had received some form of enlightenment, as up to that moment he could hardly count up to 10. Finding some people disputing over a calculation, he gave the result that they had failed to solve. This appears to have been the point at which his previous state of mental power deviated from the present. Up to then his intelligence, as regards calculating power, appears, if anything, to have been below the average. He admits that when entrusted with a few coppers to buy petty articles of food for his mother, he brought the things and whatever change was given to him without being able to estimate what the requisite change should be.

From this time onwards the power of calculation appears to have become spontaneous, so much so that he is unable to explain his process of solving problems except by a method something akin to a ratio.

I asked him if he could or did form a mental picture of a sum or group of figures, but his answer was a decided negative. I next tried him by putting down on paper the figures 275/1846, but the moment I attempted to hand the paper to him he turned away his face as if it was something he did not wish to see or look at. On the other hand, when asked to multiply 873 by 873 he gave the answer in an instant, just as one might say six times six is thirty-six; no mental effort appeared to follow.

He appeared to be quite ignorant of the ratio of the circumference of a circle to its diameter; so to illustrate this that I gave him a practical example by passing the edge of a handkerchief across the mouth of a tumbler, and then applying the same to the circumference. This appeared to him to be a remarkable thing.

On being asked if he ever looked at the stars, and did they not convey the idea of an immense multitude, he could not say that they did. They were only specks and nothing else. On testing him as to anything regarding the direction of places, I put the question, could he tell the road by which he came to my house; his reply was that he would have to inquire, yet the distance was under one-third of a mile by a street that has only two "bends" in it.

On being asked the age of a child in minutes that was eleven years old his reply was given instantly, 5,781,600 being the product of $365 \times 11 \times 1,440$. This example obviously disclosed the fact that to him a year was equal to 365 units, and that multiplied by 11 times 24×60 must give the required answer, regardless of leap years, or the fraction over that the year has in minutes and seconds, he being ignorant of any such conditions.

Asked what he understood by cube root, he could only say that he divided a thing into itself by three, but he could not say how or why. He explained that 3 must be the cube of 27. When asked to multiply four figures by four figures he seemed to be hugely amused, and almost roared with laughing while giving his result.

In the matter of time, how long ago a thing took place, he appeared to be quite uncertain, and I feel confident that in his mind an actual interval of time or years conveys no particular impression.

When considering a problem, he appears to think intently on the actual figures given, but the process that follows seems to be mechanical.

To test this, I asked him to divide a certain figure by another, the actual figures being to divide 47,526,421 by 13. In a moment he said 7 remains over. I stopped him and asked him to explain how he knew what remained before giving the first part of the answer.

He explained that the figures would make certain groups, but the ultimate group would not divide without a remainder. These groups would make together 3,655,878, with an indivisible quantity of 7 still left. But he was entirely unable to explain how he could

retain the sum of each group in his brain and add it to the next till the groups were exhausted. Here, however, is a clue to the mental process that flashes with such truly astounding rapidity through the boy's brain, and it clearly shows that there is no thought reading, or, as I understand it, no hypnotic action.

To test the theory of his retention of the figures as set, I purposely challenged his answer, restating the same with an intentionally altered figure. His reply was to instantly correct me by restating the figures as I first quoted them, adding that with *those* figures he could give no other result !

After giving him 7/22 as the ratio (nearly) of the circumference of a circle to its diameter, I stated the following problem. A railway line is 70 miles long, and one of the wheels of an engine that runs along this line is 10 feet in diameter. How many revolutions would that wheel make in doing the distance ? His answer was given almost in a moment, and was 11,760 if the wheel was 10 feet wide and 29,400 times if the wheel was 4 feet wide. I leave the reader to work out the *exact* sum and see how long he takes.

In point of height the lad is rather above the average for a person sixteen years of age, which is what he states his age to be. He has an additional little finger on each hand, and an extra toe on each foot, besides being knock-kneed. His face is that of an ordinary Tamil boy, with no particular development of the skull so far as I could detect without careful measurement. His lips are thick, protruding, with rather fat cheeks. The nose is small, much depressed between the eyes, and somewhat Simian. The chin is small, rather pointed, and somewhat retreating. His voice is variable, and much changed by any excitement as would follow in an argument over a solution given, but in this respect he is in no way abnormal. He appears to be childlike, and while I was questioning him he would play with one of the gentlemen who accompanied him, much as a kitten would play on being tickled.

His movements impressed me with the idea that he was highly nervous, and equally that he was completely oblivious of his own abnormality.

He would laugh without provocation, and when answering a question involving long figures he would appear to be extraordinarily amused.

Beyond this, and a sort of indifference to anything other than calculation, his whole manner was that of a completely illiterate child.

He stated, on being questioned if among any of his relations were there any who could read or write, that only one, who had married a female of his family, could read ; so that I failed to find a trace from his own statements—and I see no reason to doubt them—of anything that might be brought to bear on the question from the standpoint of hereditary gift.

It remains to be seen, if any attempt is made to educate this youth, will it improve or diminish his extraordinary powers, or if they will vanish as suddenly as he states they came.

September 8, 1912. FREDERICK LEWIS.

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26. *Pioneers of Natural History in Ceylon.*—To Mr. E. E. Green's account of "The Pioneers of Ceylon Natural History" might be added some notice of Colonel and Mrs. George Warren Walker who were in the Island in the twenties, and are "famous in the annals of Ceylon botany."* Sir Emerson Tennent says: "Amongst the collections of Ceylon plants deposited in the Hookerian Herbarium are those made by General and Mrs. Walker. Some admirable letters of Mrs. Walker are printed in Hooker's 'Companion to the Botanical Magazine.' They include an excellent account of the vegetation of Ceylon."

Also we should certainly add J. W. Bennett, F.L.S., some time of the Civil Service, whose book, "Ceylon and its Capabilities," contains a good deal on the natural history of the Island, and who wrote besides books on "A Selection of the Most Remarkable Fishes found on the Coast of Ceylon," and on "The Fruits of Ceylon," published in 1830 and 1842 respectively. On the subject of the fishes of Ceylon he was decidedly the pioneer, though his book "never proceeded beyond the description of about thirty individuals."† It was accompanied by fine plates depicting the species described.

Several other Ceylon Civilians have given their attention to its natural history. The late Mr. M. S. Crawford sent many specimens of Ceylon plants, with their Tamil names attached, to Dr. Trimen, thus enabling him, as he has duly acknowledged, to identify them by their scientific names, and he compiled lists of the jungle products used as food in the Mannar District, and of the *flora* (with notes) of Mannar Island, originally intended for a projected "Manual" of that district. These lists he had printed privately, and they were ultimately published in the "Ceylon Forester," Vol. II., pp. 141–4. Mr. A. O. Brodie and his papers in the R. A. S. (C. B.) Journal might also be mentioned.

Some of the birds of Ceylon described by Knox attracted attention as long ago as 1760. There is in my possession a coloured drawing with the following description written below it :—"A Bird from the Island of Ceylon drawn from Nature of the size of Life by George Edwards, April 4, 1760 ..... See Knox's Hist. of Ceylon in the East Indies,' London, 1681, page 27." The sketch represents a Paradise Fly-catcher with chestnut plumage and long chestnut tail feathers—the *gini-hora* of the Sinhalese.

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* "Ceylon in 1837–1846," by A. M. Ferguson, C.M.G., p. 48. Vol. I., p. 84, note.

† *Ibid*, p. 205.

George Edwards was a well-known naturalist and Fellow of the Royal Society, born 1694, died 1773, the author of "A Natural History of Uncommon Birds and of some Rare and Undescribed Animals.' He did about 900 sketches for it, and drew his birds from life. He had travelled in Europe, but never out of it, so that the specimen of *Tersiphone paradisi* of which he made this sketch must have been one imported into Europe from Ceylon. I suggest that its importer was Jan Gideon Loten, the retired Dutch Governor of Ceylon (1752–7), who on leaving Ceylon seems to have lived for a time in England, where, in 1765, at Banstead in Surrey, he married an English woman as his second wife. He was "a great lover of birds," and "collected and employed people to procure specimens of species which attracted his notice." If it was not Loten, it was probably the notorious Earl Ferrers, who, "when he was Captain Shirley, had contributed a number of birds captured by him and intended for Madame Pompadour's collection." (See "Notes and Queries" 11s. lv., pp. 150, 190).

Whether Edwards' book contains sketches of other Ceylon birds I am not at present able to say, but the next member of the Ceylon Natural History Society who happens to visit the British Museum would have an opportunity of ascertaining.

Walton-by-Clevedon, Somerset, August 5, 1912. J. P. LEWIS.

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27. *Cave Inscription at Kurunegala.*—How amazingly accurate is Sinhalese tradition! In 1890 Mr. F. H. Modder, in a Paper on "The Animal-shaped Rocks of Kurunegala" (R. A. S., XI.), had recorded the fact that according to the popular belief the beautifully situated cave of Ahas Lena was formed by Pusba Dewa, nephew of King Devanam Piyatissa.

Six miles from where the precious Tooth Relic had lain enshrined by the massive base of Eta Gala, where it sinks to rise again in Kuruminiya Gala, on the left hand of the traveller journeying from Kurunegala to Puttalam, commence the forest-clad heights of the Natagane range. Parallel with it runs a second range, which, beginning with the sinuous outline of the Anda Gala, reaches its highest point in the pallid austerity of the Yakdessa crag, from where the hapless Kuweni had invoked the curse of heaven on her faithless lover. A sudden depression in the Natagane range, running north and south, separates it from the Atu Kanda; and buried within this cleft lies a deeper hollow of a few acres in extent, the site of Mudu Konda Pola, the Rahas Nuwara of the deified Irugal Bandara. A massive ring of stone encircles the great hollow; large caves on the side, rising 30 and 40 feet from the ground level, afford a dry and secure retreat in times of peril; and here in 1555 the gallant Widiye Bandara, driven from Pelenda; and repelled from

Senkadagala, took shelter with his kinsman the ruling chief. Here he played his last desperate card when he murdered his host and tried to seize the power, but had once again to flee before the united armies of the south, through Kalpitiya to Nellore, there to meet his destiny.

The approach to the Rahas Nuwara is through a tunnel formed by an enormous boulder resting against the main rock. The inner side of this is grooved above and contains a cave, while the top of the rock is a strong fortlet, from which a handful of men could block the passage of an army. It must have been through this tunnel that the Portuguese made their dash in 1598, when they surprised and killed the Mudaliyar in charge and committed the place to the flames.

Above the grooving of the cave runs an inscription. With some trouble a rough ladder was constructed, and from there my clerk, Mr. Moonemala, laboriously traced the writing, which runs as follows :—

" The cave of Parumaka Pusa, for the priests of the four quarters, present and not present " is the translation of the learned Simon de Silva Mudaliyar. Dewa is merely an honorific ; surely Pusa of Muda Konda Pola is the same as Pusba of Ahas Lena a few miles away ?

The inscription is not copied to scale.

Kurunegala, June 24, 1912. P. E. PIERIS.

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28. *Some Dutch Medals : Plate I.*—Obverse of medal contains the inscription, the translation of which is as follows :—This medal was, in the year 1724, in the month of November, given by Joannes Hertenberg, Governor and Director of the Island of Ceylon, as a token of love and favour, on behalf of the Company, to Don Joan Sinnewiratne Wijeje Wickreeme Tinneeon Modliaar, Gaisenaike, Master of the Hunt and of the Sowing at Mature, and Superintendent of Cattoene, Oedebocke, Kireme, the Girrewais, and Baigams, to incite him more and more in his present good zeal in the prosecution of the elephant hunt and rice culture and also coffee cultivation.

Plate II.—Reverse of the same medal shows within a shield the usual type of armed vessel, while below are the Hortenberg arms.

Arms.—A fess—charged with three trefoils slipped and two bendlets alternately, between a stag tripping in chief and three hills in base.

Crest.—A stag's head, as in the army.

The illustration shows the full size of the medal. The grantee was a grandson of the great Tennekon Disawa, described by Knox as one of Raja Sinha II.'s "greatest and most valiant Generals, and that had been notably successful against the Dutch." The Gajanayaka was the head of the Elephant Department, and under the Sinhalese Kings ranked amongst the three highest household officers. The Dutch word translated Superintendent was the equivalent of the Sinhalese Vidane. A Vidane was in charge of each of the royal villages, and till lately there was such a Vidane over Ambatalenpahala near Colombo. The reference to coffee culture at such an early date is of interest.

Plate III.—Obverse.—The inscription reads thus in English:—By me, Julius Valentyn Stein van Gollenesse, Chief Councillor and Director-General of the Dutch Indies, and departing Governor and Director of the Island of Ceylon: having, as justice requires, considered the good and faithful services in various capacities to the Hon'ble Company during our eight years' presence in this Island, of Philip Philipsz Widjejecoon Panditeratne, Maha Modliaar and Chief Interpreter of Our Gate, so are we moved to confirm and secure among his descendants by this medal our good disposition towards him. Given in the Fort of Colombo, 5th March, 1751.

The reverse is not illustrated here. It also bears the customary vessel. The full size of the medal from the top of the ring to the end of the lowest knob is $5\frac{3}{4}$ inches. The grantor was the Governor who built the Wolvendahl church. The grantee was born in 1686, and represents about the only prominent Sinhalese family which adopted a Dutch surname. The Maha Mudaliyar is always the Chief Interpreter of the Governor, this being the European development of the Sinhalese office of Basnayaka. "Tolk onzer porta" is a curious adaptation from the Portuguese. To the Sinhalese the King was the *Maha Wasala*, for great personages were spoken of after their residences. *Wasala* also meant Gate, Port. *porta;* and the palace officers, or *Fidalgos da casa*, became with the Dutch Officers of the *Porta; Cf.* the Sublime Porte. Also note the reference to descendants in the inscription.

Plate IV.—Obverse.—Inscription:—This is given to the Modliaar of the Galle Guard, Nicolaas Dias Abesinge Ameresekere, by the Hon. Jan Schreuder, Extraordinary Councillor of the Dutch Indies, Governor and Director of the Island of Ceylon, with its dependencies, as a token of honour in that he, not only in the present revolution in the country, above all others of his nation, has so far acquitted himself honourably as befits a faithful and honourable servant, but also that he and his ancestors have given us proofs of their fidelity. Given in the Fort of Colombo on the 24th January, 1768.

Plate V.—A finely engraved vessel with apparently the spirits of the air speeding the voyage.

The full length of this handsome medal is $5\frac{1}{4}$ inches. The grantee was born May 8, 1719, was appointed Maha Mudaliyar March 8, 1785, and died on May 10, 1794. There were two Guards of Lascarins under the Dutch Government, commanded by the Maha Mudaliyar in Colombo and the Guard Mudaliyar at Galle. They still survive in the Lascarin Guards of the Colombo Maha Mudaliyar and the Galle Atapattu Mudaliyar. The Maha Mudaliyar's coffin was carried to the grave by sixteen Dutch sergeants, escorted by forty-eight soldiers and the Lascarins of the Guard and Attapattu.

Notice the extraordinary variation in the form of the letters in the three medals. The oldest has the most modern looking, and *vice versâ*.

The translations of the inscriptions are by Mr. F. H. de Vos., and the heraldic reading by Mr. R. G. Anthonisz.

Kurunegala, September 23, 1912. P. E. PIERIS.

29. *On a Collection of Transfers of the Wings of Ceylon Butterflies, prepared by Mr. C. C. Gilbert of Ratnapura.**—The transfers shown have been made by pressing the wings of butterflies between two surfaces of gummed paper. On separating the paper an impression of both upper and under surface of the wing adheres to the gummed surface, while the wing membrane can be removed, devoid of scales. The impressions are then carefully cut out and gummed on to cards.

While this method is not quite an ideal one for a serious collection of butterflies, it has certain advantages, and might be employed in conjunction with a collection of specimens mounted in the more usual manner.

Amongst the advantages are economy, compactness, and portability. The expense of store boxes and entomological pins is avoided. A large number of specimens can be kept in a small space, and can be carried about or submitted by post without danger of injury. The transfers are permanent, and are not subject to the attacks of insects. They are in a handy form for reference, and the cards upon which they are mounted afford space for useful data and notes. A complete named collection, mounted in this manner, could be circulated by post to collectors in any part of the Island, to assist them in the determination of their specimens.

I should be sorry to see unique or rare specimens treated in this manner, but it affords a useful and economic means of studying our butterflies for such persons as are not in a position to undertake the more elaborate method of forming a collection.

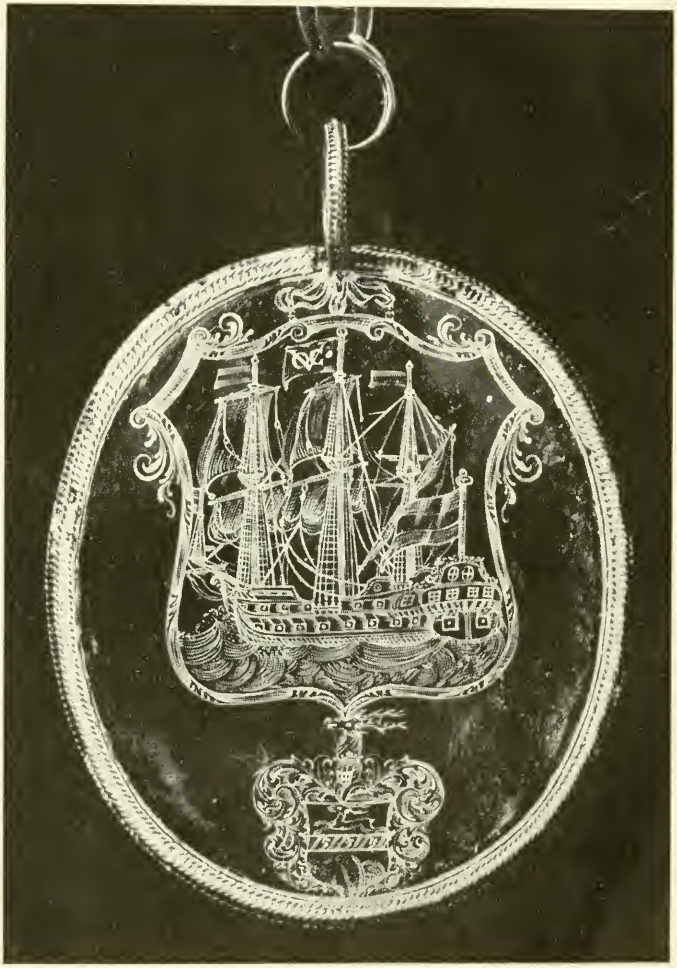
Peradeniya, June, 1912. E. ERNEST GREEN.

* Read before the Ceylon Natural History Society on June 7, 1912.

Plate I.


Dese Medallie
werd in den Jaare 1704, inde
maand november door
Joannes Hertenberg
Gouverneur en directeur des Eylands
Ceylon, tot een teeken van genegent-
heyd en gunste Comp:s wegen verreert aan
Dom Joan Sinnewiratne Wijese
Wiekreeme Tinteeon Modliar
gaisenaike, jaug en zeuymeester van Matu-
re, en Opsiener over Cattivene, Oedetorck
Kireme, de girreswais en Cayagams,
om hem in synen presenten geeden
yver tot voortsettinge van den
Elipbants vangst en Nely-
gewaay, ylem de Coffey Cul-
ture, meer en meer te
animeeren

Plate II.




Bÿ my
JULIUS VALENTYN
STEIN VAN GOLLENESSE
eerste Raad en directeur gener:
van Nederlandsch India en, afg:
gaande Gouverneur en directeur
van het Eyland Ceilon, Beleyt
gelet Zynde op de goede ingetouwe
diensten gedreerende ons agt garig aan
wesenten dezen Eylan de door
PHILIP PHILIPSZ: WIDJEJECOON
PANDITE RATNÉ, maha modliaar
en, Eerste Volk Onzer porta, in verschÿ
dene qualiteyten, aan, d'E. Comp:
bewesen: zo Zyn wÿ daar door
bewogen geworden Onze wel
wellend hÿd te hem Waards door
dezen gedenk penning, bÿ Zyne
nazaten te bevestigen en
Verzekeren
Gegeven in het Casteel
Colombo
den 5: Maart: 1751

Plate IV.


Voor den wel
Edelen groot Agtb:
Heer Jan Schreuder
Raad Ordre ordinair van
Nederlands Indiae Gouvernm
en directeur van 't eijland Ceylon
met dies onderhorige heeren
diese aan den meerderen van de
Tweede Quartier Vergaderd dies
Affesinge ommeroken, tot een teeke
van eere, om redenen hij niet alleen
in de presente Staats revolutie
boven alle andere van zijn natie
zig in het stuk van Gelijkmatigh
tot nog wel gequeelen heeft, gelijcker
wijs om enige blijvende dienaar te
laaten, maar ook om dat hij zig
wel als Zijne ouders in voor
dese allerley preuves van fidelit
heeft gegeven hebben afgegeven
van 't Casteel Colombo
den 29. January
A. 1765

Plate V.

30. *On a Stridulating Reduviid Bug.*—On picking up a living specimen of the large apterous reduviid bug—*Physorhynchus linnæi*—a distinct stridulation was noticeable. A closer examination showed that the sound was produced by friction between the tip of the short stout rostrum and a deep groove running between the bases of the anterior legs. The groove is demarked by a strongly raised margin, and contains a narrow, elongate, transversely striate plate (see figure). This structure is common to both sexes, and occurs also in the allied species *Physorhynchus tuberculatus*.

Peradeniya, August, 1912. E. ERNEST GREEN.

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31. *Dragon Flies capturing Butterflies.*—The following notes are extracted from a letter received from Mr. John Pole, whose observations on insect life are always valuable, and, in this case, are of particular importance, as throwing light upon the vexed question of the enemies of butterflies. He writes, under date April 22 :—

" There seemed to be a migratory flight of the white butterfly, *Appias paulina*, at 1.30 to-day. Whilst watching this from the bungalow, I observed wings floating to the grass, and wishing to ascertain particulars, went outside to watch. The sky was clouded over temporarily, and a crowd of the butterflies were seeking shelter in an orange tree from an anticipated shower of rain. Two large dragon flies hawking over the grass attracted my attention, and I had barely attributed the floating wings to them before one of them caught a white butterfly and, nipping off its wings, made off with it. I called to a friend who was staying with me to come and watch the sport. He had barely come on the scene when the other dragon fly caught a male *Papilio polytes* and danced about whilst devouring it. It came so near us that my friend knocked it down with his hat and picked it up together with one wing of the butterfly that it had been devouring."

The dragon fly in question is a large Libellulid, possibly a species of *Anax*, measuring 5½ inches across the expanded wings.

Peradeniya, August, 1912. E. ERNEST GREEN.

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32. *" Herpestes vitticollis," the Stripe-necked Mungoose. Sinhalese, " Loku Mugatiya."*—This is the largest species of mungoose found in India and Ceylon, and its colour varies from grizzled dusky iron gray to rich unspeckled ferruginous or chestnut red, the red colour frequently confined to the hinder part of the body and tail, the head always iron gray above, a black band down each side of the neck from behind the ear to the shoulder, and tail rufous black at the tip.

During the Acting Directorship of Mr. Gerard A. Joseph, I was sent by him on a collecting expedition to the southern part of the Island in July, 1910, and on that trip, when in the boundary of the Southern and Uva Provinces, I left the camp very early one morning accompanied by a tracker, and proceeded to the Kirindi-oya, about two miles from Lunuganwehera. Whilst traversing the river beds, during then the driest season of the year (only a little water being found here and there under the roots of the kumbuk trees), I came across several monkeys (*Semnopithecus priamus*), the Madras Langur; and whilst walking about two miles further on, I espied at a distance of 600 yards two large-sized mungoose near the water edge by a huge kumbuk tree, but as soon as they saw me they disappeared into the jungle. I visited the spot where I first saw them and found a quantity of dead putrid fish, some floating in the water. Feeling that the fish must have been the attraction that brought the mungoose to the spot, I watched there under cover of a bush, and after an hour or two I saw a large-sized mungoose approach the water-hole. Keeping very quiet till the animal came within about 100 yards from me I fired and secured the specimen. In all my various jungle travels in Ceylon, extending over twenty-seven years, I had never before come across this rare species of mungoose, so I was naturally very pleased. The specimen was a full-grown male. The next morning I re-visited the same spot where good luck had rewarded me the day before, and kept watch in the same bush, and was so fortunate that within half an hour another of the same species, which at first I took for the ruddy mungoose, appeared on the scene, which shared the same fate as the previous one. This too happened to be a male, somewhat smaller than the first one, but with better fur. I paid several other visits to the spot, and kept silent watch in the hope of securing a female to complete the collection, but all my efforts were of no avail. I, however, got specimens of the ruddy mungoose (*Herpestes smithi*) in the vicinity and a few birds. I hope to be able in July next to go to the same place, and trust fortune will again smile on me, and that I shall be able to complete the collection in the Museum by getting a female of the very rare *Herpestes vitticollis*.

The specimens of this expedition, the two male stripe-necked mungoose and the ruddy mungoose, have been mounted by me in a group, and they adorn the Mammalian Gallery. I hope that the group may be added to and made more attractive by the addition of a female or two of this rare species later on.

Colombo Museum, May 2, 1912. H. F. FERNANDO.

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33. *Note on "Orthotomus sutorius" (the Indian Tailor Bird).*— This interesting little bird is essentially a creature that appears to have no choice of situation, frequenting gardens, cultivated districts, and open country, as well as thick jungle and the depths of the

forest, flitting and hopping about among the shrubs and plants looking for insects. Abundant though they be, the tailor bird is unknown to quite a number of people ; this is due to the fact that he is not arrayed in gay plumage and is very small, so fails to attract the eye. His feathers are of sober hue, but he makes up with vivacity what he lacks in brilliance of plumage.

The tailor bird is ubiquitous in Ceylon, inhabiting the whole Island, without regard to the nature of the locality, from the sea coast to the highest part of the upper hills. It is widely distributed through the low-country, being quite as common in the north and east as it is in the south. In the Kandy District and throughout the Central Province and about Nuwara Eliya it is not common.

In India this little bird is a permanent resident throughout the Empire, ascending the Himalayas and other hill ranges up to 4,000 feet of elevation. It is rather rare in Sind and portions of the Punjab, but it appears to be found in all parts of those Provinces. In Burma its range ceases at Mergui, and extends into Siam and China, but not to so great an altitude as in Ceylon.

During the greater part of the year the male and female are alike in outward appearance—the female differs but slightly from the male, merely having the rufous on the head paler. The upper plumage is greenish, with a dash of gold or chestnut on the head. This last is set off by a neat black colour, visible only when the neck is stretched. The lower parts of the bird are dull white, and are thus lighter in colour than the back and wings.

The male, during the breeding season, is a bird of very restless habit, and when watched at that period quickly disappears into the nearest thick foliage, and is most persistent in giving forth his sharp " twike, twike," and the muscular action consequent on the display of these vocal powers exposes the naked black skin at the side of the throat, giving the appearance of a dark stripe at this part. The two middle feathers of the cock bird grow to a greater length than the others, and project 2 inches beyond them as sharp bristles. The breeding season in the west and south of the Island lasts from about February to November, during which period probably more than one brood is reared. In the Central Province it commences somewhat later, and in the north it is during the cool or north-east monsoon.

The tailor bird is interesting chiefly on account of the nest it constructs, which is one of the most wonderful things in Nature. The nursery in which the young tailors are born is composed of one or more leaves, which are sewn together by the parents. The bird's beak is its needle. If the fruit of the silk cotton tree be ripe the tailor bird extracts cotton from this and spins into thread with beak and feet. The method of nest-building varies with the kind of leaf. If it be a large one the sides are drawn together and stitched to keep them *in situ ;* if no large-leafed plants are available in the

selected site the bird has to content itself with smaller leaves, and it sews two or more of these together. The nest, which is thus a kind of purse or pocket, is well lined with bits of cotton, thread, coir fibre, wool, and small roots. As soon as the nursery is ready, three, four, or five diminutive eggs are laid in it. The tailor bird, like several other species, lays more than one type of eggs. In some cases there are three varieties: those with a white background with red blotches, those whose surface is white and but faintly speckled with red, and those which have a bluish background blotched with red.

The tailor bird nest and three young ones mounted for exhibition were found by Mr. G. M. Henry, the Laboratory Assistant, in one of the canna beds at the Museum grounds, and the other tailor birds were presented by Master Eric Fernando.

Colombo Museum, September, 1912. H. F. FERNANDO.

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34. "*Rhipidura albifrontata*" (*White-browed Fantail Flycatcher*). —The "Fantail" is chiefly an inhabitant of the dry jungle region between the Haputale mountains and the south-east coast, the eastern portion of the low-country as far as the delta of the Mahaweliganga, and the Province of Uva. In the first-named tract of country it is more common than elsewhere, frequenting the jungle on the borders of tanks. In Uva it is found chiefly on tree-dotted patanas; and in the Eastern Province, coconut topes in the vicinity of villages. It is rare to the west of Tangalla and Hambantota Districts.

Jerdon says: "It is found all over India except lower Bengal, extending to the foot of the Himalayas. It is most common in Malabar and Deccan, and it is not rare in the North-west Provinces and in Sind."

This showy little bird is one of the most interesting of our flycatchers; it frequents little groves of trees or those standing on patanas and cultivated ground, jungle on the borders of tanks, and open grassy glades.

It is a fearless species, and when not paired for breeding is usually of solitary habit. At this time its manners are most amusing; for the male, in his endeavour to attract the attention of his consort, displays a nature much akin to that of the peacock. He will sometimes alight on a tree close to a bystander, and proceed with a measured little pace, with an outspreading movement of its wings, combined with an expanding and contracting of its long tail. Elegance marks every moment of the fantail flycatcher. It runs swiftly among the branches, and every now and then makes a pretty bow and spreads its tail, then suddenly it will make a little sally in the air, and return with easy sweep to the place whence it started. In grace of movement a fantail flycatcher is nearly equal to a wagtail.

It is very active in catching its prey, and does not fly far after it, but snaps it up with a sudden dart. This flycatcher breeds in Ceylon during the early part of the year, from January to May.

In March, 1911, during a collecting tour in the Southern Province, and while I was camping in a village called Weligatta, about seven miles from Hambantota, I came across the nest of this bird, placed on a forked branch of a leafless thorny tree at a height of about 7 feet from the ground. The nest was composed of fine grass and plant stalks coated with cobwebs, and the inside lined with a few feathers; and in this elegantly-shaped, shallow, cup-like nursery were found one cream-coloured egg spotted with grayish brown. On my return from the collecting tour in Wirawila and Tissamaharama, after a fortnight, I paid a visit to the nest, and found two newly-hatched young ones. It must have taken ten to twelve days for incubation. When the young hatched out they are of course ugly, large-mouthed creatures, innocent of a single feather. At first they are very weak, and seem to have scarcely strength enough to raise their heads to receive the insects brought by their parents. Their growth is however exceedingly rapid. After three days, when I saw them again, they were fully twice the size they were when first hatched out. They keep their fond parents very busy seeking food for them. This consists entirely of minute insects, many of which are picked off the trunks and branches of trees, some are taken off the ground, while others are caught on the wing.

By the sixth day the young birds had grown so big that there was no room for them to lie side by side in the nest. By this time the tail and great wing feathers had grown rapidly, and their conduct in the nest was unlike that of any other young birds I have seen. The moment a parent arrived, up into the air go their gaping mouths. While seeking for food the parents never go far from the nest. They keep a most jealous guard over their precious nursery, and most necessary is it that they should do so for fear of crows and hawks, as they are exceedingly fond of eating young birds, and are always on the lookout for nests. I was watching on the sixth day, and saw the pair of fantails performing their nursery duties, when a black crow (*Corvus macrorhynchus*) alighted near the next tree. Both fantail flycatchers immediately attacked it. Their method of attack was to make a series of dashes at the back and tail of the crow, pecking at it each time they approached. The crow did not appear to mind this treatment very much, and as my sole intention was to secure the nest and young, and fearing I might loose such a nice group for the Museum I scared the crow away. But after a little while they calmed down and resumed their search for food. I thought I would see what they would do to me if I attempted to take their young ones. Accordingly, when both the parents were near by, I moved up to the tree and stretched my hand towards the nest and secured both the young ones. The flycatchers made no

attempt to attack me. They are naturally afraid of so large a creature as a human being. While I was removing the young ones to the camp the parent birds followed me for a short distance. After I had killed and mounted the young ones I went in the afternoon and cut the branch with the nest, and I then found both the fantail flycatchers perched on the same branch near the nest and shot them both, and thus secured the nest, young, and parent birds, which are now mounted as near as possible to the natural surroundings for exhibition in the Bird Gallery of the Museum.

Colombo Museum, September, 1912. H. F. FERNANDO.

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35. *Distribution of Snakes in Ceylon.*—Some months ago Dr. Pearson, the Director of the Colombo Museum, asked me to prepare a Paper on the distribution of snakes in Ceylon. As this means a considerable amount of work and time, I am sending a short preliminary note on the subject derived from my own observations only. In consequence the lists must not be taken to be by any means complete.

Anuradhapura, July 10, 1912. A. F. ABERCROMBY.

Snakes found in Ceylon.

No.	Snake.
1	Typhlops mirus.
2	Do. braminus.
3	Python molurus.
4	Cylindrophis maculatus.
5	Uropeltis grandis.
6	Rhinophis oxyrrhinchus.
7	Do. punctatus.
8	Do. planiceps.
9	Do. blythii
10	Silybura melanogaster.
11	Aspidura brachyorrhos.
12	Do. copii.
13	Do. guentheri.
14	Do. trachyprocta.
15	Do. drummondhayi.
16	Haplocercus ceylonensis.
17	Lycodon aulicus.
18	Do. striatus.
19	Do. carinatus.
20	Hydrophobus nympha
21	Do. gracilis.
22	Polyodontophis subpunctatus.
23	Ablabes calamaria.
24	Simotes arnensis.
25	Oligodon templetonii.
26	Do. sublineatus.
27	Do. subgriseus.
28	Do. ellioti.
29	Zamenis mucosus.
30	Do. fasciolatus.
31	Coluber helena.
32	Dendrophis pictus.
33	Do. bifrenalis.
34	Do. caudolineolatus.
35	Tropidonotus ceylonensis.
36	Do. plumbicolor.
37	Do. asperrimus.
38	Do. stolatus.
39	Helicops schistosus.
40	Dipsas barnesii.
41	Do. ceylonensis.
42	Do. forstenii.
43	Dryophis mycterizans.
44	Do. pulverulentus.
45	Chrysopelea ornata.
46	Cerberus rhynchops.
47	Hypsirhina enhydris.
48	Callophis trimaculatus.
49	Bungarus ceylonicus.
50	Do. cæruleus.
51	Naia tripudians.
52	Vipera russellii.
53	Echis carinata.
54	Ancistrodon hypnale.
55	Trimeresurus trigonocephalus.

List of Localities of various Ceylon Snakes.

A = Very common ; B = Rather rare ; C = Very rare.

Place.	Snake Nos.
Colombo (about) ..	17, 29A, 31, 33, 37, 38, 43, 49C, 52, 54B, 55, 1, 22.
Kandy ..	17, 29A, 31, 38, 41, 44, 43A, 49, 52, 51A, 55, 9, 7C, 39.
Badulla ..	38A, 37, 36, 41, 49, 52, 27, 42, 26, 3, 11, 17, 23, 51, 54A, 29A, 31, 43A, 55, 5.
Matale ..	32, 33, 37A, 38, 39A, 41A, 43A, 44B, 48C, 51A, 31A, 1, 3B, 11A, 14, 17A, 19, 52A, 54B, 29A, 25B, 26A, 22A, 24, 55A, 30.
Anuradhapura ..	2, 3A, 39, 51, 29A, 55B, 54A, 43A, 33, 44C, 52, 17A, 20C, 25, 35C, 36C, 37A, 38A, 40C, 41, 42, 4, 25, 26.
Kurunegala ..	43A, 37A, 36, 38A, 33A, 27B, 51, 44, 29A, 17, 28B, 52, 26, 35, 54.
Polgahawela ..	45C, 29A, 51, 43, 41, 17, 2, 52, 32, 37, 38.
Negombo ..	42, 51, 17, 52, 54, 29A, 33, 37, 38, 13, 26.
Trincomalee ..	52A, 51, 29A, 48C, 37, 3.
Jaffna (Province) ..	53C, 47, 50C, 51, 52, 33, 29, 19, 20, 30, 50C.
Rangalla (Knuckles)	12, 26, 29A, 43, 37, 51B, 33, 52B, 55, 49C, 39B, 38B, 7.
Ratnapura ..	3, 44C, 51, 52, 55, 17, 37, 29, 25, 26.
Nuwara Eliya ..	29, 9.
Balangoda ..	44, 40, 34C, 17, 37, 3, 12, 35, 36, 39, 49.
Avisawella ..	12, 51, 52, 55, 17, 33.
Sigiriya ..	33, 29, 41, 51, 43, 17, 37.
Minneriya ..	17, 54, 29A, 51, 43, 33, 37, 3.
Horana ..	44, 41, 42, 37, 29A, 51, 52.
Tissamaharama ..	48C.
Kirinda ..	29, 51.
Yala ..	3.
Udugama ..	34C, 25, 35.
Wadduwa ..	44.
Elephant Pass ..	33.
Kalutara ..	42, 29A, 51, 52, 41, 22.
Puttalam ..	17, 29.
Matara ..	5.
Mullaittivu ..	6, 53.
Bogawantalawa ..	14, 32, 41, 40C, 54A, 29.
Illagolla ..	34C.
Dimbula ..	49.
Dikoya ..	12.

36. *How Snakes swallow.*—One of the most striking points about the snake is its astonishing swallowing capacity, though when the structure of a snake's jaws and body is taken into consideration this is not so extraordinary as it at first seems.

In a snake each mandible, or lower jawbone, is not directly hinged on to the skull, but articulates with a second bone, the quadrate, which in its turn is jointed on to the supratemporal, another bone, which is loosely attached at one end to the skull. The two lower jawbones are connected with each other in front merely by muscles and ligaments, which are extremely elastic, as is the skin between the two bones. Such, indeed, is the elasticity of a snake's interstitial skin, that when a fourteen-foot python is swallowing anything large the scales will be divided from each other by nearly a quarter of an inch. The upper jawbones of the snake

can also be moved in addition to the palatines—two parallel bones lying along the palate, and usually bearing teeth; and each of the four jawbones is capable of independent action.

The food of the snake, if furred or feathered, is swallowed head first, and is drawn into the mouth by the alternate protrusion and retraction of each of the upper and lower jawbones, which are armed with short needle-like teeth curving backwards. The movements of the lower jawbones occur after the upper jaw has been pushed as far forward as possible over the food. If the animal to be eaten is small, it is drawn into the mouth; if it is large, the snake draws his mouth over it, though the action, in each case, is the same.

When once the food is in the mouth, the palatine teeth come into play and assist in pushing the food into the gullet. When a snake has anything at all large in its mouth, and is in danger of choking, it will ease its breathing by protruding the end of the windpipe beyond the lower lip, which it is enabled to do by the elasticity of the skin at the base of the former. When once the food is in the gullet, the snake proceeds to draw its body over it, gripping it with the muscles of the throat, and curving its body so as to get a purchase against it. In other words, the snake draws itself over its food until its stomach reaches it, the process being much faciliated by the oily condition of the gullet. As the ribs of the snake are only loosely attached to the vertebræ, and the undersurface merely composed of shields of thick skin, and is innocent of breast bone, the body is capable of much expansion.

Snakes, particularly pythons, will sometimes saliver their prey, apparently to assist digestion, but this is not invariably the case, and I have never seen a snake saliver a *reptile*, though it will often tongue one it has killed to discover the size, whether it is palatable, and whereabouts the head is.

After swallowing, a snake usually gapes several times, moves about a bit, and then coils up and goes to sleep.

Anuradhapura, May 4, 1912. A. F. ABERCROMBY.

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37. *Whipsnakes.*—This morning I found one of my green "whip-snakes" (*Dryophis mycterizans*), about 4½ feet long, in the act of swallowing a smaller whipsnake. I do not think it was a case of deliberate cannibalism, as I have always kept these snakes together and never known of them swallowing each other before. Probably, in this case, they had both seized the same frog, and the smaller snake had refused to leave go and got swallowed with the frog.

At any rate, the snake that was being swallowed appeared to be dead, and only moved its tail occasionally, which I supposed to be merely muscular action after death, and I allowed the larger snake to go on swallowing. When the head reached the stomach, there was

still about 2 feet of body and tail remaining out of the swallower's mouth, so that the latter was compelled to disgorge the snake it had swallowed, which reappeared alive and apparently none the worse from its involuntary visit to the " internal regions."

Anuradhapura, July 10, 1912. A. F. ABERCROMBY.

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38. I have been watching with some interest a male and a female *Dipsas forstenii*, which I have in a large cage. At night the male begins coiling in and out of the coils of the female, trying to wind its tail round that of the female, apparently with the purpose of copulating, but whenever the female feels the tail approach her own she lashes her tail quickly out of the way and buries it as much as possible inside her coils, and the male has to continue winding and twisting about her for a long time before he can get hold of her tail again. I have watched this going on for an hour and a half without any result.

There is another male *Dipsas* in the cage, and whenever it approaches the female the other male darts at it in a savage way, as though trying to butt it with its head, but never tries to bite. This threatening behaviour seems quite sufficient to drive away the other snake.

Anuradhapura, July 10, 1912. A. F. ABERCROMBY.

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39. *Kabaragoya raiding Crow's Nest.*—While walking over the bridge near Tebuwana resthouse, in the Kalutara District, on July 17, I found a couple of crows cawing loudly in a great state of excitement, and on seeking for the cause I discovered a kabaragoya (*Varanus salvator*) of respectable size on the topmost branches of a tall ingasamam tree (*Pithecolobium saman*) raiding a nest in a most leisurely manner by feasting upon the eggs.

The surprising part of the proceeding was the dexterous manner in which the creature was able to balance itself on the tiny branches of the tree, and its agility in climbing to such a height.

Colombo, July 29, 1912. C. DRIEBERG.

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40. *Donations and Loan Collections for the Colombo Museum.*—It is well known that private collections disappear altogether within three generations, and it is often owing to this that valuable donations are made by private persons to Museums in Europe and

America. In Ceylon the people have not yet realized that it is best for one's children and for the community to preserve and pass on in perpetuity valuable material possessions of educational or historical value. Collections or articles of educative interest which have been brought together for their beauty, their history, or their illumination of life and customs can best be preserved in a Museum. Not to go very far back, one has only to ask what has become of the valuable and interesting things possessed by one's great-grand-parents. Antique furniture, utensils, and other property, old books and prints of Ceylon, in the possession of families or collected by enthusiasts, get dispersed sooner or later, and nobody benefits by them. Many art treasures of Ceylon find a place in Museums abroad, or form private collections in Europe, and many are daily being removed from the Island. These articles possess stronger interest and value when shown in Ceylon, and form part of the records of the Island. It is the duty of one whose life has been centred in the collecting of anything, and to which he has given his time, his strength, and his means, to take steps to ensure such collections not being dispersed, and this can only be done by preserving them in a public institution like a Museum, where they will be seen by posterity and be available for inspection, study, and reference. Many articles which are now considered trifles will be of great value hereafter, as illustrating the mode of life or history of those that passed away. Customs change with rapidity, and this is especially so in Ceylon, and if old articles are not kept together all evidence of customs disappear, and are difficult to understand without actual illustrations.

In the Colombo Museum there is an enlarged picture of the grand audience granted by Governor Falk in 1772 to the Ambassadors from the Kandyan Court, taken from the original in the Rijks Museum at Amsterdam. In the picture the Maha Mudaliyar is seen carrying a hat like an Admiral's, which several put down to the imagination of the artist, but such a hat, called a *jagalat toppiya*, is to be seen in the Colombo Museum. This hat was fortunately presented many years ago by the family of Rajapakse, Chief Mudaliyar of the Mahabadda, 1701 A.D., to the Museum. It must be a source of pride to that family to see the hat suitably labelled and preserved, and forming part of the historical collections of the Island. If this hat had not come to the Museum, doubtless it would have been lost or destroyed ere this ; at all events it would never have been kept in the present excellent state of preservation.

Articles kept in a Museum, besides being of value to one's children and the public, prevent loss, breaking up of collections, and ensures the continuance of association of the name of the original owner or collector with the article or articles. Private collections in Ceylon, however carefully preserved, for several reasons get dissipated by the heirs of the person who owned or gathered them, the chief reason

being that the same interest in the pursuit of collecting seldom manifests itself in succeeding generations of the same family.

Isolated specimens of historical and ethnographical interest in the possession of people are not of much value by themselves, but brought together in a collection in the Museum they become of great value. When got together and properly arranged, such collections are of the greatest interest, but taken individually they often appear commonplace. The Colombo Museum, thanks to the exertions of the present Director, will shortly issue Bulletins and Memoirs, in which historical and ethnographical specimens and articles of *vertu* will be figured and described. This will afford a splendid opportunity to those possessing treasures to donate or loan them, that they may be dealt with by specialists and made known. People in Ceylon do not yet understand that the public Museum is after all the logical custodian of all things of historical, scientific, and artistic value.

GERARD A. JOSEPH.

Colombo Museum, August, 1912.

THE CEYLON NATURAL HISTORY SOCIETY.

Second General Meeting.

THE Second General Meeting of the Society was held on Friday, June 7, 1912, at 9 P.M., in the Colombo Museum. In the unavoidable absence of the President, Dr. Andreas Nell was voted to the Chair.

Mr. A. H. Pertwee read a Paper on "The Fresh-water Fishes of Ceylon."*

In the absence of Mr. E. E. Green, Dr. J. Pearson read a Note on "A Remarkable Mimetic Spider,"† and also a Note on a collection of butterfly transfers made by Mr. Gilbert of Ratnapura.‡

Dr. J. Pearson also exhibited a set of Naturalists' collecting apparatus sent by Messrs. Lawrence & Mayo of Madras.

Third General Meeting.

The Third General Meeting of the Society was held on Wednesday, October 9, 1912, at 5.30 P.M., when Mr. A. H. Pertwee presided.

The following resolution, proposed by Mr. F. M. Mackwood and seconded by Mr. Julius, was carried: "That the members of the Ceylon Natural History Society congratulate Sir Hugh Clifford, K.C.M.G., upon his appointment as Governor of the Gold Coast, and desire to place on record their appreciation of his services as the first President of the Society."

Mr. F. M. Mackwood was unanimously elected President of the Society in succession to Sir Hugh Clifford, K.C.M.G.

Capt. J. A. Legge read a Paper on "The Ceylon Pearl Banks."§

Mr. E. E. Green read a Paper on "Some Suggestions for Members of the Ceylon Natural History Society."‖

Mr. John Hagenbeck read a Paper on "Ostrich Farming in Ceylon." He gave the history of the bird, and where the different species could be found. For a long time he had the idea of having an ostrich farm in Ceylon, but was afraid that the climate would not be favourable. Since then, however, it had been proved beyond question that the climate was favourable to the laying of eggs in Ceylon. In the absence of the real incubators, he was trying fowl incubators for the hatching of the eggs which had already come. He had received several letters from Africa promising help. Whether the undertaking could be made a paying concern and a successful one, only time could tell. But so far everything seemed to point to success. An ostrich hen took twenty-four days to hatch an egg. An ostrich laid from 80 to 100 eggs per annum, and in six weeks 9 eggs. Two specimens of ostrich eggs laid in Bombay were produced for inspection.

An interesting discussion followed Mr. Hagenbeck's remarks.

Two Notes by Mr. H. F. Fernando on "Nest, Young, and Parent Bird of the Indian Tailor Bird," and The White-browed Fantail Fly-catcher."¶ Specimens of these were shown.

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* Printed in full on p. 243 of the present number of *Spolia Zeylanica*.

† Printed in full in *Spolia Zeylanica*, Vol. VIII., Part XXX., p. 92.

‡ Printed as a Note on p. 298 of the present number of *Spolia Zeylanica*.

§ Printed in full on p. 195 of the present number of *Spolia Zeylanica*.

‖ Printed in full on p. 285 of the present number of *Spolia Zeylanica*.

¶ Printed in full as Notes on pp. 300 and 302 of the present number of *Spolia Zeylanica*.