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VOL. 15 MARCH, 1952 NO. 1

THE EVOLUTION OF THE OPHIOGLOSSACEAE OF THE EASTERN UNITED STATES [1]

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Floral City, Florida

III.—THE EVOLUTION OF THE LEAF

1. *Relationships between the pattern of venation and the external form of the leaf.*—Conclusions as to the course of evolution in the *Ophioglossaceae* which are reported in this series of papers are based chiefly on the patterns made by the vascular systems of the leaves of the various species as they are revealed by a clearing process. Therefore brief introductory consideration is given to the relationships between the external forms of the more primitive plants and the number, branchings, and fusions of their veins.

The first multicellular land plants had no veins. They were very small, and parts that were in contact with the soil absorbed mineral solutions which passed through the cells to more distant parts. As plants elongated toward the source of light there was an almost continuous flow of fluids through the basal and central parts, and in time series of cells at the middle of the plant were modified to facilitate and control the flow of the plant fluids, thus forming a primitive vein. These plants were of linear form, and each was supplied with a single vein.

When plants increased in size and numbers until crowding occurred those that were shaded on every side could make only slender vertical growth; but the older or more vigorous of the competitors overtopped their neighbors and, having abundant supply of the nourishing juices, expanded rapidly in full sunlight. When in some such way the tissues at the apex of the leaf reached so great thickness or width that the lateral parts were not well supplied by the single vein the same process that originally produced

[1] Continued from Vol. 12, No. 4.

the vein caused it to divide into two branches, and this division of the nutritional supply caused the plant body to fork in a similar way. The successive repetition of this process produced those primitive plants in which the branching is dichotomous and each branch or segment, whether it is of early or late origin, has a single vein.

In these simple plants there was no differentiation into branch and leaf. It is probable that the branches approached cylindrical form, and in some plants they grew in vertical position, as in living *Psilotum* and *Equisetum.* If they had branched and continued growth in one plane the branches would have shaded each other laterally, but as the successive branches appeared, by the fundamental processes of growth in response to lighting, they diverged from each other and were able to continue growth without mutual shading. The adaptive habit of abaxial branching was then established. Ultimately some plants made the adaptation of branching in several planes as a more efficient mode of securing adequate lighting. But if the branches of the early plants for any reason took a horizontal position, as they might in prostrate plants or in weak-stemmed climbing plants that overtopped their competitors, it is clear that the photo-synthetic processes would be furthered by broadening of the branches, while the lower surfaces of the branches would be modified by continual shading.

Whatever the mode of production, sooner or later appeared the immediate ancestors of the ferns, in which the dorsi-ventral branches seem to have been thin and ribbon-like in form, each supplied with a single vein. These delicate plants were not preserved as fossils, but Bower (1923; pp. 83 and 85) cites the juvenile leaf of *Todea superba* (Pl. I, Fig. 1) as representative of such plants.

This primitive form of leaf-architecture was later modified by the process called webbing, which is the response to certain conditions of lighting. Because of the nature of their life-processes

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PLATE I

1, Juvenile leaf of *Todea superba,* enlarged, after Bower; 2, hypothetical representation of plant with four dichotomously branching divisions; 3, juvenile leaf of *Botrychium australe* var *Millefolium;* 4, sterile leaf of *B. dissectum* Spreng.; 5, progress of webbing in *Botrychium,* a, *B. dissectum,* b, c, d, varieties *Oneidense, obliquum* and *Tenuifolium* of Clausen's Monograph; 6, fusion of veins in new tissues produced by webbing between lobes in three species of *Thelypteris,* latest form at top. Drawings by A. M. Laessle.

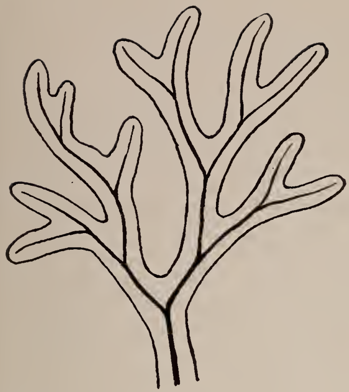

Fig. 1

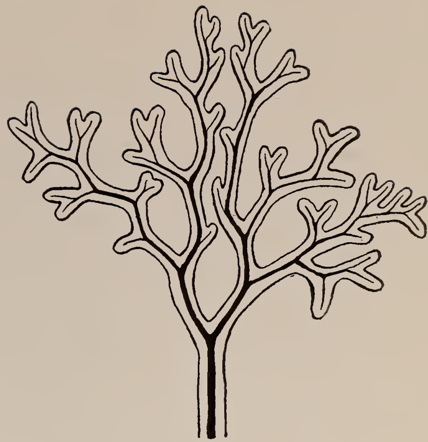

Fig. 2

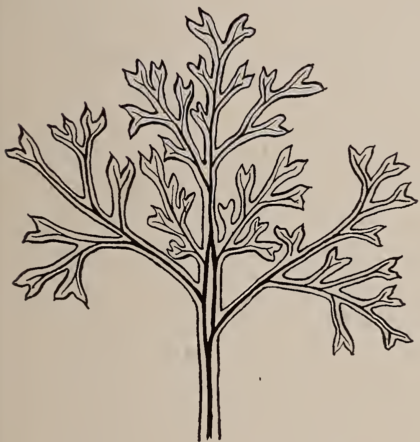

Fig. 3

Fig. 4

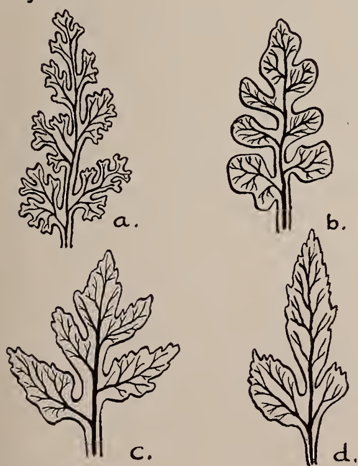

Fig. 5

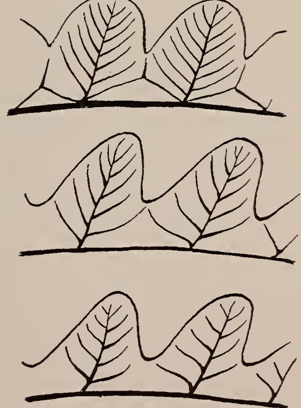

Fig. 6

A.M.L.

PLATE I

all plants grow toward the source of light. If they developed under conditions of dense crowding, as in a field of grass, lateral shading necessitated an erect linear leaf. If from the first the leaves lay in a horizontal plane fully exposed to sunlight, as in the floating leaves of many aquatic plants, growth took place on all margins of the leaves and they became peltate in form. If atmospheric conditions caused diffusion of light for a very long period of time a general marginal enlargement of leaves would be produced. In the shade of tall vegetation the light is diffused, and here too growth takes place on all exposed margins; but under such conditions equal enlargement on all margins cannot take place because some parts of the blade are less fully exposed than others. Thus every variation of form between the linear and the peltate leaf has been produced as plants acquired adaptations to the varying conditions of lighting.

Webbing not only enlarges the leaf but also, especially in small leaves, more or less completely closes the gaps between segments of the leaf. This is illustrated in Pl. I, Fig. 5, which shows the progress of webbing in four related forms of *Botrychium*. This kind of enlargement complicates the pattern of venation, since many forkings of veins are required to supply the needs of the new marginal tissues—each new branch being the response to a wider demand for the nutritional fluids. On the other hand, if veins from different segments of the leaf approach each other in the new tissues that close the former gap between them, and if the area of the new tissues is so narrow that one vein can supply its needs, they fuse into one (Pl. I, Fig. 6); and this vein, if it is further extended into new tissues, may then fork or fuse in response to the new conditions. This process, acting on small and much divided leaves, accounts for the origin of the simple leaf-blade and of anastomosing venation.

As plants increased in size the chief function of the veins of their basal and central parts came to be the conduction of the plant fluids between the rootstock and more distant areas of the leaf, and the tissues that surrounded them functioned more and more as supporting parts for the enlarging leaf. Hence these supplying veins were little changed in form by altered environmental conditions that brought considerable change in the patterns of the distributing veins of the marginal parts of the leaf. Therefore the conducting veins in the basal and central parts of the leaf reveal the primitive structure of the remote ancestors, while the pattern of the mariginal distributing veins is the product of the life-processes of the plant today. In the more highly developed flowering plants many successive adaptations have so obscured these records that often they are practically illegible, but in plants as primitive as the *Ophioglossaceae* they provide much reliable information as to phylogeny.

2. *Origin of the vascular pattern in the Ophioglossaceae.*—At the present time there is almost complete agreement among botanists that *Botrychium* was earliest in origin of the three or more genera of the *Ophioglossaceae.* Chrysler (1945, Nov.; pp. 498-504) is inclined to believe that the subgenus *Eubotrychium* includes the more primitive forms of the genus. Eames (1936, p. 118) considered the large ternate-leaved forms of earliest orgin. In a series of drawings which illustrate progressive reduction in the evolution of the species he places *B. virginianum,* of the subgenus *Osmundopteris,* first. Clausen (1938; pp. 27 and 166) believes that those species of the subgenus *Sceptridium* in which the ultimate divisions of the leaf are intermediate in size are of earlier origin, and places *B. multifidum* first in what "he considers to be a natural series."

B. dissectum Sprengel (*B. dissectum* var. *typicum* of Clausen's Monograph) in several characters of fundamental nature (to which further attention will be directed in succeeding parts of this paper) is more primitive in structure than either *B. virginianum* or *B. multifidum.* As is generally true in this genus, it is connected by transitional forms with related species; but in the abundant plants that show the more primitive characters it is clear that each segment of the blade was produced by dichotomous branching, and in nearly all each is supplied by one vein, the exceptions being in segments in which webbing has obviously taken place. Furthermore, several series of intermediate plants connect it with more elaborated forms that seem to have been derived from it, and that are recognized as species. It seems to be the most signicant form in the genus, and to be as worthy of specific rank as others that have universally been so recognized. The name *B. dissectum* will be used with that connotation in the following pages. *B. dissectum* provides much evidence that it is the most primitive of North

American Botrychiums, and apparently of all known species, unless it be one found in New Zealand to which further reference will be made. If the significance of the pattern of venation of these primitive Botrychiums can be discovered it will afford a basis for the study of relationships throughout the family.

Among the ferns are many examples of leaves the structures of which show that they are descended from plants which were wholly dichotomous in branching and venation. They may have two, four, or eight principal divisions of the blade, depending on whether the framework of the leaf was determined by the first, second, or third stage of dichotomy in the primitive ancestor (Bower, 1923; pp. 81-93)—which of the three forms is present being determined by the extent to which lateral shading limited the expansion of the leaf in an early stage of its evolution. A hypothetical representation of a primitive plant having four major divisions is shown in Pl. I, Fig. 2. The blade has been produced by successive dichotomous forking, the equality of the divisions being modified in parts of the leaf by shading which has retarded or terminated the growth of one limb of a dichotomy. The lateral divisions are alike in form and size. The two median divisions, better lighted and ascending to meet the stronger light, have crowded each other, and therefore the segments along their adjacent margins have been stunted in development. Each division of the leaf, whatever its rank, has one vein.

The external form and vascular pattern of the sterile leaf of *B. dissectum* is shown in Pl. I, Fig. 4. If this is compared with Pl. I, Fig. 2 the general resemblance is obvious. In the two figures the lateral divisions are similar in form and venation; but the two median divisions of Fig. 2 are replaced in *Botrychium* by one nearly symmetrical division which has an incompletely developed rachis and is supplied by two veins. Comparison of the two vascular patterns makes the relationship between them clear. Fusion, by webbing, of the median divisions of the plant represented in Fig. 2 would produce the subpinnate terminal division of *Botrychium.* The two veins that supplied the original median divisions are represented by the two that lie side by side in the petiole and rachis of *Botrychium,* each supplying the pinnae of its own side of the blade. The origin of these veins is at the point corresponding to that of the first dichotomy in the plant represented in Fig. 2.

As long as there is a strong lateral demand for the fluids which they transmit they remain separate; when the blade narrows toward its apex they fuse into one which is sufficient to supply the lessened demand. We have here an adequate explanation of the origin and significance of the vascular pattern of a sterile leaf of *B. dissectum.*

The fundamental pattern of venation of the leaf that is found in *B. dissectum* appears, with modifications that depend chiefly on the size of the leaf, in every species of the genus that has been available for study. It is almost exactly duplicated in the more primitive species of *Ophioglossum,* and is the basis of the patterns in all species of the genus that are found in North America.

After the conclusions that have been outlined above had been reached impressive confirmation of them was found in two sterile leaves of *Botrychium,* apparently from immature plants, which Dr. Robert T. Clausen has identified as *B. australe* var. *Millefolium* (Hochst.) Pratl. These juvenile leaves certainly represent the most primitive form of *Botrychium* that has been found in the course of this study. One was cleared to show the vascular pattern. Its form and venation are shown in Pl. I, Fig. 3. Obviously its place in the evolutionary series is between the plant represented in Fig. 2 and *B. dissectum* (Fig. 4). The segments of the leaf are ribbon-like. Dichotomous branching can be traced in all parts of the plant, and each segment ends in a dichotomy. The incipient rachis extends but a short distance into the median division, leaving the upper parts of the fused divisions free, and showing that the fushion is incomplete. This plant provides the one intermediate stage that was needed to demonstrate *in living plants* the nature of the relationship between *Botrychium* and the fully dichotomous plants.

In the development of leaf-architecture the triangular leaf-blade, formed by the process that has been outlined above, was an early departure from the strictly dichotomous form. It seems to have originated early in the phylogeny of the *Filicales,* and had a very important part in the evolution of that group of plants.[2] The fan-shaped leaf produced by simple dichotomy, which is

[2] Flowering plants show a parallel stage in the development of leaf-architecture. The vascular patterns of many cordate leaves (e.g. *Viola*) show that the midvein was formed by fusion of two median veins, while dichotomous branching is preserved in other parts of the leaf.

suited only for growth in an uncrowded habitat, had now taken a form which far more successfully responded to the varied conditions of lighting in crowded plant-associations in which flowering plants predominated. The two veins at the middle of the blade gave supporting strength, and prepared the way for the development of a true rachis. There seems no doubt that the majority of modern ferns with pinnately divided leaves were derived from such a form. Indeed, every stage of the transition from the earliest subternate form to the completely pinnate structure may be traced in both external form and vascular pattern within the genus *Botrychium*.

Bower (1923; pp. 87, 88 and 90) believed that monopodial branching of the supplying veins and external parts of pinnate leaves was derived from primitive dichotomous branching through the formation of a sympodium—that is, a series of dichotomies in which the right and left branches are alternately retarded in growth, thus producing a leaf with a zigzag rachis-like axis on which the retarded branches appear as alternate pinnae. He suggests that *Lygodium* represents an early stage in the development of monopodial branching. He finds confirmation of this theory in the developing patterns of venation of several primitive ferns, but records an unexplained difficulty in applying the theory to juvenile plants of *Botrychium* and more advanced ferns. This difficulty does not exist under the interpretation offered above. It appears that primitive *Botrychium*, rather than *Lygodium*, reveals the origin of the pinnate leaf in at least the great majority of modern ferns. Indeed study of the vascular patterns of *Botrychium* and *Ophioglossum* indicates that the *Ophioglossaceae*, because in their phylogeny the usual evolutionary processes ceased at an early stage, throw more light on early stages of the development of leaf-architecture than any comparable group of plants.

Campbell (1940; p. 307) in describing the cotyledon of *B. obliquum*, says that it "appears above ground as a long-stalked ternate leaf. The venation is dichotomous, and the ternate form results from unequal dichotomy." However, the vascular pattern of the mature plant seems to afford unquestionable evidence that the ternate form was produced through the fusion of two median branches, as described above.

The departure of the *Ophioglossaceae* from the *Filicales* was long after the appearance of the ternate leaf, and came with the development of the specialized fertile segment and the subterranean habit of the gametophyte. That the first steps in the development of the fertile segment came before *Botrychium* broke away from the *Filicales* is indicated. In several species of *Anemia* the fertile basal pinnae are elevated in a way that is very suggestive of *Botrychium;* and, as Chrysler has pointed out (1941; pp. 16 and 17), the arrangement of the fertile segments in *A. elegans* resembles that of *Cheiroglossa.* The ancestors of these ferns seem to have originated with the *Ophioglossaceae* but were able to carry these characters on to higher levels of development, while the *Ophioglossaceae* at about this stage of development adopted the subterranean habit of the gametophyte, and because of consequent self-fertilization were unable to rise above the Eusporangiate level.

3. *Origin of the Fertile Segment.*—The conflicting theories as to the genetic relationships of the *Ophioglossaceae* have been based on the peculiarity of the fertile segment. Interest has centered on the apparently adaxial branching of the peduncle from the petiole or blade, and upon this basis attempts have been made to trace descent from each of several orders of primitive plants. Campbell (1907-1940) considering *Ophioglossum* the genus of earliest origin, believed that it was derived from the *Bryophyta.* (Bower 1896) at first held the view that the spike of *Ophioglossum* was derived from the strobile of plants related to the *Lycopodiales.* Roeper (1859) suggested that the fertile segment originated from the fusion of two basal pinnae of a fernlike plant; and Chrysler (1910), having put this theory to the test of careful study of the venation of *Botrychium,* presented a widely accepted argument for that view. Bower at first opposed, but later accepted this interpretation. Zimmerman (1930) offered the theory that the leaf of *Botrychium,* with its sterile and fertile segments, developed from the telome of the primative *Psilophytales.* This theory was accepted by Bower, and perhaps is gaining favor at the present time. Eames (1936, pp. 117-142 and 380-407) definitely accepts the fused-pinnae theory and emphasizes it throughout his discussion of the family; yet in other parts of the same book makes general statement of his acceptance of the telome theory. In the light of present knowledge it seems impossible to reconcile the two theories, and internal evidence indicates that the chapter on the *Ophioglos-*

saceae represents his later view. Thirty-five years after his original presentation of the fused-pinnae theory Chrysler (1945) considered the application of the telome theory to *Botrychium* in the light of his studies of the vascular systems of the genus, but with inconclusive results. His final statement is, "The possibility of deriving *Ophioglossales* more or less directly from *Psilophytales* receives some support from the present investigation. If the evidence should be held sufficient, the hypothesis of Roeper would be abandoned."

Chrysler's studies of the vascular systems of *Botrychium* were made by the process of sectioning. The investigations on which the present study is based were made by use of a clearing process (see page 16) which reveals, as in a line drawing, the venation of the entire leaf—petiole, blade, peduncle and spike. While this method gives little information as to the internal structure of the veins it does provide a more accurate and far more complete view of the vascular system as a whole. It is especially suited to the study of the leaf as a functioning organ, and therefore to the explanation of adaptive evolutionary changes. The information that has thus been secured is wholly confirmatory of the fundamental thesis of Chrysler's early study (1910). The evidence that he offered is considerably enlarged, and reveals itself in more direct and impressive form.

It has been shown in the preceding section of this paper that in *B. dissectum* the leaf trace, soon after it enters the petiole, divides into two veins which pass up into the blade, each supplying the pinnae of its own side of the leaf (Pl. I, Fig. 4). The fertile segment of this plant is inserted on the petiole a little below the basal pinnae, and is supplied by two veins (Pl. II). The vein that lies in the right side of the peduncle branches from the right vein of the petiole exactly as do the veins that supply the pinnae of that side of the blade. The left vein of the peduncle has the same relationship to the left vein of the petiole. The conclusion

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PLATE II ➡

Botrychium dissectum Spreng., showing pattern of venation in fertile leaf. Inset, diagram of ancestral eight-parted leaf, showing its relationship to leaf of *Botrychium*. A, basal pinnae fuse to form fertile segment; B, C, next pair of pinnae on each side fuse to form large basal divisions of the ternate leaf; D, two median divisions fuse to form terminal divisions of ternate leaf. Drawings by Arthur Odegard.

PLATE II

is that the original basal pinnae have been elevated and fused to form the fertile segment.

If, now, the pattern of venation of petiole and blade is compared with that of peduncle and spike they are found to be substantially identical. No one who examines the two patterns as they appear in the same plant (see Pl. II) can doubt that they are produced by a similar process of fusion. Cleared specimens of the various species of *Euophioglossum* show patterns that are fundamentally the same, and add other important evidence that indicates a similar origin of the spike in this genus. Even in the very complicated pattern of *Cheiroglossa* (*O. palmatum*) the same basic structure of the spike is indicated.

The evolution of the spike in the *Ophioglossaceae* was not a direct and uniform process, but the record of its essential nature, and of various stages of the process, which appears in the patterns of venation of the successive species is so clear that its course may readily and safely be inferred.

First of all, it is clear that the fusion of segments that produced the blade of Botrychium could not have been accomplished by webbing after the axes of the thin dorsi-ventral branches of the ancestral plant had been condensed into subcylindrical supporting structures; therefore we know that the primitive *Ophioglossaceae* were small plants. It is possible that some of the early *Filicales* had already overtopped them. Certainly there were many primitive plants that exceeded them in height. Unfitted for assertive competition with these more robust neighbors, they were compelled to find unoccupied ground and—probably a much greater hazard —soil in which the fungus on which the embryo depends for life was already present. Wide distribution of their spores was essential; but they were handicapped in securing this by their low stature. Therefore any variation that elevated the position of the sporangia and provided better distribution by wind was highly advantageous. Some form of such adaptation is frequent among ferns, but in the *Ophioglossaceae* it is especially prominent. In both *Botrychium* and *Ophioglossum* the height of the fertile segment frequently is six to eight times that of the highest part of the blade of the living plant. The most superficial examination of the species as they grow among associated plants confirms the importance of this adaptation. Also it is significant that the taller species in both genera are most abundant at the present time.

Owing to persistence until the present time (because of self-fertilization of the plants) of very ancient forms of *Botrychium* we have remarkably complete knowledge of the variety of forms among which selection acted to further the production of the most efficient mode of elevation of the sporangia. From study of these plants it is evident that the immediate ancestors of *Botrychium* bore sporangia on various parts of the blade, and that various segments of the blade were elevated to secured better distribution of spores. Later these forms will be discussed in some detail, but two questions that arise from the variety of ways in which elevation of the sporangia was secured demand immediate answer. First, why were the basal pinnae selected to form the specialized fertile segment? The first exponents of the fused-pinnae theory offered the satisfactory explanation that the sporangia were chiefly located on this part of the blade. Taking the habit of the living plants into consideration we may go a step further. After the triangular blades of the more primitive species are fully grown they are nearly horizontal in position, and droop at the apex. At the time when the spores matured the basal pinnae were the most elevated parts of the blade. The same selective influences that later produced the elaborated spike had already effected a considerable concentration of the sporangia on these segments.

There follows the question, why were plants that not only elevated but also fused the pinnae perpetuated as the most efficient types? The answer is found when attention is given to the necessary stages in the process of transition from the separate to the fused pinnae. Fusion could not proceed far until the pinnae had reached a position nearly at right angles to the plane of the blade. Sometimes it did not take place, as in *Anemia* and in frequent primitive forms of the ternate species of *Botrychium* (commonly called "abnormal") in which the usual fertile segment is replaced by two fertile segments, each supplied by a single vein. Sometimes it was incomplete, as in many of the "abnormal" plants in which the peduncle is fused at its base but above divides into separate spikes. We understand why, among these forms, those that fused the pinnae were preferred if we remember that before fusion the fertile pinnae were of the thin dorsi-ventral type, and that the presence of two veins at the middle of the fused organ greatly contributed to its strength as a supporting member. Confirmation of this deduction is found in the fact that in the atypical plants spikes that are supplied by only one vein are always shorter than those in which two veins are present.

The apparently adaxial branching of the peduncle from the petiole or blade is explained when consideration is given to the processes that produced it. Because of the nature of photosynthesis, in all partly shaded habitats the axis of the leaf grows toward the source of optimum lighting. When the fertile basal pinnae of the primitive Botrychiums rose above the plane of the blade they invariably turned toward the stronger light (to which the apex of the blade was already directed), producing, when the habit had been genetically established, the effect that has perplexed generations of botanists. Only if they had turned away from the strongest light could there have been the superficial effect of abaxial branching. A recapitulation of this process may be observed in the unfolding leaf of *Anemia adiantifolia.* In these plants fusion of the pinnae never took place and hence this stage of phylogeny was not completely eliminated from ontogenetic development.

Further consideration of the primitive Botrychiums as functioning organisms, rather than merely as plant structures, affords added information as to the evolution of the fertile segment. The most striking difference between the primitive ternate-leaved Botrychiums and most modern ferns is that the sporangia are so widely separated from the photosynthetic tissues of the blade. Usually the sporangia are borne on the margin or the under surface of the blade, where they are almost surrounded by chlorophyll-bearing cells which provide them with the nourishing juices upon which they depend for growth. In the *Ophioglossaceae* the isolation of the sporangia from the ordinary source of nourishment is so unusual and so great that it suggests search for compensating conditions. They are readily found.

The fertile segment is not merely a supporting structure for the sporangia; it also is to a very considerable extent a photosynthetic organ. In *Botrychium* the sporangia are very large, and the fleshy tissues that surround the developing spores are well supplied with chlorophyll until the spores are mature, when they fade in color from green through yellow to brown. In *Ophioglossum* the spores are imbedded in similar photosynthetic tissues. Indeed, the chief function of the blade seems to be to provide nutritive material for storage in the rootstock and roots. From these reservoirs the fertile segment receives nutrients which provide for the period of its growth, after which it seems to carry on the life-processes with a large degree of independence. The functional isolation of the two parts of the leaf is so nearly complete as to permit, in the genus *Ophioglossum,* of the development of such extreme forms as *O. simplex* in which the blade has disappeared, and *O. Bergianum* in which blades and fertile segment seem to arise separately from the rootstock. Saprophytic nourishment has had an important part in these courses of development, but it has not dominated them unless in the extreme cases.

The photosynthetic function of the tissues that surround the spores directly aided the development of the specialized fertile segment. As the spore-bearing pinnae were elevated they progressively required better support, and as the consequent process of condensation proceeded the chlorophyll-bearing tissues were reduced in area and required better lighting that they might function to the same effect. The tendency to satisfy this need cooperated with the need for better distribution of the spores to produce the remarkable height of the fertile segment.

All students of the *Ophioglossaceae* call attention to the fact that among the ferns only these plants have a direct vascular supply to the sporangia. These distributing veinlets represent those that supplied the segments of the ancestral dorsi-ventral fertile pinnae. Their chief present function seems to be to supply the raw mineral solutions to the photo-synthetic tissues that surround the spores.

Acceptance of the fused-pinnae theory of the origin of the fertile segment requires reconsideration of the form of the hypothetical ancestor of *Botrychium* which is presented in Pl. I, Fig. 2. A four-parted ancestral plant provides reasonable basis for the production of the sterile leaf of *Botrychium;* but in order to produce the blade and a fertile segment there must have been at least six divisions of the leaf of the ancestral plant. This is a number that is not produced in the normal process of dichotomy, and that fact led to further study of the vascular pattern of the mature fertile leaf. It was found that in large leaves the vein that supplies a basal division of the blade sometimes has two connections with the vein of the petiole from which it arises. This indicates that crowding by associated plants which produced deep lateral shading has forced the original basal pinnae of the blade upward until they have fused with the next pair above to form the strong basal divisions of the present plant. This fusion also accounts for the appearance of monopodial branching in these divisions of the blade. Several stages of the process by which the fusion was accomplished are so clearly shown in the vascular patterns of *B. multifidum, B. matricariaefolium,* and other species that the fact is indubitable. (These data will be presented in discussion of the species of *Botrychium.*) In this way the conclusion is reached that there must have been eight divisions of the leaf in the ancestor of *Botrychium.* Pl. II, upper left insert, is a representation of such a plant, and shows the relation between its major divisions and the corresponding parts of *Botrychium.*

If the fused-pinnae theory of the origin of the fertile segment is accepted a revision of terms used in description of the species should follow. Several that are in current use are definitely misleading. For example, to apply the word *petiole* to that part of the supporting stalk of these plants that lies between the insertion of the peduncle and the blade, or if that part is lacking to describe the leaf as *sessile,* is to imply that the peduncle is a part of the main axis of the leaf. The use in technical descriptions of terms that direct attention to the structural bases of taxonomic classification is not unimportant. The term *dissected,* as used in description of the blade of *B. dissectum* suggests a process exactly the opposite of that which produced the character to which it is applied. It is probable that its use long delayed perception of the obvious and exceedingly important dichotomous structure of the leaf.

Clearing Process and Method of Dissection

In primitive plants such as the *Ophioglossaceae* the patterns of venation of their leaves carry a significant record of phylogenetic history. For study in this field a satisfactory clearing process has several advantages over the usual process of sectioning.

After washing place the fresh plants base upward in a test tube or similar receptacle. Cover with a 3 to 1 mixture of hydrogen peroxide and ammonia. Use some form of stopper or weight which will allow gas to escape but will prevent any part of the plant from rising above the liquid. (An ordinary cylindrical olive bottle, in the metal cover of which several holes have been punched, is a convenient receptacle for the smaller specimens.) For average specimens clearing requires about an hour—more or less according to the size of the specimen and the strength of the reagent. When most of the chlorophyll has been removed pour off the liquid and fill the tube with alcohol. After an hour—when the specimen is sufficiently hardened—it may be drained, and arranged on a sheet of thin letter paper in such way as to avoid twisting or overlapping of the parts. Roll with a test tube to secure complete contact with the paper and slightly to flatten the thicker parts. Cover with another sheet of smooth paper, and place between driers under pressure. Within an hour the specimen will dry and adhere to the paper upon which it was placed, and may be examined by transmitted light without removing it. For permanent preservation the fragile specimen may be peeled from the paper and mounted between sheets of mica or plastic.

If the specimens remain too long in the first bath contrasts are lost and essential tissues are destroyed. Recently dried specimens respond well to the process. It is slower and less satisfactory with old material, but herbarium specimens that were twenty years old have been cleared successfully. In leaves that are not fully grown the vascular structures are immature and the entire vascular pattern may not be shown. For study of the supply to the sporangia plants which are shedding their spores give best results.

For study of Botrychiums of the subgenus *Sceptridium* it is possible to expose the vascular bundles of the petiole and rachis for direct observation of their branchings and fusions. Follow the clearing process described above but harden in alcohol only long enough to permit handling of the specimen. Spread it on paper as in the clearing process, and roll lightly. With needle, tweezers and brush of stiff bristles remove about one-half of the tissues of petiole and rachis, exposing the vascular bundles. Slip a needle under the bundle at the base of the petiole and lift it free from surrounding tissues, smoothing them beneath it, and allowing it to fall back into place as the needle is moved toward the apex of the blade. Cover with thin smooth paper and dry under light pressure. The specimen may be observed by both transmitted and reflected light.

Summary

1. The first small land plants in which no parts were far removed from contact with the soil could exist without vascular structures. As plants enlarged series of cells were modified to factilitate and control the flow of fluids to distal parts. As webbing enlarged the leaves and widened the marginal areas the same process that produced the veins caused them to fork in order to supply the needs of the new tissues. Thus the pattern of venation of the leaf was determined by successive stages in its development.

With further enlargement of the leaves the basal and central parts of the leaf were chiefly useful as supporting parts, and the veins that passed through them functioned chiefly in the transmission of fluids between the rootstock and more remote parts; therefore they were little altered by environmental changes that brought considerable modification of the distal parts. Hence the supplying veins of the central and basal parts of the leaf reveal the primitive structure of the remote ancestors, while the pattern of the marginal distributing veins is the product of the life-processes of the plant of today.

2. *Botrychium dissectum* Spreng. in its adult stage shows more primitive characters than any other species of the *Ophioglossaceae.* Study of its vascular pattern by use of a clearing process reveals that it was derived from an ancestor whose branching was wholly dichotomous, through fusion of two median divisions of the ancestral leaf. This vascular pattern is the basis of the vascular patterns throughout the family, and affords a means of tracing relationships all through the group.

The ternate leaf, produced by this process of fusion by webbing, originated early in the phylogeny of the *Filicales,* and was the basis for the development of monopodial branching.

3. The vascular pattern of the fertile leaf of the *Ophioglossaceae* shows that the fertile segment originated from the elevation and fusion of two fertile pinnae of the ancestral plant. This course of development was the response to the special need for wide dispersal of spores in small plants that could not aggressively compete with more robust species but must find unoccupied ground.

Several stages and phases of the adaptive process by which the fertile segment was produced are discussed as to their relations with the life-history of the plants.

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THE BIRDS OF WELAKA

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This paper presents the results of a study made at the University of Florida Conservation Reserve from June 1949 through June 1950. The Reserve is situated on the east side of the St. Johns River at Welaka, Putnam County, Florida.

The purpose of the study was to list the birds found during a twelve-months' period and to investigate the existing relationships between this avifauna and the major plant associations on the Reserve. Previous biological investigations were conducted on the Reserve by Friauf (1942), Frye (1941), Laessle (1942), McLane (1948), Moore (1946), Pierce (1941), Pournelle (1950), and others.

The Conservation Reserve consists of an area of 2180 acres. It is roughly one and one-half miles wide from the east to the west boundary, the St. Johns River, and two and one-half miles long from north to south. Fish hatchery ponds are located at the north and south boundary. Numerous trails and fire lanes make all parts of the Reserve accessible.

The vegetation units listed in this study are based on Laessle's description of the plant communities of the area. I selected eleven associations and two communities as a basis for my investigation. These were: turkey oak, scrubby flatwoods, longleaf pine flatwoods, black pine flatwoods, slash pine flatwoods, bayhead, live oak hammock, mesic hammock, hydric hammock, river swamp, and marsh associations; and ruderal and aquatic communities. The term "live oak hammock" was used in place of Laessle's "xeric hammock" as the former term seemed more descriptive for my purposes.

Method of Obtaining Field Data

Daily field trips were made of three to five hours duration. During this period several different associations were visited. Notes were recorded concerning the birds observed and the association in which they were found. At the end of five or six days of field work, representative portions of all the communities and associations had been studied.

A small bird collection was made, with emphasis on the birds about which there was any doubt as to subspecific identification.

TABLE I

Occurrence of Birds in Plant Associations

		Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Pied-billed Grebe. *Podilymbus podiceps podiceps.* Sept 28 - May 2.	WV												*	
Double-crested Cormorant. *Phalacrocorax auritus.* Oct 28 - May 7.	WV												*	
Florida Water-turkey. *Anhinga anhinga leucogaster.*	PR										*		*	
Great Blue Heron. *Ardea herodias.*	PR												*	
American Egret. *Casmerodius albus egretta.*	PR												*	
Snowy Egret. *Leucophoyx thula thula.* March - July.	SR												*	
Louisiana Heron. *Hydranassa tricolor ruficollis.* March - June.	SR												*	
Little Blue Heron. *Florida caerulea caerulea.*	PR												*	
Eastern Green Heron. *Butorides virescens virescens.*	PR										*		*	
American Bittern. *Botaurus lentiginosus.* April.	M												*	
Wood Ibis. *Mycteria americana.* April 28 - July.	SR												*	
White Ibis. *Guara alba.* May 4 - Oct 2.	SR									*	*	*	*	
Florida Duck. *Anas fulvigula fulvigula.* July 3 - Oct 9.	SR												*	
Green-winged Teal. *Anas crecca carolinensis.* January.	WV												*	
Blue-winged Teal. *Anas discors.* March 11 - April 25.	M												*	
Baldpate. *Mareca americana.* Nov 7 - April 21.	WV												*	
Wood Duck. *Aix sponsa.*	PR										*		*	
Ring-necked Duck. *Aythya collaris.* Nov 30 - April 12.	WV												*	
Lesser Scaup Duck. *Aythya affinis.* Nov 28 - May 25.	WV												*	
Buffle-head. *Bucephala albeola.* Jan 20 - March 11.	WV												*	
Turkey Vulture. *Cathartes aura septentrionalis.*	PR			*	*	*	*	*	*		*		*	
Black Vulture. *Coragyps atratus atratus.* April 13 - Nov 7.	SR					*	*		*		*		*	
Red-tailed Hawk. *Buteo jamaicensis umbrinus.* June 7 - Aug 16.	SR	*	*											
Red-shouldered Hawk. *Buteo lineatus alleni.*	PR	*	*	*	*	*	*	*	*	*	*		*	*
Bald Eagle. *Haliaeetus leucocephalus leucocephalus.*	PR												*	
Marsh Hawk. *Circus cyaneus hudsonius.* April 12.	M												*	

TABLE I (continued)

		Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Osprey. *Pandion haliaetus carolinensis.* April 10 - Oct 2.	SR										*		*	
Eastern Sparrow Hawk. *Falco sparverius sparverius.* Oct. 5 - Feb 22.	WV					*								*
Florida Bobwhite. *Colinus virginianus floridanus.*	PR	*	*	*	*	*	*	*	*	*				*
Florida Turkey. *Meleagris gallopavo osceola.*	PR				*									
Limpkin. *Aramus pictus pictus.*	C												*	
Florida Gallinule. *Gallinula chloropus cachinnans.*	PR												*	
American Coot. *Fulica americana americana.* Sept. 28 - May 10.	WV												*	
Killdeer. *Charadrius vociferus vociferus.*	PR												*	*
Greater Yellowlegs. *Tringa melanoleuca.* April 26.	M												*	
Spotted Sandpiper. *Actitis macularia.* April 17.	M												*	
Wilson's Snipe. *Capella delicata.* Nov 20 - May 10.	WV											*	*	
Semipalmated Sandpiper. *Ereunetes pusillus.* May 18 - 30.	M												*	
Least Sandpiper. *Erolia minutilla.* May 10 - 25.	M												*	
Pectoral Sandpiper. *Erolia melanotos.* November 21.	M												*	
Herring Gull. *Larus argentatus smithsonianus.* December.	WV												*	
Ring-billed Gull. *Larus delawarensis.* Dec 11 - Jan 20.	WV												*	
Forster's Tern. *Sterna forsteri.*	PR												*	
Black Tern. *Chlidonias nigra surinamensis.* Aug 14 - 20.	M												*	
Eastern Mourning Dove. *Zenaidura macroura carolinensis.*	PR	*		*	*	*	*	*					*	*
Eastern Ground Dove. *Columbigallina passerina passerina.*	PR	*	*	*	*	*		*					*	*
Yellow-billed Cuckoo. *Coccyzus americanus americanus.* Apr 20 - Oct 9	SR	*	*	*	*	*	*	*	*	*	*			
Barn Owl. *Tyto alba pratincola.* June 21.	SR			*										
Great Horned Owl. *Bubo virginianus virginianus.*	PR	*		*										
Florida Barred Owl. *Strix varia georgica.*	PR						*		*	*	*			
Chuck-will's-widow. *Caprimulgus carolinensis.* March 16 - Sept 5.	SR	*						*	*					*
Whip-poor-will. *Caprimulgus vociferus vociferus.* February.	WV							*	*					*

TABLE I (continued)

		Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Nighthawk. *Chordeiles minor chapmani.* April 25 - Sept 7.	SR							*	*					*
Chimney Swift. *Chaetura pelagica.* May 7 - Sept 28.	SR	*											*	*
Ruby-throated Hummingbird. *Archilochus colubris.* May.	SR							*						
Eastern Belted Kingfisher. *Ceryle alcyon alcyon.* Aug 31 - April 28.	WV						*		*	*	*		*	
Southern Flicker. *Colaptes auratus auratus.*	PR	*	*	*	*	*		*	*	*	*		*	*
Pileated Woodpecker. *Hylatomus pileatus pileatus.*	PR			*		*	*	*	*	*	*			
Eastern Red-bellied Woodpecker. *Centurus carolinus carolinus.*	PR	*	*	*	*	*	*	*	*	*	*		*	*
Eastern Red-headed Woodpecker. *Melanerpes e. erythrocephalus.*	PR	*	*					*					*	*
Yellow-bellied Sapsucker. *Sphyrapicus varius varius.* Oct 21 - Mar 9.	WV		*				*	*		*	*			*
Southern Hairy Woodpecker. *Dendrocopos villosus auduboni.*	PR					*		*	*		*			*
Southern Downy Woodpecker. *Dendrocopos pubescens pubescens.*	PR	*	*	*		*		*	*		*			*
Red-cockaded Woodpecker. *Dendrocopos borealis hylonomus.*	PR	*	*	*		*	*	*			*			
Eastern Kingbird. *Tyrannus tyrannus.* April 4 - Aug 30.	SR		*					*					*	*
Crested Flycatcher. *Myiarchus crinitus crinitus.* April 12 - Sept 13.	SR	*	*	*	*	*	*	*	*	*	*			*
Eastern Phoebe. *Sayornis phoebe.* Oct 12 - March 31.	WV	*	*	*	*	*	*	*	*	*	*	*	*	*
Eastern Wood Pewee. *Contopus virens.* Aug 20 - Sept 23.	M	*		*		*		*	*					
Tree Swallow. *Tachycineta bicolor.* Dec 2 - 10, March 2 - April 7.	M			*				*					*	*
Rough-winged Swallow. *Stelgidopteryx ruficollis serripennis.* Mar 29.	M													*
Barn Swallow. *Hirundo rustica erythrogaster.* Aug. 22 - Sept 1.	M													*
Purple Martin. *Progne subis subis.* Feb 13 - June 30.	SR					*							*	*
Southern Blue Jay. *Cyanocitta cristata cristata.*	PR	*	*	*	*	*	*	*	*	*	*			*
Florida Crow. *Corvus brachyrhynchos pascuus.*	PR			*		*								*
Fish Crow. *Corvus ossifragus.*	PR			*	*	*		*	*		*		*	
Florida Chickadee. *Parus carolinensis impiger.*	PR	*	*	*		*		*	*					*
Tufted Titmouse. *Baeolophus bicolor.*	PR	*	*	*	*	*	*	*	*	*	*	*		*
Gray-headed Nuthatch. *Sitta pusilla caniceps.*	PR			*	*	*		*						

TABLE I (continued)

Species	Status	Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Eastern House Wren. *Troglodytes aëdon aëdon.* Oct 3 - May 4.	WV	*	*	*	*	*	*	*	*		*		*	*
Florida Wren. *Thryothorus ludovicianus miamensis.*	PR	*	*	*	*	*	*	*	*	*	*	*		*
Long-billed Marsh Wren. *Cistothorus palustris palustris.* Sept 28.	M												*	
Prairie Marsh Wren. *Cistothorus palustris iliacus.* Sept 28, Jan 20-26.	M											*	*	
Mockingbird. *Mimus polyglottos polyglottos.*	PR	*	*	*	*	*	*	*	*				*	*
Catbird. *Dumetella carolinensis.* Sept 23 - May 4.	WV	*	*	*	*	*	*	*	*	*	*	*	*	*
Brown Thrasher. *Toxostoma rufum rufum.*	PR	*	*	*	*	*	*	*	*	*	*	*	*	*
Eastern Robin. *Turdus migratorius migratorius.* Nov 7 - April 1.	WV	*	*	*	*	*		*	*	*	*		*	*
Eastern Hermit Thrush. *Hylocichla guttata faxoni.* Oct 29 - April 27.	WV	*	*	*		*	*	*	*	*	*			
Eastern Bluebird. *Sialia sialis sialis.*	PR			*				*					*	*
Blue-gray Gnatcatcher. *Polioptila caerulea caerulea.*	PR	*	*	*		*	*	*	*	*	*			*
Ruby-crowned Kinglet. *Regulus calendula calendula.* Oct 12 - April 29.	WV	*	*	*	*	*	*	*	*	*	*	*		*
American Pipit. *Anthus spinoletta rubescens.* Dec 30 - Feb 8.	WV												*	
Loggerhead Shrike. *Lanius ludovicianus ludovicianus.*	PR	*	*		*								*	*
Southern White-eyed Vireo. *Vireo griseus griseus.*	PR	*	*	*	*	*	*	*	*	*	*	*		*
Northern White-eyed Vireo. *Vireo griseus noveboracensis.* Sept 21.	M			*										
Yellow-throated Vireo. *Vireo flavifrons.* April 15 - Sept 15.	SR	*						*		*				
Blue-headed Vireo. *Vireo solitarius solitarius.* Oct 22 - April 21.	WV	*		*		*	*	*	*	*	*			*
Mountain Vireo. *Vireo solitarius alticola.* Oct 22.	WV													*
Red-eyed Vireo. *Vireo olivaceus.* April 10 - Oct 7.	SR	*	*	*		*		*	*	*	*	*		*
Black and White Warbler. *Mniotilta varia.* July 16 - May 4.	WV	*	*	*		*	*	*	*	*	*			
Prothonotary Warbler. *Protonotaria citrea.* July 14-29, April 10-20.	M								*	*	*			
Worm-eating Warbler. *Helmitheros vermivorus.* Sept 30, April 13-26.	M						*		*	*	*			
Orange-crowned Warbler. *Vermivora celata celata.* March 7.	M							*						
Parula Warbler. *Parula americana americana.* March 7 - Oct 12.	SR	*	*	*		*	*	*	*	*	*			*
Yellow Warbler. *Dendroica aestiva.* August 24.	M								*					

TABLE I (continued)

		Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Black-throated Blue Warbler. *Dendroica c. caerulescens.* Sept 1 - Oct 10, April 26 - May 26.	M	*												
Cairns' Warbler. *Dendroica caerulescens cairnsi.* Sept 1, April 26.	M							*	*	*	*			
Myrtle Warbler. *Dendroica coronata coronata.* Oct 21 - April 10.	WV	*	*	*	*	*	*	*	*	*	*		*	*
Yellow-throated Warbler. *Dendroica dominica dominica.*	PR	*	*			*	*	*	*	*	*			*
Black-poll Warbler. *Dendroica striata.* April 27 - May 19.	M	*						*	*	*				
Florida Pine Warbler. *Dendroica pinus florida.*	PR	*	*	*	*	*	*	*	*	*				*
Northern Prairie Warbler. *Dendroica d. discolor.* Mar 22 - Apr 28, July 21 - Oct 28.	M	*	*	*		*	*	*	*	*	*			*
Western Palm Warbler. *Dendroica p. palmarum.* Oct 22 - April 27.	WV	*		*		*		*		*			*	*
Yellow Palm Warbler. *Dendroica palmarum hypochrysea.* Nov 6.	WV	*												
Ovenbird. *Seiurus aurocapillus.* Sept 1 - Oct 28, Feb 27, Apr 20 - May 1.	M							*	*	*	*			
Northern Water Thrush. *Seiurus n. noveboracensis.* Aug 25 - Sept 30, April 14 - May 13.	M										*			
Grinnell's Water Thrush. *Seiurus noveboracensis notabilis.* April 14.	M										*			
Maryland Yellow-throat. *Geothlypis trichas trichas.*	WV		*	*	*	*	*	*	*		*	*	*	*
Florida Yellow-throat. *Geothlypis trichas ignota.*	PR	*	*	*	*	*	*					*		
Hooded Warbler. *Wilsonia citrina.* Aug 24 - Oct 10.	M							*	*	*				
American Redstart. *Septophaga ruticilla.* July 28 - Oct 12, April 20 - May 30.	M	*	*	*	*	*	*	*	*	*	*			
English Sparrow. *Passer domesticus domesticus.* April 1.	C													*
Bobolink. *Dolichonyx oryzivorus.* May 7 - May 19.	M												*	*
Southern Meadowlark. *Sturnella magna argutula.*	PR			*									*	*
Red-winged Blackbird. *Agelaius phoeniceus.*	PR		*	*			*	*					*	*
Baltimore Oriole. *Icterus galbula.* September 23.	M							*						
Rusty Blackbird. *Euphagus carolinus.* February 28.	WV									*				
Boat-tailed Grackle. *Cassidix mexicanus major.*	PR												*	
Florida Grackle. *Quiscalus quiscula quiscula.* May 8 - Nov 7.	SR										*	*	*	*

TABLE I (continued)

	Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Eastern Cowbird. *Molothrus ater ater.* December. WV												*	
Summer Tanager. *Piranga rubra rubra.* April 15 - Sept 15. SR	*	*	*	*	*	*	*	*	*	*			
Florida Cardinal. *Richmondena cardinalis floridana.* PR	*	*	*	*	*	*	*	*	*	*	*		*
Indigo Bunting. *Passerina cyanea.* October 29. M		*											*
Painted Bunting. *Passerina ciris.* Aug 29 - Sept 5. M							*						*
Eastern Goldfinch. *Spinus tristis tristis.* Nov 16, Mar 20 - May 4. M	*		*				*					*	*
Red-eyed Towhee. *Pipilo e. erythrophthalmus.* Oct 24 - May 8. WV	*	*	*	*	*	*	*	*	*	*			*
White-eyed Towhee. *Pipilo erythrophthalmus alleni.* PR	*	*	*	*	*	*	*	*					*
Savannah Sparrow. *Passerculus sandwichensis savanna.* Nov 9, Jan 6. M												*	*
Vesper Sparrow. *Pooecetes gramineus gramineus.* Feb 4 - 24. WV													*
Pine-woods Sparrow. *Aimophila aestivalis aestivalis.* Oct 12 - Apr 21. WV	*		*		*		*						*
Chipping Sparrow. *Spizella passerina passerina.* Nov 5 - April 12. WV			*				*					*	*
Field Sparrow. *Spizella pusilla pusilla.* April 21. M							*						
White-throated Sparrow. *Zonotrichia albicollis.* Nov 5 - April 27. WV						*	*						*
Swamp Sparrow. *Melospiza georgiana.* Oct 17 - May 1. WV		*			*	*				*	*	*	*
Song Sparrow. *Melospiza melodia melodia.* Jan 19 - March 9. WV		*	*										*

	Turkey Oak	Scrubby Flatwoods	Longleaf Pine	Black Pine	Slash Pine	Bayhead	Live Oak Hammock	Mesic Hammock	Hydric Hammock	River Swamp	Marsh	Aquatic	Ruderal
Total number trips	146	190	293	83	178	146	162	150	101	105	32	157	223
Total number species	50	44	53	31	50	41	67	52	43	51	15	74	64

Birds Recorded at Welaka

During the twelve-months' period, 143 forms were recorded. Of these, 46 were permanent residents, occurring throughout the year; 22 were summer residents, breeding at Welaka but absent during winter; 37 were winter visitants, occurring only during winter; 36 were migrants, transient during spring or fall; and two were casuals.

In Table I the presence of a species in a plant association is indicated by an "*". In the first column the following abbreviations are used: PR—permanent resident, WV—winter visitant, SR—summer resident, M—migrant, C—casual.

Relationship of Birds to Plant Associations

In order to analyze the relationship of the bird species to the plant associations, it was necessary to determine the composition of the bird inhabitants in each association as well as the relative abundance of the species. A direct census was not practical because of the dense vegetation, therefore I used the frequency of occurrence of each species.

To calculate the frequency of occurrence of a species, the number of times the species was observed in an association was divided by the number of trips to the association (on a monthly basis). If the same species was observed more than once during the same visit it was still only counted one time. In this way the most noticeable birds were more likely to be given an equivalent value to the shy, retiring birds which nevertheless might be just as numerous. This method also indicated to some extent the relative numbers of individuals since there was more chance that an abundant species would be seen at least once during each trip than a less abundant species. It is desirable to make many trips into the field if this type of data is used.

The tables of the monthly frequency of occurrences are not presented because of their lengthiness.

For purpose of comparison, it would seem desirable to separate the typical or characteristic bird inhabitants of each association from the birds which were found only a few times. No objective criterion was found by which this could be accomplished so that it was necessary to compare the total bird populations of each association.

For plant names used in the following discussion, see Kelsey and

Dayton (1942). Complete descriptions of the plant associations and communities used in this study and maps of the area are found in Laessle (1942).

Birds of the Turkey Oak Association

This association was composed predominately of turkey oak (*Quercus laevis*) with a scattering of longleaf pine (*Pinus palustris*). See Laessle (1942).

A total of 50 bird species was recorded.

The ten most frequently recorded species were Titmouse, Blue Jay, White-eyed Vireo, Summer Tanager, Ruby-crowned Kinglet, Myrtle Warbler, Pine Warbler, Gnatcatcher, Red-bellied Woodpecker, and Crested Flycatcher, respectively.

The percentage of Turkey Oak bird species in common with the other associations is indicated as follows:

Live Oak Hammock	86 per cent	Hydric Hammock	64 per cent
Longleaf Pine	82 per cent	Bayhead	62 per cent
Slash Pine	78 per cent	River Swamp	60 per cent
Scrub	78 per cent	Black Pine	54 per cent
Mesic Hammock	70 per cent	Aquatic	30 per cent
Ruderal	70 per cent	Marsh	20 per cent

Thus despite the distinctness of the Turkey Oak Association as a plant community, its bird population was shared with many other associations. The food and cover conditions were very poor, so that relatively few bird species were found constantly. A much larger number were observed sporadically which probably accounts for the close relationship to many other associations.

The birds were often found in small groups which fed through the trees more or less as a unit. These groups usually contained Titmice, Chickadees, Gnatcatchers, Red-bellied Woodpeckers, Pine Warblers and Summer Tanagers.

No exclusive bird species were found in the association.

Birds of the Scrubby Flatwoods Association

Three species of small scrubby oaks formed most of this association. They were twin live oak (*Quercus virginiana geminata*), myrtle oak (*Q. myrtifolia*), and Chapman oak (*Q. chapmani*). The dense thickets formed by the scrubby oaks provided cover for a number of birds. A few scattered pines were present.

A total of 44 bird species was recorded.

The ten most frequently recorded species were White-eyed Towhee, White-eyed Vireo, Yellow-throat Warbler, Mockingbird, Cardinal, Blue Jay, Thrasher, Prairie Warbler, House Wren and Catbird, respectively.

The percentage of Scrubby Flatwoods bird species in common with the other associations is indicated as follows:

Turkey Oak	89 per cent	Bayhead	73 per cent
Live Oak Hammock	89 per cent	River Swamp	70 per cent
Ruderal	86 per cent	Hydric Hammock	64 per cent
Slash Pine	84 per cent	Black Pine	59 per cent
Longleaf Pine	82 per cent	Aquatic	39 per cent
Mesic Hammock	75 per cent	Marsh	25 per cent

Scrubby Flatwoods was usually found adjacent to Turkey Oak which partly accounts for the high percentage of species in common. Thus even shrub-dwelling birds, i.e., towhees, yellow-throat warblers, thrashers, etc., were occasionally recorded in the edge of the Turkey Oak.

The relationship to Bayhead was possibly due to the dense shrubby edge of the Bayheads. Here many birds were found which were also common to the Scrubby Flatwoods.

No exclusive species of birds were found.

Birds of the Longleaf Pine Flatwoods

This association consisted of longleaf pines in scattered or dense stands and a dense shrubby understory. The flatwoods on the Reserve have not been burned for a number of years.

A total of 53 bird species was recorded.

The ten most frequently recorded species were Yellow-throat Warbler, Pine Warbler, White-eyed Towhee, Mockingbird, House Wren, Cardinal, Red-bellied Woodpecker, White-eyed Vireo, Catbird, and Florida Wren, respectively.

The percentage of Longleaf Pine bird species in common with the other associations is indicated as follows:

Live Oak Hammock	91 per cent	Bayhead	62 per cent
Slash Pine	83 per cent	River Swamp	62 per cent
Turkey Oak	77 per cent	Hydric Hammock	57 per cent
Ruderal	75 per cent	Black Pine	53 per cent
Mesic Hammock	70 per cent	Aquatic	41 per cent
Scrubby Flatwoods	68 per cent	Marsh	19 per cent

The somewhat low correlation between Longleaf Pine and Black

Pine bird populations was unexpected since the vegetation was similar in the two associations. I feel that this was due not to the slight difference in vegetation but rather to the small size of the Black Pine area on the Reserve. All but two Black Pine bird species were found in Longleaf Pine Flatwoods but 23 Longleaf Pine bird species were not recorded in Black Pine.

No exclusive bird species were found in this association.

Birds of the Black Pine Flatwoods

This association consisted of scattered black pine *(Pinus serotina),* slash pine *(P. elliotti),* and longleaf pine. The somewhat stunted understory was composed of fetterbush *(Lyonia lucida),* sawpalmetto *(Serenoa serrulata),* and gallberry *(Ilex glabra).*

A total of 31 bird species was recorded.

The ten most frequently recorded species were Yellow-throat Warbler, White-eyed Towhee, Mockingbird, Bobwhite, Pine Warbler, Cardinal, White-eyed Vireo, Flicker, Phoebe and Titmouse, respectively.

The percentage of Black Pine bird species in common with those of the other associations is indicated as follows:

Slash Pine	93 per cent	Bayhead	81 per cent
Live Oak Hammock	93 per cent	Ruderal	81 per cent
Longleaf Pine	90 per cent	River Swamp	74 per cent
Turkey Oak	87 per cent	Hydric Hammock	68 per cent
Scrubby Flatwoods	84 per cent	Aquatic	48 per cent
Mesic Hammock	84 per cent	Marsh	26 per cent

All but two Black Pine bird species were found in Longleaf Pine and Slash Pine Flatwoods but the populations of each of the two latter areas were considerably larger than that of the Black Pine.

Birds of the Slash Pine Flatwoods

This type of flatwoods was found on slightly lower ground than the Longleaf Pine Flatwoods, although the two were sometimes difficult to distinguish from each other. Usually Slash Pine was found around flatwoods ponds and near the St. Johns River. The shrubby vegetation of sawpalmetto, gallberry, and waxmyrtle *(Myrica cerifera)* formed dense thickets in some areas; in others the understory was open and consisted mostly of broomsedges *(Andropogon* spp.).

A total of 50 bird species was recorded.

The ten most frequently recorded species were White-eyed Vireo, Pine Warbler, Cardinal, Yellow-throat Warbler, White-eyed Towhee, Summer Tanager, Catbird, Florida Wren, House Wren, and Titmouse, respectively.

The percentage of Slash Pine species in common with those of the other associations is shown below:

Live Oak Hammock	90 per cent	Ruderal	74 per cent
Longleaf Pine	88 per cent	Bayhead	70 per cent
Mesic Hammock	80 per cent	Hydric Hammock	60 per cent
Turkey Oak	78 per cent	Black Pine	58 per cent
River Swamp	76 per cent	Aquatic	38 per cent
Scrubby Flatwoods	74 per cent	Marsh	22 per cent

The variety of habitat conditions for birds, i.e., thickets, open areas, and numerous trees, attracted many birds. As in the Live Oak Hammocks, this resulted in a high number of species in common with a number of other associations.

No exclusive species of birds occurred.

Birds of the Bayhead Association

This association occurred in depressions in the flatwoods and was dominated by broad-leaved evergreen trees. The characteristic trees were loblolly bay *(Gordonia lasianthus),* swampbay *(Persia palustris),* and sweetbay *(Magnolia virginiana).* The edge of the bayheads consisted of dense shrubby vegetation. The interior had practically no understory because of the dense tree canopy.

A total of 41 bird species was recorded.

The ten most frequently recorded species were White-eyed Vireo, Catbird, Yellow-throat Warbler, Cardinal, Ruby-crowned Kinglet, Florida Wren, Blue Jay, Pine Warbler, White-eyed Towhee and Thrasher, respectively.

The percentage of Bayhead bird species in common with those of other associations is shown as follows:

Live Oak Hammock	88 per cent	Hydric Hammock	76 per cent
River Swamp	85 per cent	Turkey Oak	76 per cent
Slash Pine	85 per cent	Ruderal	73 per cent
Mesic Hammock	83 per cent	Black Pine	61 per cent
Longleaf Pine	80 per cent	Aquatic	37 per cent
Scrub	78 per cent	Marsh	24 per cent

The peculiar habitat conditions found in Bayheads, i.e., shrubby edge and highly shaded interior, is reflected by the above percentages of species in common. For example, the similar relationship to the two very different communities, River Swamp and Slash Pine.

No exclusive bird species recorded.

Birds of the Live Oak Hammock Association

Live oak *(Quercus virginiana)* and numerous shrubs characterized this plant community. Some of the typical shrubs were myrtle oak, Chapman oak, farkleberry *(Vaccinium arboreum),* beautybush *(Callicarpa americana),* and dwarf sumac *(Rhus copallina).* The small oaks formed numerous scattered thickets.

A total of 67 bird species was recorded.

The ten most frequently recorded species were White-eyed Vireo, Titmouse, Parula Warbler, Cardinal, Red-bellied Woodpecker, Pine Warbler, Gnatcatcher, White-eyed Towhee, Yellow-throated Warbler, and Prairie Warbler, respectively.

A comparison of Live Oak Hammock species with those of the other associations showed the following relationships:

Longleaf Pine	72 per cent	River Swamp	57 per cent
Ruderal	71 per cent	Hydric Hammock	55 per cent
Mesic Hammock	69 per cent	Bayhead	54 per cent
Slash Pine	67 per cent	Black Pine	43 per cent
Turkey Oak	64 per cent	Aquatic	34 per cent
Scrubby Flatwoods	58 per cent	Marsh	15 per cent

Live oak hammocks were apparently the most suitable bird habitats on the Reserve. Food and cover conditions here seemed more conducive to bird life than in any of the other associations. Not only were the highest number of different species found but also the greatest number of individuals, according to my data. Since tree-inhabiting and shrub-inhabiting birds were well represented, Live Oak Hammocks had many bird species in common with other associations.

Exclusive species were Hummingbird, Orange-crowned Warbler, Baltimore Oriole, and Field Sparrow.

Birds of the Mesic Hammock Association

This association had many plants common to the Live Oak Hammocks but the vegetation was much denser. Some of the characteristic trees were southern magnolia *(Magnolia grandiflora)*, American holly *(Ilex opaca)*, water oak *(Quercus nigra)*, and live oak. Thick stands of saw palmetto were usually present.

A total of 52 bird species was recorded.

The ten most frequently recorded species were Parula Warbler, White-eyed Vireo, Titmouse, Cardinal, Florida Wren, Thrasher, Ruby-crowned Kinglet, Red-eyed Vireo, Crested Flycatcher, and Yellow-throated Warbler, respectively.

A comparison of the birds of this association with those of the other associations showed the following percentage of species in common:

Live Oak Hammock	88 per cent	Bayhead	65 per cent
River Swamp	79 per cent	Ruderal	65 per cent
Slash Pine	77 per cent	Scrub	63 per cent
Hydric Hammock	73 per cent	Black Pine	50 per cent
Longleaf Pine	71 per cent	Aquatic	29 per cent
Turkey Oak	67 per cent	Marsh	19 per cent

The only exclusive species was Yellow Warbler, but this was the only record for the year.

Birds of the Hydric Hammock Association

This poorly drained hammock formed a narrow strip between the River Swamp and Mesic Hammock. The characteristic trees were water oak, sweetgum *(Liquidambar styraciflua)*, and cabbage palmetto *(Sabal palmetto)*. Characteristic shrubs were a large gallberry *(Ilex coriacea)* and patches of saw palmetto.

A total of 43 bird species was recorded.

The ten most frequently recorded species were Cardinal, Parula Warbler, Ruby-crowned Kinglet, Florida Wren, Red-eyed Vireo, White-eyed Vireo, Myrtle Warbler, Titmouse, Red-bellied Woodpecker and Pileated Woodpecker, respectively.

A comparison of the Hydric Hammock bird species with those of the other associations showed the following relationships:

Mesic Hammock	88 per cent	Longleaf Pine	70 per cent
Live Oak Hammock	86 per cent	Scrub	67 per cent
River Swamp	84 per cent	Ruderal	60 per cent
Turkey Oak	74 per cent	Black Pine	49 per cent
Bayhead	72 per cent	Aquatic	25 per cent
Slash Pine	72 per cent	Marsh	23 per cent

This association was poorly defined since its borders between Mesic Hammock and River Swamp were seldom distinct.

Rusty Blackbirds were found exclusively in Hydric Hammock, but were present only during a short period.

Birds of the River Swamp Association

This association formed large areas along the St. Johns River. Characteristic trees included bald cypress *(Taxodium distichium)*, swamp tupelo *(Nyssa biflora)*, red maple *(Acer rubrum)*, and cabbage palmetto. Characteristic shrubs included buttonbush *(Cephalanthus occidentalis)*, a willow *(Salix longipes)*, and wax myrtle. Numerous vegetation-filled creeks ran through the area.

A total of 51 bird species was recorded.

The ten most frequently recorded species were Cardinal, Parula Warbler, Florida Wren, Red-eyed Vireo, Pileated Woodpecker, Titmouse, Gnatcatcher, Myrtle Warbler, Ruby-crowned Kinglet, and Red-bellied Woodpecker, respectively.

A comparison of the River Swamp bird species with those of the other associations showed the following relationships:

Mesic Hammock	80 per cent	Scrub	61 per cent
Slash Pine	74 per cent	Turkey Oak	59 per cent
Live Oak Hammock	74 per cent	Ruderal	57 per cent
Hydric Hammock	71 per cent	Black Pine	45 per cent
Bayhead	69 per cent	Aquatic	41 per cent
Longleaf Pine	65 per cent	Marsh	25 per cent

Water thrushes *(Seiurus noveboracenses)* were found exclusively in this association. This species occurred only on migration.

Birds of the Marsh Association

The marshes on the Reserve consisted mostly of sawgrass *(Mariscus jamaicensis)* and marshgrass *(Spartina bakeri)* which formed dense stands from four to eight feet high. Standing water was present during most of the year.

A total of 15 bird species was recorded. Wilson's Snipe, Yellow throat Warblers and Swamp Sparrows were the most common species. Yellow-throat Warbler was the only species observed consistently in the marshes.

As so few birds were observed in the association, the relationship with the other plant communities has no particular significance. However, for the sake of completeness, it was as follows:

River Swamp	87 per cent	Turkey Oak	67 per cent
Ruderal	80 per cent	Longleaf Pine	67 per cent
Slash Pine	73 per cent	Mesic Hammock	67 per cent
Scrub	73 per cent	Live Oak Hammock	67 per cent
Bayhead	67 per cent	Aquatic	60 per cent
Hydric Hammock	67 per cent	Black Pine	53 per cent

There was one large marsh on the Reserve but only a few birds were recorded from it. The absence of creeks through this marsh and the dense nature of the vegetation possibly discouraged the ordinary marsh inhabitants.

No exclusive species were recorded.

Birds of the Aquatic Communities

Included in this community were the fish hatchery ponds, flatwoods ponds, creeks, and the St. Johns River adjacent to the Reserve.

A total of 74 species was recorded.

The ten most frequently recorded species were Pied-billed Grebe, Anhinga, Great Blue Heron, American Egret, Little Blue Heron, Green Heron, Lesser Scaup, Coot, Killdeer, and Red-winged Blackbird.

A comparison of the Aquatic Community birds with those of the other associations is indicated as follows:

Ruderal	40 per cent	Black Pine	20 per cent
Live Oak Hammock	31 per cent	Turkey Oak	20 per cent
Longleaf Pine	29 per cent	Bayhead	20 per cent
River Swamp	28 per cent	Mesic Hammock	20 per cent
Slash Pine	26 per cent	Hydric Hammock	15 per cent
Scrub	23 per cent	Marsh	12 per cent

As seen from Table I, many species included in this community were not actually aquatic birds, i.e., mourning dove, ground dove, myrtle warbler, palm warbler, etc. These species were observed around the aquatic areas so constantly that they were included in the bird population of the community.

There were obviously a number of exclusive species since the truely aquatic birds (ducks, etc.) were confined to the community. Two non-aquatic exclusives found here were the American Pipit and cowbird, neither of which breeds in Florida.

Birds of the Ruderal Communities

Included in this "community" were areas which had been altered or disturbed to a considerable extent by man. The apartment area, roadsides, and old fields were included. It was thus a rather heterogeneous community.

A total of 64 species was recorded.

The ten most frequently recorded species were Mockingbird, Red-winged Blackbird, Chuck-will's-Widow, Loggerhead Shrike, Purple Martin, Blue Jay, Cardinal, Meadowlark, Nighthawk and Bobwhite Quail.

A comparison of the Ruderal Area bird species with those of the other associations is shown as follows:

Live Oak Hammock	75 per cent	Bayhead	47 per cent
Longleaf Pine	62 per cent	Aquatic	47 per cent
Scrub	58 per cent	River Swamp	45 per cent
Turkey Oak	58 per cent	Hydric Hammock	41 per cent
Slash Pine	58 per cent	Black Pine	39 per cent
Mesic Hammock	53 per cent	Marsh	20 per cent

As many different areas were included under the category of "Ruderal", the large variety of species recorded was not unusual. As in the Live Oak Hammocks a number of conducive food and cover conditions for birds were present.

Conclusion

A comparison of the bird populations of the associations and communities showed a considerable amount of overlap or number of species in common. This is further indicated by the following analysis:

3 species occurred in all 13 communities
8 species in 12 communities
7 species in 11 communities
9 species in 10 communities
5 species in 9 communities
4 species in 8 communities
5 species in 7 communities
3 species in 6 communities
8 species in 5 communities
13 species in 4 communities
11 species in 3 communities
15 species in 2 communities
47 species in 1 community (32 of these species were aquatic)

The three species found in all communities were phoebe, catbird, and thrasher.

Most of the shrub-dwelling species, i.e., towhees, Yellow-throat Warblers, and Florida Wrens, were found wherever dense shrubs occurred, regardless of the association. Some of the tree dwelling birds likewise showed a tendency to occur in any association which contained broad-leaved trees (Parula Warbler, Myrtle Warbler, and Crested Flycatcher, for example). Thus in many instances the presence or absence of certain birds was correlated with the general vegetation type and not a specific group of plants.

A few species were found exclusively in one association. Most of these however, were migrants or rare visitants to the area.

With these considerations in mind there seems to be little correlation between birds and plant associations, per se. In the terrestrial communities the differences between populations was due more to the differences in the abundance of species than to the presence or absence of any particular species.

One of the major difficulties met in working with this type of problem is the lack of an accurate method of determining the size of a bird population in an area. I believe that the frequency of occurrence method used in this study is reliable when based on a sufficient number of field trips, but the data thus derived has limited application.

I wish to express my appreciation to Dr. Pierce Brodkorb for his aid in preparing this paper.

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THE GEOGRAPHIC FACTOR IN THE HISTORY OF BULGARIA

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The strained international situation following the cessation of hostilities focussed attention upon the twilight zone of Europe which now is hidden by the iron curtain. In this elongated belt stretching from the frozen Arctic to the sunny Mediterranean, live approximately 125 million people on 771,200 square miles of land. Lying between the vast USSR and western Europe, this area contained almost half (13) of Europe's 29 independent states. This zone covers 35% of the continent's area and 30% of its people. It is rather typical of the region's economic development that its 37 cities having over 100,000 inhabitants comprise only 17% of the large European cities, yet Wien, Warszawa and Budapest have over one million inhabitants each. These three represent one third of the number of European metropolises.

At the turn of the century three great powers dominated this zone: Austria-Hungary, Turkey, and Russia. The second decade of the century witnessed the collapse of Turkey, the Soviet revolution in Russia, and the dissolution of Austria-Hungary. Both Turkey and Russia lost their dominance outside their core lands beyond which their ethnic-cultural influence did not extend firmly. The small nations which were minority nationalities have become sovereign states precariously existing by the tolerance or active support of the western powers. It was of preeminent political significance that the vanquished nations came out with a much greater degree of ethnic and cultural unity than the victors' allies. Austria, Hungary, Bulgaria, Turkey, and the European part of the USSR have become practically one nation states, whereas Poland, Rumania, Yugoslavia and Greece were all beset by serious problems due to the inclusion of contiguous national minorities of the vanquished within their political boundaries. With the irredenta movements brewing, this shatter zone was the powder keg of Europe.

The significance of this area as far as Europe was concerned was great. The economic, cultural and religious life was European. The people's outlook upon life was western with some phases of life resembling the east. This latter was especially noticeable in the Balkan states where the racial kinship of Slavism was enhanced by the cultural influences of the Orthodox Eastern Christianity which tied especially the Slav countries but also Rumania, a non-Slav state, to Imperial Russia. The anti-national and cosmopolitan attitude of the young USSR weakened but did not completely sever these ties. It was then only natural that, when the USSR in the fire baptism of the German invasion turned strongly Russian and Slav, her influence should become paramount in the Balkans.

How long the Russian influence will last and how far she will be able to change Hungary, Poland and Lithuania from an individualistic, Catholic, western civilization into a semi-oriental, atheistic, collective civilization is problematical. All three countries have suffered degradations, persecutions, and oppression, all three valiantly preserved their national consciousness, faith and language in the face of all vicissitudes of fortune. Even in the case of Rumania the situation is rather doubtful. Not so in the case of the Slav Balkan states of Yugoslavia and Bulgaria. Catholicism and western orientation of the Slovenes, but especially of the Croats, is a possible stumbling block which can easily explain the vicious attacks of the Titoist government upon Archbishop Stepinac and the Catholic clergy in general during the early phases of the present regime. Lately Yugoslavia, asserting its independence from the USSR, came in open diplomatic conflict with Moskva and abandoned its overt attacks on the church. It even released Archbishop Stepinac from formal prison life and permitted him to live in a quasi-exile in his native village without restoring to him his high office as the Catholic Primate of Yugoslavia.

In the meantime all other satellite countries have taken drastic measures against leading members of the Catholic clergy and churchmen of protestant faith. The almost identical pattern of these widespread attacks shows the relentlessness of this coordinated fight against the basic foundation of western civilization in this tragic zone of Europe. How long the western elements can withstand the onslaught without adequate help from the west is highly problematical, but probably not for very long.

During the early period of Yugoslav-Russian cooperation, in order to reach Yugoslavia the USSR had to control the key of the Balkan peninsula, Bulgaria. Since the Tito revolt Bulgaria's importance has increased tremendously. Only by the control of Bulgaria can the overland pressure upon Yugoslavia be fully maintained and the Russian influence upon the Balkans manifested. Thus the strategic significance of Bulgaria has reached a new high peak in its hectic history.

This small backward country of about 6 million simple peasant folk includes in its territory of 40,000 square miles the most strategic routes in eastern Europe. Not only is Bulgaria the key for the Russian domination of the peninsula but also the most threatening citadel whence the two extreme sub-peninsulas, Greece and European Turkey (which latter really means the straits of the Dardanelles and Bosporus) could easily be overrun. In a minor way Bulgaria is a heartland area, which, controlled by a land power, will force a sea power to do her utmost in order to remain in control of the extreme peninsulas or else these will be dominated by the land power in control. Thus Bulgaria commands a far greater geopolitical significance than its size or economic development would warrant. The Russians, who are far better students of geopolitics than the westerners, realized this fact; hence the last minute declaration of war and invasion of Bulgaria while the western powers were "negotiating" the terms of an armistice with the Bulgars. By this last minute act the rest of the Balkan peninsula and Hungary fell into Russian hands. Czechoslovakia, under some pressure but mostly of her own volition, joined in with the USSR and the iron curtain could then be drawn along an almost straight line from the Baltic to the head of the Adriatic. This action and its consequences were not forseen in the west, particularly in the United States, resulting in a resentment against the USSR, which, kindled by charges and countercharges of bad faith on both sides, often approaches a feverish war cry.

The sadness of the situation lies in the fact that the western powers, in their ignorance of, or disinterest in "little problems", actually delivered the key of the situation to the USSR almost on a silver platter. This woeful episode, let it be hoped, will teach the people of the west, especially of the United States, that no matter how small or poor a nation be, it has to be studied and known so as to permit the formulation and support of a foreign policy which makes sense and does not make careless mistakes which will take great efforts and sacrifices to rectify if that be possible at all!

In order to clarify some points in this "little matter" Bulgarian history will be summarized briefly, after which the various geographic factors will be studied in order to ascertain their influence upon the development of Bulgaria. Time and space limitations of course preclude all but a most generalized introductory study of the problem.

Bulgarian History

The Bulgars migrated from the lower Volga Basin through the Pontic steppes towards the lower Danube basin and the Dobrudzha. One of the earliest references occurs in a Byzantine annal of the fifth century concerning Emperor Zeno's invitation of the Bulgarians to fight the Ostrogoths.

A century later the Bulgars crossed the Danube and settled in the Dobrudzha where Asparukh (679-700) organized the tribes and invaded the Balkan Foreland. The Byzantine Empire, threatened by the growing Islamic power in Asia Minor, was weakened by the fight between iconoclasts and iconodules raging in Constantinople. Thus, not being able to fight on both eastern and northern fronts, the emperor recognized the Bulgarian kingdom as an independent unit limited to the Dobrudzha and the Balkan Foreland as far as the Iskŭr river. During the next century the Empire either checked the growing power of the Bulgars or depended upon their aid against the Islamic foe. The Bulgars subdued the Slavic people of the area but in turn they were absorbed by the latter, lost their original language and became a Slav nation.

The overwhelming victory of Leo the Iconoclast over the Arabs in 717 secured Asia Minor but in the north the Bulgarian Empire was expanding fast. The Avar power was broken by Charlemange, woman rule and intrigue further weakened Byzantium while Tsar Krum (802-814) extended his domain to the Sofiya basin, hence to the Morava-Danube area, and finally into Macedonia. He annexed even portions of the former Avar empire—those lying east and south of the Tisza river, and Transylvania. Emperor Nicephorus wanted to reduce Krum's power but was defeated and killed in 811. Krum's successor, Omurtag (814-831) further extended his empire at the expense of Byzantium by the acquisition of the upper valley of the Maritsa as far as Kharmanlii.

The author is indebted to Mr. Edward Steere, formerly historian of the U. S. Board on Geographical Names, Department of the Interior, who had aided him in the collection of the historical material and with whom he discussed many phases of the problems presented.

Yet the greatest expansion of Bulgaria was to follow at the close of the century. Under the able leadership of Boris (853-880) the Bulgars became Christians, joining the Eastern Church and thus establishing strong cultural and political ties with Byzantium. Under his successor Simeon (880-922) the Bulgarian Empire had its widest expansion. The Magyar invasion caused the loss of the trans-Danubian possessions but they were amply compensated for by the inclusion of parts of the Albanian coast into the empire. With its seat at Okhrida, the independent Bulgarian exarchate was also established, which coincided with the political boundaries of the state. Simeon had been recognized by the Byzantine Emperor and assumed the title "The Tsar of the Bulgars and Ruler of the Romans". This empire did not last and soon after Simeon's death it fell apart.

Byzantine intrigue enticed the first Russian invasion of the Balkans. Svyatoslav of Kiev descended upon the Bulgars, now split into eastern and western empires. Finally the emperor, John Zimisces, decided that of the two the Russians were worse than the Bulgarians; hence in 971 he marched against the Russians defeating them. The terms of peace were so generous that the Russians became the ally of Byzantium affirming their pledges by assuming the eastern form of Christianity. The doom of the first Bulgarian empire was sealed by their disastrous defeat by Basil II who became known as Bulgaroctonos (Slayer of Bulgars). The campaign lasted 12 years and ended in the loss of Bulgarian independence in 1018.

In the meantime the Islam power slipped into the hands of the Seljuk Turks who revitalized the military strength of Mohammedanism. In the tragic battle of Manzikert the emperor was captured and his army annihilated. Asia Minor had become a Turkish province. The Crusades launched by Pope Urban II in 1095 instead of helping actually harmed Byzantine power. Finally the fourth "crusade" turned against the Byzantines and captured Constantinople establishing there the "Latin Empire" in 1204 which lasted until 1261.

The Bulgars revolted in 1186 and about 1230 under Ivan Asen II practically the whole empire of Simeon had been reconquered. This second empire did not last as long as the first. Hungary, later Serbia, reduced Bulgaria to a vassal state. (See Inset)

The final blow came with the rise of the Ottoman-Turk power. In 1361 the Turks crossed the Dardanelles and by 1371 subdued

Bulgaria and Macedonia. In 1389 they broke the power of the Balkan coalition in the first battle of the Kosovo Polye. For four and a half centuries after Bulgaria remained under the Turkish yoke, which was stricter and more oppressive there than in any other part of the Balkan Peninsula.

The Geographic Factors

The Bulgarian scene is dominated by two mountain areas, the bold flattened arc of the Stara Planina (Balkan mountains) and the old, resistant block of the Rodopi massif. The Stara Planina, a rather low link in the Alps-Himalaya system is a more serious barrier than its general elevation would warrant, though its highest peak rises only to 9,465 feet yet the passes in the Central Balkans are rarely under 6,000 feet. The Iskŭr gorge in the west and the Shipka pass in the eastern half are the two most important passes with relatively easy access to the lands on both sides of the mountains.

The Rodopi massif is the higher of the two mountains. It forms roughly a triangular area of complicated mountain ranges divided by a few river valleys. In these isolated areas many a remnant people found refuge adding confusion and complication to ethnic and political problems.

Where the outer bend of the Stara Planina approaches the apex of the Rodopi triangle the two mountain systems enclose the Sofiya basin. This relatively low (1,800 feet) area is crossed by the Iskŭr river, the only one to transect the Balkans, linking the basin northward to the Danube. An easy grade leads to the Maritsa valley. The Nišava leads to the Morava-Vardar corridor, the Struma to eastern Macedonia. Between the two mountain systems, east of the Sofiya basin, lies the broadest lowland area of the country, the mild Maritsa valley. North of the Balkan mountains stretches the Danubian Foreland, a dissected, loess covered low plateau terminating in a series of 200-600 feet high bluffs at the Danube. This presents a very different picture from the low, swampy shore of the river on the Rumanian side.

The Deli-orman forms a hilly transition from the Danube Foreland to the Dobrudzha. Its Turkish name meaning “wild wood” is descriptive of the region’s character. Only the southernmost extremity of the Dobrudzha, a constant bone of contention between

Bulgaria and Rumania, belongs to the former. This low, dry plateau was the first home of the Bulgars on the Balkan peninsula. It was here that Asparukh consolidated them and invaded the Danube Foreland.

The last unit of the country is Pontic Bulgaria consisting of two amphitheatre like lowlands separated by the low easternmost spurs of the Balkans, one centering on Varna in the north and the larger on Burgas in the south. (See Inset)

The climate of Bulgaria is influenced by the continental interior whence cold winds blow out from Russia during the winter and by the Mediterranean and Black seas which ameliorate the winter cold. The Stara Planina forms the climatic boundary. North of it the dominant influence is continental, to the south, Mediterranean. The precipitation is over 20 inches, and over most of the country it shows a summer maximum. A tendency for the fall-winter maximum of the Mediterranean type is confined to the southeastern corner of the country.

The soils, where not too rocky or shallow, are of fair fertility. In the south fruit crops, except citrus, are well suited to climate and terrain. Here also are grown corn, tobacco, mulberry trees for silkworms and roses, whereas in the north, wheat and barley are the chief products. The alpine meadows and the dry pastures of the Dobrudzha support many herds of sheep. There are some cattle, goats and hogs also. The mineral resources hold a promise but outside of some coal mining no other mineral industries exist on a commercial scale as yet.

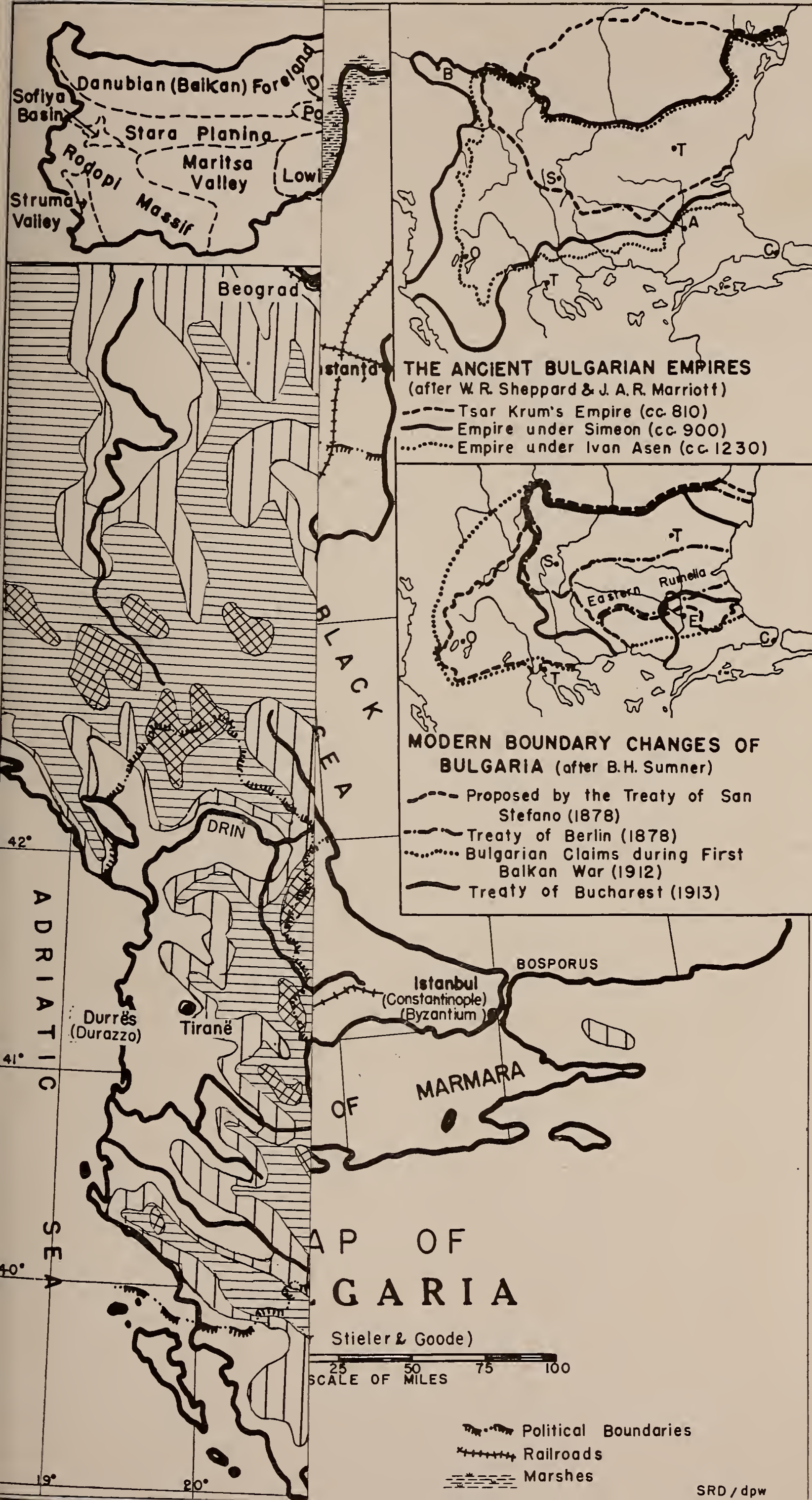
This is the immediate environment of Bulgaria. The protected, warm southern part opening up through the Maritsa valley towards Thrace had always been closely linked with the three seas, the Aegean, Marmora and Black Sea. On the other hand the Danube Foreland, being separated by the mountains and having a colder climate, was less desirable and had been occupied by the people of the south only during periods of expansion. Such was the situation during the classical times and again during the Byzantine epoch. That is why the Bulgarians were permitted to settle on the land north of the Balkans. The main routes led from Constantinople through the Maritsa valley to Sofiya, Niš, Beograd and through the Pear Tree pass into Italy. The other followed the sea coast through Thrace-Macedonia to Durazzo, the Adriatic terminus of the southern route, known partly as Via Egnatia. By retaining the control of the Stara Planina the Byzantines secured their overland trade route.

The early Bulgar state crystallized around Tŭrnovo. It is on the edge of the plateau at the head of the lower Yantra valley, and near the northern terminus of the Shipka pass. Thus it controls the easiest route into Inner Thrace and is in an excellent position of defense against Byzantine operations which per force had to use the Shipka pass for attacking the Bulgars. Tŭrnovo, in addition, controlled also the east-west route along the outer margin of the plateau beyond which it was deeply dissected by the numerous tributaries of the Danube originating in the Balkans. This route continued towards Shumen and Varna. By limiting the Bulgars to the Foreland east of the Iskŭr the Byzantines secured the control of the gorge of the same and the approach to the Sofiya basin.

The significance of the Sofiya basin on the peninsula is paramount as far as the Straits are concerned. The great trade and military routes leading from the Baltic and from the Po valley to Byzantium converge upon Sofiya. Of lesser importance is the crossing of the north-south route from the Aegean through the Struma valley to Sofiya and hence down along the Iskŭr to Nikopol on the Danube, which city is located somewhat down stream from the mouth of the Iskŭr. The city faces the Olt river, a northern tributary of the Danube, which crosses the Transylvanian Alps by the way of the low Red Tower pass. Along the Olt the route leads into Transylvania. Hence, Nikopol developed at the early classical times and has remained since then an important trading center. It was at this junction where the united Christian armies, led by King Sigismond of Hungary, were defeated by Bayazet in 1396 sealing the fate of the Balkan peninsula for 500 years to come.

Growing in strength, the Bulgars used the timely Islamic assault on Byzantium to cross the Iskŭr and capture Sofiya, and hence to expand in all directions both during the first and the second empires. Modern Bulgaria, while controlling the Sofiya basin, has been checked, mainly by outside influences, from occupying the Morava-Vardar corridor and the ancient seat of the Bulgarian exarchate, Okhrida.

The same factors of easy access and mild climate together with the strategic significance of the Maritsa valley explain the great number of Turkish settlements in that region. Thrace and the Maritsa-Arda valleys were densely settled by Turkish immigrants


Danubian (Balkan) Foreland
Sofiya Basin
Stara Planina
Rodopi
Maritsa Valley
Struma Valley
Massif
Beograd
THE ANCIENT BULGARIAN EMPIRES
(after W. R. Sheppard & J. A. R. Marriott)
Tsar Krum's Empire (cc. 810)
Empire under Simeon (cc. 900)
Empire under Ivan Asen (cc. 1230)
Eastern Rumelia
MODERN BOUNDARY CHANGES OF BULGARIA (after B. H. Sumner)
Proposed by the Treaty of San Stefano (1878)
Treaty of Berlin (1878)
Bulgarian Claims during First Balkan War (1912)
Treaty of Bucharest (1913)
BLACK SEA
DRIN
ADRIATIC SEA
42°
41°
40°
19°
20°
Durrës (Durazzo)
Tiranë
BOSPORUS
Istanbul (Constantinople) (Byzantium)
OF MARMARA
Stieler & Goode)
25 50 75 100
SCALE OF MILES
Political Boundaries
Railroads
Marshes
SRD / dpw

Danubian (Balkan) Foreland
Deli-Orman
Pontic
Sofiya Basin
Stara Planina
Maritsa Valley
Lowlands
Rodopi Massif
Struma Valley
RED TOWER PASS
KLISURA (KAZAN) PASS
IRON GATE
Beograd
OLT
Bucuresti
Constanta
DUNAV (DANUBE)
Nikopol
TIMOK
MORAVA
Niš (Nish)
NIŠAVA
ISKUR
YANTRA
Shumen
Varna
Tŭrnovo
BLACK SEA
Sofiya
SHIPKA PASS
TUNOZHA
Burgas
MARITSA
Plovdiv (Philippopolis)
Kharmanlii
Edirne (Adrianople)
AROA
DRIN
STRUMA
MESTA
VARDAR
Istanbul (Constantinople) (Byzantium)
BOSPORUS
Durrës (Durazzo)
Tiranë
Okhrida
Thessalanikë
SEA OF MARMARA
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MAP OF BULGARIA
(After Stieler & Goode)
25 0 25 50 75 100
SCALE OF MILES
RELIEF
5,000 Feet
1,000 "
500 "
Sea Level
Political Boundaries
Railroads
Marshes
SRD / dpw

from Asia Minor who brought along a number of agricultural techniques such as the rose culture for the production of attar of roses. Certain Bulgarian elements have accepted Mohammedanism, just as earlier the nation embraced the form of Christianity of nearby Constantinople. The Mohammedan Bulgars known as Pomaks inhabit mostly the Rodopi region and conflicts between them and the Orthodox Bulgars in recent times have presented some unpleasant pictures of wanton cruelty and destruction.

The main factor that has influenced the history of the country, however, is not found among the internal geographic conditions. It is really Bulgaria's relationship to the Straits which governed its destiny in the past and is going to govern it in the future. The Straits have been one of the most contested territories in Europe. The narrowness of the water, the fast outflowing current, and the convenient hills along the shores, render the Straits easily controllable from the land. On the other hand the very same narrowness of the water makes this an ideal crossing place. Thus next to the unbroken Pontic and Asiatic steppes, Asia Minor and Thrace formed the most important land bridge between the Orient and Europe.

The Bulgarians therefore could not have determined their own history. Their local resources were insufficient to allow them to conquer and control the Straits. Only beyond the Balkan mountains could they maintain themselves during periods of foreign domination. Here they were protected by mountains in the south and the great Danube on the north, which, with its marshy northern shore, was the only common boundary of all Bulgarian empires. But even here the Deli-orman was settled by Turks, not the horticulturalists who settled in the south, but mostly shepherds bringing their flocks along from the dry Anatolian plateau.

Bulgarian empires rose twice in the past. In both instances the struggle for the control of the outer defenses of the Straits engaged the main energies of the Byzantine empire. As soon as these had been secured, at least temporarily, and the Byzantines had recuperated their strength, with or without the aid of outsiders, the Bulgars were challenged by Constantinople and their power broken. The inherent weakness of Byzantium and good diplomacy were responsible for the utilization of outsiders for the purpose of checking the Bulgars. Such was the invitation to the Hungarians in the 10th, and the Kiev Russians in the 11th century to attack the Bulgars from the north. These power politics did not bring about always the desired results as in the case of Svyetoslav who proved to be a more dangerous ally than the Bulgars were foes.

Just before the fall of the Byzantine Empire, the growing Danubian power Hungary expanded and Bulgaria was reduced to a vassal status. Unfortunately, the intransingence of Louis the Great and his hostility towards the Oriental Christianity precluded a peaceful consolidation of the Danube basin with the Morava-Vardar-Sofiya-Maritsa corridors. Similarly, the Serbian empire of Stephen Dushan which defeated the Bulgar-Greek alliance and made Bulgaria an "allied state" did not suit the Bulgars, especially since it included much of the territory of the two Bulgar empires lying west of Struma and Timok valleys. All of these made an effective common defense against the Turks impossible and one by one these countries were conquered by Islam. Again the proximity and accessibility to the Straits explain why it was Bulgaria that fell first and regained her independence last. With the Turkish invasion land power conquered the Straits and has held it since that time.

The history of modern Bulgaria is even more involved but still it revolves around the Straits. The consolidation of powers in Europe produced a few, but very powerful, protagonists. First the sea power of Great Britain, to whom the Mediterranean became a life line. But to France too the Mediterranean was a life line and even Italy considered it "Mare Nostrum".

At the same time two young rising land powers appeared on the scene. One was Russia, which was in desperate need for an outlet to the sea. Hemmed in by ice on its long northern shore, save inaccessible White Sea ports, blocked by the Skagerrak and Kategat at the Baltic and bottled up in the Black Sea by the Bosporus, Russia had to make a choice. No one can fight the Arctic ice, to the west she faced Europe, so her choice was expansion towards the south. That meant an attempt to conquer Constantinople.

The second power was Imperial Germany, well organized, efficient and ambitious. Gaining unity too late for colonial expansion and not trusting her own naval development too highly, she decided on a peaceful land penetration of the Orient. The outcome of her "Drang nach Osten" policy was the ambitious project of building the Berlin-Baghdad railroad, which of necessity had to lead through Sofiya. In between these conflicting geopolitical sectors lay two empires which in a 400 year's struggle have succeeded in bleeding each other to death: Austria-Hungary and Turkey. The immediate problem was the Slav pressure on both of them. Russia, the defender of Slavs and of Orthodoxy, was just as dangerous a foe of Austria-Hungary on the first account as of Turkey on the second. It was therefore to their mutual advantage to strengthen each other. But it was too late. Had they realized this fact 200 years ago history may have been different.

Fortunately, the dynamic powers could not agree what to do with these two sick men of Europe. They all agreed not in so many words, that the best solution would be for no dynamic power to control the Straits and not to disturb the status-quo in the Danube area. Nationalism, however, was rampant. Thus the next step was to use local patriotism for the selfish interests of the great powers.

Bulgaria became a pawn in the hands of Russia. She gained her religious independence first, and the Bulgarian Exarchate was reestablished. This was followed by the independent Great Bulgaria of the treaty of San Stefano which expanded her boundaries to almost the limits of the Empire of Simeon. This was too an overt threat to the Straits and all the powers convened to draw up a new treaty. The treaty of Berlin practically nullified the treaty of San Stefano. Bulgaria was reduced to the Danube Foreland and the Sofiya basin. Inner Thrace was renamed East Rumelia and was to be governed by a Christian governor general under Turkey. This was a rebuke to Russia. The major part of the Dobrudzha was handed to Rumania for her aid in liberating Bulgaria. (See Inset)

Russia, suffering a diplomatic defeat, shifted her interest to the Serbs in order to deal with Austria-Hungary directly and this resulted in the reorientation of Bulgaria towards the Danubian countries. In the first Balkan War Bulgaria hoped to regain Macedonia but the conflicting demands based upon historic and rather dubious ethnic grounds resulted in a fight between the allies in which Bulgaria lost most of her conquest and which left her dissatisfied and revengeful.

Like once before, in World War I, she allied herself with the power controlling the Straits against the Serbs. Again she lost. With the ascendance and economic recuperation of Nazi Germany Bulgaria became an economic colony of the Reich. The hope of regaining her lost territories made her join Germany and she lost again.

Through the Teheran and Yalta agreement the USSR gained a free hand in the Balkans and Bulgaria is now under complete Russian domination. Too late have the western powers realized what it meant to let the Russians march into Sofiya. Thus now Greece and Turkey, after having been "marshalled", have been included into the North Atlantic Pact in order to protect them against the expansion of a land power more threatening than any other of the past.

Here, however, a question has to be raised concerning the importance of the Straits in an atomic air age! The tremendous strategic significance of the Straits in the past is undeniable, but isn't their importance still being measured in terms of ships and cannons rather than airplanes and A-bombs? With India's independence the Mediterranean ceases to be a life line for Britain even in peace times. It wasn't much of a life line during the past war! Thus the threat is more of an ideological nature. One phase of that Pan-Slavism is threatening Europe; the other, communism, threatens the capitalistic system. Thus the issues involved have outgrown even the importance of the straits themselves and now the fate of Bulgaria has become inseparably linked with a conflict world wide in its scope, the struggle between the East and the West.

THE FUNCTION OF MAST CELLS
A METHYLCHOLANTHRENE-INDUCED "MASTOCYTOMA" [1]

PERIHAN CAMBEL

According to the available literature, Sabrazès and Lafon (1908) were the first authors to report a tumor composed of mast cells. They observed this orange-sized tumor in the injured upper lip of a horse. Schreus (1924) made the first record of a skin nodule composed of mast cells in a white mouse which had been painted with a neutral tar oil for three and a half months. Fabris (1927) called attention to similar subcutaneous, but multiple mast cell nodules in mice which had been intermittently exposed to fine pulverized tar in an enclosed atmosphere for several months. He coined the term "mastocytoma" for these lesions.

Three years later, Twort and Twort (1930) described an increase in mast cells in the skin of mice painted with carcinogenic agents (tar and oils). Among four thousand induced tumors they observed a "diffuse infiltrative condition" of mast cells in various internal organs following tar application. They considered this condition the cause of death of mouse No. 21079. Mastocytic skin infiltration and "granulomas" were noted in mice by De Vinyals (1931) during and after tar painting. Lignac (1930-32) observed in two out of fifty-four mice exposed repeatedly to benzol a "benzol leukemia" accompanied by a mast cell infiltration.

The term "mastocytoma" came into wider circulation after Bloom's (1942) excellent description of mast cell nodules composed of "neoplastic mast cells" in dogs.

Deringer and Dunn (1947) discovered five cases of "mast-cell neoplasia" in mice (strains ALF and LA-ABC) from an experiment originally designed to study the incidence of renal disease and amyloidosis. These authors state that "reports on the autonomous growth of cells characterized by basophilic granules are infrequent". Therefore, a subcutaneous "mastocytoma" associated with a fibrosarcoma in a Swiss Albino mouse painted with 20-methylcholanthrene will be reported. The tumors were observed in the course

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[1] A contribution from the Cancer Research Laboratory, University of Florida and the Anatomy Department, Cancer Research Division, Washington University School of Medicine.

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of an experiment that had been set up for the study of epidermal carcinogenesis. Numerous mast cells were seen in the tissues around the tumors. Mast cells were also seen in the fibrosarcoma.

Materials and Methods

Seventy-five Swiss Albino mice from the Albino Farms, aged 5 to 6 weeks, were painted 3 times in one week, with a 0.6 per cent benzene solution of 20-methylcholanthrene (MC) with 3 strokes of a No. 4 camel hair brush on the shaved dorsal skin. They were fed Purina laboratory chow and tap water *ad libitum*. Fifteen mice out of this group were observed for 18 months after which 14 were sacrificed, and one showing two peculiar growths on the dorsal skin died from a general infection.

The tissues of this mouse were fixed in Bouin's fluid and chilled 80 per cent ethanol. The skins and stomachs of MC-painted and non-treated control mice were fixed in chilled 80 per cent ethanol. The alcohol fixed tissues were dehydrated and cleared in the cold room at 4°C., and embedded *in vacuo*. Paraffin sections cut at 7μ were stained with hematoxylin and eosin, Van Gieson, and Toluidine Blue O. The alkaline phosphatase (AP) reaction was carried out on ethanol-fixed material by Gomori's (1941) method, and the periodic-acid-Schiff reaction (PAS) according to McManus (1948) on ethanol and Bouin fixed materials.

Case Report

A tumor appeared under the skin in the dorsal lumbar region of the mouse approximately 13 months after the paintings. It grew rather rapidly at first and then remained stationary for about 3 months until the death of the animal. During this period it slowly developed a central delling due to ulceration of the covering skin in the center of the tumor.

At autopsy, the mouse (20 g. body weight) showed bilateral suppurative panophthalmia, four lung adenomas (one in each lower lobe and 2 in the left upper lobe), a slightly mottled hyperemic liver, enlarged spleen, markedly dilated stomach with atrophic glandular mucosa, brownish coloration of the cortex of the adrenals, absence of the thymus, and two tumors of the dorsal lumbar skin. The large tumor was partly covered with hairy skin, and had a central ulcerated delling involving skin and tumor. The ulcer was covered with a bloody crust. The tumor measuring 1.9 x 1.3 x 1.5 cm. was of firm, fish-flesh-like consistence and of whitish color on its cut surface.

The second tumor, barely visible as a lentil-like elevation under the hair-covered skin, was located craniad of the former. It was whitish and firm, lying as a minute nodule in the corium.

It was evident that the first tumor was a subcutaneous sarcoma. The second tumor could not be identified without histological examination.

Microscopic observations.—The lungs showed bronchopneumonia, abscesses, typical adenomas and rare disintegrating mast cells. A necrotizing hepatitis with accompanying small granulomas was found. Bacteria were seen in the portal vein branches. The spleen contained numerous, megakaryocyte-like, uni- and multinuclear giant cells, occasional neutrophil leucocytes in the pulp, and mast cells in the capsule. The spleen pulp showed diffuse, irregular necroses, and the kidney a nephrosis in the Henle loops and the tubuli recti. Numerous mast cells were observed in the ovary and some under the uterine mucosa. The glandular stomach showed slight atrophy and gastritis, and the forestomach papillary excresences. The number of mast cells in the stomach wall seemed slightly decreased. Diagnosis: Bacterial toxemia.

The large tumor was composed of interlacing bundles of fusiform cells. It contained wide blood spaces lined only with a thin endothelial cell layer (Fig. 1, E). The tumor also contained metachromatic mast cells (Fig. 1, D) which decreased in size (0.6-1.2μ) and disintegrated toward the central and deeper parts of the malignant growth. Larger mast cells varying from 1.2 to 1.8μ in length and large scatterings of extracellular metachromatic granules (Fig. 2) were seen in the corium around the tumor which was infiltrating the skin muscle. Gram-positive bacteria were found on the tumor's ulcerated surface which was covered with a PAS-positive fibrin layer. No basement membrane could be distinguished under the epidermis in the PAS-sections. The corium and the cytoplasm of all its cells and its intercellular cement, the ground substances of the tumor, and portions of the plasma in the blood spaces were PAS-positive. No mitotic figures (ana-, meta-, and telophases) were noted. Histological Diagnosis: Fibrosarcoma.

The small, metachromatic tumor (Fig. 1, A) consisted of large, irregular cells with apparently anastomosing processes. They con-

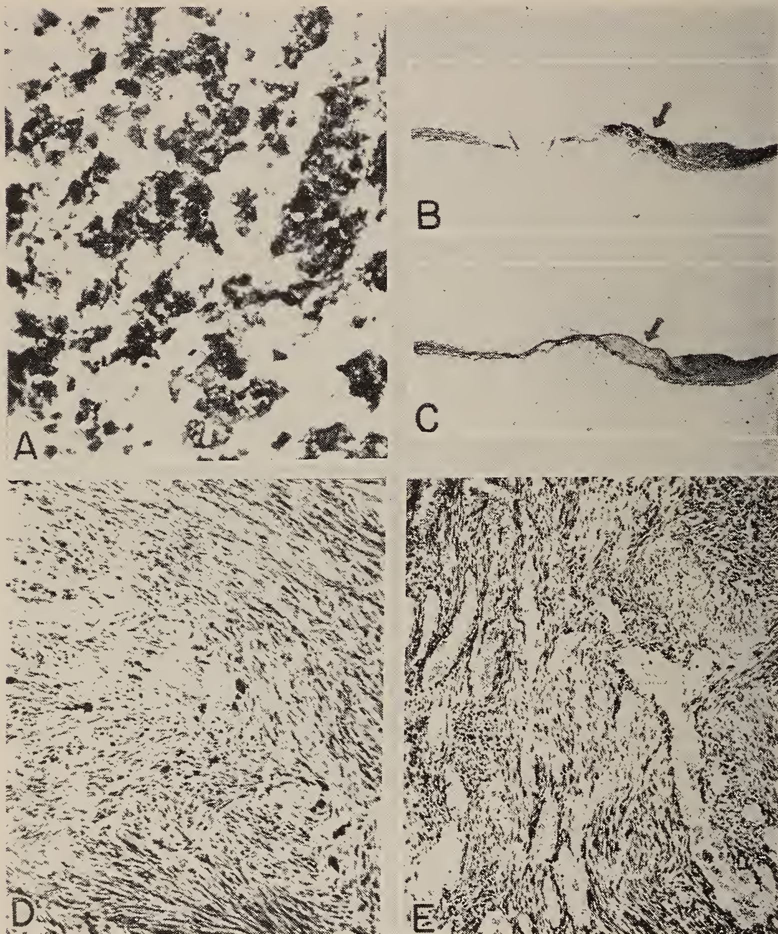

Fig. 1.—(A) Neoplastic mast cells with intensely metachromatic granules. × 165. (B) Mastocytoma seen as flat metachromatic nodule. × 5. (C) Negative alkaline phosphatase reaction in mastocytoma. × 5. (D) Fibrosarcoma with intensely metachromatic mast cells of various sizes. × 120. (E) Fibrosarcoma with blood spaces. × 120.

tained purple granules in their sometimes vacuolated, blue cytoplasm. The granules sometimes masked the spherical nuclei (0.36-0.72μ). The tumoral mast cells ranged from 1.8 to 3.0μ in length in which they exceeded the mast cells (0.6-1.2μ) found ordinarily under the epidermis in mice, and those around the fibrosarcoma, but not those located closely around the metachromatic tumor.

Although the mast cells around and in the fibrosarcoma gave a positive AP-reaction, the neoplastic mast cells and the mast cells adjacent to the metachromatic nodule were AP-negative (Fig. 1, C). The PAS-reaction was slightly positive in the cytoplasm, in the nuclei and in some granules of the neoplastic mast cells. Histological Diagnosis: Mastocytoma.

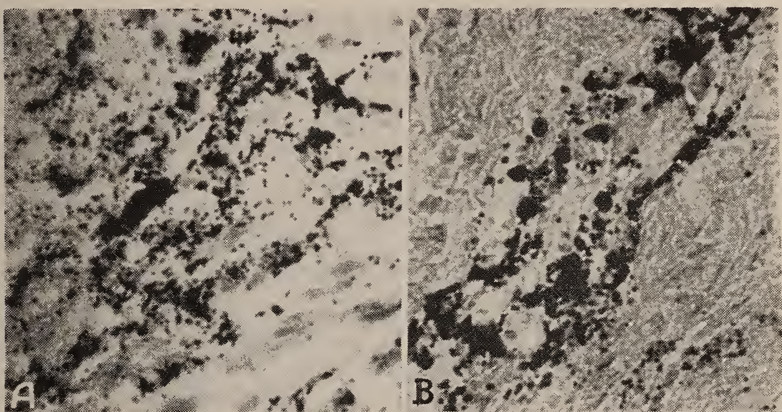

Fig. 2.—Extracellular granular shedding of mast cells in subcutaneous connective tissue around fibrosarcoma. (A) Areal distribution of metachromatic granules. (B) Linear type of distribution of metachromatic mast cell granules. × 500.

Discussion

Although Schreus (1924), Fabris (1927), and De Vinyals (1931) observed nodular "mastocytomas" after experimental tar exposure, and others of unknown etiology have been reported by Deringer and Dunn (1947), no mastocytoma traceable to treatment with MC or other pure carcinogenic hydrocarbons was encountered in the literature reviewed. However, mast cell infiltrations were noted by Cramer and Simpson (1944) in the skin of mice treated with MC, and in rat sarcomas induced by MC and benzpyrene by Holmgren and Wohlfart (1947). Cloudman (1941) states that spontaneous fibrosarcomas are not observed frequently in mice, although, in our experience, they can be induced occasionally by skin painting with carcinogens, and Strong (1950) has induced them by subcutaneous injection of MC. An intense mast cell reaction with many, often diffusely spread, extracellular mast cell granules (Fig. 2) was observed around the fibrosarcoma. Mast cells penetrated into the tumor, becoming smaller and scarcer toward its central portion in accordance with the findings of Holmgren and Wohlfart (1947) in experimental rat sarcomas.

Paff and Bloom (1949) have shown that mast cells in tissue cultures possess ameboid movement and a secretory cycle which involves the shedding of metachromatic granules and ends with cell death. These properties were confirmed by Cambel *et al.* (1952) who presented evidence for mast cell migration from the gastric wall into the stomach lumen, and for a secretory cycle of the mast cells which is completed in the glandular mucosa and the gastric lumen of rats. These authors employed the term gastric mast cell diapedesis to designate this migration, because Tomenius (1947) and previous authors defined the wandering of leucocytes through the gastric wall as leucocytic diapedesis. Because the mast cells and their extracellular granules were seen in greatest numbers around the fibrosarcoma presented here, and because they became scarcer and smaller toward the tumor center, as shown also by Holmgren and Wohlfart (1947), it is assumed that tumor diapedesis of mast cells also occurs. To judge from their smaller size and their gradual disintegration in the tumor tissue, and their complete absence in the center of the blastoma, it is also assumed that they end their secretory cycle in the tumor tissue. Tumor diapedesis and the related secretory cycle could, therefore, explain apparently uneven distribution of mast cells around and in tumors, as well as their absence in others; facts which have caused controversy (Holmgren and Wohlfart, 1947; Bali and Furth, 1949).

Cramer and Simpson (1944) launched the concept of the role of the mast cell in the defensive mechanism against MC-induced epidermal carcinogenesis. The view that the mast cell contributes by means of its heparin secretion to the formation of mucopolysaccarides is supported by the investigations of Holmgren and Wilander (1937), Jorpes (1946), and Oliver, Bloom and Mangieri (1947). By means of polymerization, polysaccarides could be formed from heparin which is a disaccharide containing chondroitin sulfuric acid (Jorpes, 1946) since it has been suggested by Larsson and Sylven (1947) that metachromatic granules of the mast cells "are delivered to the skin in order to restore its content of labile sulphurous compounds."

A relatively light PAS-reaction was found in the nuclei, cytoplasm, granules, and intercellular cement of the blastomatous mast cells. We assume that the PAS-reactive material of mast cells varies in intensity of reaction and distribution at different phases of the secretory cycle, becoming scarce or absent upon liberation from the cells. It seemed as if the mast cells in and around the mastocytoma had partly liberated their PAS-positive material because the reaction was not intense or uniform. However, the reaction was intense in the ground-substance of the fibrosarcoma which did not show mitotic figures. Also, the tumor remained stationary after a certain period of growth without causing a marked decrease in weight of its host. Heilbrunn and Wilson (1949) showed that heparin inhibits mitosis in fertilized chaetoptera and frog eggs. Mucopolysaccharides used by Shear (1944) in the treatment of tumors had a cytotoxic effect on the neoplasms. Heilbrunn and Wilson (1950a, 1950b) found that Shear's bacterial polysaccharides also prevented cell division and prevented fertilization. Furthermore, the bacterial polysaccharide prevented mitotic gelation in protoplasmic viscosity tests. Therefore, in accordance with Heilbrunn's theory on mitotic gelation, it is presumed that the PAS-reactive polysaccharides found in the fibrosarcoma checked the growth of the tumor in spite of its histological malignancy by preventing the formation of mitotic figures. They may have derived partly from the mast cells during tumor diapedesis. The mast cells participating in this diapedesis were probably both histogenous and neoplastic mast cells. The wandering tumoral mast cells could be distinguished from other mast cells in the corium by their larger size. The mast cells decreased in size during tumor diapedesis. None of neoplastic size were found in the fibrosarcoma.

The large neoplastic mast cells in and around the mastocytoma were AP-negative while the other mast cells around and in the fibrosarcoma were AP-positive. Mast cells in non-treated mice were found AP-positive by Montagna and Noback (1948) and the present author (Cambel, to be published). Riley and Drenhan (1949) found that in the mouse and in the rat only a proportion of mast cells contained granules which gave a positive AP-reaction. Therefore, we believe with these authors that two functional states of the mast cells as shown by the AP-reaction exist during their secretory cycle.

In view of the reports in the literature and our personal observations it seems that the mast cells are capable of tumor diapedesis and are concerned in a defensive reaction against tumor growth.

By shedding their metachromatic substance into the surrounding tissues, they may supply these with heparin or related substances. These could be polymerized into polymucosaccarides able to counteract tumor growth. The mastocytoma adjacent to the fibrosarcoma may have originated in response to an overstimulation or tumorigenic incitement of the histogenous dermal mast cells.

Summary

A case of subepidermal fibrosarcoma with an adjacent mastocytoma induced by 20-methylcholanthrene in a Swiss Albino mouse is presented. Histochemical studies in mice seem to indicate that mast cells may show different functional phases during the secretory cycle. The role of these cells in a mechanism checking tumor growth by means of tumoral diapedesis and granular shedding is discussed.

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SOME CONSIDERATIONS AND PROBLEMS IN THE ECOLOGY OF FLOATING ISLANDS

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University of Florida

The late Dr. Thomas Barbour has said (1944:173), "In no region in the world is one more frequently interested and impressed by the floating vegetation than in Florida." In addition to the usual floating plants, many lakes throughout the state are noted for large floating mats of vegetation which, in some instances, support trees and shrubs 15 feet or more in height. Lake Washington, which heads the St. Johns River, Lake Hellen Blazes, and Orange Lake are probably the most notable examples.

Orange Lake is the largest of several lakes in north central Florida, and is a tributary of the St. Johns River. The climate in this rolling karst region is generally mild and comparatively uniform, with subtropical temperatures influenced by winds from the nearby Gulf of Mexico. A wet period occurs generally from June through September, with precipitation in the form of thundershowers of high intensity and short duration. The dry period extends from October through May.

Orange Lake lies almost wholly within Alachua County. The lake has an open water surface area of approximately 14,000 acres surrounded by *Nymphaea* marsh. This marsh, much of which is floating, may be over a mile wide in places. The depth of the lake is fairly uniform, sloping gradually from an ill-defined shoreline to 25-30 feet. The water is usually tinted brownish or greenish due to large amounts of suspended detritus, zoo- and phyto-plankton, and their extractives. The bottom is composed of thick layers of autochthonous silt and plant detritus, which in some places is rather compact, overlying sandy clay and limestone. Chemically, the water is usually circum-neutral (pH: 6.8-7.2). Submergent plants are scarce in the open water.

Floating islands, varying in size from a few feet to several acres, are impressive features of Orange Lake. They usually support abundant stands of vegetation whose roots penetrate a rather dense matrix of decaying plant detritus of peat-like nature.

No particular hydrophyte appears to dominate all of the floating islands. Pickerel weed, *Pontederia lanceolata,* and arrowhead, *Sagittaria lancifolia,* are probably the most characteristic forms, although many islands have been observed which supported dominating growths of twig rush, *Mariscus jamaicensis,* smartweed, *Persicaria* sp., or spatterdock, *Nymphaea macrophylla,* with elder, *Sambuccus simpsonii,* willow, *Salix* sp., and myrtle, *Myrica cerifera,* frequently present. An abundant lower stratum flora is usually present and consists of such plants as pennywort, *Hydrocotyl umbellata,* parrot's feather, *Myriophyllum proserpinacoides,* duckweed, *Lemna minor,* or mosquito fern, *Azolla caroliniana.* In season, much color is added to the islands by the flowers of *Bidens,* arrowhead, spider lilies, *Hibiscus,* and the ubiquitous water hyacinth.

The fauna of the islands, and, more properly, the marsh in general, is varied and quite abundant. This is especially true of the invertebrate groups.

Of the mammals, the raccoon, *Procyon lotor elucus,* has been observed wandering and swimming from island to island. Evidences of the marsh rabbit, *Sylvilagus palustris paludicola,* and the round-tailed muskrat, *Neofiber alleni nigrescens,* have been noted.

As would be expected, in view of the extensive shallow marshes about Orange Lake, birds are abundant, many of them finding food and nesting sites on floating islands. Bird Island, with an area of 2-3 acres, has been recognized since the turn of the century for its phenomenal bird fauna. Egrets, ibises, herons, gallinules, red-winged blackbirds, grackles, and water turkeys are some of the more characteristic breeding birds associated with floating islands. Coots and migratory ducks are common in the area.

Certain amphibians and reptiles are conspicuous elements in the biota of floating islands. Among the amphibians, the Louisiana newt, *Triturus viridescens louisianensis,* and the striped mud-eel, *Pseudobranchus striatus axanthus,* are often found among the submerged roots of the plants growing on the islands. Hylid frogs (*Acris gryllus dorsalis, Hyla cinerea cinerea, Hyla squirella*) and bullfrogs (*Rana catesbeiana, Rana grylio, Rana sphenocephala*) occur in varying numbers. Turtles and snakes are associated with floating islands in the procurement of food and selection of nesting sites. The more common forms of turtles are the stink-jim, *Sternotherus odoratus,* which is frequently found nosing around submerged roots, and cooter, *Pseudemys floridana,* often seen sunning on logs and edges of islands. The green water-snake, *Natrix cyclopion floridana,* and the Florida banded water-snake, *Natrix sipedon pictiventris,* are common inhabitants of the marsh and floating islands. Allen's water-snake, *Liodytes alleni,* and others of fossorial tendencies (*Farancia abacura abacura, Seminatrix pygaea pygaea*) burrow in the substrate. The lizard, *Anolis carolinensis,* is often at home hundreds of feet from shore on an island. Much of the food of these reptiles consists of vegetation, frogs, small fishes, and invertebrates which are abundantly associated with the islands.

Of 36 species of fishes which I have listed for Orange Lake (1950a), several show interesting affinities for floating islands. Among such, the topminnow, *Gambusia affinis holbrooki,* least killifish, *Heterandria formosa,* and darter, *Hololepis barratti,* which are usually considered littoral or bottom forms, are commonly found around the edges of islands some distance from shore. Black crappie frequently make their redds under the edges of islands which have become anchored or incorporated into the marsh.

Prodigious numbers of invertebrate animals are produced in the lush emergent vegetation and submerged roots of the plants of floating islands. Seasonally, diptera emerge in vast droves and aquatic hemiptera and coleoptera thrive in the shallow waters of the edges and surfaces of the islands. Nymphs of 12 species of Odonata have been taken from stomachs of black crappie (Reid, 1950b:149). A species of ant, *Tetramorium guineese,* appears to be characteristic of the emergent vegetation, and the spider, *Dolomedes,* is common. Crustaceans such as the amphipod, *Hyalella azteca,* and freshwater shrimp, *Palaemontes paludosa,* occur in the submerged portions of the marsh and floating islands in quantities sufficient to cause these organisms to be major items in the diet of many young and adult fishes.

Quite naturally, several explanations for the genesis of floating islands are at hand. Barbour (*op. cit.,* 173-174) says that fluctuations in water level float the dense tangled masses of vegetation bordering the water, and, once floating, the mats are made lighter by having the bottom of the mat scraped off by the lake bottom. Another explanation is that of the mat being made to float due to the buoyancy offered by the air chambers in the roots of many plants growing on the islands, that these islands were originally outer edges of littoral marsh which became broken off from the main mass. Still another theory conceives of varying sized mats of peat-like material, composed mostly of *Nymphaea* roots, being floated from the bottom of the lake as the result of accumulations of gases of decomposition, these mats being invaded later by vegetation.

The apparent fate of floating islands in Orange Lake is to become incorporated into the marsh, where they continue to contribute to the productivity of the lake. Some have been observed to die and sink.

The preceding description of the general aspects of the biota of floating islands has, of necessity, included only the most conspicuous elements in the ecological relationships existing throughout the lake as a major community, or microcosm, and the marsh and floating islands as lesser communities. From what has been presented, innumerable ecological problems become apparent at once. Studies could be undertaken to determine something of (1) the oxygen-carbon dioxide relationships of the plants and animals on, in, and underneath the islands, (2) the intracacies of lacustrine food chains from the rich organic detritus stratum to the higher animals, (3) the physical, chemical, and biological requirements in the life cycles of the myriads of plants and animals, and (4) the assemblage of animals, some of which might be hitherto unreported for this ecologic niche, or biotope.

All of these, and other relationships, present an intriguing challenge for more detailed examinations of the many facets in the ecology of floating islands.

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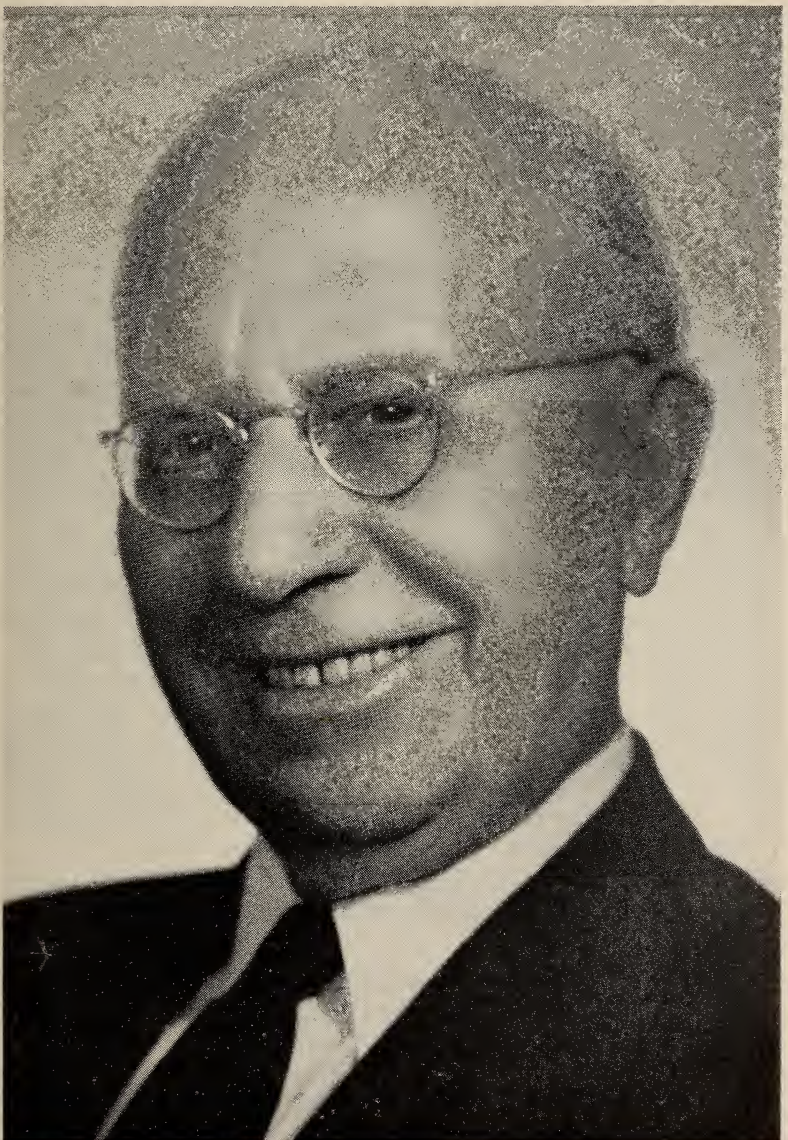

MELVIN AMOS BRANNON — 1865 - 1950

MELVIN AMOS BRANNON — 1865 - 1950

In the passing of Dr. Melvin Amos Brannon the Florida Academy of Sciences lost one of its staunchest supporters. A loyal member since 1939, when he moved to Gainesville, he was always happy to give of his time and talents whenever called upon. A distinguished scientist and educator, he received his early training at Wabash College earning the bachelors and masters degree there in 1889 and 1890. His Alma Mater honored him in 1893 with an honorary degree of Master of Arts and in 1932 with the honorary degree of Doctor of Laws. He earned his degree of Doctor of Philosophy at the University of Chicago in 1912 after spending some years as instructor in Natural Sciences in Fort Wayne High School and as Professor of Biology at the University of North Dakota. In 1917 Whitman College honored him with the presentation of the degree of Doctor of Laws and in 1936 this honor was repeated by the University of Montana. The honorary degree of Doctor of Science was presented by the University of North Dakota in 1947.

Dr. Brannon was most active during his middle years in the field of administration. Among his accomplishments was the organization of the School of Medicine at the University of North Dakota in 1905, of which he served as dean from 1905 to 1911. He was appointed Dean of the College of Liberal Arts at this same university in 1911 and held this post until 1914 when he moved to the University of Idaho as President. In 1917 he accepted the presidency of Beloit College and remained there until 1923 when he accepted the chancellorship of the University of Montana.

The years 1889-1933 must surely have been busy ones for in addition to all of the accomplishments already mentioned Dr. Brannon also made a survey of the forage plants of North Dakota for the Federal Government, organized the Devil's Lake Biological Laboratory and served as its first director from 1908 to 1914, and in 1909 organized the Public Health Laboratories of North Dakota. He served as a Trustee of Beloit College from 1917 until the time of his death.

During all the years of administrative endeavor he was able to maintain an interest in research and remarkably enough was able to find time in an already crowded schedule to pursue this interest. He published numerous contributions on fresh water and marine algae, the effects of growth substances on green algae, the influence of heat on the maturation of fruits and vegetables, the influence of the Salton Sea on vegetable tissues and on the biological phenomena of a dying lake. In "retirement" at the University of Florida since 1939, he continued as an active research scientist until his death.

He was a Fellow of the American Association for the Advancement of Science, President of the National Association of State Universities, and a member of many national scientific societies. Additional honors came to him as a member of Phi Beta Kappa, Phi Kappa Phi, Sigma Xi, Phi Sigma and Phi Delta Theta.

The group of students and faculty that had the pleasure of Dr. Brannon's friendship during his years at the University of Florida will long remember his outgoing nature. He lent encouragement to many and his democratic nature was an inspiration to all. He and his charming wife, Yvonne Tissier Brannon, enjoyed their contacts with younger groups and both were quite active in local scientific affairs. Dr. Brannon was president of the local chapter of Sigma Xi at the time of his death. He and Mrs. Brannon were most influential in keeping the Sigma Chapter of Phi Sigma alive during the war years when the student body at the University of Florida was reduced and interest was lagging.

Dr. Brannon was also active in the civic affairs of the Gainesville community, serving as president of the Gainesville Rotary Club and acting as a moving figure in his neighborhood civic organizations.

Dr. Brannon's article on the Myxophycae was in the final stages of preparation at the time of his death and the editors of the Quarterly Journal are proud that its publication has been accomplished through the cooperation of Dr. C. S. Nielsen of Florida State University and Dr. Francis Drouet of the Chicago Natural History Museum.—J. C. D., Jr.

SOME MYXOPHYCEAE IN FLORIDA [1]

MELVIN A. BRANNON
Gainesville, Florida

This paper is a list of Myxophyceae collected in Florida during the years 1942-49. The specimens, including those referred to in my earlier paper in Journ. Florida Acad. Sci. 8: 296-303 (1945), come principally from stations in central Florida; random collections were made in many other parts of the state. All of them are on file in the Herbarium of the University of Florida, Chicago Natural History Museum, or the Museum National d'Histoire Naturelle in Paris. Most of the material was named by Dr. Francis Drouet. I wish to acknowledge, with grateful appreciation, the laboratory facilities provided by the Department of Biology and the Agricultural Experiment Station of the University of Florida at Gainesville. I am indebted for considerable and varied assistance to Dr. Hermann Gunter, Dr. Archie N. Tissot, Dr. Richard A. Carringan, Dr. Fred H. Heath, Miss Lillian E. Arnold, Miss Esther Coogle, and the several persons cited as collectors below. In the listing of specimens, numbers set in italics refer to my own collections unless otherwise noted.

CHROOCOCCACEAE

Anacystis firma (Kutz.) Dr. & Daily.
In sink at Dr. Hull's residence on Route 441, Gainesville, *R. K. Strawn 308,* May 1948; Sink I, Hibiscus Park Gainesville, *170,* May 1948; in culvert, Bivins Arm to Paynes Prairie, south of Gainesville, *268,* Aug. 1942.

Anacystis marginata Menegh.
Sink I, Hibiscus Park, Gainesville, *70,* June 1942.

Coccochloris elabens (Breb.) Dr. & Daily.
On Chara, Hernando county, *557,* Oct. 1948.

Coccochloris Peniocystis (Kutz.) Dr. & Daily.
Red Water sink, Gainesville, *Dr. J. Speed Rogers, 170,* May 1943.

Coccochloris stagnina f. *rupestris* (Lyngb.) Dr. & Daily.
Sink I, Hibiscus Park, Gainesville, *30,* Jan. 1942.

[1] This paper is published posthumously. Dr. Brannon's original manuscript has been prepared for publication by Dr. Francis Drouet, Chicago Natural History Museum.

Diplocystis aeruginosa (Kutz.) Trevis.
Sink III, Palm Terrace, Gainesville, *11, 12, 25, 27, 227b, 419, 422, 526,* Sept. 1941.
Gloeocapsa alpicola (Lyngb.) Born.
On soil, Gainesville, *F. B. Smith 37,* Nov. 1942; in Hatchett creek, Gainesville, *126,* Nov. 1941; on sand, Sand Point, Everglades, *J. E. Davis, Jr., 19,* Jan. 1942; greenhouse, U. S. Forestry Station, Olustee, *226,* May 1944.
Gloeocapsa dimidiata (Kutz.) Dr. & Daily.
Bivins Arm, Gainesville, *126,* Nov. 1942.
Gloeocapsa limnetica (Lemm.) Hollerb.
In shallow water, shore of Lake Harris, Leesburg, *Drouet & Brannon 11064,* Jan. 1949.
Gloeocapsa membranina (Menegh.) Dr. & Daily.
Hibiscus Park, Gainesville, *290, 305,* Feb., Aug. 1945.
Gomphosphaeria lacustris Chod.
Lake III, Orlando, *489,* May 1948.
Merismopedia tranquilla (Ehrenb.) Trevis.
In Griffin's lake, Leesburg, *244,* July 1941; La Belle, Everglades, *J. E. Davis, Jr. 20,* Oct. 1941.

Chamaesiphonaceae

Entophysalis Brebissonii (Menegh.) Dr. & Daily.
Rainbow Springs, Marion county, *375,* Oct. 1946.
Entophysalis rivularis (Kutz.) Dr.
In culvert, Bivins Arm to Paynes Prairie, 40 rods east of Route 441, Gainesville, *40, 144,* Feb. 1943; Sink II, Hibiscus Park, Gainesville, *47,* Feb. 1942.

Stigonemataceae

Fischerella ambigua (Born. & Flah.) Gom.
In Sink II, Hibiscus Park, Gainesville, *108,* Oct. 1942.
Hapalosiphon pumilus Born. & Flah.
Under culvert one mile southeast of Devils Millhopper, Gainesville, *6, 140a,* Sept. 1941; Sand Point, Everglades, *J. E. Davis Jr. 19,* Oct. 1941; in pond, Fourteenth and Center streets, Leesburg, *Drouet & Brannon 11067, 11068,* Jan. 1949.
Nostochopsis lobatus Born. & Flah.
In Santa Fe river two miles southwest of High Springs, May 1941.

Stigonema ocellatum Born. & Flah.
On grass in Griffin's lake, Leesburg, *248,* July 1944.

Nostocaceae

Anabaena circinalis Born. & Flah.
In Sink III, Palm Terrace, Gainesville, *49,* Mar. 1942.
Anabaena flos-aquae Born. & Flah.
In Sink III, Palm Terrace, Gainesville, *49,* Mar. 1942.
Anabaena inaequalis Born. & Flah.
Devils Millhopper, Gainesville, *166,* Apr. 1943.
Anabaena oscillarioides Born. & Flah.
In Sink II, Hibiscus Park, Gainesville, *141a,* Apr. 1942.
Anabaena sphaerica Born. & Flah.
In Sink I, Hibiscus Park, Gainesville, *279,* Oct. 1944.
Anabaena spiroides Klebahn
In Sink II, Hibiscus Park, Gainesville, *523,* July 1948.
Anabaena unispora Gardn.
In culvert from Bivins Arm to Paynes Prairie, south of Gainesville, *346,* July 1946.
Anabaena variabilis Born. & Flah.
On decayed wood at the J. C. Dickinson dock, Bivins Arm, Gainesville, *64,* May 1942.
Aphanizomenon ovalisporum Forti
In Sink III, Palm Terrace, Gainesville, *69,* June 1942.
Cylindrospermum licheniforme Born. & Flah.
Near Sink II, on waste pasteboard, Hibiscus Park, Gainesville, *136,* Jan. 1943.
Cylindrospermum majus Born. & Flah.
University avenue, University Park, Gainesville, *52,* Apr. 1942.
Cylindrospermum muscicola Born. & Flah.
Midway down the cone of Devils Millhopper, Gainesville, *165,* Apr. 1943.
Nodularia spumigena Born. & Flah.
On decayed wood in Hatchett creek, Gainesville, *141a,* Feb. 1943.
Nostoc carneum Born. & Flah.
Sink I, Hibiscus Park, Gainesville, *270,* Aug. 1944.
Nostoc commune Born. & Flah.
Hatchett creek, Gainesville, *8,* Apr. 1941.

Nostoc cuticulare Born. & Flah.
Sink I, Hibiscus Park, Gainesville, *277,* Oct. 1944.
Nostoc ellipsosporum Born. & Flah.
Wet ground, Primrose street, Hibiscus Park, Gainesville, *62,* May 1942.
Nostoc Hederulae Born. & Flah.
Sink I, Hibiscus Park, Gainesville, *57,* Apr. 1942.
Nostoc humifusum Born. & Flah.
On stone, south end of Orange lake, *157,* Mar. 1943.
Nostoc Linckia Born. & Flah.
Hernando, *211a,* Apr. 1944.
Nostoc Muscorum Born. & Flah.
Lake Alice, Gainesville, *13, 21-23, 27, 53, 60,* Apr.-June 1941.
Nostoc spongiiforme Born. & Flah.
Culvert, Bivins Arm to Paynes Prairie, south of Gainesville, *118,* Oct. 1942.
Raphidiopsis curvata Fritsch & Rich
St. Johns river, Welaka, *E. Lowe Pierce 83,* Aug. 1942.

RIVULARIACEAE

Amphithrix janthina Born. & Flah.
At J. C. Dickinson's dock, Bivins Arm, Gainesville, *60, 80, 205,* Sept. 1943; on root of tree in water, west shore of Orange Lake, *Drouet & Brannon 11013a,* Jan. 1949.
Calothrix adscendens Born. & Flah.
In pothole, Hernando, *44,* Nov. 1940.
Calothrix parietina Born. & Flah.
In Hatchett creek, Gainesville, *3, 36, 51,* Feb. 1942; on a floating dock, west shore of Orange lake, McIntosh, *Drouet & Brannon 11100,* Jan. 1949.
Calothrix stellaris Born. & Flah.
Bivins Arm, Gainesville, *39, 50,* Feb. 1942.
Gloeotrichia natans Born. & Flah.
In culvert from Bivins Arm to Paynes Prairie, south of Gainesville, *81,* July 1942.

SCYTONEMATACEAE

Aulosira implexa Born. & Flah.
On floating Eleocharis, Lake Okeechobee, *J. E. Davis Jr. 17, 279,* Oct. 1941; in Sink II, Hibiscus Park, Gainesville, *112,* Oct. 1942.

Fremyella diplosiphon (Born. & Flah.) Dr.
In Hatchett creek, Gainesville, *2, 22, 34, 174, 178,* Feb. 1942.

Fremyella tenera (Born. & Flah.) J. de Toni
In Hatchett creek, Gainesville, *141,* Feb. 1943.

Hassallia byssoidea Born. & Flah.
At corner of my house, Hibiscus Park, Gainesville, *229,* May 1944; cement walk west of Science Hall, University of Florida, Gainesville, *263,* Aug. 1944; on wall of greenhouse, Experiment Station, Leesburg, *250,* July 1944.

Scytonema cincinnatum Born. & Flah.
In Hogtown creek, west of golf course, Gainesville, *W. R. Carroll 122,* Nov. 1942.

Scytonema coactile Born. & Flah.
In Sink I, Hibiscus Park, Gainesville, *10,* Sept. 1941; at Hernando, *88,* Aug. 1942.

Scytonema crustaceum Born. & Flah.
Lake Tsala Apopka, Hernando, *85,* Aug. 1942.

Scytonema guyanense Born. & Flah.
On ground by greenhouse, Experiment Station, Leesburg, *251,* July 1944.

Scytonema Hofmannii Born. & Flah.
On boards of chicken house, Gainesville, *W. R. Carroll 265,* Aug. 1944.

Scytonema ocellatum Born. & Flah.
On street in front of Dr. Gaddum's residence, Hibiscus Park, Gainesville, *139, 189,* Jan. 1943.

Scytonema tolypotrichoides Born. & Flah.
In Everglades 7 miles south of La Belle, *J. E. Davis Jr. 20,* Oct. 1941; in pond at Fourteenth and Center streets, Leesburg, *Drouet & Brannon, 11067, 11086,* Jan. 1949.

Tolypothrix tenuis Born. & Flah.
In front of Prof. N. Bourke's residence, Hibiscus Park, Gainesville, *604,* Apr. 1948.

Oscillatoriaceae

Arthrospira Jenneri Gom.
Sugar Hill creek, Gainesville, *289,* Oct. 1944.

Lyngbya aestuarii Gom.
In Sink I, Hibiscus Park, Gainesville, *9, 111,* Sept. 1941; Her-

nando, *86,* Aug. 1942; in sand on a log on shore of Battery Point, Hernando county, *578,* Oct. 1948.

Lyngbya contorta Lemm.

In Griffin's lake, Leesburg, *253,* July 1944.

Lyngbya Diguetii Gom.

In Sink I, Hibiscus Park, Gainesville, *10, 29, 34, 177,* Sept. 1941.

Lyngbya limnetica Lemm.

In shallow water, shore of Lake Harris, Leesburg, *Drouet & Brannon 11064,* Jan. 1949.

Lyngbya ochracea Gom.

On sand in Hibiscus Park, Gainesville, *192,* Aug. 1943.

Lyngbya Patrickiana Dr.

In Sink I, Hibiscus Park, Gainesville, *84, 120,* Aug. 1942.

Lyngbya putealis Gom.

In Sink I, Hibiscus Park, Gainesville, *26,* Aug. 1941; in Lake Wauberg, Gainesville, *Dr. J. S. Rogers 106,* May 1943.

Lyngbya semiplena Gom.

On Juncus, Battery Point, Hernando county, *561,* Oct. 1948.

Lyngbya Taylorii Dr. & Strickl.

Bivins Arm, Gainesville, *9, 202,* Sept. 1941; Lake Wauberg, Gainesville, *Dr. J. S. Rogers 106, 111,* May 1943.

Lyngbya versicolor Gom.

In Griffin's lake, Leesburg, *253, 254, 279,* July 1944; fish aquarium, University of Florida, Gainesville, *H. E. Brantley 72.*

Microcoleus acutissimus Gardn.

Surface soil, Primrose street, Hibiscus Park, Gainesville, *187,* Apr. 1944.

Microcoleus lacustris Gom.

Wet surface of Primrose street, Hibiscus Park, Gainesville, *172, 179,* May 1942.

Microcoleus paludosus Gom.

Surface of wet street, Hibiscus Park, Gainesville, *221,* Apr. 1944.

Microcoleus rupicola (Tild.) Dr.

Surface of wet street, Hibiscus Park, Gainesville, *218, 235,* Apr. 1944.

Microcoleus tenerrimus Gom.

On Juncus, Battery Point, Hernando county, *563,* Oct. 1948.

Microcoleus vaginatus Gom.
Surface of wet street, Hibiscus Park, Gainesville, *173, 180, 189,* May 1943.
Oscillatoria Agardhii Gom.
Sink III, Palm Terrace, Gainesville, *69, 76,* June 1942.
Oscillatoria amoena Gom.
Lake Alice, Gainesville, *1,* May 1940.
Oscillatoria amphibia Gom.
Sugar Hill creek, Gainesville, *75, 90,* May 1942.
Oscillatoria anguina Gom.
Bivins Arm, Gainesville, *94, 109,* Aug. 1942.
Oscillatoria articulata Gardn.
Fish aquarium, University of Florida, Gainesville, *H. E. Brantley 74,* June 1942.
Oscillatoria chlorina Gom.
Sink II, Hibiscus Park, Gainesville, *110,* Oct. 1942.
Oscillatoria Corallinae Gom.
On Gracilaria, Battery Point, Hernando county, *556,* Oct. 1948.
Oscillatoria curviceps Gom.
Battery Point, Hernando county, *575,* Oct. 1948.
Oscillatoria geminata Gom.
West shore of Orange lake, Orange Lake, *Drouet, Brannon, & Don McKay 11034,* Jan. 1949.
Oscillatoria limosa Gom.
J. C. Dickinson's dock, Bivins Arm, Gainesville, *65,* June 1942.
Oscillatoria nigro-viridis Gom.
In Salt Springs, Hernando county, *551,* Oct. 1948.
Oscillatoria ornata Gom.
Rattlesnake creek, Dr. Laessle's place on Hartman avenue, Gainesville, *196,* Aug. 1943.
Oscillatoria princeps Gom.
Sink I, Hibiscus Park, Gainesville, *9, 110,* Sept. 1941, 1942.
Oscillatoria proboscidea Gom.
Sink I, Hibiscus Park, Gainesville, *129,* Nov. 1942.
Oscillatoria rubescens Gom.
Freshwater pool, Hernando, *91,* Aug. 1942.
Oscillatoria splendida Gom.
On submerged stones in Rattlesnake creek, Gainesville, *194, 200, 213,* Aug. 1943.

Oscillatoria subuliformis Gom.

On Juncus, Battery Point, Hernando county, *564,* Oct. 1948.

Oscillatoria tenuis Gom.

In freshwater pond, Hernando, *46,* Mar. 1942; Bivins Arm, Gainesville, *65, 120, 193,* June 1942.

Oscillatoria tenuis var. *natans* Gom.

Sink I, Hibiscus Park, Gainesville, *252,* May 1942.

Oscillatoria tenuis var. *tergestina* Gom.

Sugar Hill creek, Gainesville, *59,* May 1944.

Phormidium autumnale Gom.

In H. E. Brantley greenhouse, University of Florida, Gainesville, *43, 74, 123, 130,* Feb. 1943.

Phormidium calidum Gom.

In Hatchett creek, Gainesville, *38,* Jan. 1942.

Phormidium minnesotense (Tild.) Dr.

Sink I, Hibiscus Park, Gainesville, *178,* June 1943; in freshwater lake, Leesburg, *283,* July 1944.

Phormidium papyraceum Gom.

In Ichtucknee Springs run, Columbia county, *80, 105,* July 1942.

Phormidium subfuscum Gom.

On stones, Hibiscus Park, Gainesville, *40,* Feb. 1942.

Phormidium tenue Gom.

In Sink II, Hibiscus Park, Gainesville, *129, 284,* Apr. 1942; in Lakes Tsala and Apopka, Citrus county, *131,* Dec. 1942.

Phormidium valderianum Gom.

In Orange lake, Alachua county, *153,* Mar. 1943.

Plectonema Nostocorum Gom.

On sand rock in Tallahassee, *A. B. Maclay 2, 23, 102,* Dec. 1940; in Sink I, Hibiscus Park, Gainesville, *28, 108,* Nov. 1941; culture (in water from city water supply of Gainesville, Apr. 1933), Dec. 1949.

Plectonema purpureum Gom.

In a bird bath in Hibiscus Park, Gainesville, *41,* Feb. 1942.

Plectonema Wollei Gom.

In Harris lake, Leesburg, *329,* May 1948.

Schizothrix arenaria Gom.

Culvert, Bivins Arm to Paynes Prairie, south of Gainesville, *97,* May 1942.

Schizothrix calcicola Gom.
  In pothole, Hernando, *44, 219,* Nov. 1940.
Schizothrix Stricklandii Dr.
  On wet ground in Hibiscus Park, Gainesville, *219,* Aug. 1944.
Skujaella Thiebautii (Gom.) J. de Toni
  On Ruppia, Battery Point, Hernando county, *558,* Oct. 1948.
Spirulina stagnicola Dr.
  Rare, Bivins Arm, Gainesville, *65,* June 1942.
Symploca Kieneri Dr.
  On wet sand, Hibiscus Park, Gainesville, *172, 249,* May 1942.
Symploca muralis Gom.
  In pine seed-bed, U. S. Forestry Station, Olustee, *228,* May 1944; on soil at Experiment Station, Leesburg, *228, 297,* July 1944.

Quar. Journ. Fla. Acad. Sci., 15(2), 1952.

NOTICE OF ANNUAL MEETINGS

The Seventeenth Annual Meeting of the Florida Academy of Sciences and the Sixth Annual Meeting of the Florida Junior Academy of Science will be held on December 11, 12 and 13, 1952, at the University of Florida, Gainesville, Florida.

Titles of papers to be presented should be sent to the appropriate Section Chairman prior to November 13, 1952.

Biological Sciences: C. J. Goin, Biology Department, University of Florida, Gainesville

Physical Sciences: H. P. Hanson, Physics Department, University of Florida, Gainesville

Social Sciences: J. O. Boynton, Geography Department, Florida State University, Tallahassee

DAYLIGHT OBSERVATION OF STARS

Alex G. Smith
University of Florida

There is no reason to believe that the quantity of starlight reaching the surface of the earth is less in the daytime than at night. Nevertheless it is a matter of common experience that the stars are ordinarily invisible during the daylight hours. The explanation lies, of course, in the great amount of sunlight scattered by particles in the earth's atmosphere. This scattered light creates a brilliant background, the familiar blue daylight "sky", against which the stars disappear.

Naked Eye Observations

It is popularly believed that stars may be seen during the day by viewing the sky from the bottom of a deep shaft, such as a well or chimney. The writer knows of two careful attempts to verify this phenomenon, both of which yielded negative results. In one instance J. A. Hynek of Ohio State University watched, with a group of students, for the culmination of Vega over the opening of a chimney 235 feet in height. The other experiment was conducted by A. N. Winsor of the University of Florida. Mr. Winsor attempted to detect Pollux at a time when that star passed near the zenith above a chimney 157 feet high. In neither case was any trace of the star seen from the chimney, even with slight optical aid. The Hynek experiment seems particularly conclusive, since Vega is the brightest star which can be seen from a vertical shaft anywhere in the northern hemisphere.

H. F. Weaver has shown, from an analysis of sky brightness data, that it is theoretically impossible to see any star with the naked eye in broad daylight. This same analysis indicated, however, that the planets Venus, Mars, and Jupiter are at times brilliant enough to be seen without optical aid during the day. It seems probable that chance sightings of these bodies from shafts have been responsible for the belief that stars may be seen under such conditions. In these instances the function of the shaft was in all likelihood merely that of focussing attention on a particular area of the sky. Hynek, in fact, remarks that ". . . the sky through the opening appeared just as bright as the sky outside."

Telescopic Observations

When one considers telescopic observations, the situation is quite different. It is a fundamental property of visual instruments that whatever their aperture or magnification they cannot increase the apparent brightness of extended objects. Thus, the sky observed through a telescope never appears brighter than it does to the naked eye, and in general the brightness is actually reduced by the instrument as the magnification is increased. On the other hand, the apparent brightness of a point object, such as a star, increases as the square of the aperture of the telescope. It follows, then, that as the aperture and magnification are increased, the sky will grow darker and the star will grow brighter, until finally the star becomes visible against the sky.

Accounts of daylight sightings of stars in telescopes are not uncommon in astronomical literature. The Rev. T. W. Webb states that Arcturus was observed during the day by Morin as early as 1635. Nevertheless, the writer knows of no quantitative study made to determine the apertures and magnifications necessary to render stars of various magnitudes visible against the daytime sky. The practical importance of this problem was suggested by Mr. A. N. Winsor, who has organized a project in the Department of Civil Engineering at the University of Florida to investigate the feasibility of using daylight observations of stars and planets for purposes of surveying and navigation. While it was clear that successful sightings of stars could be made with relatively large telescopes, there were no available data to indicate that instruments small enough to be practical for field use could be utilized

The author made a series of preliminary observations with a six-inch reflecting telescope which was equatorially mounted and equipped with setting circles, so that the location of stars in the daytime presented no great difficulty. It was found that the brighter stars could easily be observed with the aperture of this instrument diaphragmed to one or two inches. Accordingly, a small refracting telescope was constructed, using an objective lens with a diameter of two inches and a focal length of thirteen inches. The instrument was equipped with a rotating diaphragm providing a series of apertures ranging from one-quarter inch to two inches, and provision was made for introducing filters in front of the eyepiece. This telescope was attached to the mounting described above.

Systematic observations were made on a graduated sequence of six stars with stellar magnitudes which vary from –1.58 to 3.25, corresponding to a brightness range of 86 to 1. Since the brightness of an area of the sky changes appreciably with its own altitude, with the altitude of the sun, and with its azimuthal angle from the sun, the region of the sky under observation was monitored with a photometer, and data were taken only when the sky brightness was within about ten percent of 1.1 lamberts. This figure corresponds to a kind of "average" condition for a clear Florida sky, with both the sun and the sky region at an altitude of 45°, and with an azimuthal angle of 90° between the two. Each star was observed with six different apertures and four magnifications. The results of the observations were expressed in terms of a scale of relative visibility, with 0 corresponding to complete invisibility and 6 indicating a very conspicuous object. Objects rated at 5 or 6 strike the eye immediately when it is applied to the telescope; an object described as 3 is easy, once seen, but may require a momentary search of the field of view before it is detected. A rating of 1 is applied to an extremely difficult object, visible only if the observer knows precisely where it is located in the field.

Figure 1 shows typical portions of the data; in order to avoid confusion, the curves for 0.5″ aperture are plotted separately from those of the 1″ and 2″ apertures. While visibility generally increases with aperture and magification, in accord with the simple considerations outlined above, it will be noted that this is not always the case. In particular, the 10x curves are practically coincident for all three apertures, but this could have been predicted from optical theory. If the exit pupil (that is, the beam which emerges from the eyepiece) is larger than the pupil of the eye, then the eye acts as the aperture stop of the system and any increase in the aperture of the telescope has no effect on the brightness of the image. Now, the diameter of the exit pupil is obtained by dividing the aperture of the instrument by its magnification, and it follows that with a power of ten and an aperture of 0.8″, the exit pupil just matches the 0.08″ diameter of the daylight-adapted eye. Under these conditions any aperture in excess of 0.8″ is wasted.

The curves for 0.5″ aperture show an effect which is more surprising, in that 15x gives better visibility than 40x. A probable explanation lies in the relatively large size of the diffraction discs

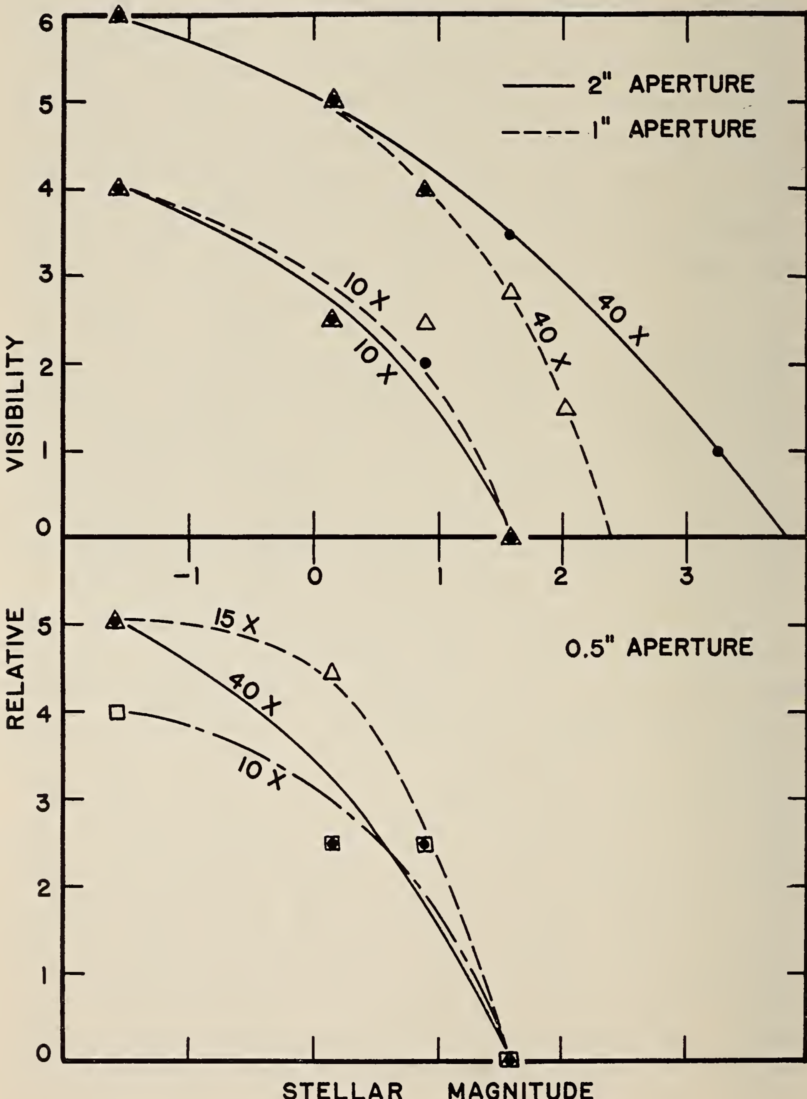

Figure 1.—Dependence of Stellar Visibility on Magnitude, Aperture, and Magnification.

produced by these small apertures. At high magnifications such discs appear diffuse and tend to fade out against the sky, being in reality no longer point objects. This hypothesis is confirmed by the observation that it is necessary to have a critically sharp focus in order to render stars visible against the daytime sky. In many instances failure to locate a star was traced to poor focussing, resulting from attempts to focus the telescope on terrestrial objects several hundred feet away. As a correlary, it follows that good optics are essential, since a poor telescope has no really sharp focus. Figure 2 shows a similar effect which was observed consistently throughout the data. For low powers, the visibility tends to peak at an aperture somewhat smaller than that at which the eye ceases to act as the stop. Although both the sky and the star are equally dimmed by the reduced aperture, the visibility apparently increases for physiological reasons. In spite of these complications which arise for small optical power, there is no doubt that aperture and magnification pay big dividends in going after the fainter stars.

Like all scattered light, the light from the sky is partially plane

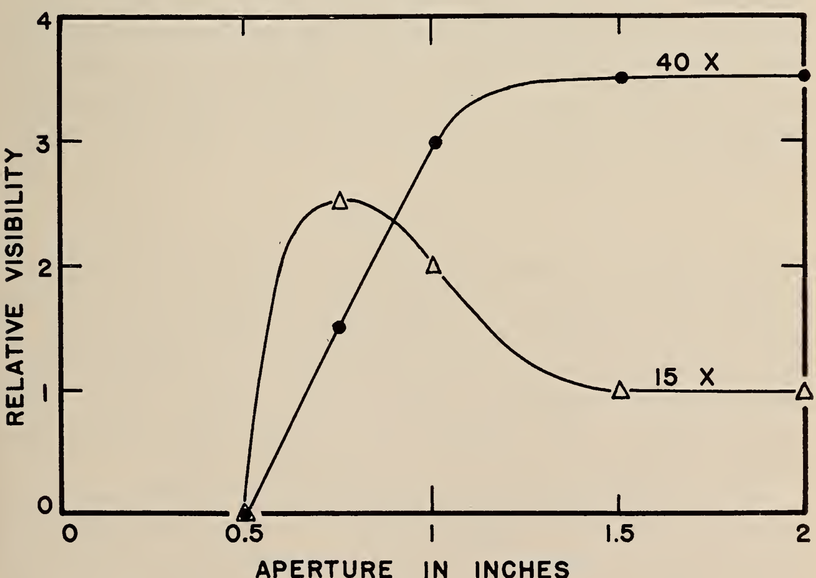

Figure 2.—Anomalous Increase of Visibility at Small Apertures (Castor, Magnitude 1.58).

polarized. The degree of polarization in a given region depends on that area's angular relationship with the sun, since it rises to a maximum in a direction 90° from the sun. This fact immediately suggests the use of a Polaroid filter to suppress the sky background and render stars more easily visible. Numerous tests have indicated that in regions of the sky where polarization is high the improvement is indeed appreciable, amounting to about one unit on the visibility scale. Unfortunately, this gain cannot be fully realized for the fainter stars, for which the unavoidable loss of light in the filter partially nullifies the benefits of the reduced background. This limitation even more severely affects the usefulness of ordinary colored filters. Since the sky is distinctly blue, while many stars are yellowish or red, it should be possible to discriminate against the sky by using filters which transmit only the longer wavelengths. It is even possible to determine from the spectral distribution curves for sky light, starlight, and the sensitivity of the eye a particular wavelength at which the visibility of the star should be a maximum. When this experiment was performed with a narrow-band filter, however, the loss of light proved disastrous. The best results were achieved with very light yellow or orange filters; in favorable cases the gain was from one-half step to a full step on the visibility scale. Summarizing the results for all of the filters tested to date, it may be said that the greatest improvements resulted in the cases where they were least needed —that is, on the brighter stars.

Conclusion

The present investigation has shown decisively that daylight observations of stars are possible with apertures of one to two inches and reasonably low magnifications. The twenty stars of first magnitude are easy objects, and there are an additional fifty stars of second magnitude which can be reached with a little more difficulty. The visibility of the brighter stars can be increased appreciably by the use of appropriate filters.

An interesting by-product of this work was the discovery that at times a sky which appears perfectly clear to the naked eye shows rapid and marked fluctuations in transparency, as evidenced by the fading in and out of star images. This condition was repeatedly found to precede by several hours the onset of a cloudy sky. One is tempted to speculate that observations of this type might be of value in short-range meteorological prediction.

Acknowledgment

The author is greatly indebted to Mr. H. W. Schrader of the Department of Physics, University of Florida, for the construction of the special telescope used in the research.

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1917. *Celestial Objects for Common Telescopes* (Sixth Edition), p. 48. Longmans, Green & Co., London.

A LIST AND BIBLIOGRAPHY OF THE MAMMALS OF FLORIDA, LIVING AND EXTINCT

H. B. Sherman
University of Florida

Much of the information contained in this article has been available, in mimeographed form, to students of mammalogy at the University of Florida for several years. A number of students and former students have added references and made corrections. While space does not permit mentioning all of these, Dr. B. A. Barrington, Jr., Mr. Joseph C. Moore and Dr. George H. Pournelle have been especially helpful in this work. References to certain obscure publications, some of which I have not seen, have been furnished me by Dr. Remington Kellogg, Director of the U. S. National Museum, and also by Mrs. Venia T. Phillips, Librarian of the Academy of Natural Sciences of Philadelphia.

The inclusion of fossil mammals, with which the author has had but little experience, is facilitated by the lists of Sellards, 1916a; Simpson, 1930d; and Kellogg, 1944, each of which contains a valuable summary. Dr. Theodore E. White has been the most active author contributing to our knowledge of the fossil mammals of the state in recent years and I am indebted to him for criticizing the list presented here. Through his advice, *Hexabelomeryx* and *Hexameryx* are listed as separate genera, instead of referring *Hexameryx* to *Hexabelomeryx* as in Simpson 1945b, p. 157. Also, Dr. White states that his record of *Megatherium hudsoni* from the Pliocene, 1941a, was due to erroneous collection data and that it is of Pleistocene age. Dr. R. A. Stirton has furnished advice concerning Miocene and Pliocene members of the Equidae. In regard to Pleistocene mammals, Mr. H. James Gut has supplied information which would otherwise have been missed.

The lists of recent mammals is largely the result of bringing up to date the lists of Sherman, 1937b and 1945b, and the inclusion of marine forms. In regard to the latter, the work of Mr. Joseph C. Moore, which is to appear soon in the *American Midland Naturalist,* has been most useful.

While it is a pleasure to acknowledge the assistance received from the various individuals mentioned above, the use made of information which they supplied, as well as omissions and errors which may be present, is the responsibility of the author.

A List of the Mammals of Florida, Living and Extinct

Order MARSUPIALIA.—Opossums, Kangaroos, etc.

Family Didelphidae—Opossums.

Didelphis virginiana Kerr. 1792.—North American Opossum. Pleistocene

Dedilphis virginiana pigra Bangs. 1898.—Florida Opossum. Recent

Order INSECTIVORA.—Moles, Shrews, etc.

Family Talpidae.—Moles.

Scalopus aquaticus (Linnaeus). 1758.—Eastern Mole. Pleistocene

Scalopus aquaticus howelli Jackson. 1914.—Howell's Mole. Recent

Scalopus aquaticus australis (Chapman). 1893. Florida Mole. Recent

Scalopus aquaticus anastasae (Bangs). 1898. Anastasia Island Mole. Recent

Scalopus aquaticus parvus (Rhoads). 1894.—Little Mole. Recent

Scalopus aquaticus bassi A. H. Howell. 1939.—Bass's Mole. Recent

Family Soricidae.—Shrews.

Sorex longirostris longirostris Bachman. 1837. Bachman Shrew. Recent

Cryptotis floridana (Merriam). 1895. Florida Short-tailed Shrew. Pleistocene—Recent

Blarina brevicauda (Say). 1823.—Short-tailed Shrew. Pleistocene

Blarina brevicauda carolinensis (Bachman). 1837. Carolina Short-tailed Shrew. Recent

Blarina brevicauda penisulae (Merriam). 1895. Everglades Short-tailed Shrew. Recent

Order CHIROPTERA.—Bats.

Family Vespertilionidae.

Suaptenes whitei Lawrence. 1943. Miocene

Miomyotis floridanus Lawrence. 1943. Miocene

Myotis austroriparius austroriparius (Rhoads). 1897.
Little Southeastern Brown Bat. Recent
Myotis grisescens A. H. Howell. 1909.—Little Gray Bat. Recent
Pipistrellus s. subflavus (F. Cuvier). 1832.—Georgian Bat. Recent
Eptesicus fuscus osceola Rhoads. 1902.
Florida Big Brown Bat. Recent
Lasiurus borealis borealis (Muller). 1776.—Red Bat. Recent
Lasiurus seminolus (Rhoads). 1895.— Seminole Bat. Recent
Lasiurus cinereus (Beauvois). 1796.—Hoary Bat. Recent
Dasypterus floridanus Miller. 1902.—Florida Yellow Bat. Recent
Nycticeius humeralis humeralis (Rafinesque). 1818.
Rafinesque Bat. Recent
Nycticeius humeralis subtropicalis Schwartz. 1951.
Florida Rafinesque Bat. Recent
Corynorhinus macrotis (LeConte). 1831.
LeConte Lump-nosed Bat. Recent

Family Molossidae.—Free-tailed Bats.

Molossides floridanus G. M. Allen. 1932. Pleistocene
Tadarida cynocephala (LeConte). 1831.
LeConte Free-tailed Bat. Recent
Eumops glaucinus (Wagner). 1843.
Glaucous Free-tailed Bat. Recent

Order PRIMATES.—Lemurs, Monkeys, Marmosets, Apes, Man, etc.

Family Hominidae.—Man.

Homo sapiens Linnaeus. 1758.—Man. Pleistocene—Recent

Order CARNIVORA.—Carnivores.

Suborder Fissipeda.—Land Carnivores.

Family Ursidae.—Bears.

Agriotherium schneideri Sellards. 1916.—Bear-dog. Pliocene
Arctodus floridanus Gidley. 1928.
Florida Short-faced Bear. Pleistocene
Euarctos sp. Simpson. 1930b.—Black bear. Pleistocene
Euarctos floridans (Merriam). 1896.
Florida Black Bear. Pleistocene—Recent

Family Procyonidae.—Raccoons, Pandas, Coati, etc.

Procyon nanus Simpson. 1929. Pleistocene
Procyon lotor (Linnaeus). 1758.—Raccoon. Pleistocene
Procyon lotor elucus Bangs. 1898.—Florida Raccoon. Recent
Procyon lotor varius Nelson and Goldman. 1930.
Alabama Raccoon. Recent
Procyon lotor marinus Nelson. 1930.
Chokoloskee Raccoon. Recent
Procyon lotor inesperatus Nelson. 1930.
Matecumbe Raccoon. Recent
Procyon lotor auspicatus Nelson. 1930.
Key Vaca Raccoon. Recent
Procyon lotor incautus Nelson. 1930.
Torch Key Raccoon. Recent

Family Mustelidae.—Weasels, Mink, Otters, etc.

Aelurocyon spissidens White. 1947. Miocene
Oligobunis floridanus White. 1947. Miocene
Mephitataxus ancipidens White. 1941. Miocene
Leptarctus progressus Simpson. 1930. Pliocene
Mustela frenata peninsulae (Rhoads). 1894.
Florida Weasel. Pleistocene—Recent
Mustela frenata olivacea Howell. 1913.—Alabama Weasel. Recent
Mustela vison lutensis (Bangs). 1898.—Florida Mink. Recent
Mustela vison evergladensis Hamilton. 1948.
Everglades mink. Recent
Lutra canadensis (Schreber). 1776.—Otter. Pleistocene
Lutra canadensis vaga (Bangs). 1898.—Florida Otter. Recent
Spilogale ambarvalis Bangs. 1898.
Florida Spotted Skunk. Pleistocene—Recent
Spilogale putorius (Linnaeus). 1758.
Alleghenian Spotted Skunk. Miocene—Recent
Mephitis mephitis elongata (Bangs). 1895.—Florida Skunk.
Pleistocene—Recent

Family Canidae.—Dogs, Wolves, Foxes, etc.

Daphaenus caroniavorus White. 1942.	Miocene
Amphicyon pontoni Simpson. 1930.	Miocene
Amphicyon longiramus White. 1942.	Miocene
Amphicyon intermedius White. 1940.	Miocene
Parictis bathygenus White. 1947.	Miocene
Nothocyon insularis White. 1942.	Miocene
Tomarctus thomasi White. 1941.	Miocene
Tomarctus canavus (Simpson). 1932.	Miocene
Aelurodon johnhenryi White. 1947.	Miocene
Temnocyon sp. Simpson. 1932.	Miocene
Paradaphaenus noblis (Simpson). 1932.	Miocene
Paradaphaenus tropicalis White. 1942.	Miocene
Mesocyon iamonensis (Sellards). 1916.	Miocene
Pliogulo dudleyi White. 1941.	Pliocene
Urocyon seminolensis Simpson. 1929. Extinct Gray Fox.	Pleistocene
Urocyon cinereoargenteus Schreber. 1775.—Gray Fox.	Pleistocene
Urocyon cinereoargenteus floridanus Rhoads. 1895. Florida Gray Fox.	Recent
Vulpes palmaria Hay. 1917.—Extinct Red Fox.	Pleistocene
Canis ayersi Sellards. 1916.—Dire Wolf.	Pleistocene
Canis riviveronis Hay. 1917.—Extinct Florida Coyote.	Pleistocene
Canis niger niger (Bartram). 1791.—Florida Wolf.	Recent

Family Felidae.—Cats, Pumas, Jaguars, Lions, Tigers, etc.

Felis inexpectata (Cope). 1895.—Extinct Puma.	Pleistocene
Felis concolor coryi Bangs. 1899.—Florida Puma.	Recent
Panthera augusta (Leidy). 1872.—Jaguar.	Pleistocene
Smilodon floridanus (Leidy). 1899. Florida Saber-tooth Tiger.	Pleistocene
Lynx rufus Schreber. 1777.—Bobcat.	Pleistocene
Lynx rufus floridanus (Rafinesque). 1817.—Florida Bobcat.	Recent

Suborder Pinnipedia.—Seals, Sea Lions, and Walruses.

Family Phocidae.—True Seals.

Monachus tropicalis (Gray). 1850.—Monk Seal.	Recent
Cystophora cristata (Erxleben). 1777.—Hooded Seal.	Recent

Order RODENTIA.—Rodents.

Family Sciuridae.—Squirrels.

Sciurus carolinensis carolinensis Gmelin. 1788.
Southern Gray Squirrel. Pleistocene—Recent

Sciurus carolinensis extimus Bangs. 1896.—Everglades Gray Squirrel. Recent

Sciurus carolinensis matecumbei H. H. Bailey. 1937.
Key Largo Gray Squirrel. Recent

Sciurus niger niger Linnaeus. 1758.
Southern Fox Squirrel. Recent

Sciurus niger avicennia A. H. Howell. 1919.—Mangrove Fox Squirrel. Recent

Glaucomys volans querceti (Bangs). 1896.
Florida Flying Squirrel. Recent

Glaucomys volans saturatus A. H. Howell. 1915.
Southeastern Flying Squirrel. Recent

Family Mylagaulidae.

Mesogaulus sp. Wood. 1947. Miocene

Family Erethizontidae.—Porcupines.

Erethizon dorsatum (Linnaeus). 1758.
Eastern Porcupine. Pleistocene

Family Hydrochoeridae.—Capybara.

Hydrochoerus holmesi Simpson. 1928.
Extinct Capybara. Pleistocene

Neochoerus pinckneyi (Hay). Giant capybara. Pleistocene

Family Geomyidae.—Pocket Gophers, Salamanders.

Plesiothomomys orientalis (Simpson). 1928.
Extinct Western Pocket Gopher. Pleistocene

Geomys pinetis Rafinesque. 1817.—Pocket Gopher. Pleistocene

Geomys pinetis mobilensis Merriam. 1895.
Alabama Pocket Gopher. Recent

Geomys pinetis floridanus (Audubon and Bachman). 1854.
Florida Pocket Gopher. Recent

Geomys pinetis austrinus Bangs. 1898.
Southeastern Pocket Gopher. Recent

Geomys pinetis goffi Sherman. 1944.—Goff's Pocket Gopher. Recent

Family HETEROMYIDAE.—Pocket Rats and Mice, Kangaroo Rats and Mice, etc.

Proheteromys floridanus Wood. 1932. Miocene
Proheteromys magnus Wood. 1932. Miocene

Family CASTORIDAE.—Beavers.

Castoroides ohioensis Foster. 1838.—Giant Beaver. Pleistocene
Castor canadensis Kuhl. 1820.—Beaver. Pleistocene
Castor canadensis carolinensis Rhoads. 1898. Carolina Beaver. Recent

Family CRICETIDAE.—New World Rats and Mice.

Reithrodontomys humulis humulis (Audubon and Bachman). 1841.—Eastern Harvest Mouse. Pleistocene—Recent
Peromyscus sp. Gut. 1939.—Deer Mouse. Pleistocene
Peromyscus polionotus polionotus (Wagner). 1843. Old Field Mouse. Recent
Peromyscus polionotus rhoadsi (Bangs). 1898. Rhoads White-footed Mouse. Recent
Peromyscus polionotus decoloratus Howell. 1939. Pallid Beach Mouse. Recent
Peromyscus polionotus niveiventris (Chapman). 1889. Micco Beach Mouse. Recent
Peromyscus polionotus phasma (Bangs). 1898.—Anastasia Island Beach Mouse. Recent
Peromyscus polionotus albifrons Osgood. 1909. White-fronted Beach Mouse. Recent
Peromyscus polionotus peninsularis Howell. 1939. St. Andrews Beach Mouse. Recent
Peromyscus polionotus leucocephalus Howell. 1920. White-headed Beach Mouse. Recent
Peromyscus gossypinus gossypinus (LeConte). 1853. Cotton Mouse. Pleistocene—Recent
Peromyscus gossypinus restrictus Howell. 1939. Chadwick's Beach Cotton Mouse. Recent

Peromyscus gossypinus palmarius Bangs. 1896.—Florida Cotton Mouse. Recent

Peromyscus gossypinus anastasae Bangs. 1898.—Anastasia Island Cotton Mouse. Recent

Peromyscus nuttalli aureolus (Audubon and Bachman). 1841.—Southern Golden Mouse. Recent

Peromyscus floridanus (Chapman). 1889. Florida White-footed Mouse. Pleistocene—Recent

Oryzomys sp. Gut. 1939.—Rice Rat. Pleistocene

Oryzomys palustris palustris (Harlan). 1837. Swamp Rice Rat. Pleistocene—Recent

Oryzomys palustris coloratus Bangs. 1898. Everglades Rice Rat. Recent

Oryzomys palustris natator Chapman. 1893. Central Florida Rice Rat. Recent

Sigmodon hispidus hispidus Say and Ord. 1825. Northern Cotton Rat. Pleistocene—Recent

Sigmodon hispidus floridanus A. H. Howell. 1943. Canal Point Cotton Rat. Recent

Sigmodon hispidus littoralis Chapman. 1889. Florida Cotton Rat. Recent

Sigmodon hispidus spadicipygus Bangs. 1898. Cape Sable Cotton Rat. Recent

Sigmodon hispidus exputus G. M. Allen. 1920.—Pine Key Cotton Rat. Recent

Sigmodon hispidus insulicola A. H. Howell. 1943. Captiva Island Cotton Rate. Recent

Neotoma floridana floridana (Ord). 1818. Florida Wood Rat. Pleistocene—Recent

Pitmys pinetorum parvulus A. H. Howell. 1916. Florida Pine Mouse. Pleistocene—Recent

Synaptomys australis Simpson. 1928. Extinct Lemming Mouse. Pleistocene

Ondatra zibethica (Linnaeus). 1758.—Flat-tailed Muskrat. Pleistocene

Neofiber alleni alleni True. 1884. Florida Round-tailed Muskrat. Pleistocene—Recent

Neofiber alleni nigrescens A. H. Howell. 1920. Everglades Round-tailed Muskrat. Recent

Neofiber alleni struix Schwartz. 1952. Recent

Family Muridae.—Old World Rats and Mice.

Rattus rattus rattus (Linnaeus). 1758.—Black Rat. Recent

Rattus rattus alexandrinus (Geoffrey). 1803.— Roof Rat. Recent

Rattus rattus frugivorus (Rafinesque). 1814.—Fruit Rat. Recent

Rattus norvegicus (Erxleben). 1777.—Norway Rat. Recent

Mus musculus domesticus Rutty. 1772.—House Mouse. Recent

Mus musculus brevirostris Waterhouse. 1837.—Southern House Mouse. Recent

Order LAGOMORPHA—Rabbits, Cotton-tails, Hares, Pikes, etc.

Family Leporidae.—Rabbits, Cotton-tails, Hares, etc.

Sylvilagus sp. Sellards. 1916. Pleistocene

Sylvilagus palustrellus Gazin, 1950.—Pigmy Marsh Rabbit Pleistocene

Sylvilagus floridanus floridanus (J. A. Allen). 1890. Florida Cotton-tail. Pleistocene—Recent

Sylvilagus floridanus ammophilus A. H. Howell. 1939. Beach Cotton-tail. Recent

Sylvilagus floridanus mallurus (Thomas). 1898.—Eastern Cotton-tail. Recent

Sylvilagus palustris palustris (Bachman). 1837. Carolina Marsh Rabbit. Pleistocene—Recent

Sylvilagus palustris paludicola (Miller and Bangs). 1894. Florida Marsh Rabbit. Recent

Order EDENTATA.—Armadillos, Sloths, Anteaters, etc.

Family GLYPTODONTIDAE.

Boreostracon floridanus Simpson. 1929.—Tortoise Armadillo. Pleistocene

Family MEGATHERIIDAE.

Megatherium hudsoni White. 1941.—Giant Ground Sloth. Pleistocene

Family MEGALONCHYIDAE.

Megalonyx jeffersonii (Desmarest). 1822. Jefferson Ground Sloth. Pleistocene

Megalonyx wheatleyi Cope. 1871. Wheatley's Ground Sloth. Pleistocene

Family MYLODONTIDAE.

Paramylodon harlani Owen. 1842.—Harlan's Ground Sloth. Pleistocene

Thinobadistes segnis Hay. 1919.—Ground Sloth. Pleistocene

Family DASYPODIDAE.—Armadillos.

Holmesina septentrionale (Leidy). 1889a. Northern Giant Armadillo. Pleistocene

Dasypus bellus (Simpson). 1929.—Armadillo. Pleistocene

Dasypus novemcinctus mexicanus Peters. 1864. Nine-banded Armadillo. Recent

Order PROBOSCIDEA.—Elephants, Mastodons, etc.

Family GOMPHOTHERIIDAE.

Serridentinus floridanus (Leidy). 1886.—Serrate-toothed Mastodon Pliocene

Serridentinus leidii Frick. 1926.—Serrate-toothed Mastodon. Pliocene

Serridentinus brewsterensis. Osborn. 1927. Serrate-toothed Mastodon. Pliocene

Serridentinus simplicidens. Osborn. 1923. Serrate-toothed Mastodon. Pliocene

Family MAMMUTIDAE.

Mammut sellardsi (Simpson). 1930.—Sellard's Mastodon. Pliocene

Mammut americanum Kerr. 1792.—American Mastodon. Pleistocene

Family Elephantidae.

Mammuthus floridanus (Osborn). 1929.—Mammoth. Pleistocene
Mammuthus imperator (Leidy). 1858.—Imperial Mammoth. Pleistocene
Mammuthus columbi (Falconer). 1857.—Columbian Mammoth. Pleistocene

Order PERISSODACTYLA.—Odd-toed Ungulates.

Family Equidae.—Horses.

Anchitherium clarencei Simpson. 1932.—Three-toed Horse. Miocene
Archaeohippus blackbergi (Hay). 1924.—Three-toed Horse. Miocene
Parahippus leonensis Sellards. 1916.—Three-toed Horse. Miocene
Parahippus barbouri White. 1942.—Three-toed Horse. Miocene
Merychippus gunteri Simpson. 1930.—Three-toed Horse. Miocene
Merychippus westoni Simpson. 1930.—Three-toed Horse. Miocene
Miohippus sp. White. 1942.—Three-toed Horse. Miocene
Nannippus minor (Sellards). 1916.—Three-toed Horse. Pliocene
Nannippus ingenuus Leidy. 1885.—Three-toed Horse. Pliocene
Neohipparion phosphorum Simpson. 1930.—Three-toed Horse. Pliocene
Hipparion plicatile Leidy. 1887.—Three-toed Horse. Pliocene
Equus sp. See Savage, 1951.—One-toed Horse. Pleistocene

Family Tapiridae.—Tapirs.

Tapiravus sp. White. 1942. Miocene
Tapirus veroensis Sellard. 1929.—Florida Tapir. Pleistocene
Tapirus haysii Leidy. 1852.—Hay's Tapir. Pleistocene
Tapirus copei Simpson. 1945. Pleistocene
Tapirus terrestris (Linnaeus). 1758.—American Tapir. Pleistocene

Family Rhinoceratidae.—Rhinoceroses.

Caenopus platycephalus (Osborn and Wortman). 1894. Slender-limbed Rhinoceros. Miocene

Diceratherium sp. Simpson. 1932.	Miocene
Teleoceras proterus (Leidy). 1885.—Short-legged Rhinoceros.	Pliocene
Aphelops longipes (Leidy). 1890.—Long-footed Rhinoceros.	Pliocene

Order ARTIODACTYLA.—Even-toed Ungulates.

Family ENTELODONTIDAE.—Extinct Giant Pigs.

Daeodon (Dinohyus sp.) Simpson. 1930.	Miocene

Family TAYASSUIDAE.—Peccaries.

Floridachoerus olseni White. 1941.	Miocene
Prosthennops elmorei White. 1942.	Pliocene
Tayassu cf. *tetragonus* (Cope). 1899.	Pleistocene
Platygonus cf. *cumberlandensis* Gidley. 1920.	Pleistocene
Mylohyus gidleyi Simpson. 1929.	Pleistocene
Mylohyus browni Gidley. 1920.	Pleistocene
Mylohyus cf. *exortivus* Gidley. 1920.	Pleistocene
Mylohyus lenis (Leidy). 1869.	Pleistocene
Mylohyus pennsylvanicus (Leidy). 1889f.	Pleistocene

Family CAMELIDAE.—Camels.

Oxydactylus floridanus Simpson. 1932.—Giraffe-camel.	Miocene
Miolabis cf. tenuis Simpson. 1932.	Miocene
Megatylopus major (Leidy). 1886.—Extinct Camel.	Pliocene
Procamelus minor (Leidy). 1886.—Extinct Camel.	Pliocene
Procamelus minimus (Leidy). 1886.—Extinct Camel.	Pliocene
Tanupolama mirifica Simpson. 1929.—Extinct Camel.	Pleistocene
Tanupolama americana (Wortman). 1898.—Extinct Camel.	Pleistocene
Camelops sp. Simpson. 1932.—Extinct Camel.	Pleistocene

Family HYPERTRAGULIDAE.—Pigmy Deer.

Floridatragulus dolichanthereus White. 1940.	Miocene
Floridatragulus barbouri White. 1947.	Miocene
Leptomeryx sp. White. 1947.	Miocene
Hypermekops olseni White. 1942.	Miocene

Family NOTHOKEMADIDAE.

Nothokemas grandis (White). 1947.	Miocene

Family PROTOCERATIDAE.

Synthetoceras douglasi White. 1947.	Miocene
Syndyoceras australis White. 1941.	Miocene

Family CERVIDAE.—Deer, Elk, Moose, etc.

Machaeromeryx gilchristensis White. 1940.	Miocene
Dromomeryx cf. *americanus* Simpson. 1932.	Miocene
Blastomeryx floridanus (White). 1940.	Miocene
Blastomeryx cf. *marshi* Simpson. 1932.	Miocene
Blastocerus extransus Simpson. 1928.	Pleistocene
Cervus sp. Gazin. 1950.	Pleistocene
Odocoileus sellardsiae Hay. 1917.—Sellard's Deer.	Pleistocene
Odocioleus virginanus virginianus (Boddaert). 1784. Virginia Deer.	Recent
Odocoileus virginianus osceola (Bangs). 1896.—Florida White-tailed Deer.	Recent
Odocioleus virginianus seminolus Goldman and Kellogg. 1940.—Seminole White-tailed Deer.	Recent
Odocioleus virginianus clavium Barbour and Allen. 1922. Key Deer.	Recent

Family OREODONTIDAE.

Genus undetermined. Simpson, 1932.	Miocene

Family BOVIDAE.—Bison, Cattle, Sheep, Goats, etc.

Bison latifrons (Harlan). 1825.—Broad-headed Bison.	Pleistocene
Bison bison (Linnaeus). 1758.—Bison.	Recent

Order SIRENIA.—Sea Cows, Manatees, and Dugongs.

Family DUGONGIDAE.—Dugongs.

Hesperosiren crataegensis Simpson. 1932.—Extinct Dugong.	Miocene
Felsinotherium floridanum (Hay). 1922.—Extinct Dugong.	Miocene

Family TRICHECHIDAE.—Manatees, Sea Cows.

Trichechus sp. Simpson. 1929c.	Pleistocene
Trichechus manatus latirostris (Harlan). 1823. American Manatee.	Recent

Order CETACEA.—Whales, Dolphins and Porpoises.

Family Basilosauridae.

Basilosaurus brachyspondylus Sellards. 1916. Eocene
Basilosaurus cetoides Sellards. 1916. Eocene

Family Platanistidae.—River Dolphins.

Goniodelphis hudsoni G. M. Allen, 1941.—River Dolphin Miocene or Pliocene

Family Ziphiidae.—Beaked Whales.

Mesoplodon europaeus (Gervais). 1848-52. Gervais' Whale. Recent
Ziphius cavirostris G. Cuvier. 1823.—Cuvier's Beaked Whale. Recent

Family Physeteridae.—Sperm Whales.

Hoplocetus sp. Kellogg. 1944. Pliocene
Kogiopsis floridanus Kellogg. 1929.—Small Sperm Whale. Pliocene
Kogia breviceps (Blainville). 1838.—Pygmy Sperm Whale. Recent
Physeter catodon Linnaeus. 1758.—Cachalot, Sperm Whale. Recent

Family Acrodelphidae.

Pomatodelphis inequalis G. M. Allen, 1921.—Long-beaked Porpoise. Miocene
Schizodelphis bobengi Case, 1934.—Long-beaked Porpoise. Miocene
Schizodelphis depressus G. M. Allen. 1921.—Long-beaked Porpoise. Miocene

Family Delphinidae.—Dolphins, Killer Whales, Blackfish, etc.

Megalodelphis magnidens Kellogg, 1944. Miocene
Globicephala baereckeii Sellards. 1916. Pleistocene
Globicephala macrorhyncha (Gray) 1846.—Blackfish, Pilot Whale. Recent
Steno rostrata Gray. 1846.—Rough-toothed Dolphin. Recent
Stenella plagiodon (Cope). 1866.—Spotted Dolphin. Recent
Stenella frontalis (G. Cuvier). 1829.—Bridled Dolphin. Recent

Stenella longirostris (Gray). 1828.— Long-beaked Dolphin. Recent
Delphinus delphis Linnaeus. 1758.—Common Dolphin. Recent
Tursiops truncatus (Montague). 1821.—Bottle-nosed Dolphin. Recent
Grampus orca (Linneaus). 1758.—Killer Whale. Recent
Pseudorca crassidens (Owen).—False Killer. Recent

Family Cetotheriidae.

Isocetus species? Kellogg. 1944. Miocene
Mesocetus species? Kellogg. 1944. Miocene

Family Balaenopteridae.—Whalebone Whales.

Balaenoptera floridana Kellogg. 1944. Pliocene
Balaenoptera physalis (Linnaeus). 1758.—Finback. Recent
Balaenoptera borealis Lesson. 1828.—Sei Whale, Pollack Whale. Recent
Balaenoptera acutorostrata Lacepede. 1804.—Pike Whale. Recent
Megaptera nodosa (Bonaterre). 1789.—Humpbacked Whale. Recent

Family Balaenidae.—Whalebone Whales.

Eubalaena glacialis (Bonaterre). 1789.—North Atlantic Right Whale. Recent

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THE QUARTERLY JOURNAL OF THE FLORIDA ACADEMY OF SCIENCES

VOL. 15 SEPTEMBER, 1952 No. 3

NOTES ON THE LARVAE OF TWO FLORIDA SALAMANDERS [1]

JOHN S. MECHAM and ROBERT E. HELLMAN

This paper presents data on the newly hatched larva of *Triturus perstriatus* Bishop, and the mature larva of *Ambystoma cingulatum cingulatum* Cope. In addition, an extension of the range of the latter species into peninsular Florida, is reported.

We are indebted to Doctors Coleman J. Goin and Arnold B. Grobman, of the University of Florida, for suggestions and criticisms. We also wish to thank Mr. Walter Auffenberg who collected the first specimen of *cingulatum* in this locality, and Messrs. Nicholas Nader and Sam R. Telford who aided us in seining for these salamanders. These three gentlemen are students at the University of Florida. The photograph and line drawings were made by the senior author.

Triturus perstriatus Bishop

The value of descriptions of newly hatched salamander larvae, in providing uniform bases for comparison with other species, has been recently brought to attention (Goin, 1951: 253). As far as the writers have been able to ascertain, such information is lacking for this species.

On February 28 and 29, 1952, two large series of adult *Triturus perstriatus* were seined from a hammock pond about three miles east of Gainesville, Alachua County, Florida. The newts were apparently concentrated in large numbers in certain areas of the pond, possibly for the purpose of feeding on the eggs and newly hatched larvae of an undetermined species of frog. These abundant egg masses had been heavily invaded by the *Triturus*, and while no actual predation was observed in the field, the newts

[1] A contribution from the Department of Biology, University of Florida.

very thoroughly decimated the eggs once brought into the laboratory.

The newts were in breeding attire, the males with well developed tail crests and horny excrescences on their toes. Very shortly after placing them in an aquarium, courtship patterns were observed. These were essentially similar to those described by E. O. Jordan (in Bishop, 1941: 62) for *Triturus v. viridescens.* A single spermatophore was found in the tank on March 2. It closely resembled the illustration of the spermatophore of *T. v. viridescens* in Bishop (*op. cit.:* 67). The gelatinous basal disc measured 7.5 mm. in diameter, the vertical stalk approximately 3 mm. in height, and the spherical cap of sperm slightly over 1 mm. in diameter.

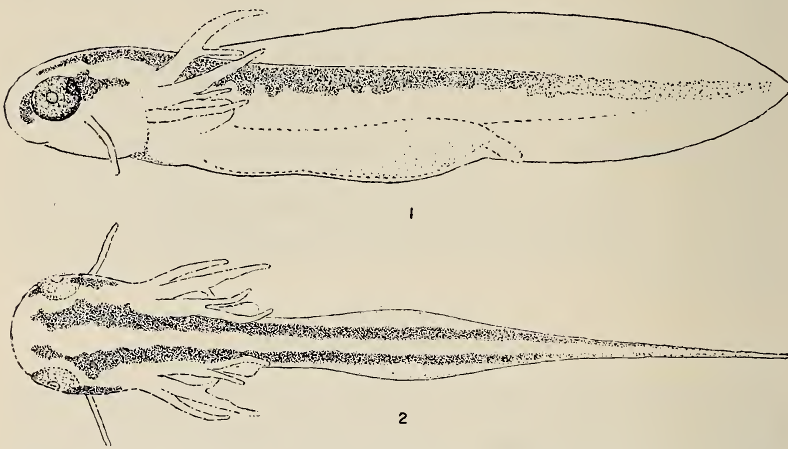

Fig. 1.—(1) Lateral view of newly hatched larva of *Triturus perstriatus.* Actual size 8.1 mm. (2) Dorsal view of same.

On March 13, four eggs were discovered. These were attached to an aquatic sedge which had been planted in the tank. One of the eggs was cemented between two adjacent leaves or stems. All were in a fairly advanced stage of development. The first larva to hatch had broken through the egg membranes by 9:00 A.M. on March 16. It remained partially within the egg most of that day. By early afternoon a second egg had ruptured. That evening, at 10:30 P.M., the first larva was noticed on the floor of the aquarium entirely free of the egg. It was immediately preserved and the following description made:

In general structure the larva is very similar to that of *T. v. viridescens* from New York as described by Bishop *(op. cit.:* 65), and to a lesser degree to that of *T. v. louisianensis* from Florida as described by Goin *(loc. cit.).* The balancers are located somewhat below and behind the eyes, and the dorsal fin begins above the base of the last gill. On the basis of its partially branched gills, our specimen appears to have attained a slightly more advanced stage than that illustrated by Goin *(op. cit.:* plate 18). Conversely, it seems to be less advanced than the comparable stage figured by Bishop *(op. cit.:* 55), the gills of the latter being more completely branched and its front limb buds considerably larger.

Two broad, dorso-lateral bands, dark gray to black in color, with rather irregular edges, extend from between the eyes to the tip of the tail. These were readily noticeable even while the animal was still in the egg. They occupy the same relative positions as the dorso-lateral red stripes of the adult. There is a club-shaped, dark spot extending from the posterior margin of the eye (on which it is superimposed) to a point just anterior to the region of the gills. A second dark spot occupies the anterior margin of the eye and the area immediately in front of it. The eye is heavily pigmented. Aside from the areas of dark markings, the animal is somewhat translucent with either a complete absence of pigment, or with the slightest suffusion of greenish-yellow. The heart region is faintly pigmented. The yolk mass is still clearly visible and possesses a distinctly greenish tinge. The total length measured 8.1 mm.

As may be seen by a comparison of the accompanying figure with those of Goin (1951) and Bishop (1941), the recently hatched larva of *perstriatus* appears to have greater similarities, both in outline and color pattern, to *viridescens* than to *louisianensis.*

Two other *perstriatus* larvae were obtained, and they agreed with the first one in all major respects. They both lost the very distinct dorso-lateral stripes within a week and a half after hatching.

Ambystoma cingulatum cingulatum Cope

Goin (1950: 312-313) has given a description of a newly transformed specimen of this subspecies which still retained some elements of the larval pattern; the larva itself is unknown. Orton (1942: 171) has published a description based on three preserved, young larvae from Jackson County, Florida, but these specimens belong to the western race, *A. c. bishopi* Goin. There is no published description of the larva of either subspecies from life.

Fig. 2.—Larval *Ambystoma cingulatum cingulatum* from Alachua County, Florida. Actual size approximately 75 mm.

A large series of mature larvae were seined from a cut-over cypress pond located in a pine flatwoods area seven miles northeast of Gainesville, Alachua County, Florida. Eleven of these were obtained on March 15, 1952, 21 on March 20, and less than a dozen specimens on the 27th of the same month. Several adults were taken earlier in the year at the same locality, and were positively identified as belonging to this subspecies. A description of the larva taken from life is as follows:

The larva is an unusually beautiful and striking animal. Both the head and body are boldly striped. Ventro-laterally a yellow-gold stripe extends from axilla to groin, and continues more indistinctly along the lower portion of the ventral tail fin. A similar, but paler, mid-lateral stripe extends from the base of the last gill, along the body, and breaks up distally on the tail. It is separated below from the aforementioned ventro-lateral stripe, and above from a flesh-colored vertebral stripe by a wide black band. The vertebral stripe runs from the base of the head along the length of the body and tail; its color extends up onto the dorsal crest, the margin of which is heavily suffused with dark pigment. The top of the head is pale yellow suffused with dusky pigment. A horizontal black stripe passes along the side of the head from the gills forward through the eye, and is bounded below by a horizontal pale gold stripe extending forward to the nostril. This stripe in turn is delimited ventrally by an irregular black stripe which extends forward from the posterior margin of the head and tapers along the upper lip. Some dusky flecks are present along the lower edge of the mandible. The throat is unpigmented and the belly is dusky, darker toward the sides, with the mid-ventral blood vessel visible as a faint line. The gills are reddish, with a heavy flecking of gold on the anterior face of the fleshy basal portion. The limbs are light below, and dark, speckled with gold above.

In pattern our specimens agree fairly well with the *bishopi* described by Orton, with the exception that the ventro-lateral stripe is very vivid and well defined in all of our specimens. This stripe was absent in Orton's three larvae, but as her specimens were considerably smaller, it is possible that such a stripe would have appeared later in the course of development. A recently transformed *bishopi* examined by Goin *(op. cit.:* 313) showed traces of this stripe.

Measurements in mm., costal groove counts, and gill raker counts for four specimens preserved at the time of capture, are as follows:

Total length	71.4	72.0	78.4	59.8
Snout-vent length	35.2	37.7	35.8	32.1
Head length	12.8	13.0	13.2	12.2
Head width	10.5	9.5	10.2	8.5
Axilla to groin	19.0	19.8	17.9	16.1
Gill rakers (anterior face, third arch)	8-8	8-8	8-8	8-8
Costal grooves (axilla to groin, all forks)	16-16	16-16	16-16	16-16

The larval vomerine teeth occur in two patches on either side of the palate, one extending anteriomedially and the other posteriorly from a point near the inner margin of the internal naris. The anterior tooth patch is elongate, the posterior one shorter and broader. In one specimen from which a reasonably accurate count was taken, there were 27 and 26 teeth in the two anterior vomerine patches respectively, and 28 and 25 in the posterior ones. There is a single row of premaxillary-maxillary teeth. The mandibular teeth occur in two elongate series on either ramus, overlapping each other by about a third of their lengths. The outermost and more anteriorly extending of these two toothed areas consists of essentially a single row of teeth at the mandibular symphysis and for most of the length of the series, with the exception that two poorly defined rows appear to be formed laterally. The more posterior, inner group of teeth form a patch, shorter and broader than the preceding series, and the teeth are not arranged in rows. The teeth of the larvae are pointed, while those of the adult are "knob-like" (Goin, *op. cit.:* 308).

A large proportion of the larvae were maintained alive in the laboratory, and many of these underwent transformation in relatively short periods of time. One specimen collected on March 15, was observed to be nearly transformed on the afternoon of the 20th of that month, and another specimen collected on the former date had completed transformation by the 25th. Many of the specimens taken on the 20th showed a reduction in the size of their gills when captured, and one animal taken on this date was well on the way toward transformation. Moreover, a much larger number of seine hauls was required on the 27th to obtain a smaller number of specimens, suggesting that many of the larvae had already left the pond. It is probable, therefore, that the larvae had begun to leave the pond at the time of, or shortly subsequent to the time of, the first collection, and that transformation of our specimens in captivity was not unduly hastened by the conditions of confinement.

Loss of the larval pattern is initiated by the gradual invasion of the mid-lateral and dorsal light stripes by dark pigment, and occurs subsequent to a marked reduction in the size of the fins on the tail and back, and atrophy of the gills. Coincidental with the invasion of the light stripes, the pigment in the dark areas is gathered into irregular shaped spots or blotches. Numerous very small light flecks soon became apparent in the intermediate areas, and as transformation progresses these become arranged into lines which form the reticulate pattern of the adult. Traces of the ventro-lateral light lines still persist after the rest of the larval pattern has completely disappeared.

The measurements, in mm., of five newly emerged young that underwent transformation in the laboratory, are given below:

Total length	69.3	68.5	73.0	64.0	64.4
Snout-vent length	35.5	36.3	38.3	34.8	36.4

On May 7, 1952, Mr. Sam Telford found a newly transformed specimen beneath a log near the edge of the pond (then dry) from which the larvae had been seined. This specimen measured 74 mm. total length, 38 mm. snout-vent length, and still retained traces of the ventro-lateral light stripes.

Two adult females collected in the area on January 26 and 31 contained very few pigmented eggs, apparently having laid them sometime earlier that winter. It is possible that the western race breeds at a somewhat later date than the eastern one, as is suggested by the fact that two larval *bishopi* (Dept. Biol., U. of Fla. 2917) collected in a pine flatwoods near Cottondale, Jackson County, Florida, on April 5, 1934, measure only 23 mm. snout-vent length. Since many Florida flatwoods ponds are dry for part of each year, breeding dates for both races, may depend to a large extent, upon the availability of water.

The locality from which the larvae described herein were taken, constitutes a range extension of approximately 60 miles southwest of Jacksonville, Florida, the only other place from which the subspecies has been recorded in the state.

A series of the larvae and recently transformed specimens has been deposited in the collections of the Department of Biology, University of Florida, and designated as DBUF 3533.

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SOME PHYSICAL AND CHEMICAL PROPERTIES OF CERTAIN SNAKE OILS

C. B. Pollard and David C. Young, Jr.
University of Florida

At the beginning of the hibernation period, well-fed snakes have fat lobes deposited along both sides of the intestines in the area between the stomach and vent. This fat supply is nearly or completely exhausted at the end of the hibernation period.

Although snake oil has been used and discussed for generations, very little information concerning its composition is available in the literature. Most of the publications which have dealt with physical and chemical properties of snake oils have neglected to state whether the oils were obtained from the whole snakes or from the lobes. For this reason the available data have little value for purposes of comparison with respect to species differences.

Pollard and McLaughlin [1] reported physical and chemical properties of oils obtained from the lobes of the boa constrictor *(Constrictor constrictor)*, prairie rattler *(Crotalus viridus viridus)*, and the moccasin *(Agkistrodon piscivorus)*. In continuation of their work, this paper reports the results of a study of the oils obtained from the lobes of the eastern diamond-back rattler *(Crotalus adamanteus)*, western diamond-back rattler *(Crotalus atrox)*, banded water snake *(Natrix sipedon pictiventris)* and Congo water snake *(Natrix cyclopian floridana)*.

Experimental

The cold-pressing method of extraction, with the use of the Carver laboratory press, was employed for all samples, since it eliminates changes in the lipoids which are often caused by heat and oxidation. Several snakes of each species were butchered soon after capture and the lobes of the respective species pooled. Lobes which were not processed immediately were kept frozen until the beginning of the purification procedure.

The lobes were dried on filter paper, and all connective tissues and blood vessels were carefully removed. They were then

[1] C. B. Pollard and Joseph McLaughlin, Jr., The Journal of the American Oil Chemists' Society, Vol. XXVII, No. 10, 393, October 1950.

TABLE 1

Characteristics of Cold-Pressed Oil from Fat Lobes of Certain Snakes.

	Crotalus adamanteus (Eastern Diamond-back Rattler)	Crotalus atrox (Western Diamond-back Rattler)	Natrix sipendon pictiventris (Banded Water Snake)	Natrix cyclopian floridana (Congo Water Snake)
Specific Gravity (25/25°)	0.9145	0.9148	0.9163	0.9158
Index of Refraction (25°)	1.4686	1.4682	1.4695	1.4684
Iodine Number (Hanus)	96.55	97.06	95.28	99.83
Thiocyanogen Number	77.7	75.7	83.7	78.3
Saponification Number	194.7	196.5	196.4	198.4
Soluble Acids, %	0.68	0.82	0.52	0.67
Insoluble Acids, %	94.62	93.95	92.40	94.91
Free Fatty Acids, %	0.10	0.28	0.21	0.14
Soluble Volatile Acids (Reichert-Meissl Value)	0.19	0.27	0.00	0.47
Insoluble Volatile Acids (Polenske Value)	0.19	0.30	0.14	0.26
Saturated Acids, %	25.15	26.08	25.49	24.15
Unsaturated Acids, %	65.55	62.62	65.64	65.66
Acetyl Value	8.2	0.0	3.5	7.1
Unsaponifiable Residue	0.51	0.28	0.28	0.25

wrapped in filter cloth and pressed. The expressed oils were centrifuged at 1400 r.p.m., and clear samples were decanted for analysis.

The methods employed in the analyses are the Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists. Analytical data for the characteristics of the cold-pressed oil are shown in Table 1.

The percentage yields of oil from the lobes were: eastern diamond-back rattler, 63.5; western diamond-back rattler, 50.0; banded water snake, 54.5; congo water snake, 65.3. The determination and calculation of Specific Rotation gave inconclusive results in all cases. The actual values ranged from $-.22°$ to $+0.06°$. Since these values fall within the range of the experimental error of the instrument used, it is improbable that any optically active component was present. No nitrogen was found in any of the oils and the amount of moisture and volatile matter was found to be less than 0.1 per cent.

All snakes used in this project were in excellent condition and were captured during the season when the deposit of fats is at a maximum.

Acknowledgment

The authors appreciate the cooperation of Mr. Ross Allen of Ross Allen's Reptile Institute, Silver Springs, Florida, who furnished the fat lobes used in this research.

SOME TOPOGRAPHIC AND EDAPHIC FACTORS AFFECTING PLANT DISTRIBUTION IN A TIDAL MARSH [1]

Curtis R. Jackson

Introduction

Florida, with 1145 miles of coastline, has great areas of tidal marshes, especially along the Gulf Coast between Tarpon Springs and Panama City. Tidal marshes of the Gulf Coast are similar to those of the lower Atlantic Coast with respect to dominant species and major ecologic conditions. In many Gulf Coast marshes the black rush, *Juncus Roemerianus*,[2] is the most abundant species and occupies the most seaward position. A prairie-like community composed mainly of *Fimbristylis castanea* and *Spartina patens* often occupies the most landward position in the marsh.

The objectives of the study were (1) to describe the well-defined plant communities in terms of species composition, edaphic and elevational conditions, and (2) to investigate the importance of edaphic conditions and elevation in the occurrence and boundaries of the communities.

The author wishes to thank Dr. Herman Kurz, Botany Department, Florida State University, for his valuable suggestions and comments.

Area Studied

The tidal marsh is located within the St. Marks National Wildlife Refuge in Wakulla County, Florida, about 1 mile northwest of St. Marks lighthouse. It is delimited by a road along the east boundary; a bight, formed by the mouth of the St. Marks River, along the west boundary, and partially by an embankment on the south. At the northern edge there is an irregular transition into pine flatwoods. The entire area slopes gently toward the water.

The black rush community forms an unbroken stand over the seaward portion of the marsh. A discontinuous strip of sandy soil with little or no vegetation occurs between the black rush community and the landward *Fimbristylis-Spartina* community. Between the bare strip and the black rush community is a smaller

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[1] Contribution number 51, Botanical Laboratory, Florida State University.

[2] Small's Manual of the Southeastern Flora, 1933, has been followed closely.

distinct community dominated by *Distichlis spicata* and *Spartina cynosuroides*.

Climate

Rainfall and temperature data were computed from weather bureau records for St. Marks station (Weather Bureau, 1942-1948). Average monthly rainfall is maximum during July with 9.6 inches; minimum during November with 2.6 inches. Average yearly rainfall is 55 inches. Temperatures are moderate during the year varying from an average monthly low of 55°F in January to 84°F in July.

Methods of Study

The tidal marsh was visited twice a month for a period of ten months. A belt transect, 12 feet wide and of such length that all well-defined communities were included, was delimited for sampling vegetation and edaphic factors. On each trip, soil and soil-water samples were obtained and the relative abundance and condition of the vegetation noted. Elevations were determined with a dumpy level using bench mark 3, 1933, 7.096 as an original reference point. Elevation is reported as an average figure to a tenth of an inch. Records of tidal movements in the area of study were obtained with a portable water level recorder. Recordings were made during periods of spring and neap tides when it was possible to get a partial recording of sub-surface water movements and a complete record of all inundating tides.

Soil samples were used for determinations of soil organic matter (Kitchen, 1948) and hydrogen-ion activity. Salinity measurements of the free soil water were made in the laboratory using a method described by Denny (1927). The results are expressed as a percentage of chlorine in the samples.[3]

Results and Discussion

Results of the investigation are tabulated in figure 1 and table 1. Four communities were found, each having distinct elevation, salinity range and soil characteristics. Zone A includes a part of the *Fimbristylis-Spartina* community. Only the edge of this zone is inundated during normal weather conditions and tides; however,

[3] Average total Cl in sea water taken as 1.97 g./100 g.

the saline water table greatly influences the vegetation. Salinity determinations have not been made for this zone because of the depth of the water table.

TABLE 1

Vegetation of the zones given in order of abundance.

Zone A

Fimbristylis castanea
Spartina patens
Spartina spartinae
Limonium carolinianum
Juncus Roemerianus
Salicornia ambigua
Distichlis spicata
Batis maritima
Seutera nitida Vail[4]

Zone B-S

Salicornia ambigua

Zone C

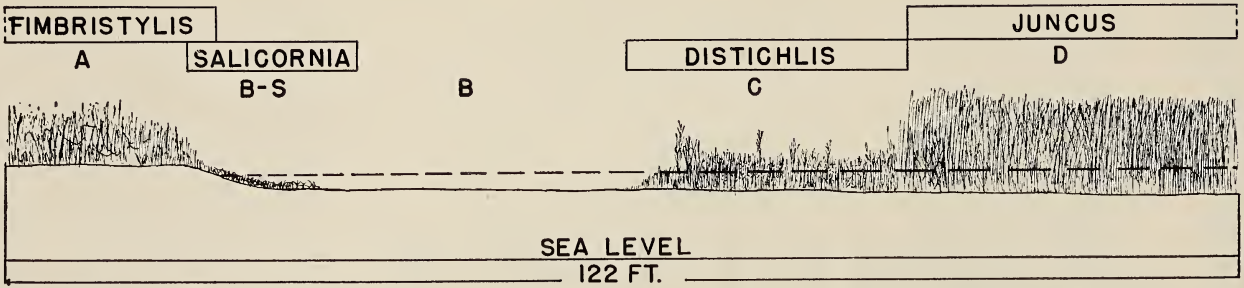
Distichlis spicata
Spartina cynosuroides
Salicornia ambigua
Batis maritima
Borrichia frutescens
Juncus Roemerianus
Limonium carolinianum

Zone D

Juncus Roemerianus
Limonium carolinianum
Batis maritima

Zone B is a unique area of the transect because of its almost total lack of vegetation. Such areas are very numerous in the marsh and seem to form an interrupted strip. Zone B and similar areas are generally the most landwardly parts of the marsh that are inundated. The high salinity of the soil water here, prohibits plant growth during the driest months of the year when little rain is available to ameliorate the unfavorable conditions. During times of consecutive low tides, the sub-surface water table falls constantly due to drainage and evaporation; these conditions lead to

[4] Synonymous with Small's *Lyonia palustris* (Pursh.) Small. A synonym is used because of the doubtful validity of *Lyonia* Ell. (Asclepiadaceae).



ZONE	ELEVATION		SALINITY		% ORGANIC MATTER		H-ION ACTIVITY			
	ZONE AVERAGE	ZONE RANGE	HIGH	LOW	SURFACE	6 INCHES	SURFACE		6 INCHES	
							HIGH	LOW	HIGH	LOW
A	26.5				0.56	0.92	7.10	6.57	7.00	6.85
B-S	19.9	1.1	5.2	2.3	0.28	0.62				
B	19.4	1.5	9.8	5.6	0.27	0.60	8.90	7.85	8.80	7.45
C	18.8	1.5	2.5	1.2	0.33	0.33	7.47	7.45	8.80	7.45
D	17.6	1.2+	1.4	0.6	6.25	1.85	6.35	5.70	6.50	6.30

Fig. 1.—Diagrammatic profile of transect, relative scale exaggerated. Salinity and Hydrogen-ion activity reported as an average. Broken line represents maximum recorded inundation.

the formation of a salty crust over the surface of the soil. A sparse community of *Salicornia ambigua* is found on the margins of the bare zone. The elevation range (Fig. 1) is specific for all *S. ambigua* communities within and adjacent to the transect. At a lower or higher elevation the plant does not grow in distinct patches but only as an occasional component of another community. These plants generally do not develop full size but are spindly and stunted. A better growth is found in areas having a soil water salinity of less than 3.45%. Halket (1915), using *Salicornia ramosissima* and *S. oliveri*, found that the best growth of these plants was at 2.0% to 3.0% (sea salts) but that these plants could tolerate a salinity of 17.0%. While no salinity tolerance range has been found for this species, it is improbable that it could tolerate a salinity of 8.0% (Cl).

The vegetation of zone C is composed primarily of *Distichlis spicata* and *Spartina cynosuroides*. *D. spicata* predominates throughout the zone; *S. cynosuroides* is found principally near the bare area. This latter distribution is coincident with an increase in salinity. The salinity range in which the best growth of *D. spicata* is found is 1.18% to 1.71% which agrees with the range given by Chamberlain (1949). *S. cynosuroides* grows throughout the zone but its frequency is greater in more saline spots.

The most abundant and widely distributed plant of the tidal marsh is *Juncus Roemerianus*. The vegetation of zone D is composed almost entirely of this plant. Because of the great extent of this community, edaphic conditions suiting the growth of this plant are not entirely known. An elevation of greater than 18.2 inches supports smaller and less vigorous stands of the plants. The salinity of the soil water is consistently lower here than in any other zone. No indication of an enlargement of this community toward a more saline habitat has been found during this study.

Tides

Vertical range and frequency of tides are important factors in a tidal marsh. The vertical extent of tides above mean low water is of importance in estimating whether any given high tide will be great enough to inundate the marsh land. Tides that do not inundate the marsh are also significant, as evaporation, with a consequent rise in salinity, proceeds unhampered during these tides. Inundating tides tend to mitigate salinity extremes.

A recording of sub-surface water fluctuations and tidal inundation made (in zone B) during spring tides shows the constant submergence of the land for periods up to 48 hours in duration. The extent to which land is inundated is less than would be expected if calculations were made in which land elevations were the only consideration. The distance from open water, presence or absence of ponds and frictional effect of dense vegetation and soils are factors affecting the vertical extent of tides in the marsh.

Land inundation has not been recorded during neap tides. During these periods, recordings of sub-surface water show a gradual decrease in level. From the recorded data, it appears that any tide less than 2.2 feet above mean low water will not, under normal weather conditions, cause general inundation.

The frequency of tidal changes varies here during any month from diurnal to semidiurnal or a combination of the two. The inundation period and the depth to which any portion of the marsh is covered is determined by the vertical extent and frequency of the tides, in addition to the factors mentioned above. Sequential high tides resulted in prolonged inundation; inundation resulting from one tidal movement was ephemeral.

Rainfall

Rainfall has a direct effect on the concentration of soil solutions, which in turn may be thought of as a partial limiting factor of plant growth. Rains which dilute the soil solution influence osmotic values of some plant saps and may also permit establishment of seedlings (Chapman, 1936).

Insolation and Wind Action

Insolation in all tidal-marsh communities is generally not inhibited or altered. Insolation greatly influences evaporation from the soil in bare areas as well as affecting the transpiration rate of the marsh vegetation.

The marsh lands are exposed to the direct action of the wind. Wind, at times, has a visible local effect on tidal movements and these movements affect the relative distribution of plant communities. High temperatures, insolation, transpiration and the dessicating effect of the wind are the most important factors causing evaporation of the surface and sub-surface water of the marsh soils.

Soils

The hydrogen-ion activity of the soils studied varies from 5.60 to 8.90. The alkaline ranges roughly correspond to the salinity differences found in the transect. The most alkaline zone (B) had a greater pH than the remaining zones with a decrease in pH accompanying a decrease in salinity. Soils with a pH of 7.0 or below have in common either a low soil water salinity or a high organic matter content or both.

The soils of this area are similar to the soils of many littoral areas in Florida. They differ from many marsh soils of southern Florida in that they are not composed of calcareous marl. Here, the soils are composed primarily of quartz sand, the relative abundance of organic matter giving them their visible distinctness. They are classified as azonal tidal-marsh soils (Henderson, 1939).

Land Elevation

Species composition, relative positions and spatial extent of tidal-marsh communities are a result of the development of certain edaphic conditions at specific elevations. The salinity range found in any area of the marsh appears to be the result of the interaction of tides, soil characteristics and climatic factors. As elevations change, soil characteristics and tidal relations change thus producing different salinity conditions. This is perhaps a patent observation since the effects of considerable changes in elevation are easily seen in any maritime region. However, it is emphasized that the elevation variations found here are not obvious. Figure 1 illustrates this point well, showing a gradient of 8.9 inches in 122 feet. A very slight change in elevation is related to a marked change in appearance and composition of communities.

Plant communities were found within narrow limits of elevation. An example of this is found in the distribution of *Salicornia ambigua* which forms a small community on the edge of zone B and has an elevation range of 1.1 inches. This range holds true here but will not do so for every section of the marsh in which *S. ambigua* communities are found. For example, the community found here at an average elevation of 19.9 inches is found exhibiting the same growth form and habits at an elevation of 24.0 inches approximately 600 feet from the transect. The elevation range of a species or community may not be the same throughout the whole marsh. This however, does not alter the conclusion that plant communities are distributed according to their elevation but indicates that other factors such as soil characteristics and extent of inundation also appreciably influence distribution. Extent of inundation of diverse sections of the marsh is variable and may be different for two widely separated areas having the same elevation. Land located near sources of water, although having the same elevation of more remote areas, is inundated to a greater depth.

Salinity

The distribution of plant communities appears to be most directly influenced by salinity conditions, but specific relationships between the distribution of communities and salinity or elevation have not been established. In certain areas, relations between these factors can be clearly seen; in other places these relations are either different or difficult to discern. Certain relations, however, have been found to exist throughout the marsh. Stated briefly they are:

(1) All areas which are devoid of or support a paucity of vegetation, and are subjected to periodic inundation are more saline than surrounding areas.

(2) Salinity conditions are periodically mitigated by rainfall and/or tidal inundation. An increase in salinity results from a lack of either or both of these conditions.

(3) Growth forms as well as growth limits are determined by salinity of the soil water.

The dwarfed condition of *Salicornia ambigua, Borrichia frutescens, Limonium carolinianum, Batis maritima* and occasionally, *Distichlis spicata* appears to be related to high salinity conditions.

Summary

1. An ecological investigation of a tidal marsh was conducted on the Gulf Coast of Florida within the St. Marks National Wildlife Refuge, Wakulla County.

2. Three major plant communities were found. Dominant species are:

   A. *Fimbristylis castanea* and *Spartina patens.*

   B. *Distichlis spicata* and *Spartina cynosuroides.*

   C. *Juncus Roemerianus.*

3. Investigation of tidal conditions lead to the following tentative conclusions:

   A. Inundation of landward areas of the marsh, within ¾ mile from open water, occurs when a tide reaches 2.2 feet above mean low water unless wind conditions are adverse.

   B. Inundation of the marsh is uninterrupted when tides above 2.2 feet occur in sequence.

4. Tidal inundation, rainfall and evaporation control the salinity of free soil water. Degree of inundation is, in some places, significantly affected by slight differences in elevation; evaporation, by temperature, wind action, insolation, density of plant cover and soil texture.

5. Slight differences in land elevation are indirectly responsible for such characteristics of the communities as species composition, relative position and size.

6. Soil water salinity is the most important single factor in limiting plant growth in the communities studied.

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EFFECTS OF HISTAMINE AND EUGENOL ON GASTRIC MAST CELL DIAPEDESIS AND LEUCOPEDESIS IN THE ALBINO RAT [1]

PERIHAN CAMBEL, JAMES T. SGOURIS and CECILIA E. CONROY

Evidence was brought by Cambel *et al.* (1952) that mast cells were present in the stomach wall as well as in smears obtained from the gastric juice of albino rats. The authors concluded, therefore, that migration of these cells by means of their ameboid movement occurred from the stomach wall into the gastric lumen. It seemed of interest to investigate if histamine or the gastric irritant eugenol (Hollander and Lauber, 1948) would effect gastric mast cell diapedesis. Stained smears from the gastric secretion on the stomach wall were prepared as previously described (Cambel *et al.*, 1952).

All experiments were conducted on albino rats of the Sprague-Dawley-Holtzman strain. They were fed Purina Dog Chow *ad libitum.* Histamine administration: Fifteen female and 15 male rats were supplied with tap water [2] *ad libitum.* The average age of the animals was 6 weeks at the onset of the experiment, while their weights ranged from 165 to 240 g. Daily injections of 1 ml. of an aqueous histamine dihydrochloride solution in a concentration of 0.040 mg.|ml. were given over a period of one, two and four weeks. Totals of 0.28 mg. of histamine were administered for one week, 0.56 mg. for 2 weeks, and 1.12 mg. for 4 weeks. Eugenol administration: Twelve female and 12 male rats, aged from 5 to 8 weeks, and weighing from 136 to 190 g. at the onset of the experiment were used. They were kept without water supply and conditioned to drinking from a pipette daily 24 ml. of a 0.1% and 6 ml. of a 1% aqueous eugenol emulsion mixed in a Waring Blendor according to Kraus and Hollander (1949). Tergitol-Penetrant [3] (1|50%) was used to stabilize the emulsion. Eugenol

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[1] A contribution from the Cancer Research Laboratory, University of Florida, Gainesville, Florida.

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[2] The water supply of Gainesville is fluorinated to a concentration of 1 part/1,000,000.

[3] Tergitol 7 was kindly supplied by Carbide and Carbon Chemical Company.

was administered for a one week period and a 4 weeks period.

The findings in the smears of the non-treated controls were reported previously (Cambel *et al.*, 1952). The smears taken from the histamine-treated rats showed microscopically a progressive decrease of the bacterial flora as the period of treatment was augmented. Usually, the numbers of polymorphonuclear leucocytes, squamous and columnar cells decreased as compared to those in non-treated rats. In a 1 week histamine-treated rat, lymphocytes and in a 4-week histamine-treated animal, a few erythrocytes were noted. In only one 2-week treated rat were mast cells present, while in all the others no mast cells or free metachromatic granules could be detected.

In the smears from the eugenol treated animals a definite decrease in the bacterial flora was also noted. The greatest decrease was observed in the 4-week treated rats. In only one animal could polymorphonuclear leucocytes be distinguished among the cellular debris. No mast cells or free metachromatic granules were seen.

Summary

Histamine dihydrochloride as well as eugenol, as administered above, impaired both gastric mast cell diapedesis and gastric leucopedesis (Tomenius, 1947) in the albino rat. Both substances depressed the bacterial flora in the gastric juice.

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SOME EVOLUTIONARY FEATURES INHERENT IN THE INSECT FAUNAS OF THE TROPICS

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This preliminary statement is of very general nature, designed to present views developed over many years, most recently as the result of a prolonged sojourn in the Philippines. I have been persuaded to present it after reading a very illuminating paper on Evolution in the Tropics by the distinguished geneticist, Dobzhansky (1950).

Is there more variety and specialization in the insect fauna of tropical countries than in more temperate regions? Is the "exhuberance" of life really greater, or is this only our own viewpoint since the insects of temperate regions have been longer known and accepted as commonplace?

If variety is greater, is this due to more active metabolism at higher temperatures, to a longer active season, or to keener competition with other insects, animals or plants?

Such questions have intrigued me for many years, and I have been unable to accept wholly any of the specific pronouncements made by entomologists and other biologists concerning its several phases. The abundance of insect life is regulated by food-supply, reproductive potential and disease, including the depredations of parasitic and predatory enemies, as well as non-living factors in the environment. Aside from the present status, there is also an historical aspect dating back into their geological history. This is complex and cannot be evaluated with our present knowledge of the ecological relations, abundance and migration of special types during the long period that insects have existed in practically the same variety that they now exhibit.

During the past several decades I have had the opportunity to visit a number of tropical areas for periods extending over several months or more. These include Jamaica, Cuba, the Windward Islands and equatorial South America in the Neotropical Region, and several parts of the Indomalayan Region. These personal experiences serve to supplement information gained from other sources.

Viewed critically from a morphological, ecological and behavioristic standpoint, and restricting consideration to insects alone, the following statements seem to be well justified.

There exists a greater variety and more extensive specialization in the insect faunas of the tropics, except with regard to some types of ecological adaptation such as cold hardiness. The difference is by no means so striking as appears at first sight to a visitor from one of the north temperate countries who finds the face of Nature strange and unexpected in any tropical environment. Nevertheless, more extended familiarity with any tropical insect fauna seems never to erase this first impression.

Whether the tropical fauna is as a whole more numerous in genera, species and individuals remains a separate and more difficult question to answer with complete assurance, since our knowledge of the two areas is not coordinate. It seems, however, that the long series of species that are rarely seen or collected is larger than that met with in temperate climates. Also, from the standpoint of climate, the warmer regions are most hospitable to insect life and these include several widely separated very extensive faunas and many faunistically isolated, but smaller areas. None seems to have suffered comparatively recent catastrophic disturbances such as the extensive glaciation of northern faunas.

In spite of the opportunities, there does not seem to have been the same rapid dissemination of insects by artificial means in the tropics as in the north temperate world. The south temperate regions are of course far less extensive and less disturbed by the march of civilization so they offer little confirmation for any generalizations at the present time. Some insect pests are tropicipolitan but these are mainly semi-domesticated species such as cockroaches, flour-beetles and mosquitoes. This dissimilarity may be only apparent as large-scale cultivation in tropical countries is not yet in full operation and more extensive migration may follow rapidly in the future. It is already notable in the case of various trypetid fruit-flies and scale insects. In this respect tropical insects appear to differ radically from tropical weed-plants as an excessive number of the latter seem to have girdled the globe magnificently; no more widely, however, than some of their temperate region counterparts.

Taking all such matters into consideration it appears that no conclusion can be drawn with certainty, but it may be said that tropical insects are more intimately dependent upon exact environmental conditions, particularly in the struggle for existence with competing species, and with their enemies, most of which are other insects.

What has been commonly termed "the exhuberance of life" in the tropics does not apply to warm-blooded animals like ourselves, and perhaps partly for this reason, has appealed to many naturalists, particularly since the time of Darwin and Wallace. Such peculiarities as the outrageously modified pronotum of certain tree-hoppers and the bold, contrasting color patterns of fishes are to be cited in this category. We may, of course, note similar modifications in the hypertrophied ovipositor of certain parasitic wasps in our region, but the latter are clearly to be considered as functionally useful adaptations. Such exhuberance seems to withstand critical examination as a general phenomenon and to represent one of the trends of evolution in the tropics to which I wish to call attention at this time. It finally came to mind most forcibly during a recent sojourn in the Philippines, where we spent nearly a year on Negros Island. As is often the case on tropical islands, there are foothills which edge the coast and rise to higher elevations further inland where they culminate in mountain peaks. These latter rise to a height of over 6,000 feet toward the interior of the island, and as the result of meteorological conditions, are clothed with a jungle of perpetual rain forest above an elevation of about 4,000 feet. The mountainsides are furrowed by deep ravines and suitable areas below 3,000 feet are cultivated irregularly amid an overall growth of weeds that range from coarse grasses to shrubs and are in great part intruders from other tropical floras.

As we gradually became acquainted and grew more familiar with the insect fauna of the foot-hills and the upper reaches of the mountains there was evidence of a prevailing low density in the insect population. One group of insects failed completely to fit into this picture, however. Ants of many kinds were far more abundant than we had previously noted in any other area, even in the tropics. On the whole, ants are a dominant group of insects in practically all regions under the most varied environmental conditions, but both their abundance and variety is clearly enhanced in warm, and especially tropical, regions. This is particularly true of the predatory forms. Ordinarily these are not very prolific, producing small colonies and not affecting to any great extent the prevalence of small animals, mainly insects, on which they feed. Outstandingly among predatory ants are the members of the subfamily Dorylinae, represented in the tropics by the driver ants of the genus Eciton in America and by Dorylus and Ænictus in the African and Indomalayan regions. These ants are among the most rapacious of all insects, forming very populous colonies whose members scour the vicinity of their nests for insect food and, moreover, migrate widely and at frequent intervals in order to encompass fresh hunting grounds.

Other ants that occur in excessive abundance in many parts of the American tropics are the large leaf-cutter ants of the genus Atta whose colonies are probably the most populous of any ants, but these feed exclusively on fungi cultivated on a vegetable substratum in subterranean mushroom-gardens and do not affect the general insect fauna except in an indirect and very minor way. The same relationship prevails to a lesser but very considerable extent among the more abundant types of ants in temperate regions. Many such appear to select their food primarily on the basis of its saccharine content as they are particularly enamoured by sweets, either directly from a plant source or through the intermediary of aphids, coccids, membracids, food pantries, or the like. Their appetites often extend to other types of vegetable food, but rarely to the living tissues of green plants, except the seeds which form the diet of many graminivorous ants. Dead insects are attractive and freshly pinned specimens of insects must be protected from many small ants in all parts of the tropics. This attraction extends also in some cases to living insects. One little species of Dolichoderus in the Philippines commonly invades cages housing caterpillars or even large, powerful mantises, swarming over them in such incredible numbers that death may ensue within a few hours. This same ant is commonly seen running in long files on the porches and sills of houses, and appears to be a quite general feeder.

A greater intensity in the struggle for existence is the factor which has generally been invoked in connection with the greater specialization and bizarre structural modifications that appear more commonly among the insects of tropical faunas. That it is related to the phenomenon of "exhuberance", as mentioned previously, seems very likely and if so, it should be possible at least to surmise what the relationship may be. It is quite naturally assumed that there is some effect of higher temperatures in stimulating greater metabolic activity among cold-blooded animals like insects. This is borne out by the presence of numerous insects in the tropics which are conspicuously larger than those of colder climates. We cannot question the truth of this difference as it prevails in a number of unrelated types native to several faunal areas.

It must be admitted that there appears a paradoxical situation among numerous cold-blooded marine invertebrates of our northern Pacific coast where they are represented by a series of species of unexpectedly large size. This seems attributable to a superabundant supply of plankton-food persisting over a long period, and not comparable to the phenomenon just cited.

Another matter which may seem somewhat irrelevant is a peculiarity of the greatly limited fauna of an oceanic island like Hawaii, where two genera, one a weevil and the other a parasitic wasp, have each developed some one hundred species, although these genera are practically confined to Hawaii. This is a case of elaborate speciation, perhaps associated with a lack of competition with other insects, as the native fauna of Hawaii is very limited, lacking a great many widespread groups of insects. Similar cases occur among snails, but not always on isolated islands. Such extensive speciation occurs in certain genera of insects sporadically in all parts of the world and it would appear that such speciation cannot be attributed to any single extraneous stimulus.

It has been generally assumed that the conditions involved in the phenomenon of tropical exhuberance are present in the environment, but whether they pertain to the animate or to the inanimate world, or to both is an open question.

Since insects are as a group the most abundant and diversified of all specialized animals, we may look at the components of the insect fauna itself for indications as to what part they may take in furthering or hindering the evolution of the other components which make up the whole.

I am satisfied that inquiry along this line brings to light one comparatively small group, comprising a single family among the several hundred into which taxonomists divide the insects, that has played a major role in the evolution of many other types. There are the ants. We cannot say with assurance why these are more abundant in the tropics, nor why the predatory forms of ants are better represented in such warm climates. That a temperature factor is concerned seems likely. As a group they enter, particularly the predatory forms, into the struggle for existence among a great variety of other insects, and as a result of their highly integrated social habits possess a powerful advantage over most other forms of insect life. A far larger proportion of ants serve as important enemies of other insects in tropical countries than they do elsewhere. Also, the influence of the ants is reflected in other ways not related directly to inimical contact with other insects.

This is patent among myrmecophilous insects of many groups. Their peculiarities are both structural and behavioristic and their development as the direct result of association with ants has never, and cannot be questioned. Myrmecophily is world-wide and reaches its most conspicuous development in the tropics. It is prevalent among both predatory and other ants, but reaches its peak with the highly predatory doryline ants in both the new and the old world tropics.

The results of contact between ants and plants are shown likewise in the appearance of many very remarkable modifications among varied types of flowering plants. These are conspicuous in the Neotropical, Ethiopian and Indomalayan regions and we may mention Cecropia, Triplaris, Acacia, Myrmecodia, Hoya and many others. The two latter genera are common in the Philippines where both are excessively modified and adapted as nesting sites for particular kinds of ants.

In other words, the ants have stepped up the speed of evolution among other insects in the tropics quite generally.

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THE MECHANISM OF SKIN TUMORIGENESIS [1, 2]

Michael Klein

When mice are painted repeatedly on the skin with a chemical carcinogen such as 20-methylcholanthrene, the skin generally is observed to pass through distinct pathological stages including, 1. preneoplastic epithelial hyperplasia, 2. appearance of macroscopic benign tumors referred to as papillomas or warts, 3. proliferation of these papillomas, 4. development of malignant tumors (carcinomas) from papillomas and, 5. growth of the carcinomas leading to the death of the animal. It was discovered by Rous and Kidd (1941), MacKenzie and Rous (1941), and Friedewald and Rous (1944, 1950) who experimented with rabbits, and by Berenblum (1941 a,b) and Berenblum and Shubik (1947 a,b) who used mice, that while a carcinogen elicited all these changes, stages 2 and 3 above could be obtained in the absence of a carcinogen. Rous and his collaborators repeatedly painted the ears of rabbits with coal tar or with chemically pure hydrocarbon carcinogens and obtained skin papillomas. The location of these growths was carefully mapped. When painting with the carcinogen was stopped, the tumors regressed completely and were no longer perceptible to the naked eye. If non-carcinogenic substances such as chloroform or turpentine were painted on the skin even as long as 3 to 5 years following application of the carcinogen, skin tumors reappeared, some being in sites originally occupied by other macroscopic tumors which had regressed earlier. It appeared that surviving tumor cells, although indistinguishable microscopically had remained dormant over a long time, and then had been stimulated to develop into visible tumors. Wound-healing, obtained in response to punching a hole in the rabbit's ear was especially effective as a substitute for chloroform or turpentine in eliciting such tumors. On the basis of the latter experiments, it was concluded that at least 2 major stages were involved in the development of skin tumors in rabbits. The first stage, referred to as *initiation,* involved the transformation of untreated cells to "latent tumor cells" which remained dormant unless stimulated

[1] A contribution from the Cancer Research Laboratory, University of Florida, Gainesville, Florida.

[2] Supported by a grant from the Damon Runyon Memorial Fund.

further. The second stage involved the production of papillomas from these altered cells, a process referred to as *promotion.*

In the course of studies on the role of non-carcinogenic irritants in skin tumorigenesis in the mouse, Berenblum (1941 b) observed that the application of croton oil after a limited number of paintings with a carcinogen greatly increased the incidence of papillomas. However, croton oil, when administered prior to the carcinogen, proved ineffective. Finally, croton oil appeared to enhance the production of malignant from benign tumors. From these observations, Berenblum (1941 b) concluded that skin tumorigenesis consisted of several stages which he designated pre-, epi-, and metacarcinogenesis. Precarcinogenesis referred to the initial cellular or tissue response to treatment with a carcinogen; epicarcinogenesis, to the development of visible benign tumors in a tissue already in a precarcinogenic state; and metacarcinogenesis, to the transformation of benign to malignant tumors. Croton oil possessed epi- and some metacarcinogenic activity but no precarcinogenic activity. A comparison of these stages with those formulated by Rous and his associates reveals that *initiation* and *promotion* correspond to pre-, and epicarcinogenesis respectively.

When the process of carcinogenesis is enhanced by application of a non-carcinogenic agent, the action is referred to as co-carcinogenesis (Berenblum, 1941 b). This term was employed originally by Shear (1938), Cabot *et al.* (1940), and Sall and Shear (1941) who demonstrated that more tumors could be induced in the skin and subcutaneous tissues of the mouse if the non-carcinogenic basic fraction of creosote oil was added to the carcinogen 3,4-benzpyrene. Berenblum (1941 a, b) considered the increased tumor production obtained with croton oil as another instance of co-carcinogenesis. It has been observed that tumor incidence may increase according to the particular solvent employed with a carcinogen (Peacock, *et al.*, 1949). Since such results frequently are ascribable to changes in the rate of absorption or elimination of the carcinogen, they may not be considered examples of co-carcinogenesis. Thus, Berenblum (1947) suggested that co-carcinogenesis be limited to "augmentation of tumor production resulting from a direct, local effect on a tissue." In testing a compound for co-carcinogenicity, it should be administered long enough following application of the carcinogen to rule out the possibility of a solvent effect. This was not considered in the experiments of Shear and his associates.

The observation of Mottram (1944) that croton oil possessed cocarcinogenic activity in the mouse following one painting with the carcinogen 3,4-benzpyrene was important, for now the factors involved in skin tumorigenesis could be considered more quantitatively. Berenblum and Shubik (1947 b) reinvestigated skin tumorigenesis in the mouse using Mottram's technique and reported that when the same amount of croton oil was applied following a single painting with one of several carcinogens, the number of tumors observed varied according to the carcinogen used and its concentration, but the average latent period remained the same in each group. If mice were painted once with the same carcinogenic solution, and at different intervals thereafter were painted repeatedly with croton oil, tumor incidence remained the same but the average latent period was delayed in direct proportion to the interval between application of the carcinogen and the croton oil. Thus, when one group was painted with croton oil at 5 weeks and another at 10 weeks following application of the carcinogen, the average latent periods were observed to be 11.2 and 16.8 weeks respectively (Berenblum and Shubik, 1947 b). Berenblum and Shubik (1947 a, b) concluded that a single application of a carcinogen resulted in a permanent transformation of normal cells to latent tumor cells. These cells remained dormant but could develop into visible tumors by application of the non-carcinogen, croton oil. These conclusions arrived at independently agreed with those of Rous and his co-workers.

In order to determine whether the action of croton oil was specific for the skin, Klein (1951) injected albino mice intramuscularly with methylcholanthrene in croton oil. At the dosages employed, tumors were observed among those animals which had received either the carcinogen or both compounds together. The incidence of tumors was highest and their time of appearance (latent period) lowest in those mice injected with both methylcholanthrene and croton oil. No tumors were observed when croton oil alone was injected. Mice from the same colony also were injected with progressively lower doses of methylcholanthrene to a point where few or no tumors were induced with the carcinogen alone. The presence of croton oil at these low concentrations had no observable effect on intramuscular tumorigenesis (Klein, 1952 b). It is not clear, then, whether the enhanced tumorigenesis observed for croton oil at higher concentrations of methylcholanthrene may be considered an illustration of co-carcinogenesis (Berenblum, 1947), or whether a solvent effect is involved.

It has been observed by Shubik (1950), Allsopp (1948), Bielschowsky and Bullough (1949), and Klein (1952 a) that the tumors induced in mice with one application of a carcinogen when followed by croton oil are predominantly benign and have little or no tendency to become malignant. If the carcinogen is applied repeatedly (Berenblum, 1941 b; Rusch and Kline, 1948) or if one massive dose of carcinogen is applied (Bielschowsky and Bullough, 1949), a greater number of malignant skin tumors arise. Thus it would appear that the malignant change requires a greater amount of carcinogen than the benign. It is also of importance to know how long an exposure to a non-carcinogen may be required for tumors to develop in a tissue sensitized by previous contact with a carcinogen, and whether the effect of such exposure may be cumulative. These problems are now under investigation in this laboratory using mice painted once on the skin with a carcinogen. Subsequently the treated area is painted with croton oil or is wounded and then receives croton oil.

Friedewald and Rous (1950) painted the ears of rabbits repeatedly with methylcholanthrene and at varying intervals thereafter punched holes in the ears to test for the presence of latent tumor cells. Care was taken not to cut through a tumor or through an area previously occupied by a tumor. In the rabbit, the presence of a carcinogen is needed not only for induction of skin tumors but also for their survival and continued growth. The skin becomes hyperplastic and appears hyperemic and inflamed in response to repeated painting with a carcinogen. Although these changes may persist after the carcinogen no longer is applied, the reaction gradually subsides and the skin improves progressively toward normal. According to Friedewald and Rous (1950) conditions for the proliferation of latent tumor cells to visible tumors and for tumor maintenance would seem most favorable during carcinogenic treatment or soon thereafter, and would appear to become less favorable with time. This was not observed in the wound-healing experiments of the latter authors, for tumors appeared at a fairly constant rate even after a period of several years. On the basis of these results, Friedewald and Rous (1950) suggested that the initial action of a carcinogen on the skin was the production of numerous cells with "latent neoplastic potentialities" and not "latent tumor cells". Cells so altered by the carcinogen automatically developed into tumor cells after varying periods of time and at a fairly constant rate. The latter cells, like the latent tumor cells proposed originally by Rous and his associates and by Berenblum and Shubik, then remained dormant until stimulated by the wound-healing process. The existence of latent tumor cells was not questioned, however, in those instances where a papilloma arose in response to a non-carcinogenic stimulus and occupied the same site as one which had been observed to disappear previously.

Klein (1952 a) painted mice once with a carcinogen and then repeatedly with croton oil and observed that the tumors which arose included rapidly as well as slowly growing papillomas. If as Shubik (1950) suggested, latent tumor cells were induced initially which varied in growth potential, one might have expected those tumors with greater growth potential to appear first while others with less to become visible later. This, however, was not observed, for tumors with varying growth rates appeared early as well as late (Klein, 1952 a). These results, however, may be explainable on the basis of Friedewald and Rous' recent observations (1950) if one assumes that the tumors which continued to arise from cells with latent neoplastic potentialities possessed various growth potentials.

Conclusions obtained from skin tumorigenesis experiments in mice and rabbits may be helpful in understanding the etiology of similar tumors in man. Thus an individual may be exposed early in life to a carcinogen with the resultant production of cells with latent neoplastic potentialities. Years later, tumors may arise from such altered cells in the absence of a carcinogen if the tissue is exposed to non-carcinogenic stimulation, as for example, wounding or burning. Numerous instances of skin cancer in man which appear to be explainable on this basis already have been reported (Arndt, 1933; Treves and Pack, 1930; Stauffer, 1928-9; Kennaway, 1947; and Lewis, 1931).

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A STUDY OF THE TOXICITY AND STABILITY OF DRIED MOCCASIN *(Agkistrodon piscivorus)* VENOM

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Since the availability of poisonous snakes in some localities is somewhat seasonal, it is desirable to collect, process, and store the venom for future use.

Although the practice of drying venom has been employed for many years, the literature affords little information concerning the toxicity or the relative stability of the dried venoms. In view of this situation, a study of the toxicity and the stability of dried moccasin *(Agkistrodon piscivorus)* venoms was undertaken.

A limited number of experiments here have shown that the toxicity of the venom from individual snakes of the same species varies even though the snakes are approximately the same size.

In order to secure relatively uniform samples of venom for experimental use, the venom from fourteen to eighteen moccasins of uniform size was pooled. Eleven of these pooled samples were prepared. Each pooled sample was thoroughly mixed and then centrifuged to remove sediment. The clear, supernatant liquid was separated from the sediment and was then dried at room temperature at 4-8 mm. Hg. All fresh venom was kept at 15°-20° C. while awaiting processing, and all samples were dried within seventy-two hours after "milking."

Doses of 0.5 gm./kg. of the sediment, injected intraperitoneally, failed to produce death of any test animal, although severe diarrhea was observed in animals receiving this substance. This condition may have been caused by magnesia present in snake venom. The sediment was discarded since it was not toxic.

Method of Assay

There have been a considerable number of biological assay techniques developed which could be employed for the determination of the toxicity of venom. In these studies, it was necessary to have a method which would enable detection of a small loss in potency of the toxic principles of the venom. Several variations of previously investigated methods were studied. The white rat was selected as the test animal since best results were obtained with this species. By determining the MLD and LD_{50} values of the original dried, pooled samples, it was a relatively easy task to determine the LD_{50} for each sample after it had been stored at 15°-20° C. for periods of 6, 12, 18 and 24 months.

White rats from eight to twelve weeks of age, showing no pathological defects, were placed on a standard feed which contained all known growth factors. No nutritional deficiencies or clinical manifestations of disease were observed on any rat which was selected for inoculation with venom samples.

Various concentrations of venom were prepared by dilution of the dried venom with physiological saline solution (0.89% sodium chloride). The rats were placed upon an inoculation board and an intraperitoneal injection of the diluted venom samples was administered, using a sterile one-inch hypodermic needle. The rats were then individually caged and observed. Feed and water were supplied *ad libitum*. Six to twelve rats were used for each determination.

The results of these studies are shown in TABLE 1.

TABLE 1

Data Concerning the Toxicity and Stability of Moccasin *(Agkistrodon piscivorus)* Venom

Sample No.	LD_{50} Initial	LD_{50} After storage for 6 months	LD_{50} After storage for 12 months	LD_{50} After storage for 18 months	LD_{50} After storage for 24 months
1	29	31	35	35	34
2	28	32	33	31	30
3	36	34	42	37	38
4	41	38	41	39	40
5	45	44	44	45	44
6	42	45	53	44	46
7	39	37	41	39	41
8	38	43	50	42	41
9	34	38	36	40	36
10	29	34	35	32	32
11	45	42	49	52	50

LD_{50} in mg./kg.

Summary

It is apparent that the toxic portion present in the pooled and dried samples of moccasin venom tested in these investigations is

relatively stable over a period of twenty-four months when stored at 15°-20° C. The slight difference in the LD_{50} values might be attributed to variations in animals and experimental errors.

Acknowledgment

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Venom used in this investigation was obtained from the Ross Allen Reptile Institute, Silver Springs, Florida.

A NEW CRAYFISH OF THE GENUS PROCAMBARUS FROM GEORGIA WITH A KEY TO THE SPECIES OF THE CLARKII SUBGROUP [1]

(Decapoda, Astacidae)

Horton H. Hobbs, Jr.

The new species described below is of especial interest because its presence in the Altamaha drainage system partially closes what has appeared for many years to be a gap in the range of the members of the Clarkii Subgroup (Hobbs, 1942: 98).

The apparent gap was located between the range of *P. paeninsulanus* and that of *P. troglodytes*. The former species is known to occur in the following drainage systems of Georgia: Apalachicola, Ochlocknee, Suwannee, St. Mary's, and Satilla; whereas, *P. troglodytes* has been found in the Ogeechee and Savannah rivers. Thus a triangular wedge existed in the southeastern part of Georgia (in the lower Piedmont and Coastal Plain) in which no representative of the Clarkii Subgroup was known. This subgroup of the Genus *Procambarus* consists of the species described below along with four which have been known previously [*Procambarus clarkii* (Girard, 1852: 91), *Procambarus troglodytes* (Leconte, 1856: 400), *Procambarus paeninsulanus* (Faxon, 1914: 369), and *Procambarus okaloosae* Hobbs (1942: 100)]. Although there are a number of features which these species share in common, the presence of a shoulder on the cephalic margin of the first pleopod of the male some distance proximal of the terminal elements is the best single diagnostic characteristic of the Subgroup.

The combined ranges of the group extend from Texas to South Carolina. In the Mississippi basin *P. clarkii* has been collected as far north as Arkansas and southwestern Kentucky; farther east, however, the members of the group appear to be restricted largely to the Coastal Plain, and invade the Piedmont Provience in few places.

All five species frequent sluggish to moderately flowing streams; however, as a group they are found more abundantly in lentic situations: swamps, ponds, roadside ditches, borrow pits, and

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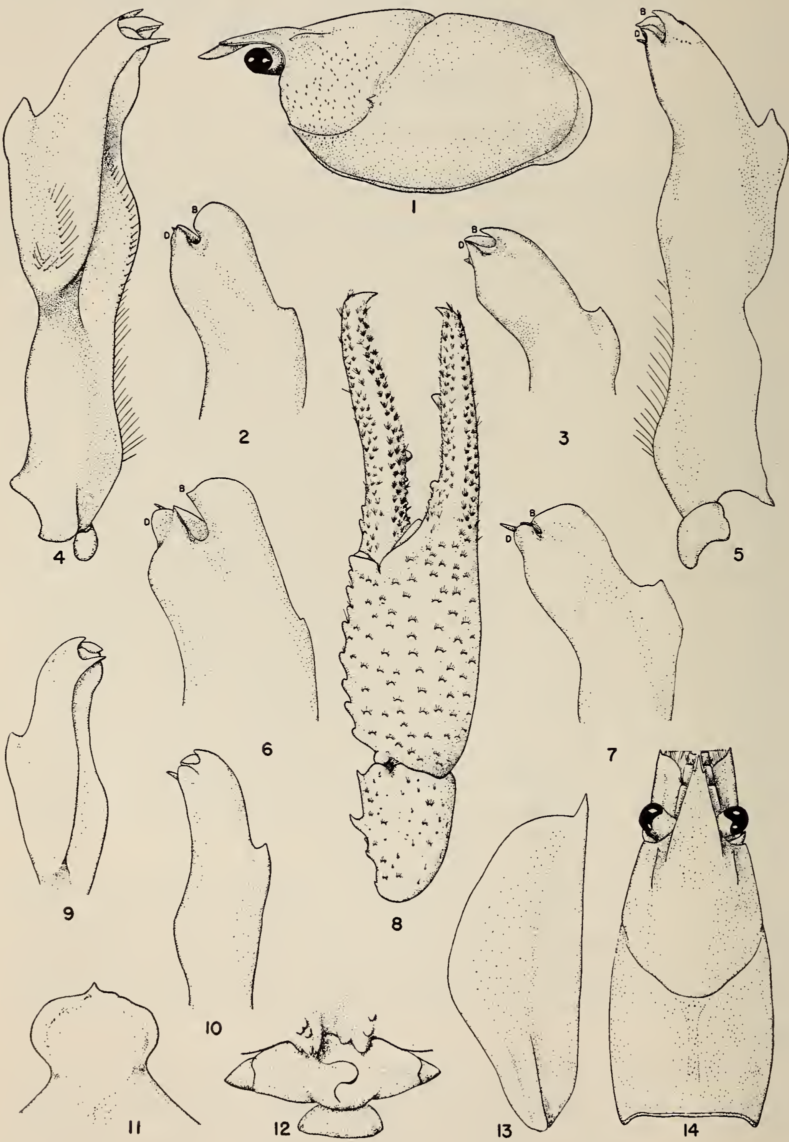
[1] Contribution from the Miller School of Biology, University of Virginia.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temporary bodies of water. All of the species previously described are known to burrow.

It is with pleasure that I name this new species in honor of Miss Thelma Howell of the Department of Biology, Wesleyan College, who sent me the first specimens I had seen, and who has been most cooperative and helpful in adding a large number of crayfishes to my collection. I also wish to thank Dr. D. C. Scott of the U. S. Public Health Service, Augusta, Georgia for the specimens which he collected in Emanuel and Telfair counties, Georgia.

Procambarus howellae, sp. nov.

Diagnosis.—Rostrum with or without lateral spines or tubercles; areola narrow with two or three punctuations in narrowest part, from 9 to 17 times longer than broad; a single lateral spine present on each side of carapace. Male with hooks on ischiopodites of third and fourth pereiopods; palm of chela of first form male not bearded but bearing a row of seven to nine tubercles; postorbital ridges terminating cephalad in spines or prominent tubercles. First pleopod of first form male with an angular shoulder on cephalic surface near base of distal third of appendage, and distal portion terminating in four distinct parts: mesial process slender, non-corneous, and directed caudad; cephalic process blade-like, partially corneous, lies cephalolaterad of central projection and directed

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Explanation of Plate

Fig. 1. Lateral View of carapace of holotype, *P. howellae.*
Fig. 2. Lateral view of distal portion of first pleopod, first form male, of *P. troglodytes* from Liberty County, Georgia.
Fig. 3. Lateral view of distal portion of first pleopod, first form male, of *P. paeninsulanus* from Bacon County, Georgia.
Fig. 4. Mesial view of first pleopod of holotype, *P. howellae.*
Fig. 5. Lateral view of first pleopod of holotype, *P. howellae.*
Fig. 6. Lateral view of distal portion of first pleopod, first form male, of *P. clarkii* from Aransas County, Texas.
Fig. 7. Lateral view of distal portion of first pleopod, first form male, of *P. okaloosae* from Covington Co., Alabama.
Fig. 8. Carpus, propus, and dactyl of cheliped of holotype, *P. howellae.*
Fig. 9. Mesial view of first pleopod of second form male morphotype, *P. howellae.*
Fig. 10. Lateral view of first pleopod of second form male morphotype, *P. howellae.*
Fig. 11. Epistome of holotype, *P. howellae.*
Fig. 12. Annulus ventralis of allotype, *P. howellae.*
Fig. 13. Antennal scale of holotype, *P. howellae.*
Fig. 14. Dorsal view of carapace of holotype, *P. howellae.*

caudodistad (and sometimes somewhat mesiad); caudal element consisting of a caudal process closely applied to the caudoproximal surface of the central projection, and an adventitious ridge-like prominence on the caudal and mesial flank of the caudal process — caudal knob not well-defined; central projection beak-like, corneous, and directed caudad (and sometimes somewhat mesiad).

Holotypic Male, Form I.—Body subcylindrical, only slightly compressed laterally; abdomen narrower than thorax (11.7-14.0 mm. in widest parts respectively); width and depth of carapace subequal in region of caudodorsal margin of cervical groove (14.0-14.1 mm.).

Areola narrow, about 16 times longer than broad with two punctations in narrowest part; cephalic section of carapace almost twice as long as areola (length of areola about 33.6 percent of entire length of carapace).

Margins of rostrum converging to base of acumen where there is a small acute tubercle on each side; acumen only slightly upturned at cephalic extremity; rostrum subplane above and without swollen margins, but margins distinctly elevated and flanked mesially by a row of setiferous punctations which continues onto acumen. Postorbital ridges not prominent, grooved laterally, and terminate cephalad in small acute tubercles; subrostral ridges well defined and evident in dorsal aspect to midlength of rostrum; suborbital angle scarcely discernible; brachiostegal spine well developed and acute; carapace with a small acute spine on each side. Surface of carapace punctate dorsally and granulate laterally.

Abdomen longer than thorax (31.8-29.7 mm.).

Cephalic section of telson with three spines in each caudolateral corner, the outer one considerably larger than the inner two which are subequal in size.

Epistome subovate, emarginate cephalically, and with an cephalomedian projection; margin elevated (ventrally) and sparsely beset with simple setae.

Antennule with a strong acute spine on ventromesial surface of basal segment.

Antenna extends caudad of base of telson; antennal scale broad with a well-developed spine on outer distal margin; lamellar portion rounded mesially, and broadest slightly proximad of middle (fig. 13).

Right chela slender, with inflated palm; palm studded with setiferous tubercles on all surfaces. Inner margin of palm with a row of nine tubercles which are only slightly larger than those immediately above and below this row. In addition to other tubercles on lower surface of palm strong conical tubercle present near base of dactyl. Fingers not gaping. Opposable margin of immovable finger with a row of five small tubercles on basal half, the third from base largest; a strong tubercle extends mesiad from lower opposable margin at base of distal two-fifths of finger; otherwise opposable margin with crowded minute denticles. Opposable margin of dactyl with a row of five small tubercles on basal half, the second and third from base largest; a strong tubercle extends laterad from lower opposable margin at distal end of basal third of finger; between and distad of these tubercles are crowded minute denticles. A low longitudinal ridge present on upper surface of both fingers; upper and lower surfaces of both fingers with setiferous punctations as is outer surface of immovable finger and distal three-fourths of dactyl; proximal fourth of dactyl with a few tubercles.

Carpus of first right periopod about 1.5 times longer than broad with a very shallow oblique furrow; mesial upper, mesial and mesial lower surfaces with tubercles; other surfaces with setiferous punctations. Upper mesiodistal margin with a prominent tubercle, and a large one on mesial surface near midlength of podomere; lower distal margin with two prominent tubercles, one at lateral and one as mesial angle.

Merus of first right pereipod with upper and lower surfaces tuberculate as are also the upper and lower portions of the mesial surface; lateral surface punctate; two strong acute tubercles near upper distal end of podomere; lower surface with a lateral row of 10 tubercles and a mesial one of 22, two in the lateral row are much longer than the others, and the distal one in the mesial row is the largest; a few additional tubercles present between and to the sides of these two rows.

Ischiopodite of first right pereiopod with a row of five tubercles along lower margin, and basipodite without tubercles.

Ischiopodites of third and fourth pereiopods with hooks; hooks simple, that on fourth opposed by a bituberculate prominence on the basipodite. Coxopodites of fourth and fifth pereiopods with accessory prominences: those on fourth swollen and extending caudoventrally, while those on fifth are smaller, project ventrally and are less inflated.

First pleopods slightly asymmetrical, the left one situated slightly caudad of the right, and reaching coxopodite of third pereiopod when adbomen is flexed. Cephalic surface of appendage with a distinct angular (acute) shoulder located near base of distal third of appendage; shoulder on right pleopod appressed against mesial surface. See diagnosis for description.

Morphotypic Male, Form II.—Differs from the holotype in the following respects: Lateral spines on rostrum more prominent; epistome more broadly ovate; cephalic section of telson with only one spine in the caudosinistral corner; inner margin of palm of chela with seven tubercles, opposable margin of immovable finger with only the two large ones, and opposable margin of dactyl with only the three tubercles; lower surface of merus of cheliped with mesial row of 15 tubercles and a lateral row of six; ischiopodite of cheliped with four tubercles on lower surface. The usual secondary sexual differences occur with smaller hooks on ischiopodites of third and fourth pereiopods and less well-developed armature of the coxae of the fourth and fifth pereiopods. First pleopod with all terminal elements represented and disposed as illustrated (figs. 9, 10). Shoulder on cephalic margin of pleopod not quite so well developed; shoulder on right pleopod more clearly evident in lateral aspect in that it is not so strongly appressed to mesial surface of appendage. (See Measurements.)

Allotypic Female.—Differs from the holotype in the following respects: Rostrum without lateral spines; epistome broadly ovate with central raised (ventrally) area; inner margin of palm of chela with a row of seven tubercles; opposable margin of immovable finger of chela with three tubercles and that of dactyl with four; lower surface of merus of cheliped with a lateral row of five tubercles and a mesial row of 15, and lower surface of ischiopodite with a row of four tubercles.

Annulus ventralis broader than long with cephalic margin elevated (ventrally) as a broad caudomedian knob-like area. Sinus originates on dextral side of median line near cephalic margin of annulus, makes an oblique S-curve and continues in a broad U-turn to the median line just cephalad of caudal margin of annulus (fig. 12). Sternum immediately cephalad of annulus bearing a number of large tubercles, several of which overhang (ventrally) the cephalic portion of annulus on each side of median line.

MEASUREMENTS (IN MILLIMETERS).

Carapace:	Holotype	Allotype	Morphotype
Height	14.1	12.5	10.9
Width	14.0	12.5	11.0
Length	29.7	26.1	23.9
Areola:			
Length	10.0	9.0	7.6
Width	0.6	0.9	0.6
Rostrum:			
Length	8.6	6.0	6.8
Width	4.4	4.1	3.7
Right Chela:			
Length of inner margin of palm	9.8	5.0	4.6
Width of palm	7.3	4.2	3.6
Length of outer margin of hand	24.6	13.3	12.9
Length of dactyl	13.2	7.3	7.1

The largest specimen available, a male form I, has a carapace length of 38.2 mm. The smallest first form male has a carapace length of 25.0 mm.

TYPE LOCALITY.—A small spring-fed drainage ditch on the campus of Wesleyan College at Rivoli, Bibb County, Georgia. The ditch leads into a small artificial pond some 30 by 50 feet and about five feet deep, and the overflow from the pond drains into a lake covering about six acres and finally joins other small streams to flow into the Ocmulgee River. Most of the specimens on which this description is based were collected from the ditch between the pond and lake. The ditch is very close to an almost pure stand of loblolly pine *(Pinus taeda)* but along its banks are the following trees and shrubs: *Liquidamber styraciflua, Quercus nigra* (predominant species), *Cornus florida, Magnolia grandiflora, Ilex opaca, Prunus serotina, Crataegus* sp. Here the water ceases to flow at times so that there are dry areas alternating with pools. At such times the crayfish may be found "in piles of very wet leaves as well as in the pools". Both *Procambarus spiculifer* (LeConte, 1856:401) and *Cambarus latimanus* (LeConte, 1856:402) have been collected from this stream.

Disposition of Types.—The holotypic male and allotypic female (No. 93158), and the morphotypic male, form II (No. 93159), are deposited in the United States National Museum. Of the paratypes, one male, form I, one male, form II, and one female are deposited in the Museum of Comparative Zoology, and two males, form I, seven males, form II, one female, five immature males, and four immature females are in my personal collection at the University of Virginia. The entire type series was collected in the type locality.

Range.—This species has been collected in three localities located in the Altamaha drainage system in Georgia. *Bibb County.*—the type locality: 1♂I, 1♂II, February 5, 1941; 1♀, 1943; 1♂II, February, 1950; 3♂♂II, January, 18, 1952; 3♂♂I, 4♂♂II, 2♀♀, 5♂♂imm., 4♀♀imm., March 3, 1952, all collected by Miss Thelma Howell. *Emanuel County.*—Ohoopee River, one mile east of Adrian, U.S. Hy. 80: 1♂II, March 25, 1950, D. C. Scott collector. *Telfair County.*—Turnpike Creek, one mile east of Milan on U.S. Hy. 280: 2♂♂I, 4♂♂II, March 26, 1950, D. C. Scott collector.

Variations.—Rostrum with or without lateral spines. Areola varies from 9 to 16 times longer than broad with two or three punctations in narrowest part. Suborbital angle in some specimens moderately well developed. Cephalic section of telson with from one to five spines in each caudolateral corner. Inner margin of palm of chela with a row of from seven to nine tubercles (seven most frequently). Opposable margin of immovable finger with a row of three to ten tubercles and that of dactyl with from four to eleven; however, the number of larger tubercles are as in holotype. Basipodite of fourth pereiopod without a bituberculate prominence opposite tip of hook on ischiopodite. None of these variations is correlated with local populations; however, the terminals of the first pleopods of the males from Telfair and Emanuel counties seem to be twisted somewhat clockwise so that the mesial process springs from the cephalomesial angle of the appendage and the central projection is directed caudomesiad.

Relationships.—*Procambarus howellae* has its closest affinities with *Procambarus paeninsulanus.* These two species, occupying adjacent ranges, (see below) appear to be more generalized members of the subgroup while their more specialized relatives *P. clarkii* and *P. okaloosae* are found to the west and *P. troglodytes* to the northeast. *P. howellae* can be distinguished from its relatives by the laterally displaced, blade-like cephalic process of the first pleopod and by the structure of the annulus ventralis with the ornate sternum lying immediately cephalad of it.

Key to the Species of the Clarkii Subgroup (Genus *Procambarus*)

[Based on First Form Males]

1 Cephalic process of first pleopod consisting of a broad rounded lobe, the caudodistal margin of which may be angular or rounded (Figs. 2, 6, 7) 2

1′ Cephalic process acute (Figs. 3, 5) 4

2 (1) Caudal margin of cephalic process with a distinct angle (Figs. 6, 7) .. 3

2′ Caudal margin of cephalic process rounded, never with a distinct angle (Fig. 2) .... *P. troglodytes* (LeConte)
Range: North of the Altamaha River in Georgia and South Carolina.

3 (2) Gap between cephalic (B) and caudal (D) processes greater than one-half the width of the caudal process (Fig. 6) .... *P. clarkii* (Girard)
Range: Texas to Escambia County, Florida, and north to Arkansas and southern Kentucky.

3′ Gap between cephalic (B) and caudal (D) processes less than one-half the width of the caudal process (Fig. 7) .... *P. okaloosae* Hobbs
Range: Between the Yellow and Perdido rivers in Alabama and Florida.

4 (1′) Distal portion of first pleopod bulbous; in lateral aspect constricted immediately distad of shoulder (Fig. 3) .... *P. paeninsulanus* (Faxon)
Range: From the Choctawhatchee River to the Atlantic Ocean, and from southern Georgia to Hillsborough County, Florida.

4′ Distal portion of first pleopod tapering; in lateral aspect never constricted immediately distad of shoulder (Fig. 5) .... *P. howellae* sp. nov.
Range: Tributaries of the Altamaha River in Bibb, Emanuel, and Telfair counties, Georgia.

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A HERPETOLOGICAL SURVEY IN THE VICINITY OF LAKE SHIPP, POLK COUNTY, FLORIDA

Sam R. Telford, Jr.
Winter Haven, Florida

Polk County is the third largest county in Florida, 1,992 square miles in area. It is situated in the highest section of the State and small areas of it have yet to be despoiled. Many of its numerous lakes are still surrounded by dense woods and swamps. One of the major rivers of south-central Florida, the Peace River, has its origin in the outlet of Lake Hancock, about ten miles from Winter Haven, in Polk County. The principal industries of the region are citrus, cattle and phosphate.

Lake Shipp is one of the county's many medium-sized lakes (about 0.6 miles wide by 0.7 miles long). The north-eastern side of the lake forms the Winter Haven city limits, the south-west side, which is now still thickly wooded, will probably be turned into residential districts within the next few years.

Seventy-six acres of woodland and citrus grove constitute the main locality for my observations between 1944 and 1950. During this period I have collected 52 forms of reptiles and amphibians. These represent almost one-third of the 179 forms recorded from Florida.

The woodland is composed chiefly of pine, bay and palmetto, with scattered oak, cypress, dahoon holly, maple, myrtle and guava. There are 16.5 acres of citrus grove, and the remainder is woodland. The soil is principally Leon Sand.

Specimens of the species listed, with the exception of *Terrapene c. bauri* and *Gopherus polyphemus,* are in my collection. When hatching of snake or lizard eggs is indicated, the incubating medium was damp sawdust or wood shavings—a material which has proven extremely satisfactory. Damp sand is apparently better for turtle eggs.

Species designated by an asterisk indicate new records for the county.

I wish to particularly thank Mr. Chester A. Mann of Winter Haven, Florida for his encouragement and help during the preliminary preparation of this paper, and Dr. James A. Oliver of the

Department of Biology, University of Florida for his generous advice and criticism. I also wish to thank Dr. Arnold B. Grobman, Dr. Archie F. Carr, and Mr. Edwin H. McConkey of the same department for critically reading the manuscript.

* *Amphiuma means means* Garden—The "Congo Eel" may be found in numbers, during the spring, summer and fall, under the mats of water hyacinths and other aquatic vegetation along the lake shore. All specimens collected have been rather small; the largest, only 306 mm in total length, was found under the roots of a willow tree removed during some clearing operations on August 28, 1950.

* *Manculus quadridigitatus* (Holbrook)—I have collected ten of these small plethodontids in the area. Four were found among water hyacinths, and six under objects along the lake shore. None were found between 1946 and 1950. On May 14, 1950 a specimen was dug from among water hyacinths. Measurements are 22 mm snout-vent length, 33 mm tail length. Since then, several more have been found.

* *Siren lacertina* Linnaeus—"Mud Eels" are uncommon compared to the preceding species. Specimens have been collected in May, August, and November. Most are rather small; the largest, collected under the same tree root with the previously-mentioned *Amphiuma,* was 407 mm in total length.

Scaphiopus holbrooki holbrooki (Harlan)—Spadefoot Toads are seen about twice a year, following the heavy spring and midsummer rains. At such times they are abundant, and the chorus is deafening.

Bufo quercicus Holbrook—Oak Toads are abundant throughout the dry pine woods; they appear to be largely diurnal.

Bufo terrestis terrestis (Bonnaterre)—Toads are very common, and may be found all year round.

Acris gryllus dorsalis (Harlan)—Probably the most common frog of the region is the Cricket Frog. Occasionally, I have found it over 100 yards from water.

* *Pseudacris ocularis* (Holbrook)—The presence of any form of *Pseudacris* in this area was unsuspected until February 18, 1950. While digging in a sphagnum bed in search of *Manculus,* two small *Pseudacris* were uncovered. The frogs were apparently just

coming out of hibernation, as they were inactive and an odd shade of grayish-white, which matched the moss they were in. From then until the 19th of March, 12 specimens were taken. March 19th was the first really warm day, and 24 specimens were taken in an hour or so, many more eluding capture. Specimens range from brick-red to dark brown in color. The largest of these frogs taken was 18 mm snout-vent; the smallest was 11 mm snout-vent.

* *Hyla cinerea cinerea* (Schneider)—Green Tree Frogs were formerly abundant in an old overgrown clay-pit about 500 yards from the lake, but they have almost disappeared during the last two years. The largest specimen is 52 mm snout-vent length.

* *Hyla gratiosa* Le Conte—One adult was found in April, 1946. Snout-vent length is 61 mm. This specimen was found in company with numerous *H. c. cinerea,* in the previously mentioned clay-pit. I have seen only six *gratiosa* from the Winter Haven area.

Hyla squirella Latreille—This frog is fairly common and is usually found in palm and palmetto fronds, and under eaves of sheds.

Rana catesbeiana Shaw—Bullfrogs have been found in an old clay-pit, but they seem to be uncommon. The largest specimen measured 195 mm snout-vent.

Rana pipiens sphenocephala (Cope)—The Leopard Frog is our most common *Rana.* Specimens are frequently found with a snout-vent length of five inches. These frogs appear to be the principal food of *Natrix s. pictiventris.*

Microhyla carolinensis carolinensis (Holbrook)—"Rubber" Frogs, as they are known locally, are usually found in and under rotten logs and other decaying vegetable matter. The most common color phase is light gray.

Eleutherodactylus ricordi planirostris (Cope)—These small frogs are common among litter on the floor of an abandoned barn. Two color phases are found. Thirteen adults and four juveniles of the striped phase were taken. Two measured 28 mm in snout-vent length; the others were about 18 mm in snout-vent length. Seven adults and 6 juveniles of the mottled phase were taken. The largest was only 20 mm in snout-vent length, and the average is about 14 mm in snout-vent length. Specimens were collected in June, September, and October 1949. Three clutches of eggs were found in another locality, on September 4, 1950, while searching for *Neoseps* in decaying logs.

Alligator mississippiensis (Daudin)—Alligators have occasionally been seen during the past five years. The last one I personally observed, in August, 1948, was approximately three feet long. Later during the same month, a friend and I released a six foot gator from another locality. During September, a neighbor told me that he had killed three gators in one night along the lake shore. None were seen until October, 1949, when it was reported that three young ones had been seen in shallow water. Another was released on September 15, 1950.

Anolis carolinensis carolinensis (Voight)—The Carolina Anole is probably our most common lizard. Specimens may be collected at any time of the year. One deposit of three eggs was found.

Leiolopisma laterale (Say)—Ground Skinks are common among fallen leaves. One female contained five eggs; size of one hatchling was 34 mm in total length. My largest specimen measured 40 mm snout-vent length and 80 mm tail length.

Eumeces inexpectatus Taylor—Thirteen *E. inexpectatus* have been collected. Two are exceptionally large, 85 and 86 mm in snout-vent length. These are larger than any of the Lake Shipp *laticeps* that I have collected. From my observations, *E. laticeps* is more often found in dry woods and *inexpectatus* is usually in close proximity to buildings, trash heaps, etc.

* *Eumeces laticeps* (Schneider)—I have collected 8 Broad-headed Skinks from the area. *Eumeces* is very common, but the majority are *inexpectatus*. The largest specimen is rather small for the species—only 80 mm in snout-vent length.

Cnemidophorus sexlineatus (Linnaeus)—"Race-runners" are fairly common on high dry ground. One female deposited four eggs. A specimen collected on March 19, 1950 had a forked tail; the forks being about two inches long.

Ophisaurus ventralis ventralis (Linnaeus)—"Glass" Lizards are common all year round. Large numbers are killed when the groves are cultivated twice a year. Tails of 6 perfect specimens averaged 68% of the total length. On June 10, 1950 a female *Ophisaurus* was found coiled around seven eggs in a small hollow under a box. On other occasions deposits of seven and thirteen eggs were found in decaying vegetable matter. Size of several hatchlings averaged 85 mm in total length.

* *Farancia abacura abacura* (Holbrook)—Mud snakes are rather rare; only five specimens were taken in three years, and none since April, 1947. One four foot specimen ate a large *Amphiuma;* all other food was ignored. Three were over 36 inches in total length.

* *Diadophis punctatus punctatus* (Linnaeus)—Ring-neck snakes are fairly common. The largest specimen measured 349.25 mm in total length. A female, 286 mm in total length, contained four eggs; several clutches of three to seven eggs have been found. Hatching time of two clutches was about 43 days; the size of one hatchling is about 85 mm total length.

* *Rhadinaea flavilata* (Cope)—Four specimens were collected. One, a female, 207 mm total length, laid four eggs, 20 mm x 4 mm. All specimens were found beneath logs along the creek bank and lake shore. None would accept food while in captivity.

Heterodon platyrhinos platyrhinos (Latreille)—Spreading Adders are common in the area; the last one was seen on November 9, 1949. Males are usually brightly colored, with orange, yellow or red between the scales. One melanistic female, 838 mm in total length was collected. Three females, 814 mm, 736 mm and 650 mm, total lengths, deposited clutches of 28, 17, and 15 eggs, respectively. These averaged 33 mm x 18 mm and took approximately eight weeks to hatch. Eggs were laid on the fifth and ninth of July, 1946.

* *Opheodrys aestivus* (Linnaeus)—Seven specimens were collected; the most recent, a female 762 mm total length was found dead on the road, October 2, 1949. The largest was a male, measuring 967 mm total length. The tail is about 28 per cent of the total length. Captive specimens, although very nervous, fed readily on green, short-horned grasshoppers.

Coluber constrictor priapus (Dunn and Wood)—Blacksnakes are our most common snakes; I have seen as many as 19 in one hour. A female, 1070 mm in total length, laid 20 eggs on May 25, 1947. The eggs hatched about ten weeks later; the hatchlings averaged ten inches in total length. All specimens I have had in captivity would often accept *Eumeces* in preference to other food offered. *Hyla c. cinerea* was also readily accepted. Other items of food include *Rana p. sphenocephala, Anolis, Cnemidophorus,* and an occasional small bird or rodent. Only one case of ophiophagy has been noted; while walking along the lake shore, I noticed a blacksnake, about four feet long, attempting to engulf a *Farancia* about three inches shorter than itself. The mud snake was already dead when I arrived upon the scene, so no conclusions could be drawn about the snake's demise. This snake, as with others of its kind, showed no hesitancy about taking to the water to evade capture. Only one case of agressiveness has been observed, and this was in another locality. A small blacksnake, about three feet long, followed me for about fifty feet along a ditch bank, and persisted in striking at my ankles. There were numerous others of its kind along the bank, as it was a hot April day, but all others carefully avoided me.

* *Coluber flagellum flagellum* (Shaw)—Coachwhips are not common in the area. I have seen six from the tract under observation; the smallest was about five feet four inches, and the largest seven feet two inches. Of about a dozen from the Winter Haven area, these were the palest in coloration, with almost no black or brown anteriorly.

* *Elaphe guttata guttata* (Linnaeus)—Red Rat snakes are scarce in this region. The average length of specimens is about three feet; the largest I've seen was four feet nine inches. Juveniles are more or less common from late September through November. Most of my specimens came from around buildings, occupied or vacant. This snake appears to be very particular about its food habits; small ones sometimes accept *Anolis,* but the almost invariable item on the list is young rodents.

Elaphe obsoleta quadrivittata (Holbrook)—Chicken snakes are occasionally found in the area; they appear to be more common than the preceding species. Average length is about five feet; the juvenile blotches are usually evident on the largest adults. I have seen only a few hatchlings in the wild; one, apparently newly hatched, was found in an abandoned barn on October 10, 1949. This individual measured 349 mm total length, and possessed 39 sharply-defined dorsal blotches. All specimens I have had were excellent feeders, including in their diet rodents, birds, eggs, raw meat, *Anolis,* and *Hyla c. cinerea.*

Lampropeltis doliata doliata (Linnaeus)—Scarlet King snakes are rare in the Winter Haven area. Two specimens from Lake Shipp have been collected—a specimen 333 mm total length was caught in 1946, and a 487 mm total length specimen was found dead on the road February 12, 1950.

* *Lampropeltis getulus floridana* Blanchard—Four King snakes were caught between 1944 and 1946; none since then. The largest was a male, five feet seven inches total length. A four foot female, captured two months before under the same cover as the male, deposited 10 eggs on July 4, 1946. The eggs averaged 51.6 mm x 19 mm, and hatched on August 28, 1946, 55 days later. The average hatchling size was 363 mm, total length; the coloration was jet black with bright yellow markings. The adults were dull brown, with the male slightly darker in color. The female very closely resembled *L. g. brooksi*. A three foot specimen (September, 1946) was evidently in the transition period, as each of the black scales had a brownish edge. The previously mentioned female was in captivity three years, and during that time was an indiscriminate feeder, with a slight preference for warm-blooded prey.

* *Natrix cyclopion floridana* Goff—Green Water snakes are fairly common along the lake shore. I would say, from the average run of specimens of Florida's three larger types of water snakes, that this species is by far the largest. The average length seems to be about 50 inches. The other two forms, *N. s. pictiventris* and *N. taxispilota,* average about 38 and 33 inches, respectively. This estimate is based on my observations in the South-central Florida area. My largest specimen, a female (April, 1946) was five feet six inches in total length. Most specimens were reluctant to eat, and those that did, ate only fish.

* *Natrix sipedon pictiventris* (Cope)—Banded Water snakes are very common here, as in almost all localities in Florida. Erythrism is not uncommon in this species. Specimens of *pictiventris* are usually very good feeders, with a preference for *Rana* and small fish. Females 793 mm and 853 mm in total length gave birth to litters of 11 and 21 respectively. Litters born to captive specimens indicate that *floridana* is the most prolific of the three forms of *Natrix* known from the area. Observations included litters of 101,[1] 37, 11, and 8 (one female contained 67 embryos) from females of three to five and one-half feet long.

[1] S. R. Telford, *Herpetologica*, Vol. IV, part 5 (1948).

* *Natrix taxispilota* (Holbrook)—Brown Water snakes are less common, and usually smaller (at least in South Florida) than the two preceding species. These appear to be better climbers and are usually found in low branches over-hanging the water, and on dock supports. My specimens were much more vicious than the preceding species, and I have yet to be successful in inducing one to feed. One four foot female contained 47 embryos (June, 1944).

Seminatrix pygaea cyclas Dowling—I have collected only one from this lake, but have seen a few others. The form apparently prefers water hyacinths to other cover.

* *Liodytes alleni* (Garman)—This snake is much more common than the preceding. Numerous specimens were disclosed during a hyacinth eradication program. One female, 508 mm, contained 15 embryos, about 50 mm long. Of six Lake Shipp specimens, only one has a completely plain, unspotted ventral surface. Two have clear ventrals, but the subcaudal dividing line is dark. Three have readily discernible dark spots along the posterior half of the ventrals. A colored slide, made before the preservation of one specimen, reveals the dark spots much clearer than they now appear. I believe these specimens are intergrades between *L. a. alleni* (Garman) and *L. a. lineapiatus* Auffenberg. One juvenile, 160 mm total length was captured on July 22, 1950.

* *Thamnophis sirtalis sirtalis* (Linnaeus)—Garter snakes, once very common, are still found occasionally. Specimens from this region are light green to gray in color. A large specimen, 1120 mm, was captured in July, 1946; the average length is about 30 inches. One litter of four was born dead in August, 1947.

* *Thamnophis sauritus sackeni* (Kennicott)—Ribbon snakes rank second to *Coluber c. priapus* in abundance here. The average length is about 26 inches; my largest was 891 mm. Several litters, all born to females over 28 inches long, numbered 12, 16, 17, 22, and 26. Most were born in July and August. One female, after giving birth to 12 healthy young on July 9th, 1946, gave birth on September 16th to 4 malformed, contorted, dead young. Every litter was accompanied by 2 or 3 yellow infertile eggs. Size of snakes at birth was about 224 mm. Although nervous, these snakes are usually good feeders, preferring *Hyla c. cinerea* to other food.

Micrurus fulvius fulvius (Linnaeus)—Only two Coral snakes have been seen in the Lake Shipp area. One, captured in October, 1947 escaped two days after capture. The other, 534 mm in total length, was caught in January, 1949 as it emerged from a bed of fallen leaves under an oak tree. It disgorged an *Ophisaurus* 163 mm long. Coral snakes are rather scarce in Polk County, and appear to be most conspicuous from October to March.

Agkistrodon piscivorus piscivorus (Lacepede)—I include this form as a doubtful entry, as no specimens have been taken. In early 1944, a moccasin was killed on the lake shore. Unfortunately, positive identification was impossible. Undoubtedly, *Agkistrodon* was found along the lake in previous years.

Crotalus adamanteus—Diamond-backs were plentiful in the area until as late as 1941. Five specimens have been collected or reported by reliable sources since then. One, a juvenile, was permitted to go its way in peace (1946). One was killed by fishermen as it swam up to their boat in early 1947. The largest, 5 feet 3 inches, was captured in November, 1947 in a palmetto area about fifty yards from the lake. On May 23, 1950, at 6:00 P.M., a neighbor killed a diamond-back 38 inches in total length. In November, 1950, some workers clearing a lake front area attempted to kill a five foot rattler, which disappeared in the underbrush. I believe these last three were strays, and that the species no longer breeds in this vicinity. The largest rattlesnake I have seen was killed in an orange grove on Eagle Lake, less than a mile away. This specimen was seven feet three inches in total length, excluding the rattle, and had a circumference of 15 inches. The fangs measured 27 mm along the outside curve. Fortunately I was able to save the skin and fangs. Polk County ranks third in the State in abundance of rattlesnakes ("Florida Wildlife", September, 1949), but I rarely see over five or six a year. Mr. E. Ross Allen tells me that the largest rattler his Reptile Institute has received was a seven foot three inch individual from Polk County. Because of the exceptional length of the Eagle Lake specimen, the following characters may be of interest: sex, male; ventrals, 175; sub-caudals, 26; scale-rows, 34-28-21; 31 dorsal blotches, 7 tail bands, and 7 rattles.

Sternotherus odoratus (Latreille)—Musk turtles up to about one inch in length are exceedingly common. As they mature, apparently they scatter, thin out, and develop more secretive habits. In a half-hour, with a wire scoop along the lake shore, in Spring and Summer, I can usually catch several dozen of the year's hatchlings. Apparently, no more than two eggs are deposited at a time, with a hatching time of about three months. I believe this species breeds year round, as I have found eggs in all stages of development every month of the year.

Kinosternon bauri bauri (Garman)—Adults and juveniles are equally abundant. The mud turtles lay two or three eggs at a time, in drier material than the preceding species. Adults from creeks and swamps are much darker in coloration than those from the lake. Females are usually paler, almost tan in coloration. These *bauri* are very similar to *K. b. palmarum*.

Kinosternon subrubrum steindachneri (Siebenrock)—Uncommon, juveniles are rare. These turtles grow to a larger size than *bauri*, and their disposition is on a par with the worst of the turtle clan. I have yet to find a specimen in shallow water in this lake, all being taken on hook and line.

Chelydra serpentina osceola (Stejneger)—Snappers are common in Lake Shipp. The largest from the lake weighed 16 pounds. The young are occasionally found in company with juvenile *Sternotherus* and *Kinosternon b. bauri.* Medium-sized and large specimens are often caught while fishing with live bait for bass. The larger ones provide good eating, but the meat is not comparable to *Amyda* meat.

Terrapene carolina bauri (Taylor)—Only one specimen was recorded; an average-sized specimen was captured under a palmetto in October, 1945. The specimen was not preserved.

Pseudemys floridana peninsularis Carr—"Cooters" are common, especially in the Spring. Specimens are easily collected in the morning, while feeding in shallow water. All stomachs examined contained only vegetable matter. Young are occasionally found in late Summer.

Pseudemys nelsoni Carr—Two specimens were recorded. One young adult was found in August, 1949 and a large female was caught in June, 1949. The female laid two eggs, 47 mm x 19 mm in size, a short while after capture. I have found this turtle rather uncommon in all localities.

Deirochelys reticularia (Latreille)—Chicken Turtles are occasionally found in shallow water. In other parts of the county, they appear to be common, judging from the number found dead on the roads.

Gopherus polyphemus (Daudin)—One medium-sized adult was caught in August, 1948. The soil, locally is not typical of the usual Gopher habitat, which is generally St. Lucie Fine Sand, or Norfolk Sand, so I think this one was a wanderer.

Amyda ferox (Schneider)—Soft-shelled Turtles are rarely seen, probably because of their secretive habits. Occasionally, a large one is caught while fishing. A few young can be found while scooping for *Sternotherus* and *Kinosternon*.

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PARASITIC CRUSTACEANS FROM ALLIGATOR HARBOR, FLORIDA

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From April 16 to June 16, 1952 the writer worked at the Oceanographic Institute of the Florida State University at Alligator Harbor. The Director, Dr. Harold J. Humm, did everything he could to further my search for parasitic crustaceans. The caretaker at the Institute, Richard Durant, also helped materially in the collection of hosts. Professor Franklin Olson, William Hargis, Charles Yentsch, Edward Joseph, and others helped in the collection and identification of hosts. Dr. Fenner Chace of the United States National Museum gave free access to E. B. Wilson's collection of copepods and their literature. Grateful acknowledgment is made to these persons. An account of the commensals and parasites observed follows.

Order COPEPODA

Suborder ARGULOIDA

Family ARGULIDAE

Argulus americanus Wilson

A single female was taken from the outside of the head of a bony gar, *Lepisosteus osseus* (L.).

Argulus laticauda Smith

Ten females were taken from the skin and mouths of nine stingarees, *Dasyatis sabina* (Le Sueur).

Argulus megalops Smith

A single female was collected from the gills of six toadfishes, *Opsanus tau* (L.).

Argulus varians Bere

Two females were taken from the skin of a bat-fish, *Ogcocephalus nasutus* Ginsberg, and from a spiny boxfish, *Chilomycterus schoepfi* (Walbaum).

Suborder NOTODELPHYOIDA

Family MYICOLIDAE

Pseudomyicola glabra Pearse

Fourteen females were collected from ten oysters, *Ostrea virginica* Gmelin.

Family DOROPYGIDAE

Doropygus molgulensis n. sp.

Figure 1

Host.—Several females were taken from the branchial cavity of ascidians, *Molgula occidentalis* Traustedt, trawled in Alligator Harbor on June 3.

Female.—Head elongated and turned down very little. First thoracic segment shorter than those that follow. Incubatory pouch inflated and rounded dorsally; eggs large, 4-6 in number, urosome 4-segmented, fourth segment shortest; genital segment longer than any in the abdomen. Caudal rami slender, with two terminal setae, more than twice as long as last abdominal segment.

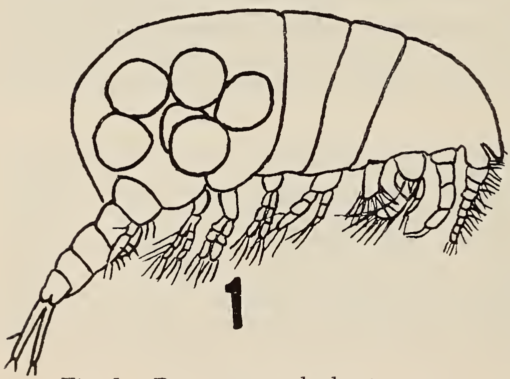


Fig. 1. *Doropygus molgulensis* n. sp.

First antennae 9-segmented; basal segment longer than wide, the base wider than distal end; second segment wider than long, as are the third, fourth and fifth; sixth segment as wide as long; seventh and eighth wider than long; ninth longer than wide; the basal segment has a stout anterior seta; segments 2-8 are setose on the anterior margins, 9 is also setose at tip. Second antennae slender, 4-segmented; all segments longer than wide and about equal in length; stout setae near the distal end of the second and fourth segments; a curved terminal hook at the distal end of the fourth.

The legs are all biramous and have 3-segmented rami, except the first in which the endopod is 2-segmented, the terminal segment strongly tapering. Fifth leg 2-segmented, the terminal segment three times as long as the basal and with five equally spaced short setae on the distal two-thirds of the anterior border and a longer and a shorter terminal seta; also a short seta on the posterior border of the basal segment.

Length.—1.3 mm.

Type.—U. S. Nat. Mus. No. 93714.

Male.—Unknown.

This species is somewhat like Wilson's (1932) *D. laticornis,* but is smaller in size, has longer caudal rami, different segmentation of the endopods of the first and second legs.

Doropygus robustus n. sp.

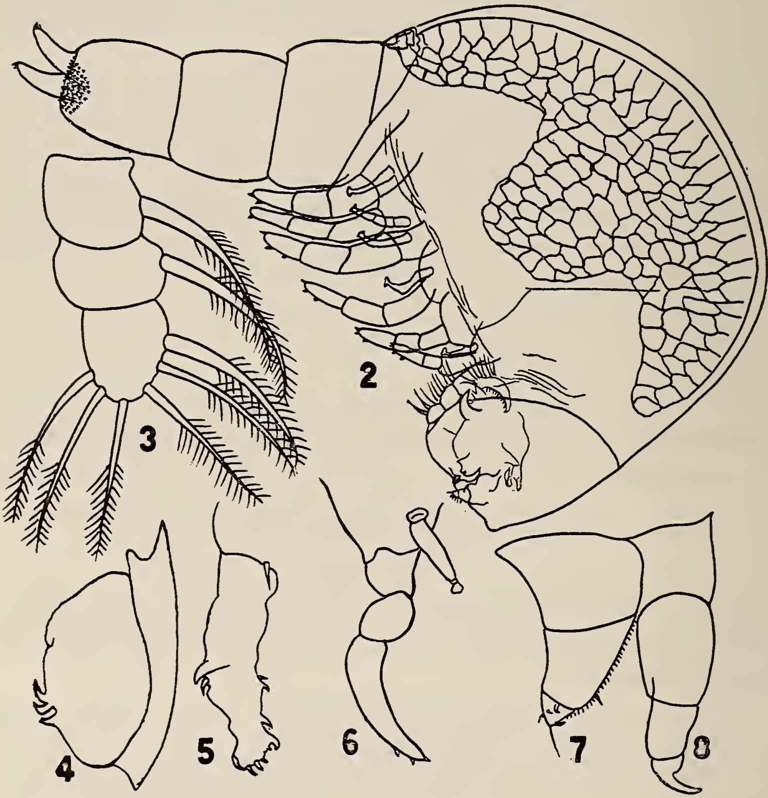
Figures 2-8

Hosts.—Seventeen females were taken from the branchial cavities of thirty-five ascidians, *Styelia plicata* (Le Sueur), dredged in Alligator Harbor.

Female.—Head turned ventrally; the front with a short rounded process, the dorsal posterior corner angulate. Thoracic segments not clearly defined, except along the ventral margin; first segment shortest, second segment a little longer, third and fourth segments a trifle longer and about equal in length. Incubatory pouch much inflated dorsally and containing more than 700 eggs. Genital segment mostly covered by the brood pouch. Abdomen 3-segmented, the segments increase in length slightly from front to rear and decrease slightly in width; last segment indented to anus and minutely spinulose at tip. Caudal rami slender, tapering, two-thirds as long as anal segment, with three short setae at tip.

First antennae 3-segmented; basal segment wider than long, tapered; second about the same length as the basal, but tapered, armed with a small curved spine at tip; two terminal segments minutely spinulose; segments poorly defined. Second antenna 3-

segmented, the second segment longest; terminal curved hook with an expanded base.



Figs. 2-8. *Doropygus robustus* n. sp. 2, side view of female; 3, exopod of first leg; 4, fifth leg; 5, endopod of second leg; 6, third leg; 7, first antenna; 8, second antenna.

First legs biramous, rami 3-segmented; with long plumose setae:—exopod (Fig. 3): 1, 1, 6, and a spinulose tip; endopod: 1, 1, 7. Legs 2-4 are biramous; exopods all 3-segmented, segments increasing somewhat from proximal to distal, minutely setose and with about three small spines at and near tip; endopods (Fig. 6) slightly more than a third the length of the exopods, unsegmented, with spines at tip and on margins. Fifth legs short, wide, uniramous, 2-segmented, with three curved spines at tip.

Length of body, 5.7 mm.

Type.—U. S. Nat. Mus. No. 93715.

Male.—Unknown.

This species differs from other notodelphids in the great extent of the brood pouch, the rudimentary character of the endopods of legs 2-4, the lack of setae on the caudal rami, and the large number of eggs in the brood pouch.

Suborder Cyclopoida

Family ERGASILIDAE

Ergasilus lizae Kryer

Fourteen large females were taken from the gills of the striped mullet, *Mugil cephalus* L., and thirteen from those of the white mullet, *Mugil curema* Curier & Valiencennes.

Ergasilus mugilis Vogt

Fifty-nine were taken from the gills of twenty-one striped mullet, *Mugil cephalus* L.

Family BOMOLOCHIDAE

Tucca impressus Kryer

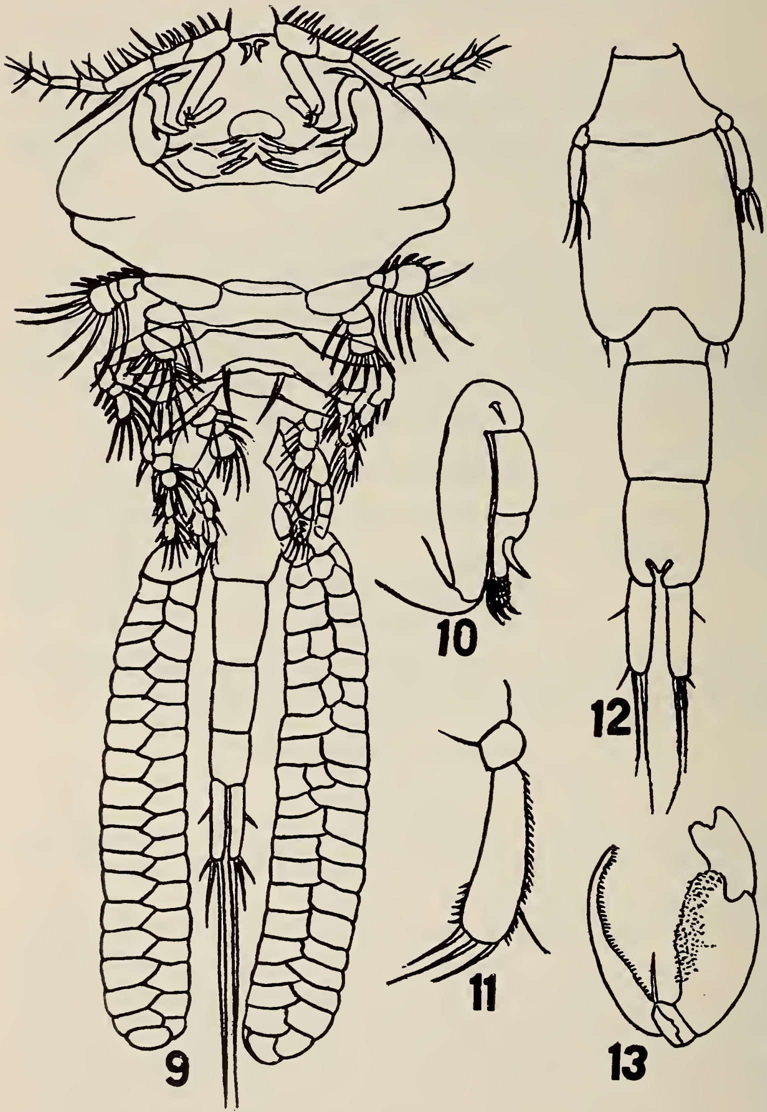
Fourteen females and males were taken from the gills of four spiny boxfishes, *Chilomycterus schoepfi* (Wallbaum).

Bomolochus achirus n. sp.

Figures 9-13

Hosts.—Six females, a male, and a young male were taken from the gills of thirteen hog chokers, *Achirus fasciatus* Lacepede, collected in Alligator Harbor.

Female.—Cephalothorax almost twice as wide as long (1.0-0.51 mm.). First thoracic segment fused with head and separated by deep lateral sinuses from the second segment. Cephalon rounded in front; separation from first thoracic segment indicated by lateral indentations; first segment almost as wide as cephalon; second segment much narrower than first (0.8-0.52 mm.); third, fourth and fifth segments progressively narrower. Genital segment not as wide as preceding segment. Abdomen slender, 3-segmented, segments shorter toward posterior; caudal appendages a little longer than preceding segment, with a short lateral seta near base and a



Figs. 9-13. *Bomolochus achirus* n. sp. 9, female; 10, second antenna; 11, fifth leg; 12, posterior end of male; 13, maxilliped of male.

short, intermediate, and a very long terminal seta. Egg strings (1.2 mm.) reach almost to tip of long setae on caudal appendages.

First antennae long and slender, setose and spinulose on anterior border; one long forwardly directed seta on the base and one backwardly directed at the tip of the base. Two small spines occur between the bases of the antennae. Second antenna stout, a corrugated finger-like process at its tip; the terminal segment with a curved spine near its base and three more slender curved spines at its tip. The second segment has a stout lateral seta near its tip.

The mandibles lie along the posterior border of the upper lip and terminate in a single spine. The first maxilla ends in two stout setae. The second maxilla ends in a single smooth spine. The maxilliped has a stout basal segment and an s-shaped sharp terminal claw which bears a stout basal seta and a sharp lateral hook; the basal segment bears two spines, a stout one at its base and a more slender setose one on its inner margin.

All the swimming legs are biramous and have 3-segmented rami. The fifth legs are 2-segmented with a lateral and three terminal setae; the lateral margin is minutely setose throughout and the median margin on its distal fourth.

Length of female, 2.59 mm.; width of cephalothorax, 1.24 mm., length, 0.95 mm.; length of abdomen, 0.9 mm.; length of egg strings, 1.62 mm.

Type.—U. S. Nat. Mus. No. 93716.

Male.—The body is much smaller than that of the female. The cephalothorax is longer than wide. The second maxillae end in strong curved hooks. The maxillipeds end in a single strong curved hook which is finely spinulose along its entire inner margin; the preceding segment is spinulose on its inner basal third and bears a seta on its distal angle. The swimming legs are similar to those of the female. The abdomen is also 3-segmented but the first segment is shortest and the middle segment longest. The genital segment bears a small appendage with a single terminal seta at its posterior corners. The caudal rami are similar to those of the female.

Type.—U. S. Nat. Mus. No. 93717.

Length of male, 1.24 mm.; width of cephalothorax, 0.42 mm., length, 0.35 mm.; length of abdomen, 0.4 mm.

This species differs strikingly from other in the genus Bomolochus in the shape of its cephalothorax, the proportions of the male and female abdominal segments. It differs from Wilson's (1913) *B. nothrus* and *B. attenuatus* that he described from the West Indies in the number of segments in the exopod of the first swimming legs, the length of the abdomen, the shape of the cephalothorax, and the size of the abdomen in relation to the egg strings. It is named for its host, *Achirus fasciatus* Lacepede.

Bomolochus mugilis n. sp.

Figures 14-17

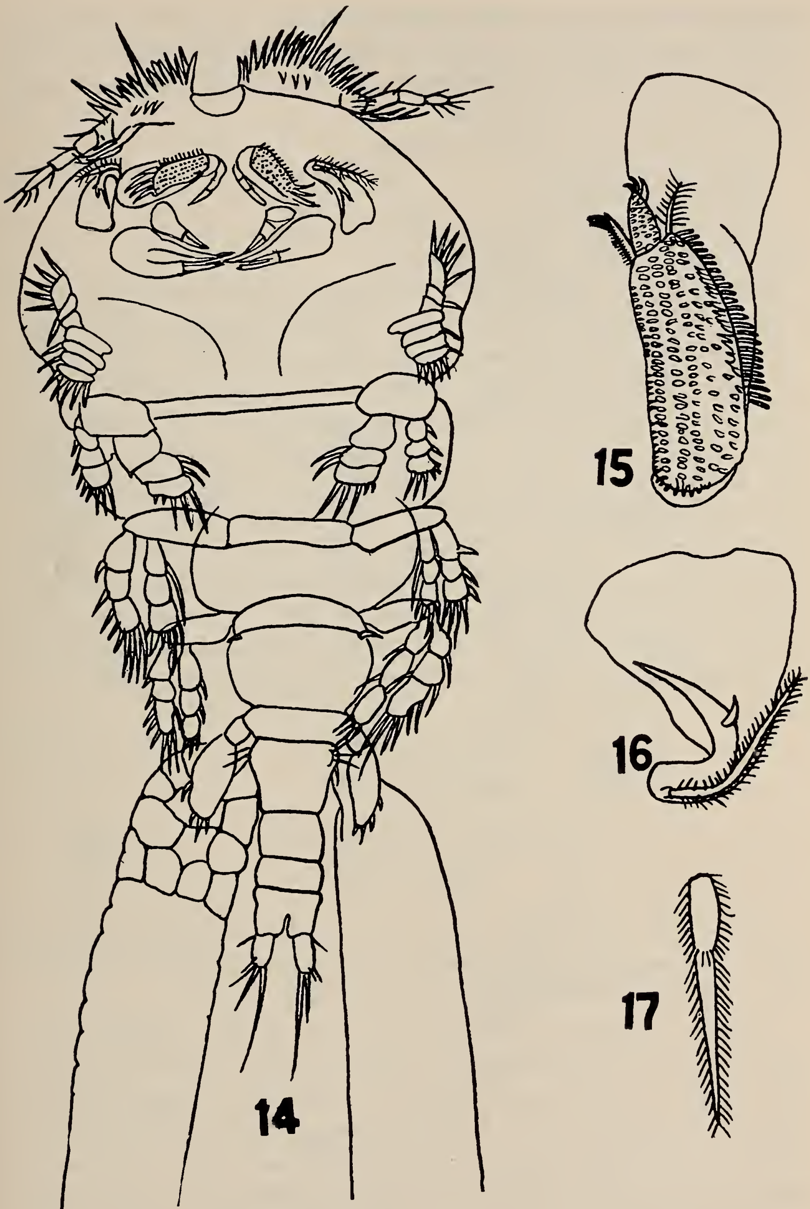
Hosts.—Eight females were taken from the gills of twenty-one mullet, *Mugil cephalus* L., from Alligator Harbor on May 7.

Female.—Cephalic segments rounded in front, about twice as wide as long. Metasome segments decrease in width posteriorly. Genital segment about as wide as preceding segment. Abdomen 3-segmented; second segment shortest; third segment longest. Caudal rami about as long as preceding segment; with a short lateral, two short and two long terminal setae. Ovisacs with 3-4 eggs across, about the same length as the body (2.1 mm.).

First antenna densely setose at base and segments not easily observed; setae spinulose near base and slender near tip; one very long seta near the end of the densely setose basal portion. Second antenna with a smooth basal segment, rugose second segment with a row of small lateral spines with recurved tips, and a bifid terminal rugose segment with one and three spines at the tips of the branches. There is also a terminal seta.

The mandibles are slender and turned under the upper lip. The first maxilla is more robust and ends in three stout setae. The second maxilla has a stout backwardly directed basal segment and ends in two setose tapering segments. The maxilliped has a wide triangular basal segment; the terminal claw is S-shaped, has a sharp lateral spine and a long plumose seta that arises near its base.

The first legs have 3-segmented rami; those of the endopod are very wide, the terminal segment bears five plumose setae, the first and second segments each bear one; the exopod bears 0, 1, and 5 plumose setae. The 2, 3, and 4 legs have 3-segmented rami; the endopod of the second legs has very wide segments with 0, 2, and 5 setae; three of those of the last segment are plumose, stout and



Figs. 14-17. *Bomolochus mugilis* n. sp. 14, female; 15, second antenna; 16, second maxilliped; 17, seta from endopod of third leg.

long, the other two are short. The plumose setae on the endopods of the second legs are peculiar in having setae across them near the base (Fig. 17). The fifth legs are 2-segmented, with one lateral and three short terminal setae.

Type.—U. S. Nat. Mus. No. 93728.

Male.—Unknown.

Length of body, 2.1 mm.; width of cephalon, 1-2 mm.; length of egg strings, 2.1 mm., width, 0.3 mm.

This species is somewhat like Wilson's (1913) *Bomolochus attenuatus* but differs in that it has a shorter abdomen and longer egg strings; the first legs have 3-segmented rami; the second antennae differ in their armature. From his *B. nothrus* it differs in the shorter egg strings, the 3-segmented exopod of the first legs, the termination and armature of the second antennae, and the presence of a longer plumose seta on the maxilliped. From Wilson's (1932) *B. albidus* it differs in possessing a 2-segmented fifth leg, a different terminal spine on its maxilliped, and a quite different second antenna. From his (1911) *B. teres* in not having 4-segmented exopods on the 2, 3, and 4 legs. From his (1911) *B. nitidus* from the same host in the segmentation of the legs, the length and character of the egg strings, and the character of the second antennae.

Suborder Caligoida

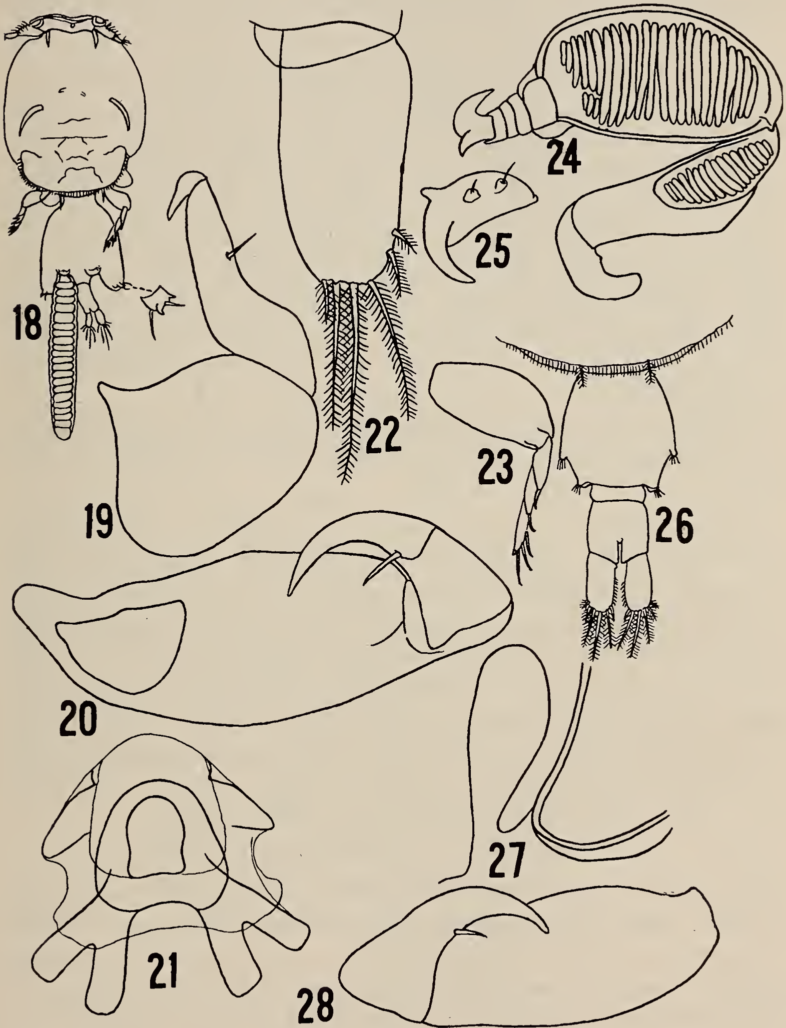
Family CALIGIDAE

Caligus bifurcatus n. sp.

Figures 18-28

Host.—Two males and a female were taken from the skin of three shark remoras, *Echeneis naucrates* L., that were caught in the Gulf by a whistle buoy offshore on June 10, 1952.

Female.—Carapace a little longer than wide. Frontal plates rather narrow; lunules shallow, well separated. Posterior sinuses narrow and nearly closed posteriorly. Median lobe not projecting beyond the lateral lobes. Free thoracic segment short, constricted at both ends. Genital segment narrowed in front, with two rounded lateral lobes behind; these bear a short leg that has two setae and two short stout spines. Abdomen straight and 1-segmented, about half as long as genital segment, twice as long as wide. Caudal rami half as long as the abdomen, with three long and three short plumose setae, all shorter than the ramus. Egg strings slightly longer than the genital segment and abdomen; with about twenty-three eggs.



Figs. 18-28. *Caligus bifurcatus* n. sp. 18, female; 19, second antenna; 20, maxilliped; 21, furca; 22, caudal ramus; 23, fourth leg; 24, male second antenna; 25, first maxilla; 26, posterior end of male; 27, posterior sinus; 28, maxilliped.

The first antenna is short; the terminal segment shorter than the preceding one. Behind each frontal plate is a strong accessory spine. Second antenna with a wide basal segment and a slender curved terminal one which bears a seta near its middle; terminal hook short and sharp. First and second maxillae are blunt slightly curved spines, the former with two minute separate setae on its base and the latter with a small bulb which bears two little setae. The first maxillipeds are slender and of the usual form. Second maxillipeds have a triangular depression on their bases; terminal hook curved, sharp, with a seta near its middle, less than half as long as basal segment. Furca with two biramous divergent branches, a rounded anterior loop which has two conical lateral processes. First two swimming legs of the usual form. Third legs short and wide with the hook on the posterior border. Fourth leg with a very wide basal segment; three terminal segments short with five short spines. Fifth legs with two short strong spines and two short setae.

Length of body, 4.8 mm.; carapace length, 2.2 mm., width, 2.1 mm.; abdomen length, 0.6 mm., width, 0.2 mm.; genital segment length, 1.3 mm., width, 1.2 mm.

Male.—Similar to female except as follows. Cephalothorax wider than long. Accessory frontal spines are longer than those of female. First maxilla bears a tubercle on the anterior border. The second antenna has corrugated areas on the two first segments, and the terminal hook has an accessory lateral hook. The genital segment bears two pairs of small lateral appendages near the posterior end, each with three or four terminal setae. Abdomen 2-segmented, the first segment about a sixth as long as the second.

Length of body, 3.2 mm.; carapace length, 2.0 mm., width 2.1 mm.; genital segment length, 0.5 mm., width, 0.5 mm.

Types.—Male and female, U. S. Nat. Mus. No. 93713.

This species is given its specific name for the bifid branches on the furca, which differ from all other members of the genus Caligus. The species is further distinguished by the broad base and small spines on the other segments of the fourth legs. The fifth legs of the female are also distinctive. The furca remotely resembles those of *Lepeophtheirus bifurcatus* Wilson (1905) and *L. hippoglossi* Krøyer (1838), but the lunules on the front definitely place it in the genus Caligus.

Caligus amplifurcus n. sp.

Figures 29-35

Hosts.—A male and a female were taken from two hard tailed jacks, *Caranx crysos* (Mitchill) from Octakocne Cove on June 12, 1952.

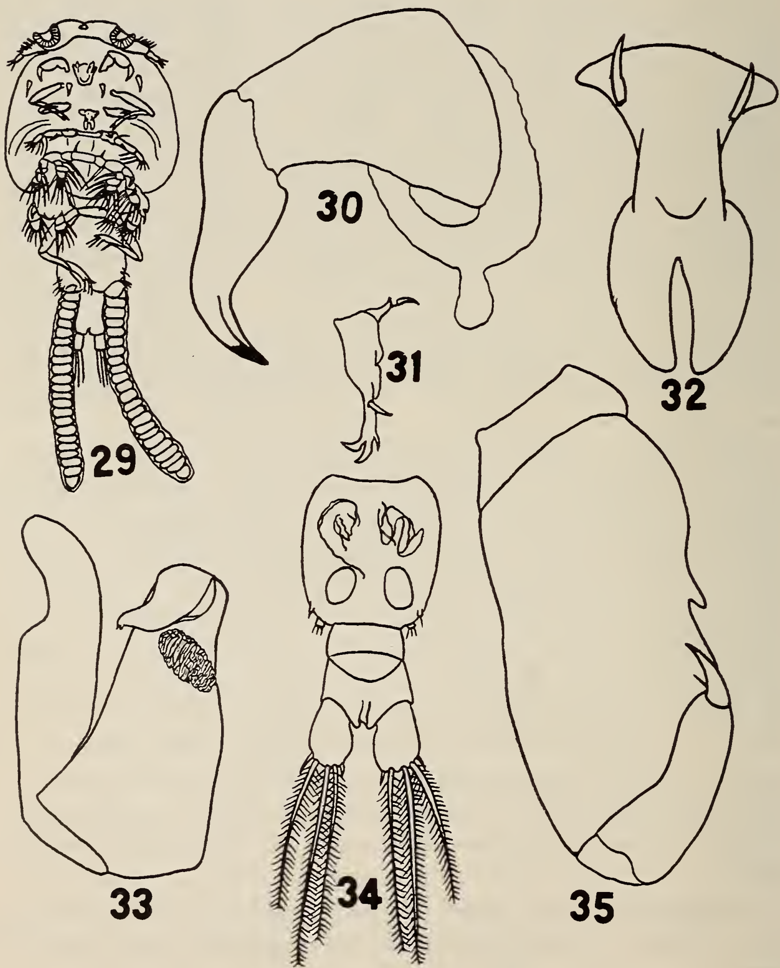
Female.—Carapace slightly longer than wide and more than half the entire length, slightly narrower in front. Frontal plates not very wide; lunules projecting very little and directed forward. Posterior sinuses with a sharp angle at the anterolateral corner; median lobe projects behind the lateral lobes. Free thoracic segment short spindle-shaped, about a fourth as wide as the carapace. Genital segment slightly longer than wide, sides nearly straight, somewhat narrowed in front; short rounded lateral lobes at back; a little less than half as long as carapace; two rudimentary legs, posterolateral, with one and two setae. Abdomen wide with straight sides; half as long as genital segment. Caudal rami nearly half as long as abdomen; with three long plumose setae and two short terminal setae. Egg cases more than half as long as the body; with about twenty-two eggs.

First antennae short, equal to slightly less than the space between the lunules. Second antenna with a stout and sharp terminal spine that has a brown tip. Maxillae both simple spines; the second with a seta at its base. First maxillipeds slender, with two terminal setae. Second maxilliped rather small and slender; the terminal hook not much curved. The furca is very stout; posterior branches wide, incurved with little space between them; anterior portion with a narrower "waist" that narrows slightly anteriorly and leads to an expanded part that is wider than the posterior branches and bears two anteriorly directed hooks laterally. The legs are not peculiar, except that the first legs are short; the basal segment of the second leg bears a peculiar process with three small terminal hooks; the fourth legs are 3-segmented and bear only four long setae.

Length of body, 4.6 mm.; carapace length, 2.2 mm., width 2.1 mm.; length of genital segment, 1.8 mm.; length of egg strings, 2.6 mm.

Male.—Much like the female except as follows. Second antennae with a stronger, longer terminal hook with two small terminal spines and a corrugated area for it to meet on the preceding segment (Fig. 33). The maxillipeds are wider, have a rounded process on the margin proximal to the hook. The abdomen is rather poorly indicated to consist of two segments, the first being shortest.

Length of body, 3.1 mm.; carapace length, 2.0 mm., width, 1.7 mm.



Figs. 29-35. *Caligus amplifurcatus* n. sp. 29, female; 30, second antenna; 31, appendage on basal segment of second leg; 32, furca; 33, male second antenna; 34, posterior end of male; 35, second maxilliped.

Types.—U. S. Nat. Mus. No. 93710.

This species differs from others in the genus in its peculiar wide furca, the 3-spined appendages on the second legs, and the second antennae of the male with its characteristic terminal hook and its corrugated chitinous area. It perhaps remotely resembles Krøyer's (1863) *C. pelamydis* but its furca is wider, it has three, not four, segments of its fourth leg, and lacks the appendage on the second leg.

Caligus schistonyx Wilson

Two were taken from a bony gar, *Lepisosteus osseus* (L.), and ten from twenty-four striped mullet, *Mugil cephalus* L.

Caligus praetextus Bere

Two specimens were taken from stingarees, *Dasyatis sabina* (Le Sueur), and one from a striped mullet, *Mugil cephalus* L.

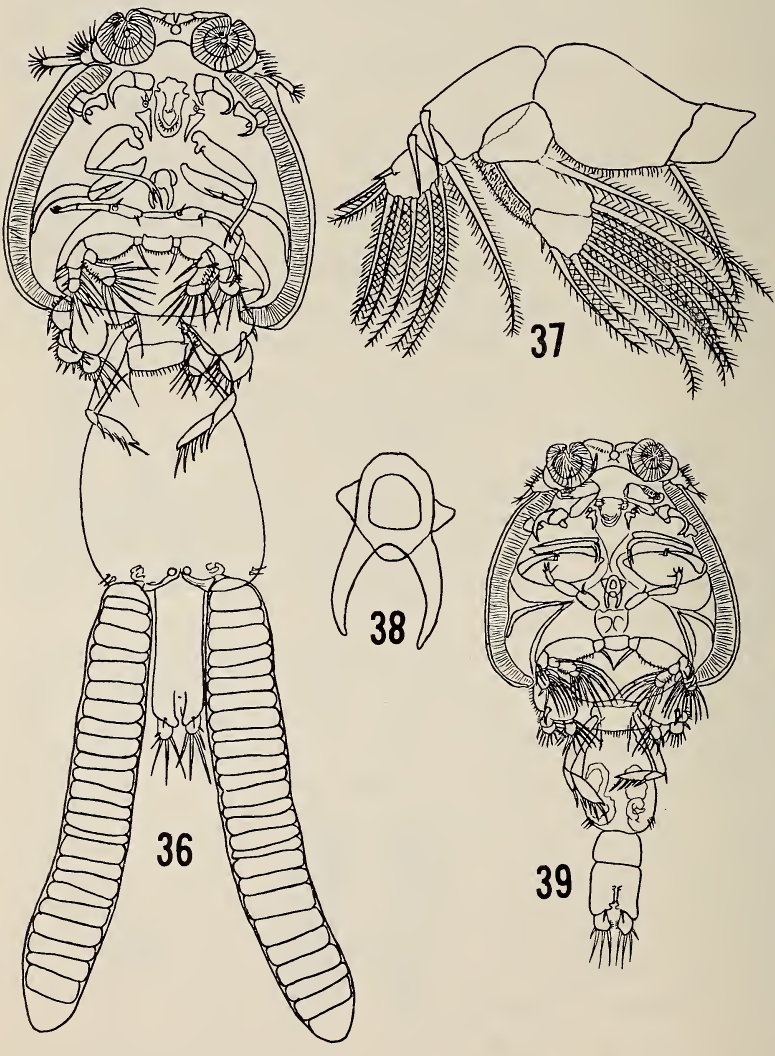
Caligus setosus n. sp.

Figures 36-39

Host.—Twenty-three individuals were taken from the roof and sides of the mouths of two sea catfishes, *Galeichthys felis* (L), three from the same situation in six Gulf kingfishes, *Menticirrhus littoralis* (Holbrook), and a male and a female from a gaff-topsail catfish, *Bagre marina* (Mitchill).

Female.—Carapace less than half the entire length, narrowed in front, anterior border indented in middle. Frontal plates deep. Lunules large, circular, projecting. Posterior sinuses rather wide. Lateral lobes strongly curved inward. Posterior border of carapace nearly straight. Lateral striated area with a sinus near anterior end to receive a lateral appendage. Free thoracic segment short, slightly wider than long. Genital segment oval, narrowed anteriorly, with small lateral lobes at posterior end; two lateral setae near posterior margin. Abdomen 1-segmented, shorter than genital segment, with straight sides. Caudal laminae short, with three long and three short setae at tip, setose on inner margin. Egg strings nearly two-thirds as long as body; with 26-30 eggs.

First antenna stout and setose. Second antenna rather short; terminal hook sharp. First maxilla small; with a swollen base and a single terminal hook. First maxilliped slender with two terminal, curved hooks. Second maxilliped also rather slender; terminal hook with a small seta. Furca with a rounded anterior border that has a slight median notch; posterior branches pointed, incurved,



Figs. 36-39. *Caligus setosus* n. sp. 36, female; 37, second leg; 38, furca; 39, male.

longer than anterior portion; a more delicate triangular projection extends laterally and somewhat posteriorly.

First leg short, slender; with three small terminal claws and a single seta; basal segment with two setae. Second leg biramous, rami 3-segmented; the second segment of the endopod is abundantly provided with about four rows of short setae along its whole posterior margin. This feature of the second segment is unique, and is the basis for the specific name of the species. The other segments of the second leg are not very different from other species in the genus Caligus. Third leg with a wide basal segment; rami separate. Fourth leg 3-segmented, the setae gradually longer toward the tip; leg more than half as long as genital segment.

Length of body, 3.17 mm.; cephalothorax length, 1.35 mm., width, 1.35 mm.; length of abdomen, 0.53 mm.; length of egg strings, 2.1 mm.

Male.—Like female but carapace slightly wider than long; abdomen 2-segmented, the first segment shorter than second; second antenna with long segments and second segment corrugated opposite terminal hook; maxilliped stout, with a strong spine opposite the end of the terminal hook and a seta on the inner margin of the hook; second legs as in female.

Length of body, 2.2 mm.; carapace length, 1.05 mm., width, 1.1; length, genital segment, 0.45 mm., abdomen, 0.35 mm.

Chalimus.—Without lunules; carapace longer than wide, about two-thirds of entire length; genital segment wider than fifth segment, about as long as abdomen, and the latter with very short caudal rami.

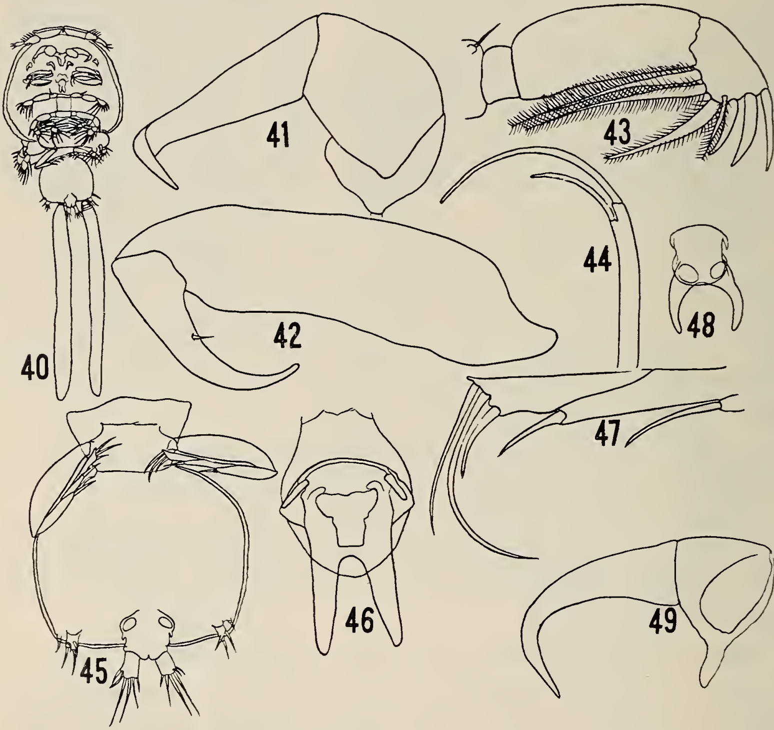
Types, male and female.—U. S. Nat. Mus. No. 93712.

This species is distinguished by the numerous setae across the posterior margins of some of the thoracic segments and certain segments of the second and third legs. This is particularly striking on the lateral margin of the endopod of the second leg of the female and male. Hence the name *setosus* is given. The furca is peculiar, with curved posterior branches and triangular lateral appendages on the base. It resembles Wilson's (1908) *C. rufus* but the cephalothorax is wider, the abdomen is not tapered, the second maxilliped is more ellipsoidal in form, the egg strings are longer, and the furca is quite different.

Lepeophtheirus bonaci n. sp.

Figures 40-49

Host.—A female and what appears to be the carapace and first thoracic segment of a male was taken from the gills of a black grouper, *Mycteroperca bonaci* (Poey), along with two *Thysonate triloba* Pearse and seventy *Hatchekia serrana* Pearse.



Figs. 40-49. *Lepeophtheirus bonaci* n. sp. 40, female; 41, second antenna; 42, second maxilliped; 43, first leg; 44, tip of first maxilliped; 45, posterior end; 46, furca; 47, tip of fourth leg; 48, male furca; 49, second antenna.

Female.—Carapace ovate, a trifle longer than wide, slightly narrower anteriorly. Frontal plates rather wide and not very deep, less than half the width of the carapace. Median lobe half the width of the carapace, slightly rounded on posterior margin, projecting well back of posterior lobes. Posterior sinuses narrow and short. Free thoracic segment short and less than half as wide as genital segment, widest in middle. Genital segment less than half as long and wide as carapace, slightly narrowed anteriorly, posterior border straight. Abdomen 1-segmented, more than one-sixth as long as genital segment. Caudal rami shorter than abdomen, longer than wide, tipped with three long and three short setae. Egg strings slightly longer than whole body.

First antenna short, with spines and setae. Second antenna rather narrow; terminal hook narrow, tapered, rather straight, with a small sharply bent terminal spine. First and second maxillae each consist of a stout, blunt spine. First maxilliped slender with a long and a short seta at tip. Second maxilliped rather slender, with a curved terminal hook that is half as long as the basal segment and has a short seta near its middle. Furca with straight branches; almost as long as base; with finger-like projections on either side near anterior end of base and a triangular papilla dorsal to that, the center of the base with a space that is rectangular behind and has two blunt triangular processes in front. The first legs have three short terminal spines and a seta at the tip, three plumose setae on the posterior margin of the terminal segment; the posterior margin of the second segment is also plumose. Second leg biramous, with 3-segmented rami. Third leg with a wide flat basal segment, a strong hook, and two short 2-segmented rami. Three basal hooks on fourth leg short, next hook longest; leg 4-segmented. Fifth leg visible in dorsal view, with three setae. Just anterior to this leg near the margin of the genital segment is a small seta which has an expanded base and is also visible in dorsal view.

Total length, 3.9 mm.; carapace length, 2.4 mm., width, 2.3 mm.; genital segment length, 1.0 mm., width, 1.0 mm.; abdomen length, 0.25 mm., width, 0.25 mm.

Tentative male cephalothorax.—Cephalothorax longer than wide. Appendages on it similar to those of female, as far back as first leg. Second antenna with a longer, more curved terminal hook. Furca with curved branches. Width of cephalothorax, 1.45 mm.

Types.—U. S. Nat. Mus. No. 93709.

This species is much like *L. dissimulatus* Wilson (1905), but differs in the character of the furca of the male and female; shape of the genital segment, the longer egg strings, the larger number of setae on the caudal rami, the comparative length of the claws on the fourth leg, the presence of a seta on the middle of the terminal claw of the second maxilliped, the comparative length of the cephalothorax with the remainder of the body, and the simpler border of the male second antenna.

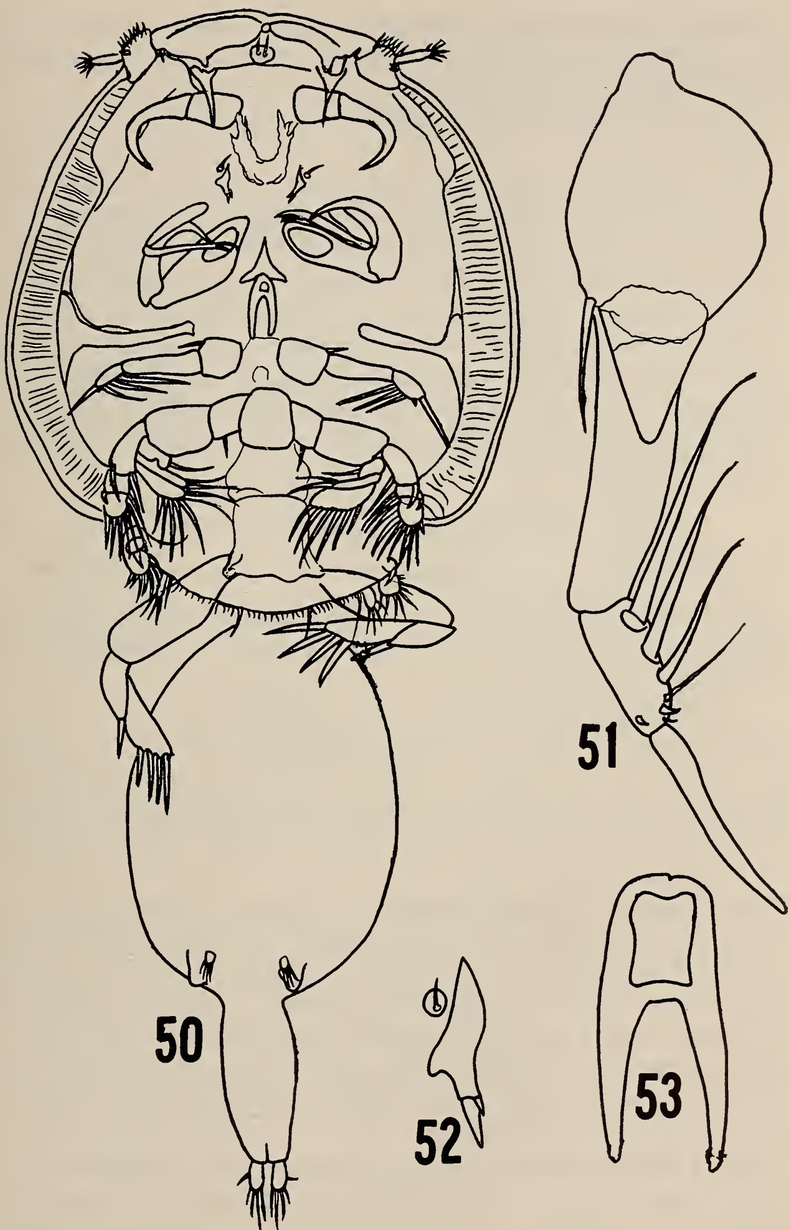
Lepeophtheirus unispinosus n. sp.

Figures 50-53

Host.—A single female was taken from the gill of a sea catfish, *Galeichthys felis* (L.), caught in Alligator Harbor. This fish also had twelve *Caligus setosus* on the roof of its mouth. It had been in an outdoor tank for several days and was examined on May 22, 1952. Another individual was taken from the same host from the same locality on May 12, 1952.

Female.—Carapace elliptical, a little longer than wide. Frontal plates with posterior rounded projections; on these the forked bases of two long accessory spines rest. Posterior sinuses narrow with sides nearly parallel. Free thoracic segment short and narrow, about a fourth as wide as genital segment. Genital segment elliptical, half as wide as carapace. Abdomen more than a third as long as genital segment. Caudal rami short, less than a fifth as long as the abdomen. No egg strings present.

First antennae short, the basal segment about the same length as the terminal one. Second antenna with the curved terminal claw longer than the base. First maxilla slender, with a small lateral spine. Furca narrow, the branches slender, straight, and longer than base, which has a narrow margin, is rounded anteriorly, and has almost straight sides. First maxilliped slender and short. Second maxilliped curved terminal hook two-thirds as long as base; with an oval thin section in the basal two-fifths. The terminal segment of the first legs is quite peculiar and gives the species its name; basal segment with a seta and a triangular terminal process with a rounded tip; terminal segment with the usual three setae and a single terminal spine with two minute spines at its base. Second legs with the second and third segments of the endopod very broad and narrow; the spine on the first segment of the exopod large, and that on the second segment a third as long and more curved. Third legs wide and rather short. Fourth legs 3-segmented, short, with short spines.



Figs. 50-53. *Lepeophtheirus unispinosus* n. sp. 50, female; 51, first leg; 52, first maxilla; 53, furca.

Total length, 3.95 mm.; carapace length, 1.8 mm., width, 1.72 mm.; genital segment length, 1.27 mm., width, 0.9 mm.; abdomen length, 0.55 mm., width, 0.23 mm.

Type.—U. S. Nat. Mus. No. 93708.

Male.—Unknown.

This is distinguished by its long accessory spines behind the frontal plates, the single large terminal spine on the first leg, and the furca. Its furca is somewhat like that of *L. dissemulans* Wilson (1905), but it differs from that and other species in the character of the first legs and other features. It differs from Bere's (1936) *L. marginatus* in the segmentation and spinosity of the fourth leg, the shape of the furca, the longer genital segment and abdomen, and the longer second maxilliped. It differs from Wilson's (1944) *L. christianensis* in the peculiar ending of the first leg, the furca, and the long abdomen.

Lepeophtheirus hummi n. sp.

Figures 54-59

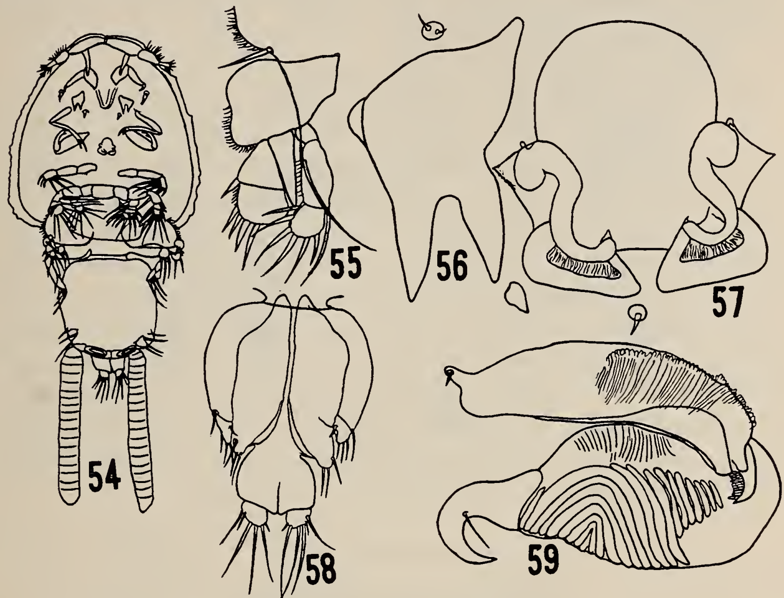
Host.—Three females and a male were taken from the skin of a southern fluke, *Paralichthys lethostigma* Jordan & Gilbert, on June 11, 1952.

Female.—Carapace rounded and slightly narrower in front, barely longer than wide. Frontal plates rather narrow, one-fourth the width of the carapace. Posterior lobes rounded, irregularly spinulose in some individuals. Median lobe five-twelfths of entire width, with rounded corners and straight posterior margin, projecting well back of lateral lobes.

Free thoracic segment slightly more than a fourth as wide as carapace, constricted at both ends; slightly more than half as wide as genital segment. Genital segment slightly longer than wide, with rounded corners but rather rectangular in outline. Abdomen less than a fourth as long as genital segment, longer than wide, with straight sides. Caudal rami a third as long as abdomen, with three long and two short setae. Egg tubes about half as long as body, with about eighteen eggs.

First antenna short and spinulose. Second antenna slender, with a small terminal spine. First maxilla small, the base wide. Second maxilla wide with two posterior stout spines which are without lateral lamellae. First maxilliped slender, with two terminal setae.

Second maxilliped rather slender, terminal claw with a seta at the middle of its inner margin. Furca short and wide, with flat posterior lamellae that are striated across the center, with S-shaped inner margins; anterior end rounded and clear, angulate on lateral margins.



Figs. 54-59. *Lepeophtheirus hummi* n. sp. 54, female, 55, third leg; 56, second maxilla; 57, furca; 58, posterior end of male; 59, second antenna of male.

First swimming legs with a short seta near the middle of the posterior margin and typical terminal claws and setae. The second legs are of the usual form for the genus. The third legs bear an unusual papilla and strong spine (Fig. 55) on the flat basal segment. The fourth legs have a wide basal segment and are 4-segmented; the terminal seta is the longest; the basal one is minute and has laminae on both margins. The fifth legs protrude at the posterior border of the genital segment and bear three setae.

Total length, 5.2 mm.; carapace length, 3.0 mm., width, 2.8 mm.

Type.—U. S. Nat. Mus. No. 93706.

Male.—Carapace about as wide as long (2.15:2.18 mm.); nearly half as long as entire body; median lobe extending behind the lateral lobes; posterior sinuses rather wide and deep. Genital segment as wide as long, rounded in front and constricted; at the posterior corners are two short conical appendages with rounded tips and plumose setae. Second antenna biramous; both rami with terminal hooks, the anterior one most robust and more curved, the posterior one setose at tip on inner margin; both rami with strong chitinous ridges.

Length of body, 3.7 mm.; width, 1.8 mm.

Type.—U. S. Nat. Mus. No. 93707.

This species somewhat resembles Wilson's (1905) *L. edwardsi.* The female differs in the shape of the furcula, the lack of lamella at the base of the second maxillipeds, a shorter body, shorter egg strings, and notably in the peculiar body that bears the hook on the third leg. The male has biramous second antennae with strong striated chitinous ridges, and has an appendage with a stout spine on the third leg like that on the female. Both sexes have second maxillae much like those of *L. edwardsi.* The species also is somewhat like Wilson's (1905) *L. bifurcatus* but the furcae of both sexes are quite different; the second maxillae are bifid but lack lateral lamellae; the fourth legs lack the little rosettes at the bases of their spines. The species is named for Dr. H. J. Humm.

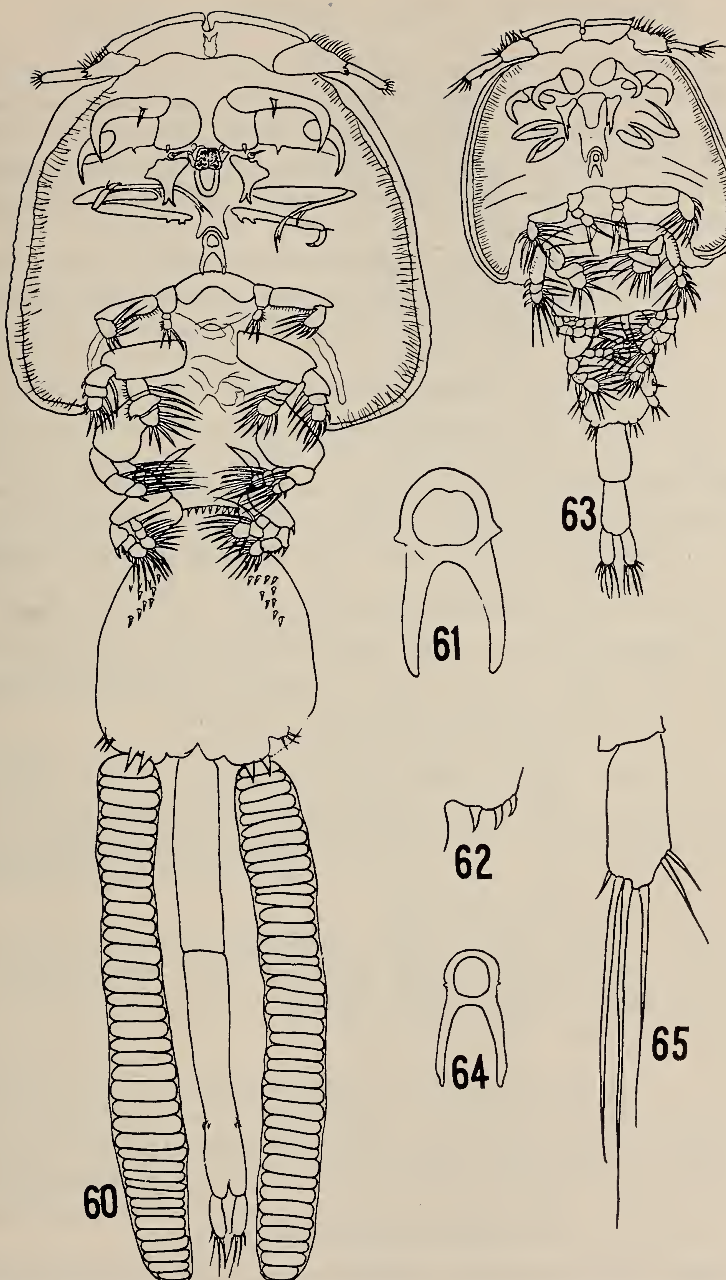
Family TREBIDAE

Trebius tenuifurcatus Rathbun

Figures 60-65

Hosts.—Thirty-two males and females were taken from the skin of eight stingarees, *Dasyatis sabina* (Le Sueur) on May 9, and fourteen from a single representative of the same host on May 20. These parasites moved about actively.

Female.—Carapace slightly wider than long, sides not much curved. Frontal plates of medium width, together more than half as wide as carapace; no lunules. Eyes in contact. Free thoracic segment small, about a sixth as wide as carapace, wide in the middle. Genital segment oval, without posterior lobes but with three dorsal spines; on the ventral surface is a small lobe with three setae and two spines, on the lateral surfaces in the anterior third there are about eleven small spines and a row of eight similar spines across the anterior end. Abdomen elongated and narrow, 2-segmented,



Figs. 60-65. *Trebius tenuifurcatus* Rathbun. 60, female; 61, furca; 62, tip of posterior lobe; 63, male; 64, furca; 65, caudal ramus.

the second twelve-fifteenths longer than the first; less than a quarter as wide as the genital segment and somewhat more than one and a half times as long; a little less than a fifth of the distance from the posterior end are small lateral lobes with two minute setae. Caudal rami less than a fifteenth of length of abdomen, with three long and two short setae.

First antenna rather long. Second antenna robust, with a strong terminal hook which bears a lateral seta about a third of the distance from its base and a short spine on the posterior margin of the base. First maxilla stout, with a strong terminal hook, about four-ninths as long as the second antenna. Second maxilla with a divided tip, the rami about a fifth the length of the appendage and somewhat divergent, about equal in length, the median one slightly more slender. At the base of each maxilla is a small papilla which bears a single strong seta. First maxilliped slender and elongate, one terminal claw long and bears two small spines at tip; second claw short and robust, reaches only a little beyond the base of the terminal claw and bears a single terminal seta. Second maxilliped short, slender, with two small conical papillae on the posterior margin near base; second segment somewhat less than half the length of first, terminal hook with a seta on its base.

Furca with a rounded base that has two blunt conical lateral processes; arms about a fifth longer than base, slender slightly curved inward. The four swimming legs all biramous; the first with 2-segmented rami, the others with 3-segments; basal segments of all legs very robust. Egg strings a little longer than abdomen and caudal rami, with 32-40 eggs.

Length of entire body, 4.2 mm.; cephalothorax length, 1.2 mm., width, 1.3 mm.; genital segment length, 0.7 mm., width, 0.6 mm.; abdomen length, 1.4 mm., width, 0.3 mm.

Type.—U. S. Nat. Mus. No. 93705.

Male.—Carapace almost a third wider than long. Second maxilla with median branch very short. Maxillipeds more robust than that of female. Furca with lateral spines on base shorter. Genital segment about as long as abdomen, which is 2-segmented with the second segment a trifle longer; with two pairs of rudimentary legs, each with three setae, another seta on the lateral margin.

Length of body, 1.6 mm.; carapace length, 0.5 mm., width, 0.75 mm.; genital segment length, 0.3 mm.; abdomen length, 0.5 mm.

Type.—U. S. Nat. Mus. No. 93705.

Only one female of this species has previously been recorded from the east coast of the United States. As it was imperfectly known and no male has been seen it seems proper to give rather complete descriptions of both sexes. The writer doubts if Wilson's (1908) *T. tenuifurcatus* is the same. It differs in the shape of the furca, the position of the terminal spines on the first maxillae, the length of the short egg strings and short abdomen, the shorter free thoracic segment, and the shape of the genital segment.

Family PANDARIDAE

Pandarus sinuatus Say

Four females were taken from the skin of seven bonnet-head sharks, *Sphyrna tiburo* (L.), and four from the skin of a spot-fin ground shark, *Carcharhinus limbatus* (Muller & Henle).

Nesippus alatus Wilson

Four were collected from the skin of a bonnet-head shark, *Sphyrna tiburo* (L.).

Family ANTHOSOMIDAE

Lernanthropus longilamina Pearse

A single female was taken from the gill of a spade fish, *Chaetodipterus faber* (Broussonet).

Lernanthropus amplitergum Pearse

Three were taken from the gills of two pinfishes, *Lagodon rhomboides* (L.), ten from eight white grunts, *Haemulon plumieri* (Lacepede), and five from three blue-striped grunts, *H. sciurus* (Shaw).

Lernanthropus brevoortae Rathbun

A single female was collected from a gill of a menhaden, *Brevoortia tyrannus* (Latrobe), and four from three *Brevoortia patronus* Gunter.

Lernanthropus leidyi Wilson

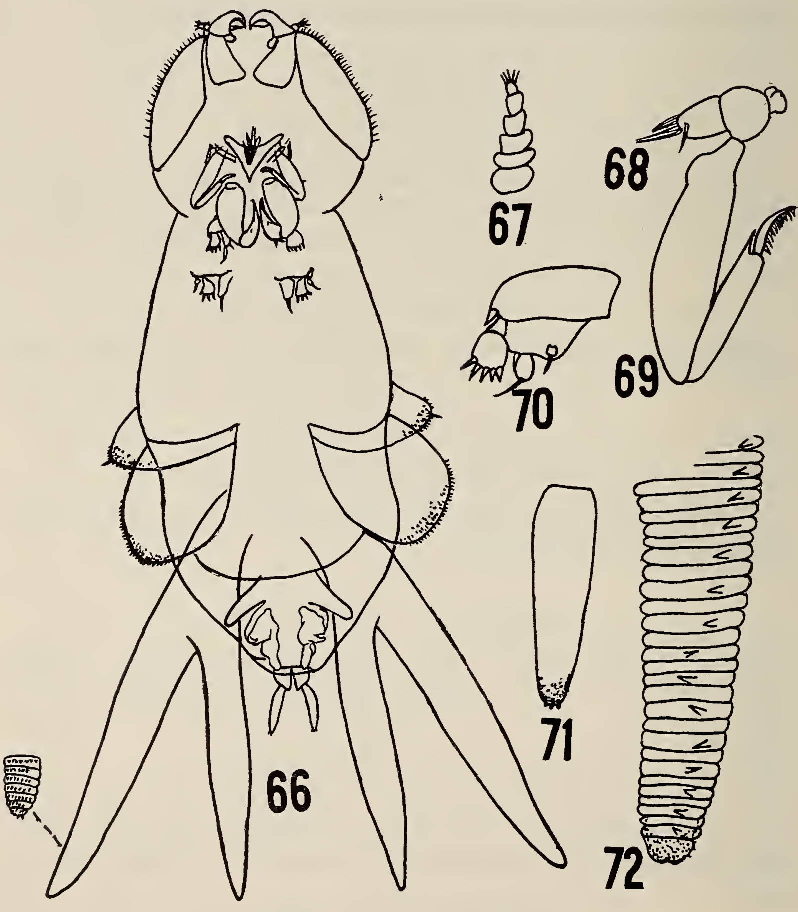
One specimen was taken from three silver perch, *Bairdella chrysura* (Lacepede).

Lernanthropus hirsutus n. sp.

Figures 66-72

Host.—A single female was taken from the gill of a white grunt, *Haemulon plumieri* (Lacepede), caught in Alligator Harbor on May 21.

Female.—Body rather robust. Cephalon, with posterior border



Figs. 66-72. *Lernanthropus hirsutus* n. sp. 66, female; 67, first antenna; 68, first maxilla; 69, second maxilla; 70, first leg; 71, caudal ramus; 72, tip of ramus of fourth leg.

slightly indented, with two long lateral plates with hirsute margins, narrower in front. Post cephalic body slightly wider than cephalon, a shallow indentation where the third legs arise; posterior end tapered, but with a straight posterior border, reaching to middle of abdomen. Two finger-like lateral lobes at anterior end of genital segment, which is short. Caudal rami, short, narrow with three minute spines and smaller brown denticles at tip.

First antenna short, 6-segmented, with setose tip. Second antenna, curved, tapered; terminal hook sharply bent. Mouth tube, conical, pointed posteriorly. First maxilla with rounded tip and three setae. Second maxilla slender, terminal claw minutely spinulose on inner margin. Maxilliped robust, terminal claw two-thirds as long as preceding segment. First legs with a lateral spine on basal segment; exopod with five spines; endopod with a single terminal seta; a small papilla with a single seta on basal segment. Second leg with a round papilla with a single seta on lateral margin; exopod with four spines; endopod with a single terminal seta. Third leg with two very short hirsute rami. Fourth legs nearly two-thirds as long as body; both rami with small cross segments; exopod with both dorsal and ventral surfaces with a spine on about every second segment; margins also minutely hirsute; endopod with a row of minute spines across each segment. The tips of the rami of the third and fourth legs, and the caudal rami and the lateral margins of the cephalon are thickly covered with minute brown bodies which are setose on the cephalon and are minute granules on the legs. No egg strings are present.

Total length, 3.2 mm. with the fourth legs, 2.8 mm. without them; carapace length, 0.6 mm., width, 0.7 mm.; post cephalic body length, 1.7 mm., width, 0.8 mm.

Type.—U. S. Nat. Mus. No. 93703.

Male.—Unknown.

This species is unique in its hirsute lateral plates on the cephalothorax, the pseudo-segmented spinulose rami of the fourth legs, and the short flat rami of the third legs. It is named for the hirsute border of the cephalon. The general form is somewhat like Wilson's (1913) *L. spiculatus* and his (1935) *L. manicatus* but it differs from these in the features just mentioned and others.

Lernanthropus wilsoni n. sp.

Figure 73

Host.—Two males were taken from the gills of a black grouper, *Mycteroperca bonaci* (Poey), collected near the light buoy offshore in the Gulf of Mexico.

Male.—Body short and stocky. Cephalothorax about as long and wide as body, with smooth lateral margins, somewhat narrower in front. Remainder of body about as long as cephalothorax. Abdomen short and narrow, longer than wide, with three lateral lobes that are narrower posteriorly, rounded on margins. Caudal rami divergent, half as long as abdomen with a dorsal and two terminal setae.

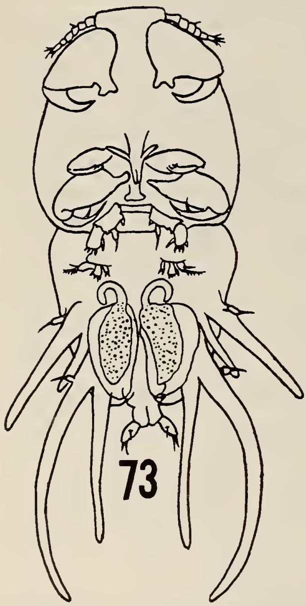


Fig. 73. *Lernanthropus wilsoni* n. sp. Male.

First antenna 6-segmented, with a seta on the third segment and about five on the tip. Second antenna very stout, with a projection on base opposite the tip of the curved terminal claw. Second maxilla rather short and robust, terminal claw two-thirds as long as preceding segment and spinulose at tip. Maxilliped very stout; terminal claw also robust, slightly curved.

First leg with endopod much smaller than exopod, with a single terminal seta; exopod with five short blunt spines; a minute spine mesiad to the base of the endopod. Second leg with a papilla with a stout terminal and a slender lateral seta on the lateral margin; exopod with a short lateral spine and three minute terminal spines; endopod with a single basal papilla with a minutely plumose terminal seta. Third and fourth legs biramous and unsegmented; third with endopod half as long as exopod; fourth with endopod three-fourths as long as exopod; both legs have a lateral papilla with a single seta on the base of the exopod.

Length of body, 1.7 mm., with fourth legs 1.9 mm.; carapace length, 0.85 mm., width, 0.78 mm.

Type and cotype.—U. S. Nat. Mus. No. 93704.

Female.—Unknown.

This species is somewhat like Wilson's (1922) *L. paenulatus.* But it differs from this and all other species in the genus in the length of the rami on the third and fourth legs and the papilla with a single seta on the bases of those legs. The proportions of the cephalon and the remainder of the body are like Wilson's *L. brevoortae* but the biramous third and fourth legs with their basal setose papillae differ. The shape of the body is somewhat like Burmeister's (1833) *L. pupa* but there are setose papillae on the third and fourth legs, those legs are longer and more slender, and the caudal rami are 1-segmented.

Family EUDACTYLINIDAE

Nemesis tiburo n. sp.

Figures 74-81

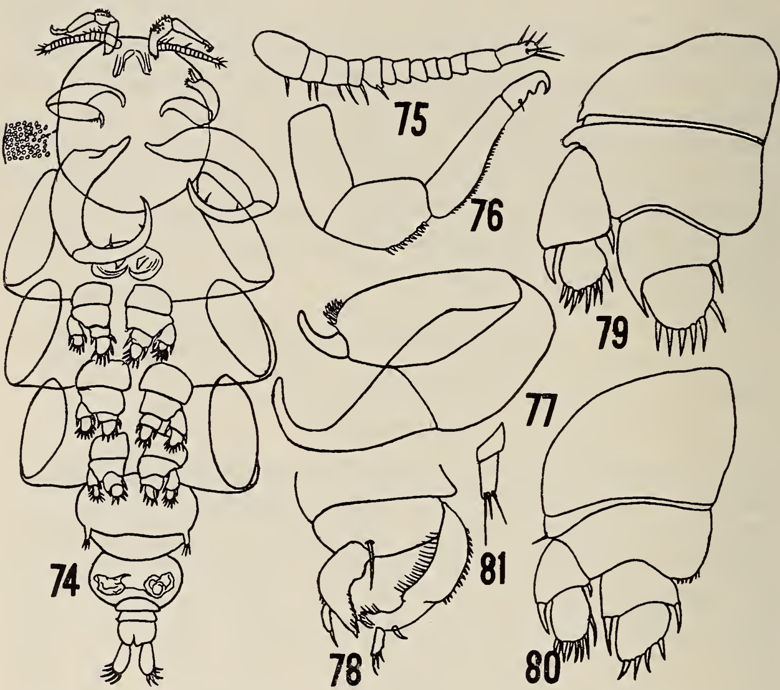
Host.—A single female was taken from the gill of a bonnet-head shark, *Sphyrna tiburo* (L.), from Alligator Harbor on June 2.

Female.—Carapace elliptical, longer than wide and evenly rounded, lateral margins with many small tubercles. Second and third segments about twice as wide as carapace; fourth segment seven-eighths as wide as the third; fifth segment slightly more than half as wide as fourth. Genital segment wider than long. Abdomen 3-segmented, third segment longest; two and a half times narrower than genital segment. No egg strings present.

First antenna with about thirteen segments. Second antenna with setose posterior margin; terminal hook slender, sharply recurved at tip, and rather slender, with a seta near base. Second maxilla stout, with a short curved terminal spine that is minutely spinulose along its margins; and the preceding segment spinulose where the claw meets it. Second maxilliped large, with a long curved terminal claw that has two short setae on its inner margin.

First leg with wide basal segment, exopod longer than endopod, setose on both margins of basal segment, terminal segment with two setae at tip; endopod with second segment shorter and more slender than first, with a terminal seta; basal segment setose at tip.

Second leg with exopod a little shorter than endopod, terminal segment with seven and six spines. Third leg with exopod almost as long as endopod, with eight and four spines. Fourth leg with exopod a little shorter than endopod, with eight and four spines. Fifth leg, slender, with three terminal setae.



Figs 74-81. *Nemesis tiburo* n. sp. 74, female; 75, first antenna; 76, second antenna; 77, second maxilliped; 78, first leg; 79, second leg; 80, fourth leg; 81, fifth leg.

Length of body, 2.7 mm.; cephalon length, 0.9 mm., width, 0.7 mm.

Type.—U. S. Nat. Mus. No. 93702.

Male.—Unknown.

This female differs from other species in the genus in the straight terminal hook on the second antenna with its short sharply curved tip. Her 2 to 4 legs also differ in the number of spines on the exopods. Her first legs also differ in the shape and spinosity of the segments. She appears to be closest to the writer's *N. pilosus* (1951) and Wilson's (1932) *N. pallida* but the second antenna differs in structure. The number and length of the spines on the legs and the comparative width of the segments is different. As the specimen bears no egg strings or spermatophores it is probably somewhat juvenile, but its appendages appear to be mature.

Eudactylina longispina Bere

Ten females were collected from a bonnet-head shark, *Sphyrna tiburo* (L.).

Eudactylina turgipes Bere

Two were collected from the gills of five butterfly rays, *Pteroplatea micrura* (Schneider).

Family PSEUDOCYCNIDAE

Cybicola elongata Pearse

Four were taken from the gills of a king mackerel, *Scomberomorus cavalla* (Cuvier & Valenciennes).

Family DICHELESTHIDAE

Hatschekia linearis Wilson

Twelve were taken from the gills of seven white grunts, *Haemulon plumieri* (Lacepede), and one from a gill of a pinfish, *Lagodon rhomboides* (L.).

Figs. 82-83. *Hatschekia harkema* Pearse. 82, first and second antennae; 83, egg strings.

Hatschelsia harkema Pearse

Figures 82-83

Twenty-three females and seven males were collected from spiny boxfish, *Chilomycterus schoepfi* (Walbaum), April 23 and May 26. These furnished better materials than those collected at Beaufort, N. C. The females had 4-segmented first antennae. Some of them also bore a lineal series of egg strings which contained about a dozen eggs.

Hatschekia serrana n. sp.

Figures 84-92

Hosts.—One hundred and thirty-two (0,131,1) females were obtained from the gills of three red groupers, *Ephinephelus morio* (Cuvier & Valiencennes), and 78(8,70) from two black groupers, *Mycteroperca bonaci* (Poey).

Female.—Head slightly wider than long, nearly circular in outline; narrower than trunk (0.31-0.46 mm.). Eggs large, 4-6(7) in a string.

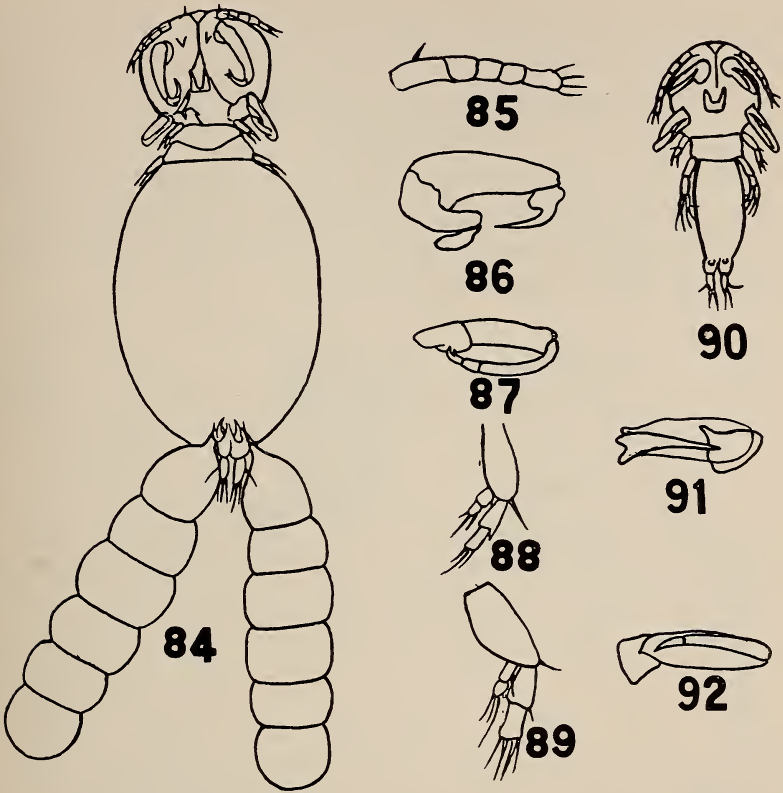
First antenna 5-segmented, with few setae. Second antenna 2-segmented and armed with a sharp terminal claw. Mouth tube anterior to bases of maxillipeds, nearly rectangular, longer than wide. Maxilliped more slender than second antennae, with a large and a small terminal claw.

First and second legs with 2-segmented rami. The basal segment of each with a terminal seta. Exopods of first with three and the second with 4 terminal setae; endopods both with 3 terminal setae; first segment of first exopod with a terminal spine, second with a seta. The caudal appendages are slender and armed with three terminal and a lateral seta. The abdomen is short and bilobed; the preceding body is produced a little on either side of it.

Length of body, 1.12 mm., width, 0.48; length of egg string, 0.87 mm.

Male.—A single male was taken from the gill of *Mycteroperca bonaci* (Poey). It was similar to the female but the head was about as long as wide (0.2 mm.) and the trunk was narrower (0.12 mm.). The total length of the body was 0.57 mm.

Types.—U. S. Nat. Mus. female 93701, male 93700; both from *Mycteroperca bonaci* (Poey).



Figs. 84-92. *Hatschekia serrana* n. sp. 84, female; 85, first antenna; 86, second antenna; 87, maxilliped; 88, first leg; 89, second leg; 90, male; 91, second antenna; 92, maxilliped.

This species is named for the family (Serranidae) of fishes to which the two hosts belong. It differs from three related species that Wilson (1913) described from the West Indies. It differs from *Hatschekia insolata* in the shape of the body, the lack of two pairs of lateral setae, and the larger number of eggs in its strings. From *H. uncata* in the shape of the head, body, and abdomen; in the segmentation and armature of the first antennae; and in the number of eggs in its strings. From *H. iridescens* it differs in the shape of the head and body, the number of segments in the first antenna, the fewer setae on the legs, and the smaller number of eggs in its strings.

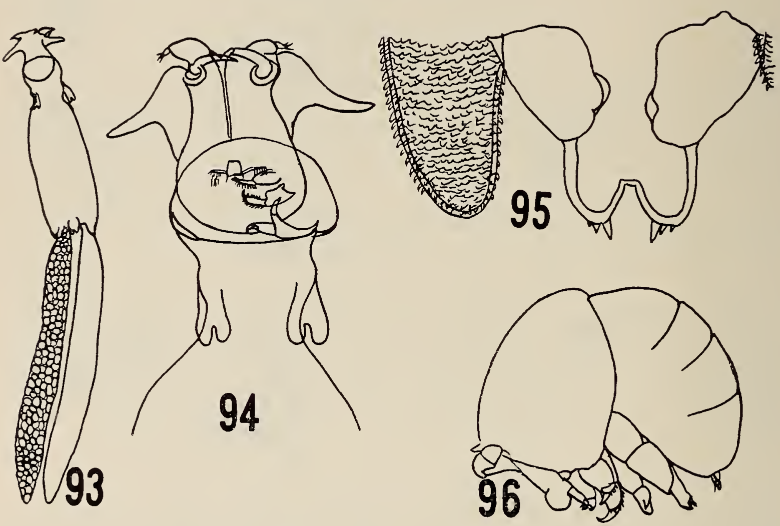
Suborder Lernaeopodoida

Family CHONDRACANTHIDAE

Pseudochondracanthus elongatus n. sp.

Figures 93-96

Host.—Twenty-eight females, mostly with attached males, were removed from the gills of six southern swellfishes, *Spheroides spengleri* (Bloch), taken off the mouth of Alligator Harbor in the Gulf and in the harbor on April 23 and May 16.



Figs 93-96. *Pseudochondracanthus elongatus* n. sp. 93, female; 94, anterior end that shows first antennae, second antennae, lateral horns, mandibles, maxilla, maxilliped, legs; 95, posterior end; 96, male.

Female.—Head longer than wide, truncate in front, one-fourth narrower in front than further back, rounded posteriorly; from each anterior corner a blunt, slightly curved, and strongly tapered horn extends laterally. Head is partially covered with a carapace that is narrower anteriorly, and has a deep median groove for the anterior half of its length. A single free thoracic segment is slightly narrower than the head; it bears a pair of unsegmented, biramous appendages, with very short rami. A narrower neck succeeds the second segment. Behind this the body is unsegmented and covered with minute scales, which are more spinulose at the margins and rounded toward the interior. At the posterior end it is produced into two rounded lateral lobes, which are not quite as long as the abdominal processes which are rounded, clearly separated in the middle and tipped with three short spines of which the largest is toward the median line. Egg strings are 1/9 longer than the body; they have 37-43 rows of eggs with 4-9 in a row.

First antenna with a wide basal segment; terminal segment narrow, short, and tipped with three short setae. Second antenna short; basal segment wide and round, terminal segment a sharp curved claw. Mouth parts at posterior end of head. The mandible ends in a curved claw which has a row of small blunt teeth along its convex border. The maxilla has such teeth along both borders of the terminal hook. The maxilliped is large and ends in a sharply recurved hook.

Length of female, 4 mm.; of egg strings, 4.5 mm.

Type.—U. S. Nat. Mus. No. 93698.

Male.—A pigmy attached to the abdomen of the female. Carapace ellipsoidal in lateral view. Second antenna ending in a stout hook. Abdominal segments indicated dorsally. Caudal rami short, conical, with two setae. Mouth parts all hooked at distal ends. No thoracic appendages.

Length.—0.42 mm.

Type.—U. S. Nat. Mus. No. 93699.

This species differs from Wilson's (1908, 1935) *P. diceraus* and *P. hexaceraus* in being longer, more slender, having longer egg strings, non-articulated caudal rami, the structure of the legs, the shape of the cephalon and the following neck, and the character of the first antenna. The male differs in the shape of the cephalothorax, the segmentation of the abdomen, and the character of the appendages. It is on the whole closest to Wilson's *P. diceraus* but is easily separated from it by the female caudal rami and first legs and by the shape of the male cephalon.

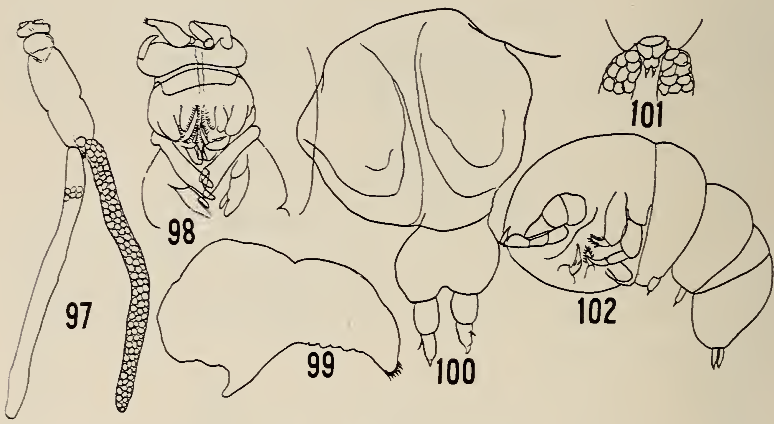
Acanthochondria tenuis n. sp.

Figures 97-102

Host.—Two females with attached males were taken from four bat-fishes, *Ogcocephalus nasutus* Ginsberg, on April 19 and 24.

Female.—Head with posterior margin straight; narrower toward anterior end, but with two anteriorly directed rounded lateral lobes.

First metasome segment short and distinct; second segment twice as wide as long, not clearly defined; third and fourth segments slightly longer than wide, their limits indicated by slight lateral indentations. End of fused thorax with very short rounded lateral prolongations and a very short median plate between them. Genital segment slightly wider than long, widest near anterior end. Abdomen 1-segmented, wider than long, shorter than genital segment. Caudal rami stout, 2-segmented, with a single short terminal spine and a short lateral seta.



Figs. 97-102. *Acanthochondria tenuis* n. sp. 97, female; 98, anterior end; 99, first antenna; 100, 101, posterior end; 102, male.

First antenna narrow and cylindrical; setose at tip. Second with a stout basal segment and a curved terminal claw. Mandibles curved, spinules on anterior smaller than those on the posterior margin. Second maxilla stout, terminal claw with spinules on anterior smaller than those on the posterior margin. Maxillipeds rather slender. First and second legs cylindrical, biramous, exopod longer than enodopod, rami unsegmented, shorter than basal portion.

Length of body, 4.1 mm., width, 1.0 mm.; length of egg strings, 5.8 mm.

Male.—Cephalothorax robust, with a dorsal sinus that indicates the boundary between the head and thorax. Trunk 3-segmented. Caudal rami rather stout and sharply pointed. First antenna small and short. Second antenna robust, with a curved terminal hook, mandibles similar to those of female. Maxillae stout with a single terminal spine. Maxillipeds slender, 3-segmented with a terminal hook. Legs both 1-segmented with a single terminal spine.

Length of body, 0.54 mm.

Types, male and female.—U. S. Nat. Mus. No. 93695.

This species is named for its slender form. It differs from others in the genus Acanthochondria in the short processes at its posterior end, the great length of its egg strings, and the shape of its abdomen. It also differs from those described by Wilson (1908, 1935) from the Pacific Coast in the same features, and from Scott's (1913) figures of Chondracanthus.

Acanthochondria albigutta n. sp.

Figures 103-110

Host.—Two females, each with an attached male, were taken from the roofs of the mouths of two flounders, the Gulf flukes, *Paralichthys albiguttulus* Jordan & Gilbert. One of these bore egg strings and was 8.3 mm. long, the other had none and measured 4.3 mm. in length. The species is named for the host.

Female.—Head elliptical, slightly longer than wide, with lateral lobes at the anterior end; split to near the posterior margin along the median line; a dorsal plate covering the posterior third. First two metasome segments free; the first very short and not as wide as head; the second somewhat wider than head and with two anterior lobes. The two pairs of legs are biramous and unsegmented; the exopods project at the side of the body. Third segment of thorax free; fourth and fifth segments fused; all these wider than head. The fifth segment is produced into two posterior processes with rounded tips; these are less than 2.5 as long as the preceding segment is wide. Genital segment, tapering, somewhat wider than long. Abdomen nearly twice as wide as long; near its base on each side is a stout 2-segmented seta on a small caudal ramus.

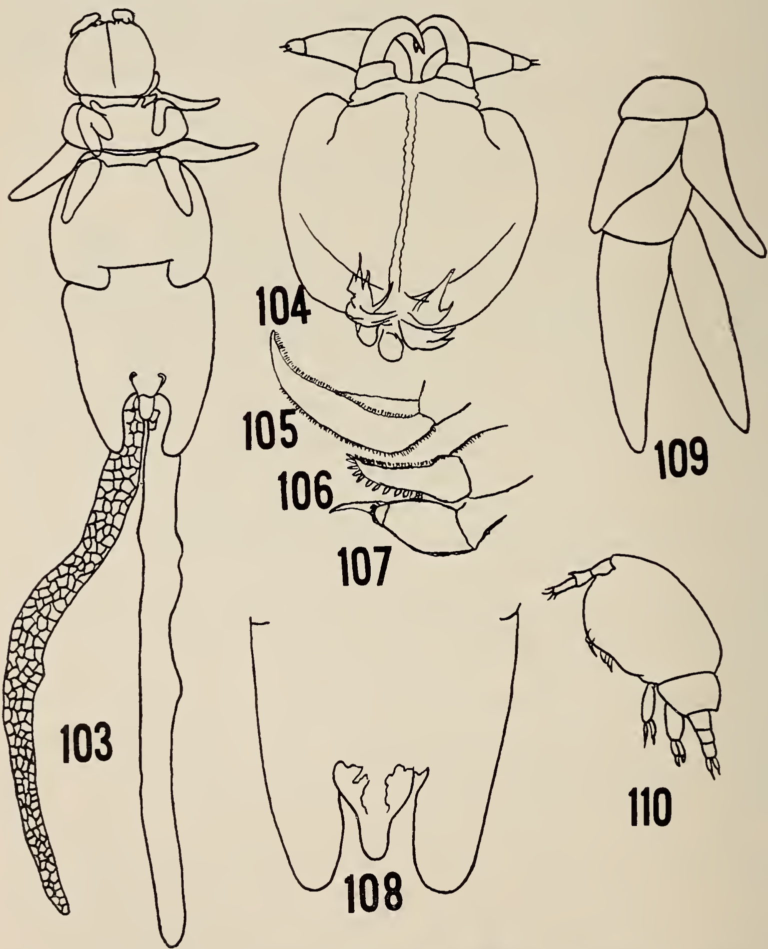
First antenna tapering, cylindrical, 2-segmented; the second segment short and tipped with a group of about five short setae. Second antenna with a broad basal segment and terminated with a long curved hook. Mandibles curved and with fine teeth on both margins. The rami of the legs are about equal in length.

Length of body, 8.3 mm., width, 2.4 mm.; length of egg strings, 11.0 mm.

Type.—U. S. Nat. Mus. No. 93696.

Male.—Cephalothorax rounded dorsally. First antenna 3-segmented. Two pairs of biramous legs on last two thoracic segments. Abdomen 3-segmented, the last segment longest. Caudal rami stout, less than half as long as preceding segments; tipped with two short setae.

Length of body, 0.16 mm.



Figs. 103-110. *Acanthochondria albiguttula* n. sp. 103, female; 104, anterior end; 105, mandible; 106, maxilla; 107, maxilliped; 108, posterior end; 109, first and second legs; 110, male.

Type.—U. S. Nat. Mus. No. 93697.

This species differs from others in the genus in that the first thoracic segments are not both narrower or wider than the head. The head is peculiar in having anterior lateral lobes, and such lobes are present on the second thoracic segment. The third thoracic segment is clearly set off from the fourth. The posterior processes are too short for Wilson's (1932) *A. exilipes* and too long for Krøyer's (1863) *A. flurae.* The male is unique in having 3-segmented antennae, large biramous swimming legs on the thorax, and a long 3-segmented abdomen. It differs from the writer's *A. cyclopsetta* (1952) in the shorter legs, the first antenna, and the stouter second maxilliped. The male differs from all of Oakley's (1930) species.

Triphyllacanthus ancoralis Bere

Four were taken from the gills of three short-nosed bat-fishes, *Ogcocephalus radiatus* (Mitchill) and one from two other bat-fishes, *O. nasutus* Ginsberg.

Family LERNAEOPODIDAE

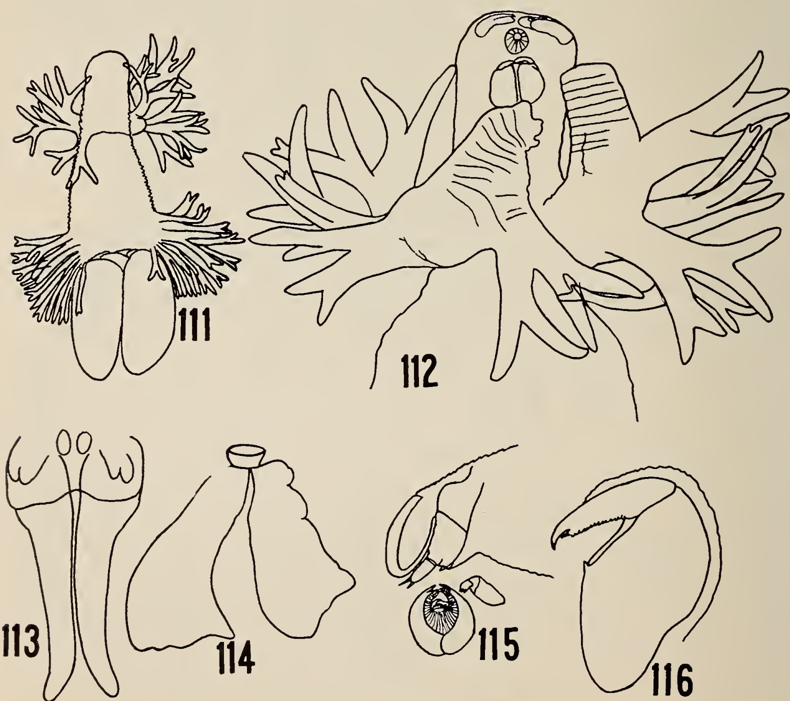
Thysanote triloba n. sp.

Figures 111-116

Host.—Two females were taken from the posterior corner of the gill cavity of a black grouper, *Mycteroperca bonaci* (Poey), collected on May 16 by the light buoy in the Gulf of Mexico.

Female.—General form elongate, gradually narrowed toward anterior end. Cephalothorax, bluntly rounded in front, sides nearly parallel; more than a third of the entire length. Body slightly wider posteriorly. Sides of cephalothorax and body rather rough. Egg strings more than half the length of body and cephalothorax; containing about fifteen eggs lengthwise and six crosswise; elliptical in form. The processes at the posterior end on the sides of the body mostly have short bifid tips; those at the base of the cephalothorax divide two or three times. Between the egg strings are two finger-like processes that are nearly as long as the posterior appendages.

First antenna imperfectly 3-segmented and tipped with a very short pair of spines. Second antenna biramous, bent across the anterior end, and meeting in front of the mouth tube; exopod broad, 1-segmented, and bluntly rounded; endopod 2-segmented, narrower and tipped with two spines. Mandibles curved, with about twelve strong teeth on the posterior margin. First maxilla with a broad base and tipped with five stout setae. Maxilliped with basal segment nearly twice as long as wide, rather stout, with a short spinous process where the terminal hook meets it; terminal hook corrugated on inner margin, with a small seta near tip. Second maxilla fused at tip, with a short terminal bulla, shorter than the cephalothorax, reaching slightly beyond the eyes but not to the anterior end. The branches on the tips of the lateral processes number 14, 21, 16 and 16 on the two specimens available; those on the sides of the posterior end of the body number about 28, 26, 21, and 21. The smaller numbers probably are on less mature appendages, or one has been lost.



Figs. 111-116. *Thysanote triloba* n. sp. 111, female; 112, ventral view of anterior end; 113, caudal rami; 114, second maxillae; 115, left side of anterior end, ventral; 116, maxilliped.

Length of body, 4.5 mm.; cephalothorax length, 1.0 mm., width, 0.6 mm.; body length, 2.0 mm., width, 1.2 mm.; egg strings length, 2.8 mm., width, 0.7 mm.

Type.—U. S. Nat. Mus. No. 93694.

Male.—Unknown.

This species is like Heller's (1865) *T. lobiventris* but the egg strings are visible for their entire length; the posterior processes are separate to nearer their bases; the egg strings are somewhat longer; the body is narrower. The species name indicates that many of the lateral processes are branched three times.

Naobranchia lizae Kryer

Eight taken from the gills of a short-nosed bat-fish, *Ogcocephalus radiatus* (Mitchill), seventy from six other bat-fishes, *O. nasutus* Ginsberg, fifty-nine from twenty-five striped mullet, *Mugil cephalus* L., and six from a spiny boxfish, *Chilomycterus schoepfi* (Walbaum).

Naobranchia variabilis Brian

One was taken from the gill of a common sea bass, *Centropristes striatus* (L.), one from ten sand fishes, *Diplectum formosum* (L.), and two from ten white grunts, *Haemulon plumieri* (Lacepede).

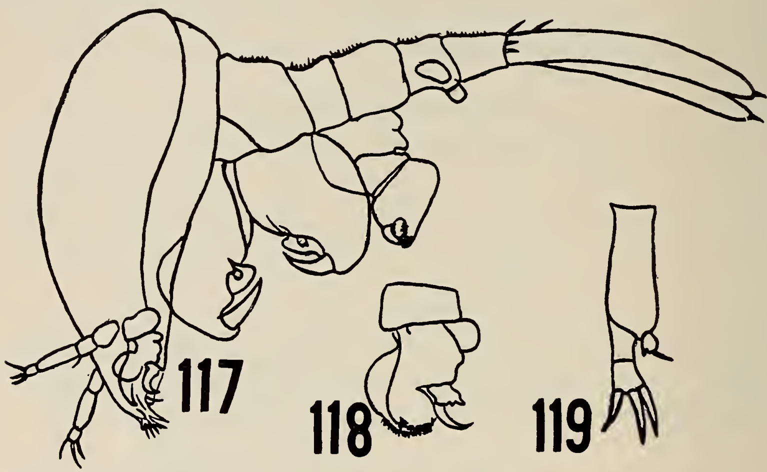
Charopinus dasyatis n. sp.

Figures 117-119

Host.—A single male was taken from the skin of a stingaree, *Dasyatis sabina* (Le Sueur), one of eight taken in Alligator Harbor on May 9.

Male.—Head elongated, tapered toward the front. Antenna 4-segmented; with three terminal setae, one of which is spinulose near the tip. Second antenna biramous, the exopod 2-segmented, the basal segment extends past the terminal one and is twice as long as it; the terminal segment is wider than long and is armed with a separate curved claw; the endopod is shaped like the basal segment of the exopod, exceeds it a little in length and has a fringe of minute bristles at its tip. The first maxilla is biramous, the basal segment nearly twice as long as the 2-segmented endopod; exopod very short and bearing a single terminal seta and a minute lateral spine. Second maxilla larger than maxilliped and subchelate with a clear expansion for the terminal claw to meet. Maxilliped 3-

segmented, the second segment very short, the third segment square, almost twice as wide as long, terminal claw stout and sharply curved; projection that claw meets minutely ciliate. The free thoracic and abdominal segments are minutely ciliate on their anterior dorsal regions. The genital segment bears a ventral process. The caudal rami are nearly as long as the combined cephalic, thoracic, and abdominal segments; each bears a short terminal seta.



Figs. 117-119. *Charopinus dasyatis* n. sp. 117, male; 118, second antenna; 119, first maxilla.

Length of male body, 2.72 mm.; length of cephalon, 1.35 mm.; length of caudal rami, 0.83 mm.

Type.—U. S. Nat. Mus. No. 93693.

Female.—Unknown.

This male differs from others in the genus Charopinus in the structure of the first maxillae, the great length of the caudal rami. It somewhat resembles Retzius' *C. dalmanni* (1830), but differs in the length of the caudal rami, larger size, and more slender first antenna and the greater number of segments in it. Its specific name refers to the host.

Clavellopsis longilamina Bere

Eleven specimens were taken from the gills of twenty-nine striped mullet, *Mugil cephalus* L.

Brachiella concava Wilson

Four females were taken from the gills of nine stingarees, *Dasyatis sabina* (Le Sueur).

Brachiellina, n. gen.

Family Lernaepodidae; Subfamily Clavellinae

Female cephalothorax about as long as second maxillae. Second maxillae have three ovoid appendages on their median surfaces, and a similar appendage and two groups of three are attached to the posterior end.

Genotype, *Branchiellina papillosa* Pearse

Brachiellina papillosa, n. sp.

Figures 120-121

Host.—A single female was collected from the gill of a cowfish, *Lactophrys tricornis* (L.), on June 7.

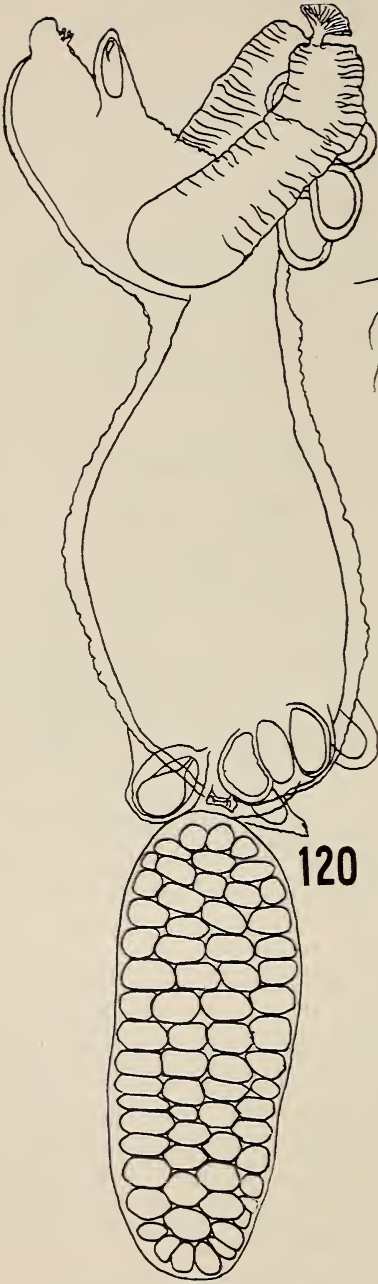
Female.—Cephalothorax stout, cylindrical, and about four-sevenths as long as the trunk. No carapace on scolex. Second maxillae separate to tips, with a terminal bulla, there are three ovoid appendages on the inside of each. There is no constriction at the end of the scolex. The trunk is twice as wide as the scolex, with four ovate appendages on each side at the posterior end in groups of one and three; there is no abdomen. Egg strings slightly more than a third as wide as long; with about four eggs crosswise and fifteen lengthwise.

First antennae 3-segmented, with two short terminal setae. Second antennae rounded at tips, turned down across frontal margin, biramous, endopod with a single seta. Mouth tube with divergent setae around its margin, which reach almost to the tip of the first antennae. First maxillae tripartite, the two longest lobes with longer setae than the short basal lobe. Maxillipeds in a separate lobe, slender; with a short sharp curved terminal hook.

Length of body with egg strings, 5.1 mm., without, 3.2 mm., width, 1.15 mm.; second maxilla length, 1.75 mm., width, 0.71 mm,; scolex length, 1.2 mm., width, 0.6 mm.

Type.—U. S. Nat. Mus. No. 93723.

Male.—Unknown.



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121

Figs. 120-121. *Brachiellina papillosa* n. sp. 120, female; 121, antennae and mouth parts.

The species is named for the ovoid papillae on the end of the abdomen and on the second maxillae. It differs from all lernaeopodids in possessing these ovoid papillae.

Order ISOPODA

Suborder Cymothoidea

Family AEGIDAE

Rocinela signata Schiodte & Meinert

A female was taken from a blue-striped grunt, *Haemulon sciurus* (Shaw), that was caught in a trawl near Buoy 26, nine miles southeast of Alligator Point.

Family CYMOTHOIDAE

Agathoa medialis Richardson

Eight were taken from the skin of eight stingarees, *Dasyatis sabina* (Le Sueur), and one from a gill of a pinfish, *Lagodon rhomboides* (L.).

Agathoa oculata (Say)

Four were taken from the skin of a bony gar, *Lepisosteus osseus* (L.).

Family SPHAERIDAE

Paracerceis caudata (Say)

A single female was collected from twenty-five ascidians, *Styelia plicata* (Le Sueur).

Suborder Bopyroidea

Family BOPYRIDAE

Capitetragonia n. gen.

Body of female broad, flattened and somewhat asymmetrical. Abdomen unsegmented, but segmentation indicated by lateral notches. Head square, as the name indicates; posterior corners more rounded than anterior. All seven pairs of thoracic legs present. Five pairs of pleopods biramous, rugose. Uropods absent. Male with thoracic segments distinct and each with a pair of legs. Abdominal segments fused, appendages indicated by five pairs of rounded nodules and lateral indentations. Branchial parasites.

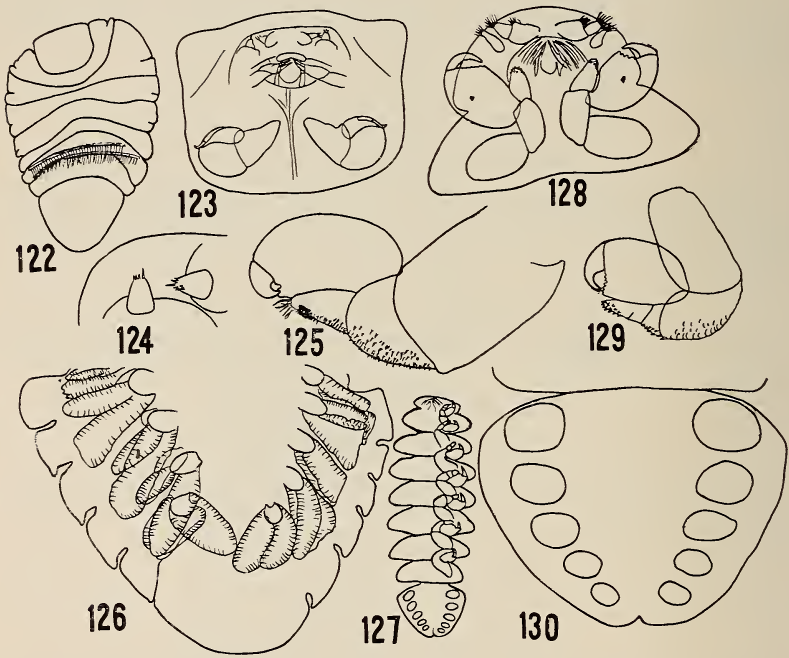
Type.—Capitetragonia asperotibialis Pearse.

Capitetragonia asperotibialis n. sp.

Figures 122-130

Host.—Two females with attached males were taken from the gill chambers of two shrimps, *Crangon normanni* (Kingsley).

Female.—Head wider than long, square with rounded corners. Eyes absent. Both pairs of antennae with a very wide rounded base and a single conical terminal segment which is setose at tip. Maxillipeds with palp that has a small claw at tip.



Figs. 122-130. *Capitetragonia asperotibialis* n. sp. 122, female; 123, head ventral view; 124, first and second antennae; 135, seventh leg; 126, abdomen ventral view; 127, male; 128, head and first thoracic segment; 129, seventh leg; 130, abdomen ventral view.

Thorax with separate segments; the first four with a small posterior lateral lobe; epimeral plates on second and third segments wide. Legs all present, with strong curved terminal claw. Marsupial plates narrow, last one with about forty-three setae across posterior margin.

Abdomen unsegmented but segmentation indicated by lateral notches. Sixth segment without appendages, rounded and short; all other segments with biramous lamellate appendages that have rounded tips posteriorly, but the endopods are wider and truncate toward the anterior margin.

Length of body, 5.2 mm., width, 3.1 mm.; head length, 1.0 mm., width, 1.2 mm.; abdomen length, 1.5 mm., width, 2.03 mm.

Male.—Head fused with first thoracic segment much wider than long; with small eyes. First antenna 2-segmented, setose on antero-distal corner of basal segment and at tip of terminal segment. Second antenna 1-segmented, setose at tip.

Thoracic segments separate, about equal in length, widest in middle of body. The seven pairs of legs quite similar, with short curved terminal hooks, anterior borders lamellose and spinulose.

Abdomen unsegmented, a median notch at posterior end; appendages indicated by five rounded ventral nodules; no uropods.

Length of body, 1.35 mm., width, 0.47 mm.; head length, 0.12 mm., width, 0.24 mm.; abdomen length, 0.3 mm., width, 0.37 mm.

Types, male and female.—U. S. Nat. Mus. No. 93720.

This species resembles Shino's (1933) *Bopyrella pacifica* in the general form of the female, but differs in the shape of the head and the character of the abdominal appendages of the female. The male has differently shaped thoracic appendages and his abdomen has no lateral notches. It also resembles Krøyer's (1838) *Bopyroides hippolytes,* but the antennae of both males and females have fewer segments; the abdominal segments of the female are not indicated by lateral sinuses and show no other evidence of segmentation except the biramous pleopods; the male thoracic segments and abdomen are quite different in shape.

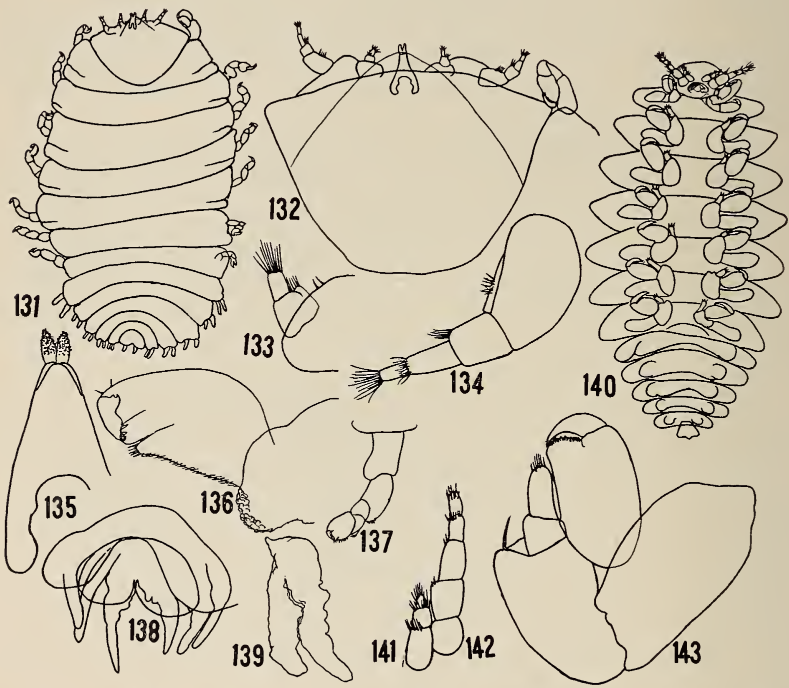
Phyllodurus robustus n. sp.

Figures 131-143

Host.—A female with an attached male was taken from the branchial cavity of *Upogebia affinis* (Say) on June 19 by Dr. H. J. Humm and forwarded to the writer. The host was collected on the flats west of Alligator Point.

Female.—Body three-fifths as wide as long; rounded at both ends. Head a third as long as wide, somewhat triangular and front little curved, corners rounded. Eyes absent. First antenna 3-

segmented; basal segment very wide; terminal segment with about eighteen terminal setae; middle segment with about six on its medio-distal angle; basal segment with two setae. Second antenna 4-segmented; two distal segments setose around tip; two proximal segments setose on anterior distal corner, two short spines among the setae on the basal segment.



Figs. 131-143. *Phyllodurus robustus* n. sp. 131, female; 132, head and right leg; 133, first antenna; 134, second antenna; 135, frontal process; 136, seventh leg; 137, sixth leg; 138, posterior end of abdomen; 139, fifth abdominal leg; 140, male; 141, first antenna; 142, second antenna; 143, fourth leg.

Seven distinct segments in the thorax; the first five with a small rounded lobe behind the epimeral plates. Abdomen with six distinct segments which are more strongly curved posteriorly, and the last two are completely enclosed, except behind, by the preceding segment. Abdominal appendages unsegmented; first five biramous and sixth uniramous. The sixth segment is wider than long, rounded in front and with a median notch behind.

There are five pairs of incubatory plates; the posterior pair have a row of stout setae across the posterior border. The seven pairs of legs are subchelate; the terminal claw is not sharply pointed and may bear accessory spines.

Length of body, 8.2 mm., width, 5.0 mm.; head length, 1.5 mm., width, 1.95 mm.

Male.—Body twice as long as wide. Head slightly more than half as long as wide. Eyes small, elongated, near posterior margin and not very close to lateral margins. First antennae 3-segmented; segments decrease in length and width from base to tip; setae also decrease in the same way. Second antenna 5-segmented, basal segment widest, second segment longest, setae increase from second segment to tip. The thoracic segments decrease in width in the following order: 5, 4, 6, 3, 7, 2, 1; all have rounded lateral angles and those on 6 and 7 slant backward. The thoracic legs are 5-segmented; segment 4 is beside 5 and bears a bunch of about ten terminal setae; terminal hook curved, sharp and bears against a surface with rough granulations. The six abdominal segments decrease progressively in width; terminal segment with base less than half as wide as tip, which has three short rounded lobes. Abdominal appendages are indicated by rounded ventral protruberances.

Length of body, 2.7 mm., width, 1.35 mm.

Types, male and female.—U. S. Nat. Mus. No. 93719.

This species differs from Stimpson's (1857) *P. abdominalis,* as described by Richardson (1903). The female does not have her abdomen tapered and it does not end in a pointed terminal segment but in a segment that is wider than long with a median sinus. The abdominal segments grow gradually narrower and wrap about one another more and more. The posterior incubatory plates have a row of stout setae across them. The male has the fifth thoracic segment widest; the head is much narrower; all thoracic segments have rounded and more pointed lateral epimera; the final abdominal segment is similar in shape but much shorter.

Suborder Amphipoda

Family LEUCOTHOIDAE

Leucothoe spinicarpa (Albidaard)

Five were taken from twenty-five ascidians, *Styelia plicata* (Le Sueur); sixteen from twenty other ascidians, *Molgula occidentalis*

Traustedt; and one from eight stingarees, *Dasyatis sabina* (Le Sueur).

Family GAMMARIDAE

Melita nitida Smith

From twenty ascidians, *Molgula occidentalis* Traustedt, a single female was taken.

Melita fresnelii (Audouin)

From twenty ascidians, *Molgula occidentalis* Traustedt, sixteen specimens were taken, and from twenty-five other ascidians, *Styelia plicata* (Le Sueur) sixteen were collected.

Corophium lousiananum Shoemaker

Hosts.—Several specimens were taken from an ascidian, *Styelia plicata* (Le Sueur), and from an unidentified colonial ascidian, both from Alligator Harbor.

Order CIRRIPEDIA

Suborder Lepadomorpha

Family LEPADIDAE

Octolasmis mulleri Coker

This barnacle commonly occurred on the gills and mouth parts of the blue crab, *Callinectes sapidus* Rathbun.

Suborder Balanomorpha

Family BALANIDAE

Chelonibia patula (Ranzani)

Common on the blue crab, *Callinectes sapidus* Rathbun, on the carapace and appendages.

Suborder Rhizocephala

Loxocephalus texanus Boschma

From one to five were present on the abdomens of blue crabs, *Callinectes sapidus* Rathbun.

Order DECAPODA

Suborder Paguroidea

Family PAGURIDAE

Pagurus floridanus (Benedict)

This hermit crab sometimes occupied a snail shell but more often lived in a sponge which it dragged about.

Summary

Three hundred and eighty-six fishes of seventy-seven species were examined. Thirty-nine of these harbored parasites:— copepods 36, isopods 11, and amphipods 1. Fifty species of copepods were found and twenty of these appear to be new. Six species of isopods were recorded from fishes, shrimps, and ascidians; two apparently new. Four species of amphiopods occurred in ascidians, and one also in a stingaree. Three barnacles lived in or on crabs; one of these was a sacculinid. A hermit crab commonly lived in a sponge, which it dragged about over the floor of the ocean. One copepod occurred in an oyster.

The writer made similar studies at Bimini in the Bahamas (1951) and at Port Aransas, Texas (1952). The collections at Bimini were about coral islands in the open sea; those at Port Arkansas were from the open Gulf of Mexico and the channels between the islands alongshore and the Gulf; and those at Alligator Harbor were from a long completely enclosed bay and from the open Gulf. The last had the closest association with fresh water, but Port Aransas furnished collections from the greatest variety of habitats. Table 1 shows the influence of habitat on the occurrence of parasitic copepods. Of course some of the results are due to the chance opportunity to examine hosts, but on the whole they have some significance. Most argulids were found at Alligator Harbor, most cyclopods and caligids at Port Aransas, and equal number of lernaepodids at Port Aransas and Alligator Harbor. The hosts at Bimini were fresh and in good condition, but at the other two localities they were often old or had been preserved, yet there were no argulids at Bimini. In general there were the greatest number of types of parasites where there was the greatest variety of habitats explored (Port Aransas) and fewest where there were fewer types available.

TABLE 1

Distribution of Genera of Parasitic Copepods in Three Localities Along or in the Gulf of Mexico or in the Gulf Stream

Number of new species found is indicated in parentheses

Genera	Bimini	Port Aransas	Alligator Harbor
Arguloida			
Argulus			4
Dolops		1	
Cyclopoida			
Bomolochus		3	2 (2)
Ergasilus		1	2
Grandiungus		1 (1)	
Taeniacanthus		1 (1)	
Telson		1 (1)	
Tucca		1	1
Tuccopsis		1 (1)	
Total cyclopids	0	9 (4)	5 (2)
Caligoida			
Anthosoma		1	
Anuretes	1		
Caligus	3 (3)	9 (5)	5 (2)
Cybicola	1 (1)	1	1
Dysgamus		1 (1)	
Echetus		1	
Eirgos		1 (1)	
Elytrophora		1 (1)	2
Eudactylina		1 (1)	2
Hatschekia	9 (4)	1	3 (1)
Kroyeria	1	1	
Lepeophtheirus		2	4 (2)
Lernanthropus	5 (4)	8	7 (2)
Lernaeeicus	1	1	
Nemesis	1 (1)		1 (1)
Nesippus		1	1
Pandarus		1	1
Perissopus		1	
Pseudocycnus	1	1 (1)	
Sagum		1 (1)	
Trebius			1
Tuxophorus		1	
Total caligids	23 (14)	35 (11)	26 (8)
Notodelphyoida			
Doropygus			2 (2)
Pseudomyicola			1
Total notodephids	0	0	3 (2)
Lernaeopodoida			
Acanthochondria		1 (1)	2 (2)
Brachiella		4 (1)	1 (1)
Charopinus			1 (1)
Clavellopsis		2	1 (1)
Naobranchia		2 (1)	2
Paeon		1	
Pseudochondracanthus			1 (1)
Thysanote	1		1 (1)
Tryphyllacanthus			1
Total lernaepodids	1	10 (3)	10 (7)
Grand Total	24 (14)	45 (15)	43 (17)

However, the number and variety of hosts was different at the three localities. At Bimini 368 fishes and 73 species were studied, at Port Aransas 803 fishes of 138 species, and at Alligator Harbor 386 fishes of 77 species. This indicates that Alligator Harbor with fewer hosts and species examined and nearly equal degree of infestation was more favorable for parasitic copepods than the other two localities. Furthermore infestation was at times very heavy. For example, eight stingarees, *Dasyatis sabina* (Le Sueur), harbored 8 argulids, 33 caligids, 8 isopods, and 1 amphipod on the outsides of their bodies, and 2 lernaepodids on their gills. A black grouper, *Mycteroperca bonaci* (Poey), 1 caligid on its skin, 2 Thysanotes at the bases of its gills, 70 Hatschekias, 2 lernaepodids, and a nematode on its gills. Altogether the findings indicate that Alligator Harbor with its less direct connection with the open sea is most favorable for the development of large infestations with copepod parasites. Limited observations on isopod, amphipod, and barnacle parasites point in the same direction.

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THE DISTRIBUTION OF HYDROCORYNE BORN. & FLAH.[1]

C. S. NIELSEN

The monotypic genus *Hydrocoryne,* Schwabe ex Born. & Flah., Ann. Sci. nat. VII Série, Bot. 5: 128 (1887), with the species *H. spongiosa,* were first described in Sprengel's *Systema Vegetabilium,* 4 (1): 373 (1827). The original description is somewhat inadequate: "Alga sordide virens clavata lubrica filis densissime intricatis composita". These plants consist of sheathed filaments with one-several trichomes and are sparsely branched; the cells are ovoid to subglobose; the heterocysts are intercalary.

The first American record of the alga is that of W. A. Setchell in 1892 from Connecticut. It apparently was not reported until collected again by the author in 1948 near Tallahassee, and identified by Dr. Francis Drouet of the Chicago Natural History Museum. In the following year it was collected by Drouet et al. in the same general area.

Drouet (1951) has removed the genus from the *Scytonemataceae* in which family it was included by Bornet & Flahault, and placed it in the family *Nostocaceae.* According to the International Rules, legitimate nomenclature in this group of plants begins with Bornet & Flahault's Révision des Nostocacées hétérocystées in 1887.

One species:

H. spongiosa Schwabe ex Born. & Flah., loc. cit. 1887; Schwabe in Sprengel, loc. cit. 1827; Fl. Anhalt., 136, 1839. Schizothrix spongiosa Grunow in Rabenh., Fl. Eur. Alg. 2: 270. 1865. Calothrix tenuissima A. Braun in Rabenh., ibid p. 271. 1865. Symphyosiphon minor Hilse in Rabenh., Algae Exsiccatae, No. 1776. 1865. Cystocoleus minor Thuret, Ann. Sci. Nat., VI Ser., 1: 381. 1875. Hilsea tenuissima Kirchner, Krypt.-Flora von Schlesien 2 (1): 239. 1878.

[1] Contribution number 54, Botanical Laboratory, Florida State University.

H. spongiosa Schwabe ex Born. & Flah.

Commonly epiphytic, forming thin irregular web-like membranes of a dark grey-green color; filaments of interwoven trichomes, 4-6.5 mic. in diameter, occasionally branching, and forming bundles up to 30 mic. thick; pale blue-green cells sub-globose, 3-4 mic. wide with narrow colorless sheaths; heterocysts approximately 4 mic. in diameter and from one to two times as long.

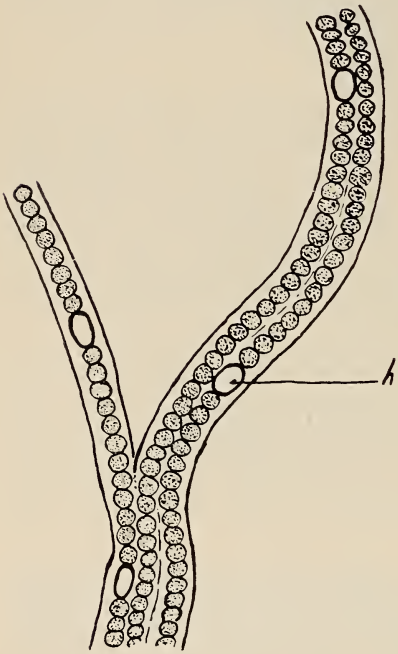

Fig. 1.—*Hydrocoryne spongiosa* Schwabe ex Born. & Flah.

The heterocysts of the specimens examined averaged about 5.5 mic. in length. Hansgirg (1892) reports the presence of solitary spores, 5-7 mic. in diameter, and about twice as long. These were not observed in the specimens cited below.

Specimens seen: (All are represented in the cryptogamic herbarium of the Chicago Natural History Museum, and those from Florida are to be found also in the herbarium of the Florida State University.)

Germany: Gross-Kühnauer See, Dessau, *Schwabe,* 1823-24 (type material of *H. spongiosa*); clay pit, Kavallen, near Breslau, *Hilse,* 16 Nov. 1864 (type material of *Calothrix tenuissima* and *Symphyosiphon minor*); Alter Rhein bei Praest, Rheinland, *H. Royers,* 26 Aug. 1909. Bohemia: in pool, near Lnáře, *B. Fott,* 1 Aug. 1947; near Stupritz, *A. Hansgirg,* 1884. Connecticut: Lantern Hill, North Stonington and Ledyard, *W. A. Setchell,* 13 Sept. 1892. Florida: Leon county, pond north of Tallahassee, *Nielsen* 25, March 1948; Ochlockonee river, near Stephensville, *Drouet, Crowson,* & *Petersen* 10506, 6 Jan. 1949.

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A MODIFIED CUPRA-AMMONIA TEST FOR DETERMINING CATION EXCHANGE CAPACITY OF MINERAL SOILS [1]

S. N. EDSON AND F. B. SMITH

Testing the soil for plant food elements has developed to a remarkable degree in the past few years. Tests for most of the nutrient elements have been fairly well established. Every index of the potential crop-producing power of the soil should be used in diagnosing the fertilizer needs of soils. The cation exchange capacity of the soils is such an index, but it is rarely determined for this purpose because of the long, tedious leaching processes.

The importance of cation exchange capacity—hydrogen, calcium, and magnesium saturation in relation to soil acidity and lime requirement, soil microbiological and physical properties of soils—is well recognized. However, there is need for rapid, accurate methods for determining these characteristics if they are to find wider use in soil testing programs. It is generally agreed that a knowledge of the reaction, cation exchange capacity, and a history of the local cultural practices are of considerable value in determining the fertilizer needs of a soil. For example, a soil that has a high cation exchange capacity and soil reaction near neutral may be assumed to have an adequate supply of calcium and also possibly magnesium.

Even more specific information concerning the needs of the soil is at hand if one knows that the cation exchange capacity is influence principally by clay or organic matter. Many of the red soils in northwest Florida are fairly heavy in texture and, judging from the clay content, one might expect them to have a high exchange capacity, but by actual test they are frequently found to have a cation exchange capacity of only 2 to 3 m.e. per 100 gms. A better knowledge of the soil means better soil fertility control and considerable savings in applied fertilizer.

Fieger, Gray, and Reed (1934) proposed a rapid exchange capacity soil test by the use of the highly colored cupra-ammonia ion. Later, Mehlich (1938-1942) introduced the use of triethanolamine acetate-barium hydroxide buffer as a rapid estimation of base exchange capacity of soils. Bower and Truog (1940) offered a colorimetric method using manganese as the exchange ion. All of

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[1] Florida Agricultural Experiment Station Journal Series No. 104.

these methods had certain disadvantages which prevented them from popular use as a rapid soil test. Not the least was the necessity of titration, centrifuging, oxidation process, and other time-consuming techniques.

Probably the nearest approach to a rapid soil test for cation exchange capacity was developed by Sieling (1941). This method differed from the cupra-ammonia method of Bower et al. in that copper acetate was used as the copper-carrying salt instead of copper nitrate. Sieling found, among other things, that (1) copper forms a stable and highly colored solution which is easily standardized; (2) the small ionic radius and positive valence of two makes copper an effective replacing ion; (3) copper acetate is much less acid than the nitrate, sulfate, or chloride salts, thus allowing the reaction to go more to completion.

To remain within the sensitivity range and conform to Beer's law, Sieling developed two separate sets of dilutions, one for soils with exchange capacity less than 27 m.e. per 100 gms. of soil and one for soils from 28 to 64 m.e. per 100 gms. Results by this method were found to be closely correlated to results obtained by various leaching methods when tried on 21 soil types.

Since most mineral soils in Florida have a cation exchange capacity less than 20 m.e. per 100 gms. of soil, a modification of Sieling's procedure using only the dilute solution of copper acetate and comparing the resultant color with a permanent color standard calibrated to read directly in m.e. cation exchange capacity is proposed. The use of tightly sealed permanent cupra-ammonia color standards, developed in the same manner as the cation exchange capacity test, eliminates the necessity of additional equipment and results in a saving of time.

The Method

The basis for the test is the use of 5 ml. of 0.2 *N* cupric ions to supply 1 m.e. of copper for each 5 gms. of soil sample, or 20 m.e. per 100 gms. of soil. When a 5 gm. air-dry soil sample is shaken for a full minute all of the cation positions on the exchange complex are replaced by the copper ion. The amount of copper remaining in solution, if any, is effectively measured by adding a definite amount of ammonium hydroxide, which forms the cupra-ammonia complex, and comparing this with the standards prepared in a similar manner.

Preparation of the Reagents

For measuring the cation exchange capacity of the soil, the following reagents are needed:

Solution A. Copper acetate-acetic acid solution, approximately 0.07 *N* in terms of acetic acid and 0.2 *N* in terms of cupric ions. The final reaction should be adjusted to pH 4.62. To prepare this solution, measure exactly 4.0 ml. of 99.7% glacial acetic acid and add to about 500 ml. of distilled water. Dissolve exactly 19.962 gms. of C.P. $Cu(C_2H_3O_2)_2.H_2O$ in this solution and make up to 1000 ml. in a volumetric flask with distilled water. For all practical purposes, standardization is not necessary; however, for research and exploratory work, solution A may be readily standardized by one of any of the approved methods.

Solution B. Dilute 1 volume of concentrated NH_4OH to 4 volumes with distilled water. Keep tightly stoppered to prevent the escape of NH_3.

Preparation of Permanent Color Standards

Fill 11 screw cap vials with 20 ml. of solution A and distilled water, as indicated in columns 1 and 2, Table 1, and mix thoroughly. Remove 10 ml. of the mixture and add 5 ml. of solution B. Screw a wax-coated plastic cap on the vial and mix the solutions. The standard which contains 5.0 ml. of solution A corresponds to a soil which has an exchange capacity less than 2 m.e. per 100 grams, and the one with no solution A corresponds to 20 m.e. per 100 grams exchange capacity as indicated in column 3, Table 1.

Procedure for Conducting the Test

The steps taken to conduct the cation exchange capacity test may be briefly stated as follows:

1. To 5.0 ml. of solution A in a 16 $\times$ 150 mm. test tube, add 15 ml. of distilled water.
2. Carefully weigh out 5 gms. of a representative air-dry soil and add to the test tube.
3. Cover the mouth of test tube with a small piece of wax paper, hold with the thumb and shake vigorously for a full minute.

4. Filter through a No. 1 Whatman filter paper and collect *exactly* 5 ml. in a marked tube.

5. With a pipette, add 2.5 ml. of solution B.

6. Swirl tube to mix, and filter into a clean 16 $\times$ 150 ml. test tube. Repeat the filtration a second time in order to remove all of the Fe-Al-hydrate. Considerable error is involved if all of the Fe-Al-hydrate is not removed. Compare the resultant clear blue color with the prepared set of cupra-ammonia color standards.

TABLE 1

Cupra-Ammonia Permanent Color Standards

Ml. of Solution A	Ml. of Dist. H_2O	M.E. per 100 gms. Soil
5.0	15.0	0
4.5	15.5	2
4.0	16.0	4
3.5	16.5	6
3.0	17.0	8
2.5	17.5	10
2.0	18.0	12
1.5	18.5	14
1.0	19.0	16
0.5	19.5	18
0	20.0	20

Results

Results obtained by the cupra-ammonia rapid cation exchange capacity method on 15 soils representing the principal soil groups in Florida were compared with those obtained by the conventional ammonium acetate method (Table 2). The readings were made in a simple comparator fashioned from a test tube rack with a solid piece of frosted glass secured to the back. The permanent color standards were placed in the rack; the unknown samples were matched with them. Results were recorded to the nearest whole m.e. per 100 gms. of soil. Agreement was good in all instances except for one sample of Scranton sand, which gave a lower value by the cupra-ammonia method than by the ammonium acetate method. The time required to conduct a single soil test is about 5 minutes. Judging from these results, the simplified test should aid materially in characterizing soils and add to the efficiency of any well rounded soil testing program.

TABLE 2

Comparative Values of the Exchange Capacity of Some Florida Soils by the Standard Ammonium Acetate and Cupra-Ammonia Methods

Soil Type	Depth of Soil	pH	$NH_4C_2H_3O_2$ M.E./100 gms.*	$Cu(C_2H_3O_2)_2$ M.E./100 gms.
Red Soils				
Ducker, s.l.	6″	5.8	9.00**	10.0
Greenville f.s.	6″	5.9	8.50	8.0
Phosphatic Soils				
Gainesville l.f.s.	7″	6.4	8.35	8.0
Fellowship l.s.	5″	6.3	9.69	9.0
Arredondo	6″	6.3	2.07**	2.0
Flatwoods Soils				
Plummer f.s.	8″	5.1	2.70	3.0
Leon s.	5″	4.4	4.20	4.0
Rex f.s.	8″	5.2	3.19	3.0
Parkwood f.s.	6″	5.9	3.25	4.0
Scranton s.	6″	4.8	11.50	5.0
Scranton s.	6″	5.1	7.05	7.0
Scranton s.	6″	5.0	2.30**	2.0
Yellow Sands				
Lakeland f.s.	9″	5.5	2.05	2.0
Blanton f.s.	6″	5.5	1.81**	2.0
Lakeland f.s.†	6″	5.5	2.00	2.0

* Recorded data from the Alachua County Soil Survey of Florida.
** Recorded soil samples, College of Agriculture, University of Florida.
† 250 lbs. per acre total Cu.

Reuther, Smith, and Specht (1952) reported that many citrus soils contained over 200 pounds per acre of total copper, a few with as much as a ton per acre. Since copper is used as a soil amendment as well as an important ingredient in many sprays, it was decided to investigate a typical citrus grove soil to learn what influence copper added to the soil may have on the exchange capacity as determined by the cupra-ammonia method. Varying amounts of copper sulfate up to one ton per acre were added to soils and the exchange capacity was determined. Results of this test indicated that amounts up to 250 pounds per acre of total copper did not affect the determination. Where copper in excess of this amount is suspected, a blank should be made at the same time the test is made on the soil, using only distilled water, for use as a correction factor.

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A STUDY OF GASTRIC SECRETION OF TOLUIDINE BLUE O IN THE RAT [1] [2]

Michael Klein and Mary F. Argus

Numerous studies on gastric secretion employing dyes have been reported for the dog, (Dawson and Ivy, 1925; Kobayashi, 1926; Visscher, 1942). Inasmuch as some laboratories are not equipped to accommodate so large a species, it was considered worthwhile to investigate the possibility of substituting a smaller experimental animal such as the rat for studies of this type. The dye, Toluidine Blue O, was employed since experiments on the dog had shown this compound to be rapidly secreted by the gastric glands (Visscher, 1942).

Methods

Sprague-Dawley male rats weighing 290 to 478 gms. which were employed were maintained on Purina Laboratory Chow pellets and water *ad lib.* before the start of the experiment. Animals were fasted 48 hours, but were allowed water prior to the time of operation. A laparotomy was performed on each animal using ether anesthesia, and a loop of the intestine adjacent to the pylorus ligated to prevent backflow into the stomach. The abdominal cavity was closed using nylon sutures and each animal returned to its original cage. The animals were not treated further until 3 to 3½ hours following the laparotomy by which time all had emerged from the anesthesia. Some of the animals were injected intraperitoneally with a solution of histamine dihydrochloride [3] in a concentration of 0.6 mg. per ml., each receiving 0.002 mg. of histamine per gm. body weight. Toluidine Blue O (C.I. 925) [4] was dissolved in varying concentrations in water and in propylene glycol. These solutions were injected into 5 groups of rats as follows:

Group I —6 rats, injected intravenously (femoral vein) with an aqueous solution containing 5 mg. of dye per

[1] A contribution from the Cancer Research Laboratory, University of Florida.

[2] Supported by a grant from the Damon Runyon Memorial Fund.

[3] Obtained from Eastman Kodak Co., Rochester, N. Y.

[4] Obtained from National Aniline Division, Allied Chemical and Dye Corp., New York, N. Y.

ml. Each rat received 0.25 ml. per 100 gm. body weight.

Group II —3 rats, injected intraperitoneally with an aqueous solution containing 5 mg. of dye per ml.

Group III—2 rats, injected intraperitoneally with an aqueous solution containing 1.25 mg. of dye per ml.

Group IV—4 rats, injected intraperitoneally with a propylene glycol solution containing 1.25 mg. of dye per ml.

Group V —2 rats, injected intraperitoneally with 1.0 ml. of propylene glycol per 100 gm. body weight.

Each of the rats in Groups II, III and IV, received 1.0 ml. of dye solution per 100 gm. body weight. When both histamine and Toluidine Blue O were injected into the same animal, this was done simultaneously.

Each animal was anesthetized ½ hour following the time of injection and a blood sample withdrawn either by heart puncture or from the aorta. The abdominal cavity was exposed, the esophagus ligated below the diaphragm, and the stomach removed and rinsed in Ringer's solution maintained at room temperature. The gastric contents were collected in a calibrated centrifuge tube, the volume recorded, and the pH obtained with Hydrion paper. The stomach contents and blood samples were each diluted 1:1 with acetone, stirred, and centrifuged for 10 minutes at 2000 r.p.m. The supernatant was withdrawn and a 1 ml. aliquot diluted with acetone to 10 ml. This was stored at 5° to 10° C. overnight following which it was centrifuged 20 minutes at 2000 r.p.m. and the supernatant removed for spectrophotometric analysis. An acetone blank was used for all determinations. In the case of gastric samples, the pH of the blank was adjusted to that of the sample using HCl. The same acetone was used throughout the experiment and was redistilled prior to use. A Beckman Model DU Spectrophotometer was employed in making the measurments. Spectrophotometric curves for Toluidine Blue O standards showed this compound to have maximum absorption at 620 mμ. All gastric and blood extracts were analyzed over the range of 575 to 675 mμ. The presence of Toluidine Blue O in these extracts was established when spectrophotometric analysis resulted in maximum absorption at 620 mμ. Extracts from control animals (Group V) showed no peak absorption in the region of this wave length. The presence of dye in the urine was determined by examination of urinary bladder contents.

Results and Discussion

A total of 17 rats was employed, 15 experimentals injected with the dye and 2 controls. All but two of the experimentals received simultaneous injections of histamine. The latter compound was administered since it had been reported by Ray and Peters (1951), that a high level of gastric secretion was thereby obtained. It was found subsequent to the initiation of the present experiment that injection of histamine even in the large amounts employed did not alter the volume of gastric secretion in the rat (Klein *et al.,* 1953).

Analysis of stomach extracts ½ hour following intravenous injection of Toluidine Blue O established the presence of the dye in the gastric contents of all the animals of Group I (Table 1). Thus it is shown that the rat stomach, like that of the dog (Visscher, 1942), is capable of secreting Toluidine Blue O when an aqueous solution of the dye is administered directly into the blood stream.

An attempt was made to repeat these results using the intraperitoneal route since this method of administration is more convenient than the intravenous one. For the first group of animals injected in this manner (Group II), the dose of Toluidine Blue O was increased fourfold. The time between injection and collection of the samples was extended to 1 hour for two animals. These alterations in dose and time were instituted since it was anticipated that the dye would be diluted in the peritoneal cavity and might be absorbed slowly. When spectrophotometric analysis of the gastric extracts revealed the presence of the compound in both rats, the time was shortened to ½ hour for 1 additional rat in the same group. Again the dye was found to be secreted by the stomach (Table 1).

In another series of rats (Group III), the dose given intraperitoneally was decreased so that these animals received the same amount of dye on a body weight basis as the intravenously injected animals (Group I). Spectrophotometric analysis of gastric extracts showed Toluidine Blue O to be present in both animals (Table 1). Thus studies in gastric secretion with aqueous solutions of Toluidine Blue O are practicable using the intraperitoneal route.

TABLE 1

Gastric Secretion of Toluidine Blue O
in Pylorus-Ligated Rats

Group	Total rats	Dose Toluidine Blue per 100 gm. b. wt.	Solvent	Injection route	Presence of Toluidine Blue in stomach
no.	no.	mg.			
I	6	1.25	aqueous	i.v.*	+
II	3	5.0	aqueous	i.p.**	+
III	2	1.25	aqueous	i.p.	+
IV	4	1.25	propylene glycol	i.p.	—
V	2	0.	propylene glycol	i.p.	--

* i.v., intravenously
** i.p., intraperitoneally

Since some dyes are poorly soluble while others are completely insoluble in aqueous media, it was desirable to investigate the possibility of substituting another solvent. Thus, Toluidine Blue O was dissolved in propylene glycol and injected intraperitoneally into 4 rats (Group IV). Propylene glycol was selected because it was desired subsequently to investigate the ability of the stomach to secrete a series of fluorene-azo dyes, some of which are insoluble in aqueous media but soluble in propylene glycol, and to compare this with the gastric secretion of Toluidine Blue O. Each animal received 1.25 mg. of dye per 100 gm. body weight and was sacrificed ½ hour thereafter. Spectrophotometric analysis of stomach extracts failed to reveal the presence of the compound (Table 1). Similarly, analysis of the blood from these animals, as well as from rats of Group I, also was negative.

It may be that Toluidine Blue O in propylene glycol would be secreted by the stomach if a greater amount of the dye were injected intraperitoneally or if the time between injection and collection of gastric contents were extended. On the other hand, it has been observed that the solvent, propylene glycol, exerts a toxic effect when injected in an amount comparable to that employed in the present experiment. Thus, pylorus-ligated rats were prostrate and appeared to be in a state of shock following injection with this compound (Groups IV, V). When autopsied at ½ hour, the peritoneal cavity was filled with fluid. It has been observed in this Laboratory that unoperated rats injected intraperitoneally with the same dose of propylene glycol on a body weight basis also appeared to enter a state of shock. A majority of these animals died within 48 hours. It is apparent that greater amounts of a dye could not be employed for intraperitoneal injection if this necessitated the concomitant use of a large volume of propylene glycol. Furthermore, in view of the profound disturbance produced by injection of large amounts of this solvent, a comparison of gastric secretion of Toluidine Blue O following intraperitoneal injection of the dye dissolved in aqueous media and in propylene glycol is unwarranted.

Following intravenous injection of a saturated solution of Toluidine Blue O in physiological salt solution into Pavlov pouch dogs, it was observed that the dye rapidly appeared in the pouch and that after 5 minutes no more secretion was obtained (Dawson and Ivy, 1925). It is possible that this is the result of a rapid elimination of the dye from the blood stream. Examination of the urine of rats injected with aqueous solutions of Toluidine Blue O (Group I, II, III) showed the definite presence of the blue dye in every animal. Although the shortest time interval observed was ½ hour, it is probable that the dye was excreted before then.

Summary

Gastric secretion has been studied in pylorus-ligated rats with Toluidine Blue O. The dye was administered intravenously or intraperitoneally as an aqueous solution or dissolved in propylene glycol. The dye was secreted by the stomach in all the rats except those which had been injected intraperitoneally with the propylene glycol solution. Toluidine Blue O is readily eliminated following intravenous injection appearing in the urine within ½ hour.

Acknowledgments

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OBSERVATIONS ON THE GROWTH RESPONSE OF *ASPERGILLUS NIGER* AND OTHER FUNGI TO VARIOUS LEVELS OF ZINC[1]

SETON N. EDSON

INTRODUCTION

Considerable information is available on the major elements essential for the growth of fungi such as carbon, nitrogen, potassium, phosphorus, magnesium, and sulfur. However, information available on the minor elements—zinc, manganese, copper, boron, iron, and molybdenum—which are necessary for the growth of fungi, as well as for higher plants, is limited.

Active research in this field has been stimulated by the use of molds for determining available plant nutrients in the soil. Steinberg (1919) suggested the use of fungi for the study of minor elements. Later, (1934), he confirmed the essentiality of heavy metal nutrition for these organisms. Mulder (1940) used this principle in solving the "reclamation disease" problem in Holland with his *Aspergillus niger* test for available copper in connection with soil fertility. Beadle (1945) concurred in the findings of Steinberg with his exhaustive study of the genetics and metabolism of *Neurospora*. Nicolas (1950) and Nicholas and Fielding (1951) used *A. niger* for determining available Mg, Cu, Zn, and Mo. in soils.

A thorough investigation of the effects of zinc on the physical and chemical characteristics of *Aspergillus niger* was carried out by Porges (1932) in his study of heavy metal nutrition. He found that *Aspergillus niger* gave superior responses to zinc than to any other minor element. It is of special interest to note in his table of proximate composition that a 470 per cent increase in dry weight of the mycelium was recorded when zinc was added to the medium. These data should indicate corresponding increases in sugar consumption, since one is affected by the other.

Foster (1949) supported the viewpoint that minor elements are largely functional or dynamic in metabolism, because they are in tight or loose combination with the catalysts of the cell—the enzymes. Without the minor elements, the enzymes of the cell be-

[1] Florida Agricultural Experiment Station Journal Series, No. 109.

come inoperative; consequently, no growth occurs. Considering the large group of enzymes that require Mn, Cu, Fe, and Ca, most of the heavy metals appear to be nonspecific and, to a large degree, interchangeable. It seems that zinc would fall into this class, with copper being the most specific, since it is confined to only laccase, tyrosinase, and ascorbic oxidase. In each case, Steinberg (1939), Foster (1939), and Tanner (1944) pointed out that an exceedingly small excess of zinc in the medium would bring about a characteristic inhibition of sporulation with a subsequent reduction of spore coloration. This phenomenon is ultilized to good advantage in a number of highly important vitamin assays where a large amount of sterile mycelium is desirable for accurate weighing.

Utilizing these characteristics, the following preliminary observations were carried by growing several common species of molds.

Experimental

Molds were selected that had been known to give a definite response to one or more of the minor elements. *Aspergillus niger* was of primary interest because of its wide use in the field. *Trichoderma viride, Penicillium expansum,* and *Penicillium chrysogenum* included the remainder of the group. Each species was isolated in pure culture; no attempt was made to secure a definite recorded strain.

Two well-known mold nutrients were selected that had been previously tested in actual practice. Barton-Wright's (1936) modification of Stokes' medium and Mulder's (1940) copper assay medium were used, principally because they contained all factors that lead to rapid development of mycelium, as well as being strictly synthetic in nature. The procedure used by Mulder (1940) for his biological determination of copper was adopted with certain revisions, the principal changes being in the method of purification and the size of the flask used in the test.. For simplicity, the Steinberg (1919) $CaCO_3$ co-precipitation method was utilized to purify the basal medium.

The entire procedure can be conveniently presented in the following steps.

1. Nutrient Media

Mulder's Medium	pH 6.6
Glucose	50.000 gm
KNO_3	5.000 gm (Basal medium)
K_2HPO_4	2.500 gm
$MgSO_4.7H_2O$	1.000 gm
$FeCl_3.6H_2O$	0.050 gm or 10.3 ppm Fe
$ZnSO_4.7H_2O$	(Variable)
$MnSO_4.4H_2O$	0.003 gm or 0.74 ppm Mn
$CuSO_4.5H_2O$	0.001 gm or 0.25 ppm Cu
Distilled water	1000 ml
Stokes' Medium	pH 4.8
Sucrose	30.000 gm
$NH_4C_4H_4O_6$	10.000 gm (Basal medium)
KH_2PO_4	5.000 gm
$MgSO_4.7H_2O$	1.000 gm
NaCl and $CaCl_2$	0.200 gm each
$FeCl_3.6H_2O$	0.010 gm or 2.0 ppm of Fe
$ZnSO_4.7H_2O$	(Variable)
Distilled water	1000 ml

2. To remove traces of zinc from the basal medium, Steinberg's $CaCO_3$ method was used. (Heat the nutrient solution for 15 minutes at 15 lbs. pressure in the presence of 15 gms. per liter of pure $CaCO_3$. Filter while hot.)

3. The iron, copper and manganese salts were added to the nutrient solution after filtration.

4. A basal solution of 20 ml. was sterilized in the autoclave at 105° C. for 5 minutes in two 500 ml. flasks containing zinc in the following amounts:

0 p.p.m.
2 p.p.m.

5. In the same manner, using Stokes' medium, a series of five 500 ml. flasks containing zinc in the following amounts were prepared: none, 0.12, 0.25, 0.50, 1.00 p.p.m.

6. The solutions in the flasks were inoculated with a few drops of a heavy spore suspension of the molds under investigation. The suspension was prepared by washing the growth of a 5-day-old test tube culture with 2 to 3 ml. of sterile distilled water.

7. The cultures were incubated at 28° C. for 4 days, after which the comparative development of spores and mycelium was recorded.

Effects of zinc and types of media on the growth and sporulation of *Aspergillus niger.*

Mulder's Medium

		Sporulation	
p.p.m. Zinc	*Mycelium Growth*	*Amount*	*Color*
none	fair	abundant	black
2	good	abundant	black

Stokes' Medium

		Sporulation	
p.p.m. Zinc	*Mycelium Growth*	*Amount*	*Color*
none	fair	abundant	black
2	abundant	none	white

Stokes' Medium

		Sporulation	
p.p.m. Zinc	*Mycelium Growth*	*Amount*	*Color*
none	fair	abundant	black
0.12	good	medium	dark gray
0.25	abundant	very little	pale gray
0.50	abundant	none	white
1.00	abundant	none	white

Discussion and Summary

Spore formation was not inhibited by 2 p.p.m. of Zinc in Mulder's solution. This was probably due to the presence of interchangeable Fe, Mn, and Cu. Although some physiological changes were noticeable, similar results were obtained with the other molds using the same media. This was not the case when Stokes' medium was used. Of the molds tested, only *Aspergillus niger, Penicillium expansum,* and *Penicillium chrysogenum* exhibited a distinct response to added zinc. This was particularly striking for *Aspergillus niger* in the repression of spore formation and the amount of mycelium developed.

Since a simple color comparison was desirable for future study, it was decided to extend the investigation of *Aspergillus niger* to include a series of dilutions, starting with zero through 0.12, 0.25, 0.5 and 1.0 p.p.m. of zinc. After the prescribed inoculation and incubation, it was found that the variation in spore formation ceased at about 0.5 p.p.m. of zinc. This may indicate that future investigation should include the fractions between zero and 0.5 p.p.m. of zinc.

It is thought that the addition of Fe and a secondary source of energy in the form of $NH_4C_4H_4O_6$ in Stokes medium may play an important part in the rapid growth and repression of sporulation of *Aspergillus niger.* Another advantage for using $NH_4C_4H_4O_6$ is that the ammonia is rapidly used by the mold as a source of nitrogen, thus leaving the organic acid to assist in buffering the solution at the desired acid reaction.

Aspergillus niger appears to be superior to other molds used for further investigation because of its black spore contrast and rapid growth. Above 0.5 p.p.m. of zinc in the medium prevented spore formation. This was particularly true when in combination with Fe, but was not noticeable when in combination with Cu, Mn, and Fe. Variations in spore color occurred below this concentration.

With the use of a small amount of soil as a source of zinc, it would seem possible to set up a relatively simple biological test for available zinc in soils. Additional research is necessary in order to correlate actual plant response to *Aspergillus niger* requirements of zinc. Of further interest is the necessity of establishing a specific strain of the mold for study of a particular element such as zinc.

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WINTER BIRD CENSUS IN A SOUTH FLORIDA HAMMOCK AND SLOUGH

C. Tyler Hotchkiss

A number of the ornithologists who have visited south Florida have published lists of the birds which they were able to collect or see. Such an annotated list of the birds of Paradise Key and Taylor Slough was published by A. H. Howell (1921). Paradise Key is but one of a band of islands or keys mostly forested by Miami Rockland Pine (Davis, 1943, vegetation map) which extends southwesterly from Miami into the heart of Everglades National Park. These keys rise two or three feet above the sawgrass marshes to the southwest. Fingers of sawgrass glades, which reach southeastwardly through from the Everglades to the coastal marshes, separate the pinelands into islands which are known collectively as the Everglades Keys.

In the past Paradise Key has differed markedly from the other Everglades Keys. Instead of sunny, open pineland, it was characterized by a dense jungle of immense live oaks whose great limbs were clustered with tons of epiphytic orchids, ferns, and tillandsias, and strung with many kind of vines and lianas. Lofty royal palms towered up through this hammock. Small (1917) has described its many tropical botanical features in detail, and Safford (1919, p. 378) points out that this interesting crescendo of tropical hammock growth was originally attained because fire was kept from it by the especially deep finger glades which protected it on either side. The one to the east, Taylor Slough, is so deep that before the drainage of the Everglades it was thought never to go dry.

Probably drainage of the Everglades, begun at New River in 1906, contributed to excessive dryness which permitted fire to raze the north end of Paradise Key in 1929 and to destroy four-fifths of the remaining hammock in 1945. Two years after this latter fire, Paradise Key was a part of the great wilderness which was accepted by the National Park Service for protection as Everglades National Park. A token remnant of the great old hammock trees exists today, little disturbed by the fires mentioned and protected from further threat by fire-fighting crews of park rangers. Over the remainder of the area formerly occupied by the hammock an almost impenetrable scrub growth of young hammock trees has sprung up.

Small (1916) has told how Kirk Monroe was probably the first white man to visit Paradise Key (1882) and has chronicled the early visits of naturalists to the area. Safford *(loc. cit.)* mentions that Paradise Key and some of the surrounding glades and nearby pine-lands were set aside in 1915 as Royal Palm State Park, and the hammock has often been called Royal Palm Hammock. The presence of a Royal Palm Hammock at Collier-Seminole State Park in nearby Collier County, Florida, however, offers such potentialities for confusion that for the area under discussion it seems better to adhere to the older name of Paradise Key.

The glade which bounds Paradise Key on the east differs from most of the finger glades. In addition to the ordinary expanse of sawgrass *(Mariscus jamaicensus)*, usually somewhat dwarfed where the mantle of soil is thin over the bedrock, this finger glade contains a feature known as Taylor Slough. During the summer and fall this slough constitutes a broad, sluggish water course. As the dry seasons of winter and spring progress, however, flow ceases, and water levels gradually disappear below the surface of the glade everywhere except in the deep pools of the slough. Aquatic animal life during this drying up period gradually funnels into less and less space. As this takes place, alligators, otters, and wading birds gather about the residual pools and feed upon the concentrating fishlife. Taylor Slough differs vegetatively from the rest of the glade it occupies. In the part of Taylor Slough with which this paper is concerned, willows flank the deeper ponds of the slough on either side for 100 feet or more, and patches of tall, dense sawgrass occur. There are also patches of tall cane *(Phragmites phragmites)*, areas of nearly pure buttonbush *(Cephalanthus occidentalis)* and occasional pond apple trees *(Annona glabra)*.

While seasonally employed by the National Park Service during the winter of 1951-52, the writer was stationed at Royal Palm Ranger Station which is situated on the eastern edge of Paradise Key by Taylor Slough. This assignment permitted a program of weekly bird censuses carried out by walking the road (Florida Route No. 27) which crosses east and west through the center of the hammock and slough, and the Anhinga Trail, an elevated board-walk extending north into the slough 375 feet from the road. This route includes 100 yards of mature hammock, 780 yards of scrubby second growth hammock, and 830 yards of slough. Each census was begun between 8:15 and 9:00 A.M. and lasted from 1½ to 2½ hours. While returning over parts of the route already censused, the writer recorded only new species. The twelve censuses were made on the following dates: December 11, 18, 26, January 2, 10, 17, 24, 31, February 7, 14, 21, 28. Species of birds observed were recorded for all of these censuses, but recording numbers of individuals began with the first January census. While the number of censuses on which any species was seen applies to all three months, numbers of individuals generally applies only to January and February. Exceptions to this are made in special cases such as that of the rare short-tailed hawk. In preparing this manuscript only 3 months after finishing the census, the writer has relied on his memory in regard to numbers of some such rare birds seen on December censuses. It should perhaps be mentioned that the writer was stationed here in a similar capacity during the winter and spring of 1950-51, and spent much time on bird walks both winters.

The present paper indicates the kinds and numbers of birds observed during these censuses and compares these with abundance reported by Howell *(op. cit.)*, wherever a difference appears to exist.

It is interesting to speculate on possible explanations of a few of these differences. If drainage operations in the Everglades have truly reduced winter water levels in the park area as much evidence suggests, this may explain the present lack of ducks and shore birds which were at Taylor Slough in Howell's time. His opportunities to see ground doves and perhaps mourning doves, may relate to the then dusty gravel structure of the road. It is now asphalt, and no doves were observed during my censuses. A further change which might be expected to influence the abundance of birds is the burning of much of the great hammock as already described.

This may have improved the hammock area for sparrowhawks and account for the apparent increase in their abundance. Howell's winter records of Savannah sparrows "fairly common", Grasshopper Sparrows, White-throated Sparrows, and Song-sparrows are very interesting today since these birds are not only absent from my census records, but have eluded me entirely during my two winters of bird-watching at Paradise Key. Other winter birds recorded by Howell *(op. cit.)* but not in the 1951-52 census, are either accidentals or were present in the vicinity outside of my census area.

The writer observed seven species this winter which were not reported by Howell for 1917-18-19. Two of these, the American and Snowy Egrets, demonstrate by their presence now as regular and abundant winter visitors, the success of the conservationist movement to save them from extinction. The occurrence here now of the Roseate Spoonbill may be due in large part to the rescue from destruction of the remnant Florida Bay rookery which was nurtured back to a healthy colony by organized birdwatchers clubs and particularly Robert P. Allen. If any local changes may be construed to have contributed to an apparent increase in numbers of the Short-tailed Hawk, the protection afforded it in the recently established 1,228,000-acre Everglades National Park is surely one. The Duck Hawk may be responding also to the establishment of this park; although it is by no means now regular at Paradise Key.

Rapid departure of many of the wading birds from the slough area in early February seemed to be related to heavy rains on the 2nd and 5th. This phenomenon has been noted over the years by oldtimers such as park warden M. Barnie Parker and park ranger Erwin C. Winte. Their explanation for it is that steady lowering of water levels during the dry season progressively concentrates the fish and keeps them easily available to the wading birds. Then, when a heavy rain interrupts the dry season, water rises and spreads markedly in the slough permitting the fish to disperse. The wading birds then move out. We have no records of water levels for Taylor Slough during this period, but U. S. Geological Survey records are available for water levels in the Ingraham Highway canal in the Everglades 13 miles west of Taylor Slough. These are presented in Figure 1 for the dates of the censuses and show a considerable average increase in the numbers of wading birds per census during the drying up period in January and a sharp decline in their numbers coinciding with the abrupt rise in water level. The birds showing a decline in numbers are Wood Ibis, White Ibis, American Egret, Snowy Egret, Black-crowned Night Heron, Louisiana Heron, Little Blue Heron, and Green Heron. It seems equally interesting that the numbers of the Ward's Heron showed no response to these changes.

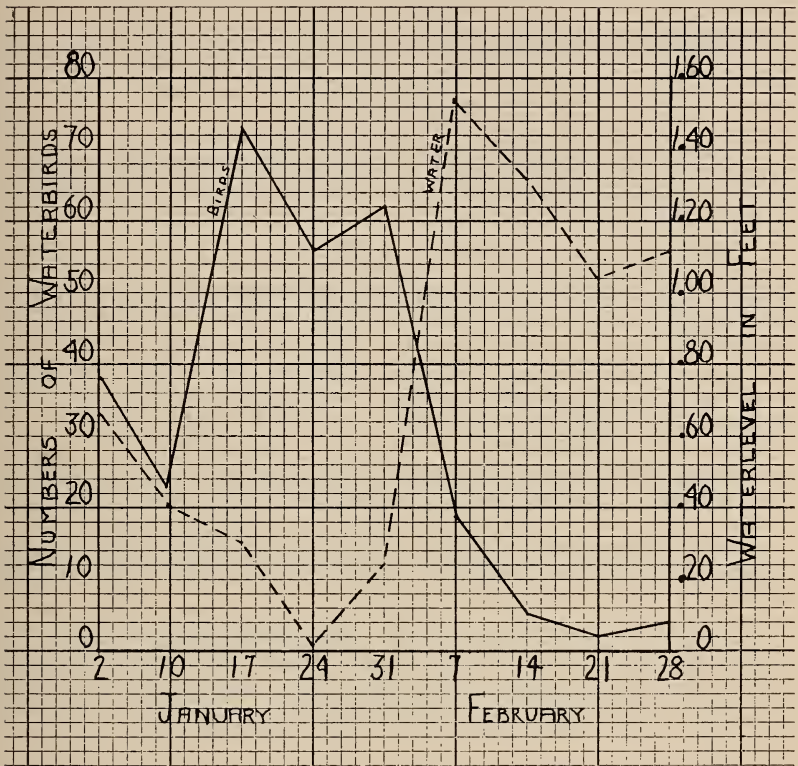

Fig. 1.—The relation of water level changes to the abundance of certain wading birds at Taylor Slough in January and February, 1952. The numbers per census of Wood Ibis, White Ibis, American Egret, Snowy Egret, Black-Crowned Night Heron, Little Blue Heron, Louisiana Heron, and Little Green Heron are totaled to provide the figures used.

The writer is indebted to district ranger Paul Barnes and superintendent Daniel B. Beard whose cooperation and interest made the project possible; to park biologist Joseph C. Moore who offered helpful suggestions during the planning stage and who contributed much to the preparation of the manuscript; and to National Park Service collaborator William B. Robertson and park naturalist Willard E. Dilley for help and encouragement throughout the census.

Where no comparison is made in the following species accounts to Howell's report, it may be assumed that the present writer considers the 1951-52 status of the species to approximate that of 1917-18-19.

Collecting was not attempted, and therefore no subspecific names are used.

Annotated List

Pied-Billed Grebe, *Podilymbus podiceps.* Observed on eleven censuses. Two or three seen each January census, but none February 7 and only one on each remaining February census.

Florida Cormorant, *Phalacrocorax auritus.* Limit of occurrence to December 11 and 26 suggests that it finds the slough more suitable in its high or medium water stages. Not considered common in such small freshwater slough ponds.

Water-Turkey, *Anhinga anhinga.* Present every census. Maximum count was 15 on January 31. Average for 9 January-February counts is 10. Nearly all males in February.

Great White Heron, *Ardea occidentalis.* Observed on 3 censuses in Taylor Slough. Two together January 24. One each February 7 and 28.

Wards Heron, *Ardea herodias.* Present every census, averaging 3 per count in January-February with 5 the highest count on January 10. Numbers consistent in spite of changes in water level.

American Egret, *Casmerodius albus.* Entirely absent from this area during Howell's time, it is now a common winter bird. Found in Taylor Slough in December and January averaging 5 per census. Its absence in February apparently relates to rising water level in glades pools (see fig. 1).

Snowy Egret, *Leucophoyx thula.* Also unknown in this area during Howell's time, this egret is now common in the slough during December and January. On January 24 and 31 there were 13 and 12 recorded. One lone bird February 7, none thereafter.

Louisiana Heron, *Hydranassa tricolor.* It would be of interest to know if this and the next heron's disappearance (Howell *op. cit.* p. 254) after being " . . . numerous . . . January 15-26, 1918 . . . " was related to a rain and rise of water level, and if the presence of this one February 20-28, 1919, correlated with absence of rains. My censuses show an average of 6 per census in January, and 3 on February 7, after which there were none.

Little Blue Heron, *Florida caerulea.* Common in winters of 1917, 18, and 19. My count averaged 2-3 birds through December and January and until February 14, after which none were seen. A count of 20 made in Taylor Slough January 31.

Eastern Green Heron, *Butorides virescens.* Moderately numerous as it was in Howell's period. Average of 6 seen each count with a high of 15 on January 17. Tapered off in February with one bird the 21st, none thereafter.

Black-Crowned Night Heron, *Nycticorax nycticorax.* Records were spotty through December and February. January showed an average of 3 per count. Adults and immatures seemed to be represented equally. They seem to have been more numerous in 1918, and were recorded only as winter birds.

Yellow-Crowned Night Heron, *Nyctanassa violacea.* Only 1 record for the entire winter. An adult roosting in the willows of Taylor Slough on January 31. Howell also found it to be an uncommon winter visitor to the slough.

American Bittern, *Botaurus lentiginosus.* One secretive individual discovered December 11 in the slough. Probably more common than would be indicated by this lone observation. Howell writes of having seen 1 or 2 almost daily January 15 to February 4, 1918.

Wood Ibis, *Mycteria americana.* Observed on 9 evenly distributed censuses. Usually single ones overhead, but 21 were feeding in the slough January 24. These birds also seemed discouraged by the rising water level in early February. Apparently more abundant now than in Howell's day.

White Ibis, *Guara alba.* Commonest in early December apparently finding this locality suitable for feeding and roosting in the medium water stages of early winter.

Roseate Spoonbill, *Ajaja ajaja.* One immature bird flew over Taylor Slough on February 29. The numbers of spoonbills are steadily increasing at their rookeries in Florida Bay and their dispersal from there to the mainland at this time of year is to be expected (R. P. Allen, 1942, p. 39).

Turkey Vulture, *Cathartes aura.* Commonly counted while soaring high over the slough and hammock. 9 per census was the average for the entire area during the winter.

Black Vulture, *Coragyps atratus.* Our census showed this interesting vulture to be locally common. In 1918 it appears to have been uncommon. A high of 25, a low of 7, with an average of 18 for each count.

Sharp-Shinned Hawk, *Accipiter striatus.* Single birds seen December 11, January 31 and February 7 in the slough area.

Insular Red-Shouldered Hawk, *Buteo lineatus.* At least 2 pairs wintered in the vicinity. One to four seen or heard each count.

Short-Tailed Hawk, *Buteo brachyurus.* We were quite fortunate in observing this rare hawk on 6 of the 12 censuses January 10 to February 28.

Both color phases were seen, indicating at least 2 individuals, dark phase 3 times, light phase 2 times, 1 unrecorded color phase. It was not known to occur here in Howell's time.

Marsh Hawk, *Circus cyaneus.* It is interesting that all the individuals seen were in the drab brown female and immature plumage. Occurred on ten censuses, singly on all counts excepting on January 31 and February 21 when pairs were seen.

Osprey, *Pandion haliaetus.* Single individuals over Taylor Slough on 3 censuses.

Duck Hawk, *Falco peregrinus.* One seen flying over the slough January 17.

Sparrow Hawk, *Falco sparverius.* Single records on 7 of the 12 censuses. In the 3 instances when sex was distinguished they were female. Four of the records from the hammocks and three from the slough. Apparently this bird frequents the hammock much more than in Howell's time.

Limkpin, *Aramus guarauna.* This secretive species was seen twice on censuses this winter in the slough. December 11 and January 2 were the dates. While Howell reports 3 present February 20-27, 1919, he apparently did not see them in the winter of 1918.

Sora, *Porzana carolina.* A very tame individual delighted park visitors as they watched it from Anhinga Trail (boardwalk) over the slough. It first appeared January 10 and was recorded on nearly every census thereafter.

Purple Gallinule, *Porphyrula martinica.* Through the winter there were always Purple Gallinules in Taylor Slough. These usually secretive birds appear quite friendly at the boardwalk in the slough. Nine and three were the most and least recorded on censuses.

Florida Gallinule, *Gallinula chloropus.* A regular standby all winter in Taylor Slough. Usual numbers being 5 or 6 per census with a high of 13 on January 17.

American Coot, *Fulica americana.* Along with the gallinules, 3-4 coots were present every census in the slough. They did not appear to be affected by the changes in water level.

Killdeer, *Charadrius vociferus.* The highpitched calls of these excitable shorebirds were heard high overhead on December 11 and 18. Two were seen flying over the area January 2. In 1918 they appear to have been more numerous.

Florida Barred Owl, *Strix varia.* Regularly heard in the hammock all winter. A pair roosted each morning in a particular live oak tree during the first three weeks of February. Recorded, mostly from their voices, on nine censuses.

Ruby-Throated Hummingbird, *Archilochus colubris.* Single males were seen in the hammock on three occasions. December 18, February 7 and 28.

Eastern Belted Kingfisher, *Megaceryle alcyon.* At least three individuals wintered in the area. One, two or three were seen on every census.

Southern Flicker, *Colaptes auratus.* These woodpeckers seem to prefer the pine woods. However, this winter our census shows single birds observed on Paradise Key on three days, and one heard from Taylor Slough on February 14.

Florida Pileated Woodpecker, *Dryocopus pileatus.* Calls of single birds were heard during censuses on February 7 and 28.

Florida Red-Bellied Woodpecker, *Centurus carolinus.* One or two birds seen or heard each count. There are three records from isolated trees in the slough but the "redbelly" is most often seen in the hammock.

Southern Downy Woodpecker, *Dendrocopos pubescens.* One female observed on 5 occasions in the hammock. Seen regularly in the same area each time, December 18 to February 28.

Southern Crested Flycatcher, *Myiarchus crinitus.* Recorded on 8 censuses. Single observations each census day were usual, however four were seen on February 21 in the hammock.

Eastern Phoebe, *Sayornis phoebe.* One or two records appear nearly every census all winter. Commonly seen along the road through Taylor Slough as they darted out from a perch in the willows to capture a flying insect.

Tree Swallow, *Iridoprocne bicolor.* These swift flyers are seen over Taylor Slough and Paradise Key all winter. On three early morning counts an estimated 100 swirled over the slough and 200 were estimated to be over the same area on February 28. It is a fascinating sight to watch a flock of swallows pinwheel over the surface of a glade pool as they take turns drinking.

Semple's Blue Jay, *Cyanocitta cristata.* More often heard than seen. Two per count is average for nine censuses, with a high of seven on January 24.

Florida Crow, *Corvus brachyrhynchos.* Appear to be much less numerous today than in 1918. Generally one or two seen or heard calling in the hammocks. Never more than two at a time.

Eastern House Wren, *Troglodytes aedon.* Just as in 1918, we found this little wren to be rather uncommon with single observations noted for six of the twelve counts.

Florida Wren, *Thryothorus ludovicianus.* The loud, clear tones of this wren's song was heard throughout the winter. Nearly every count included at least one heard. Most of the censuses show the birds occurring in the hammock but several records from the slough indicate its presence there as well. Count average 3 for all twelve censuses.

Eastern Mockingbird, *Mimus polyglottos.* The cheering mocker is an uncommon sight around Paradise Key. One or two individuals were seen on 8 to 12 mornings, usually in the fig trees bordering the road through the slough.

Catbird, *Dumetella carolinensis.* This secretive bird was most often heard in the tangles of brush lining the hammock road. Eight was the average count per census for the winter.

Blue-Gray Gnatcatcher, *Polioptila caerulea.* Although seen in the willows bordering the slough, this lively sprite seemed to prefer the hammock trees. Five per count was average for the entire winter, with thirteen recorded in the hammock on January 24. By contrast, Howell found it "uncommon" in the winters of 1917-18-19.

Ruby-Crowned Kinglet, *Regulus calendula.* An uncommon winter visitor. Single birds were seen December 18, January 24, February 7 and 28 in the trees of Paradise Key. Howell reported only one record.

Key West Vireo, *Vireo griseus.* A resident species which first made its presence known vocally late in January. Numbers most commonly heard from the willows in the slough as well as in the hammock. Average of 6 per count through February.

Blue-Headed Vireo, *Vireo solitarius.* Lone individuals of this uncommon winter resident were recorded in the hammock on December 18, January 24 and February 28.

Parula Warbler, *Parula americana.* Three of these beautiful warblers first appeared in the hammock on January 24. All records were from the hammock ranging from 2 to 4 per count (4 censuses).

Myrtle Warbler, *Dendroica coronata.* Park Naturalist Dilley considers this energetic warbler to be ordinarily quite common here in the winter. However, this winter I have only 3 records of single birds on December 18 and 26 and January 31.

Yellow-Throated Warbler, *Dendroica dominica.* Paradise Key hammock harbored single males recorded on the following census days. December 11 and 26, January 17 and February 21.

Florida Prairie Warbler, *Dendroica discolor.* This colorful warbler was recorded singly on 3 counts, and three were tallied on January 17. They were usually seen in willows bordering the road through the slough.

Western Palm Warbler, *Dendroica palmarum.* Whereas this warbler occurred, " . . . in the open parts of the hammock and along roadsides in the pineland" according to Howell *(op. cit.*, p. 262), my censuses show a frequency of occurrence of 10 for the slough to 5 for the hammock with a prominent lumping of frequency and abundance in the hammock in February. The winter average was 5 with a high of 10 reached on February 14 and 21.

Eastern Ovenbird, *Seiurus aurocapillus.* The hammock was home this winter for at least 2 of these unobtrusive warblers. At least one was seen on 6 of the twelve counts.

Florida Yellow-Throat, *Geothlypis trichas.* By far the most common glades warbler. My records indicate that both males and remales were abundant in Taylor Slough. They were also present but less numerous in the hammock. The average for the 12 counts was 11 per day.

Southern Meadowlark, *Sturnella magna.* One or two were the usual numbers on 8 censuses from Taylor Slough.

Maynard's Red-Wing, *Agelaius phoeniceus.* Small groups of 2 or 3 wintered in the slough. All appeared to be males. The first larger flocks appeared on February 14, at which time there were 12 males and 3 females. The next week a flock containing 17 males and 5 females was counted and on February 28, 10 males and 5 females. Absence of females during the early part of the winter may be unusual here since Howell did not report it.

Boat-Tailed Grackle, *Cassidix mexicanus.* These large, noisy blackbirds were quite numerous on the slough all winter. Counts (10 censuses) show an average of 4.

Florida Grackle, *Quiscalus quiscula.* Although this bird was also seen on 10 of the 12 counts, it was not as numerous as the boat-tails. Average per count was 2, and habitat was the slough.

Florida Cardinal, *Richmondena cardinalis.* A common resident in the hammock area and occasional on the slough. Seen or heard on ten counts, averaged 5 per census.

Eastern Goldfinch, *Spinus tristis.* Drab-plumaged goldfinches were observed in small flocks over the slough and hammock on December 11, 18, and January 17.

Swamp Sparrow, *Melospiza georgiana.* One recorded in Taylor Slough on December 26 and 3 on February 7.

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QUALITATIVE AND QUANTITATIVE THEORY AS APPLIED TO BODY BUILD RESEARCH [1]

CASE STUDY OF 547 WOMEN

A. K. Bullen

I. Theory

A recent article in the *American Scientist* (Whittaker, 1952) on "Eddington's Principle in the Philosophy of Science" has called several points to our attention which seem pertinent to the problem under consideration: qualitative and quantitative theory as applied to body build research. We read

> . . . Eddington's Principle depends on the distinction between what we have called quantitative and qualitative assertions: it may be stated thus: *All the quantitative propositions of physics, that is, the exact values of the pure numbers that are constants of science, may be deduced by logical reasoning from qualitative assertions, without making any use of quantitative data derived from observation.*

However, the author does not neglect to point out the procedure familiar to us all:

> . . . in the usual account of the development of science, we are told that accurate knowledge regarding the external world begins with the observation and measurement of phenomena that are apparent to our senses, followed by the endeavor to find in the measures some regularity that can be represented by a mathematical formula . . .
> . . . measurements of a phenomenon under different circumstances, and the subsequent codification of the measures into a mathematical formula, is the normal procedure.

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[1] The Department of the Army has granted official release for this article based on data collected for them by the author in the capacity of Civilian Consultant and subsequently analysed for them by the author at Peabody Museum, Harvard University. The Army report was submitted in May, 1948. The present paper does not include complete coverage of subsequent literature. This paper was submitted for official release August, 1952.

"But," he continues

> But Eddington's Principle belongs to theoretical, not to experimental physics, and it carries the implication that theoretical and experimental physics are developed by wholly different methods.

For anyone concerned with problems of body build, as I have been for the past ten years, it becomes very apparent that there is some gap between our theory and our quantitative measurement. W. W. Howells, in discussing "Factors of Human Physique" (Howells, 1951), says

> . . . We have not bridged the distance between appraising body form by measurement and comprehending the organizing factors which the body form expresses . . .
> . . . Man is a straightened-out quadruped, with a trunk and limbs, and we may be blinding ourselves to a great deal if we persist, in all large scale work, in measuring him as though he were a snake.

Perhaps in dealing with a thing as tangible as the human body, there has tended to be a certain disdain for theoretical discussion. While we may agree that "facts don't speak for themselves," we have tended to treat the data of discrete measurements as something which, by correlation or interrelation, will produce its own "types" for us. All we need is a great hopper to receive the data, and the answers will spring "full blown from the head of Zeus."

That this has not proved to be the case, Howells and other users of anthropometric findings are quick to agree. Howells (1951) points out in relation to about twenty-four studies by factor analysis, that "results have been on the whole somewhat indefinite." He attributes this situation to the fact that usually measurements have not been gathered with the idea of a factor analysis in mind, that already-existing standard assortments of measures have been used.

If, on the other hand, someone were to collect a series of measurements with factor anyalysis in mind, it is of interest to think on what basis he would gather them. In other words, what would be his theory?

Here, we are apt to stand wide-eyed and become defensive in a belligerent sort of way. It seems to many like an affront to their competence to face them with the fact that they are destitute of theory or to suggest that the "pet" theory they have been toying with for years does not apply to the present problem. However, if this is the case, it is not irremediable. There are sources of working hypotheses. There are clues on which to build new theoretical structures.

If we have experimental methods to test theoretical hypotheses, we also have the results of our experience and observation to help us in setting up theories to test. I like to call these data "experiential" as opposed to experimental and theoretical aspects of research. Experiential data reaches us in a number of ways. It may come from observing the findings of other disciplines or evidence from other areas of research within our own field. It may be as simple and "down-to-earth" as observing ourselves or others or the situations we plan to investigate.

In research on body build, morphological study provides an experiential base for the anthropometrically minded investigator. When he decides which measurements to take for his study, he need not blindly use the blank from his college course! He can choose, on the basis of his observational experience, criteria or relationships between criteria which appear as though they might be related. He builds his hypothesis and then checks his "hunch" from the statistical relationships between the exact figures of the measurements.

This sounds very simple and is a familiar process to us all. However, Rafferty in discussing "Mathematical Models in Biological Theory" (1950) warns us of one danger. We may merely be proving to ourselves mathematically what we already KNOW from observation. In other words, circular description has entered the picture. The neatest mathematical work can be done with data we already understand! I am sure Eddington would agree with this.

Therefore, unless we need the mathematical expression of our data for some particular purpose, let us not change it into numbers with the idea that we are *discovering* something new. To determine whether we are testing our hypothesis or indulging in circular description, we must appraise the state of our knowledge *before* the initiation of mathematical analysis.

We begin to see where theorizing and concept building about body types in the way that Sheldon has approached the problem in "Varieties of Human Physique" (1940) is a logical stage in the development of theory. Obviously, his is not the only possible set of observational criteria. Nor are the hypotheses stemming from his work the only hypotheses which should be investigated. However, at least, here is one body of data which lays itself open to testing on a numerical level. It has gone through the state of experientially perceived congeries of traits, of morphological observations. If it does not "stand up" under mathematical analysis, then the congeries of criteria are obviously without relation and the theory based on these experiential observations must be rejected or the observations in themselves found unreliable.

On the other hand, if the data are found consistent from a mathematical point of view, we may wish, on the basis of this finding, to explore the reasons for this. We may wish to set up a new hypothesis beyond the original Sheldonian theory to further explain the proven co-varying features. We may wish to set up experimental studies based on our initial findings. These studies carried out on the experimental level may involve physiological, sociological, psychological and other tests both at given moments in time and carried on over long periods of time. Here we can be exact in our measurements of the features being studied. Our experiential back-log will increase. Also we can note reactions or facets of the problem we had not thought to test. From this experience our new theories and working hypotheses will emerge.

Thus we follow the steps in sequence: 1. Experiential, 2. Theoretical, 3. Experimental. And the exact measurement phase is planned to implement our theory. We know "why" we are measuring "what" before we begin elaborate statistical treatment of the data. We shall then be testing our working hypotheses and setting up other experiments in the laboratory or the field to further elucidate the meaning of what has remained valid after being subjected to the rigors of a mathematical check.

In the present study, we shall present first the qualitative (morphological) data which was collected in accordance with a theory based on experiential evidence. We shall then check this material quantitatively to see whether it stands the scrutiny of anthropometric handling via standard measurements taken with this problem in mind. Here numerical analysis performs two distinct functions. First we recognize the circular process of putting what we KNOW from observation into numbers. This expression in numerical form is a means of showing whether our descriptive observations are, in fact, reliable. In other words, this helps meet the challenge as to the presence or lack of objectivity in our observations. Secondly we shall use the findings to check the validity of our working hypotheses. The hypothesis particularly under scrutiny in this paper is: *measurement trends and proportional relationships of body types tend to vary quantitatively as they vary qualitatively.*

II. Data for Inspection

1. Qualitative Data

Rafferty would be glad to know we did as he recommends in his discussion of building mathematical models in biological theory. He says:

> *Technique. 2.* Reduce the number of variables by combining several in a construct; that is, go to a higher level of abstraction. Working at too low a level of abstraction one becomes virtually lost in a morass of detail and specificity. (Rafferty, 1950)

Data consisted of body build photographs and anthropometric measurements for 547 WAC and Nurse volunteers from six Army General Hospitals. For the purposes of this study, after appraising the pictures morphologically (somatotyping) it seemed most fruitful to group them into seven categories or "types." The seven types were distinguished by grouping individuals of similar, although not identical, bodily characters. The three extreme types were called *Endo, Meso,* and *Ecto.* Three types combined two of the major trends: *Meso-Endo, Meso-Ecto,* and *Endo-Ecto.* A final medium variety displayed a combination of tendencies in all three basic trends with no extreme tendency: *Moderate Mixture.* While finer judgments were made, the practicality of seven categories had been borne out by previous research and is discussed in a recent paper (Bullen, 1952). Morphological criteria were based on Sheldon (1940) and on the author's subsequent arrangements of these characters used in research on men and women at the Fatigue Laboratory, Harvard University, and in a study of college women (Bullen and and Hardy, 1946). Diagnostic criteria are arranged for ready reference in Bullen and Hardy's paper and will not be reprinted here.

Tentative somatotypes were grouped by assigned similar 1-7 ratings and arranged in ascending and descending sequences of components so that neighboring somatotypes tended to be contiguous or not far distant when spread out in a sequential array. Then each group of pictures *without reference to assigned ratings at any time* was compared with neighboring groups; pictures were moved from one group to another to agree with the majority of each group and to try to perfect the sequence of observational increments of each component. No effort was made to adhere to tentative ratings, but the aim was to achieve harmonious groups for each somatotype. Where certain ratings in the sequence were apparently lacking, increment spaces were left vacant. There was no arbitrary crowding or over-refinement in increment amounts to make a "complete" sequence in all directions.

After this cross-check comparative resorting, each resultant group of pictures was assigned to the majority somatotype ratings which held its place in the sequential order of increments for a given component. (It is of interest to know that in no instance was any rating changed by more than one unit in any component as compared with ratings originally assigned or as compared with ratings given examples of extremes by regional traits.) Somatotypes were next grouped by general trends of each component to form the seven major body types. Correlation of anthropometric measurements with the seven body types *followed* the definition and allocation of types by morphological criteria (qualitative analysis). *In no instance* was a picture moved from one type to another to fit measurement data. The Master Sheet (Table I) summarizes over-all percentage incidences of the seven major types of body build for the total group and for the twenty-five breakdowns analyzed in this report. Breakdowns are arranged under the following seven major headings: 1. WAC-Nurse groups, 2. Army Occupation, 3. Civilian Occupation, 4. Age, 5. Race, 6. National Origin, and 7. Regional Distribution.

TABLE I

Percentage Incidence of Seven Body Types

Body Types	Total Group (547)	WAC-Nurse Group: WAC Officer (58)	WAC Enlisted (221)	Army Nurse (268)	Army Occupation: Army Physiotherapist (59)	Army Medical Technician (107)	Army Clerical Worker (54)	Civilian Occupation: Civilian Nurse (289)	Civilian Office Worker (83)	Civilian Student (40)	Civilian Teacher Physical Education (11)	Civilian Teacher (23)	Civilian Factory Worker (36)
Endo	14.1	5.2	14.0	16.0	11.9	11.2	14.8	16.3	15.7	7.5	9.1	8.7	16.7
Meso-Endo	11.2	3.4	16.3	8.6	6.8	20.6	9.3	9.0	14.4	2.5	0.0	21.7	22.3
Meso	7.0	12.1	6.8	6.0	11.9	6.5	9.3	6.6	7.2	2.5	18.2	4.3	5.5
Meso-Ecto	5.3	10.3	6.3	3.4	5.1	7.5	9.3	4.1	8.4	10.0	18.2	4.3	0.0
Ecto	22.5	27.6	22.2	21.6	27.1	19.6	29.6	20.4	16.9	55.0	18.2	17.5	16.7
Endo-Ecto	4.0	3.4	3.6	4.5	1.7	4.7	1.8	4.1	3.6	2.5	0.0	8.7	5.5
Moderate Mixture	36.0	37.9	30.8	39.9	35.6	29.9	25.9	39.5	33.8	20.0	36.3	34.8	33.3

Body Types	Age: Women Aged 35 and Under (466)	Women Aged Over 35 (81)	Race: White (518)	Negroid (27)	National Origin: Old American (272)	British (30)	Russian (19)	Balto-Ugric-Slav (25)	Regional Distribution: New England (171)	Middle Atlantic (190)	East North Central (49)	West North Central (23)	South Atlantic (39)
Endo	14.2	13.6	13.9	14.8	12.9	10.0	36.8	8.0	13.4	16.8	8.2	13.0	17.9
Meso-Endo	10.5	14.8	11.2	11.1	12.1	16.7	21.1	4.0	11.7	10.5	14.3	21.7	7.7
Meso	6.7	8.6	6.6	14.8	5.9	6.7	10.5	4.0	7.0	4.7	6.1	17.4	10.2
Meso-Ecto	4.7	8.6	5.6	0.0	5.5	10.0	0.0	12.0	3.5	5.3	8.2	4.3	2.6
Ecto	23.8	14.8	21.6	37.0	24.3	13.3	0.0	20.0	21.1	21.6	22.4	8.7	30.8
Endo-Ecto	3.2	8.6	4.2	0.0	5.1	6.7	0.0	4.0	4.1	4.2	4.1	0.0	10.2
Moderate Mixture	36.9	30.9	36.9	22.2	34.2	36.7	31.6	48.0	39.2	36.8	36.7	34.8	20.5

In looking at the percentage incidences in Table I it becomes apparent that, although most occupational and other categories have Moderate Mixtures and Ecto women as leading types, they show other distinct differences in trend when compared with each other. (It should be mentioned that Moderate Mixtures, who show no extreme tendency in body build, tend to be below average in size.) The following eight points of comparison within the total group seem of particular interest:

1. WAC Officers are relatively high in Meso and Meso-Ecto women and relatively low in Endo and Meso-Endo women.

2. WAC Enlisted are high in Meso-Endo women as compared with the WAC Officers and Nurses and high in Endo as compared with the WAC Officers.

3. Nurses have over three times as many Endo women as the WAC Officers. (The extremely *low* incidence of Endo women among the WAC Officers is an important factor in this comparison.)

4. Physiotherapists are relatively high in Meso women.

5. Army Medical Technicians have a high incidence of Meso-Endo women as compared with other groups.

6. Army Clerical Workers show a wide range of body types with more than the incidence for the total group in Ecto, Meso, and Meso-Ecto types.

7. Older women (over 35 and under 60) have fewer Ecto women and more than twice as high an incidence of Endo-Ecto women as the total series or the Under 35 group. There is a steady increase of Meso, Meso-Endo, and Meso-Ecto women as compared with the younger women and the group as a whole.

8. The Negroid group has more than twice as many Meso women as the total group or the White group. The Negroid group is also relatively high in occurrence of Ecto women.

In gaining experiential clues from the present pilot study, it may be of interest to summarize the groups with highest and lowest percentage incidence of each of the seven body types. In physical potentialities and anthropometric indices, groups that cluster together as relatively high or low in one of the given categories may have many features in common.

Occupational trends of Table I indicate that Endo types cluster in Army and Civilian Nurses, Civilian Office Workers, and Civilian Factory Workers. Occupational groups that fall at the low end of the Endo tendency are WAC Officers, Civilian Students, and Teachers. Therefore this series seems to suggest that Nurses, Office and Factory Workers are frequently Endo whereas WAC Officers, Civilian Students, and Teachers are seldom Endo. (Subsequent publication of the author's findings on civilian groups will help to shed light on some of these experiential clues.)

In the high Meso-Endo group, Factory Workers appear with Civilian Teachers and Army Medical Technicians. Low in Meso-Endo we again find WAC Officers and Civilian Students, as well as Civilian Physical Education Teachers.

High in Meso trends are Physical Education Teachers, WAC Officers, and Army Physiotherapists, while Civilian Students and Teachers are low in Meso types.

As we leave the three heavy, strong groups and come to the Ecto types, we note a sharp shift in trends. In the Meso-Ecto group, WAC Officers and Civilian Students are high, with Physical Education Teachers Highest. Factory workers, on the other hand, are rarely Meso-Ecto people according to this series.

Civilian Students are highest in Ecto types and Civilian Teachers are high in occurrence of Endo-Ecto women. Endo-Ecto women are not found among the Physical Education Teachers and are rare among the Army Physiotherapists and Clerical Workers.

Nurses are high in Moderate Mixture, whereas Civilian Students have least Moderate Mixtures.

2. *Quantitative Data—Anthropometric Findings*

A clear realization of the Height-Weight relationship for each body build group is of critical importance in appreciating basic distinctions in trends of the seven different body types. It will be noted (Tables II and III) that length measurements tend to correspond with relative heights, while breadths, depths, and circumferences tend to correspond with relative weights.

Weight. Means for Weight (Table II) place Mesos, Endos, and Meso-Endos above the average for the total group with Ecto groups (Ecto, Endo-Ecto, Meso-Ecto) and Moderate Mixtures below the average. Ectos have least mean Weight (Rank Order 1, Table III); Endos and Meso-Endos highest mean Weights (Rank Orders 6 and 7 respectively).

TABLE II

Body Type Distributions of Means for 38 Measurements

Measurements	Ecto	Endo-Ecto	Moderate Mixture	Meso-Ecto	Total Group	Meso	Endo	Meso-Endo
WEIGHT	118.015	128.135	126.820	131.655	132.980	138.445	151.480	158.885
CHEST CIRCUMFERENCE	72.967	74.773	75.383	76.793	77.097	77.947	81.532	85.787
BREAST CIRCUMFERENCE	84.008	88.318	87.665	88.000	89.444	89.868	95.325	99.557
WAIST CIRCUMFERENCE	64.780	69.318	67.076	68.552	69.344	70.316	74.974	78.541
HIP CIRCUMFERENCE	91.374	95.909	95.421	95.414	96.968	98.500	104.053	104.426
Upper Arm Circumference	238.340	254.500	257.205	247.345	261.190	265.025	286.935	288.270
Forearm Circumference	218.910	222.000	229.400	226.655	231.440	236.475	242.265	252.665
Wrist Circumference	147.303	147.045	149.564	151.586	150.804	154.342	152.921	158.033
Ball Circumference	213.300	209.955	214.025	220.105	216.900	224.235	221.080	224.540
Neck Circumference	31.373	32.045	32.005	32.428	32.342	33.132	33.065	34.230
Biacromial	36.154	35.545	35.719	37.172	36.291	37.289	36.312	37.607
Bideltoid	39.447	39.500	39.919	41.103	40.490	41.395	41.169	43.082
Chest Breadth	28.309	29.091	29.000	29.655	29.506	29.974	30.520	32.066
Chest Depth	18.393	18.864	18.746	19.138	19.209	19.737	20.065	21.082
Trunk Depth	18.574	20.591	19.556	19.655	20.372	20.579	22.558	23.689
Bi-iliac	27.284	28.526	27.911	30.053	28.751	29.000	30.479	31.511
Hip Breadth	35.041	36.591	36.426	36.621	36.958	37.210	39.364	39.683
Hand Breadth	76.439	75.864	76.462	78.621	77.124	78.789	77.221	79.230
Foot Breadth	90.098	88.364	90.162	92.345	91.376	94.026	93.206	94.644
Heel Breadth	59.813	59.409	59.777	61.241	60.673	62.132	62.117	62.754

Measurements	Ecto	Endo-Ecto	Moderate Mixture	Meso-Ecto	Total Group	Meso	Endo	Meso-Endo
STATURE	164.049	163.667	160.584	167.517	162.075	163.974	160.623	160.410
Cervicale Height	141.106	141.000	137.903	143.793	139.271	140.500	138.143	137.852
Acromion Height	134.984	135.682	131.726	137.655	133.119	134.053	131.844	131.803
Waist Height	105.195	104.909	102.117	106.517	103.461	104.184	102.896	102.590
Hip Height	83.748	83.045	80.782	84.690	81.949	83.134	80.753	81.082
Patella Height	48.528	48.682	47.215	49.379	47.868	48.316	47.714	47.524
Sitting Height	83.901	83.409	80.897	86.655	83.475	84.132	82.592	83.033
Trunk Height	53.606	53.500	53.173	54.724	53.411	54.000	52.922	53.377
Arm Length	71.894	70.545	69.502	72.793	70.355	71.290	69.237	69.590
Shoulder-Elbow	34.252	33.727	33.310	34.862	33.750	34.368	33.453	33.623
Forearm-Hand Length	43.431	43.045	42.563	44.138	42.974	43.737	42.481	42.951
Hand Length	175.512	173.682	172.589	179.414	173.956	176.237	171.935	173.869
Foot Length	242.664	238.954	240.256	247.052	242.196	246.552	241.928	244.008
Buttock-Knee	56.780	58.091	56.133	57.793	57.126	57.526	58.610	58.230
Head Height	124.361	125.091	123.306	125.552	125.077	127.842	126.104	125.738
Head Length	185.203	186.182	185.431	187.103	186.027	187.816	186.039	187.984
Head Breadth	144.065	144.591	145.574	146.069	145.684	146.605	146.714	147.623
Head Circumference	549.765	550.635	552.975	558.965	554.710	561.735	556.610	562.985
INDEX OF LINEARITY	13.2	12.8	12.6	12.9	12.5	12.5	11.9	11.7

TABLE III

Rank Order of Means of 38 Measurements for Seven Body Types

Measurements	Ecto	Endo-Ecto	Moderate Mixture	Meso-Ecto	Total Group (Between)	Meso	Endo	Meso-Endo
WEIGHT	1	3	2	4	4-5	5	6	7
CHEST CIRCUMFERENCE	1	2	3	4	4-5	5	6	7
BREAST CIRCUMFERENCE	1	4	2	3	4-5	5	6	7
WAIST CIRCUMFERENCE	1	4	2	3	4-5	5	6	7
HIP CIRCUMFERENCE	1	4	3	2	4-5	5	6	7
Upper Arm Circumference	1	3	4	2	4-5	5	6	7
Forearm Circumference	1	2	4	3	4-5	5	6	7
Wrist Circumference	2	1	3	4	3-4	6	5	7
Ball Circumference	2	1	3	4	3-4	6	5	7
Neck Circumference	1	3	2	4	3-4	6	5	7
Biacromial	3	1	2	5	3-4	6	4	7
Bideltoid	1	2	3	4	3-4	6	5	7
Chest Breadth	1	3	2	4	3-4	5	6	7
Chest Depth	1	3	2	4	4-5	5	6	7
Trunk Depth	1	5	2	3	3-4	4	6	7
Bi-Iliac	1	3	2	5	3-4	4	6	7
Hip Breadth	1	3	2	4	4-5	5	6	7
Hand Breadth	2	1	3	5	3-4	6	4	7
Foot Breadth	2	1	3	4	3-4	6	5	7
Heel Breadth	3	1	2	4	3-4	6	5	7

Measurements	Ecto	Endo-Ecto	Moderate Mixture	Meso-Ecto	Total Group (Between)	Meso	Endo	Meso-Endo
STATURE	6	4	2	7	3-4	5	3	1
Cervicale Height	6	5	2	7	3-4	4	3	1
Acromion Height	5	6	1	7	3-4	4	3	2
Waist Height	6	5	1	7	3-4	4	3	2
Hip Height	6	4	2	7	3-4	5	1	3
Patella Height	5	6	1	7	3-4	4	3	2
Sitting Height	5	4	1	7	4-5	6	2	3
Trunk Height	5	4	2	7	3-4	6	1	3
Arm Length	6	4	2	7	3-4	5	1	3
Shoulder-Elbow	5	4	1	7	4-5	6	2	3
Forearm-Hand Length	5	4	2	7	3-4	6	1	3
Hand Length	5	3	2	7	4-5	6	1	4
Foot Length	4	1	2	7	3-4	6	3	5
Buttock-Knee	2	5	1	4	2-3	3	7	6
Head Height	2	3	1	4	2-3	7	6	5
Head Length	1	4	2	5	2-3	6	3	7
Head Breadth	1	2	3	4	3-4	5	6	7
Head Circumference	1	2	3	5	3-4	6	4	7
INDEX OF LINEARITY	7	5	4	6	4-5	3	2	1

Height and its relation to Weight.

1. Ecto. The Ecto group has least mean Weight (Rank Order 1) with next to the greatest mean stature (Rank Order 6). Ectos show the greatest degree of Linearity (Table II) figured by Sheldon's method of height over cube root of weight.

2. Meso-Ecto. Meso-Ectos, though highest in Rank Order of mean Stature (7), have about average Weight (Rank Order 4). Therefore, their resultant Index of Linearity is a little less than the Ectos. This Height-Weight relationship would lead us to expect Meso-Ectos to lead in linear measurements but to have nearer average breadths, depths, and circumferences.

3. Endo-Ecto. Although the three Ecto groups (Ecto, Meso-Ecto, Endo-Ecto) show greatest Index of Linearity Rank Orders (7, 6, and 5 respectively), the Height-Weight relationships are more striking in the case of the Ectos and Meso-Ectos. As the group name implies, Endo-Ectos have some aspects of the divergent Ecto and Endo trends. The combination of these different tendencies place Stature and Weight Rank Orders in less extreme positions. It is third in Rank Order of Weight and fourth in Rank Order of Stature. Its specific Ecto and Endo manifestations will be pointed out in relation to particular items below. The net result shows Endo-Ectos fifth (above average) as to Index of Linearity.

4. Meso-Endo. Meso-Endos show striking Height-Weight trends almost exactly opposite to Ectos. Instead of being tall and thin, they tend to be short and heavy. They have Rank Order 7 in Weight—greatest mean Weight of any group—and Rank Order 1 in Stature—shortest of any group. Consequently, they show lowest Index of Linearity of any group (1).

5. Endo. Endos are almost as heavy but less short than the Meso-Endos. Their means show Rank Order 6 for Weight, which is very close to that of the Meso-Endos, and a Rank Order for Stature (3) a little below that of the total group. The heavy Weight and relatively short Stature place them next to Meso-Endos in lowness of Index of Linearity (Rank Order 2).

6. Meso. Means for Mesos show a Rank Order of 5 for *both* Stature and Weight. This is above the means for the total group in both features with emphasis on Stature. Mesos place third in

Rank Order of Index of Linearity. Therefore, Meso-Endos, Endos, and Mesos show less than average linearity. They are *not* thin, fragile types.

7. Moderate Mixture. Moderate Mixtures do not show striking tendencies as do the high Linearity Ecto groups (Ecto, Meso-Ecto, Endo-Ecto) or low Linearity Meso and Endo groups (Meso-Endo, Endo, Meso). They have a relatively low Rank Order (2) for means of *both* Stature and Weight and the resultant Index of Linearity falls exactly on the mid-point rating (4). We should not expect means for items for Moderate Mixtures to have either high Weight or high Linearity trends.

Vector Representation of Seven Body Types. Figure 1 (on the next page) illustrates by a vector representation the comparative Rank Order of means for *Height, Weight,* and *Depth* (Chest) for each of the seven body types. From this rough ordering of the data, it will be easy to visualize the various proportional tendencies of the different types. The vertical line represents relative Rank Order of heights and locates the total group. The horizontal weight lines can roughly represent body breadths as we know that breadths, depths, and circumferences for each type tend to correspond with the weight. Chest depth, which corresponds to weight, can roughly represent most other relative depths. Relative body circumferences can be inferred by thinking of ellipses encompassing the breadth and depth lines for each type. Mean tendencies of the total 547 are represented by the dashed line which falls between the third and fourth Rank Orders for Height and between the fourth and fifth Rank Orders for Weight and Depth (Chest).

The meaning of the directional interrelationships of these three dimensions in delineating different body types will be clearly understood when we look for a moment at the relatively tall, lightweight, shallow-depth *Ecto* woman as compared with the relatively short, heavy-weight, thick-depth *Meso-Endo* woman. The Total Group is roughly in a middle position for all three dimensions. Moderate Mixtures, who have exactly balanced dimensional tendencies, will be seen to appear like slightly thinner, small editions of the average for the Total Group. *Endo-Ecto* women are slightly taller and less heavy than the Total. *Ecto* women stretch up and shrink in strikingly as compared with the average. Of the other four types, it will be noticed that with lowering in height, there is a fairly regular increase in weight and depths from *Meso-Ecto* women at the top of the diagram to *Meso,* to *Endo* (most have some muscling under the fat), to *Meso-Endo* women at the bottom of the diagram.

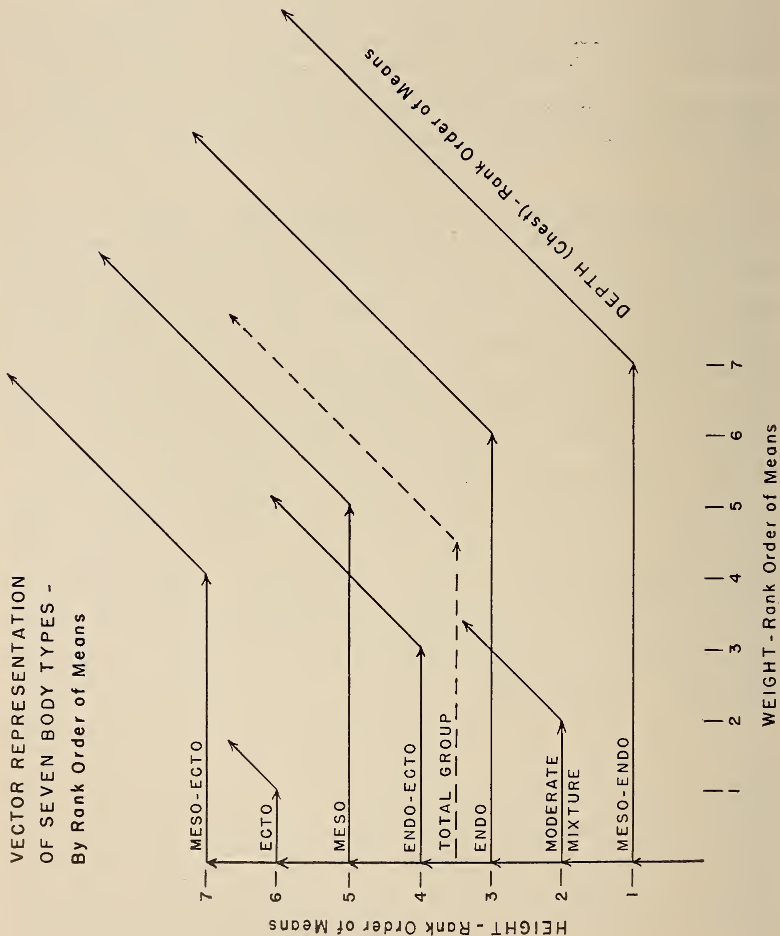

Fig. 1.

III. Interrelations of Qualitative and Quantitative Data

The following summary descriptions tie in the observational criteria used in the photographic analysis with the measurement trends of the seven body types (Tables II and III) discussed, for convenience, by body regions. It is important to bear in mind that, while mean measurement variations may not show significant differences statistically when compared with certain neighboring body types, they have validity (meaning) when they tend to vary consistently in the direction of observational criteria so that their probability of recurrence is not merely a matter of chance. Large body regions most influential in determining body size and proportion will be discussed first, with data on the peripheral areas of head, hands and feet at the end of the description for each type.

1. Ecto. Ecto women tend to be tall and thin.

General Characteristics. Measurement for Cervicale tends to be high for Ecto women although means for Sitting Height and Trunk Height rank less than for Meso-Ecto or Meso women. The relatively longer trunks of Meso-Ecto and Meso women are probaby decisive in producing a similar increase in Sitting Height. Ecto women have highest Index of Linearity as mentioned above. Although second in mean Height, the top Index of Linearity goes to Ecto women because of their relative tallness *combined with* maximum thinness.

Thoracic Trunk. Ecto women are lowest on all chest and breast measurements. This reflects their general linearity and fragility with slight, "thready" muscling, narrow thorax, and tendency to flat bony chests. They have lowest mean measurement for Breast Increment (Table IV) which means that they tend to have the smallest breasts of any group.

Abdominal Trunk. Abdomen, waist and hip measurements for Ecto women reflect the height-weight trends to high linearity with tiny breadths, depths, and circumferences—the smallest means of any group. Ecto women tend to have slender waists; flat, shallow, or relatively small abdomens (reflected in smallest mean trunk depth of any group); and smallest average measurements for Bi-iliac, Hip Breadth and Hip Circumference. Hip and Waist Heights (from the floor) are exceeded only by those of Meso-Ecto women.

TABLE IV

Comparative Breast Increments for Seven Body Types

	Ecto	Endo-Ecto	Moderate Mixture	Meso-Ecto	Total Group	Meso	Endo	Meso-Endo
Breast Circumference	84.008	88.318	87.665	88.000	89.444	89.868	95.325	99.557
Chest Circumference	72.976	74.773	75.383	76.793	77.097	77.947	81.532	85.787
Breast Increment	11.032	13.545	12.282	11.207	12.347	11.921	13.793	13.770
Rank Order of Breast Increment	1	5	4	2	4–5	3	7	6

A tendency to long legs is reflected in these over-all measurements. The inference should not be made that Ecto women are "high-waisted" in the ordinary use of the term. A measurement of Waist Height in relation to the torso only was not taken. However, comparison of Rank Orders for Acromion (shoulder), Waist and Hip Heights locates the waist in relation to shoulders and hips. In comparison with other groups, Ectos do not show striking trends as to waist placement although, if anything, Ecto waists are high in relation to slightly lower shoulder height.

While Ecto women may have small accumulations of fat on upper and lower hip regions which give the figure a feminine contour, these deposits are small in degree. Also, buttocks tend to be thin and relatively flat. Therefore, it is not surprising to find that Ecto women have the smallest average Hip Circumference of any group and a low Rank Order for the Buttock-Knee measurement.

Shoulders and Arms. Ecto women tend to have relatively delicate or narrow shoulders as shown by a tendency to lower than average measurements for shoulder breadth (Biacromial measurement). In accordance with Ecto trends, the narrow shoulders are above average in height (Acromion measurement). Tiny arm circumferences and trends to long lengths characterize Ecto women's arms. They are described as relatively long and spindly with weak upper arms. Narrow shoulders and weak upper arms with tendency to little muscles and lack of fat result in Ecto women's having the narrowest mean of any body type for the Bideltoid measurement (Maximum breadth between outer measurements of Deltoid muscles of both upper arms). Delicate, fragile wrists are reflected in small wrist circumferences.

Legs. Measurements of leg circumferences were not included in this series, so the observational description of long, spindly legs with weak thighs and space between the thighs cannot be checked anthropometrically. However, these characteristics were noted in assigning individuals to body type groups and women with long spindly arms tended to have relatively long spindly legs also. Due to lack of large muscling or fat, space between the thighs was more common for Ecto women than for other groups. The low Buttock-Knee measurement has been discussed above. Its relation to Rank Order of knee (Patella) height suggests that the lower leg of Ecto women may tend to be elongated as compared with the relative proportions of the upper leg.

Hands and Feet. As would be expected, Ecto women's hands and feet are above average length and very narrow, with a small Ball Circumference for the foot.

Head and Neck. A small, slight head (smallest length, breadth, and circumference of any group) tops a long, slender neck (smallest Neck Circumference of any group).

2. Meso-Ecto. Meso-Ecto women tend to be tall, but of nearly average weight.

General Characteristics. As will be seen in Figure 1, the tendency to relatively tall height present in both Ecto women and, to a lesser extent, in Meso women appears mutually reeinforced in tendencies of Meso-Ecto women to extreme height. Meso-Ecto women have greatest mean measurements for Stature, Cervicale, Sitting Height, and Trunk Height. At the same time, the pronounced weight tendency (reflected in greater breadth, depth, and circumference trends) of Meso women associated with the minimum weight tendency (reflected in minimum breadth, depth, and circumference trends) of Ecto women appear to combine in a resultant weight (with breadth and depth manifestations) for Meso-Ecto women which falls between the two more extreme uncombined trends (See Figure 1). It is as though the Ecto (narrow) tendency were subtracted from the Meso (broad) tendency.

The combination of height-weight trends for Meso-Ecto women give them a resultant Index of Linearity one Rank Order below the most linear Ecto women. Although Meso-Ecto women are often taller than Ecto women, they are also usually heavier. As Meso-Ecto women tend to be relatively unpadded with fat, this greater weight appears not to result from pronounced fat increase, but primarily from tendencies to a heavier bony framework and greater muscling than Ecto women. Comparative Rank Orders of Ecto and Meso-Ecto women for mean measurements of Shoulder Breadth (Biacromial), Wrist Circumference, Hand Breadth, and head measurements (Table III) indicate effects of a greater bony framework for Meso-Ecto women. Details of bone-muscle influence are noted below under the appropriate body regions.

Thoracic Trunk. As would be expected from the fourth place Rank Order of weight for Meso-Ecto women (Table III), the thoracic breadth, depth, and circumferences are not extreme, but fall close to the average for the total group. Only Breast Circumference falls decidedly below average. In Table IV it will be noted that Meso-Ecto women have next to the smallest average Breast Increment.

Abdominal Trunk. Hip Circumference of Meso-Ecto women is next to the lowest (Ecto women) in Rank Order in spite of pelvic width (Bi-iliac measurement) which is over average. Hip and Waist Heights (from the floor) have a maximum average for any group. Other measurements of the Abdominal Trunk (Waist Circumference, Trunk Depth, and Hip Breadth) tend to fall slightly below average.

Shoulders and Arms. Meso-Ecto women tend to have high, rather broad shoulders. Shoulder breadth (Biacromial measurement) is above average, which suggests the influence of the Meso (bone-muscle) component (discussed further in next section on Meso women). Shoulder height, however, mirrors the Ecto linear influence with maximum shoulder height (Acromion) for any group. As compared with Ecto women's arms, the Meso-Ecto women have longer arms with relatively greater circumferences. If anything, Forearm Circumferences are comparatively greater than Upper Arm Circumferences (Table II). However, both arm circumferences are below averages for the Total 547. The Bideltoid measurement tends to be slightly above average. Probably this primarily reflects increase in shoulder breadth rather than pronounced upper arm muscling. Wrist circumference is a little above average.

Legs. As with the Ecto women, the lower leg (Patella Height) appears to be relatively long as compared with the Rank Order of the upper segment (Buttock-Knee). Though buttocks may have some muscling, they tend to be relatively small.

Hands and Feet. Meso-Ecto women tend to have very long, fairly broad hands and feet. They are of maximum length and broader than average. Proportions of length and breadth for hands and feet are almost identical with the Meso-Ecto height-weight relationship. Increases in breadth as compared with Ecto women suggest bone-muscle influence.

Head and Neck. There is a striking difference between the heads of Ecto and Meso-Ecto women. The heads of Ecto women tend to be tiny compared with Meso-Ecto women, who have much larger, longer heads above less slender necks. All head and neck measurements (Head Height, Length, Breadth, Head and Neck Circumferences) for Meso-Ecto women are above average, although heads of Meso and Meso-Endo women are even larger. These trends suggest that the Meso (bone-muscle) component may be importantly influencing head size as compared to the Ecto women who lack bone-muscle emphasis.

3. MESO. Meso women tend to be taller and a little heavier than average.

General Characteristics. As can be seen from Figure 1, Meso women tend to be taller and a little broader (heavier) and thicker than the averages for the Total Group. They are strong, powerful women. With Height and Weight both above average, they fall in one of the low Linearity groups. Whereas Ecto and Meso-Ecto women have highest Rank Orders for Index of Linearity, Meso women are third from the lowest in the three least linear groups, with Endo and Meso-Endo women even larger. Although Cervicale tends to be a little above average, as reflected by fourth Rank Order (Table III), Sitting and Trunk Heights are extreme for Meso women.

Thoracic Trunk. Meso women have wide, fairly deep chests, with a tendency to relatively small, well supported breasts. They have above-average means (5 in Rank Order) for all Thoracic Trunk Measurements (Chest Breadth, Depth, Chest Circumference and Breast Circumference). Mean Breast Increment (Table IV) is below average, although not as low as for Ecto and Meso-Ecto women. Tendency to muscling in the pectoral area provides adequate support for relatively small breasts. However, there are Meso women with some fat who have moderate sized breasts which tend to be slightly pendulous.

Abdominal Trunk. A medium waist (slightly above average circumference) of average height from the floor characterizes the Meso woman. However, when Rank Orders of Acromion (shoulder), Waist and Hip Heights are studied to locate the waist in relation to shoulders and hips Mesos appear to tend to "low-waistedness" (an observed characteristic of Mesos) with greater relative Rank Orders for Hip Height.

Mesos tend to have close to average Trunk Depth and Bi-iliac measurements. While abdomens of Meso women are relatively compact and show minimum abdominal protuberance in a majority of instances, this series suggests that mature women or women with presence of some fat may tend to have less occurrence of flat, highly muscular abdomens than college girls.

Shoulders and Arms. Shoulders of Meso women tend to be very broad (next to the highest Rank Order) and of moderate height. Arm segments are solid and tend to be evenly proportioned, with total Arm Length above average. Bideltoid measurement is large, second only to that of Meso-Endo women. Massive bony wrists have next to the largest average circumference of any group. Effects of bone-muscle development are very apparent in this region.

Legs. Legs are solid and have approximately even proportions. They are a bit over average length.

Hands and Feet. Thick, heavy feet are reflected in next to highest Rank Orders for all foot measurements (Foot Length, Breadth, Heel Breadth, and Ball Circumference).

Head and Neck. Meso tendencies to a rugged massive head are substantiated by relatively high and extreme Rank Orders for head measurements. Pyramiding of trapezius muscles and development of the Sternocleidomastoids give Meso women next to the greatest mean for Neck Circumference.

4. Endo. Endo women tend to be a little shorter than average and heavy.

General Characteristics. (As the reader is probably quite familiar with the items in Table III by this time, only general statements will be made as to these Rank Order findings for the rest of these descriptions. For measurements of especial interest, detailed comparisons can be made easily from Tables II and IV.).

Next to the highest Rank Order for Weight and below-average Rank Orders for all general length measurements give Endo women next to the lowest Rank Order of Linearity. Trunk Height is lowest and Sitting Height next to the lowest of any group, although Stature and Cervicale are only slightly below average. (The extreme Buttock-Knee measurement may help explain this.)

Thoracic Trunk. Endo women have next to the highest Rank Order for means of all chest measurements. They tend to have a fatty pectoral area and largest Breast Increment as shown in Table IV. Breasts tend to be pendulous but vary.

Abdominal Trunk. Lowest Hip Height with next to the highest Rank Order of means for all breadths, depths, and circumferences in the Abdominal Trunk bear out observational criteria: large abdomen; faint, high, wide waist (about average in height from the floor but "high-waisted" in relation to comparative Hip Height); abdominal protuberance; fat pads on upper and lower hip regions; soft, large round buttocks.

Shoulders and Arms. High, square, soft shoulders are reflected in a slightly above average measurement for shoulder breadth (Biacromial). As with Waist Height, shoulder height (Acromion) is about average. However, in relation to waist and hip height, Endo Hip Height is two Rank Orders below the relatively higher Rank Orders for Endo waist and shoulder heights. Thus measurement trends demonstrate the observational criteria as to Endo occurrence of high waist and shoulders.

Bideltoid is above the average. Endo women have the lowest Rank Order for Arm Length. Short arm segments with Rank Orders of 2 for upper and 1 for lower arm suggest forearm shortening. These arm segments with high circumference means tend to bear out descriptions of smooth, plump contours with lower arm markedly smaller than upper arm. Soft wrists have a Rank Order above average, but not as high as Meso or Meso-Endo wrists. Endo wrists are plump, but the bone-muscle tendency is not great.

Legs. Highest Buttock-Knee Rank Order with below-average mean for knee (Patella) height suggest the tapering of the lower leg and the greater relative mass of the upper leg. Soft, round, large buttocks are also reflected in the Buttock-Knee measurement.

Hands and Feet. Endo women tend to have very short hands (lowest Rank Order) and short (below-average) feet. Small, plump feet and small, soft hands have above average breadths due to plumpness.

Head and Neck. Heads of Endo women tend to be high and broad. They show next to the greatest Rank Order for height and breadth and near average length and circumference. Due to plumpness, Neck Circumference is above average, but not as great as that for Meso and Meso-Endo women where muscle development is more pronounced.

5. MESO-ENDO. Meso-Endo women tend to be very short and very heavy.

General Characteristics. Meso-Endo women have the highest Rank Order for Weight and lowest for Stature. As will be seen from a quick glance at Figure 1, Meso-Endo women are almost the polar opposites of Ecto women. Another glance at Figure 1 will give a preview of almost every remark to be made about Meso-Endo women. They are extreme in weight, breadths, depths, and circumferences, and low in height. They have the lowest Index of Linearity. It seems that the Endo and Meso trends to breadth have been mutually reinforcing. Descriptive items combine the characteristics for parts of the body as discussed under *Meso* and *Endo* women above. Therefore, only striking features will be mentioned for each area of the body.

Thoracic Trunk. All chest measurements are maximum, but Meso-Endo women have slightly less large average Breast Increment. (See Table IV.) This may reflect influence of the Meso women's tendency to have less heavy breasts. This is suggested by the fact that, in some instances, Meso-Endo women show evidence of pectoral muscular support for breasts with a slight lateral effect on bust contour which is also common with the smaller breasts of Meso women.

Abdominal Trunk. All breadths, depths, and circumferences are maximum, with waist and hip height (from the floor) below average. Like Mesos, Meso-Endos appear to tend to low-waistedness with greater relative Rank Order for Hip Height. The Buttock-Knee measurement is high, as was the case with Endo women. Here again, fat and muscular buttocks tend to augment this length measurement.

Shoulders and Arms. All breadths and circumferences are maximum. Arm length has lowest Rank Order of any group and all other lengths are below average.

Legs. Lower leg (Patella Height) is next to the shortest in Rank Order and Buttock-Knee high, as commented upon above.

Hands and Feet. Maximum hand and foot breadths with just below average hand length and above average foot length show the massiveness of these extremities. It should be noted, however, that they are not elongated.

Head and Neck. Neck Circumference and all head measurements except Head Height are maximum. Head Height is well above average.

6. Endo-Ecto. Endo-Ecto women tend to have a little above average height and below average weight. (Although plump in some parts of the body, they definitely have linear tendencies.)

General Characteristics. (Endo-Ecto women are rare and almost any series—including this one—will tend to have relatively few. Therefore, except for discussion here of a few major points, the reader is referred to Tables II and IV for details.)

Length tendencies outweigh lateral ones for Endo-Ecto women so they fall next below Ecto and Meso-Ecto women in Index of Linearity. Therefore, all groups which have an Ecto component have most pronounced linearity.

Thoracic Trunk. Breast Increment is large, next to that for Endo and Meso-Endo women (Table IV). Breasts vary but many appear to reflect the Endo influence, although other chest measurements are below average suggesting the Ecto linear trends.

Abdominal Trunk. Hip and Waist Height are slightly above average with all breadths and circumferences a little below average. These reflect height-weight trends faithfully. The only measurement out of line is a large Trunk Depth, exceeded only by Endo and Meso-Endo types. Apparently, lack of muscling in Endo-Ecto women tends to relax the abdomen and here again is an item that reflects Endo influence. The Buttock-Knee measurement has Endo trends to larger buttocks, which probably raises this mean as for Meso-Endo and Endo women.

Shoulders and Arms. Narrowest shoulders and smallest wrists emphasize the enhancement of these tendencies, which occur in *both* Endo and Ecto women. Length tendencies appear in high shoulder height (Acromion), which is only exceeded by Meso-Ecto women. Arm circumference and Bideltoid measurement are below average.

Legs. Knee (Patella) height is extreme, which suggests evidence of the Ecto tendency to long lower leg segments. Meso-Ecto is the only group with greater knee height. A relatively high Rank Order for the Buttock-Knee measurement includes a tendency to Endo buttocks.

Hands and Feet. Endo-Ecto women have smallest feet and narrowest hands of any body type. This brings to mind the possibility of the exaggeration of tendencies for small hands and feet which is present as shortness in Endo women and narrowness in Ecto women. Logically, the present combination of Endo and Ecto tendencies might produce just about the result we find here. Hand length is below average although not Rank Order 1. Here the short Endo trend appears to have subtracted from the Ecto linear tendency. All other hand and foot ratings for Endo-Ectos are below average as would follow from the small (Endo) and narrow (Ecto) tendencies.

Head and Neck. Head height and length are slightly above average, whereas breadth and circumference are below average. Here again are combined tendencies. Neck Circumference is a little below average.

7. Moderate Mixture. Moderate Mixtures are relatively low in both height and weight. (They do not show extreme tendencies of any kind.)

General Characteristics. As has been demonstrated in Figure 1, Moderate Mixtures are evenly balanced in all three directional dimensions and are relatively low in all tendencies. Their balance between height and weight places them at exactly the middle rating (4) for Rank Order of Index of Linearity. As all Rank Orders of measurements are below average, there are no extreme tendencies to mention except to note a few instances where Moderate Mixtures receive lowest Rank Order ratings. They have lowest average for Sitting Height.

Thoracic Trunk. Although all chest measurements are below average, Breast Increment (Table IV) places Moderate Mixtures close to average with a 4 Rank Order. Moderate Mixtures apparently tend to have small chests with nearly average breast development. Pronounced extremes of breast development are rare.

Abdominal Trunk. Waist Height (from the floor) averages lower than for any other body type. Moderate Mixture waists are low when compared with their relatively greater Hip Height.

Shoulders and Arms. Shoulder Height (Acromion) and Shoulder-Elbow measurements are lowest Rank Order.

Legs. Both upper and lower leg segments have the smallest mean of any group.

Hands and Feet. Hands and feet are little, but not extremely small.

Head and Neck. Moderate Mixtures have the shortest Head Height of any group.

As we have now discussed the different body types in detail, a word may be in order on the occurrence of inharmonious types which exhibit disproportion (dysplasia). In the first place, we are now in a far better position to determine what is appropriate to a given body type and what is a real trend away from its harmonious form. Even though at first glance Endo women's small, tapered hands may appear inharmonious with their big bodies, careful study of comparative proportional measurements (Tables II and III) shows us that Endo women's hands tend to be relatively short and plump (above average width) as compared with hands of other types in roughly the same way that the large regions of their bodies tend to be short and plump in relation to other types of body build. The logical interrelationships between height and weight in the different body types and their equally logical reflection in means for length measurements and breadths, depths, and circumferences make one cautious about indiscriminate discussion of dysplasias.

Also, the tapered extremities of the Endo women and their expanded central portions (Thoracic and Abdominal Trunks and upper segments of arms and legs) make one consider how an analysis of the total body form may explain tendencies in any one region as shown by D'Arcy Thompson in representation of related forms by use of Cartesian co-ordinates (Thompson, 1942). Where one region is expanded, another region is diminished with mathematical consistency. It is not within the province of this paper to make an exhaustive mathematical analysis of transformations of related forms, but the author would like to point out that the meaningful interpretation of many of the tendencies found in body types might be profitably investigated from this approach.

For example, outstanding instances of disproportion in women's body builds appear when the Thoracic Trunk is comparatively small as contrasted with the same individual's larger Abdominal Trunk and Legs. A rough survey of outstanding instances of this situation brings out the fact that this is fairly common in Endo women and Endo-Ecto women. In these two groups, about a quarter of the women show these tendencies. About a tenth of the Meso-Endo women and Moderate Mixtures incline in this direction. Cases are extremely rare or very slight in the Ecto, Meso, or Meso-Ecto groups. In other words, the narrow shoulders and little "top" with heavy hips and legs are restricted almost entirely to body types which are predominantly Endo or have some of the Endo component.

Since no one body type has these tendencies to disproportion predominant within the group itself, a given body build can have its measurements checked against the norm for the basic tendencies of its body type group. If the thoracic measurements are below the mean and if abdominal and leg measurements are above the mean for the body type, then disproportion in this standard form may be assumed.

IV. Summary and Conclusions

Presentation of qualitative and quantitative data on 547 women seems to indicate that means of the seven body types distinguished in this study vary for the 38 measurements presented here (Tables I-IV) and reflect the trend of the observational (qualitative) criteria for the seven body types. By the "circular descriptive" method, we appear to have validated the presence mathematically of the features we saw morphologically.

And beyond this, the types as wholes suggest something at work on the whole form as contrasted with isolated features. These features are really only parts of the whole and vary in accordance with the mathematics of solid geometry when applied to the total form. As D'Arcy Thompson writes:

> . . . when the morphologist compares one animal with another, point by point or character by character, these are too often the mere outcome of artificial dissection and analysis. Rather is the living body one integral and indivisible whole, in which we cannot find, when we come to look for it, any strict dividing line even between the head and the body, the muscle and the tendon, the sinew and the bone. Characters which we have differentiated insist on integrating themselves again; and aspects of the organism are seen to be conjoined which only our mental analysis had put asunder. The coordinate diagram throws into relief the integral solidarity of the organism, and enables us to see how simple a certain kind of *correlation* is which had been apt to seem a subtle and a complex thing. (Thompson, 1942, pp. 1036-1037)

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THE STUDY OF FUNGI WITH THE ELECTRON MICROSCOPE[1]

Manuel B. Azoff and Floyd S. Shuttleworth[2]
University of Miami

Introduction

It is the purpose of this report to present some interesting findings related to a fungal organism as studied with the aid of the electron microscope. A search through the literature indicated that there has been very little, if any, work published on the study of true fungi with this new tool. Excellent reviews of the biological applications of electron microscopy have been published by Williams (1947) and by Marton (1943).

The organism used in this investigation was obtained from diseased poinsettia plants grown in Coral Gables, Florida. This organism was not the cause of the diseased condition of the plants but was a secondary invader of the necrotic tissue of the host. It was discovered in the process of streaking out the conglomerate of organisms found on the poinsettia plants.

Discussion

Among the colonies resulting from isolation streaks on potato dextrose agar, (PDA), was an organism whose mycelium and conidiophores were a pale pink color. Observations with a conventional optical microscope revealed multiseptate, crescent-shaped, macroconidia which were 25 to 30 microns in length and approximately 3 to 5 microns in width. These features helped to establish the taxonomic position of the organism in the order Moniliales and in the form genus *Fusarium.*

Further isolations were made on PDA, and from the new cultures, specimens were placed on a drop of water on a formvar-filmed grid for observation in the electron microscope. These observations revealed the structures in Figure 1-A, B and C. The

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[1] The original paper was presented at the Seventeenth Meeting of the Florida Academy of Science, Gainesville, Florida, December 13, 1952.

[2] The authors are indebted to Professor Claude F. Carter, Associate Professor of Physics and, Mr. William A. Murphy, Graduate Fellow in Botany both of the University of Miami.

structure in Figure 1-A is about ten microns long and is part of a structure approximately fifty mircons in length. (At five thousand diameters this model of electron microscope can take electromicrographs of a field ten by ten microns square.[3]) Similar structures as viewed under a conventional light microscope did not reveal the protrusions on the walls of the structure and the opaque bodies attached to and surrounding the structure were not visible.

If one cares to speculate on the possibility that these opaque bodies may be a type of spore, their absence in some cases may possibly indicate an immature condition of the hypha. It is quite possible that these structures may be merely fine verrucose markings of the wall which are not visible under the conventional light or the phase microscopes. Such verrucose markings, visible with ordinary light microscopy, are common on the walls of many spores.

Further isolations were made on PDA and on nutrient agar 211.[4] The colonies streaked on 211 were larger and sporulated faster than those on PDA. Smears and dilutions were again made of the organism in preparation for observation in the electron microscope.

The electromicrograph of Figure 1-D shows a portion of a macroconidium extending from the top of the picture. The more or less transparent structure, below the dark macroconidium is a segment of a young hypha showing a septum. The dark expanded portion above the hypha may be part of the sporodochium.

One of the problems in electron microscopy involves the development of techniques in the preparation of specimens which will endure the electron bombardment. Attempts were therefore made to culture the organism directly on the fine wire grids. Slide cultures using nutrient agar 211 were made and the grids were placed directly on the cooled agar. The culture was streaked on the agar at a distance of about five millimeters from the rows of grids. After six days, observations were made with the electron microscope at five hundred diameters. An electromicrograph made of this culture, (Figure 1-E), shows portions of two macroconidia and many strands of firmly attached hyphae. This method of grid culture proved to be the most satisfactory.

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[3] RCA Console model.

[4] Laboratory Product No. 211 contains destrose, amigen, mineral salts and vitamins. Mead Johnson & Co., Evansville, Indiana.

Another major problem is, of course, the interpretation of results obtained. In so much as there are apparently no other electron microscope studies of the true fungi, interpretation is very difficult. Further work with the same and other organisms must be made and comparisons drawn with high magnification photographs of the same organisms studied under a light microscope. Such work is being continued.

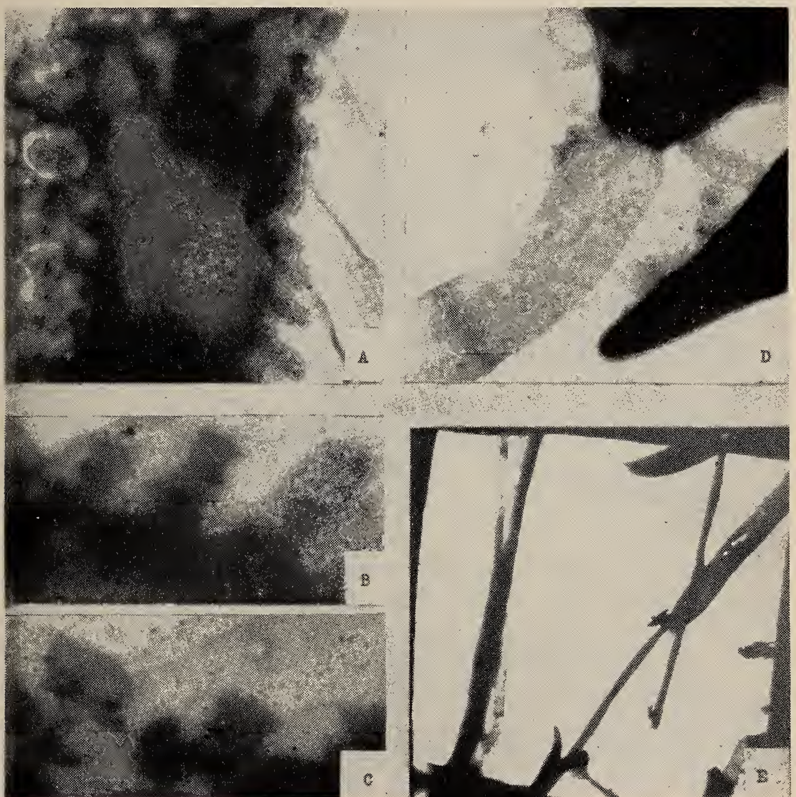

Fig. 1.—A—Electromicrograph taken at 5,000 diameters showing protrusions on walls of *Fusarium* organism; B and C—enlargements of surface structures of organism in 1-A; D—portion of a macroconidium is shown extending into the lower right corner. The dark expanded portion above the hyphae may be part of the sporodochium; E—electromicrograph taken at 500 diameters showing one complete opening in the grid. Strands of hyphae can be recognized. The lunate-shaped structures are macroconidia.

Results and Conclusions

The results of this paper do not warrant definite conclusions. In the first place the organism needs further taxonomic identification although it is apparently some species of *Fusarium*. Secondly, isolation of the various structures of the organism should be observed individually under the electron microscope.

New methods or modifications of some of the standard methods must be devised.

Although the results at present are only fragmentary, the electron microscope promises to be an important new tool in the study of fungi.

Summary

1. An organism identified as a species of *Fusarium* was isolated from necrotic tissue of diseased poinsettia plants.

2. Random portions of the *Fusarium* organism were placed on formvar-filmed grids. Unidentified structures were observed.

3. A new method of preparing fungi for observation in the electron miscroscope was developed. This method involves culturing the organism directly over grids without the use of a suspending film.

4. Interpretations of the electromicrographs is extremely difficult and comparisons with conventional microscopes must be made.

5. The electron miscroscope promises to be an important new tool in the study of fungi.

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PROBLEMS OF THE UTILIZATION OF FLORIDA'S RESOURCES

A symposium presented in cooperation with the Florida Resource-Use Education Committee at the First General Session of the Sixteenth Annual Meeting of the Academy, Tampa, Florida, November 29, 1951.

OPENING REMARKS

RALPH E. PAGE
University of Florida

In many ways, Florida is a frontier state. From this point of view an interesting paradox prevails. The United States presents few examples of a more highly developed social organization than that which exists in the "Gold Coast" on the lower East Coast. At the same time there are few, if any, areas of the country which are less developed than the Everglades, the "piney flats," and the "hammock" sections.

Because of this parodoxical situation, Florida has an exceptional opportunity to devote careful and thoughtful attention to the utilization of the resources of the state. It would appear self-evident that many of the answers to questions of this sort which have been acquired elsewhere through a process of trial and error can be applied in the Florida environment. It seems reasonable to assume that the state should profit materially as a result of this situation.

The Social Science Division of the Florida Academy of Sciences has arranged this symposium in conjunction with the Florida Resource-Use Education Committee. It is our hope that the material contained in these papers will contribute materially to the welfare of the state and its inhabitants.

SOIL CONSERVATION PROBLEMS IN FLORIDA

Colin D. Gunn
Soil Conservation Service

The accomplishment of the basic physical objective of soil conservation activities of the Department of Agriculture is the primary soil conservation problem of Florida. This basic objective is the use of each acre of agricultural land within its capabilities and the treatment of each acre of agricultural land in accordance with its needs for protection and improvement.

This primary problem may be broken down into two principal phases: 1. Human; 2. Physical.

The great human problem is to get our citizenship to realize that our population in this Nation has increased from approximately 5-¾ million in 1800 to approximately 165-¾ million at the present time, while our acres of crop land per person have been reduced from 5.1 acres in 1800 to 2.5 acres in 1953. Florida land owners particularly should be interested in this situation for we still have land that can be brought into production and land wastage can be prevented and production per acre increased in Florida by use of soil and water conservation techniques.

Much is being accomplished toward making our Florida population more soil conservation conscious by women's clubs, garden clubs, civic clubs, churches, farm organizations, the press and through the public schools, colleges and universities. The Florida Resource-Use Education Committee, appointed by the Governor, is accomplishing much in cooperation with the State Department of Education, the public schools and the institutions of higher learning.

The physical phase of Florida's soil conservation problem has a number of angles.

The most recognizable symptom of soil loss is erosion which is caused by wind or water. Heavy run-off of rainfall on sloping land results in actual removal of productive soil, destruction of growing crops, damage to highways and secondary roads and siltation or filling in of streams, lakes and reservoirs. Water management and water disposal systems to prevent loss of sloping land consist of terraces, sodded outlets and adequately protected areas to which excess water can be conducted. Cultivated crops, including orchards, are planted on the contour. A Florida farmer was quoted recently as saying he was building a complete terrace and water disposal system and planting his crops on the contour because he learned in school that a straight line is the shortest distance between two points and he has learned by observation and experience that a straight furrow is the shortest route to idle land. Use of close growing vegetation and forest trees helps prevent erosion.

Wind is another destructive agent on clean cultivated, light soils. Wind erosion not only removes soil from a field but the top soil which is depended upon for production is, of course, the soil that is blown away. Here again we have crops actually destroyed and roads damaged. "Sand dunes" and "blow holes" result from heavy wind erosion and much damage is done to fences.

Use of grass and trees and retirement of land from cultivation is the ideal remedy for wind erosion. On cultivated land the planting of windbreaks, permanent or temporary, will remedy the situation. The incorporation of large quantities of organic matter in the soil and "trashy" cultivation are very beneficial.

The productiveness of many Florida soils is reduced through leaching and rapid oxidation of organic matter. Here again plowing in heavy crops of vegetation, particularly legumes, will be very helpful.

One of Florida's acute soil conservation problems is subsidance (sinking or wasting away) of her very productive organic (muck) soils. When water is removed from muck soil the subsidance averages approximately an inch per year. There appears to be little variation in rate of subsidance between cultivated and uncultivated areas. Ultimate exhaustion seems inevitable. Good management practices, maintaining a high water table and returning large amounts of organic matter to the soil tend to lessen the oxidation process and to prolong the life and usefulness of organic soils.

In addition to the problem of erosion prevention touched upon earlier, there are approximately 13,000,000 acres in Florida requiring some form of water management or control to accomplish the optimum use of this land within its capabilities. This involves the proper use of water and may involve drainage or irrigation or both and sometimes neither.

A conservation problem involving both land and water and generally spoken of as Biology or wildlife phases of a soil conservation program has particular significance in Florida.

Conservation farmers are finding that measures that conserve soil and water and increase crop yields also contribute to the supply of game and fish. Quail, dove, turkey, migratory water fowl, deer and fur-bearing animals find favorable living conditions on areas under soil conservation plans. Farm ponds, natural or artificial, are sources of food production in addition to their uses for irrigation, stock water and recreation. Productivity of an area of water can be increased by proper management and fertilization the same as an area of land.

Florida's soil conservation problems are being attacked and solved by the land owners through Soil Conservation Districts. There are 56 of these farmer-created and farmer-operated districts in Florida. They include 59 of the 67 counties in the State. Each district is governed by a Board of Supervisors who are farmers and who must be elected by farmers. This governing body develops a district-wide plan of operations and invites each land owner to work out a conservation plan for his farm. This Board of Supervisors secures technical assistance for individual farmers from whatever source it is available. In Florida assistance has been secured from The Florida Agricultural Experiment Station, The College of Agriculture, The Agricultural Extension Service, Florida Forest Service, Florida Game and Fresh Water Fish Commission, State Road Department and other State Agencies. Federal Agencies assisting are Soil Conservation Service, Forest Service, Geological Survey and others.

Here we find true democracy at work. Farmers building and operating their own organization with the assistance of any and all public servants who can help them to use each acre of agricultural land within its capabilities and to treat each acre according to its needs for protection and improvement.

WATER CONSERVATION PROBLEMS IN FLORIDA

Richard A. Edwards
University of Florida

Most of the water used in Florida by industries, agriculture, municipalities and homes is derived from ground water supplies, that is, water secured from below the surface of the earth.

In the development and conservation of water from these sources, three main problems confront the people in the State of Florida: first, the development of adequate supplies of fresh water, particularly in coastal areas; two, the prevention of encroachment by salt water around the borders of the State; and, three, the maintenance of pressure or "head" in the deep artesian aquifers.

The first problem, that of adequate supplies of fresh water, is experienced primarily along the east coast from St. Augustine south and in the southern part of the peninsula. There the deeper artesian waters are salty because as yet fresh water has not replaced the original salt water locked up in the marine formations. The near surface formations do not, for the most part, contain good aquifers so that abundant fresh water is not always available in the amounts desired.

Salt water contamination and encroachment are serious problems in the coastal areas. As a result of extensive drainage by canals, or of excessive well pumping, salt water may move into the aquifers thus contaminating the ground water. The balance between fresh water and salt water has developed over a period of time as a result of the accumulation of fresh water on the land. If the level of ground water is lowered, the salt water from under the ocean moves inland to take the place of the fresh water which has been removed. This encroachment then causes the wells to be contaminated by saline waters. Encroachment of this nature has taken place in Dade and Pinellas Counties and at Panama City. About twenty-five years ago, Tampa was forced to abandon its well fields and utilize water from the Hillsboro River (Cooper, et al., 1950). Some years ago the well fields at Miami were contaminated by ocean water which flowed up the drainage canals at low water and worked downward in the solution channels into the aquifers. Necessary steps have been taken to prevent a recurrence of this condition.

In some of the deeper artesian aquifers, such as the limestones, sufficient pressure is maintained by downward moving ground water to cause the water to flow out of the wells and springs much like the way water flows out of a faucet in your home as a result of the pressure produced by the storage of water in an elevated standpipe. As the pressure decreases, the amount of water flowing out of the system diminishes. The same situation exists in the artesian aquifers under the State of Florida. Where wells flow or are pumped, the water level in the aquifer decreases. In some areas the head or the height to which the water rises in the wells has been lowered. Near Jacksonville it has been determined that the head has decreased about thirty feet below the level at which it was prior to the production of water from this horizon (Stringfield, et al., p. 705). This means that up the slope of the formation, in this case, a little distance west, wells which formerly would just flow now have the water thirty feet below the surface. Continued removal of water from the aquifers will lower the water level still more, so that, locally, a level may be reached below which it is not economical to pump water.

These illustrations indicate that in certain localities there are difficulties in securing adequate supplies of water. As the State develops it should be expected that the difficulties will be multiplied. However, it is well to point out that there is adequate water in the State. Silver Springs alone produces on the average about as much water as is consumed in the State each day. Unfortunately, the areas which have inadequate supplies of water are not close to major springs.

It is to be noted then that most of the problems of water supply are found in the coastal areas. Certainly, extensive drainage along the coastal regions has contributed to the salt water contamination in those areas. Sensible plans of drainage must be developed to prevent further contamination.

It is known that the lowering of the water table in coastal areas has destroyed the balance between salt and fresh water. Some methods of maintaining the level of ground water such as securing supplies from widely separated wells and controlling the amount withdrawn are steps in the direction of maintaining the present balance. Where it appears that the aquifer is being depleted at a rate faster than the water is being replaced by natural processes, artificial recharge of the aquifer may be accomplished by supplying it with uncontaminated surface water.

In the artesian aquifers most of the water discharged, either in springs or by wells, has been derived from precipitation falling on the recharge area. If the present levels are to be maintained, then it is necessary to withdraw only the amount of water which can be supplied and can be moved through a particular aquifer. Studies of the nature of the aquifer and route of migration of the ground water from the area of recharge to the point of discharge are necessary to keep withdrawals within the capacity of the aquifer. Here, too, it might be feasible to use artificial recharge to maintain the levels.

In the central part of the State from Lake Okeechobee north, there are large quantities of fresh water available, for this is the region of the "Big Springs" and it seems that there is small likelihood of the problem of salt water contamination in the deep aquifers of this area. A thoughtful development of the sources of ground water should place Florida in a position to meet the growing needs of industry, agriculture and an increasing population.

NATURAL VEGETATION, FLORIDA'S BASIC RESOURCE

John H. Davis
University of Florida

So much of Florida's natural vegetation is unaltered or only slightly altered that even after four hundred years of occupancy by Europeans, it remains one of the state's greatest resources. The pine and cypress forests and woodlands, the hardwoods forests, and the prairie and marsh grasslands cover the largest areas. The forests have yielded abundant lumber and other forest products, and now with better management their yearly output is being gradually increased. They are the greatest of the natural vegetation resources.

The grasslands, which include not only prairies and marshes but also the ground cover vegetation of the open flatwoods type of pine forest, are extensive and they have been used for pasturage for centuries. Recently many of the grasslands have been improved by various engineering practices, introduced grasses, and proper management so that now "improved pastures" with large herds of cattle are one of the state's growing assets. Millions of acres of unimproved grassy woodlands are cattle ranges, the cattle depending upon native grasses for forage.

The Everglades, and other marshes or swamps, that built up organic soil deposits of peat and muck furnished some of the best agricultural land after proper drainage. Reclaimed marshland areas in the Everglades and similar areas constitute a soil resource that would not have been present without the saw grass and other plant growth that formed the muck and peat. Over-drainage is destroying or retarding some of this marsh vegetation that would accumulate more organic soils for future use, and a better management of marsh and swamp areas is imperative if this soil resource is to be preserved.

Numerous types of vegetation are resources as the habitats for wildlife and fish, and for recreation and scenic purposes. The value of these is much greater than generally supposed mainly because the tourist trade is partly built around hunting, fishing, and recreation. Deer, turkey, quail, ducks and many other animals depend almost entirely upon natural vegetation for food and cover. Wild life management is becoming increasingly more important, and to do this properly a detailed understanding of the natural vegetation is most essential to maintain or improve the populations of the game animals.

Probably the least understood and most poorly managed natural areas are the state's waters, both inland and coastal, and the aquatic and marsh vegetation of these constitute a very valuable resource. The plant life in all waters is the basis of the food chain or food pyramid at the top of which are the sport and food fishes. Mullet and other herbivorous fish depend entirely on aquatic plants for food and if it were not for the great shoal water areas of marine aquatic vegetation, these and other fish would be far less abundant. Fresh water lakes, ponds, and rivers abound in marsh and aquatic plant vegetation, and as yet these are not properly understood so as to supply information for the better management of the fish, water fowl, and other animals. Hydrobotanical investigations on an extensive scale are needed to bring about the fullest development of inland water resources, that constitute about 6 per cent of the total area of the state.

Last, but not least, are the recreational and scenic values of the natural vegetation. Highways that pass through swamp, hammock, prairie and other scenic areas attract tourists and local residents alike and there should be a program to encourage the maintenance of as many of these scenic types of vegetation as possible. The parks, both state and national, are in most cases in areas where the unaltered vegetation is the chief attraction. This is particularly the case of the great Everglades National Park in southern Florida that contains some of the most unusual types of vegetation in the United States, and which is visited by about a million persons per year. County and urban parks are also important.

There are some types of vegetation, as the great mangrove swamps of the southwest coastal areas, that are potential future resources. These mangrove forests may later prove valuable for tannin extracts, lumber and charcoal, as they have in the Orient. Recently paper has been made from saw grass plants, and since there are over a million acres of dense saw grass marshes in the Everglades alone, this vegetation may prove a great resource.

Thus vegetation as a whole is a great, if not the greatest, resource of Florida as at present used or enjoyed, and there remain many uses to which it has not yet been put. The present and the future best utilization of all types of vegetation will depend upon many numerous and thorough studies of its composition, nature, environment, and changes, all of which are the concern of botanists, and plant ecologists particularly.

SOME PROBLEMS OF FLORIDA'S FORESTS

C. H. Coulter
Florida Forest Service

The care, management, and support of natural resource programs are only justified by their value to our human resource—our people. Forestry, with its broad scope in land area, its present economic value, its much larger potential value, is worthy of our combined constructive thoughts and sustained effort to make it more adequately serve our people.

Our Woods of Great Benefit

Florida's forest land—21,500,000 acres—amounts to 60% of the total acreage of our State. Annually $200,000,000 are received from the sale of forest products at the primary manufacturing plants. An additional $50,000,000 are derived from re-manufacture. In addition to sustaining the third largest industry of the State, our forests are of great additional value. Soil, water, and wildlife conservation are intimately tied in with proper forestry practices. Furthermore, Florida is a more comfortable, better place to live in because of our trees.

The Condition of Our Woods

The original timber, virgin longleaf pine, numerous hardwoods, and long-lasting cypress, are practically all cut out. Second growth stands are being immaturely harvested. We must grow from seed and little seedlings our future crops of trees. Yet even in the face of increased demands, firm markets and good profits, we are cutting and burning more than we are replacing.

Forest Fire Control

In over 20 years, 12,600,000 acres have been placed under organized protection. Even so, annual losses—despite the modern suppression efforts—amount to 3 to 4% annually. A blacker picture is the 7,400,000 acres—one-third of the forest areas of Florida—which have no organized protection and about 40% burns over annually. The combined losses in the woods amount to about $8,000,000 annually. In economic loss this is over $50,000,000 as the wholesale economic value is 7 times the standing tree loss. Jobs, payrolls, and profits go up in smoke. People cause 98% of these fires—30% carelessly and 68% incendiary—and only 2% is caused by lightning.

Tree Planting

Some 130,000,000 seedlings have been set out in the past 20 years, reforesting about 209,000 acres. At this rate it would require 200 years to plant the cut over and burned land that needs planting to make it productive. Current efforts are being accelerated to raise 50 million seedlings per year, but this is a scant half of what is necessary.

Management and Utilization

Large ownerships are doing a generally good job of proper cutting and utilization. They are managing their areas to keep the land productive. Only 31 ownerships of 50,000 acres or more comprise 22% of the forest area.

Medium ownerships—5,000 to 50,000 acres—show a lower percentage of good management and amount to 31% of the acreage.

Small ownerships—under 5,000 acres—total 55,000 in number and are very poor in their cutting and utilization. They own 38% of the forest land.

At the present time some 12 trained foresters are working primarily with the small woodland owners in some 34 counties. They are reaching only a small segment but are providing in the woods assistance to get good management.

Why This Lagging Progress?

With our forests only producing about one-third of their capacity, why is not more being done to meet the problem? Lack of information, lack of support, and human indifference are the reasons for our failure to do what should be done.

Education and Information

Well integrated education in conservation, including forest conservation, will help solve this problem. Since education is primarily accomplished with our youth, colleges, high schools, and grammar schools can be of great value in maintaining and building up this valuable resource. To accomplish this education, we need to touch the spark with our adults. You teachers, you scientists, and you educators need to be informed and aroused to do something toward the goal.

Other adults—businessmen, legislators and Mr. Average Citizen—need to get the message and to be aware of the need for action. Only wide-spread information and enlightenment will accomplish this.

Action Program

With proper information and education of both youth and adults, the door can be opened to do the forestry conservation job that is necessary to the benefit of our citizenry, present and future.

Cooperation in reducing wildfires, in more reforestation or tree planting, and assistance in management of our woodlands, will come. It will take some additional funds to accomplish this worthwhile job but Florida will be repaid many times over.

FLORIDA'S WILD LIFE RESOURCES

Fred Jones

Florida Game and Fresh Water Fish Commission

Just how important are Florida's wild life resources, how big a business is hunting and fishing in the State, and how is it measured in terms of the economic and social benefits derived from participating in such outdoor pleasures? These are the questions to be answered below.

Arthur Carhart, renowned outdoor writer, asserts in an article published in the Sports Afield Magazine that, as ascertained by research of several years duration, the average sportsman spends $600 a year on fishing and hunting. This figure includes such items as ammunition, guns and fishing tackle, transportation, meals and lodging, guides, boats, dogs, clothes, fishing and hunting fees, and other miscellaneous equipment bought primarily because of these outdoor activities. In order to be conservative in his estimate, Carhart took this figure, reduced it by one-third, and arrived at $400 as the average annual expendure of a sportsman. This sum, though based on nation-wide estimates, can be accepted as valid also for Florida.

In discussing the importance of Florida's wild life resources, the State's fresh water fishing and hunting should be considered first. In 1950 about 100,000 persons bought licenses to hunt. There were others who hunted but who were exempted from purchasing a license. Therefore, there were obviously more than 100,000 persons who actually hunted. However, to remain on the conservative side, those hunters who were unlicensed will not be counted. Even so, accepting Carhart's estimate, the annual expenditure for hunting amounted to $40,000,000 in 1950.

At the same time there were roughly 280,000 fresh water fishing licenses sold. In this case, however, the unlicensed people have to be considered since so many are exempted from purchasing fishing licenses. Under present laws of Florida, children under 15, persons over 65, and all persons who fish in their home counties with cane poles, are exempt. The *cane pole* provision alone has been estimated to exempt more than half the actual number of fresh water fishermen.

So, by discounting all the elderly folks and all the children, and by counting only a number of cane pole fishermen equal to the license buyers, the number of fresh water fishermen can be figured at 560,000 people. Multipling this number by the $400 and the annual expenditure will amount to $224,000,000. The combined income from fresh water fishing and hunting in Florida amounts then to $264,000,000 each year.

But of course, fresh water fishing and hunting are only the smaller part of the overall picture of hunting and fishing in Florida. Florida's salt waters are the most popular in the country, and they are the basis for the real income from sports fishing.

Since there is not salt water fishing license required in this State, only estimates can be used. On the basis of hundreds of questions asked, thousands of miles traveled, checking with the State and local chambers of commerce, and other research by this writer, and information furnished by other sources, it was possible to arrive at some reliable figures.

There can be no doubt whatever but what at least a half a million Floridians go fishing in the State's salt waters with some regularity. Likewise there can be no doubt but what there are at least a million and a half visitors who fish at one time or another. In this case, since more than half the fishermen are from other states, there can be no doubt but that the average expenditure that be traced back to fishing and/or hunting is at least the $400 per year. Thus, the two million more fishermen will spend another $800,000,000. This combined with the fresh water fishing and hunting expenditures gives a total of more than one billion dollars a year spent for fishing and hunting in Florida!

Dividing this sum by the total population of the State will give the rounded figure of $335 per person per year income from fishing and hunting. This total represents ten per cent of the total income from hunting and fishing for the country as a whole as estimated by Carhart mentioned earlier.

If this figure seems large, further proof can be found in the sales records of the national manufacturers of fishing tackle and from information of the State Chamber of Commerce. They report that the second most-asked question at their information booths on the state line is about where and how to fish. With the exception of Florida's climate, none of the other resources draws as many people to the State as do the fish and game resources. As far as climate is concerned it is well to remember that climate without recreation is not enough. No informed person will doubt that Florida's tourist business would be seriously impaired if all the State's fish and game resources were suddenly lost.

The protection of Florida's fish and wild life is of vital interest to all Floridians, not only because it is a billion dollar industry but because as Carhart states it "Outdoorsmen do not measure what they get out of hunting and fishing in dollar terms. There is treasure found in outdoor living which is beyond any measure of dollars spent. There is a very definite element of maintaining a national spirit, stamina, love of country, in outdoor ways. These are most terifically vital things—things we should emphasize in protecting what we possess in outdoor America."

THE ECONOMY OF FLORIDA

Walter J. Matherly
University of Florida

The position which the economy of Florida occupies in the present differs greatly from the position it occupied in the past. Florida in 1953 is not the same state as that which existed fifty years ago; neither is it the same state as that which existed twenty-five years ago; or even ten years ago; it has undergone a series of fundamental changes—changes that are political, social and cultural, as well as economic. More than a double decade ago we ceased to be an infant state of self-sufficing farmers, of self-contained lumber-mill communities, of small isolated tourist towns and cities. We have grown up; we have achieved adulthood; we have developed into a mature state of inter-dependent manufacturing industries, of inter-connected recreational and distributing centers, of inter-related urban communities. We have attained high distinction in the life and economy not only of the South, but also of the nation. We are the most unusual, as well as the fastest growing state south of the Potomac and east of the Rio Grande, the Republic of Texas to the contrary notwithstanding.

The economy of Florida is based on several major types of industries:

1. *Agriculture.* Agriculture is concerned with a wide variety of crops ranging all the way from corn, cotton, tobacco and peanuts in Mainland Florida, to citrus fruits, sugar cane and winter vegetables in Peninsular Florida. Cash farm income from crops in Florida increased from $79 million in 1935 to $345 million in 1950, or an increase of 336 percent as compared with 314 percent in the nation. The production of citrus fruits alone, which in 1949 represented 30 percent of all cash receipts from Florida's farm marketing, increased from 55 million boxes in 1940-41 to 105 million in 1950-51, or an increase of 89 percent, whereas the nation's increase was only 24 percent. While agriculture, including citrus, ranks high in the economic life of the state, the state is no longer predominantly rural or agricultural. It has become increasingly urban, industrial and commercial.

2. *Livestock production.* Cash farm income from livestock, which consists largely of hogs, dairy cattle and beef cattle, increased from $19 million in 1935, to $92 million in 1950, or an increase of 390 percent, as compared with 284 percent for the nation. Improvements in cattle breeding and in feeds and grasses, together with the fencing and care of ranges and the establishment of branch plants of the big packers in Florida, are bringing Florida rapidly into the forefront in the American cattle industry.

3. *Forestry.* Forestry makes use of 67 percent of the land area of Florida, and together with its allied industries, employs 39,000 people. It could, with proper fire protection, provide annually two billion cubic feet of wood or eight times our present consumption. In 1950, the value of processed forest products in Florida, as they left the manufacturing plants, was estimated at $300 million.

4. *Manufacturing industries.* Florida factories in 1947 shipped $819 million of goods manufactured in the state; employed 78,665 people to whom were paid $169 million as wages and salaries; expended in overhead, profit and taxes $181 million; and purchased raw or partly processed materials costing $451 million, all of which provided markets for the sale of products from farms, mines, forests and other plants. Florida's total income from manufacturing in 1950 was $340 million. Manufacturing enterprises are increasing rapidly in number both in Mainland Florida and in Peninsular Florida. They differ in character from the

industries of the North since they are concerned primarily with the utilization of natural resources native to Florida.

5. *Business and financial enterprises.* These non-manufacturing enterprises consist principally of wholesaling and retailing, banking, insurance, real estate, transportation and communication, public utilities, and service industries. In 1950, wages and proprietors' income from these enterprises amounted to $1.7 billion and their payrolls represented 320,782 people. Retail sales in Florida from 1929 to 1948 increased 373 percent and department store sales 377 percent whereas in the nation they only increased 170 percent and 224 percent respectively.

6. *Tourist industry.* No picture of Florida's economic activities would be complete without the tourist business. It employs 54,000 people and is concentrated mainly in Peninsular Florida. Its annual return was estimated at $790 million in 1947-48. Nobody knows what it does yield since no scientific study thereof has ever been made.

In the expansion of these industries, Florida has increasingly developed a balanced economy. In Florida it is necessary to give attention to agriculture, to the extraction of minerals, to manufacturing, to distribution, to transportation and communication, to recreation, and to other important enterprises. We cannot afford to concentrate on any one of these activities at the expense of the others. We would make a grave economic mistake if we permitted ourselves to become exclusively tourist, exclusively industrial, exclusively agricultural, or exclusively anything else. To apply ourselves exclusively to any one part of our economic system is to make ourselves a one-industry region. A one-industry region always rises or falls with the prosperity or failure of that one industry. The permanent well being of any state, or nation, is dependent upon a balanced economy, upon a diversified economic life, upon an industrial structure with many, rather than few, types of enterprises.

In 1950, the total income of Florida arising out of Florida industries and other occupations and professions, was $3,376,000,000. Reduced to a per capita basis this income amounted to $1,210 as compared with $959 for the Southeast and $1,436 for the United States. This means that if our total income in 1950 had been distributed equally among all of our inhabitants, each man, woman and child in Florida would have received $1,210. It means also that if each man, woman and child in Florida is to be as well off as each man, woman and child in the United States, we must increase our per capita income from $1,210 to $1,436. While Florida has approximately the same per capita income as Texas, Iowa, and Minnesota, it ranked first in per capita income in 1950 among the states of the Southeast and far above the Southeast as a whole.

THE FUTURE DEVELOPMENT OF FLORIDA FROM A GEOGRAPHIC POINT OF VIEW

Henry F. Becker
Florida State University

Growth, Development, and Resources

During the past decade, 1940-1950, Florida evidenced spectacular growth and expansion in population, total and per capita income, and such economic activities as the tourist industry, agriculture, manufacturing, and new construction.

Such growth and expansion must be based on the use of natural resources. Among our environmental assets brief mention should be made of wet subtropical climate; a peninsula with large areas of level land with warm sandy to sandy loam soils; numerous surface and underground water resources; long coast line with sandy beaches; great variety of native animal and plant life; phosphate and other mineral deposits; and a location accessible to markets in and outside the South.

All natural environments contain handicaps which must be taken into account because they offer resistance to man's efforts. Illustrative for Florida are such items as occasional severe freezes, much infertile sandy soil, large areas of poorly drained land, and insect pests and disease carriers.

Some Man-Made Florida Problems

Men develop the natural resources they have to meet their needs and desires in terms of what they know, what tools they have, and what they think. Often they are too greedy and know too little about natural laws—about how nature is put together and how much punishment can be visited upon the natural environment without evil results. All too often man's aims and actions in using the land are at variance with his own long-term good. The evidences of man-made problems include the small remaining stands of mature timber and the large tracts of cut-over, burned-over land; the lowered water table and contaminated water supply in some areas; too many low incomes and too much poverty; and often inadequate educational, recreational, and health facilities.

Some Comments on Florida's Future

I assume that as social scientists we are interested not in "here today and gone tomorrow" use of resources, but in possibilities for long-term or "permanent" development that will provide reasonably high levels of living for an optimum population. Taking into consideration what we now know and what we now know we have, the following lines of development seem indicated. Obviously we expect to take advantage of new discoveries and new technological developments not now foreseeable. Also we are fully aware of the dynamic character of a human society.

1. Heavy emphasis on service occupations related to tourist industry. Obviously should continue.

2. About 21 million acres or two-thirds of the total land area of the state is recommended for permanent forest; could create a resource greater than the original.

3. Further improvement of pastures and of stock.

4. Further diversification and refinement of agricultural adjustments to subtropical environment.

5. Further development of other lines of resource-use suitable to Florida environment, such as manufacturers of wood, food processing, other high value-low power and raw material manufactures, and use of sea resources.

THE ACADEMY AND FLORIDA'S PROBLEMS OF RESOURCE-USE

Sigismond deR. Diettrich
University of Florida

Ever since its foundation, in 1936, the Florida Academy of Sciences was most vitally concerned with the problems of Florida's various resources. Anyone interested in problems of Florida's resources, first, has to know what they are and where they are to be found; second, to determine the character, scope and magnitude of the problems; and, finally, to study ways and means of solving these problems. If the Academy would limit its function only to encourage scientific research it would have aided the State greatly but in its original concept it went beyond such a limitation when Article II. Purposes, of the Academy's Charter, states that one purpose shall be "to unify scientific interests of the state." To develop an effective policy of wise resource-use an integration of all scientific material is basically essential, thus, when the Academy purposefully designated the unification of the State's scientific interests it has provided a much-needed framework which permits the interchange of scientific information and ideas. Not only did the Academy set, as one of its goals, the bringing together of the best and most up-to-date scientific information pertaining to Florida, but also, through its multifarious activities, promoted the emphasis upon the problems of Florida's resources.

No better example could be quoted than the splendid admonition of the Academy's first president who, in delivering his annual address on the "Opportunities for Research in Florida," stated:

> "It is essential that the potential natural resources of Florida geological, botanical, and zoological, be investigated. Not only do we need a knowledge of our total potential resources but we also need to know how far we dare or dare not to go with the modification, utilization, and exploitation of these resources. Here I would also include some of the resources of anthropological or even aesthetic interest. If some or a part of these resources must be sacrificed at the altar of progress, then the least we can do is to create accurate pictures and records of what has been. Some of our native animals and plants together with their natural setting are at least leaning, if not actually going, toward annihilation; Indian mounds are going likewise; even natural wonders like sinkholes with their concommitant, peculiar life are choked with fenders, cans, and stoves of

yesteryear. We should study, record, and map what still remains in primeval state."

It would be hard to put better the words, the ideas underlying the wise use of Florida's resources. It even may be conceived as symbolic that the first paper of the first annual meeting of the Academy dealt with the problems of some rare and threatened Florida birds.

The establishment, in 1939, of a Social Science Section gave formal recognition to the need of a definite place for the study of the societal aspects of Florida's problems. These sentiments were clearly voiced in the Academy's *Resolution Concerning the Social Sciences* which states:

"This development is in the finest tradition of academies of sciences, and is of great importance in that the bringing together of the active workers in the biological, physical and social sciences in Florida for an annual meeting in which there can be discussed the inter-relationships of these fields, as well as their more detailed phases, will inevitably be of value to workers in every field.

"By becoming an academy of all of the sciences, the Academy's opportunities for effective service become as broad as the vast range of problems which today face a troubled world."

Concurrently, a Conservation Committee was established, the chairman of which was a member of the Council of the Academy.

Aside from the great number of papers, dealing with problems of Florida's resources, presented at annual meetings, two events focussed formal attention upon the problems of Florida's resources. The first was the Forum on Florida's Resources presented as one of sectional meetings of the Social Science Section at the Lakeland meeting of the Academy in 1950, and the second is this round table discussion, which, given in cooperation with the statewide Florida Resource-Use Education Committee, opens the Sixteenth Annual Meeting of the Academy in this hospitable City of Tampa.

From its inception until to-day the Academy was one of the stimulators for the study of Florida's resources. Based upon this experience, it is fair to conclude that, if any, the Academy's role in encouraging the study of Florida's resources, and the resultant service rendered to the State, will steadily increase with growth and maturity of the Academy.

FLORIDA'S OLDER POPULATION—A POTENTIAL COMMUNITY RESOURCE

T. STANTON DIETRICH
Florida State University

Old age is a topic which is becoming more and more important to all of us.

Since 1900, the proportion of older people in Florida has increased by more than 1,600 per cent, while the total population has increased by 400 per cent. In 1950, 237,000 persons were over 64 years old; a half-century ago there were less than 14,000 old people. Between 1940 and 1950, over 100,000 older people were added to our population, an increase of more than 80 per cent.

If we assume the current mortality rates for those over 54 years of age will continue, and if we assume no person over 54 years of age enters Florida during the next ten years, in 1960 we still will have as many old people as we have today. But if we assume that the number of persons beyond the age of 54 who will come to Florida in the next ten years is no greater than it was in the past decade, we face the probability that, in 1960, we will have almost 400,000 old people.

The change toward an aging population is not an event of the future; it is a change that already has taken place, and one that is continuing.

It suddenly has become all too apparent that our older population has grown more rapidly than we believed it would. We have been rudely awakened to the fact that our current employment practices that encourage compulsory retirement at 65, the inadequate provisions of social security, and the inability or unwillingness of children to contribute to the support of their elder parents now loom before us as ominous social barriers to adequate and satisfying adjustment in old age.

But the problems of old age are not entirely economic.

The change in the traditional age structure of Florida, from a young, rural population to an older urban population will require adjustments not only for the individual but for the social organization of the entire State community. Our attitudes toward the aged will need to be readjusted and our patterns of behavior must be re-oriented to absorb this older population into the total activity of community life. To do this without serious disruption of our social insitutions and group living is a challenging problem.

Older people want activity, friendships, emotional security, a sense of usefulness. Socially, our aging population is a huge reservoir of human resources that is eager to be exploited. If the resources of these older people are to be socially exploited, our concept of the aged as an enfeebled group must be discarded.

Therefore, rather than make elaborate plans *for* our older population, we must plan *with* them. We must plan, then, to live among our elder neighbors, to make full use of their social assets, and to plan together the type of community in which we want to live; to develop the kind of social living we wish to enjoy during the years of our anticipated retirement.

PROBLEMS OF MINORITY GROUPS IN FLORIDA

D. E. Williams
State Department of Education

The Negroes form a strong nucleus of the population of Florida, since about one-fourth of the Floridians are colored. The problems of this minority group are of vital interest to all who are concerned about the wise use of our human resources. The State of Florida recognized the significance of this societal problem and tried to solve it, at least partially, by greatly improving the educational opportunities of Negroes in Florida during the past quarter of the century. In 1927 public education for Negroes was provided in eight hundred sixty-six schools which operated an average term of 128 days. Two thousand two hundred thirty-six teachers taught ninety-three thousand five hundred thirty-nine children. Eleven per cent of the teachers had some college training. Their average annual salary was $447.00. Ninety-eight per cent of the enrollment was in Grades One through Eight and two per cent was in Grades Nine through Twelve. Most of the schools were small. Many schools were taught in churches, lodge halls, and residences. Most of the rural schools were not provided with water, toilets, equipment or teaching materials. As would be expected, teaching procedures reflected these conditions.

Understandings, attitudes and practices have changed gradually. As the economy of the State developed, its ability to provide public education increased. As citizens and officials understood the relationships between moral philosophy, governmental responsibility, and educational needs, their attitudes and practices regarding provision of education improved. As a result, the office of Supervisor of Negro Education was established in the State Department of Education, with the following objects: (1) to induce school boards to adopt policies for improvement of Negro schools; (2) to encourage adequate appropriations from public funds for the support of Negro education; (3) to enlist the active interest of superintendents in providing adequate buildings and equipment for Negro schools; (4) to promote living salaries for Negro teachers; (5) to improve teaching in Negro schools; (6) to encourage improvement of the living conditions through the schools, and (7) to co-operate with the State Board of Control in the development of the Florida Agricultural and Mechanical College and to work with the private Negro schools in the extension of educational facilities for Negroes.

Several philanthropic funds were helpful in stimulating school officials to improve Negro schools. Small grants from the Rosenwald Fund stimulated the construction of 128 schoolhouses that were well-planned, constructed, lighted, ventilated, and heated. In addition to grants on schoolhouse construction, the Rosenwald Fund helped counties to extend school terms, purchase small libraries, and provide transportation for children.

The fact that ninety-eight per cent of the school enrollment in Negro schools in 1927 was in the elementary school (Grades One through Eight) reflected the prevailing attitude toward providing high school opportunities for Negroes. The Trustees of the Slater Fund recognized this condition and sought to promote the development of high schools. Small grants were made to county school boards to help to add high school grades, employ high school teachers, and provide high school equipment in the most populated center in the county. Instruction in these schools was related directly to community needs. Agriculture, Home Economics, and Trades Courses were taught because they contributed directly toward the improvement of living in the community. On the other hand college preparatory courses were not neglected. These County Training Schools, as the Negro high schools were first called, served also as the preparatory schools for colleges. Many of the graduates of County Training Schools became teachers in the elementary schools.

The trustees of the Jeanes Fund sought to stimulate county school officials to help the small rural Negro schools through the employment of a supervisor. The Jeanes Supervisor worked with all the teachers in the rural schools to improve school facilities, methods of teaching, adjustment of the curriculum to community needs, and worked cooperatively with the churches, the county agents, home demonstration agents, health personnel and other community agencies to improve the work of the school and living in the community. Since the establishment of the State Supervisory Program, many Jeanes Supervisors have been replaced by general supervisors.

Improvement of personal health and community sanitation has been one of the most urgent school needs. Persistent and patient effort has been made to help colleges and public schools meet this need. Through help from governmental health agencies and voluntary health associations, colleges have been stimulated to provide some health education in the preparation of teachers and teachers have been helped to teach desirable health practices.

After the publication of the 1930 Federal Census Report, it was discovered that 18.8 per cent of all Negro adults were illiterate. In order to try to help these adults to learn to read and write, voluntary classes were promoted. Shortly afterwards, the Works Progress Administration provided financial support, personnel, and materials for the establishment and operation of classes for adults. These classes were helpful in developing desirable understanding and support of public education. Thousands of adults now receive instruction at all grade levels throughout the State.

The people of Florida have had such a bounty of natural resources that they used them wastefully and unwisely. The influence of the use of natural resources on the development of human and institutional resources has only recently been realized. Some progress has been made but adequate emphasis on Resource-Use Education awaits a general realization of our dependence on resources and the critical condition of our resources. The Negro schools responded splendidly to the call of resource-use education and some of the most effective programs in the State are found in Negro institutions.

Only in retrospect do we realize how much has been accomplished. The school term has been increased to 180 days for all schools. One hundred twenty-six thousand children are enrolled. Four thousand four hundred teachers are employed a minimum of ten months each year at an average annual salary of $2,743.00. Ninety-one per cent of the teachers have four or more years of college training. Sixty-nine per cent of the enrollment is in Grades One through Six and thirty-one per cent is in Grades Seven through Twelve. Fifteen per cent is in Grade One. Modern facilities are being provided as fast as tax resources permit. More money is invested in school facilities each year now than all school property was worth in 1927.

The most gratifying and encouraging growth has been in attitudes which guide action. Through a better understanding of the problems of a minority group by all people involved definite forward steps have been made in the solution of these problems through bettering educational facilities and opportunities for Negroes. This more effective education is improving the economy of the State which enables it to provide more adequate service to the people and is an outstanding example of a better use of Florida's human resources.

SUMMARY

Ralph E. Page
University of Florida

We have attempted in these papers to present pertinent data regarding the natural and social resources of Florida. We have also considered some of the problems which are involved in the educational processes which are designed to qualify the citizens of Florida to utilize these resources more effectively and more efficiently. Finally, we have directed our attention to the role of the Florida Academy of Sciences in connection with this tremendously significant problem of resource use.

It is suggested that this symposium has been logically organized. The resources of Florida have been analysed in what appears to be a rather natural sequence:

1. Soil and water conservation
2. Natural vegetation in general

3. Forests
4. Wildlife resources
5. The organized economy of Florida
6. Personnel resources
    a. The aged
    b. The negro

The purpose of this symposium has been to present an over-all picture of Florida's resources and to point out problems. The solution of these problems and the education of the persons most directly concerned will engage the best efforts of the scientists and educators of the state for many years to come. It is our sincere hope that we have presented facts and raised questions which will stimulate additional study and research designed to promote improved resource utilization.

SOME ASPECTS OF BEACH EROSION ON THE SOUTHEAST FLORIDA COAST

CLARK. I. CROSS
University of Florida

The ocean beaches of Southeast Florida are in a state of unbalance which is resulting in accelerated erosion. As a result serious losses have been suffered by property owners and the state. Most efforts at control have been directed by technically trained engineers who have built structures without understanding all forces involved in beach formation. This lack of understanding is a fundamental reason for general failure of control efforts. The influences of ground water movement and hydrostatic pressure upon beaches are of especial importance and it is believed that no consideration has been given these factors in either man-directed beach modifications or control efforts.

Losses are directly caused by beach retrogression, which destroys property by direct attack upon the land and improvements, and beach progradation which undesirably widens the beach front. Indirectly losses include cost of protective structures and the detrimental effects of erosion upon tourism.

A beach, while subject to short-term disturbances, in general represents an equilibrium condition. If the normal forces of waves and currents are disturbed in any way, as by the building of jetties or breakwaters, the character of the beach may be altered completely. The new forces created may result in highly undesirable erosion or equally undesirable deposition until a new state of equilibrium is established. This new state may render the value of structures worthless for the purpose for which they were intended.

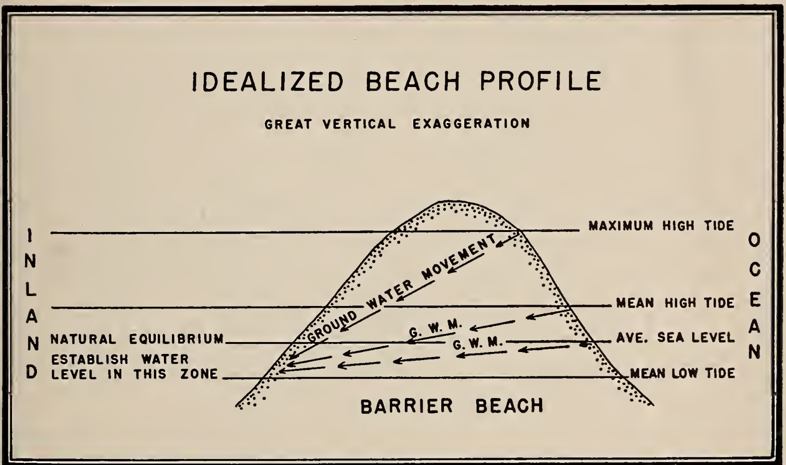
The beaches of Florida have developed over a long time under relatively uniform conditions. Recently, however, man has modified the pre-existing conditions so that the beaches, as dynamic features of the natural landscape, are no longer in a state of adjustment. The most significant of the changes wrought by man in this area have been the cutting of the Intercoastal Waterway, cutting across offshore bars to lagoons, and construction of breakwaters and jetties. Groins, bulkheads and seawalls are of more local significance and have usually been of a protective nature, built after a state of unbalance had been created by the larger projects. Unfortunately these and other protective devices modify the beach and thus the processes of beach formation, therefore may be detrimental.

Before an understanding of the modifications of beaches can be attained it is necessary to know the mechanics of beach formation. A beach is defined as the zone extending from the upper and landward limit of effective wave action to low-tide level. As the beach is exposed to the forces of moving water, which remain relatively constant, it becomes adjusted to those forces. The steepness of the curving offshore profile is a function of the power of waves. Waves beating upon a coast contribute debris which piles up and requires wave energy to move it. Any increase in debris alters the profile, slowing up erosion shoreward until the increase is moved seaward or along shore. In a profile of equilibrium the steepness of the profile is adjusted to the power of the waves and the amount of debris to be moved and will not change.

The offshore slope presented to the waves may be less steep than the slope required for a profile of equilibrium. Under this condition the line of breakers lies well offshore and if erosion is vigorous at and seaward of the breaker line, the debris stirred up may be thrown up either at the beach or as an offshore bar. Where a supply of debris is continuous, as where brought by a river or by a longshore current, the offshore bar may be extended seaward. However, offshore bars may also be attacked and cut away by the waves if there is a falling off in the supply of material.

The curve of the shoreline is determined by the littoral current. Wind-driven waves meeting the shoreline obliquely carry waste in a zigzag path along the shoreline and transport much material into the littoral zone during periods of extreme wave action. Longshore currents sweep waste into the deeper water of bays where the decrease in velocity results in deposition at the still water contact. Because beach drift material tends to go in a straight line, shorelines tend to straighten.

Tidal influence generally keeps a channel open through bay bars although such an opening is so shallow that it does not act as a permanent obstacle to migration of sand alongshore. Sediment sinking below wave base is undisturbed except by strong tidal currents which scour and keep open channels. Tidal currents sweep before them waste material carried by longshore currents. Such material may be deposited in conspicuous delta-like forms (below high water level) in sheltered waters. The incarried deposits represent a great quantity of fine waste from the outer beach which is subtracted from the longshore drift. Because a bay is relatively protected and therefore wave action seldom stirs up the deposited sediment, the outgoing tide does not contribute an appreciable amount of debris to the longshore current.



(Figure 1)

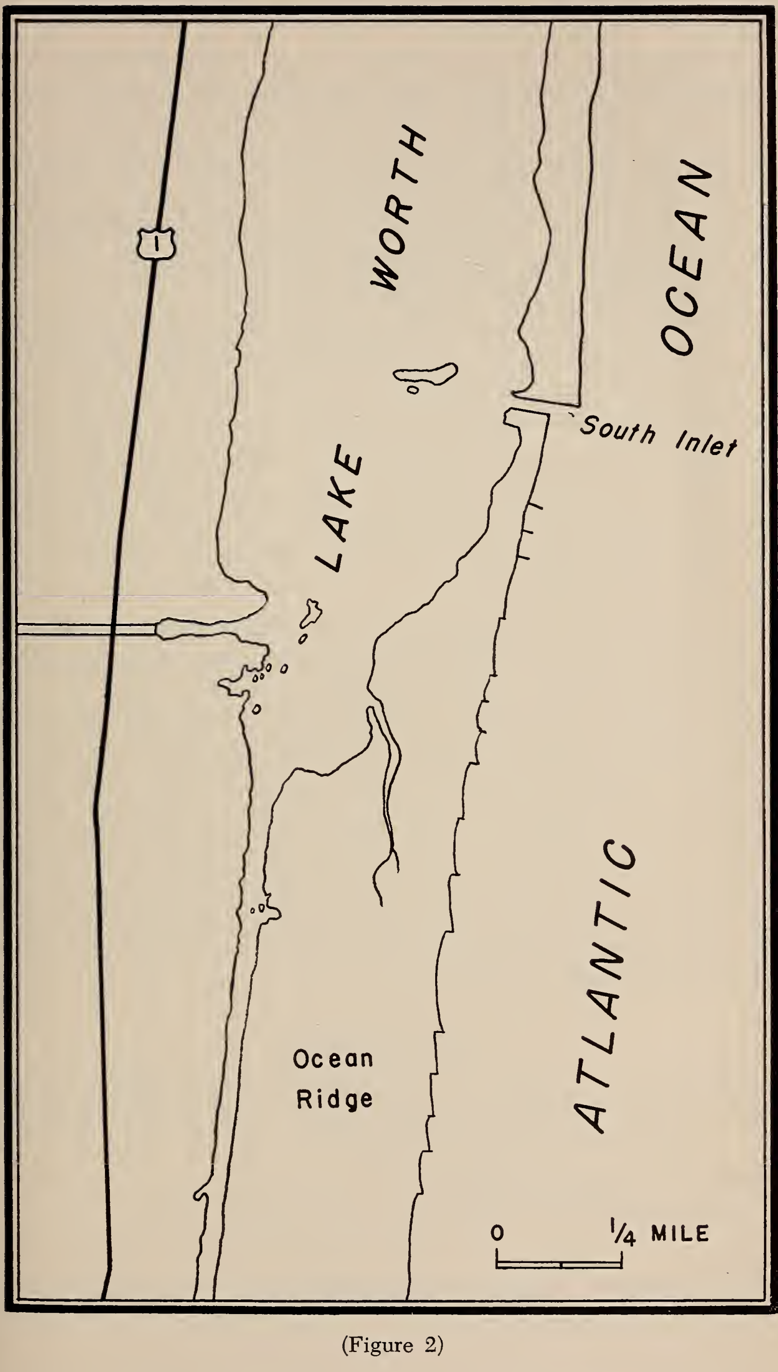
Normally beaches are subject to uniform movements of ground water and have adjusted to them. However, altered ground water conditions exist in Southeast Florida and must be considered as, in part, responsible for accelerated erosion.

The causes of erratic beach width have not been thoroughly investigated by engineers. However, geologists and physiographers have attempted to determine why a beach may narrow during one storm and widen during another storm of similar characteristics. Their findings indicate that variations in hydrostatic pressure are responsible for fluctuations in beach width.

Douglas Johnson made an early study on the effect of ground water movement upon the "quickness" of sand. Darton observed the relative firmness of beach sand during periods of both prolonged rain and drought. These early investigations and recent research indicate that the major factor in sand removal from a beach is ground water movement or hydrostatic pressure. The upward movement of water, although it may be very slight, reduces the friction of sand grains and "quickens" them. When the water table is high sand will move fast but a low water table will tend to make the beach stable or build up.

In Southeast Florida when storms, extremely powerful eroding agents, cause a sudden large rise in tide (the mean range at Hollywood Beach is 2.5 feet, the spring range 3.0, but a maximum of 10.6 feet was recorded in 1926), the normal movement of ground water would be landward into the inland lagoons (See Figure 1). However, when inlets have been cut through barrier beaches, the lagoons are but tidal estuaries and there is no stabilizing hydrostatic pressure firming beach sand. The extreme permeability of Florida's beach structure (Parker and Stringfield noted tidal effects in wells at an average maximum distance of 6,400 feet from the beach line in the Miami area), and often very narrow barrier would accentuate water movement under natural conditions and thus reduce storm damage. The completion of the intercoastal waterway in effect made virtually all the beaches in the area offshore and created an altered hydrostatic pressure condition.

Unfortunately dramatic visible proof of the effect of altering hydrostatic pressure in Southeast Florida, comparable to that noted in man-cut inlets, is lacking. At Palm Beach, Lake Worth Inlet was dredged across the barrier beach and two jetties constructed between 1918 and 1925. The jetties were 800 feet apart to allow for maximum tidal effect. South Lake Worth Inlet was dredged across the barrier beach in 1927. Since 1925 erosion of ocean beaches and formation of tidal deltas has been a problem for the Palm Beach area. Protective structures were designed and constructed but none was really effective in building up the beach (See Figure 2). Sand has been replaced by dredging from Lake Worth at a cost of approximately $50,000 a year (1947). The hurricane of 1947 doubled the amount needed. Despite the addition of material at Palm Beach erosion has steadily extended southward from South Inlet. This is at least in part due to the intercepting effect of jetties as illustrated in Figure 2.


LAKE WORTH
ATLANTIC OCEAN
South Inlet
Ocean Ridge
1
0
1/4 MILE

(Figure 2)

In 1924 Baker's Haulover Inlet was cut to connect the north end of Biscayne Bay with the ocean. Completion of solid causeways (except for small openings) across the south end of Biscayne Bay had resulted in pollution and Baker's Haulover Cut was designed to promote better circulation in the bay. Velocity of the current in the inlet is quite swift, thus interception of beach drift material has been large. Many protective structures have been constructed along Miami Beach with variable effectiveness.

To control beach erosion at Palm Beach, Miami Beach and other Southeast Florida beaches where similar conditions prevail, it is suggested that natural equilibrium be restored in-so-far as possible. Instead of long solid jetties and an open channel it is believed that there should be a narrow channel with a lock and gate to control the level of the inland waterway. The lock or locks and gates should be opened for full discharge on the ebb tide to secure channel scour and to keep the water level substantially below that of the ocean most of the time.

The low normal tide range in this area might give an impression that maintainence of differential water level was unimportant but extreme permeability and, more significant, the occurrence of maximum high tides coinciding with hurricanes of greatest wave violence makes it essential that a favorable hydrostatic pressure be secured. Tropical storms are most common in the southeast of Florida which suggests that corrective action be initiated in this area. As locks and gates prevent tidal currents from carrying sand derived from longshore currents into lagoons, this waste, aided by favorable ground water movement, would tend to rebuild eroded beaches without the expense of costly beach structures whose effectiveness is subject to question.

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WEATHER EXTREMES IN FLORIDA DURING 1950-1951

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During the years 1950 and 1951 many interesting and contrasting extremes took place in Florida's weather. Nearly all possible variations for Florida were recorded: heat, cold, drought, torrential rains, snow, and, in 1950, three full-fledged hurricanes.

The year 1950 opened with the second warmest January of record, the statewide average of 68.2° having been exceeded only once since such records were begun by the U. S. Weather Bureau in 1891. This figure was 9.0° above normal and only 1.2° below the all-time warm January in 1937. Along with January, 1937, January, 1950 was the only month of the name on record during which no freezing temperatures were registered at any time anywhere in Florida.

January, 1950 was, furthermore, the driest January on record in Florida, the average precipitation for the state being only 0.39 of an inch—far below the normal 2.73 inches. In fact, only one month of any name has ever been drier: February, 1911 with an average of but 0.18 of an inch over the state.

The warmth and dryness of January, 1950 were definitely related in that the state was under the influence of a westward extension of the "Bermuda high" during most of the month. Because of the persistence of this subtropical anticyclone, few cold fronts with their accompanying invasions of cold polar air and showers could enter the state.

The Bermuda or Atlantic high gave way during the last half of February, 1950 and thereafter a strong trend toward cooler temperatures was experienced. In fact, not until May was another month as warm as January had been in its average temperature. April was the second coolest month by that name on record. Frosts were recorded widely in northern Florida as late as April 10th.

By June there was a return to hot, dry weather. In fact, it was the fourth driest June on record with the rainfall averaging 3.74 inches for the State, compared with a normal of 6.70 inches for the month of June. One of the most severe heat waves on record for Florida occurred during the period June 17 to 28, 1950. In this

12-day period the temperature reached 98° or higher daily at Jacksonville. The peak for Jacksonville was 103°, and for the State 105°.

Map 3 shows isotherms of the highest temperatures recorded throughout Florida during the summer of 1950. Most of these high temperatures were experienced during the June heat wave. The smaller inset map shows a typical pressure pattern over the United States during this heat wave. It will be noted that the isobars extend from northwest to southeast across the South Atlantic States into Florida with a trough of low pressure tending to split the subtropical high just east of the Florida Peninsula. This pressure pattern results in westerly to northwesterly winds in contrast to the normal southerly winds of summer. Such winds in summer usually bring extreme heat and drought from the intensely heated continent. By contrast, the more normal southerly winds originate over the tropical seas and therefore have somewhat less extreme temperatures and carry much more moisture.

The significance of the hot west and northwest winds is apparent in the northwest to southeast orientation of the isotherms of highest temperatures on Map 3. It will be observed that in the northern and central portions of the peninsula, maximum temperatures for the summer were generally higher on the east coast than on the west coast. Thus the peak temperature at Melbourne, on the east coast, was 102°, while that at Tarpon Springs, in the corresponding latitude on the west coast, was only 95°. The hottest portion of the State was the interior, away from the moderating influence of the sea. The lowest maximum of all was at the city office of the Weather Bureau in Miami with only 90° as a peak temperature for the entire summer. This southeastern coast of Florida is cooled by prevailing southeasterly winds. Northwesterly winds traveling the length of the peninsula are practically non-existent during the summer. Such winds are the only true winds in southern Florida. In winter they may bring frosts almost to the southern tip of the peninsula.

It is also interesting to observe the cooling effect of Lake Okeechobee on Map 3. Highest temperature during the summer at Okeechobee, just north of the lake, was only 94°.

The hurricane season of 1950 was rather remarkable in that three fully developed hurricanes entered Florida compared with an average of only 0.83 storms per year of true hurricane intensity during the past 65 years. (Winds must reach 75 miles per hour or higher to be classified as of hurricane force.) In 1950, the center of the first hurricane moved inland from the Gulf of Mexico over the extreme western boundary of Florida, west of Pensacola, at about 10:00 p.m. of August 30th with winds just over hurricane force. Heaviest rainfall was at Panama City, with 14.96 inches.

The unique hurricane of the year was the so-called "Cedar Key" storm which hovered about Cedar Key for nearly the entire day of September 5th. Map 1 shows the erratic track of this storm, which came to an almost complete standstill and looped twice, once just east of Cedar Key, where winds attained 125 miles per hour in gusts and the barometer fell to 28.30 inches. The inset for Map 1 shows the storm as it appeared at 1:30 a.m. on the 4th, after it had moved southeastward and inland to a point about 10 miles southwest of Brooksville. By the time of this weather map winds had diminished to less than hurricane force throughout the area of the storm.

The prolonged presence of the hurricane at Cedar Key resulted in a rainfall of over two feet in a little more than 24 hours—one of the heaviest rainfalls ever to be recorded in the United States during such a brief time. Two figures have been given: 24.50 inches according to the U. S. Weather Bureau in their Climatological Data for Florida (1950), and 25.20 inches according to Bunting, Gentry and Latour (1951: 10).

Map 1 shows the distribution and quantity of rain falling in Florida during the passage of this hurricane. The area of peak rainfall around Cedar Key is conspicuous on this map. It will be noted that a second region of particularly heavy rain was centered around Brooksville, where the total fall for the storm was 20.38 inches. A short distance south of this town the storm again slowed down and changed direction, thereby causing a great concentration of rainfall. Another interesting feature of this map is the astonishing rainfall gradient along the Gulf coast northwest of Cedar Key. Less than 100 miles (by air line) to the northwest of Cedar Key (which experienced 24.50 inches of rain) only 0.20 inch of rain fell at St. Marks!

The final hurricane of the season moved inland directly over the city of Miami at midnight on October 17th-18th. In fact the eye of the hurricane actually passed *between* the U. S. Weather Bureau's International Airport Office and downtown office! The inset to Map 2 contains a weather map for Florida at 1:30 a.m. on October 18th, when the hurricane center had progressed to a point some 15 miles north-northwest of Miami. Highest wind for one minute was 122 miles per hour at the downtown office of the Weather Bureau, and momentary gusts of over 150 miles per hour were estimated by Weather Bureau observers. The barometer dropped to 28.25 inches at the downtown office.

Map 2 reveals that the heaviest rain fell not at Miami or other points over which the precise center of the storm passed, but instead about 25 to 40 miles east of the center. A gauge two miles west of Titusville accumulated 14.97 inches of water during the storm, the heaviest fall in Florida. This storm, while somewhat more intense than the Cedar Key storm, moved along at a steady rate of about 15 miles per hour. Consequently, it did not remain long enough over any one area to produce such heavy rains as fell around Cedar Key and Brooksville in the earlier storm.

The presence of far heavier rains on the eastern side of the October hurricane (Map 2) is conspicuous and in line with the conclusions of Cline (Tannehill, 1950: 76).

> "Cline's investigation leaves little doubt, however, that the travelling cyclone, when crossing the Gulf and South Atlantic coasts of the United States, is characterized by more intense rainfall to the right front quadrant than in other parts of the cyclone and that so far as observations are available, little rainfall occurs, as a rule, in the rear half of the storm area."

Cline attributes this to convergence of winds in the right front quadrant with those coming from the right rear quarter, due to the greater strength of the winds in the right half of a hurricane than in the left half.

It seems likely that when a hurricane travels the length of the Florida peninsula, as the October, 1950 hurricane did, that this effect would be made still more pronounced as a result of the moisture laden winds coming directly onshore from the warm Gulf Stream off the east coast. By the time these winds have rotated to the western side of the storm, however, they obviously have lost a large portion of their original moisture supply because of the length of time they have been depositing rain over the land. Furthermore, Brooks (Brooks, 1930: 2) has pointed out that as winds move inland from the sea, the greatly increased friction of the land surface suddenly slows air movement, thereby inducing a "pile-up" of air. This serves to accelerate the already active lifting of the air rushing into the hurricane, thereby further increasing the rate of moisture condensation and rainfall just inland from the coast.

The hurricane season of 1950 was not long over before rapid cooling heralded the approach of winter. As early as November 6th the first freezing temperatures came to northern Florida. Then on November 25-26, 1950 arrived the great cold wave which brought record low November temperatures to many places throughout southeastern United States. The lowest temperature in Florida was the 16° recorded at Secotan, which was within 1° of the all-time low for the month of November. Even afternoon temperatures hovered about the freezing point in extreme northern Florida on the 25th as strong northwest winds persisted throughout the day. This was probably the coldest football weather ever experienced in Florida. The announcer at the Gator Bowl Game being played at Jacksonville on this date actually reported a temperature of 27° at the grandstand while the game was in progress! The maximum for the day at both Jacksonville and Tallahassee was but 35°. Minimum temperatures experienced during this cold spell reached below freezing as far south as Homestead on the night of the 25th when a reading of 30° was recorded.

This remarkable November cold wave accompanied a powerful thrust of Arctic air which was drawn far southward by an unusually intense cyclonic storm that developed in the Carolinas on the 24th, then moved northward into Pennsylvania on the 25th, and finally westward into Ohio by the 26th. This storm brought the most severe winds to northeastern United States since the New England hurricane of 1938. Velocities attained hurricane force at a number of points. The temperature on the southwest side of the storm dropped to 3° above zero as far south as Atlanta, Georgia, while simultaneously temperatures were as high as 60° at New York City! On the night of the 25th temperatures were lower in southern Florida than in Maine.

The month of December following this cold wave averaged more than 3° below normal, although no outstandingly low temperatures were recorded. Nevertheless, there were many days of frost and extensive damage was done to tender winter vegetable crops. To provide some idea of the average temperatures in a cool winter month in Florida, Maps 7 and 8 have been prepared. Map 7 shows the mean daily maximum (afternoon) temperature during December, 1950, while Map 8 shows the mean daily minimum (nighttime) temperature for the same month. For comparative purposes, the inset on Map 7 depicts the normal mean daily maximum temperature in January, which is on the average the coolest month of the year in Florida. The inset for Map 8 shows the normal mean minimum temperature for the same month.

On Map 7, it will be noted that for the cool month of December, 1950, the isotherm of 68° for the mean maximum temperature extended from St. Petersburg on the west coast, northeastward to the vicinity of Daytona Beach on the east coast of the Florida peninsula. On the inset map (accompanying Map 7) the normal mean daily maximum temperature isotherm of 70° for January, commonly the coolest month of the year, occupies approximately the same position. It appears to be significant that this isotherm of comfortably warm afternoon temperature corresponds very well with the general northern limits of winter resorts and retirement towns.

An examination of Map 8 will show some startling contrasts in the average or mean nighttime (minimum) temperatures in various parts of Florida. In December, 1950 the average minimum temperature at a point 10 miles east of Jasper (on the southwestern border of the great Okeefenokee Swamp in extreme northern Florida) was but 34°, while at Miami Beach the mean minimum was 61°, and at Key West 63°. The southeast or "Gold Coast" stands out on this map for winter nights which are much warmer than elsewhere in Florida. The inset for Map 8 shows a similar nighttime temperature pattern for the normally coolest month of January. Normal mean minima vary from 40° in the extreme northern portion of the State to 62° at Miami City (figures for Miami Beach not available in this case) and 65° at Key West.

The most severe cold wave of the winter of 1950-1951 arrived on February 3rd and 4th, 1951. The lowest temperatures during this cold wave are shown on Map 4. During this cold wave a reading as low as 10° above zero was registered at Crestview in northwest Florida, the lowest February temperature since 1905. In only three previous years have lower temperatures been recorded in Florida: 9° above zero in January 1942, 8° above in January, 1940, and –2° (two *below* zero) at Tallahassee in February, 1899. During the 1899 cold wave a reading of 6° above zero was observed as far south as Gainesville on the northern portion of the peninsula.

The February 3-4, 1951 cold wave also was notable for the two-inch snowfall it brought to St. Augustine and Crescent City, probably the heaviest snow to be experienced in Florida since the 1899 cold wave. In 1951 a trace of snow fell as far south as Bradenton, while in 1899 a trace was observed at Tampa.

The inset to Map 4 shows the pressure pattern for United States at the height of the February, 1951 cold wave (1:30 a.m., Feb. 4). At the time of this map it was snowing across the northern peninsula of Florida, while heavy rain with temperatures as low as 35° to 40° was being experienced deep into the Everglades of South Florida. This bitterly cold rain, perhaps the coldest rain on record for southern Florida, resulted in the death of some 5,000 range cattle.

Following this February cold wave the weather became much milder and the month ended with a normal mean temperature. The next unusual weather was the earliest hurricane on record. Such a storm actually approached to within 100 miles of the Ft. Pierce-Stuart area of the central east coast of the Florida Peninsula on the afternoon of May 17. While hurricane winds were experienced offshore, near the center of the storm, nothing more than fresh winds and light showers took place along the coast. This early beginning was deceptive and it was followed by one of the least active hurricane seasons in many years. No hurricane touched Florida in 1951 and the only tropical storm to enter the state passed across the Everglades region on October 2nd. This storm brought 8 to 13 inches of rain, but its highest winds were not much over 60 miles per hour.

August, 1951 was the second hottest month on record for Florida in average temperature, although extreme temperatures did not reach such high levels as in June, 1950. The mean temperature for this month was 83.3°, equal to the previous hottest August in 1941, and only 0.3° below the hottest month of all in July, 1932.

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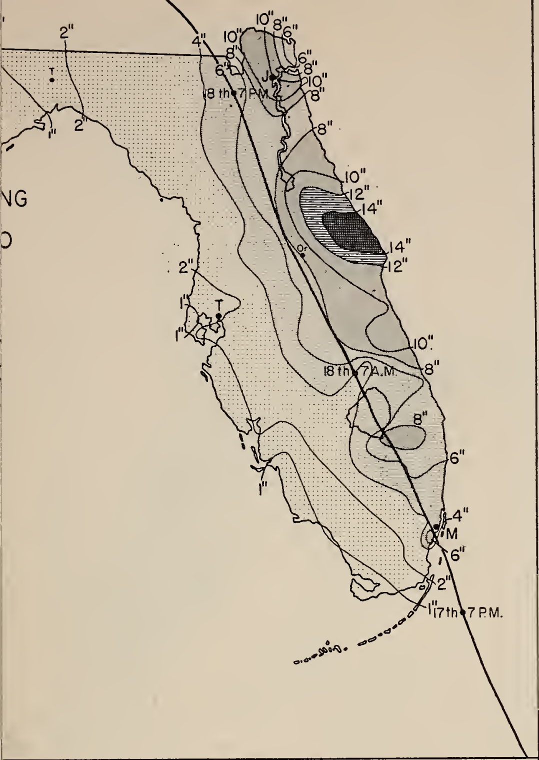

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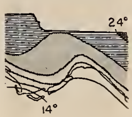

DAILY RANGE
MPERATURE
JST, 1951
(°F)

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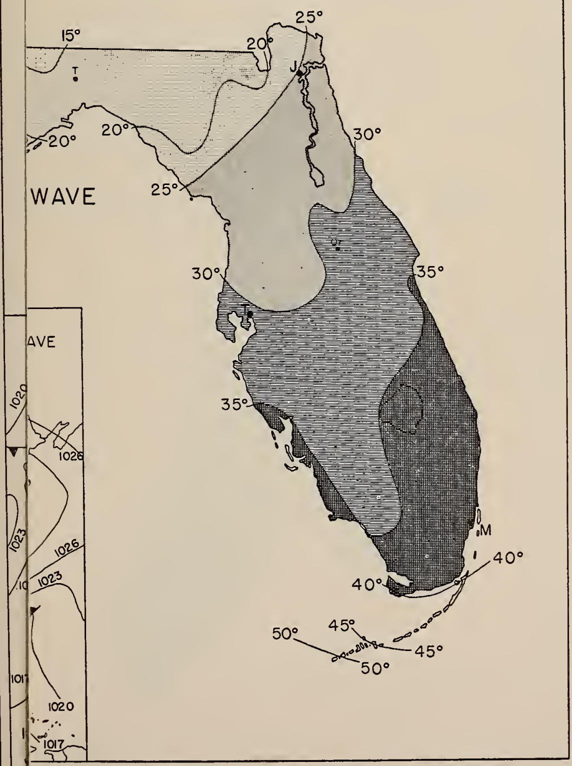

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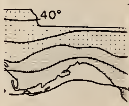

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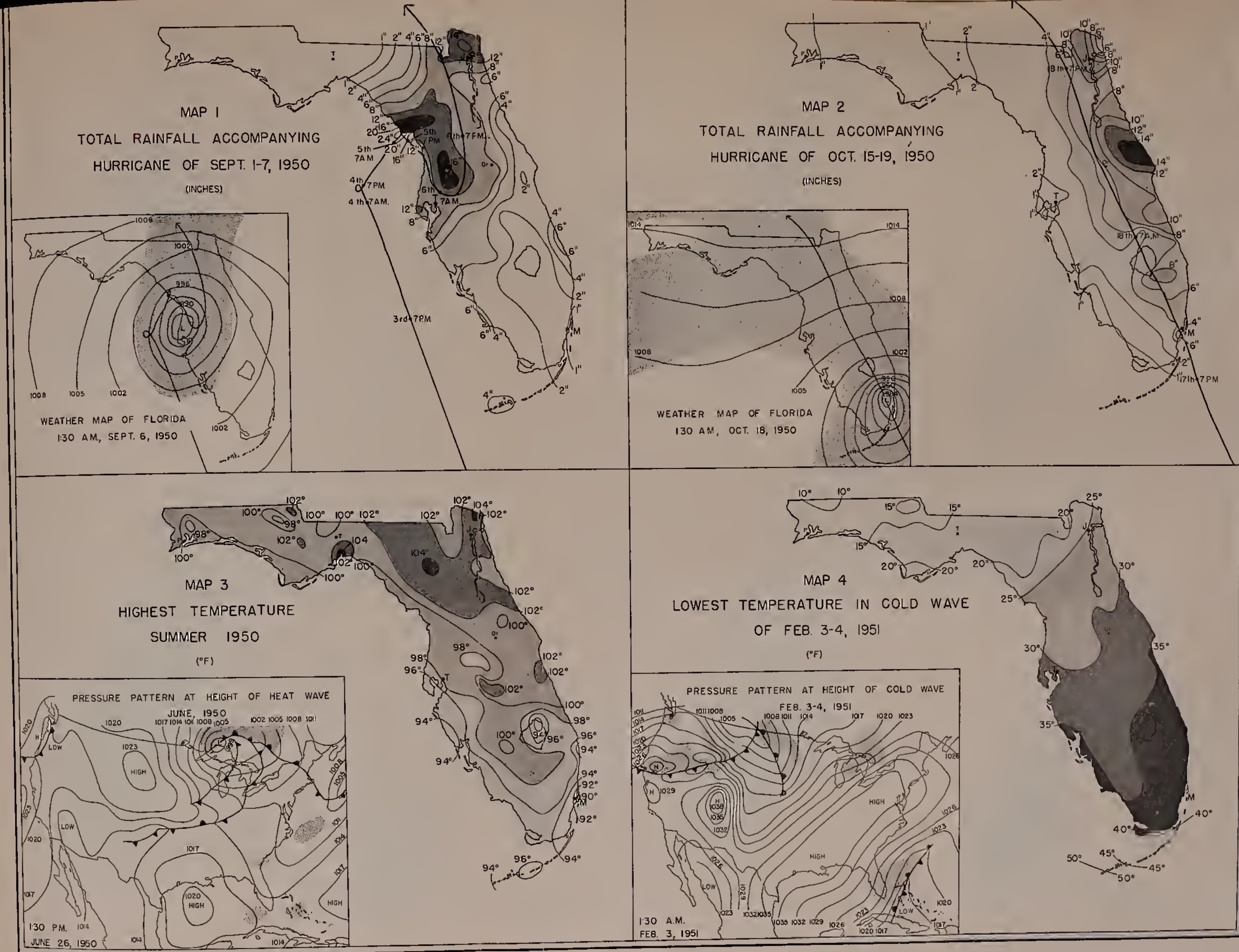
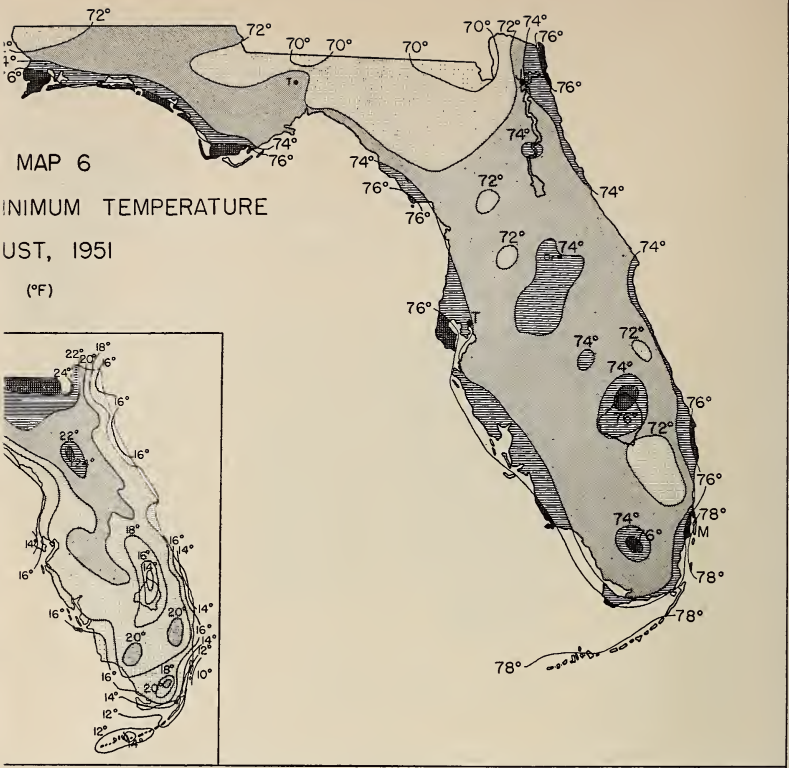


Plate I. Hurricane Rainfall and Temperature Extremes.

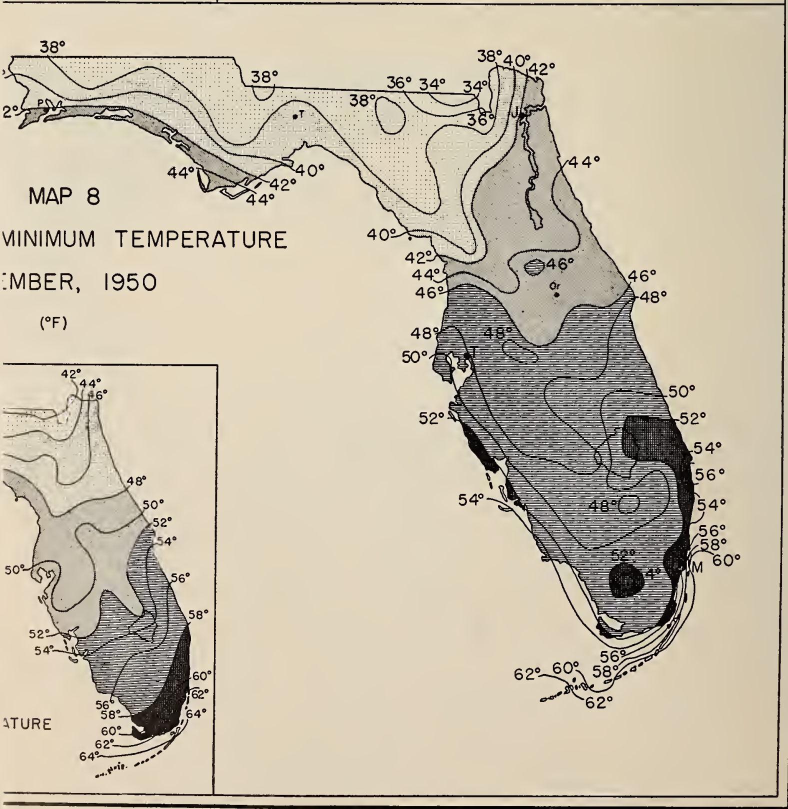


MAP 6

INIMUM TEMPERATURE

UST, 1951

(°F)



MAP 8

MINIMUM TEMPERATURE

EMBER, 1950

(°F)

ATURE

December.

Map 5 shows the mean daily maximum (afternoon) temperature during this hot August of 1951. Average maxima for the month varied from 97° at De Funiak Springs in northwest Florida down to only 89° at Miami Beach. Careful study of this map reveals that the hottest days are found on the mainland (in northwest Florida), and in the central and northern interior portions of the peninsula. A surprisingly cool spot is Okeechobee, with an average maximum of only 90°, as compared with 93° to 95° over most of the remaining interior portions of the peninsula. The moderating effect of the large lake (Okeechobee) is therefore evident.

Map 6 shows the mean daily minimum (nighttime) temperatures for the same hot month of August, 1951. It will be noticed that the temperature distribution is almost the exact reverse of daytime conditions, with the warmest (instead of coolest) places being on the southeast coast, and the coolest nights being in the extreme northern interior. Thus, average minima varied from highs of 80° at Miami Beach and Key West, and 76° at Okeechobee, down to 69° at a point 10 miles east of Jasper on the southwestern edge of the Okeefenokee Swamp.

For comparative purposes an inset has been provided for Map 5, which shows the *normal* mean maximum temperature in August in Florida. The pattern is similar to that depicted in Map 5, although not quite as pronounced. Another inset map accompanies Map 6, which shows the mean daily range in temperature during the particular summer month under consideration (August, 1951). As might be expected, the areas most modified by ocean breezes—southeastern Florida, the Florida Keys, the Pinellas Peninsula, and Cape San Blas region in northwestern Florida—have the smallest daily temperature range. These are, of course, the regions which have the coolest daytime and warmest nighttime temperatures. The greatest mean daily range was observed at Madison in extreme northern interior Florida, as contrasted to the smallest mean daily range of only 9° at Miami Beach.

In concluding this summary of unusual events in Florida's weather during 1950 and 1951, it seems appropriate to quote a paragraph from the Weather Bureau's CLIMATOLOGICAL DATA—FLORIDA SECTION, for February (1952: 14). "A waterspout, two tornadoes, a minor tropical storm, and a trace of snow were included in this month's weather (Feb., 1952)".

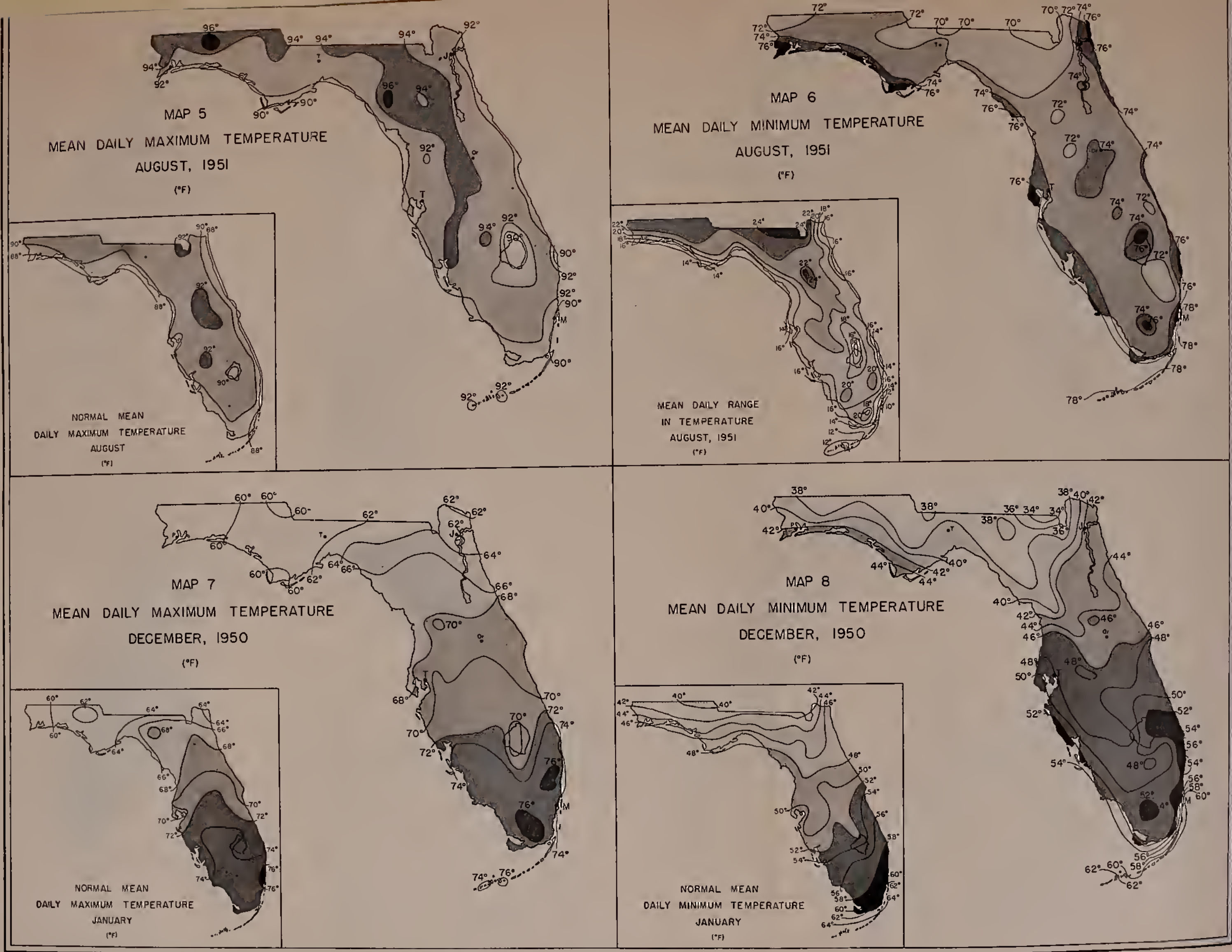


Plate II. Hottest August on Record and an unusually cool December.

The tropical storm referred to in this quotation moved northeastward across the southern portion of the state from the Naples-Everglades area of the Gulf coast to the Stuart-West Palm Beach area of the Atlantic coast during the night of February 2nd, 1952. Accompanying the storm were winds up to 60 miles per hour and 2 to 4 inches of rain. It was the first tropical storm of record between January and April.

While this out-of-season tropical storm and the other contrasting meteorological phenomena referred to in the preceding quotation did not take place in 1950-1951, they provided a striking conclusion to the chain of unusual weather events which had occurred in Florida during those two years. Despite being located at the edge of the tropics, Florida can display many of the surprising extremes which one would ordinarily expect to find much nearer the heart of the middle latitudes.

Acknowledgments

The writer wishes to extend his sincere appreciation to Dr. Sigismond deR. Diettrich for his helpful suggestions, Dr. William H. Pierson for his cartographic advice, and Mr. Dean Westmeyer for his careful drafting of the maps which accompany this article.

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THE OLDER POPULATION—A POTENTIAL COMMUNITY RESOURCE [1]

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Old age is a topic which is becoming more and more important to all of us. According to recent figures published by the Metropolitan Life Insurance Company, a child born in 1949 can now expect to live to be almost 68 (67.7) years old: for a girl the expectancy is that she will live to be 71.5 years old and for a boy, the probability is that he will survive to be 66 years old. In 1948, the chances were 99 out of 100 that a child who entered school at the age of six would survive to enter the labor force, or go to college at the age of eighteen. In other words, since those who reach the age of eighteen can expect 52.8 more years of life, 99 per cent of our children in the first grade of school may expect to live until they are 71 years of age.

Even persons who have reached the age of fifty can now anticipate exceeding the Biblical age of three-score and ten years: men can expect to live an additional 22.6 years, and the prospects were that women would continue to live for another 26.4 years. This means, because it has been tradition in our culture for persons to be considered "old" when they reach the age of sixty-five, that many of us not only can expect to be included among the increasing number of older people, but we will probably remain in this older population category for a decade, and perhaps longer.

It is one of the paradoxes of modern American society, that despite the trend in the increased tempo of urban living—due, in part, to the accelerated pace of our industrialized economy—more of us are continuing to live longer. We are becoming conscious of the fact that problems of an aging population are of personal concern because they involve our own future.

Until very recently, the number of older people was not large, and it was accepted as axiomatic that after the age of 65, the efficiency and usefulness of a person as a productive employee had

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[1] Some of the demographic material incorporated in this paper is from a research project sponsored by a grant for the Florida State University Research Council.

been dissipated. Generally, it was believed a person 65 years old was entitled to be "retired" from gainful employment. He should then be able to enjoy the leisure of his few remaining years in the relative economic comfort to be provided by his savings, his pension, or perhaps by some assistance from his children.

"Looking backward it is not difficult to see the origin of the attitudes that have tended toward regard of older people as superfluous. The country was shifting to an industrial economy in a period when youth was plentiful and when comparatively few people lived beyond the 50's and 60's. Industry required great strength and long hours of work. Young, strong bodies were needed and were available . . . Increasing application of machines and power produced more goods than purchasing power could absorb, and simultaneously shortened the work week. The birth rate continued to decline and operate as a further check on the total capacity of the country to consume the industrial output. Thus, when a plethora of workers developed in the 1930's, it was the older ones (along with the very young) whose services were eschewed" (Tibbits and Sheldon, 1952).

We are face to face today with the realistic fact that we must discard our stereotype concept of older people as an enfeebled and unusable population. With more and more of us becoming sixty-five years of age, and with those reaching this chronological mile-stone also living longer, very few of us will like to entertain the idea that we are no longer wanted or needed in the conduction of community affairs.

It would be fool-hardy, of course, to maintain that all persons who reach the age of sixty-five are still employable and are mentally and physically in good health. Older persons, themselves, undoubtedly are willing to admit they are not "as young as they used to be," but this by no means implies they are satisfied to be cast aside and segregated from the remainder of community life. If the older population merits consideration as a group with its own special problems, it is because they have been set aside by social conditions and attitudes that tend to age-type them as "old."

"In our society the changes in living required by aging are based not only on changes in physical and mental capacities but also on social pressures. There is a difference in the situation of a man who has to adjust his behavior to an actual decline in physical or mental powers and that of a man who has to adjust it to social prescription of such a change before it is necessitated by his physical or mental condition. To the adjustment required by physiological handicap there is added the adjustment required by social limitation or vice versa" (Pollak, 1948).

In the culture of our modern American society there is considerable evidence of dissatisfaction or maladjustment among the population classified as "old" (Schmidt, 1951). "There is ample evidence of their bewilderment and feeling of insecurity in a fast moving world that has failed to provide assurance of income and opportunity for obtaining normal satisfactions and for making continuing contributions to community life" (Tibbits and Sheldon, 1951; Monroe, 1951).

Social barriers to adequate and satisfying adjustments in old age include present employment practices that encourage compulsory retirement and close out the working careers of many persons simply because they are considered "too old" at the age of sixty-five. Our social security provisions, group retirement plans, etc., for the most part, have been formulated on a catch-as-catch basis largely because there has been little or no adequate information upon which to develop a long-range social program. The trend toward the small, individual family unit system in American society, together with the social pressure to maintain luxury standards of living, has resulted in an inability or unwillingness on the part of the children to include the support of elderly parents as one of their major responsibilities.

But the problems of the older people are not entirely economic. They want activity, friendship, emotional security, a sense of usefulness. Socially, our aging population constitutes a huge natural resource eager to be exploited (Wheeler, 1952).

If we are to "exploit" the resource of older people in our communities we must, of course, be motivated by more than a zealous desire to do something "for" or "about" them. We need to know who these people are; how many of them there are; to what extent is their number increasing in proportion to the total population; what are the needs of the older people—are they very different from those of younger persons; are we to be concerned only with those who are physically, mentally or economically dependent; what are the community facilities that might be utilized to assist the older people to satisfy their felt needs; and finally, what do the older people want, what can they do for themselves?

Obviously, in the limited time at our disposal, it would be impossible to discuss all of these questions; therefore, since an adequate knowledge about the population we are to work with is basic to intelligent social planning, our attention will be directed to some of the more pertinent facts about the size and growth of the older group of people in Florida. It is recognized, of course, "there is no single criterion or classification by which an individual or class may be unequivocally designated as aged or old" (*Conference on Aging*, 1951). However, traditionally and under the provisions of social security sixty-five has been widely accepted as the age of expected retirement; therefore, for statistical purposes, we shall use sixty-five as the lower age-limit of the older population.

During the past half-century, Florida has experienced an unusually rapid growth of its entire population, but of particular interest has been the phenomenal increase in the number and proportion of older people, especially among the white population. It is typical of the average community, usually through its Chamber of Commerce, to take great pride in any population increase, however small it may be. Rarely, however, do the claims of the "fastest growing community" recognize the full and realistic significance of the effect population growth and changes may have upon community life. Generally it is assumed that any population growth implies "progress." But whether or not a population increase, especially if it also includes the addition of a large number of older people, will become a valuable asset or a serious social problem often depends upon how well community leadership and lay people are aware of the impact it will have upon all aspects of community living: economic, political, educational, welfare, and other areas of social life. Therefore, as we turn our attention to the older population of Florida, two considerations should be continually kept in mind.

First of all, the trend of the past half-century indicates that our population has aged considerably and that it will continue to age for some time. This change in the traditional age structure of Florida has developed an entirely new pattern of social relationships. It is necessary to recognize that an aging population means adjustments not only for the individual members but for the entire social organization of the community. Our attitudes toward the aged will need to be readjusted and our patterns of behavior must be re-oriented to absorb this older population into the totality of community life without seriously disrupting our social groups and institutions. The change toward an aging population is not an event which we can anticipate; it is a change that already has taken place and is still continuing.

In the second place, while recognizing the fact that our population has become, and is becoming older, there is danger in considering the older people as an isolated or segregated segment of the total population, or to consider the older population as a group of mental and physical dependents. While we do not go along with the opinion expressed in the following statement, we repeat it here because it was quoted in a recent issue of a journal devoted to the problems of the aged. "Don't think the more healthy and active of America's older people are patiently waiting for the rest of us to decide their fate . . . On the contrary . . . it may be they who decide ours. Robert Havighurst, professor of education at the University of Chicago, predicts that by 1980 the balance of power in any election will be held by those over sixty. The Townsend and newer, similar movements, indicate what this may mean in the life of the country if the rapidly growing number of oldsters are forced to band together as a "special interest" group. Couldn't age vs. youth, "retired" people vs. workers, become as a real a conflict as capital vs. labor?" (Ogden and Ogden, 1952.)

Our concern in dealing with the older population is not intended to urge consideration of them as a special interest group but to focus attention upon the need for incorporating their growing numbers into community planning in order to utilize their capabilities and interests as community resources.

In view of the fact that older people are an integral part of the total population, it is well to recognize there are other population changes that will directly affect the future social planning of the State, and which will provide a sound basis for better evaluating and understanding the significance of Florida's aging population. Some of the more significant changes are summarized below:

(1) The total population of Florida has more than quadrupled since 1900 from approximately a half million (529,000) to very close to three million (2,771,000) in 1950. In the 1940-1950 decade alone, Florida's population increased by about 875,000—or a relative increase of over 45 per cent that was exceeded only slightly by two other states: California (53.3%) and Arizona (50.1%).

(2) Of the 875,000 population increase during 1940-1950, about one-third (275,000) were added through natural increase (excess of births over deaths), and two-thirds (582,000) through migration. This large influx of newcomers, particularly because they included a large number of older persons (probably about 115,000 persons over 54 years of age), is one of the more important reasons for anticipating the social adjustments Florida must make to accommodate an aging population.

(3) Despite the fact that over a half million children were added to Florida's population between 1940 and 1950, and that the preschool children was increased by 92 per cent, our population has continued to grow older. In the past decade, about one-half of the population increase occurred in the age-groups over 35 years. The median age rose from 29 to 31; the population over 64 years old increased 80 per cent, and the 55-64 year age group—many of whom will survive to the "old age" group of 1960—was increased by 66 per cent.

(4) Not only has the population became older, it has become more feminine. So rapid has been the increase in the number of women that, in 1950, every age group beyond 14 years had more females than males. Even in the younger age groups, the excess of males under 14 years of age was only 11,000, the result has been that the "man's world" now shows 100 women for every 97 men.

(5) Also of importance to the changing social structure of Florida is the proportional decline of the nonwhite population. A half century ago 44 per cent of the population was nonwhite; in 1950, the proportion was reduced to 22 per cent.

(6) One other significant fact about Florida's population should be mentioned. Fifty years ago, four-fifths of the population lived in rural areas; thirty years ago, two-thirds were rural residents;

but today only one-third of the population lives outside urban areas (communities with populations of 2,500 or more).

Time does not permit a detailed analysis of these data; however, it is clear they cannot be overlooked while attention is focussed upon the growth in the number and proportion of older persons. To summarize: in the last decade, Florida has added a large number of children to its population; it has received an unusually large number of migrants from other States; its sex ratio has changed so that in almost every age-group there are more females than males, especially in the older and potentially more dependent group over sixty-four years of age; and it has become a more white population and more of its people—about two-thirds—are living in urban areas.

Of particular interest is the fact that the older population in Florida has reflected the same type of changes as the total population. In general, the group over sixty-four years of age is predominantly white, feminine, and urban.

Racial Composition. In 1900, about 30 per cent of the older population were nonwhite; by 1940, the proportion had declined to 17 per cent, and in 1950 there were less than 15 per cent of the older population who were nonwhite.

Sex Ratio. The older group has become feminine more rapidly than the total population. From 1900 to 1920, the trend was toward a more masculine older group; that is, to have more men than women. In 1900 there were 110 men for every 100 women, and by 1920, the ratio of men to women had reached its height of 121. Since 1920, a reversal in the trend has occurred, and by 1940, there were only 105 men for every 100 women. In 1950, for the first time, there was an excess of older women: only 95 men for every 100 women.

This sharp decline in the sex ratio for the older population is significant in view of the tendency to consider the older group as largely composed of retired men. That there are now more women than men in the older population not only indicates women are outliving men, but also that older women (and perhaps younger ones, too) out-number the men who are migrating to Florida. Therefore, any plans to utilize the community resource of older people should consider the fact that the majority of the elder citizens are women, and that the proportion of older women is likely to be still greater in the future.

Older People in Urban Areas. As is true of the total population, the older group also seems to prefer to live in urban places. Back in 1900, less than 30 per cent of the older population were living in urban communities; in 1950, approximately two-thirds of them were residing in places of 2,500 or more people.

In 1940, the older population constituted 7.3 per cent (83,000) of the urban population; whereas, ten years later, the proportion was 9.4 per cent (164,000). It is interesting to note that while the total urban population (excluding the so-called "fringe") was increased by 54 per cent during the 1940-1950 decade, the older population in the urban areas was almost doubled (99%); in other words, of the 563,000 increase in the urban population, 13.4 per cent (75,600) were older people.

Although all urban areas experienced increases in their older populations, the major increase (34,000) was in the five larger cities —those with a 1950 population of 50,000 or more. These cities—Jacksonville, Miami, Orlando, St. Petersburg, and Tampa—with a total population of 728,000 have approximately 10 per cent (73,000) of their population in the older age groups as compared with 7 per cent (39,000) ten years ago.

Generally, the larger cities are not considered to be attractive to the older people, but the fact remains that almost one-third (31%) of Florida's older population live in the five most highly urbanized communities. This concentration of older people in urban communities implies that solving the problem of the aged will have to consider this residential preference. More information is needed, for example, as to whether older people really are more satisfied with city living, or whether they feel it is more economical for them to live in cities. It will be necessary to know to what extent the increasing proportion of older people is due to people living longer and how much is due to the migration of older people to the urban communities.

Over-all Growth of the Older Population. Perhaps the most striking feature of the older population has been its phenomenal growth which has far exceeded the rate of growth for the rest of the population. In 1900, less than three per cent of Florida's population was over sixty-four years of age, but in 1950 the proportion was 8.6 per cent. This means an increase from 14,000 to 237,000 during the past half-century, or an accumulative increase of more than 1,600 per cent compared with only 400 per cent for the population less than sixty-five years of age.

In part, of course, the rapid growth of the older population can be attributed to the declining birth and death rates throughout most of the current Century. Until 1940, the steady drop in the birth rate tended to increase the proportional size of the older population, while the declining death for all age groups not only has increased the probability of survival to the age of sixty-five, but, for those who attain this age, the remaining years of life have been extended. Despite the influence these factors have had in contributing to an aging population, they do not account entirely for the rapidity with which Florida's older population has grown. A most significant factor is the rather large number of older people who have been attracted to Florida from other parts of the country.

Migration of Older People. A rough estimate of annual migrants to Florida during the past decade indicates that approximately 40 per cent (95,000) of those over sixty-four years of age came to Florida between 1940 and 1950 (Dietrich, 1952). As of July 1, 1950, it is estimated there were about 240,000 persons over sixty-four years of age: 38,000 (16%) were survivors from the group who were over sixty-four years of age in 1940; 105,000 (44%) were survivors of the 55-64 year age-group of 1940; 56,000 (23%) were survivors of those who were 55-64 years old when they came to Florida during the 1940-1950 decade; and 41,000 (17%) were persons who were over sixty-four years of age at the time they came to Florida during the last ten years. In other words, of the 582,000 migrants of the past decade, almost 17 per cent of them are now sixty-five years of age or older.

These data tend to confirm the observation of T. Lynn Smith (1951) that "changes now underway in American society increased the tendency for aged persons to move to more desirable parts of the country upon retirement during the decade 1940 to 1950 and that this tendency will be even greater in the decades that lie ahead." As for the future, if the 1940-1950 survival rates for those 54 years of age remain about the same and no migrants over fifty-four years old come to Florida in the next ten years, Florida still would have just as many persons over sixty-four years of age in 1960 as it had in 1950. On the other hand, if the number of persons over fifty-four years of age who will come to Florida in the next ten years is no greater than it was during the decade 1940-1950, it would not at all be unrealistic to anticipate that Florida will have 400,000 persons over 64 years of age in its 1960 population. Thus, it is apparent that the number of older people in Florida has been swelled considerably because of the attraction the State has for those who are reaching retirement ages, and there is little doubt that the trend forecast by Dr. Smith will continue throughout the current decade.

Demographic data, such as those presented above, are one of the best means for obtaining objective and realistic information about the numerical and proportional growth of the older population in Florida. Their principal short-coming, however, is that they raise, rather than answer, questions about the social implications of an aging population. Each community will find it worthwhile to evaluate the implications of its own population trends.

In their article, "Sharing Community Responsibility," Jean and Jess Ogden (1952) present some rather interesting observations about the social adaptability of older people in various communities:

> "Many older people have been able to do their own thinking and planning in terms of their community contributions. A retired lawyer gives his time and attention to persons needing legal aid but unable to pay for it. A retired doctor, disturbed by the needs of the medically indigent in his rural community, decides to open his office and let it be known that money is not a primary consideration with him; he needs to serve. A group of retired Quakers have made themselves an important part of a rural community in Florida where they are fostering a remarkable, if not unique, program of sharecropping education. Their aim is to help raise the total social and economic level of that area. Each member of this group is past retirement age, has financial security, and can devote his years of wisdom to a socially useful community program.
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> "Among the professional group with assured incomes countless examples could be cited of conscious planning for social usefulness during the years of leisure. And some individuals can be found in the nonprofessional groups who have found a way of sharing community responsibility. There is the elderly housewife . . . who has become a self-appointed information center. Anyone who needs a baby sitter or information about where or how to register to vote in this district calls her . . . There is the retired farmer (who) has prepared for and is enjoying his retirement. But he is made miserable by seeing the unhappiness of his neighbors who have

achieved their life's goal—retirement—but who have retired *from*, with nothing to retire *to*. What can be done for them? he asks. Or are they now hopeless, and would it be better to concentrate on helping the young folks get ready for retirement? He is working on both—'and have never had so little time for my hobbies in my life!'

"Cases of this kind prove that talents of the elder citizen can be used in important community services. The fact that it is a small minority who can work out their own salvation indicates the need for accepting the facts of the increasing aging group and rethinking community life with their contributions in mind."

A number of studies throughout the country and especially those made in the Florida communities of St. Cloud, Winter Park, West Palm Beach, Orlando and St. Petersburg have found, among other things, that many old people are anxious and willing to participate in the social activities of community organizations. Relatively few of the older people retire from their employment voluntarily and most of them express a desire to do at least part-time work. For the most part, the older people are in good physical and mental health; they have the time and the desire to contribute to community life if the opportunities and facilities can be made available to them.

Perhaps the simplest approach toward finding answers to the question, "How can the older people be utilized as a Community resource?", lies not so much in a complete change in our social system that will be adapted to the needs of older persons as in adopting a different point of view—a new concept or philosophy of aging. If the information about Florida's population presented here has meaning, it is this: Florida's older population has grown tremendously and will probably continue its rapid growth for some time; and that most of us can expect to be numbered among the old people of tomorrow.

Therefore, rather than make elaborate plans *for* our older population, we must plan *with* them. In the emerging social system, there is every indication that the older people of today, and we, the older people of tomorrow, can be important and useful resources. We should make every effort, then, to integrate our elder citizens into the life of the community and to exploit them as social assets. In this way the type of community can be planned and the kind of social living be developed that we would wish to enjoy during our later years of maturity.

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THE FOREIGN TRADE OF FLORIDA

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From the standpoint of location, Florida is in an advantageous position to carry on foreign trade with our neighbors to the south. Our Atlantic Coast and Gulf Coast give us 1,277 miles of salt water coast line. This is the longest coast line giving access to the ocean of any state in the U. S.

This geographical position is very important when we consider what trading possibilities we have. Florida is nearer to Central America, South America, and the West Indies than that of any other section in the U. S. It comes as a surprise to some people to learn that Florida ports are nearer the western part of the Middle West than are New York City and other ports of the North Atlantic. Florida, instead of being directly south of the northeastern part of the U. S., is southwest. Jacksonville is south of Cleveland and Pensacola is south of Chicago. From Chicago to Pensacola by rail is the same distance as from Chicago to New York City. St. Louis is 140 miles nearer to Jacksonville than it is to New York City. Kansas City is 173 miles nearer (Campbell, 1935: 85).

From the standpoint of economy and time saved, many producers of the Middle West and South find it advantageous to route their shipments through ports in Florida.

I wonder about the possibilities of developing manufacturing in the state which would use not only the resources of Florida but also the products of South and Central America and the West Indies. The foreign products could be shipped by water to our ports at low cost. Many types of industries have grown up in recent years. Many of these are small, but they hold out a promise of future growth. Our climate is favorable for many industries. Our state and local taxes are moderate. Our labor supply is adequate.

The rate of population growth for Florida has been larger during the past decade than that of any other state except Arizona and California. Our per capita income of $1,102 in 1949 gave us buying power superior to that of any other south-eastern state, and was very close to the national average of $1,330 (Bureau of Economic and Business Research, 1951: 1).

The trend in manufacturing has been to leave the old industrial areas of the Northeast and move to the new areas in the South and West. This trend should make for further growth in manufacturing in Florida. Conditions are very favorable for certain types of manufacturing where expense for heating the plants and curtailment of operations on account of cold weather in the north could be avoided and buildings for manufacturing plants could be constructed more cheaply than they can in northern areas.

Industries such as furniture maufacturing might be developed here that would use imported products such as hardwoods. Such furniture might have a large market. If the textile industry came south to benefit from nearness to raw materials, a labor supply less troubled with union restrictions, and other low costs of production, other industries using tropical and semi-tropical raw materials, might also gain by having factories here.

There is the possibility of establishing branch factories in Florida where large U. S. manufacturers ship products to Latin-American countries. The finished products could be shipped more quickly than they could from the northern plants. The cost of production might be lower because of our climatic and other advantages already mentioned.

The advantages of branch factories in Florida would not apply in cases where it would be an advantage to have the branch factory located in a foreign country to get over the tariff wall or to save on transportation by shipping the articles in a knocked-down condition or where the manufacturer wanted to create good will in countries that are anxious to industrialize. In many cases products can be manufactured more cheaply by utilizing the full capacity of American plants than they can by establishing small units in other areas.

Florida can boast of other conditions favorable to foreign trade. Our harbors are adequate. Shipping is well developed. Loaded freight cars can be run on ships, transported to Cuba by water, and run off on to rails to be taken to their destination. This saves unloading and loading at the ports. It speeds up transportation and saves money.

In 1950 imports weighing 1,805,350 short tons came into the ports of Florida. These imports had a value of $104,200,000 (Dept. of Commerce, Bureau of the Census, 1951: 38). Exports leaving Florida weighed 2,019,050 tons and had a value of $127,900,000 (Ibid., p. 35).

The chief imports from the standpoint of weight for the Jacksonville District which includes the following harbors: Jacksonville, Charlotte, Port Everglades, Tampa, Miami, Palm Beach, Fort Pierce, Key West, and St. Petersburg, and for the Mobile District which includes the harbors of Port St. Joe, Panama City, and Pensacola, were, in short tons: residual fuel oil, 449,649, gypsum or plaster rock, 202,902, cement, 166,033, fertilizer and fertilizer materials, 201,217, bananas, 118,116, inedible molasses, 105,789, newsprint paper, 80,907, edible molasses and related sugar products, 66,552, vegetables, 35,414, coffee, 35,186, fruits except bananas, 34,207, iron and steel mill products, 31,358, petroleum, 24,528, lumber, 93,204, sugar, 21,660, and coal tar products, 24,730 (Corps of Engineers, U. S. Army, 1950).

The chief exports from these same harbors were, in short tons, fertilizer materials, 1,447,829, Department of Defense Cargo, 336,868, inedible molasses, 126,336, lumber 76,538, animal oils and fats, 58,709, naval stores, 48,528, animal feeds, 38,760, fruits prepared and preserved, 29,255, iron and steel mill products, 12,431, paper, 9,308, and coal, 4,539 (Ibid.).

It would be difficult to determine how many commodities produced in Florida are shipped to other states and then become exports of those states.

From the figures cited it is evident that the same condition exists in Florida as in the nation as a whole where we have an excess of exports over imports. Every student of foreign trade knows that the credits and debits sides of the balance of payments must balance. For everything we get we must give something in return. For everything we give up to foreigners we can expect to get something in return. In economic activity we do not get anything for nothing.

Our excess of exports over imports, including invisible items, should point to the need for more imports. Virgil O. Reed, Vice-President of J. Walter Thompson Advertising Agency, said, "Trading means both buying and selling, and without both there is no trade but merely gifts, grants, defaulted loans and bitterness and misunderstanding as a reward for forced exports. Wouldn't we help other nations raise their standards of living far more by really trading with them rather than playing rich uncle to a resentful world?" (Seattle University, 1951: 5.)

How is the U. S taxpayer ever going to get away from the burden of subsidizing Europe if protectionism is allowed to prevent other countries from earning their way in world trade by excluding imports that compete with non-economic industries? (Ibid.).

For the general welfare of Florida as well as that of the U. S. as a whole, we should welcome every move to lower trade barriers. A good beginning was made in 1934 when we began our reciprocal trade agreements with foreign countries which lowered tariff duties on a large number of imports in exchange for their lowering duties on our exports to them.

I have heard some complaints from the fruit and vegetable growers of this state. The whole history of reduction in rates of duty shows that it is far better to have a smaller part of a large trade than a large part of a small trade. We know that our trade with Cuba almost doubled during the first year after our trade agreement went into effect. Cuba has been one of Florida's leading customers. The increased trade which comes from lower tariff barriers is good evidence that the people of Florida are gaining advantages from the agreements.

When our country embarked upon the trade agreements program we increased our foreign trade in 1938 and 1939 by 30 per cent compared with 1934 and 1935. Our exports to countries with which we had concluded trade agreements increased 63 per cent, while exports to nonagreement countries increased only 32 per cent. Our imports from trade-agreement countries increased 22 per cent as compared with an increase of only 12½ per cent for imports from nonagreement countries (Office of Public Affairs, 1951: 3).

Florida has a particular interest in promoting trade with Latin America. The trade agreements help peaceful countries to carry on friendly commercial relations with each other. They furnish the means by which friendly nations can cooperate in removing irritations which make the job of carrying on international trade so difficult.

Countries which have learned to agree on thousands of individually minor possible points of difference develop common interests. They are likely to line up together on important issues. This is shown by the fact that 38 of the 39 members of the United Nations with which the U. S. has reciprocal trade agreements supported the United Nations action in Korea.

We should be particularly concerned about our trade with Cuba. Cuba is about 100 miles off the tip of Florida. Her foreign trade consists of exchanging her specialty crops of sugar and tobacco principally, for cereal crops such as wheat, rye, oats, and barley, and for automobiles and parts, textiles, machinery, iron and steel products, petroleum, and a few others (Pan American Union, 1949: 16, 17).

During 1950, for the second time in three years, Cuba bought more from the U. S. than she sold to the U. S. (The Chase National Bank, 1951: 19). In spite of this fact, on June 8, 1951, the Secretary of the U. S. Department of Agriculture increased the quotas allotted to Puerto Rico, the Virgin Islands, and the full duty countries. At the same time Cuba's quota was reduced from 98.6% of total imports from areas other than domestic sources and from the Philippine Islands to 96%, effective January 1, 1953 (82nd Congress). Cuba's quota is not to be less than 98.6% of our total requirements.

It is not beneficial to Florida nor to the U. S. to keep out Cuban imports with tariff duties and quotas. Imports from Cuba would pay for our exports to her. Increased imports mean increased exports. It would enlarge the area of territorial specialization and commodities would be produced under advantageous conditions to get low costs of production.

We annexed Texas back in 1845 and since then the other states have traded with her on a free-trade basis. Was anybody injured? What do we have to lose by freer trade with Cuba?

Much has been said about the quota on sugar which applies to Florida as well as to Cuba and to other areas. It has been said that we can produce sugar in the Everglades as cheaply as it can be grown in Cuba. Whether this is a true statement of fact or not, there is no economic justification for a quota on sugar.

Quotas reduce the volume of international trade. They create a price disparity between the importing and exporting countries.

Prices rise in the importing country and fall in the exporting country.

Quotas are more effective in restricting imports than are import duties. Imports will flow in over a tariff wall if the price difference between the exporting and importing country makes it possible. But with quotas, only a certain amount can come in. Most people know that tariffs raise prices, but they do not know that quotas do. When we use import duties, the government collects some revenue. With the use of quotas, the government does not collect any revenue. In the case of sugar, we have both a tariff duty and a quota. The sugar producers of the U. S. receive plenty of protection. Apparently, we do not want sugar on an economic basis.

Foreign Trade Zones

Is there a possibility that a foreign trade zone might be established at one of our ports in Florida? A foreign trade zone is an isolated, inclosed, and policed area in or adjacent to a port of entry, without resident population, having facilities for loading and unloading, for supplying fuel and ships' stores, for storing goods, and for reshipping them. In this inclosed area goods may be unloaded, stored, mixed, blended, repacked, manipulated, manufactured, exhibited, assembled, graded, cleaned, and marked without customs expense, or formalities. It is possible to process goods into a class subject to a lower rate of duty, e.g., separating stones from ring settings and reassembling them after entry.

After the goods are manipulated or manufactured or whatever is required to be done to them in the foreign trade zone, they can be entered into customs area on compliance with customs regulations or they can be re-exported.

This is so favorable to our import trade as well as to our export trade that its offers many advantages to light manufacturing and to the import and export trade in general.

Here are a few examples of manufacturing within the foreign trade zone. Olive oil could be imported from Spain. Domestic ingredients could be added to the olive oil to make salad dressing. The salad dressing could be exported to world markets without ever having been subject to import duties or to customs red tape. Insurance costs would be reduced.

When imported goods are entered through the customs and then are stored, insurance is carried on the duty-paid value. When they are stored in a foreign-trade zone, the insurance carried is for the actual goods value bfore the tariff duty adds to the value. The difference in insurance costs can be large on such items as liquor that carry high duties and excise taxes.

Sheet aluminum can be imported from Great Britain and fabrication can be carried on in the zone. Then knock-down dwellings for the tropics can be exported. Casein from Argentina can be mixed with chemicals from the U. S. to make glue to export all over the world.

The 1950 amendment to the 1934 act which provided for the establishment, operation, and maintenance of foreign trade zones in ports of entry of the U. S. provided for all types of processing within the zone with the exceptions of rectification of spirits, manufacturing of certain special commodities which are subject to internal-revenue taxation or supervision in customs territory, and the specific prohibition against the manufacturing of watches and clocks. This latter exception does not affect assembly operations such as fitting imported watch movements to watch cases made in the U. S. (Lyons, 1951: 120).

Imported goods subject to internal revenue, excise or processing taxes may be stored in a zone and withdrawn in lots as convenient. During the storage of such merchandise in a zone, no part of the importer's capital is tied up in taxes, bonds, or duties.

The re-export business is one of the most important reasons for the creation of the foreign trade zone. It provides a crossroads for world shipping. Goods may travel from one producer country to another with freedom by using a foreign trade zone. Goods can be transshipped either in the original form or after being processed without the penalty of customs duty and they are free from drawback headaches. Those headaches come from waiting to collect the 99% refund supposed to be paid by the U. S. Treasury Department when a previously dutiable article is exported as a part of processed goods.

The foreign trade zone permits stockpiling and this helps to develop a consignment market. The stockpiled merchandise is available for immediate delivery. No time is lost in trans-ocean travel. There is no time limit on goods stored in the zone. It is a cheap, quick way to insure adequate inventories for the U. S. market. Owners of the goods can borrow against warehouse receipts issued for goods stored in a zone without posting a bond.

Consignment stockpiling centers develop world markets for commodities. Here, domestic manufacturers, merchants, and foreign buyers may inspect or sample stockpiled merchandise.

Goods that are under quota restrictions can be shipped and stored. Quantities in excess of quota can then be held awaiting the next quota period.

Articles entering the zone from customs territory solely for export, destruction, or storage, are treated as exported for such purposes as drawback, warehousing, and bonding provisions of the tariff laws, and for exemption from liability of internal revenue taxes.

Cleaning, grading, repacking, and forms of processing may be done to enhance the value of the goods. Sub-standard goods may be brought up to standard.

In case of imports of food, drugs, cosmetics, alcoholic beverages, insecticide, fungicides, and rodenticides, particularly with regard to their labelling and packing, if they do not conform to requirements, they can be relabelled, repacked, etc., to bring them in line with the regulations, before customs appraisal and liquidation. If goods are improperly marked, marking can be done to avoid customs penalties or forced re-export.

Liquids shipped in bulk may be bottled, labelled, and packed in the zone without being subject to any licensing requirements.

The consignee can examine merchandise and avoid the dangers of defective merchandise which he might wish to return, thus saving customs duties on unsaleable or unsuitable merchandise.

An importer can cut duty costs by not paying on shrinkage. That is the part of stored merchandise lost through evaporation or seepage. Liquor, tobacco, nuts, and similar commodities lose weight this way.

In these days of turmoil and strife, foreign trade has become more important to the peace and security of the world than it has ever been before in the world's history. We should offer every facility which will assist in bringing about a freer exchange of goods. Foreign trade zones will generate more cargo for our ships, thus aiding our merchant marine, and they will serve to speed up the time spent by ships while in our ports. This reduction of time spent in our ports will decrease the turn-around time of ships and will increase the amount of cargo which a ship will carry over a given period of time (Ibid., p. 23).

We now have foreign trade zones at New York City, New Orleans, San Francisco, Los Angeles, Seattle, and San Antonio. The latter zone is, of course, for air shipments. I hope to see the time when it will be economically feasible to have a foreign trade zone in Florida.

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PLANT SUCCESSION ON KEY LARGO, FLORIDA, INVOLVING *PINUS CARIBAEA* AND *QUERCUS VIRGINIANA*

TAYLOR R. ALEXANDER
University of Miami

INTRODUCTION

During March, 1952, two field trips were made by a plant ecology class to locate and study an area on north Key Largo that had been reported by Mr. Fred Fuchs, Sr., of Homestead to contain numerous pine logs and live oak trees. It had been the general opinion of biologists in the Miami area that pines and oaks were absent from the northern Florida Keys and there was no evidence to support the fact that they had ever been a part of the flora of the northern keys. Since the remains of a pineland area and living oaks were found, it was decided to make a detailed ecological analysis of the area.

A survey of the literature available on the exact distribution of *Pinus caribaea* and *Quercus virginiana* on the Keys contributed the following facts: Small (1913), in his *Flora of the Florida Keys,* stated that *P. caribaea* was "common on some of the larger lower Keys; very rare on the upper Keys." In this publication the genus *Quercus* was not listed. In the publication *Florida Trees,* Small (1913) wrote concerning *P. caribaea* "to the keys of Southern Florida" and for *Q. virginiana,* "the live oak grows in woods and hammocks nearly throughout Florida, except the Keys." Harper (1927) in discussing the upper keys wrote . . . "The slash pine, sawgrass, cabbage palmetto, and myrtle *(Myrica cerifera),* are rare or absent on the upper Keys." Cooke (1939) stated, . . . "These keys are long, narrow islands covered by a dense jungle of low trees and shrubs but containing no pines or Spanish moss."

Thus, the occurrence of *P. caribaea* on the northern keys is a matter of record since 1913 while mention of the occurrence of

Q. virginiana in this area was not found. The occurrence of pines of north Key Largo was further substantiated by interviews with two long time residents of the keys. One reported that there were numerous pines there in 1903 and another stated that he had seen a few living pines there as late as 1936 while cutting live oak for a boat he was constructing. He commented on the fact that the oak and mahogany in that area had been cut by local people for years. This same person stated that live oaks also grow on Old Rhodes Key.

Area Studied

The area is located about 1000 feet west of a point on the main highway on north Key Largo, one mile and a tenth north of the turn off for the Barnes Point road. As nearly as can be estimated from U. S. Coast & Geodetic Survey Map T-4577 the area centers at approximately 25° 17′ 25″ Lat. and 80° 17′ 40″ W. Long. The pine logs and stumps, and the living oak trees were found only in a limited area of hammock growth which is bounded on the north and west by a mangrove swamp and the road on the east.

Methods

After a preliminary survey, it was decided to work into the hammock area from its western edge where it bordered on a mangrove swamp. A line transect, 300 feet long, was run toward the east into and through the area where pine remains and living oaks were found. A string was stretched to mark the transect and all plants whose branches extended over and under the string were listed and marked on a chart with their height and spread indicated. An eye level was used to establish the change in elevation along the line, using the mangrove area outside as station number one and zero elevation. Soil samples were collected at regular stations on the line for observation and pH measurements. A Beckman meter was used to determine pH.

Results and Discussions

Twenty-five species were found on the transect in the hammock and 160 plants were plotted. In Table I these plants are listed and arranged in order of the percentage that a species contributed toward the total. The affinity as listed indicates whether or not the plant is frequently found in or restricted to the vegetation types—hammock or pinelands as known on the mainland of south Florida. Examination of other areas of typical Key Largo hammock for comparative purposes showed little difference between them and the area studied. According to Davis (1943) the vegetation type is "Coral Rock Jungle Hammock." The species list in the table does not include the plants in the first thirty feet that ran through the mangrove swamp where a few stunted and widely spaced specimens of *Rhizophora mangle, Conocarpus erecta,* and *Laguncularia racemosa* were growing.

There was an abrupt change in vegetation type from mangrove swamps to typical sub-tropical hammock vegetation. The mangrove area was essentially "land locked" and highly saline. This probably accounted for the stunted character of the swamp trees and edaphic conditions undoubtedly played the dominant role in establishing the sharpness of the dividing line between the two types of vegetation. For example, the mangroves were on a marl-like material of pH 8.8 and a few feet within the hammock the humus and sand material was pH 6.7. Furthermore, Key Largo is well known as an emerged coral reef and the broad-leaved hammock plants grow on the coral limestone wherever it is high enough to be above the strong influence of salt water. According to measurements made, six inches of increase in elevation is enough to allow the radical change of vegetation type. Essentially, the roots of the hammock plants grow in their own organic litter as only a little sand can be found on top of the coral limestone. For the most part this limestone is not eroded or broken to any extent and does not offer a good substrate for plant roots to penetrate. Hence, the accumulation of litter aids in the very slow extension of the hammock into the mangrove area.

The first pine stumps, standing trunks, and fallen logs were found in the hammock about fifty feet from the mangrove edge and on soil about one foot higher than the mangrove area outside the hammock. The first oak tree was plotted at 140 feet from the margin where elevation had increased to its maximum of one and a half feet. At this point the pine logs and stumps became more numerous. Eight pine logs were counted in the transect area. Most were fifteen to thirty feet long and one had a diameter of fourteen inches. All were seasoned and most were burned to some extent. Some were buried in leaf litter and organic matter. Only a few standing trunks were found and one of these, near the mangroves, was thirty feet tall.

In the mariginal area of the hammock occasional oak seedlings were found and young mahogany trees were numerous. It should also be noted that specimens of *Diodia rigida, Serenoa repens, Sabal Palmetto, Rhacoma ilicifolia, Quercus virginiana,* and *Guettarda scabra* were growing in the hammock and undoubtedly could be considered relics of the pineland.

It appears from the evidence that pines were replaced by subtropical hammock growth in this area and that live oak along with mahogany acted as pioneer broad-leaf hammock trees and they

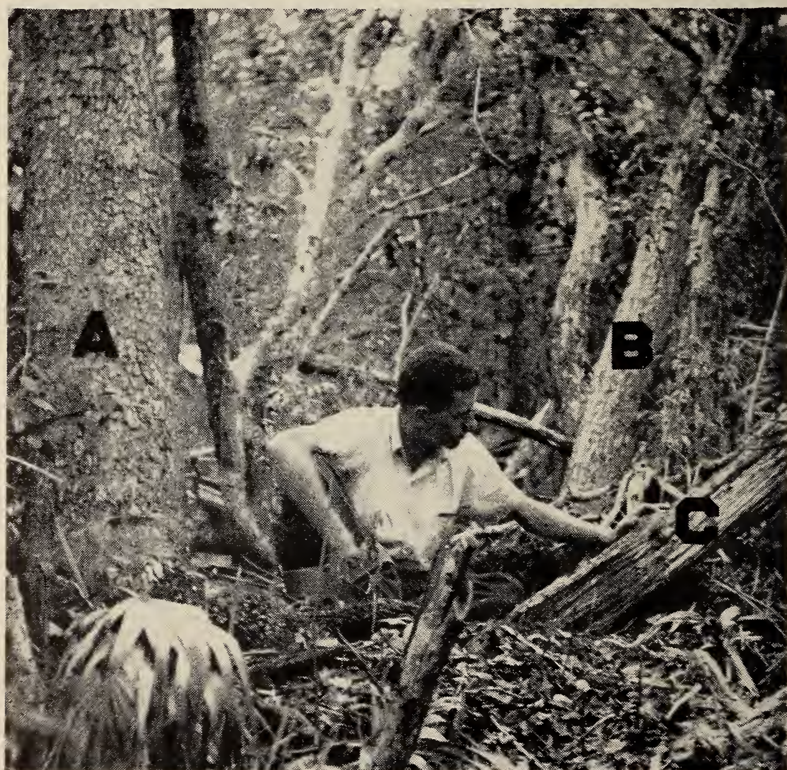

Fig. 1.—Interior of hammock near end of transect: Trunk A—Live Oak, Trunk B—Mahogany, Trunk C—Pine log.

in turn are being replaced by other species listed in Table I, as indicated by their dominance (Fig. 1). This type of succession has been widely accepted for the mainland in south Florida. Furthermore, there is good evidence that succession of this type can occur rapidly in South Florida under the extended growing period. It is recognized that there is danger that mans' activities in an area such as this could easily affect normal succession. It is worthy of note that Captain B. Romans wrote in his *Concise Natural History of East and West Florida* in 1775 that in the area of "young" Matacombe key the mahogany and other timbers had been nearly cut off. In the area studied there was no evidence of extensive clearing or cutting activity in recent years. There are fairly large oaks (up to thirty feet) and mahoganies standing and there is evidence that hurricanes had accounted for the loss of other large specimens.

TABLE I

Occurrence of Species on the Transect

Species	Percent	Affinity
Eugenia axiliaris	20.0	Hammock
E. buxifolia	10.0	Hammock
Coccolobis laurifolia	10.0	Hammock
Reynosia septentrionalis	6.9	Hammock
Swietenia Mahagoni	6.3	Hammock
Pithecolobium guadelupense	5.6	Hammock
Metopium toxiferum	5.6	Hammock
Thrinax floridana	5.0	Hammock
Icacorea paniculata	5.0	Hammock
Quercus virginiana	3.1	Pineland
Rapanea guayanensis	3.1	Hammock
Guettarda scabra	Less than 3%	Pineland
Serenoa repens	Less than 3%	Pineland
Sabal Palmetto	Less than 3%	Pineland
Rhacoma ilicifolia	Less than 3%	Pineland
Mariscus effusum	Less than 3%	Low Area
Calyptranthes zuzygium	Less than 3%	Hammock
Drypetes diversifolia	Less than 3%	Hammock
Erithalis fruticosa	Less than 3%	Hammock
Tillandsia sp. (epiphyte)	Less than 3%	Hammock
Mimusops emarginata	Less than 3%	Hammock
Jacquinia keyensis	Less than 3%	Hammock
Psychotria Sulzneri	Less than 3%	Hammock
Simarouba glauca	Less than 3%	Hammock
Torrubia longifolia	Less than 3%	Hammock

Summary

1. A line transect was used to establish the successional aspects of an area on Key Largo, Florida.

2. New evidence is given to support earlier reports that *Pinus caribaea* did grow on Key Largo.

3. The range of *Quercus virginiana* is extended to Key Largo.

4. Plant succession toward the climax subtropical hammock type apparently proceeded on Key Largo very much as it does on the mainland.

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HERPETOLOGICAL RESULTS OF THE BERNER-CARR ENTOMOLOGICAL SURVEY OF THE SHIRE VALLEY, NYASALAND

Arthur Loveridge
Museum of Comparative Zoology, Cambridge, Massachusetts

The 238 specimens, representing 48 species of reptiles and amphibians, that are recorded in this paper, were collected by Dr. A. F. Carr, Jr., when assisting Dr. Lewis Berner in a survey of insects of medical importance. This investigation was carried out in connection with the Shire Valley Project, at the request of Sir William Halcrow and Partners, the engineering firm responsible for the initial surveys.

Berner and Carr were in Nyasaland from June 15 until September 10, a period corresponding to that country's dry winter season. The almost entire lack of rain during their stay was unfavorable to herpetological collecting which, indeed, was only incidental to their primary objective. Nevertheless, Carr managed to add to Nyasaland's known herpetofauna two forms of *Hyperolius,* though one of these—*H. m. marmoratus*—has long been represented in the British Museum by an unrecorded juvenile (17.6 mm.) specimen collected at Port Herald by J. E. S. Old. The calls of both species, as noted by Carr, have been included in this report.

Naturally Berner and Carr's itinerary was almost entirely restricted to the Lake Nyasa-Shire Valley system from Kotakota on the western shore of the lake to Mutarara and Chindio near the confluence of the Shire with the Zambezi in Mozambique. Consequently their lowland collections are largely supplementary to those made during my own recent (1948-1949) expedition which was chiefly directed to the mountains of Nyasaland. Though Carr's material consists largely of widespread lowland forms, the precise locality data accompanying the specimens justify the publication of this list coming, as it does, from a region that has been herpetologically neglected for many years.

The collection has been deposited in the American Museum of Natural History, and I am indebted to its custodian, Mr. C. M. Bogert, for affording me the opportunity to study it and retain some of the duplicate frogs for the Museum of Comparative Zoology at Harvard.

Reptilia

Testudinidae

Kinixys belliana belliana Gray

♂ ex. grass flats near Lake Shirwa (Chilwa). 16. viii. 52.

A very old tortoise with the concentric rings almost obliterated from the anterior half, though sharp and distinct on the posterior lobe. Carapace length 171 mm.; height 77 mm.; breadth 115 mm.

Pelomedusidae

Pelusios sinuatus (A. Smith)

juv. ex. Chimwala Village, left bank of Shire River about 5 miles below Fort Johnston. 6. vii. 52.

Carapace length 110 mm.; height 40 mm.; breadth 84 mm.

Gekkonidae

Hemidactylus mabouia (Moreau de Jonnés)

♂ ex. Nchalu, Shire River between Chikwawa and Chiromo. 27. viii. 52.

Upper labials 13, lower 10; scansors under first toe 6, under fourth 9; preanal pores 48.

Hemidactylus mercatorius Gray

juv. ex. Ntundu Village, 3 miles south of Fort Johnston. 2. vii. 52.
♂ ex. Port Herald, Shire River. 25. viii. 52.
♀ ex. Nkula, Walker's Ferry, 22 miles N.N.W. of Chileka. 1. ix. 52.

Upper labials 9-11, lower 8; scansors under first toe 5, under fourth 7; preanal pores in ♂ 34. *H. gardineri* Boulenger is a synonym.

Lygodactylus capensis (A. Smith)

♂ ex. Ntundu Village, 3 miles south of Fort Johnston. 2. vii. 52.
♀ ex. Fort Johnston, upper Shire River. 3-5. vii. 52.
juv. ex. Elephant Marsh, 17 miles north of Chiromo. 17. vii. 52.
juv. ex. Tengadzi River, 11-14 miles north of Chiromo. 24. vii. 52.
♂ ex. Nkazi River, 30 miles south of Fort Johnston. 8. viii. 52.
♂ ex. in banana axils, Lake Malombe, Shire River. 12. viii. 52.

Preanal pores of ♂♂ 4-5; subcaudal scales subequal except on regenerated tails where they tend to be transversely enlarged.

Pachydactylus bibronii turneri (Gray)

♀ ex. Nchalu, Shire River between Chikwawa and Chiromo. 27. viii. 52.

Agamidae

Agama hispida armata Peters

♀ ex. dry scrub across Shire River from Chiromo. 27. vii. 52.

Midbody scale-rows 84.

Chamaeleonidae

Chamaeleo dilepis dilepis Leach

♀ ex. Chiromo. 23. vii. 52.

Total length 240 (120 + 120) mm.

Chamaeleo melleri (Gray)

On the outskirts of Blantyre Dr. Carr captured a Giant One-horned Chameleon, which he brought back to the States alive (cf. fig.). Unfortunately in captivity it completely wore away the characteristic rostral horn. The reptile proved a voracious and indiscriminate feeder, accepting anoles and tree frogs as well as insects. Mr. W. T. Neill of Silver Springs, Florida, to whom I am indebted for these notes and the accompanying photograph, writes me that if he wiggled a finger in front of the chameleon, it would slowly extrude its tongue for about an inch before shooting it out in an effort to capture the finger as it would a fly. Recently (1953, Bull. Mus. Comp. Zool., *110,* p. 189, pl. ii) I published a photograph of a Zomba specimen swallowing a weaver bird that it had caught. *C. melleri* is the largest of all African chameleons as it attains an overall length of almost two feet.

Brookesia platyceps carri Loveridge

3 ♂♂ ex. forest in Ruo Gorge between 3000 and 3500 feet. 6. ix. 52.

These are paratypes of the race occurring on the plateaus (about 6000 feet) of Mlanje Mountain where the typical form is found below 3000 feet. Consequently Dr. Carr's specimens are somewhat in the nature of intermediates.

Scincidae

Mabuya striata striata (Peters)

juv. ex. Rest House at Chiromo. 27. vii. 52.
2 ex. Port Herald. 25. viii. 52.

Mabuya bocagii mlanjensis Loveridge

♀♀ ex. Chambe Plateau, Mlanje Mountain. 31. viii. 52.

First labial in contact with anterior loreal on both sides of one skink, on neither side in the other; midbody scale-rows 38-42; toes of adpressed hind limb meet fingers or wrist of backward pressed forelimbs. Both examples of this recently (1953) described race are gravid, in one the ova are relatively small, in the other eyed embryos are present.

Mabuya varia varia Peters

1 ex. cloud forest stream on Zomba Mtn. 15. viii. 52.
1 ex. garden of Shire Valley Hotel at Limbe. 12. vii. 52.
1 ex. Shire River between Chiromo and Port Herald. 21. vii. 52.

Ablepharus wahlbergii (A. Smith)

♀ ex. closed forest at about 4000 feet on Mbongwe Mountain near the Mlanje Road about 4 miles east of Limbe. 5. ix. 52.

Gravid, the 4 eggs measuring about 7 x 4 mm.

GERRHOSAURIDAE

Gerrhosaurus nigrolineatus nigrolineatus Hallowell

♂ ex. Port Herald, Shire River. 26. viii. 52.

Normal in all key characters.

VARANIDAE

Varanus niloticus niloticus (Linné)

Head ex. Zomba. 1952.

TYPHLOPIDAE

Typhlops schlegelii mucruso (Peters)

1 ex. Zomba. 1952.

Midbody scale-rows 34; midbody diameter 28.5 times in total length of 570 (562 + 8) mm. Gravid ♀ holding 24 eggs measuring about 14 x 8 mm.

COLUBRIDAE

Natriciteres olivacea uluguruensis Loveridge

♀ ex. Tengadzi River, 11-14 miles north of Chiromo. 24. vii. 52.

Midbody scale-rows 17; ventrals 141; tail truncate. Gravid. That the Montane Marsh-Snake should occur on the Lower Shire is surprising; perhaps this is an aberrant individual should further collecting reveal that the majority have 19 midbody scale-rows as is usual for the lowland (typical *olivacea*) race.

Boaedon lineatus lineatus Duméril & Bibron

♂ ex. Nchalu, Shire River between Chikwawa and Chiromo. 27. viii. 52.

Midbody scale-rows 29; ventrals 208; subcaudals 61.

Mehelya capensis capensis (A. Smith)

♂ ex. Shire River, 6 miles south of Fort Johnston. 12. viii. 52.

Midbody scale-rows 15; ventrals 212; tail truncate.

Philothamnus hoplogaster (Günther)

♀ ex. Fort Johnston.
♀ ex. Ruo Gorge at about 2800 feet, Mlanje Mountain. 6. ix. 52.
♀ ex. Zomba. 1952.

Midbody scale-rows 13-15, the lower figure is remarkable, but on the Fort Johnston ♀ the last row with 15 scales is opposite the 70th ventral, which is well in advance of midbody. Curiously enough the Zomba snake has only 14 at mathematical midbody between snout and anus. Ventrals 150-159; subcaudals 88-90.

Crotaphopeltis hotamboeia hotamboeia (Laurenti)

♀ ex. Nfundu Village, about 4 miles south of Fort Johnston. 6. vii. 52. Midbody scale-rows 19; ventrals 172; subcaudals 34.

Psammophylax tritaeniatus variabilis Günther

♀ ex. Chambe Plateau, Mlanje Mountain. 31. viii. 52. Midbody scale-rows 17; ventrals 161; tail truncate.

Psammophis sibilans sibilans (Linné)

♀ ex. Tengadzi Bungalow, 12 miles north of Chiromo. 23. vii. 52. Midbody scale-rows 17; ventrals 173; tail truncate.

Dispholidus typus (A. Smith)

Head of ♂ ex. Zomba. 1952.

Elapidae

Naja melanoleuca Hallowell

Head ex. Zomba. 1952.

♂ ex. forest fringing small stream between Cholo and Mlanje. 18. viii. 52. Midbody scale-rows 19; ventrals 211; subcaudals 68.

Viperidae

Bitis arietans (Merrem)

2 heads ex. Zomba. 1952.

♂ ex. Shire River between Chiromo and Port Herald. 21. vii. 52. Midbody scale-rows 33; ventrals 134; subcaudals 33.

Amphibia

Pipidae

Xenopus muelleri (Peters)

2 ex. shallow marginal water of Shire River at Chiromo. 22. vii. 52.

9 ex. erosion potholes in flood-scoured rocks about 25 feet above Mpatamanga Gorge, 22 miles west of Chileka. 12. ix. 52.

5 tadpoles, some of which were transforming; same data as last.

Bufonidae

Bufo carens A. Smith

1 ex. Nchalu, Shire River between Chikwawa and Chiromo. 27. viii. 52.

Bufo regularis regularis Reuss

1 ex. Fort Johnston, Upper Shire River. 3-5. vii. 53.
2 ex. breeding in grassland brook between Chileka and Mpatamanga, 17 miles west of Blantyre. 13. vii. 52.
12 ex. breeding near Shire River at Chiromo. 22. vii. 52.
1 ex. Tengadzi River, 11-14 miles north of Chiromo. 24. vii. 52.
1 ex. in drying marsh 3 miles north of Port Herald. 22. viii. 52.

This last is a 9.5 mm. juvenile, only recently transformed. Carr was impressed by the sonorous calls of these toads which he heard all the way from the Lake to the Zambezi.

Rhacophoridae

Afrixalus fornasinii fornasinii (Bianconi)

11 ex. banana axils, Gande Village at edge of Elephant Marsh 17 miles north of Chiromo. 17. vii. 52.
2 ex. tall grass on banks of Ruo River at Chiromo. 24. vii. 52.
4 ex. banana axils on northeast shore of Lake Malombe. 12. vii. 52.
2 ex. banana axils on banks of Shire at Port Herald. 15. viii. 52.
1 ex. erosion pothole in flood-scoured rock about 25 feet above Mpatamanga Gorge, 22 miles west of Chileka. 2. ix. 52.

Afrixalus brachycnemis brachycnemis (Boulenger)

4 ♀♀ ex. banana axils at Limbe. 13. vii. 52.
7 ♀♀ ex. Nkazi River, a tributary of Shire River, 30 miles south of Fort Johnston. 8. viii. 52.

Brown lateral bands are absent or indistinctly indicated in the Limbe frogs; indistinct or very pronounced in the Nkazi specimens, some of which have also a vertebral stripe. Some of these may be young ♂♂.

Hyperolius marmoratus marmoratus Rapp

5 juv. ex. broad-leaved plants floating near bank of Shire River at Chiromo. 24. vii. 52.
4 ad. ♂♂, 1 ♀ ex. reeds at edge of Shire River at Port Herald. 26. viii. 52.

In the juveniles a lateral band may be present or absent; the typical hour-glass pattern on the dorsum is present or changing to a vertebral streak; the ♀ retains the hour-glass pattern, but a dark, light-edged, lateral line is all that remains of a lateral band. Two of the pouched ♂♂ retain the lateral line but a somewhat obsolescent streak is all that remains of the hour-glass pattern; one of the remaining ♂♂ is cream-spotted and black-streaked like Rapp's left-hand figure; the other is symetrically streaked with cream and black almost exactly like a specimen (M.C.Z. 20815) from Shilowane, Zoutpansberg, northern Transvaal (received in exchange from the Transvaal Museum), but not quite so comparable with our extensive series of topotypic ♂♂ from Stanger, Umvoti River, Natal. Possibly I am incorrect in applying *marmoratus* as a subspecific name to these Nyasaland frogs.

Carr, who found the frog (M.C.Z. 27872) longitudinally striped with black and yellow, and the second specimen (A.M.N.H. A56012) in which the yellow stripes were broken, calling from low twigs and grass stems at 8 P.M., compares the call to a squeaky buzzing "iiink, iiink, iiink" emitted very faintly and unobstrusively.

To those I consider subadults or adults (M.C.Z. 27871), possibly erroneously, he attributes a single whistled note, heard both at Chiromo and Port Herald, indeed "all the way from the Lake to the Zambezi." He compares this call to that of *Hyla crucifer* which species he considers the frog resembles generally in ground color, postorbital bar, and the cross-like or H-shaped marking on the dorsum. Their calls came from emergent, *Panicum*-like grass something like maiden cane.

Snout to anus of juveniles 17-21 mm.; ♂♂ 24-26 mm.; ♀ 25 mm. This is a much smaller form than the usually distinctively-marked *H. m. albofasciatus* inhabiting the Shire Highlands and Lake Nyasa.

Hyperolius marmoratus ? albofasciatus Hoffman

juv. ex. Zomba Mountain at about 6000 feet. 15. viii. 52.

This form has been taken on Zomba, and my only reason for querying the identification is because this newly-transformed froglet is only 14 mm. in length, so lacks diagnostic characters.

Hyperolius concolor tuberilinguis A. Smith

imm. ♂ ex. evaporation gauge at Nchalu on Shire River between Chikwawa and Chiromo. 27. viii. 52.

Though I have taken *tuberilinguis* at Chikwawa and it is known from Chiromo, the identification of this 22 mm. frog may be regarded as tentative for adult ♂♂ of *tuberilinguis* measure as much as 33-36 mm.

Hyperolius puncticulatus puncticulatus (Pfeffer)

ad. ♀ ex. small stream at Limbe. 13. vii. 52.

Unquestionably not *H. p. choloensis* for there are no spots on the dorsum of this fine 37 mm. sedge-frog.

Hyperolius pusillus (Cope)

imm. ♂ ex. Elephant Marsh 17 miles north of Chiromo. 17 vii. 52.
5 juv. ex. tall grass beside Ruo River at Chiromo. 24. vii. 52.
9 juv. ex. tall grass beside Shire River at Chiromo. 27. vii. 52.

These frogs, swept from the grass in an entomological net, have been compared with topotypes (M.C.Z. 23095-23100) of *pusillus*, a species that is new to Nyasaland. They have also been examined by my colleague Mr. Benjamin Shreve who concurs in the determination. Snout to anus the juveniles range from 14-15 mm., the subadult ♂ 18 mm.

Carr describes their call as ventriloquial and one of the most elusive he has ever heard. It sounded like "chick-peep-peep-peep-peep." The "peeps" were four in a row and occurred at a rate of about two per second. The calls came from tall grass along the Ruo River and, though no frog was actually seen calling, he attributes it to this species which he describes as being green, finely dotted, and as small as *Pseudacris ocularis.*

Ranidae

Rana fuscigula angolensis Bocage

♂ ex. small creek on the Upper Shire River. 11. viii. 52.
♂ ex. Zomba Mountain about 6000 feet. 15. viii. 52.
♂ ex. Chirombezi Creek on Limbe-Mlanje Road. 19. viii. 52.
3 ♂♂ ex. Chambe Plateau, Mlanje Mountain. 31. viii. 52.

Tibio-tarsal articulation of the adpressed hind limb attains nostril in ♂ (No. 424) or beyond end of snout (5 ex.); length of tibia more than half the length from snout to anus; fourth toe with from 1 to 2 phlanges free of web, fifth toe with 1, or half a phlange free of web, or webbed to the tip. Only the Chirombezi ♂ has a very black throat. A light vertebral stripe present only in the 50 mm. ♀. Snout to anus of ♂♂ 52-60 mm.

Rana oxyrhynchus oxyrhynchus A. Smith.

♂ ex. Fort Johnston. 3-5. vii. 52.
3 ♂♂ ex. potholes in flood-scoured rocks about 25 feet above Mpatamanga Gorge, 22 miles west of Chileka. 12. vii. 52 & 2. ix. 52.
♂ ♀ ex. grass beside Ruo River at Chiromo. 22. vii. 52.
♀ ♀ ex. Tengadzi River, 11-14 miles north of Chiromo. 24. vii. 52.
♂ ♀ ex. Chirombezi Creek on Limbe-Mlanje Road. 19. viii. 52.

Tibio-tarsal articulation of the adpressed hind limb reaches beyond or well beyond end of snout in all; length of tibia much more than half the length from snout to anus; first, second, third, and fifth toes with at most half a phalanx free, fourth toe with 1½ or 2 phlanges free. Snout to anus of ♂♂ 31-38 mm.; ♀♀ 30-32 mm.

Rana mascareniensis mascareniensis Duméril & Bibron

1 juv. ex. Fort Johnston. 3-5. vii. 52.
1 juv. ex. Marshy shore of Lake Shirwa (Chilwa). 16. viii. 52.
1 juv. ex. Chirombezi Creek on Limbe-Mlanje Road. 19. viii. 52.

Tibio-tarsal articulation of the adpressed hind limb reaches nostril or end of snout; length of tibia rather more than half the length from snout to anus; first, second, third and fifth toes with 1 phlanx free of web, fourth toe with 2 phlanges free. Length of juveniles 25-30 mm.

Rana mascareniensis mossambica Peters

♀ ex. edge of Elephant Marsh, Gande Village, 17 miles north of Chiromo. 17. vii. 22.

Tibio-tarsal articulation of the adpressed hind limb reaches nostril; length of tibia rather more than half the length from snout to anus; first toe with 2 phlanges free of web, second and third with 1½, fourth with 3, and fifth with 1 phalanx free; an inner and a *well-developed outer* metatarsal tubercle. This 39 mm. record fills in a gap in the distribution of *mossambica,* described from Tete on the Zambezi.

Rana ansorgii Boulenger

1 juv. ex. marshy shore of Lake Shirwa (Chilwa). 16. viii. 52.
1 juv. ex. Chirombezi Creek on Limbe-Mlanje Road. 19. viii. 52.

Tibio-tarsal articulation of the adpressed hind limb reaches well beyond end of snout; length of tibia much more than half the length from snout to anus; first, second, third and fifth toes with 1½ (Shirwa) or 2 (Chirombezi) phlanges free of web, fourth toe with 3 phlanges free. Snout to anus of both juveniles 25 mm.

Phrynobatrachus perpalmatus Boulenger

1 ex. muddy shore of Nkazi River between Liwonde and Zomba. 8. vii. 52.
3 ex. Tengadzi River, 11-14 miles north of Chiromo. 24. vii. 52.
2 ex. Pista Marsh 4 miles south of Chiromo Ferry.
4 ex. sandbar of Ruo River 5 miles above Chiromo. 18. vii. 52.
4 ex. marshy shore of Lake Shirwa (Chilwa). 16. viii. 52.

Tympanum sometimes scarcely distinguishable; tips of fingers more or less spatulate, those of the toes with tiny disks to which the webbing extends on all toes except the fourth, however the disk is often shrunken in preserved specimens so that it may be said that the phlanges free of web from first to fifth are: 1, 1, 1, 1-1½, 1; tibio-tarsal articulation of the adpressed hind limb reaches eye (in 2), between eye and nostril (8), or nostril (2).

In common with *natalensis* this species has a light, somewhat horseshoe-shaped, circum-anal marking whose arms terminate in a horizontal light line on the buttocks. It is often difficult to distinguish *perpalmatus* from young *natalensis*, but the latter are less extensively webbed and the toes, though occasionally swollen, lack the definite disks of well-preserved *perpalmatus*. Snout to anus of 11 juveniles 15-19 mm.; 2 ♂♂ 19-22 mm.; ♀ 26 mm.

Phrynobatrachus natalensis (A. Smith)

3 ex. small stream at Limbe. 13. vii. 52.
5 ex. muddy shore of Shire River at Chiromo. 22. vii. 52.
1 ex. Masengere Creek 20 miles north of Chiromo. 22 vii. 52.
4 ex. small stream on Mlanje Road 9 miles from Cholo. 18. viii. 52.
1 ex. fern bed by Likabula River, foot of Mlanje Mtn. 19. viii. 52.
1 ex. erosion pothole in flood-scoured rock about 25 feet above Mpatamanga Gorge, 22 miles west of Chileka. 2. ix. 52.

Tympanum sometimes scarcely distinguishable; tips of fingers *not* dilated, of toes more or less spatulate in young only; from first to fifth toes the phlanges free of web are: ½-1, ½-1, 1-2, 2-3, 1-1½; tibio-tarsal articulation of the adpressed hind limb reaches eye (in 5), between eye and nostril (1), or nostril (9). Mostly juveniles 18-25 mm.; presumed ♂♂ 26-30; ♀♀ 31-35.

Phrynobatrachus ukingensis mababiensis FitzSimons

♀ & 11 juv. ex. small but fast mountain stream at 2500 feet, across Shire River from Fort Johnston. 7. vii. 52.
♂ ex. muddy shore of Nkazi River between Liwonde and Zomba. 8. vii. 52.
♀ ex. small stream at Limbe. 13. vii. 52.
2 juv. ex. Tengadzi River, 11-14 miles south of Chiromo. 24. vii. 52.

Tympanum hidden; tips of fingers and toes not dilated; toes with only a trace of web at base, the phlanges free of web from first to fifth toe being: 2, 2, 3, 4, 3; tibio-tarsal articulation of the adpressed hind limb reaches eye or just beyond (♀♀ and 10 juveniles), or nostril (♂ and 3 juveniles). Snout to anus of juv. 10-15, average 12 mm.; ♂ 17 mm.; ♀♀ 20-21 mm.

Arthroleptis boulengeri de Witte

9 ex. small but fast mountain stream at 2500 feet, across Shire River from Fort Johnston. 7. vii. 52.
2 ex. stream in cloud forest on Zomba Mtn. about 6000 feet.
4 ex. small stream at Limbe. 13. vii. 52.
1 ex. small stream on Mlanje Road 9 miles from Cholo. 18. viii. 52.
5 ex. Chirombezi Creek on Limbe-Mlanje Road. 19. viii. 52.
5 ex. Likabula River, lower slopes of Mlanje Mountain. 19. viii. 52.
4 ex. closed forest at about 4000 feet on Mbongwe Mountain about 4 miles east of Limbe. 5. ix. 52.

This determination, as stated elsewhere, must be considered tentative until direct comparison has been made with the holotype from southeast Belgian Congo. The following characters have not been tested on every specimen.

Tympanum distinct, or indistinct in very young; tips of fingers and toes usually slightly swollen or distinctly dilated, their bases without web; tibio-tarsal articulation of the adpressed hind limb reaches tympanum (in 1), the eye (19), just beyond (7), or even to the nostril (3); a single small metatarsal tubercle only. Snout to anus 10-18, average 14 mm., those over 14 mm. are mostly adult.

Arthroleptis stenodactylus stenodactylus Pfeffer

1 ex. small but fast mountain stream at 2500 feet, across Shire River from Fort Johnston. 7. vii. 52.
1 ex. edge of Lower Shire River at Port Herald. 26. viii. 62.

Tympanum indistinct, its horizontal diameter about half the orbital diameter; tips of fingers and toes not dilated; tibio-tarsal articulation of the adpressed hind limb reaches the tympanum; metatarsal tubercle longer than inner toe. Snout to anus 22-27 mm.

Microhylidae

Phrynomerus bifasciatus bifasciatus (A. Smith)

1 ex. Nchalu, Shire River, between Chikwawa and Chiromo. 27. viii. 52.

SOME FURTHER STUDIES ON THE AKEE [1, 2]

EDWARD LARSON, MARK F. WYNN, S. JOHN LYNCH,
and DONALD D. DOUGHTY

The akee, *Blighia sapida,* is native to the Guinea coast of West Africa but is now commonly grown in the West Indies, Tropical America, and Southern Florida. The arils of the akee are eaten by some people, but there are numerous reports in the literature of poisoning due to its ingestion.

It has been estimated that there have been over 5000 deaths in Jamaica since 1886 due to akee poisoning (Manson-Bahr, 1950), commonly spoken of as vomiting sickness in the West Indies. Seidelin (1913) investigated a series of deaths due to vomiting sickness in Jamaica and reported no definite conclusions regarding the causative agent. Scott (1916) reported that vomiting sickness in Jamaica is due to the akee. He stated that much of the poison of the akee is extracted with boiling water and that the pathological changes induced consist chiefly of a general hyperemia and a tendency to hemorrhage in various organs. He stressed that the soup or "pot water" made from akee produced the most acute symptoms and that the akees were poisonous when unopened, picked from broken branches, or had soft spots. In later studies, Arnold (1947) reviewed 107 deaths in Jamaica which occurred over a period of 14 months. From this clinical investigation Arnold definitely states that the akee is responsible for the vomiting sickness and that the toxic principle is a saponin present in the arils of the unopened akee, whereas the arils of the ripe or "yawning" akee are non-toxic. Although this type of information may be found in standard texts on tropical diseases, the problem has not been solved from a practical viewpoint as an outbreak of vomtiing sickness in Jamaica caused more than 40 deaths during the early part of 1951.

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[1] From the Research Laboratory of the Veterans Administration Hospital and the University of Miami Medical Research Unit and the Experimental Farm, Division of Research and Industry, University of Miami, Coral Gables, Florida.

[2] Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

In addition to the clinical literature cited there has been some experimental work. Connal and Ralston (1918) fed certain extracts to dogs and found that the placenta, arils, or husk were non-poisonous when consumed individually. After blending some of the preparations which included unripe or over-ripe portions of the fruit, the animals vomited and soon died. No further reference will be made to the effects produced by the administration or eating of spoiled or over-ripe akees because we believe that most spoiled fruit will produce gastro-intestinal disturbance. Evans and Arnold (1938) state that the akee contains a saponin (which is hemolytic) and is probably the toxic substance.

Since this fruit is being introduced into Southern Florida (Smiley, 1951) by nurserymen and others, it is imperative that the nature of the poisoning be understood and an antidote developed. Our preliminary work (Lynch, Larson & Doughty, 1951 and Wynn, Larson & Doughty, 1952) demonstrated that there are many unfounded statements in the literature and further investigation was necessary. Therefore a program was initiated to determine which portion of the akee is toxic and also the anatomical and physiological changes induced.

TABLE I

Effect of Various Akee Preparations on Rabbits

Preparation Derived from:	No. of Animals	Deaths	Survivals
Arils, Ripe	10	0	10
Cotyledons, Ripe	4	4	0
Red Membrane, Ripe	8	0	8
Arils, Unripe	18	15	3
Cotyledons, Unripe	6	6	0

Fruit has been obtained from five different sources, four in the South Florida area and one from a commercial market in Jamaica. Suspensions, which were made from ripe, unripe, and artificially ripened fruit, have been fed to rabbits, rats, dogs, and monkeys. Intravenous injections of cell-free, water soluble extracts have been made into both rabbits and dogs. The material was administered to the rabbits and dogs by stomach tube or intravenously. The material given to the rats was administered by stomach tube. The material given to the monkeys was spread on either bread or banana and eaten voluntarily by the recipient.

The following quantitative determinations have been made on the blood: Chloride, non-protein nitrogen, total solids, white and red cell counts, coagulation time, and sedimentation rate. Body temperature of the animals has been taken rectally.

Table I shows the results on rabbits. The arils of the ripe or "yawning" fruit being non-toxic, all 10 animals survived, whereas with the unripe there were 15 deaths among 18 animals. This table also shows that the cotyledons from either ripe or unripe fruit are definitely toxic. Red membrane (placenta) was administered to 8 rabbits with no ill effects.

The results, Table II, with rats, monkeys, or dogs are similar to those of the previous table. There were no deaths from the arils of the ripe fruit, whereas the arils from the unripe caused the death of 5 of 24 rats, 4 of 7 monkeys, and no deaths in 6 dogs. The cotyledons caused death in 4 of 18 rats. The emetic effect is tabulated for monkeys and dogs because these animals can vomit which is not true of either rats or rabbits. Emesis was induced in both monkeys or dogs by the toxic preparations.

TABLE II

The Effect of Various Akee Preparations on Rats, Monkeys and Dogs

Material Administered	Rats			Monkeys			Dogs		
	Number Animals	Deaths	Survivals	Number Animals	Emesis	Deaths	Number Animals	Emesis	Deaths
Arils, Unripe	24	5	19	7	2	4	6	5	0
Arils, Ripe	13	0	13	2	0	0	8	0	0
Cotyledons	19	4	15	1	0	1	1	0	0

Table III shows the physiological changes induced by administration of lethal doses. Rabbits dying of akee poisoning present the following physiological picture: the blood chlorides increase;

the temperatures, red and white cell counts and the hematocrit decrease.

TABLE III

Effects of Lethal Preparations

	Chloride Ion in mg/100 ml	Temp. °F.	Red Cell Count in Thousands/ mm^3	White Cell Count per mm^3	Hematocrit %
Number of Animals	9	11	7	7	10
Normal Range	360–584	102–106	5900–8500	3700–8400	37–51
Average Deviation from Normal Mean	+65.mg	—4.29°	—2197	—1899	—8.5
Average Percent Deviation from Normal Mean	+15.%	—4.1%	—33.5%	—31.5%	—19.1%

Animals dying of akee, whether it be given intravenously or by mouth, present similar gross findings at autopsy. The lungs are congested having very marked reddish areas in them, or in some cases an entire lobe is reddish in color. Both auricles of the heart are distended with dark venous blood. The stomach and intestines of most of the animals showed hyperemia. The kidneys are usually pale. In some animals we have also noted hemorrhages in the subcutaneous fascia in the area of the internal mammary artery. The spleen, pancreas, and voluntary muscle have appeared to be normal. Microscopic studies of the sectioned and stained tissues showed the following changes: The alveolar spaces in the lung contain fluid, the heart shows myocardial degeneration, and the kidney has been congested. This syndrome resembles secondary shock.

Tests for the presence of a saponin in the akee using whole rabbit blood as a substrate were negative. Control experiments using a commercial saponin showed marked hemolysis. This might have been anticipated from some of our previous observations as we have not observed any hemoglobin-tinged urine, nor has the blood serum or plasma of the moribund or dead animals been tinged with hemoglobin. Also Sollmann (1948) states that the saponins are 10 to 1000 times more toxic by vein than by mouth but we have found no marked difference in the toxicity due to the route of administration. General tests for alkaloids were conducted by adding potassio-mercuric iodide, iodine in potassium iodide or picric acid to filtered aqueous preparations. These tests have been negative.

Manson-Bahr (1950) states that the toxic principle is precipitated by the addition of alcohol. Jordan and Burrows (1937) reported that the poisonous principle could not be precipitated by alcohol from its aqueous solution. Our work substantiates the latter report as the addition of ethyl alcohol to the aqueous preparations produced innocuous precipitates; the supernatant liquid remained toxic.

Summary

1. The arils of either the ripe or naturally "yawning" akee are non-toxic.

2. The arils of the akees which have been allowed to ripen or "yawn" after picking are not toxic.

3. The arils of the unripe or "non-yawning" akee are definitely toxic.

4. The cotyledons of either the ripe or unripe akee are definitely toxic.

5. The toxic material is water soluble; stable in aqueous medium at 100° C., and is not precipitated from aqueous medium by ethyl alcohol.

6. The toxic principle is not a saponin nor an alkaloid.

7. Some of the symptoms induced by the toxic principle are those of secondary shock.

8. The physiological and histological changes induced have been studied.

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INFLUENCE OF WOUND HEALING AND CROTON OIL ON SKIN TUMORIGENESIS [1]

Michael Klein

When mice (Deelman, 1924; Pullinger, 1943; and Pullinger, 1945b) or rabbits (Fritsche, 1943; Linell, 1947; and MacKenzie and Rous, 1941) are painted on the skin with a carcinogen and following this receive deep wounds within the treated area, tumors arise at the edges of or near the cut surfaces. Although tumors also were observed at other sites on the painted skin, they were concentrated and appeared earlier at the wounded sites (MacKenzie and Rous, 1941). Pullinger (1943, 1945b) observed a similar localization of skin tumors in mice painted with a carcinogen and receiving multiple wounds. It also was observed that among some of the mice, tumors appeared first in areas of wound healing or on scars (Pullinger, 1943).

It has been proposed that latent tumor cells (Berenblum and Shubik, 1947; Friedewald and Rous, 1944) or cells with latent neoplastic potentialities (Friedewald and Rous, 1950) are produced in the skin following painting with a carcinogen, a process referred to as initiation. These transformed cells may then be acted upon by a non-carcinogen (wounding, croton oil, turpentine) with the resultant formation of visible skin tumors (Berenblum and Shubik, 1947; Friedewald and Rous, 1944; and Friedewald and Rous, 1950), the latter process being referred to as promotion. Rous and Kidd (1941), in investigating the influence of wounding on the tar-painted ears of rabbits reported that wound healing occurred by an ingrowth of epithelium from the cut edges. On the basis of this observation, Pullinger (1945b) suggested that potentially malignant cells produced by a carcinogen might migrate towards an area which suffered repeated, deep wounding and thereby become a focus for subsequent tumor formation. If some of the cells with latent neoplastic potentialities migrated to a wounded area in response to one wounding, their presence could be detected by repeated painting with croton oil, a potent pro-

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moter in skin tumorigenesis in mice (Berenblum, 1941; Berenblum and Shubik, 1947). This problem was the subject of the present investigation.

Materials and Methods

Strain DBA/2 JAX male mice, 5-10 weeks of age, were employed. These were housed in wire cages which were maintained in air-conditioned quarters (76° - 78° F.). A supply of Purina Laboratory Chow Pellets and tap water was available to the animals at all times.

The mice were painted on both ears with a 0.5 per cent solution of 20-methylcholanthrene, referred to hereinafter as MCA, and a 5 per cent solution of croton oil [2] both dissolved in olive oil. Each solution was applied using a No. 3 camel-hair brush. Following one application of the carcinogen, the mice were isolated one to a cage for several days and then re-grouped 10 to a cage for the remainder of the experiment. The animals were wounded 2 weeks after the start of the experiment by punching a 2 mm. hole through the middle of each ear. A total of 60 mice was divided equally into Groups A and B.

Group A—Controls—These mice received no further treatment.

Group B—Two weeks after wounding, the ears were painted twice weekly for 20 weeks with croton oil.

The mice were examined routinely for the presence of skin tumors. Although all observable growths were recorded, none was considered a tumor unless it persisted at least 2 weeks and attained a minimum size of 1 mm. All surviving mice were sacrificed 1 month following the last painting with croton oil.

Results and Discussion

No skin tumors were induced among the mice in Group A (Table I) in response to one application of MCA to the ears followed by a single ear punching. The average period of observation for this group was 194 days. Pullinger (1945a) painted mice repeatedly on the nape of the neck with a low dose of carcinogen and then excised one piece of skin from each painted area. Al-

[2] Obtained from the Fisher Scientific Company, Eimer and Amend, New York, N. Y.

though many skin tumors were observed among these animals, less than 1 per cent were associated with the wounded sites. In the same experiment, another group of mice was painted once with 1/3 to 5 mg. of MCA following which a piece of skin was excised from each painted area. Among 119 mice, some observed as long as 12 months, 4 developed 1 tumor each. However, only 1 of the 4 was associated with a wounded site. It is apparent from these experiments that in mice, potential tumor cells induced with a carcinogen are not stimulated sufficiently by a single excision and its associated wound healing to develop into visible skin tumors. Croton oil which is known to be a potent promoter in skin tumorigenesis in mice also has been observed to be ineffective following one application (Klein, 1953; Salaman, 1952). It is interesting to note that a promoting influence in skin tumorigenesis (tumor localization in wounded sites) was obtained in mice exposed to a small or large dose of carcinogen when areas of the painted skin were excised repeatedly (Pullinger, 1943; 1945b).

TABLE I

Influence of Wound Healing and Croton Oil on Skin Tumorigenesis in Mice. Each Mouse was Painted Once with a 0.5 Per Cent Solution of Methylcholanthrene in Olive Oil.

Group	Treatment	Total Mice	Average Applications Croton Oil	Mice with Tumors	Tumor Incidence	Total Tumors	Total Tumors Localized *	Av. Latent Period from MCA	Av. Observation Period from MCA
		no.	no.	no.	%	no.	no.	days	days
A	wounded	27	0	0	0	0	0	------	194
B	wounded + croton oil	24	37	13	54	17	1	131	189

* On or adjacent to wounded sites.

In Group B, in addition to the wounding, the mice were treated continuously with croton oil. A skin tumor incidence of 54 per cent was observed among the mice after an average latent period of 131 days (Table I). Four of the mice bore 2 tumors each while the remaining tumor bearers bore 1 each. Only 1 of the 17 tumors induced was situated on or adjacent to a wounded site. If the effect of the wounding was to cause a migration of potential tumor cells from the surrounding areas to the cut surfaces, this should have become evident following continued painting with croton oil. The fact that tumors were not observed to be concentrated in the wounded sites suggests that potential tumor cells were absent from those sites. Recently, it was reported that one application of 0.15 per cent 9:10-dimethyl-1:2-benzanthracene followed by repeated applications of croton oil, the latter in a concentration of 2.5 per cent, resulted in the induction of numerous skin tumors per mouse (Salaman, 1952). We employed croton oil at a concentration of 5 per cent and observed only 1 to 2 tumors per mouse. One reason for the lower tumor yield at the higher concentration may be the greater skin damage produced by the latter. Thus, if potential tumor cells had migrated to the wounded sites as suggested by Pullinger (1945b), but then were destroyed by the croton oil solution, this could account for the lack of tumors at those sites. On the other hand, it may be that more than one wounding is necessary in mice before migration of potential tumor cells to wounded areas will occur.

Summary

Strain DBA male mice were painted once on the ears with 20-methylcholanthrene. These mice were then divided into 2 groups. In Group A, a hole was punched through each ear. In Group B, the mice were painted repeatedly on the ears with croton oil in addition to the wounding.

No skin tumors were obtained in Group A in response to a single wounding. A tumor incidence of 54 per cent was observed in Group B. However, only 1 of 17 tumors induced was located on or near a wounded site. Since croton oil was administered repeatedly to these mice, the lack of tumor localization in Group B suggests that potential tumor cells were absent from the skin in the wounded sites.

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AN ANATOMICAL STUDY OF TWENTY LESSER KNOWN WOODS OF FLORIDA

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Relatively little work has been done on the descriptions of the minute anatomical features of woods which at present have little or no economic importance. This is especially true of many of the woods from species which are found only in Florida and do not extend into other regions of the continental United States.

Such descriptions and keys resulting from them, while at present only of academic interest, may in time become of practical value in cases where species now considered useless may achieve commercial rank, or where questions in litigation or criminal investigation might be positively answered by accurate identification.

Materials and Methods

The materials that have served as a basis for this study consisted in part of wood samples from the xylarium collection of the University of Florida Herbarium furnished from Project I of the Department of Wood Technology, New York State College of Forestry, Syracuse, New York, and accompanied by identical herbarium material authenticated by the Arnold Arboretum of Harvard University. Four specimens were collected by the authors and authenticated by comparison with herbarium material in the University of Florida Herbarium.

A few of the woods were too hard for sectioning without further treatment; these were softened by the use of hydrofluoric acid. Dehydration was accomplished with 70% ethyl alcohol. The specimens were cut on a sliding microtome and stained by standard methods.

Anatomical Descriptions of the Woods

Olacaceae

Ximenia americana L. Tallowwood. Growth rings indistinct; wood diffuse porous. Pores showing very little gradation in size throughout the seasonal growth; numerous, but not crowded laterally, uniformly distributed, but without distinctive pattern, occurring singly; orifices broad oval; average length of the vessel segments 249-36 microns; only simple perforations observed; no spiral thickenings seen; intervessel pitting alternate, very small, scattered, orbicular to broad oval, apertures lenticular; tyloses present; no gum deposits observed.

Wood parenchyma metatracheal, in short, tangential, uniseriate lines which exhibit no regularity; crystal inclusions abundant; gum deposits present.

Fiber-tracheids present, showing no radial alignment; angular in cross-section; lateral walls 2 to 4 microns thick.

Rays simple, numerous, 5-10 per millimeter, unstoried, uni- and biseriate; heterogeneous; less than 25 cells high; pits between rays and vessels simple to half-bordered, oval, occasionally somewhat elongated, of two kinds, *viz.*, (a) medium-sized and (b) fine; crystal inclusions and gum deposits abundant.

Ripple marks absent; no gum ducts observed.

Polygonaceae

Coccolobis floridana Meisn. Pigeon seagrape. Growth rings indistinct; wood diffuse porous. Pores showing little gradation in size from springwood to summerwood; few, scattered, without distinctive pattern, occurring singly or in short radial rows of 2-3, occasionally in radial rows of 4 or more, or in small clusters; orifices broad oval; average length of vessel segments 404-62 microns; only simple perforations observed; the long oblique overlapping end walls sometimes producing the impression of diagonal arrangement; no spiral thickenings observed; intervessel pitting vestured, alternate, medium in size, abundant; the pits orbicular to oval, or polygonal through crowding; apertures lenticular and sometimes several confluent; no tyloses or gum deposits observed.

Wood parenchyma metatracheal-diffuse and sparingly paratracheal, never forming a sheath about vessels; composed of crystalliferous strands, from few to 20 or more cells in height; cells may be square or vertically flattened, up to 40 microns or more in diameter, angular in cross-section; gum deposits sparse.

Libriform wood fibers and septate wood fibers present, showing radial alignment; somewhat angular in cross-section; lateral walls 3-4 microns thick; gummy infiltrations present.

Rays simple, very numerous, 12-15 per millimeter, unstoried, mainly uniseriate, but occasionally biseriate; homogeneous; less than 25 cells high; pits between rays and vessels half-bordered, numerous, orbicular to broad oval, fine; no crystal inclusions observed; gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Coccolobis uvifera L. Common seagrape. Growth rings poorly defined; wood diffuse porous. Pores showing little gradation in size from springwood to summerwood; few, scattered, without distinctive pattern, occurring singly or in short radial rows of 2-3, occasionally in radial rows of 4 or more, or in small clusters; orifices broad oval; average length of vessel segments 348-52 microns; only simple perforations observed; long oblique overlapping end walls sometimes producing the impression of diagonal arrangement; no spiral thickenings observed; intervessel pitting vestured, alternate; pits medium to large in size, numerous, orbicular to oval, or polygonal through crowding, apertures lenticular; no tyloses present; gum deposits observed.

Wood parenchyma metatracheal-diffuse and sparingly paratracheal, never forming a sheath about vessels; composed of crystalliferous strands, from few up to 20 or more cells in height; cells may be square or horizontally or vertically flattened, up to 40 microns or more in diameter; angular in cross-section; gum deposits present.

Libriform wood fibers and septate wood fibers aligned in somewhat irregular radial rows; somewhat angular in cross-section; lateral walls 2-3 microns thick; gummy infiltrations present.

Rays simple, very numerous, 12-18 per millimeter, unstoried, uniseriate; homogeneous, however, with occasional upright cells indicating a tendency towards a heterogeneous condition; less than 25 cells in height; pits between rays and vessels half-bordered, numerous, orbicular to broad oval, fine; no crystal inclusions observed; gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Rosaceae

Chrysobalanus icaco L. var. *pellocarpa* (F. F. W. Mey.) DC. Small-fruit cocoplum. Growth rings indistinct; wood diffuse porous. Pores showing little gradation in size throughout the seasonal growth; few, irregularly distributed, without distinctive pattern, occurring singly and occasionally in short radial rows of 2-3; orifices broad oval; average length of vessel segments 640-129 microns; only simple perforations observed; no spiral thickenings observed; intervessel pits alternate, medium to large in size, scattered, orbicular to oval, apertures lenticular; tyloses sparse or wanting; gum deposits present.

Wood parenchyma metatracheal-zonate, in uniseriate, occasionally biseriate, concentric, wavy lines, which are fairly evenly spaced, sometimes broken and occasionally anastomosing; strands from few to 16 or more cells in height; no crystal inclusions or gum deposits observed.

Fiber-tracheids showing radial alignment; angular in cross-section; lateral walls 3-5 microns thick.

Rays simple, very numerous, 16-18 per millimeter; unstoried; uniseriate; heterogeneous; commonly less than 25 cells high, but sometimes up to 60; pits between rays and vessels of two types, *viz.*, (a) bordered, fine to medium, obicular to oval, with lenticular apertures, (b) large to very large, oval to much elongated, generally in scalariform arrangement with the long axes of the pits from horizontal to vertical; however, all pits in a group forming such scalariform arrangements are oriented at the same angle; showing narrow or incomplete borders; crystal inclusions present; gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Leguminosae

Leucaena glauca (L.) Benth. Whitepopinac. Growth rings indistinct; wood diffuse porous. Pores showing little gradation in size in the seasonal growth; few to numerous, and scattered, occurring singly with radial rows of 8 or more not uncommon, also in clusters; orifices broad oval; average length of vessel segments 419-76 microns; only simple perforations observed; no spiral thickenings observed; intervessel pitting vestured, alternate; pits small, numerous, orbicular, oval or occasionally polygonal through crowding, the apertures lenticular with several frequently confluent; no tyloses observed; gum deposits present, but sparse.

Wood parenchyma terminal and paratracheal; (a) terminal parenchyma forming 1- to 3-seriate bands at the ends of growth rings;

(b) paratracheal parenchyma forming 1- to 6-seriate sheaths around pores, often confluent with parenchyma of adjacent pores; crystalliferous strands common; no gum deposits observed.

Libriform wood fibers, septate wood fibers, and gelatinous libriform fibers present and displaying radial arrangement; angular in cross-section with lateral walls approximately 1.5 microns in thickness.

Rays simple, moderately numerous, 5-7 per millimeter, unstoried; 1- to 2-seriate, rarely 3-seriate; homogeneous; 25-50 cells in height; pits between rays and vessels bordered, oval, fine; crystal inclusions abundant; no gum deposits observed.

Ripple marks absent; gum ducts not observed.

Erythrina herbacea L. Eastern coralbean. Growth rings absent; tangential bands of fibers, with no definite relation to true growth rings present in concentric arrangement; wood diffuse porous. Pores very few, irregularly distributed without distinctive pattern, commonly occurring singly, but occasionally in short radial rows of 2-3; orifices angular; average length of vessel segments 193-21 microns; only simple perforations observed; no spiral thickenings observed; intervessel pitting vestured and alternate; the pits medium-sized, numerous, polygonal through crowding, apertures lenticular and frequently several confluent; no tyloses or gum deposits observed; vessel elements tending to be storied.

Wood parenchyma very abundant constituting the major portion of the wood, hence, inclosing all of the vessels observed in uniformly wide concentric bands separated by narrow bands of fibers; fusiform and 2-celled parenchyma strands abundant; crystalliferous strands present; no gum deposits observed; storied throughout.

Libriform wood fibers in 2- to 5-seriate concentric bands separated by wide bands of parenchyma; angular in cross-section; lateral cells 3-5 microns thick.

Rays aggregate, few, 2-4 per millimeter; with a tendency toward storied arrangement; up to 20 cells in width; homogeneous to weakly heterogeneous; 25-50 cells in height; pits between rays and vessels bordered, oval, of medium size, numerous; crystal inclusions abundant; no gum deposits observed; some globules of undetermined nature present.

Ripple marks present; gum ducts not observed.

Rutaceae

Zanthoxylum clavaherculis L. Hercules Club. Growth rings visible, delimited by terminal parenchyma and crowding of the pores; wood semi-diffuse porous. Pores larger and more crowded at the beginning of the ring and very gradually reduced in size towards the end of the seasonal growth; few to numerous, well-distributed, without distinctive pattern, occurring singly and occasionally in short radial rows of 2-3; orifices oval; average length of vessel segments 521-112 microns; only simple perforations observed; no spiral thickenings present; intervessel pitting alternate; the pits small, numerous, broad oval to polygonal through crowding, apertures lenticular and several frequently confluent; no tyloses or gum deposits observed.

Wood parenchyma terminal and paratracheal; (a) terminal parenchyma forming a uniseriate line at the end of the seasonal growth; (b) paratracheal parenchyma very sparse, not forming a sheath about the pores and only an occasional cell in contact with a vessel. No crystal inclusions or gum deposits were observed.

Libriform wood fibers aligned in somewhat irregular radial rows; angular in cross section; lateral walls approximately 1 micron in thickness.

Rays simple, moderately numerous, 3-8 per millimeter, unstoried, occasionally vertically fused; 1- to 3-seriate, mostly biseriate; weakly heterogeneous, upright cells marginal; less than 25 cells in height; pitting between rays and vessels bordered, medium in size, numerous, broad-oval; apertures lenticular; crystal inclusions present; gum deposits not observed.

Ripple marks absent; gum ducts not observed.

Euphorbiaceae

Gymnanthes lucida Sw. Shiny oysterwood. Growth rings indistinct; dark concentric zones not related to seasonal growth often present; wood diffuse porous. Pores showing little or no gradation in size throughout the seasonal ring; numerous, but not crowded laterally, fairly uniformly distributed without distinctive pattern; occurring singly or, more commonly, in radial rows of few to many, occasionally found in small clusters; orifices broad oval; average length of vessel segments 352-49 microns; only simple perforations observed; no spiral thickenings present; intervessel pits alternate, small, numerous, orbicular to broad oval; the apertures lenticular; no tyloses observed; gum deposits present.

Wood parenchyma metatracheal-diffuse, in short, tangential, uniseriate lines; crystal inclusions present; no gum deposits observed.

Fiber-tracheids and gelatinous fiber-tracheids, showing radial alignment, present; angular in cross-section with lateral walls 3-5 microns thick.

Rays simple, very numerous, 18-24 per millimeter, unstoried, uniseriate; heterogeneous; 25-50 cells in height; horizontal rows of cells in rays showing great variation both in their height along the grain and in radial length; all variations between the truly procumbent and truly upright condition present; square cells abundant; pits between rays and vessels half-bordered, oval, fine; crystal inclusions abundant; no gum deposits observed.

Ripple marks absent; gum ducts not observed.

Cyrillaceae

Cyrilla racemiflora L. American cyrilla. Growth rings distinct, due to large springwood pores; wood ring porous. Pores numerous, well-distributed, without distinctive pattern, commonly solitary, infrequently in contact radially; orifices somewhat angular; average length of vessel segments 752-151 microns; scalariform perforation plates with many fine and very closely spaced bars; no spiral thickenings observed; intervessel pitting opposite, small to medium in size, fairly numerous, oval to linear, apertures lenticular to splitlike; no tyloses or gum deposits observed.

Wood parenchyma fairly abundant, metatracheal-diffuse; occasionally a strand contacts a vessel, sometimes arranged in short tangential lines; no crystal inclusions or gum deposits observed.

Fiber-tracheids aligned in somewhat irregular radial rows; angular in cross-section; lateral walls 2-5 microns in thickness.

Rays simple, numerous, 6-10 per millimeter; storied; 1- to 4-seriate, occasionally 5-seriate; heterogeneous; rays of two kinds, *viz.*, (a) large, multiseriate rays, less than 30 cells high; (b) small, uniseriate rays, less than 8 cells high; pitting between rays and vessels bordered, oval to slightly elongated, opposite, fine, fairly numerous; crystal inclusions observed; gum deposits abundant.

Ripple marks absent; gum ducts apparently not present.

Rhamnaceae

Krugiodendron ferreum (Vahl) Urban. Leadwood. Growth rings indistinct; wood diffuse porous. Pores showing very little gradation throughout the seasonal growth; numerous, but not crowded laterally, well-distributed without distinctive pattern, solitary and in short radial rows of 2-3, occasionally 4 or more, also in small clusters; orifices broad oval; average length of vessel segments 276-24 microns; only simple perforations observed; no spiral thickenings present; intervessel pits alternate, very small, numerous, polygonal through crowding, apertures lenticular; no tyloses observed; gum deposits abundant.

Wood parenchyma paratracheal, sparingly developed, confined to a few cells about the vessels, not forming a sheath; crystal inclusions abundant; no gum deposits observed.

Libriform wood fibers, aligned in radial rows, present; angular in cross-section; lateral walls 3-5 microns thick.

Rays simple, very numerous, 12-15 per millimeter, unstoried, uniseriate and biseriate, heterogeneous, horizontal rows of cells in rays showing great variation in their height along the grain and in their radial lengths; all variations between the truly procumbent and truly upright condition present, square cells abundant; less than 25 cells high; pits between rays and vessels bordered, crowded, polygonal, fine; crystal inclusions abundant; gum deposits present.

Ripple marks absent; gum ducts not observed.

Combretaceae

Conocarpus erecta L. Buttonmangrove. Growth rings visible, due to size of fibers in the late summerwood; wood diffuse porous. Pores showing little difference in size throughout the seasonal growth; few to numerous; well distributed, without distinctive pattern, occurring singly and in short radial rows of 2-3, occasionally in small clusters; orifices broad oval; average length of vessel segments 359-76 microns; only simple perforations observed; no spiral thickenings observed; intervessel pitting vestured, alternate, small, abundant; the pits orbicular to broad oval or polygonal through crowding, apertures lenticular, often confluent; no tyloses observed; gum deposits abundant.

Wood parenchyma paratracheal-confluent throughout the growth ring, forming wavy tangential bands up to 8 or more cells wide between the pores; no crystal inclusions or gum deposits observed.

Libriform wood fibers, showing radial alignment; angular in cross-section, lateral walls 3-7 microns thick.

Rays simple, numerous, 7-12 per millimeter, unstoried, uniseriate throughout; weakly heterogeneous with none of the cells definitely upright, but square in shape, with these marginally situated, or arranged in bands between rows of procumbent cells; less than 25 cells high; pitting between rays and vessels bordered, oval to slightly elongated, medium in size, few to numerous; crystal inclusions and gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Laguncularia racemosa (L.) Gaertn. f. Falsemangrove. Growth rings indistinct; wood diffuse porous. Pores showing only slight variation in size from springwood to late summerwood; few to numerous, but not crowded laterally, well distributed, but without distinctive pattern, occurring singly and in short radial rows of 2-3, occasionally clustered; orifices broad oval; average length of vessel segments 300-62 microns; only simple perforations observed; no spiral thickening present; intervessel pits vestured, alternate, medium in size, numerous, orbicular to oval, apertures lenticular and sometimes several confluent; no tyloses observed; gum deposits sparse.

Wood parenchyma abundant, paratracheal-confluent, forming bands 4-10 or more cells wide between pores, showing as wavy concentric bands; fusiform parenchyma present; crystal inclusions abundant; no gum deposits observed.

Libriform wood fibers present in radial alignment; angular in cross-section; lateral walls 2-3 microns in thickness.

Rays simple, very numerous, 12-16 per millimeter, unstoried, uniseriate throughout; heterogeneous, horizontal rows of cells showing great variation in their height along the grain and in their radial length, all variations between the procumbent and the truly upright condition present, square cells abundant; less than 25 cells high; pitting between rays and vessels bordered, orbicular to oval, fine to medium in size; crystal inclusions present; gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Myrtaceae

Psidium guajava L. Common guava. Growth rings indistinct; wood diffuse porous. Pores showing little gradation in size throughout the growth ring; numerous, but not crowded laterally, well distributed without distinctive pattern, occurring singly and in short radial rows of 2-3; orifices oval; average length of vessel segments 283-46 microns; only simple perforations observed; no spiral thickening present; intervessel pits vestured, alternate, small, numerous, orbicular to broad oval, apertures lenticular; no tyloses observed; gum deposits present.

Vasicentric tracheids numerous, displaying small, numerous, orbicular to broad oval pits with lenticular apertures.

Wood parenchyma abundant, metatracheal in continuous, anastomosing, wavy, closely spaced, tangential, uniseriate lines; no crystal inclusions observed; gum deposits abundant.

Fiber tracheids, radially aligned; angular in cross-section; with lateral walls, 1.5-3 microns in thickness.

Rays simple, very numerous, 12-16 per millimeter; unstoried; uniseriate and biseriate, decidedly heterogeneous, more than one row of marginal upright cells not uncommon; less than 25 cells high; pitting between rays and vessels bordered, orbicular to broad oval, very fine, numerous; no crystal inclusions observed; gum deposits abundant.

Ripple marks absent; gum ducts not observed.

Eugenia confusa DC. Redberry eugenia. Growth rings visible, due to a narrow zone in the late summerwood somewhat deficient in pores and parenchyma, and a more or less continuous row of springwood pores; wood diffuse porous. Pores showing little gradation in size throughout the growth ring; very numerous, but not crowded laterally, irregularly distributed without distinctive pattern, occurring singly and occasionally in short radial rows of 2-3; orifices broad oval; average length of vessel segments 401-72 microns; only simple perforations observed; no spiral thickenings present; intervessel pitting vestured, alternate; the pits very small, numerous orbicular to broad oval, apertures lenticular; no tyloses observed; gum deposits present.

Vasicentric tracheids numerous; pits very small, fairly numerous, orbicular to broad oval, apertures lenticular.

Wood parenchyma abundant, metatracheal-zonate, in short wavy tangential bands, commonly uniseriate, but occasionally 2- to 3-seriate; crytalliferous strands abundant; gum deposits present.

Fiber-tracheids, showing radial alignment, present; angular in cross-section; lateral walls 3-8 microns thick.

Rays simple, very numerous 12-18 per millimeter; unstoried, commonly biseriate in the middle portion, decidedly heterogeneous, often with 2 rows of marginal upright cells, occasionally as many as 5, sometimes rows of upright cells between rows of procumbent cells; less than 25 cells high; pits between rays and vessels bordered, orbicular, very fine, no crystal inclusions observed; gum deposits sparse.

Ripple marks absent; gum ducts not observed.

Sapotaceae

Sideroxylon foetidissimum Jacq. Fetid jungleplum. Growth rings visible, due to narrow zones deficient in parenchyma; wood diffuse porous. Pores showing little gradation in size throughout the growth ring; not numerous, irregularly distributed without distinctive pattern, occurring singly, and commonly in short radial rows of 2-3, occasionally as many as 6, orifices broad oval; average length of vessel segments 463-83 microns; only simple perforations observed; no spiral thickenings observed. Intervessel pitting alternate, very small, numerous, orbicular to oval, apertures lenticular; tyloses abundant; no gum deposits present.

Wood parenchyma paratracheal and metatracheal; (a) the paratracheal never forming a complete sheath about the pores; (b) metatracheal parenchyma abundant in numerous, closely spaced, wavy tangential lines which frequently anastomose to form a reticulate pattern; crystalliferous strands abundant; no gum deposits observed.

Libriform wood fibers and occasionally gelatinous fibers, aligned in somewhat irregular radial rows; angular in cross-section; lateral walls 6-10 microns thick.

Rays simple, numerous, 7-10 per millimeter; unstoried; commonly biseriate in the middle portion; decidedly heterogeneous; less than 25 cells high; pitting between upright rays cells and vessels bordered, between procumbent cells and vessels half-bordered; the pits, orbicular to much elongated, from fine to coarse; crystal inclusions and gum deposits present.

Ripple marks absent; gum ducts not observed.

Bumelia lanuginosa (Michx.) Pers. Woolybucket bumelia. Growth rings distinct, due to uniseriate rows of large springwood pores; wood ring porous. Pores irregularly distributed, occurring in narrow concentric bands in the early wood and in the late wood in clusters and short radial multiples associated with tracheids and parenchyma, and forming a distinct flame-like or dendritic pattern; orifices broad oval to slightly angular; average length of vessel segments 120-34 microns; all perforations simple; spiral thickenings occasionally present; intervessel pits alternate, small, scattered, orbicular; apertures lenticular; tyloses present; no gum deposits observed.

Vasicentric tracheids present; pits small, scattered, orbicular, apertures lenticular.

Wood parenchyma abundant, paratracheal and metatracheal; (a) paratracheal parenchyma associated with vessels and tracheids, forming a dendritic pattern; (b) metatracheal parenchyma forming a reticulate pattern; strands from few to 20 or more cells in height; no crystal inclusions or gum deposits observed.

Libriform wood fibers without radial alignment, angular in cross-section; lateral walls 5-7 microns thick.

Rays simple, occasionally vertically fused, numerous, 7-11 per millimeter; unstoried; 1- to 3-seriate, occasionally 4-seriate; heterogeneous; less than 25 cells high; pitting between upright cells and vessels half-bordered, between procumbent cells and vessels simple; pits orbicular to somewhat elongated, from fine to coarse; no crystal inclusions observed; gum deposits sparse.

Ripple marks absent; gum ducts not observed.

Verbenaceae

Avicennia marina (Forskl) Vierh. Blackmangrove. Growth rings distinct, delimited by a wide band of conjunctive tissue and a uniseriate row of large porelike, intraxylary phloem cavities which are partially included in the inside edge of the band of conjunctive tissue.

Conjunctive tissue in concentric bands; bands more or less undulate, frequently forked, composed of a many-seriate band of conjunctive parenchyma containing a narrow 1- to 4-seriate band of stone cells. The conjunctive tissue is followed in the seasonal growth by a uniseriate row of large, orbicular to oval, isolated, intraxylary phloem cavities, which are included in the conjunctive parenchyma and the adjacent xylem tissue.

Conjunctive cells with thin walls, rectangular in cross-section, commonly 16-40 microns in length, but occasionally up to 100 microns; crystal inclusions abundant; no gum deposits observed; strands of longitudinal parenchyma occasionally present.

Stone cells forming a uniformly 1- to 4-seriate tangential band within conjunctive parenchyma, appearing square to rectangular in cross-section, 20-50 microns long, thickwalled with small lumina.

Vessels restricted to the xylem tracts, occurring singly, but more commonly in long radial rows, occasionally in small clusters; fairly evenly distributed with distinctive pattern; orifices orbicular to oval, or angular due to crowding of contiguous vessels; average length of vessel segments 275-52 microns; only simple perforations observed; no spiral thickenings present; intervessel pits alternate, very small, very numerous, orbicular to polygonal through crowding, apertures lenticular; no tyloses observed; gum deposits abundant.

Wood parenchyma abundant, paratracheal, forming 1- to 3-seriate sheaths about the pores; no crystal inclusions or gum deposits observed; occasional strands of longitudinal parenchyma found in conjunctive tissue.

Libriform wood fibers and sparse septate wood fibers with very thin septa present, not radially aligned; angular in cross-section; lateral walls 3-8 microns thick.

Rays of conjunctive tissue rare; xylem rays, very numerous, 10-15 per millimeter; unstoried, seemingly interrupted by the band of stone cells inserted in the conjunctive tissue, commonly uniseriate to biseriate, but occasionally up to 6-seriate in the conjunctive tissue; heterogeneous, cells variable in size and shape, usually square or upright, but occasionally procumbent; rays of two kinds, *viz.*, (a) large rays composed of 1-8 rows of wide cells, 25 plus cells in height; (b) small rays composed of 1-4 rows of narrow cells, less than 25 cells high; pits between rays and vessels bordered, orbicular to oval, very fine, very numerous; crystal inclusions abundant; no gum deposits observed.

Ripple marks absent; gum ducts not observed.

Rubiaceae

Cephalanthus occidentalis L. Common buttonbush. Growth rings distinct, due to flattened fibers at the end of the season's growth and large springwood pores at the beginning of the following growth ring; wood ring porous. Pores numerous, but not crowded laterally, fairly uniformly distributed without distinctive pattern, occurring singly and in short radial rows of 2-3, occasionally 4 or more, sometimes in small clusters; orifices broad oval; average length of vessel segments 333-70 microns; perforations simple; no spiral thickenings observed; intervessel pitting vestured; the pits alternate, very small, numerous, orbicular to broad oval; apertures lenticular; no tyloses or gum deposits observed.

Wood parenchyma very sparingly metatracheal-diffuse; no crystal inclusions or gum deposits present.

Fiber-tracheids and gelatinous fiber-tracheids, aligned in somewhat irregular radial rows; angular in cross-section, with lateral walls 3-5 microns in thickness.

Rays simple, very numerous, 18-22 per millimeter, unstoried, vertically fused rays not uncommon; mostly uniseriate, but occasionally biseriate; heterogeneous, horizontal rows of cells in rays showing great variation in height along the grain and in length radially, all variations between the truly procumbent and truly upright condition present, square cells abundant; commonly 25-50 cells in height; pits between rays and vessels bordered, oval, very fine; crystal inclusions present; no gum deposits observed.

Ripple marks absent; gum ducts not observed.

Caprifoliaceae

Sambucus simpsoni Rehder. Florida elder. Growth rings indistinct; wood diffuse porous. Pores showing little gradation in size toward the end of the seasonal growth; very numerous, but not crowded laterally, well-distributed, without distinctive pattern; occurring singly and in short radial rows of 2-3, occasionally 4, sometimes in small clusters; orifices oval; average length of vessel segments 374-47 microns; only simple perforations observed; no spiral thickenings present; intervessel pits alternate, medium in size, numerous, crowded, orbicular, apertures lenticular; no tyloses or gum deposits observed.

Wood parenchyma sparingly paratracheal, not forming complete sheaths about the pores; no crystal inclusions or gum deposits observed.

Libriform wood fibers, showing tendency towards alignment in radial rows; somewhat angular in cross-section; lateral wall 2-4 microns thick.

Rays simple, numerous, 7-9 per millimeter, unstoried, occasionally vertically fused; sheath cells sometimes present; 1- to 5-seriate, mostly 3-seriate; weakly heterogeneous to decidedly so, upright cells marginal; up to 50 or more cells high; pits between rays and vessels half-bordered, medium in size, oval but tending to become elongated; no crystal inclusions or gum deposits present.

Ripple marks absent; gum ducts not observed.

COMPOSITAE

Baccharis halimifolia L. Eastern baccharis. Growth rings visible; wood ring porous. Pores showing marked gradation in size from springwood to late summerwood; numerous, but not crowded laterally, occurring in clusters which, with surrounding parenchyma, form distinctive wavy tangential bands; orifices somewhat angular; average length of vessel segments 193-26 microns; only simple perforations observed; spiral thickenings present; intervessel pits alternate, very small, numerous, orbicular to broad oval, occasionally polygonal through crowding, apertures lenticular; no tyloses or gum deposits observed.

Vascular tracheids abundant; pitting alternate, very small, numerous, orbicular to broad oval, occasionally polygonal through crowding, apertures lenticular; no tyloses or gum deposits present.

Wood parenchyma paratracheal, sparingly developed, commonly fusiform and 2-celled; no crystal inclusions or gum deposits observed.

Libriform wood fibers present, in distinct radial alignment; angular in cross-section; lateral walls approximately 1.5 microns in thickness.

Rays simple, numerous, 6-12 per millimeter, unstoried, 1- to 6-seriate, occasionally wider, commonly 3-seriate; weakly heterogeneous; 25-50 cells or more high; pits between rays and vessels bordered, orbicular, fine, apertures slit-like and horizontal; no crystal inclusions or gum deposits observed.

Ripple marks absent; gum ducts not observed; intraxylary cork strands present.

Discussion

Kribs (1950), in his description of *Ximenia americana,* mentions the presence of gum deposits in the vessels. These were absent in the material studied for this investigation.

Observations of the wood of *Coccolobis uvifera* disclosed that the rays in the material studied were homogeneous. This is in accord with the statement by Record and Hess (1943) that the rays of the members of the Polygonaceae are usually homogeneous, but occasionally weakly to decidedly heterogeneous. It is at variance with the findings of Record and Mell (1924) who describe the rays of this species as heterogeneous.

Erythrina herbacea displays a tendency toward anomalous structure because of the large amount of wood parenchyma which constitutes the major portion of the xylem.

Record and Hess (1940) describe *Zanthoxylum clavaherculis* as having a ring porous structure. The present study disclosed the structure of specimens under observation to be semi-diffuse porous. The genus *Zanthoxylum* is described by the same authors (1940) as having the pores in part solitary, but more often in small radial multiples. The specimens examined in this study revealed that the majority of pores occurred singly and only occasionally were any found in short radial rows. Record and Hess (1940) further state that the ray-vessel pitting is frequently unilaterally compound, that crystalliferous strands of parenchyma are sometimes present, and that vertical traumatic gum ducts are of sporadic occurrence. None of these conditions were found in the material examined for this study.

Kribs (1950) has recorded the pitting on the walls of the fibers of *Gymnanthes lucida* as simple. The fiber pitting of this species is described by Record and Mell (1924) as being very small and bordered, which is in accord with the observations here recorded.

In a description of the genus *Sideroxylon,* Record (1939), indicates that crystalliferous strands of parenchyma are abundant. None were observed in the present investigation of *S. foetidissimum.*

Avicennia marina has an anomalous structure of the concentric type. The wood parenchyma of this wood is described by Record and Hess (1943) as being rather sparingly paratracheal; however, Panshin (1932) records it as being abundant, forming a 1- to 3-seriate sheath about the pores. A condition similar to the latter was observed in this study. The ray-vessel pitting in this species is reported by Record and Mell (1924) as half-bordered. Panshin (1932) states that it is similar to the intervessel pitting. Bordered pitpairs similar to the intervessel pitting were observed in the material under discussion.

In their description of the genus *Sambucus,* Record and Hess (1943) state that the pores tend to form tangential bands, particularly in the summerwood. They also indicate that sometimes the very small vessels have scalariform perforation plates with a few narrow bars and that thin-walled tyloses are common in the vessels. None of these conditions were observed in the material of *S. simpsoni.*

The presence of intraxylary cork strands was noted in specimens of *B. halimifolia.* The Florida species of *Baccharis* is found growing on sites which, although xerophytic in nature, do not approach the condition of dryness in which the majority of the species of this genus normally flourish. Further studies of the anatomy of this genus may indicate that the strands of intraxylary cork are remnants of more extensive inclusions in the species normally found in extremely xerophytic surroundings. Diettart (1938) describes the presence of a complete peripheral layer of interxylary cork enclosing each season's growth in the more recent annual rings in the stem of *Artemisia tridentata* Nutt. This species is a member of the same tribe in the family Compositae as is *Baccharis* and grows under extremely xerophytic conditions.

Summary

1. Twenty species of trees found in Florida, representing fifteen families, were described as to their minute anatomy.

2. Certain features of the specimens studied proved to be at variance with the published findings of other investigators.

3. The wood of *Baccharis halimifolia* revealed the presence of intraxylary cork strands.

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CHECK LIST OF FLORA OF BIG PINE KEY, FLORIDA AND SURROUNDING KEYS

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The following check list was compiled from data and plants collected in connection with a study of the Key Deer from June 1951 through September 1952. The first part of the list is made up of species found on Big Pine Key. The second part is made up of those species not found on Big Pine Key but found on nearby keys. A great number of species found on Big Pine Key were also found on many of the other keys.

The keys checked in the survey were:

Big Pine Key	Sugarloaf Key
Little Pine Key	Spanish Harbor (West Summerland) Key
Water Key (off Little Pine)	New Found Harbor Keys
No Name Key	Summerland Key
Ramrod Key	Johnson Keys
Cudjoe Key	Big Spanish Key
Little Torch Key	Little Spanish Key
Middle Torch Key	Big Knock'emdown Key
Big Torch Key	Little Knock'emdown Key
Water Keys (off Big Torch)	Mayo Key
Annette Key	Cutoe Keys
Howe Key	Toptree Hammock Key
Porpoise Key	

Specimens of all species listed (except palms and cacti) have been placed in the Buswell Herbarium, University of Miami, Coral Gables, Florida.

Field work was done by the senior author under general supervision of Dr. Alexander. Mr. Woodbury checked identifications. Further aid in identification in the field was given by Dr. E. P. Killup, retired Head Curator of Botany, Smithsonian Institute.

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[1] Project leader of Key Deer Investigation, a federal aid project of the Florida Game and Fresh Water Fish Commission.

Plant List of Big Pine Key [2]

I. Filicineae

1. Polypodiaceae
   1. Acrostichum danaeaefolium Langsd. & Fisch. (A. excelsum Maxon)
   2. Marginaria polypodioides (L.) Tidestrom. (Polypodium polypodiodes Watt.)
   3. Phlebodium aureum (L.) J. Smith
   4. Pteris caudata L.
   5. Pycnadoria bahamensis (Ag.) Small (P. pinetorium Small)
   6. Sphenomeris clavata (L.) Maxon
   7. Thelypteris normalis (C. Chr.) Moxley (Dryopteris normalis C. Chr.)
   8. Vittaria lineata (L.) Smith

2. Schizaeaceae
   1. Anemia adiantifolia (L.) Sw.

II. Gymnospermae

1. Pinaceae
   1. Pinus caribaea Morelet

III. Angiospermae

A. Dicotyledonae

1. Acanthaceae
   1. Diapedium assurgens (L.) Kuntze
   2. Dyschoriste angusta (A. Gray) Small
   3. Ruellia hybrida Pursh.

2. Allionaceae
   1. Boehaavia erecta L.

3. Amaranthaceae
   1. Achyranthes ramosissima (Mart) Standley
   2. Amaranthus hybridus L.
   3. Amaranthus spinosus L.
   4. Iresine paniculata (L.) Kuntze
   5. Philoxerous vermicularis (L.) R. Br.

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[2] Names used are for the most part according to the *Manual of Southeastern Flora*, John K. Small, New York, 1933 and *Ferns of Southeastern States*, John K. Small, Science Press, Lancaster, Pa. 1938.

4. Ambrosiaceae (Compositae)
    1. Ambrosia hispida Pursh.
    2. Iva imbricata Walt.
5. Ammiaceae
    1. Centella repanda (Pers.) Small
6. Amygdalaceae
    1. Chrysobalanus icaco L.
    2. Geobalanus oblongifolius (Michx) Small
7. Annonaceae
    1. Annona glabra L.
8. Apocynaceae
    1. Carissa grandiflora A. DC.
    2. Echites echites (L.) Britton (E. umbellata Jacq.)
    3. Nerium oleander L.
    4. Rhabdadenia biflora (Jacq.) Muell. Arg.
    5. Rhabdadenia corallicola Small
    6. Urechites lutea (L.) Britton
    7. Vallesia glabra Cav.
    8. Vinca rosea L.
9. Ardisiaceae (Myrsinaceae)
    1. Rapanea guayanensis Aubl.
    2. Icacorea paniculata (Nutt) Sudw.
10. Armeriaceae
    1. Limonium angustatum (A. Gray) Small
    2. Limonium carolinianum (Walt) Britton
11. Artocarpaceae (Moraceae)
    1. Ficus aurea Nutt.
    2. Ficus brevifolia Nutt.
12. Asclepiadaceae
    1. Amphistelma scoparia (Nutt.) Small
    2. Asclepiodora viridis (Walt.) A. Gray
    3. Epicion northropiae (Schletc.) Small (Metastelma northropiae Schlect.)
    4. Funastrum clausum (Jacq.) Schlect. (Philibertia viminalis A. Gray)
    5. Lyonia palustris (Pursh) Small
    6. Metastelma blodgettii A. Gray

13. Avicenniaceae (Verbenaceae)
    1. Avicennia nitida Jacq.

14. Batidaceae
    1. Batis maritima L.

15. Brassicaceae (Cruciferae)
    1. Cakile fusiformis Greene
    2. Lepidium virginicum L.

16. Buettneriaceae (Sterculiaceae)
    1. Waltheria americana L.

17. Burseraceae
    1. Elaphrium simaruba (L.) Rose

18. Canellaceae
    1. Canella winteriana (L.) Gaertn.

19. Capparidaceae
    1. Capparis cynophallophora L.
    2. Capparis flexosa L.

20. Carduaceae (Compositae)
    1. Aster adnatus Nutt.
    2. Aster bracei Britton
    3. Ageratum littorale A. Gray
    4. Baccharis angustifolia Michx.
    5. Baccharis halimifolia L.
    6. Bidens pilosa L. (Bidens leucantha L.)
    7. Borrichia arborescens (L.) DC.
    8. Borrichia frutescens (L.) DC.
    9. Chaptalia dentata (L.) Cass.
    10. Cirsium horridulum Michx.
    11. Coreopsis leavenworthii T & G.
    12. Emilia coccinea (Sims) Sweet
    13. Flaveria linearis Lag.
    14. Flaveria latifolia (J. R. Johnston) Rydb.
    15. Flaveria trinervia (Spreng) C. Mohr.
    16. Gaillardia picta Sweet
    17. Leptilon canadense (L.) Britton
    18. Liatris tenuifolia (Nutt.) Kuntze
    19. Melanthera deltoidea Michx.
    20. Melanthera parvifolia Small

21. Mikania batatifolia D. C.
22. Pectis leptocephala (Cass) Urban
23. Pityopsis graminifolia (Michx.) Nutt. (Chrysopsis graminifolia (Michx.) Nutt.)
24. Pluchea foetida (L.) D. C.
25. Pluchea purpurascens (Sw.) D. C.
26. Pterocaulon undulatum (Walt.) C. Mohr.
27. Sideranthus megacephalus (Nash) Small
28. Solidago petiolata Mill. (Solidago angustifolia Ell.)
29. Tridax procumbens L.
30. Vernonia blodgettii Small

21. Cassiaceae
 1. Caesalpinia pauciflora (Griseb.) C. Wright
 2. Chamaecrista aspera (Muhl.) Greene
 3. Chamaecrista keyensis Pennell
 4. Delonix regia (Boj.) Raf.
 5. Guilandina crista (L.) Small
 6. Parkinsonia aculeata L.
 7. Peiranisia bahamensis (Mill.) Britton & Rose (Cassia bahamensis Mill.)
 8. Tamarindus indica L.

22. Cassythaceae
 1. Cassytha filiformis L.

23. Casuarinaceae
 1. Casuarina equisetifolia Forst.

24. Celastraceae
 1. Gyminda latifolia (Sw.) Urban
 2. Maytenus phyllanthoides Benth.
 3. Rhacoma crossopetalum L.
 4. Rhacoma ilicifolia (Poir) Trelease

25. Chenopodiaceae
 1. Atriplex arenaria Nutt.
 2. Dondia linearis (Ell.) Millsp.
 3. Salicornia ambigua Michx.
 4. Salicornia bigelovii Torr.

26. Cichoriaceae (Compositae)
 1. Brachyrhamphus intybaceus (Jacq.) D. C. (Lactuca intybacea Jacq.)

2. Sonchos oleraceus L.

27. Convolvulaceae
    1. Calonyction tuba (Schlect.) Colla.
    2. Evolvulus alsinoides L.
    3. Evolvulus glaber Spreng.
    4. Evolvulus wrightii House
    5. Ipomoea batatas (L.) Lam.
    6. Ipomoea pes-caprae (L.) Sweet
    7. Ipomoea sagittata Cav.
    8. Ipomoea triloba L.
    9. Jacquemontia pentantha (Jacq.) G. Don.
    10. Pharbitis cathartica (Poir) Choisy (Ipomoea cathartica Poir.)

28. Cucurbitaceae
    1. Momordica charantia L.

29. Dodonaeaceae
    1. Dodonaea microcarya Small

30. Ebenaceae
    1. Diospyros virginiana L.

31. Ehretiaceae
    1. Bourreria ovata Miers
    2. Sebesten sebestena (L.) Britton (Cordia sebestena L.)
    3. Varronia globosa Jacq.

32. Epilobiaceae (Onagraceae)
    1. Gaura angustifolia Michx.
    2. Isnardia Sp.
    3. Ludwigia microcarpa Michx.

33. Euphorbiaceae
    1. Acalypha chamaedrifolia (Lam.) Muell Arg.
    2. Bivonea stimulosa (Michx.) Raf. (Jatropha stimulosa Michx.)
    3. Chamaesyce adenoptera (Bertol.) Small
    4. Chamaesyce blodgettii (Engelm.) Small
    5. Chamaesyce buxifolia (Lam.) Small
    6. Chamaesyce conferta Small
    7. Chamaesyce hirta (L.) Millsp.
    8. Chamaesyce hypercifolia (L.) Small
    9. Chamaesyce scoparia Small
    10. Chamaesyce serpyllum Small

11. Croton berlandieri Torr.
12. Croton linearis Jacq.
13. Ditaxis blodgettii (Torr.) Pax.
14. Drypetes diversifolia Krug & Urban
15. Gymnanthes lucida Sw.
16. Hippomane mancinella L.
17. Phyllanthes niruri L.
18. Phyllanthes pentaphyllus C. Wright.
19. Poinsettia heterophylla (L.) Small
20. Poinsettia pinetorum Small
21. Ricinus communis L.
22. Savia bahamensis Britton
23. Tragia saxicola Small

34. Fabaceae
1. Bradburya virginiana (L.) Kuntze
2. Canavali lineata (Thunb.) D.C. (C. obtusifolia (Lam.) D.C.)
3. Crotalaria maritima Chapm. (and C. maritima liniaria)
4. Dolicholus minimus (L.) Medic. (Rhynchosia minima D.C.)
5. Erythrina arborea (Chapm.) Small
6. Galactia parvifolia A. Rich
7. Galactia spiciformis T. & G.
8. Ichthyomethia piscipula (L.) A. Hitchc.
9. Indigofera miniata Ortega
10. Indigofera tinctoria L.
11. Leucopterum parvifolium (D.C.) Small (Rhynchosia parvifolius D.C.)
12. Meibomia cana (Gmel.) Blake (Desmodium incanum D.C.)
13. Meibomia purpurea (Mill.) Vail (Desmodium tortuosum (Sw.) D.C.)
14. Phaseolus lathroides L.
15. Rhynchosia cinerea Nash
16. Sesban sp. (Sesbania sp.)
17. Sophora tomentosa L.
18. Stylosanthes hamata (L.) Taub.
19. Vigna repens (L.) Kuntze

35. Frangulaceae (Rhamnaceae)
1. Colubrina asiatica (L.) Brongn.
2. Krugiodendron ferreum (Vahl) Urban
3. Reynosia septentrionalis Urban

36. Gentianaceae
    1. Eustoma exaltatum (L.) Griseb.
    2. Sabattia campanulata (L.) Torr.

37. Heliotropiaceae (Boraginaceae)
    1. Heliotropium curassavicum L.
    2. Heliotropium leavenworthii Torr.
    3. Mallotonia gnaphalodes (Jacq.) Britton (Tournefortia gnaphalodes (R.) Br.)
    4. Myriopus volubis (L.) Small (Tournefortia volubis R. & S.)
    5. Schobera angiosperma (Murr.) Britton (Heliotropium parviflorum L.)

38. Lauraceae
    1. Tamala bourbonia (L.) Raf.

39. Lamiaceae
    1. Ocimum micranthum Willd.

40. Linaceae
    1. Cathartolinum arenicola Small

41. Lobeliaceae
    1. Lobelia glandulosa Walt.

42. Lythraceae
    1. Ammannia latifolia L.
    2. Lythrum lineare L.

43. Malphigiaceae
    1. Byrsonima cuneata (Turcz.) P. Wilson (B. lucida (Sw.) D.C.)

44. Malvaceae
    1. Abelmoschus esculentus (L.) Moench. (Hibiscus esculentus L.)
    2. Abutilon permolle (Willd.) Sweet
    3. Gayoides crispum (L.) Small
    4. Gossypium hirsutum L.
    5. Hibiscus pilosus (Sw.) Fauc. & Randle
    6. Hibiscus rosa-sinensis L.
    7. Malvastrum corchorifolium (Desr.) Britton
    8. Malvaviscus grandiflora Hort.
    9. Sida carpinifolia L.
    10. Sida ciliaris L.
    11. Sida elliottii T. & G.

12. Sida procumbens Sw.
13. Thespesia populnea (L.) Soland

45. Mimosaceae
   1. Acuan depressum (H.B.K.) Kuntze
   2. Leucaena glauca (L.) Benth
   3. Neptunia floridana Small
   4. Pithecolobium guadalupense Chapm.
   5. Pithecolobium unguis-cati (L.) Benth.
   6. Vachellia farnesiana (L.) Wight and Arn.
   7. Vachellia peninsularis Small

46. Myricaceae
   1. Myrica cerifera L.

47. Myrtaceae
   1. Calypthranthes pallens (Poir.) Griseb.
   2. Eugenia axillaris (Sw.) Willd.
   3. Eugenia buxifolia (Sw.) Willd.
   4. Mosiera longipes (Berg.) Small (Eugenia longipes Berg.)
   5. Psidium guajava Radd.

48. Olacaceae
   1. Ximinea americana L.

49. Oleaceae
   1. Forestieria pinetorium Small

50. Opuntiaceae (Cactaceae)
   1. Acanthocereus floridanus Small
   2. Cephalocereus keyensis Britton & Rose
   3. Harrisia simpsonii Small
   4. Opuntia abjecta Small
   5. Opuntia dillenii (Ker.) Haw.
   6. Opuntia impedita Small
   7. Opuntia keyensis Britton
   8. Opuntia ochrocentra Small

51. Papayaceae
   1. Carica papaya L.

52. Passifloraceae
   1. Passiflora pallida L. (P. suberosa L.)

53. Phytolaccoceae
   1. Rivina humilis L.

54. Pinguiculaceae
    1. Pinguicula pumila Michx.
55. Pisoniaceae (Allioniaceae)
    1. Pisonia aculeata L.
    2. Pisonia rotundata Griseb.
    3. Torrubia braceii Britton
    4. Torrubia longifolia (Heimer) Britton
56. Polygalaceae
    1. Asemeia leiodes (Blake) Small (Polygala leiodes Blake)
    2. Pilostaxis carteri Small (Polygala carteri Small)
    3. Polygala praetervisa Chodat.
57. Polygonaceae
    1. Coccolobis laurifolia Jacq.
    2. Cocolobis uvifera (L.) Jacq.
58. Portulacaceae
    1. Portulaca oleacea L.
    2. Portulaca phaeosperma Urban
59. Primulaceae
    1. Samodia ebracteata (H.B.K.) Baudo. (Samolus ebracteatus H.B.K.)
60. Punicaceae
    1. Punica granatum L.
61. Rhinanthaceae (Scrophulariaceae)
    1. Agalinis keyensis Pennell (Gerardia keyensis Pennell)
    2. Agalinis maritima Raf. (Gerardia maritima Raf.)
    3. Agalinis purpurea (L.) Pennell (Gerardia purpurea L.)
    4. Bramia monnieri (L.) Pennell
    5. Buchnera elongata Sw.
    6. Capraria bflora L.
62. Rhizophoraceae
    1. Rhizophora mangle L.
63. Rubiaceae
    1. Borreria ocimoides (Burm) D.C.
    2. Borreria terminalis Small
    3. Casasia clusiifolia (Jacq.) Urban
    4. Catesbaea parviflora Sw.
    5. Chiococca alba (L.) A. Hitchc.

6. Chiococca pinetorum Britton
7. Erithalis fruticosa L.
8. Ernodea angusta Small
9. Exostema caribaeum (Jacq.) R. & S.
10. Galium bermudense L.
11. Guettarda eliptica Sw.
12. Guettarda scabra Vent.
13. Hamelia patens Jacq.
14. Houstonia filifolia (A. Gray) Small
15. Morinda roioc L.
16. Psychotria nervosa Sw.
17. Randia aculeata L.
18. Spermacoce keyensis Small
19. Strumpfia maritima Jacq.

64. Rutaceae
    1. Amyris elimifera L.
    2. Citrus aurantifolia (Christm.) Swingle
    3. Zanthoxylum fagara (L.) Sarg.

65. Sapindaceae
    1. Cupania glabra Sw.
    2. Exothea paniculata (Juss.) Radlk.
    3. Hypelate trifoliata Sw.

66. Sapotaceae
    1. Bumelia angustifolia Nutt.
    2. Chrysophyllum olivaeforme L.
    3. Dipholis salicifolia (L.) A. D.C.
    4. Mimusops emarginata L.
    5. Sapota achras Mill. (Achras sapota L.)

67. Sedaceae (Crassulaceae)
    1. Kalanchoe verticillata Elliot

68. Simaroubaceae
    1. Simarouba glauca D.C.

69. Solanaceae
    1. Capsicum annuum L.
    2. Capsicum frutescens L.
    3. Lycium carolinianum Walt.
    4. Nicotiana tobacum L.

5. Physalis angustifolia Nutt.
6. Physalis barbadensis Jacq.
7. Solanum bahamense L.
8. Solanum blodgettii Chapm.
9. Solanum nigrum L.
10. Solanum verbascifolium L.

70. Spigeliaceae
    1. Cynoctomum mitreola (L.) Britton
    2. Cynoctomum sessilfolium (Walt.) J. F. Gmel.
    3. Polypremum procubens L.
    4. Spigelia anthelmia L.

71. Spondiaceae (Anacardiaceae)
    1. Metopium toxiferum (L.) Krug & Urban
    2. Schinus terebinthifolius, Raddi
    3. Toxicodendron toxicodendron (L.) Britton (Rhus toxicodendron L.)

72. Surianaceae
    1. Suriana maritima L.

73. Terminaliaceae (Combretaceae)
    1. Conocarpus erecta L.
    2. Laguncularia racemosa Gaertnf.
    3. Terminalia catappa L.

74. Tetragoniaceae
    1. Sesuvium maritimum (Walt.) B.S.P.
    2. Sesuvium portulacastrum L.
    3. Trianthema portulacastrum L.

75. Theophrastaceae
    1. Jacquinnia keyensis Mez.

76. Turneraceae
    1. Piriqueta tomentosa H.B.K.

77. Ulmaceae
    1. Trema floridana Britton

78. Urticaceae
    1. Pilea herniarioides (Sw.) Lindl.
    2. Pilea microphylla (L.) Liebm.

79. Verbenaceae
    1. Citharexylum fruiticosum L.
    2. Lantana involucrata L.
    3. Phyla nodiflora (L.) Greene
    4. Valerianoides jamaicensis (L.) Kuntze

80. Vitaceae
    1. Cissus trifoliata L.
    2. Parthenocissus quinquefolia (L.) Planch

B. Monocotyledonae

1. Alismaceae
    1. Sagittaria sp.

2. Aloaceae (liliaceae)
    1. Aloe vera L.

3. Arecaceae (Palmaceae)
    1. Coccothrinax argentea (Lodd.) Sarg.
    2. Cocos nucifera L.
    3. Phoenix dactylifera L.
    4. Sabal palmetto (Walt.) Todd.
    5. Serenoa repens (Batr.) Small
    6. Thrinax microcarpa Sarg.
    7. Thrinax parviflora Sw.

4. Bromeliaceae
    1. Dendropogon usneoides (L.) Raf. (Tillandsia usneoides L.)
    2. Tillandsia aloifolia Hook
    3. Tillandsia balbisiana Schult.
    4. Tillandsia circinata Schlect.
    5. Tillandsia fasciculata Sw.
    6. Tillandsia utriculata L.

5. Convallariaceae (Liliaceae and Agavaceae)
    1. Asparagus officinalis L.
    2. Asparagus plumosus Baker
    3. Asparagus springeri Regel
    4. Cordyline guineensis (L.) Britton (Sansevieria guineensis Wild.)

6. Cyperaceae
    1. Abilgaardia monostachya (L.) Vahl.
    2. Cyperus brunneus Sw.

3. Cyperus elegans L.
4. Cyperus inflexus Muhl.
5. Cyperus ligularis L.
6. Dichromena colorata (L.) A. Hitchc.
7. Eleocharis atropurpurea (Reitz) Kunth
8. Eleocharis cellulosa Torr.
9. Fimbristylis castanea (Michx.) Vahl.
10. Fimbristylis spathacea Roth
11. Mariscus jamaicensis (Crantz) Britton (Cladium effusum (Sw.) Torr.)
12. Rynchospora microcarpa Baldw.
13. Schoenus nigricans L.

7. Ixiaceae
    1. Sisyrinchium sp.

8. Juncaceae
    1. Juncus romerianus Scheele

9. Leucojaceae (Amaryllidaceae—Agavaceae)
    1. Agave decipiens Baker
    2. Agave sisalana Perrine
    3. Aletris bracteata Northrop
    4. Hymenocallis keyensis Small
    5. Hypoxis wrightii (Baker) Brackett

10. Musaceae
    1. Musa sapientum L.

11. Orchidaceae
    1. Bletia purpurea (Lam.) D.C.
    2. Encyclia tampensis (Lindl.) Small (Epidendrum tampense Lindl.)
    3. Habenaria quinqueseta (Michx.) Sw.
    4. Vanilla eggersii Rolfe (V. barbellata Reichb.)

12. Poaceae
    1. Andropogon glomeratus (Walt.) B.S.P.
    2. Andropogon gracillus Spreng.
    3. Aristida purpurascens Poir.
    4. Capriola dactylon (L.) Kuntze (Cynodon dactylon Pers.)
    5. Cenchrus echinatus L.
    6. Cenchrus gracillimus Nash.

7. Chaetochloa geniculata (Lam.) Millsp. & Chase (Setaria geniculata)
8. Chloris petraea Swartz
9. Distichlis spicata (L.) Greene
10. Eleusine indica (L.) Gaertn.
11. Eragrostis amabilis (L.) Wight & Arn.
12. Eragrostis ciliaris (L.) R. Br.
13. Eragrostis elliottii S. Wats.
14. Lasiacis divaricata (L.) A. Hitchc.
15. Monanthochloe littoralis Engelm.
16. Muhlenbergia capillaris (Lam.) Trin.
17. Panicum bartowense Scribn. & Merr.
18. Panicum fasiculatum Sw.
19. Panicum adspersum Trin.
20. Panicum sp.
21. Panicum virgatum L.
22. Paspalum blodgettii Chapm.
23. Paspalum monostachyum Vasey
24. Paspalum vaginatum Swartz.
25. Saccharum officinarum L.
26. Setaria magna (Griseb.) Scribn.
27. Sorghastrum secundum (Ell.) Nash
28. Spartina junciformis Engelm. & Gray
29. Sporobolis domingensis (Trin.) Kunth
30. Sporobolis virginicus (L.) Kunth
31. Stenotaphrum secundatum (Walt.) Kuntze
32. Syntherisma sanguinale (L.) Dulac.
33. Uniola paniculata L.
34. Valota insularis (L.) Chase

13. Smilacaceae (Liliaceae)
    1. Smilax havanensis Jacq.

14. Typhaceae
    1. Typha angustifolia L. (T. domingensis Pers.)

15. Zannichelliaceae
    1. Ruppia maritima L.

List of Plants Found on Adjacent Keys But Not on Big Pine Key

A. Dicotyledonae

1. Carduaceae (Compositae)	
1. Eupatorium capillifolium (Lam.) Small	Cudjoe, Little Torch, and Sugarloaf Keys
2. Helianthus annuus L.	Cudjoe Key
3. Leptilon pusillum (Nutt.) Britton	Spanish Harbor Key
2. Clusiaceae	
1. Clusia rosea L.	Little Torch Key
3. Cucurbitaceae	
1. Melothria crassifolia Small	Little Torch Key
4. Euphorbiaceae	
1. Chamaesyce cordifolia (Ell.) Small	No Name, Ramrod, and Cudjoe Keys
2. Chamaesyce garberii Small	No Name Key
5. Fabaceae	
1. Cajan cajan (L.) Millsp. (Cajanus indicus Spreng.)	Cudjoe Key
2. Crotalaria incana L.	No Name Key
6. Frangulaceae	
1. Colubrina colubrina (Jacq.) Millsp. (C. ferruginosa Jacq.)	Spanish Harbor Key
7. Lauraceae	
1. Persea persea (L.) Cockerell (P. americana Mill.)	Cudjoe Key (grove)
8. Meliaceae	
1. Melia azedarach L.	Cudjoe Key
9. Mimosaceae	
1. Albizzia lebbek (Willd.) Benth	Cudjoe and Little Torch Keys
10. Myrtaceae	
1. Melaleuca leucandendra L.	Little Torch Key

11. Polygalaceae	
1. Asemeia grandiflora (Walt.) Small (Polygala grandiflora Walt.)	Ramrod and Little Torch Keys
12. Rubiaceae	
1. Spermacoce tetraquetra A. Rich	Cudjoe
13. Sapindaceae	
1. Melicocca bijuga L.	Cudjoe, Little Knock-'emdown Keys
14. Spondiaceae (Anacardiaceae)	
1. Rhus leucantha Jacq.	Little Pine Key
15. Vitaceae	
1. Muscadinia munsoniana (Simpson) Small	Sugarloaf Key
16. Zygophyllaceae	
1. Tribulus cistoides L.	Spanish Harbor Key
B. Monocotyledonae	
1. Arecaceae (Palmaceae)	
1. Livistonia chinensis R. Br.	Cudjoe and Little Torch Keys
2. Washingtonia robusta Wendl.	Big Torch, Ramrod Keys
2. Commelinaceae	
1. Commelina elegans H.B.K.	New Found Harbor Keys
3. Leucojaceae (Amaryllidaceae)	
1. Crinum sp.	Little Knock'emdown Key
4. Poaceae	
1. Tricholaena rosea Nees	Little Torch Key

Summary

Four hundred and fifteen species of plants occurring in one hundred and two families have been listed from twenty-five of the lower Keys.

Nine ferns and one Gymnosperm are included. The lower plant forms were not studied during this investigation.

Quart. Journ. Fla. Acad. Sci. 16(3), 1953.

RESEARCH NOTES

FURTHER EXTENSIONS OF THE RANGE OF THE SHEEPSHEAD KILLIFISH, *Cyprinodon hubbsi* Carr.—*Cyprinodon hubbsi,* a dwarf species of sheepshead killifish, was originally reported only from Lake Eustis, Lake County, Florida (Carr, 1936, Copeia (3): 160-163). Reid (1948, Quart. Journ. Fla. Acad. Sci., 11(2-3): 67-68) found *C. hubbsi* in Lake Weir, Marion County, Florida. No additional records of this small fish have ever been published.

Lake Eustis is one of a chain of large central Florida lakes forming part of the St. Johns River drainage system. Lakes Dora and Harris are connected by short waterways to the south end of Lake Eustis, and Haine's Creek joins the west side of Lake Eustis with the east side of Lake Griffin. The latter lake forms the headwaters of the north-flowing Oklawaha River, which is tributary to the St. Johns. These four lakes lie entirely within Lake County.

On June 11, 1953, I collected two specimens of *C. hubbsi* off an open sandy beach along the north shore of Lake Harris. On June 12, with the help of Mr. Rex Land, a series of *C. hubbsi* was taken in a similar situation near Yalaha on the south shore of Lake Harris. Another series was collected on the same day at the south end of Lake Griffin within the city limits of Leesburg. On June 16, we collected four *C. hubbsi* from the north shore of Lake Dora just west of Mount Dora. Two of these were very small individuals, measuring 11.5 and 12.7 mm. in standard length.

The following fishes were taken in the same general areas as the *C. hubbsi*: *Dorosoma petenense vanhyningi* (Weed), *Fundulus seminolis* Girard, *Menidia beryllina* (Cope), *Notropis petersoni* Fowler, *Opsopoeodus emiliae* Hay, and *Strongylura marina* (Walbaum). In addition, young specimens of the following were taken: *Ictalurus catus* (Linnaeus), *Lepomis auritus* (Linnaeus), *Lepomis macrochirus purpurescens* Cope, *Lepomis marginatus* (Holbrook), *Micropterus salmoides floridanus* (Le Sueur), *Notemigonus crysoleucus bosci* (Valenciennes), and *Pomoxis nigromaculatus* (Le Sueur).

Although *C. hubbsi* appears characteristically to inhabit the shallow, sparsely vegetated waters along wave-swept, sandy beaches, Mr. Melvin T. Huish, fisheries biologist with the Florida Game and Fresh water Fish Commission, informs me that it is frequently taken in an otter trawl dragged over soft mud bottoms in 11 to 13 feet of water, both in Lakes Eustis and Harris.—ROBERT E. HELLMAN, 507 East 76th Street, New York City, New York.

THE ALLIGATOR GAR IN FLORIDA.—The eastern limits of the range of the alligator gar, *Lepisosteus spatula* Lacépède, have never been satisfactorily determined. Because of the absence of recent published records and museum specimens, most ichthyologists have been reluctant to accept various unsubstantiated reports of its occurrence within the state of Florida. Evermann and Bean (1896, Report U. S. Comm. Fish.: 240) report this species from creeks flowing into Indian River and from Lake Poinsett in the St. Johns River, Brevard County, Florida. Lönnberg (in Evermann and Kendall, 1899, Report U. S. Comm. Fish: 50) cites it from Lake Johns near Oakland, Orange County, Florida. Aside from the fact that these localities are isolated from the rivers of the Gulf drainage in which the alligator gar normally occurs, the complete absence of recent reports from these heavily fished areas of Florida strongly suggests either an error on the part of earlier workers or that the fish no longer exists in the east-central region of the state. Some confusion may have resulted from the local application of the name alligator gar to the common short-nosed species, *Lepisosteus platyrhincus,* in many parts of peninsular Florida. Carr (1936, Proc. Fla. Acad. Sci., 1:78) included *L. spatula* in his key to the freshwater fishes of Florida on the basis of the above records and a belief in the strong probability that future collecting would uncover it in the northwestern Panhandle.

Recently, through the efforts of Messrs. F. G. Banks and Floyd D. Nixon of the Florida Game and Fresh Water Fish Commission, two specimens of this gar were obtained from West Florida and donated to the University of Florida collections. One was taken on a rod and reel by Swinson A. Shipman, in Pine Barren Creek, a tributary of the Escambia River, one mile east of Barth, Escambia County, June 12, 1953. Following are its measurements and scale and fin ray counts (all rudiments counted): head length 41 cm.; total length 153 cm.; scales in longitudinal series from dorsal edge of operculum to origin of caudal rays 63; D. 9; A. 8; P_1 13; P_2 6. The second specimen was caught by Wildlife Officers R. K. Henderson, R. A. Marsh, and John Miller on a trot line stretched across the Choctawhatchee River at Wise's Bluff, 2 miles south of Bruce, Walton County, also on June 12, 1953. Its measurements and scale and ray counts are as follows: head length 39 cm.; total length 148 cm.; scales counted as above 61; D. 9; A. 9; P_1 12; P_2 6.

Apparently alligator gars do not occur east of the Choctawhatchee drainage. Although they are very abundant in both the Choctawhatchee and Escambia Rivers where they have become a nuisance to sportsmen and commercial line fishermen, I can find no reports of their presence in the Apalachicola and more easterly rivers. They have been accused by one commercial fisherman of stripping baited lines in the Yellow River in the vicinity of Broxon, Santa Rosa County, although they caused him no trouble at a more northerly fishing site on the same river.

The great abundance of the alligator gar in the lower Choctawhatchee River was demonstrated to me on the afternoon of June 22, 1953, when in the company of Russel Bourkard, Floyd Nixon, and Sam R. Telford, Jr., a number of specimens were seen just north of the bridge at Florida Highway 20, about one mile west of Ebro, Washington County. In a quiet backwater three gars were readily hooked on heavy duty fishing tackle and shot with a .30-30 rifle and .38 caliber pistol. Only one of these specimens was successfully landed, however, as we were unable to retrieve the other two gars after the line broke in deep water. The former specimen was a male nearly six feet in total length. Its stomach was empty.—ROBERT E. HELLMAN, 507 East 76th Street, New York City, New York.

THE PLACE-OF-ORIGIN OF FLORIDA'S POPULATION. AN ABSTRACT. —The population of Florida is composed of a complex mixture of people from all parts of the United States. Only one-half of the total population residing in Florida in 1945 had been born in Florida—a decrease of 10 per cent since 1870, the first time that place-of-birth of all elements of the population was recorded by the Federal Census. Thus, the proportion of native-Floridians has been declining at the expense of out-of-state migrants to Florida.

The State Census of 1945, moreover, revealed that Florida's two adjacent states, Georgia and Alabama, had contributed the largest numbers from outside Florida; but the latter (Alabama) was closely followed by New York and Pennsylvania as places of origin of Florida's population. Other states, particularly Southeastern and Northeastern, also contributed significant numbers.

A more detailed record of place-of-origin of migrants to Florida, although for a short period of time, was given in the 1940 Federal Census. This report revealed that the largest number of migrants to Florida between 1935 and 1940 came from large cities (100,000 or more population), a small number from farms. In comparison, the principal destinations in Florida were small cities and towns, and, to a lesser degree, large cities and suburban areas.

A study of place-of-origin of population for small units in Florida, i.e., counties, reveals that native Floridians form a very large proportion in the northern part of the state, the oldest-settled section. Georgia-born people are concentrated in the northeastern and east central parts, Alabamans in the extreme western part, and New Yorkers and Pennsylvanians in the central and southern parts of the state. Migrants from other states follow somewhat closely one or the other of these latter three patterns of distribution.

The significance of patterns of distribution of diverse elements of population lies largely in the attitudes and abilities that each element has. Most migrants to Florida from Southern states have come from either rural areas or from small cities and towns; consequently, they bring with them largely traditional southern economic and social attitudes and largely rural technical skills. Most migrants from Northeastern and North Central states have come from large cities; consequently, they bring largely northern economic and social attitudes and largely commercial and industrial skills. Many have moved to famous retirement spots, where comfort and beauty are prime considerations. All in all, many different kinds of people have been added to the most rapidly growing southern state, Florida.—DONALD R. DYER, Department of Geography, University of Florida.

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INTERRACIAL INCIDENTS IN THE MOVEMENT OF NEGROES TO THE STATE OF WASHINGTON

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Without attracting widespread attention the Negro population of the State of Washington has been growing consistently. The bulk of this increase has been due primarily to in-migration. At various times since Negroes have been in the State there have been periods when their numbers have been relatively stable. At other times there have been periods of very rapid increase. The growth of the Negro population as presented in Figure 1 shows that the periods of most rapid growth were from 1880 to 1910 and from 1940 to 1950. Greatest stability occurred from 1860 to 1880 and from 1910 to 1940. Numerically, this growth pattern may be insignificant since at no time in the history of the State have Negroes constituted more than 1 per cent of the total population. Sociologically, the pattern is important because the movement of people and their subsequent adjustment bear directly upon a generally accepted theory that as the number of a minority racial group increases in a specific locality, there is a corresponding increase in the degree of interracial tension and animosity. The purpose of this paper is to present a brief description of interracial incidents which took place as Negroes moved to Washington, and to interpret these incidents in light of this theory.

The earliest reference obtained regarding the presence of a Negro in Washington was the case of George Bush who came to the State around 1844 (Snowden, 1909). This case illustrates the high degree of interracial acceptance which was achieved by Negroes at this time. Bush was originally a freeman in Pennsylvania but he came to Washington from Missouri in the company of William Shaw, a white pioneer. He hoped to escape racial prejudice in Missouri by living in Oregon. Upon arriving in Oregon, however, he found that laws forbade his residence there and that he would be periodically whipped if he remained. Consequently, he was forced to move farther north, in the company of his friends. Being among the first settlers in the Puget Sound area he became so completely accepted and well-liked by the white members of the community that a special act of the United States Congress was unanimously passed in 1855 which granted him and his wife ownership of a sizeable portion of land which they had been farming. This act was necessary because at this time Negroes could not legally receive benefits of the Donation Act.

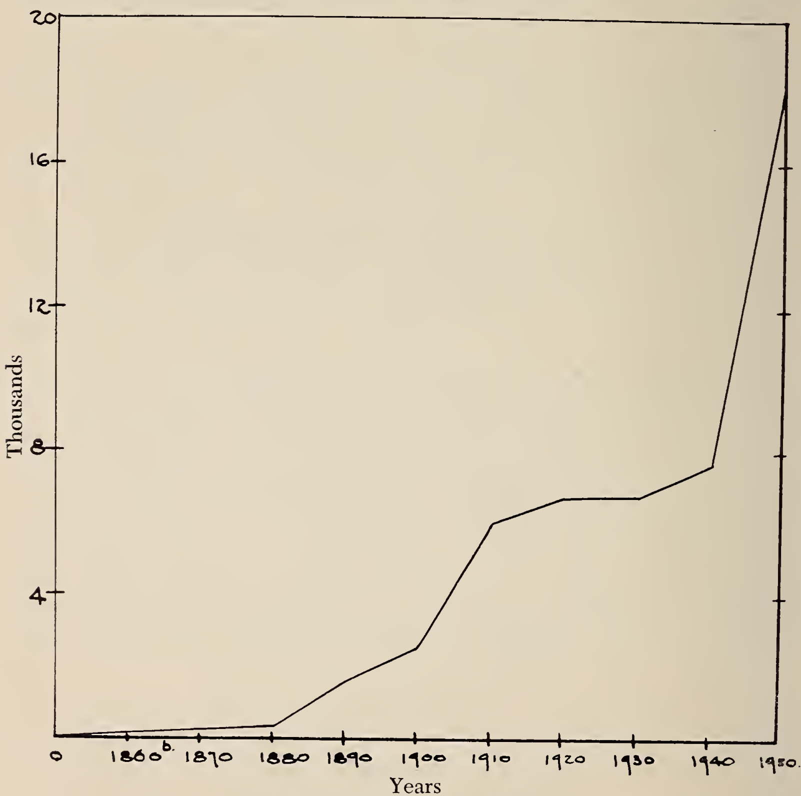

Figure 1.—Growth of Negro Population in the State of Washington, 1860-1950 [1]

[1] No Negroes reported in the Census prior to 1860.

Similar is the case of William Gross (Snowden, 1909), a Negro, who came to Seattle in 1859 at the specific request of Governor Stevens. During his lifetime in Seattle Gross became completely accepted by the white population and was on intimate terms with Yesler, Denny and other pioneers. Upon his death he was reported to be quite wealthy, a large taxpayer and a prominent citizen of the community.

These two cases indicate that in the early days of Washington there was little apparent racial prejudice and discrimination. It is quite significant that both Bush and Gross were in the State at a time when Negroes were extremely scarce. As a matter of fact the Census reported no Negroes in the State prior to 1860, and it was not until 1890 that as many as a thousand were reported.

When Negroes appeared in Washington in comparatively large numbers as they did in the latter decades of the 19th century and the first decade of the 20th, noticeable tension was aroused. Although some of the Negroes who migrated to Washington during this period came there of their own initiative, the sharp increases shown in Figure 1 are due largely to the activities of labor recruiting agents and employment organizations which sought Negro workers as a cheap labor supply to relieve the acute industrial labor shortage in the Northwest. Negroes were particularly in demand at this time for use in the mines as strikebreakers.

The incidents which occurred as a result of this in-imgration are of special interest (Spokesman Review 1890-1910). In several instances Negroes were imported to the State for certain jobs only to find upon arrival that no such jobs awaited them and/or white workers refused to work with them and agitated to have them sent back "home". These were principally jobs with railroads and in the mines, although similar situations occurred in the lumbering industry. In 1893 acts of violence were committed against the members of the Negro community in Tacoma. As a result these Negroes held a mass meeting to protest the "daily murders" of members of their group by outraged white residents. In several other instances the settlement of Negroes in white communities around 1900 aroused such animosity and tension that consideration was given to the establishment of completely separate Negro communities. Among others, Booker T. Washington investigated the possibility of such a project. Although no authoritative reports were found which showed that community projects of this type actually developed, the fact that they were even considered points to racial antipathy in the State during this period. In 1898 Negro masons were accepted by the white masonic orders only to have action taken the following year which rescinded the resolution after a flurry of protests. In 1910 the 25th Infantry, a Negro unit, was stationed at Fort Lawton in Seattle. White residents raised such vociferous objections that the unit was quickly removed to Fort Logan, Colorado. Although there was no law against racial intermarriage in the State, records show that several judges and license authorities registered strong indignation when such applications were made, and in several cases refused to grant the license or marriage. The problems of intermarriage and concomitant interracial tension were aggravated by the extreme scarcity of Negro women in the area. These events give some indication of the attitudes which developed toward Negroes in Washington from 1880 to 1910 when their numbers grew rapidly.

The period 1910 to 1940 appears to be one of relative quiet on the interracial scene in Washington. Significantly, this was a period of slow growth in the Negro population. In this interval the Negro population increased by only 1,366 persons; an average increase of 45 persons per year, as compared with an increase of 5,633 persons for the thirty years preceding (Smith, 1950). The fact that little interracial tension was apparent in the State is borne out by Horace Cayton (1930), a Negro, and a long-time Washington resident who said that ". . . A careful survey of the State would show a [Negro] population (sic.) who enjoy all the privileges of any other group of citizens . . ." The writer does not assert that no tension indicating developments occurred in this period, but simply that none were found in a careful search through available literature.

Between 1940 and 1950, due to the defense industry boom the Negro population of the State again increased with great rapidity, from 7,424 to an estimated 18,000 (Smith, 1950). This in-migration was accompanied by a number of interracial incidents (Schmid, 1944). Considerable tension developed when white aircraft workers demanded separate toilet facilities in a factory which operated on an unsegregated basis. In another case a Negro purchased a home in a white residential area but was unable to live in it because of threats and high feeling on the part of the white residents. In still another case conflict was generated when a group of Negroes was denied admittance to two skating rinks.

In November, 1945, a Negro and a white police officer were killed in a gunfight in Seattle which produced considerable interracial tension (Civic Unity Committee, 1948). This tension was aggravated by the difference of opinion as to whether the Negro was brutally murdered or his death was unavoidable homicide. Though no violence occurred, feeling ran high for some time. In the spring of 1948 when the Negro population was at its peak in Washington and the city of Seattle, a number of interracial incidents of a disturbing nature happened in the Duwamish Bend Homes, a temporary city housing project in Seattle (Dodd, et al, 1948). Two reported cases of rape of white women by Negroes and other attempted rapes in the project caused tension between the races and some fear among the 300 Negro families scattered throughout the project. Stabbings, the presence of guns, rumors and emotional talk were evidence of increasing interracial tension. Although no violence took place between the races in this housing project, the important point for this paper is that the incidents did take place and some tension resulted from them. In September, 1948, interracial tension flared when a mixed white-Negro family moved into the previously all-white Broadview community (Smith, 1950). Rumors flew, a petition was circulated requesting that the family be forced to move, and tension was focused on the situation. In this case quick constructive action made it possible for the family to remain in the community and to become gradually accepted.

In the preceding description one is able to observe the similarities in the pattern of interracial incidents from 1890 to 1910 and from 1940 to 1948. When the writer was engaged in this research in the State from 1948 to 1950, it appeared that another period of accommodation and interracial calm had begun. Systematic study at this time revealed no instances of tension and overt antipathy. To the contrary, many white residents indicated that they were more favorably inclined toward Negroes than they had been before 1940. In speaking of the interracial tensions involving Negroes and whites during the early years of World War II a representative of the Seattle Police Department states: ". . . there was some racial tension, and some instances of violence, but nothing like the situations in Chicago and Detroit . . . " This informant went on to observe that at the time that this interview was obtained in 1949, "things" [interracial disturbances] had subsided and no such events were anticipated in the near future (Smith, 1950). By 1949, the Negro population had ceased to grow perceptibly and in some areas it showed evidences of declining as the war industry boom ended. At least no important increases in the Negro population in the State were expected in the immediate future.

While the writer makes no claim that the evidence presented in this paper is conclusive, the pattern emerging from the descriptive evidence obtained is clear. At times of stability in the Negro population interracial incidents and tensions were scarce. This stability seemed to induce the process of accommodation and a general feeling of interracial well-being between Negroes and white. When Negroes migrated to the State in comparatively large numbers interracial disturbances occurred. These disturbances produced tensions of varying degrees in which disaster was averted in several instances by thoughtful and immediate civic action. On the basis of this investigation, support is given the original theory that there is a direct relationship between the increase of the numbers of a minority racial group in an area and the amount of interracial tension resulting.

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FLORIDA'S NON-METROPOLITAN URBAN GROWTH 1930 TO 1950

SIGISMOND DER. DIETTRICH
University of Florida

Florida's rapidly growing population passed the one million mark in the first half of the twenties. The first proofs of emerging from a poineer state of existence, however, were encountered by the Census of 1930. By that year three metropolitan cities with over 100,000 inhabitants each, appeared in the enumeration. At the same time the national trend of urban development has become apparent in Florida's population as well. By 1930, 51 per cent of the Floridians lived in urban communities with 2,500 inhabitants or more. There were 58 of such communities in the State. The strength of the incipient urbanization and metropolitan growth was further attested by the fact that 23.3 per cent of the Floridians lived in the three metropolises of Jacksonville, Miami and Tampa. At the same time these three metropolises accounted for 45.6 per cent of the urban population of the State. Thus, in Florida's urban development, 1930 can be considered as a critical year dividing the dominantly non-urban pioneer epoch of Florida's growth from the present, maturing urban period.

For the present study only those people who live within the incorporate limits of cities and towns of 2,500 or more inhabitants are to be considered. The redefinition by the Bureau of Census of the metropolitan-suburban areas from the *metropolitan district,* as used in the Census of 1940 to *standard metropolitan areas* in the 1950 enumeration, made direct comparisons impossible until such times when a complete enumeration of the data pertaining to the, by now four, standard metropolitan areas of Florida will be published. Since 1950 Orlando with 114,950 people in the city and vicinity has advanced to a metropolitan status.

To add to the complications, the Bureau of Census has redefined also the term *urban* and introduced a new concept under the name of *urbanized area.* Therefore, in order to keep the discussion on a comparable basis: (1) data pertaining to: (a) metropolitan districts, (b) standard metropolitan areas, (c) urbanized areas were eliminated from the basic tabulation; (2) the term *urban* is being

FLORIDA GROWTH OF URBAN COMMUNITIES — 1930-1950

Classification	Size		1930				1935				1940				1945				1950			
			Unit	People	Percentage		Unit	People	Percentage		Unit	People	Percentage		Unit	People	Percentage		Unit	People	Percentage	
					Total	Urban			Total	Urban			Total	Urban			Total	Urban			Total	Urban
Towns	2,500 to 9,999	Number	44	201,128	13.60	25.40	44	203,708	12.68	24.56	50	222,748	11.84	21.33	56	263,636	11.60	20.30	68	322,105	11.60	20.00
		Increase	....	....	....	....	0	2,580	1.86	3.69	6	19,040	6.55	8.86	6	40,888	11.59	16.38	12	60,469	11.60	19.24
Cities	10,000 to 24,999	Number	7	91,359	6.20	12.20	9	122,395	7.62	14.75	12	171,370	9.03	16.44	12	173,156	7.80	13.50	15	222,223	8.00	13.80
		Increase	....	....	....	....	2	31,036	22.30	45.22	3	48,975	16.85	22.79	0	1,786	.51	.71	3	47,067	9.03	14.97
Large Cities	25,000 to 49,999	Number	4	125,944	8.60	16.80	4	129,411	8.05	15.60	4	135,890	1.06	13.01	6	199,116	8.85	15.38	10	336,634	12.10	20.90
		Increase	....	....	....	....	....	3,467	2.50	4.97	....	6,479	2.23	3.01	2	63,226	17.93	25.31	4	137,518	26.39	43.75
Small Metropolises	50,000 to 99,999	Number	0	None	....	....	0	None	....	....	1	60,812	3.21	5.82	2	135,289	6.01	10.45	2	149,105	5.40	9.30
		Increase	....	....	....	....	....	....	....	....	1	60,812	20.93	28.29	1	74,477	21.12	29.81	0	13,816	2.65	4.40
Metropolises	100,000 and over	Number	3	341,347	23.30	45.60	3	374,010	23.28	45.09	3	453,628	23.91	43.43	3	523,040	23.20	40.40	3	578,474	20.90	36.00
		Increase	....	....	....	....	0	32,663	23.56	46.12	0	79,618	27.41	37.05	0	69,412	19.68	27.79	0	55,434	10.63	17.64
	Total:																					
	Urban		58	759,778	51.70	100.00	60	829,524	51.62	100.00	70	1,044,448	55.05	100.00	79	1,294,237	57.50	100.00	98	1,608,541	58.00	100.00
	Non-urban		....	708,433	48.30	....	....	777,318	48.38	....	....	852,966	44.95	....	....	955,824	42.50	....	....	1,162,764	42.00	....
	State			1,468,211	100.00	....		1,606,842	100.00	....		1,897,414	100.00	....		2,250,061	100.00	....		2,771,305	100.00	....
	Increase:																					
	Urban		....	....	....	....	4	69,746	50.31	....	10	214,924	73.97	....	9	249,789	70.83	....	19	314,304	60.30	....
	Non-urban			....	....	....		68,885	49.69	....		75,648	26.03	....		102,858	29.17	....		206,940	39.70	....
	State			....	....	....		138,631	100.00	....		290,572	100.00	....		352,647	100.00	....		521,244	100.00	....

Location	1930 Number	1930 Increase	1935 Number	1935 Increase	1940 Number	1940 Increase	1945 Number	1945 Increase	1950 Number	1950 Increase
Peninsula	47	....	49	2	57	8	64	7	79	15
Mainland	11	....	11	0	13	2	15	2	19	4
Total	58	....	60	2	70	10	79	9	98	19

Sources: FLORIDA: Final Population, Sixteenth Census of the United States: 1940, BUREAU OF THE CENSUS, Department of Commerce, Washington, D. C., 1941.
The Seventh Census of the State of Florida, 1945, Nathan Mayo, COMMISSIONER OF AGRICULTURE (Tallahassee, Florida), for 1935 and 1945.
Population of Florida, 1950 Census of Population, Series PC-8, No. 9, BUREAU OF THE CENSUS, Department of Commerce, Washington, D. C., 1951.

used as denoting that proportion of the population which lives within the corporate limits of towns and cities of 2,500 or more inhabitants; (3) the rest of the population is designated as *non-urban.*

The urban communities have been divided into five size classifications, those with inhabitants of (1) 2,500 to 9,999 termed *towns;* (2) 10,000 to 24,999 termed *cities;* (3) 25,000 to 49,999 termed *large cities;* (4) 50,000 to 99,999 termed *small metropolises;* finally (5) 100,000 and over termed *metropolises.* The main emphasis of this study will concern the *towns* and *cities,* groups 1, 2 and 3 of this classification.

During the first decade of the period of 1930 to 1950 the urban growth of Florida was dominated by the three metropolises of the State. In 1935 these included almost a quarter, 23 per cent, of Florida's population and contained almost half, 45 per cent, of the urban population of the State. They also accounted for almost a quarter, 23 per cent, of the total increase of the State's population and for 46 per cent of the urban population's increase. There was not a single small metropolis in the State. The situation changed little by 1940, the relative percentages of the metropolises remained almost the same as in 1935. The significant change was that while the total increase in population was more than twice as large from 1935 to '40 than from 1930 to '35, the increase in the inhabitants of metropolises was almost two and a half times as large as that of the first half of the decade. Expressed in percentages: the total increase of population was 206 per cent as compared to the 247 per cent increase in the metropolitan population.

A second important development was the appearance of a small metropolis, St. Petersburg. The 60,812 inhabitants of this new small metropolis were enough if added to the metropolitan population to dominate the situation. Almost 30 per cent of the total population and almost half of the urban population was concentrated in these four metropolises.

While Florida's largest urban communities were thus dominating the dynamic growth of the State, the large cities appeared to remain stagnant, its cities showed signs of retrogression and its towns were definitely losing out in competition with the larger places. During the decade the number of large cities remained stationary at 4. It is true that the largest one rose into the small metropolitan classification but the one, Miami Beach, which replaced the lost St. Petersburg, was only half the size of the latter. Thus, actually the increase in the three original large cities, Orlando, Pensacola and West Palm Beach amounted to approximately 20,000 people during the second half of the decade, which represents a higher rate of increase than the three metropolises showed during the same period. As a group, however, the big cities' relative position steadily declined from 1930 to 1940.

The number of cities increased slowly but steadily from 7 in 1930 to 9 in 1935 and 12 in 1940. In the same fashion during this decade their percentages of total and of urban populations rose from 6.2 and 12.2 to 7.6 and 14.8, ending with 9.0 and 16.4 respectively. Though there were these small increases both in the number of units and in the relative importance of the group, the rate of increase was much lower than in the case of total urban population or of the metropolises. Thus, while betwen 1930 and 1935 the numerical increase in population was practically the same in the case of bath groups, with an increase of 31,036 for the cities and 32,663 for the metropolises, during the second half of the decade the increases amounted to 48,975 and 79,618 respectively. This meant that the rate of increase was only 155 per cent in the case of the cities as contrasted to the metropolitan rate of 247. Actually these cities with the exception of Tallahassee, which increased its population by over 5,000, hardly grew at all. As a matter of fact three of them, St. Augustine, Key West and Sanford had either barely passed or had fallen under their respective 1930 level of population. What increase there was, was contributed mainly by the four new members of the group. Fort Lauderdale which more than doubled its population during the decade amply balanced, with its 17,996 inhabitants, the loss of Miami Beach to the large city group. Similarly, Panama City doubled its size by increasing from a small town of 5,402 in 1930 to thriving city of 11,610 people. Clearwater and Sarasota, the last of the four, each showed an increase of 3,000 people. Of the old group, besides bustling Tallahassee, only Lakeland, with an increase of 4,000 and Gainesville with 3,500 have shown dynamic growth.

In the case of the towns there was a definite decline in all respects except in the number of units which though remaining at 44 in 1935 had risen to 50 by 1940. Five vigorously growing places rose into the city class; thus in all, thirteen new towns were added to the group. Though in the aggregate this group held a higher number of people than any other group except the metropolitan, its relative significance has steadily declined.

In a dynamically growing, youthful society like Florida's, this group occupies a transitional position. New places are founded constantly which, if in the right location will attract new settlers, and if the human element can utilize the potentialities of the new settlement, will soon grow to the minimum size of a town. Chronologically, 1930 marks the end of the mushrooming of new settlements started during the Florida Boom. The majority of those which survived the bust were just reaching town size in 1930, hence, town units doubled between pre-Boom 1920 and post-bust 1930. A few stragglers came in during the decade and, as shown before, the vigorous ones outgrew the group's bounds. After 1928, especially after the Black Friday of Wall Street of 1929, though there was little founding of new cities in Florida, in-migration slackened but did not stop. Yet most of the newcomers moved into the metropolitan and large cities; hence the decline of the towns.

Not only was the first decade of this period dominated by the rapid growth of the metropolises, but it also marked the emergence of the Peninsula as a dominant section of the State. In 1930 out of the 58 urban communities 47 were on the Peninsula and only 11 on the Mainland. What was even more telling is the poor representation of the Mainland in the large units. All three metropolises are on the Peninsula and Pensacola alone represents the Mainland among the four large cities, likewise Tallahassee is the only Mainland city.

The situation is even more poignant in the case of the towns. There was an increase of four urban units; all four of them were on the Peninsula. It is true that Madison occurs for the first time in this group in 1935 but this gain was balanced by Perry dropping out of the category due to a loss of population. The two rapidly growing communities, Miami Beach and Fort Myers, which have risen into the city groups were on the Peninsula. As a strong contrast, the increase of seven Mainland towns varied between 200 and 1,500 persons.

The second half of this period is an era of rapid expansion, especiaplly is this true for the post-war years. From 1945 to 1950 the increase of population was 521,244 which almost equals the total population of the State in 1900, 528,542. Of this over half a million increase, 53 per cent was urban. But now the metropolises reaching their zenith position in 1945 went into an eclipse. The increases of their populations diminished from the all time high 79,618 in 1940, to 69,412 in 1945 and to 55,434 in 1950. Thus by the mid-century the metropolises seemed to have approached their limits of rapid growth. This is a sure sign of maturity and is quite in accordance with the national picture.

By 1945 Orlando had reached the small metropolitan size, thus raising to two the number of this class. Naturally this shift accounts for the large increase occurring in the grouping. From 1945 to '50, while Florida's population increase showed the largest gain in the State's history amounting to almost 25 per cent, both metropolitan groups showed only an approximate 10 per cent gain.

Undoubtedly this decade was the most dynamic one in Florida's history but it was not the metropolises' own anymore. Now the large cities have taken the lead. In the second half of the decade the large cities accounted for 50.5 per cent of the urban growth and 26.4 per cent of the total. The combined populations of the cities and large cities almost equal that of the metropolises. The number of large city units has risen to 10, that of the cities to 13. The new large cities are Lakeland, Ft. Lauderdale and Daytona Beach which reached this class in 1945 and Gainesville, Panama City and Tallahassee which joined the others in 1950.

The roster of cities increased only by 1 as compared to 1940 but four of them having had exceeded 25,000 inhabitants, became classified as large cities, thus actually there were five new additions to the group. Of these really noteworthy are North Miami with a 444 per cent increase in its population, Hialeah with 397 and Hollywood with a mere 130 per cent increase.

Somewhat similar is the story of the towns. Their number has risen from 50 in 1940 to 66 in '50. They still represent 11.3 per cent of the total population and 20 of the urban people. In this group too, there are a number of new members with spectacular increases of population like Miami Springs with a 468 per cent increase, and Opalocka with 960 per cent, which represents the highest percentage increase in the State. Even some of the Mainland towns show a tendency of rapid increase, like Panama City, or Crestview, both with 122 per cent increase. Similarly the new type of urbanized areas show such increases and high concentrations of population in the vicinity of Pensacola.

There can be no doubt that this large scale urbanization will continue in Florida. What are some of the factors involved that cause it? First there are a few general factors: (1) the growing industrialization of the State. Industry offers excellent job prospects for people. Industrial productivity doubles every 40 years, thus highly productive industry can give much higher wages than employment in agriculture. People moved into large cities because there the plants were, there they could earn more money. Panama City with its constant high rate of increase is an excellent example of this principle. (2) Greater cultural concentration, general increased tempo of life, which some people like. Better movies, theatres, concerts and other features of the cultural life are definite attractions of cities. (3) Many people like the privacy a city can offer. This is surely lacking in the small towns where everybody knows everyone else. In big cities one may have too much of it. Yet the submergence of oneself into the anonymous mass of a big city has its attraction.

In addition to the general considerations, there are a few specific factors like (1) political center like Tallahassee, (2) educational center like Gainesville, (3) defense establishments like Eglin Field which caused the great upsurge on Choctawhatchee Bay area including the aforementioned town of Crestview, last but by no means least (4) tourist potentials with so many examples that none needs to be mentioned.

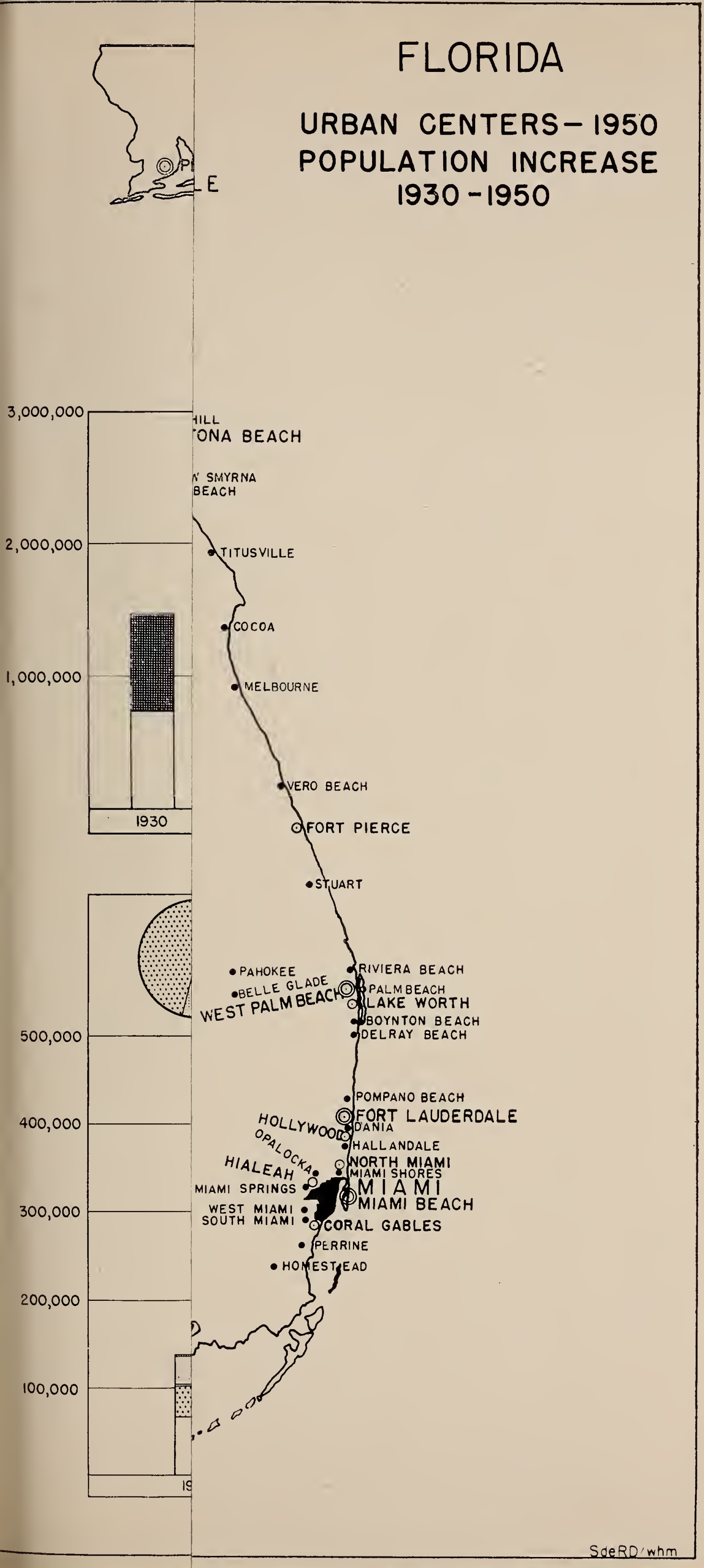
With the great significance of cities and urban life in Florida, have the Floridians paid sufficient attention to their fast growing towns, cities and metropolises? With the many blatant examples of mismanagement and abuse of natural attractions, it is high time that the people of Florida should examine and reevaluate what is being offered in Florida to induce the people to continue to come to Florida. In this modern era everything has to be advertised. But after the alluring advertisements, what are the stark realities the people face when they visit the cities of Florida. When one drives through a town and sees what it looks like, does it impress the driver to make him desirous to return and settle in the place or does he get the feeling that it is an unattractive dump?

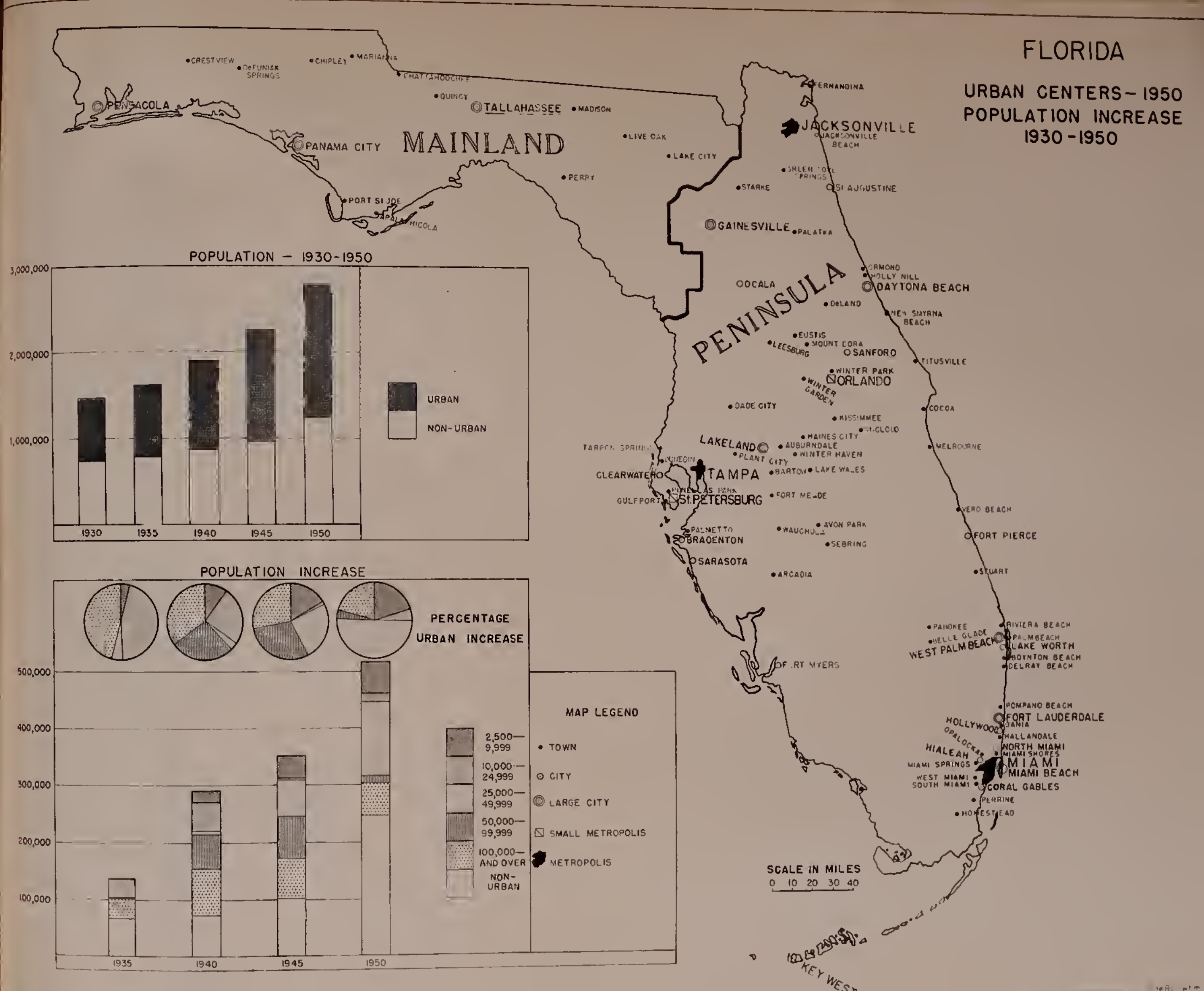
What should the cities offer? First they should offer a neat, clean place, physically attractive. There is a growing feeling among architects to try to improve the looks of the cities by improving the homes and buildings. They study now climate and topography to devise styles suited to local conditions.

Second, physical attractiveness without a friendly attitude of the people is insufficient, therefore, it is important that a friendly atmosphere should prevail.

Third, one has to make a living, sound economic foundation of the city is essential. Industrialization is important but it is not the only possible solution. People have to do a sound job of economic planning. These plans have to evolve for the intelligent uses of the natural resources which that particular locality has to offer. They have to be planned for the *whole* city. Engineers prepare city plans from their point of view which are excellent, economists make plans from their point of view, architects from theirs. Yet there seems to be a need for one in which they all have cooperated on a large scale to produce a master plan for a city as a whole in which the human factor is included as well as the physical and economic ones.

If the people of Florida wish to study the problems of their rapidly growing cities and apply intelligent solutions to their problems the future of State will be insured and a better place to live in created. Florida has the manyfold natural advantages awaiting development, the process of urbanization and city growth is undeniably here to stay, all what is needed is an intelligent leadership to build better and more beautiful towns and cities in Florida.


FLORIDA
URBAN CENTERS—1950
POPULATION INCREASE
1930-1950
TONA BEACH
TITUSVILLE
COCOA
MELBOURNE
VERO BEACH
FORT PIERCE
STUART
PAHOKEE
BELLE GLADE
WEST PALM BEACH
RIVIERA BEACH
PALM BEACH
LAKE WORTH
BOYNTON BEACH
DELRAY BEACH
POMPANO BEACH
FORT LAUDERDALE
HOLLYWOOD
DANIA
OPALOCKA
HALLANDALE
HIALEAH
NORTH MIAMI
MIAMI SHORES
MIAMI SPRINGS
MIAMI
MIAMI BEACH
WEST MIAMI
SOUTH MIAMI
CORAL GABLES
PERRINE
HOMESTEAD
SdeRD/whm
3,000,000
2,000,000
1,000,000
1930
500,000
400,000
300,000
200,000
100,000


FLORIDA
URBAN CENTERS – 1950
POPULATION INCREASE
1930 – 1950
MAINLAND
PENINSULA
CRESTVIEW
DeFUNIAK SPRINGS
CHIPLEY
MARIANNA
CHATTAHOOCHEE
QUINCY
TALLAHASSEE
MADISON
PENSACOLA
PANAMA CITY
LIVE OAK
LAKE CITY
PERRY
PORT ST JOE
FERNANDINA
JACKSONVILLE
JACKSONVILLE BEACH
STARKE
ST AUGUSTINE
GAINESVILLE
PALATKA
ORMOND
HOLLY HILL
DAYTONA BEACH
OCALA
DeLAND
NEW SMYRNA BEACH
EUSTIS
MOUNT DORA
LEESBURG
SANFORD
TITUSVILLE
WINTER PARK
ORLANDO
WINTER GARDEN
DADE CITY
COCOA
KISSIMMEE
HAINES CITY
LAKELAND
AUBURNDALE
WINTER HAVEN
PLANT CITY
MELBOURNE
TARPON SPRINGS
DUNEDIN
CLEARWATER
TAMPA
BARTOW
LAKE WALES
PINELLAS PARK
GULFPORT
St. PETERSBURG
FORT MEADE
VERO BEACH
PALMETTO
BRADENTON
WAUCHULA
AVON PARK
SEBRING
FORT PIERCE
SARASOTA
ARCADIA
STUART
PAHOKEE
BELLE GLADE
WEST PALM BEACH
RIVIERA BEACH
PALM BEACH
LAKE WORTH
BOYNTON BEACH
DELRAY BEACH
FT. MYERS
POMPANO BEACH
FORT LAUDERDALE
HOLLYWOOD
DANIA
HALLANDALE
OPALOCKA
NORTH MIAMI
MIAMI SHORES
HIALEAH
MIAMI
MIAMI SPRINGS
MIAMI BEACH
WEST MIAMI
SOUTH MIAMI
CORAL GABLES
PERRINE
HOMESTEAD
KEY WEST
SCALE IN MILES
0 10 20 30 40
POPULATION – 1930-1950
3,000,000
2,000,000
1,000,000
URBAN
NON-URBAN
1930
1935
1940
1945
1950
POPULATION INCREASE
PERCENTAGE URBAN INCREASE
500,000
400,000
300,000
200,000
100,000
2,500–9,999
10,000–24,999
25,000–49,999
50,000–99,999
100,000–AND OVER
NON-URBAN
1935
1940
1945
1950
MAP LEGEND
TOWN
CITY
LARGE CITY
SMALL METROPOLIS
METROPOLIS

SOME GEOGRAPHIC PROBLEMS OF THE BAHAMA ISLANDS

C. Wallace Dierickx

If Peter Styvesant were to land on Manhattan Island today, he probably wouldn't know where he was, but if Columbus landed on San Salvador in the Bahama Islands today he would find it in a good many respects unchanged since his arrival in 1492. While Columbus didn't know where he was going when he set out from Spain, in retrospect it seems quite natural that the Bahamas should be discovered as against some other spot. Then, as now, he had nearly three thousand islands, islets or rocks from which to choose. The winds and currents were such that perhaps it would have been harder to avoid them than find them. And if we but study Columbus it seems only just that the honors should be his, for besides being a determined man willing to endure the trials, scorns, and rejections of his ideas, he was beyond this an inspired man—nearly a superstitious one. He believed he was fore-ordained to find a new world and in his "Book of Prophecies" are found these lines from the *Medea* of Seneca: "There will come a time when the ocean sea will disclose its secret and a sailor shall discover a new world, and then shall Thule be no longer the last of the lands". So, having arrived at San Salvador Island, he explored it, and, fortunately, kept a diary to record what he saw. From what he describes, he would write very little differently today if he were to land at the exact same spot. He describes the abundance of water on the Island including a lake in the middle of it. He goes on to detail a land-locked bay which corresponds to Graham's Harbour of today. He discusses the people by saying they are "totally unacquainted with arms", "their conversation is the sweetest imaginable; their faces always smiling; and so gentle and affectionate are they that . . . there is not a better people in the world". These people, called Lucayos, were Arawak Indians who were relative newcomers to the Islands. They had been pushed progressively farther north by the warlike Carib tribe until their migration, which started in Brazil or the Guianas, had ended here. The Bahamas also served as a great tourist area for the Caribbean tribes—they came here to play and enjoy the beautiful climate. Columbus again describes them as being as "naked as when their mothers bore them", and as one old missionary who has been in the Bahamas more than thirty years has said, they had on about as much clothes apparently as the present tourist of the Bahamas wears today. Unfortunately, these gentle people were soon abducted to Hispaniola to work for the Spaniards, and in a short time every last one was gone. Then the Bahamas were temporarily without problems, but this problemless state only seems to be effected when a place is also quite without people.

After stopping at San Salvador Columbus explored various other islands in the group. What he found, with some notable exceptions such as New Providence and Eleuthera Islands, he would pretty much find today: primitive dwellings, crude agriculture, many refugees from other parts of the world, and many tourists. Today one doesn't have to visit the most remote of the islands to find houses that are given that title only because humans dwell in or nearby them. Nor, outside of the ventures of modern Americans and Europeans, has agriculture risen much above the gathering stage. As far as refugees go, the many who fled here from the European war and the Atlee labor regime form a sizeable colony along with wealthy Americans and Canadians seeking surcease from climate and taxes.

The modern history of the Bahamas begins then with the arrival of semi-permanent white people. Unfortunately these whites, far from being Pilgrim Fathers or even conquistadores such as the vicious Cortez and Pizarro (and even they had many good points), were just plain pirates. And geography could not have smiled more favorably on such a breed of men. Hundreds of quick harbors were available for a fast hide-out to those who knew their way around. Once ashore there were many a limestone cave for concealing treasure, for, contrary to many popular beliefs, the Bahamas are composed mainly of oolitic limestone and not of coral. If ships were not in the vicinity, or being in the vicinity were too strong to be attacked, it was easy to feign attack and then hurry in retreat while some unsuspecting prize cruised onto the many hidden rocks abounding in the area.

The pirate era, of course, seems a thing of the past that died when Bluebeard, Morgan, and the rest were swept off the seas. But the idea never really died and hasn't today. The motto of the Bahamas is: "Expulsis Piratis Restituta Commercia"—or freely translated, "The pirates having been driven out, commerce is restored". Yet since the time in 1718 when the pirates finally swore allegiance to the British Crown, these Islands have been the source of more loot and plunder than the most golden days of piracy. For a long period it was considered a respectable occupation to "salvage" wrecked ships—it still is. Yet sometimes the captain had been bribed in advance to take the wrong channel—and still is. In modern times, the location of these islands under a foreign power with unlimited nooks and crannies for concealment, made it the blockade running capital of the confederacy and later the liquor capital of the world when the United States tried its prohibition experiment. During those blockade and rum-running days actual piracy again returned, for not only did the runners have to dodge northern blockade ships or federal customs authorities, but they repeatedly fought armed battles among themselves in an attempt to hi-jack each others' loads. As one old schoolmaster has so aptly put it, the motto instead of "pirates expelled", should be "Ingeneratis Piratis"—pirates created, commerce was started.

With the quieting of the pirate problem, historically the Bahamas suffered the fortunes of war that many of these island areas did—the Spaniards captured them, lost them to the English, recaptured them again, only to lose them once more. Even as late as 1776 the Americans seized Nassau and held it for a brief time. Little of Spain remains, and the American imprint is of modern origin, for essentially this is an English country—except for the majority of the population. The majority, the so-called "native", is the descendant of slaves brought here by planters prior to Bahamian emancipation in 1838. The present slave-descendant is gentle, his hair "is short and coarse almost like the hair of a horse's tail", as Columbus described the Arawak, and he has but little more to say about his destiny than the original inhabitants of these Islands. His economic problems are acute: formerly many a family lived on the meager incomes of the sponge fisheries—supplemented by small returns from agriculture and domestic work. But when disease wiped out the sponges, starvation faced a good many. With piracy and rum-running gone, what remains as the Islands' main source of income? If it is true that the Arawak of Columbus' time were tourists, Columbus wouldn't be surprised to find it still the largest industry today. The city of Nassau prospers when tourists come—languishes when they don't—and as Nassau goes, so go the rest of the islands. The shops, the restaurants, the hotels, clubs, taxis and horse-drawn carriages, charatered fishing crafts, airlines, even the missionaries, depend upon the tourist for their incomes. This tourist boom, which received its initial impetus from Flagler, of Florida fame, and got its second big boost from Sir Harry Oakes, of murdered fame, seems to be a permanent one, subject only to cycles of depression and war in the United States, for geographically they are conveniently close, they have a warm winter climate, and they have the foreign atmosphere so desired by many United States vacationists. But depressions do come, and the economic shock is as bad as would be the failure of a rice crop in China. What can be done to take it off this one single standard?

Some areas of the Bahamas are thinly populated or absolutely devoid of population. Many of these areas could profitably support various agricultural enterprises. Because of their nearness to the United States and the seeming isolation that was offered by an insular position a number of loyalists from the United States came here after the Revolutionary War and had flourishing cotton plantations, only to exhaust the soil in a short time. Then the rich red "pineapple" soils of the Bahamas produced wonderful pineapples for export—today what pineapples it raises are in the main consumed locally. Formerly much of its citrus was exported abroad only to decline because of disease and neglect. Forests of good quality cover many of the islands, and while the lumbering interests of the Bahamas practice wise forestry methods, nearly all the lumber is exported, though it could be used as the basis for a local woodcraft industry. The sponges are gone—and no one seems to know how to make them return—yet Bahama waters teem with marine life of commercial value that is exploited only to the extent of a few conchs in the Nassau market and some enormous sea turtles awaiting slaughter in a specially designed pool erected by an animal humane society (while most of the population doesn't have even a single water faucet in their own homes). Industrially, native handicrafts which had nearly become dead are staging a comeback, and today mats, purses, shoes, hats, and the like are beginning to command good prices. Nearly all vegetables and meat products and some dairy products are imported—yet a New England corporation is making a good thing out of a modern dairy on Eleuthera Island, and there is good reason to believe that beef breeds suited to the tropics could replace Australian meat, local vegetables could certainly replace the ones now stamped "Grown in California" that can be purchased in Nassau. At one time Bahamian sisal was widely used in rope making and upholstering materials and was one of its large items of export only to be replaced by better-processed products grown elsewhere. The island of Inagua formerly was one of the greatest salt producing spots in this hemisphere, and salt figured large in the Bahamas trade to the United States. But failure to provide a pure product has permitted the Morton's "When It Rains It Pours" can to appear on all the grocery shelves of the islands.

All these facts are presented not so much to deprecate the islands but rather to appreciate what *has* been and can be done again. The present colonial administrators are continuing a planned program of improvement in natural resource use and the raising of quality standards of the items they export and the living standards of their own people as well. The raising of early tomatoes for export is becoming increasingly important, and they command high prices because of their quality and their early arrival date. A cannery has been opened to process some of these tomatoes, and in the off season it cans pineapples and coconuts. The Bahama's Development Board has been doing a remarkably good job of publicizing the islands to potential tourists. It has opened offices in New York, Miami, and Toronto, and just recently opened a new branch in Houston in recognition of the increasing numbers of Texans that are coming to Nassau. Their literature is well written, attractively illustrated and rightly stresses their magnificient climate—a mild climate that changes little from day to day or season to season. In addition missionaries, particularly the Benedictines, are educating the natives on the islands and sending increasing numbers of promising colored students to Benedictine universities in the North so that they can, upon their return, help lift their fellow men up the economic ladder.

But only the surface of potential economic improvement has been scratched, and until larger scale developments are started, the population, nearly the same number that were there when Columbus arrived, will continue to experience the same problems of their ancestors—the inability to use their soils properly, and a failure to fully use their other limited resources.

When a former inspector of Out Island schools, who knows the island so well, was quizzed on how the Bahamas were to survive under all types of economic conditions, he said:

"Well, of course, our main income will have to continue to be tourists."

"And if not tourists?"

He replied. "Well, I guess, we'll have to hope for unusual conditions such as prohibition or blockade-running to see us through. And that failing, there's always the good Lord."

But the Lord helps those who help themselves.

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THE QUESTION OF INNATE GREGARIOUSNESS OR SOCIABILITY

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In 1940 a textbook with a title of just one word, *Sociology,* written by Dr. William F. Ogburn of the University of Chicago and Dr. Meyer F. Nimkoff, then of Bucknell University but now at Florida State University, was published by the Houghton-Mifflin Company. Among many other things which this book contained were the following definitely worded statements: "How shall we account for man's gregariousness? It is more easily explained on the basis of need and habit than on the grounds of instinct to associate. *There is no report of any internal drive in man that impels him to seek the company of his fellows . . .*" (Italics not used in the textbook). And further: "The development of gregariousness in the child is clearly the result of learning."

These statements are quite clear and definite and in addition the caption of the paragraph is "Sociability a Learned Process".

A decade passed, a World War was fought, we quit worrying about Naziism and began worrying about communism, and a revised edition of this text came out in 1950. This time we find the following statements:

"Men are less gregarious than sheep and more gregarious than cats."

"Of the many different biological bases of human society, one that especially interests sociologists is the tendency to live in groups." It will be noted that this makes man's sociability or gregariousness a result of biological inheritance rather than training. A little further on the same thing is repeated. "That heredity is a factor in gregariousness we infer by comparing certain carnivores, as for instance cougars, with certain herbivores, such as caribou. . . . Man has evolved from the apes. . . . They live in groups larger than the cats but smaller than herds of cattle." And still later we have: "We conclude then, on gregariousness, that human society is based upon animals that inherit great capacities for social interaction, and it is this inheritance that makes our social life possible."

In direct contrast to the statements in the first edition, gregariousness is now explained by innate, inherited tendencies. To be sure, we are told that the multitudious expressions which this disposition takes are due to cultural influences, but the basic, innate disposition is accepted. The position is made clearer and more definite by a discussion of the life of the apes and a long quotation about how different our society today would be if we had descended from some of the big cats rather than apes.

This direct about face within the space of ten years may be symbolic of many things. Emphatically, it does not indicate shallow thinking, a wishy-washy disposition, or any other undesirable characteristics of the authors. On the contrary, it signifies that they are wide awake, openminded, in touch with the present trend of thought, and capable and willing to accept new findings.

There are interesting and significant questions which are suggested by these statements, especially by the changed position. Is this change indicative of a widespread and general tendency in sociological thought? Certainly there have been wide fluctuations with respect to this very question during the developing years of sociology. A century or so ago there were writers attacking the question from many different angles and striving earnestly to give a definite and final answer. Of late years the tendency has been to neglect such basic and somewhat philosophical questions as having only academic interest. When this particular question was treated at all, it was usually dismissed by the statement that there was nothing innate about our grouping tendencies, this being harmonious with the prevailing psychology of the time as developed by Watson (1914), Allport (1933), and others.

It has been the conviction of the writer that this question should not be neglected or lightly thrown aside by the sociologists. It is basic and fundamental to all sociological thought, and to build a system of sociology without taking it into account would be like building a house by beginning with the roof.

The question of man's inherent sociability or his lack of it has much more than academic interest. It is basic for many associated sciences and also for various fields of human activity. It is a central question in educational philosophy and practice. No paper on education would be complete without reference to a boy on one end of a log and Mark Hopkins on the other, and this oft quoted reference is based on the assumption that man is essentially solitary and the best educational practice is to work on individuals. Quite in contrast is the belief held by many educators today that better results are obtained in large classes. An extreme application of the social theory is found in the assignment of educational projects, not to individuals, but to groups. This practice has been used extensively in Russia since the 1917 revolution, probably more extensively there than any place else. It might be claimed that satisfactory results may be secured through group action merely because man has been taught to be social. Undoubtedly this is true, but it is only relatively true; if man is essentially solitary the *best* educational approach will be through individual instruction, and if he is innately social this approach will never be quite as satisfactory as group instruction and training.

Our question is quite as important for various phases of social work. Jane Addams (1909) believed that regardless of our approach we always get group results. Puffer (1912) came to the same conclusion through his work with delinquent boys. The George Junior Republic (W. R. George, 1912), Boystown (Flanagan, 1950), and numerous other such institutions are based on the theory that group action is natural and universal. On the contrary, much social work is undertaken without any consideration of this factor. Poor relief, medical care, and domestic troubles are frequently treated on the individual basis, and the very live question of socialized medicine is involved.

Both civil and criminal law are bound to be more efficient if based on man's true nature, whatever that may be. The Quakers established solitary confinement under the impression that it would cause contemplation and penitence and hence called their houses of incarceration penitentiaries. Quite different was Thomas Mott Osborn's (1916) belief that group action should be utilized within prison walls and in harmony with this theory organized the Mutual Welfare League. Evidently they could not both be correct.

Just at present our attention is being called to the terrifying use of drugs by juveniles, and an important question is how to combat it. The group method utilized by Alcoholics Anonymous has seemed to work wonders, but the results may not be lasting and even if they are, it is possible that they are not due to the group method. There are those who prefer working on individuals.

In all these fields, the question of innate gregariousness or the lack of it is of fundamental and final importance. The same is true in the field of sports, medicine, religion, and, in fact, every phase of our lives. If our society is to be organized and constructed in the most efficient way, it must be in harmony with original nature and it is important to know what that nature is.

The fact that such a popular and leading textbook as Ogburn and Nimkoff's *Sociology* should change its pronouncements on this question with a new revision indicates that we are not entirely certain about the answer—or, at least, if we have achieved our certainty it has been only within the last ten or twelve years.

As mentioned above, this was a burning question in the early days of sociology and anthropology, and great were the struggles undertaken to find the answer. All that those early scholars who pondered so long and deeply could do was to arrive at some kind of a logical conclusion which was based on their own inadequate observations of human behavior. Today, if we had the same depth of interest and tenacity of purpose, we should be able to arrive at an answer which would be as final and complete as the so-called laws in other fields of science. May and Doob (1937) have achieved such a degree of finality in their investigation of other phenomena which are quite as intangible and seemingly remote from scientific investigation and human insight.

The almost universal neglect which has been so evident during the last few decades has been discouraging, but the fact that some consideration of the question now appears occasionally, such as the treatment by Ogburn and Nimkoff, may be indicative of a new interest, and possibly the scholars in the field will train their heavy guns in this direction in the not too distant future. If they do, we may confidently hope that they will not only arrive at a satisfactory answer, but that if they find man is social they will be able to tell how much so. To say merely that man has a social nature tells us little; we would want to know just how social.

If any work of this kind is to be pursued, the first step should be to examine what has already been done. Many highly valuable suggestions will certainly be gained by perusing the voluminous works which have been written on the subject, and it will be found that certain investigations have already been made and do not need to be repeated. Any adequate survey of this literature would fill at least one large volume, probably several, hence very little may be expected from this brief paper. A mere glance at a few selected works is all that will be attempted.

Like every other question that ever arises, the beginning of its treatment goes back to the classic Greeks, and we are familiar with Aristotle's statement that man is a political animal and naturally formed for society. The late President Conradi, in the research which he did for his doctor's dissertation, discovered that the Greek scholars, even the very earliest ones, worked in groups or well organized learned societies. Thus Thales, Melissus, Pythagoras, etc. were merely names of outstanding leaders. He also found that the same practice of working in groups continued without a break to the present time. In the light of this fact, it is easy to see why Aristotle made the statement which he did.

Between Aristotle and modern times there was a rich assortment of scholars, religious, philosophical, literary, and semi-scientific who expressed themselves on the question, but we shall pass over them in this paper and begin with the group of writers who appeared just prior to and following the Darwinian pronouncements.

In general, the scholars of that period accepted without question the theory that man is social, at least partially so. Some of them, such as Galton, made a distinction between *sociability* and *gregariousness*, and some times this distinction is made today. There may or may not be a real distinction, but if there is, it is probably a quantitative difference only and not qualitative.

The question which puzzled these old writers was not whether man is social; they felt sure he was. What they wanted to know was how did he get that way. Almost unanimously, they refused to believe that he had always been so. They pictured original man as either the noble savage of Rousseau or the slinking brute of Nordeau, and they set out to explain how he got over it. These explanations range all the way from the scholarly to the ridiculous. Most of them pictured mankind as slowly learning through the centuries and cycles to live more social lives, each generation inheriting more and more of this disposition. This is patently contrary to our present beliefs concerning heredity, but Weismann had not made his appearance and it did no violence to the generally accepted theories of that time. However, this belief might find some support by taking into consideration the selective factor as Carvath Read (1920) and a number of other writers did.

One of the most extreme explanations was advanced by Thomas Hobbes (undated) in his well-known contract theory. He held that men originally were not only non-social but were extremely unsocial, every man being at war with all other men. They finally realized that this did not pay and came together and made a contract to quit fighting, live in peace, learn to be social, and select a ruler whom they would all obey. He must have thought of them as being highly intelligent to be able to figure this all out when they had never seen anything of the kind. Even today, if our United Nations delegates, our officials in Korea, or even our members of Congress would show that much insight—well we would be surprised.

Some of these theories were strikingly caricatured by Kipling (1914). In his story of *The Cat Who Walked by Himself,* he says that in the beginning man was the wildest of all the wild animals and slept on the wet leaves in the wet wild woods until Woman found him. She selected a dry cave, sprinkled dry sand on the floor, hung up a dried horsehide over the entrance and said, "Now, dear, wipe your feet before you come in and we'll keep house." And in his story about the invention of the alphabet, he has the Stone Age man tell his importunate little daughter that they cannot invent the alphabet yet, that it will not be time for several hundred years; but folks will have the letters some day, all twenty-six of them. But Taffy was a spoiled child who wanted what she wanted when she wanted it, so they sat down and invented the alphabet right then.

Writers like Kipling should not be omitted in a study such as this. As Lester F. Ward (1903) pointed out, poets and literary people often have an insight which the typical scientist lacks, and they frequently point out weaknesses and strengths which the scientists miss.

A popular theory of man's growing sociability was that it grew out of the primitive family. The picture generally drawn was that in the beginning a jealous and selfish old male collected as many females as possible and drove out all the young men as soon as they arrived at the age of puberty. Eventually through the cunning or perhaps the charm of one of the women, one of the sons would be allowed to remain in the group but only with the strict understanding that he would get his wife or wives outside of the group. This resulted in two things, one of which was the establishment of exogamy; the other result was to strengthen the group by the presence of two adult males, and this would insure its survival and would start the long slow process of developing our present day nation-sized groups and also the natural gregariousness of human beings. Sir Henry Sumner Maine (1864) was an outstanding champion of this theory and he was followed by a host of others. Even as late as a quarter of a century ago this belief was widely held. Not all writers were willing to accept this explanation. Bachofen (1861) in his "Mutterrecht" insisted that the human family started as matriarchal and there were some who agreed. McLennan produced one of the most scholarly works which took this viewpoint, at least the viewpoint that in some portions of the world the matriarchate was primary.

Westermarck (1912) was fairly close to this camp and explained that all our sociability grew out of mother love, but amazingly he explained mother love by saying that a mother loved her children because they had given her pleasure. This means they gave her pleasure *before* she loved them and it is indeed difficult to see how a mother could get any great amount of pleasure out of the pains of childbirth and all the wearisome care of a squalling brat which taxed her strength by day and destroyed her sleep by night unless she already loved it.

One of the most interesting writers of this early group was an Australian by the name of Sutherland (1898) who wrote two volumes of explanation of the development of sociability; to him the grouping tendency was definitely the most effective weapon in the struggle for existence, and he traced its growth from the earliest form of life. It is probably safe to say that this was the most thorough and elaborate work ever produced on the subject, and the author's knowledge of the field is nothing short of astonishing. Although his terminology is now antiquated and some of his concepts, especially in the anthropological field, are no longer held, his work is still highly suggestive and well worth reading by any serious student of sociology.

Other writers disdained all these explanations and accounted for human society in somewhat scornful terms. Max Nordeau (1911) said, "Friendship! It is a word which makes the heart beat high; alas, it is only a word." He claims that human society developed not around the hearth fire but around the camp fire. The earliest groups were groups of fighting men, freebooters, or militant robbers who banded together for efficient robberies; and, he says, bonds of comradeship develop between men who have fought side by side. This is about what Herbert Spencer (1901) said. He insisted that our organized governments are not in harmony with human nature but were forced on to an unwilling people. Hence, government is essentially an evil thing and we should have as little of it as possible.

Strikingly different from all of these was the theory of Simon N. Patten (1903) who believed that society grew up around a cave. Outside there were coldness, hostility, danger, and death, but within the cave were warmth, comfort, and safety. Inevitably, a feeling of affection grew up for the cave itself, the homesite or fatherland. By association this feeling spread to the fellow habitants and man's social nature was on the way. This is highly suggestive and should not be thrown aside lightly. The writer once did some research on the nature of patriotism and found that the physical locality plays a surprisingly prominent role in both animal and human reactions and emotions.

All these with the possible exception of Sutherland whom we have mentioned are alike in that they assumed man's gregarious nature was developed and not original. But where many would least expect it, we find a champion of the theory that man is naturally social and always has been so. Contrary to much popular belief, Darwin (1909) said, "Every one will admit that man is the most social of all animals." This was going pretty far, much farther than our original writers who made man only slightly more social than cats. In fact, it is doubtful if there has ever been another writer who ascribed so much sociability to man, with the exception of the gentle, we may even say angelic, Kropotkin who thought man was so social minded that he needed no laws whatever and who therefore preached anarchy.

Employing the same logic but coming to a contradictory conclusion, Lester F. Ward (1903) argued that man was not naturally social or he would not need any laws. We may illustrate this line of reasoning by pointing out that in a truly social group, such as the bees and ants, no individual ever has to be forced to perform any act for the group welfare. As McCook (1909) says, in an ant community which he studied there were upward of 400,000,000 ants and in all that number there was not one criminal or degenerate. But while Ward said man was not originally social, he did believe that he is now partially social and is becoming more so all the time.

Ward's contemporary, William G. Sumner (1927, 1940), as we would expect, explained man's grouping tendencies by the folkways. In the beginning, he said, man sought his sustenance in groups because it was more efficient, and as they came to realize this fact, the grouping tendency became more and more firmly established. Apparently he did not think that man had ever become truly social —he just lived in groups because it was the habit.

Again we find the same weakness that has been encountered in so many other explanations, including Nordeau's. How did human beings get to be in groups originally and thus find out that it paid?

These few writers have been selected because they presented such widely varying theories. Each was representative of a large group of scholars whose thoughts ran along the same lines. No attempt has been made to touch upon any present day literature with the exception of the work mentioned at the beginning. The modern field must be left for further study and possibly for additional papers. And after the extra literature has been covered, it will then be the task of some one to attack the central question and solve the central problem of man's gregariousness or social nature.

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A VALUABLE DRUG IN A MUSHROOM

William A. Murrill
Gainesville, Florida

Botanical Studies of *Clitocybe subilludens* Murr.

This fungus was first collected by me on a dead laurel-oak stump in Gainesville, Fla., Dec. 1, 1926. Other early collections by me in Gainesville were made in 1938 on Oct. 25, 28 and 29; and on Nov. 17. A large Canary Island palm on the grounds of the Agricultural Experiment Station was a particularly good host and has supplied excellent specimens every year up to the present time. I selected this habitat as the type locality of the species. On Nov. 26, 1938, Mr. Erdman West found specimens under a live oak near Ormond, Fla. The species occurs infrequently in northern and central Florida, chiefly at the base of living laurel-oak palms.

The description of the species appeared in an article by me in the Journal of the Florida Academy of Sciences in 1945. On page 180 I used the name *Monadelphus subilludens,* but on page 198 I made the combination *Clitocybe subilludens* for the convenience of mycologists who still used the older nomenclature.

Physiological Studies

For several years I was too busy with the taxonomy of new Florida species to devote any time to their physiology, but finally I made a start by watching the choice of the wild squirrels and experimenting with the aid of rats, calves, students and myself. When I came to *Clitocybe subilludens,* Dr. R. B. French and I fed parts of the fresh caps, mixed with ordinary food, to a white rat in his laboratory. The result was unexpected. The animal happened to be a gravid female and, instead of dying, voided her young and improved in health and appearance. This gave me the idea of extracting from the fungus a valuable drug. Cultures of the fungus were first made by Dr. G. F. Weber, at my request, and these are still alive.

Extraction of the Drug

For the extraction of the drug I secured the cooperation of Dr. P. A. Foote, director of the College of Pharmacy, and placed at his disposal a quantity of material I had collected and dried under gentle heat for this particular purpose.

Dr. Foote and also Dr. Lauter of the College of Pharmacy laid out a program for isolating the active principles. Mr. Ross Baxter, a graduate student, was assigned the extraction of the drug as a thesis. Two substances were extracted, both valuable in childbirth. One resembled ergot in its effect on the womb, the other was a sedative.

When it came to making cultures, I got Mr. Stephens, a graduate student in industrial engineering, to coach Mr. Baxter. He had been working on the vitamins in my *Agarious Blazei,* and had learned from Dr. Block the technique of submerged mycelial cultures. When Mr. Baxter made extracts from this mycelium we were astonished to discover that it contained both the valuable substances found in the fruit-bodies. This unexpected good fortune greatly simplified the production of the new drug.

In October, 1949, Dr. Laurett E. Fox joined in the research. Isolated strips of guinea pig and rat uteri were used for testing the ability of the extracts to cause contraction of the muscle. It was found that the extracts probably contained two orytoanic principles, one of which showed promise of being as useful a drug as ergotamine, an alkaloid obtained from ergot.

Since ergot is an important drug used in childbirth, these findings offer interesting possibilities.

NOTES ON THE LIFE HISTORY OF THE LIZARD, *NEOSEPS REYNOLDSI* STEJNEGER

Byrum W. Cooper
Riverside, California

The comparative rarity of a species in collections is often a reflection of the inadequacy of our knowledge of its habits and of our collecting techniques. Both *Rhadinea* and *Pseudobranchus* were considered rare until collecting in the proper places showed them to be plentiful. The same appears to be true of *Neoseps reynoldsi.*

Carr (1940) gives the habitat of *Neoseps* as "Rosemary scrub and highpine; under logs and in loose dry soil." He classes it as "rare" and describes its habits thus. "Completely fossorial; in dry sand it burrows rapidly with a swimming motion. O. C. Van Hyning received several from a crew engaged in sifting sand at the Eustis (Lake County) airport; he informs me that some of these were found at a depth of two feet." Carr lists it as "characteristic" of highpine and "occasional" in rosemary scrub. His remarks appear to be all that has been written concerning the natural history of the species.

In May and September of 1950, 13 *Neoseps,* of which 9 were captured, were seen at Winter Haven, Polk County, Florida. S. R. Telford, Jr., and Robert E. Hellman, of the Department of Biology, University of Florida, have kindly furnished data on several specimens taken since that time. These *Neoseps* were found under logs and scattered debris in two different habitats as follows:

(1) An area of heavy undergrowth in which the dominant plants are rosemary, saw palmettoes *(Serenoa repens),* several species of scrub oaks, and sand pines (*Pinus clausa),* which are the only trees of any size in the habitat. All of the logs in the scrub are from sand pines. This section has not been burned recently; therefore the undergrowth is thick and ground cover plentiful. Two *Neoseps* were taken and one other was seen here but the abundance of cover makes hunting them difficult for they seem to be dispersed and not concentrated under the logs.

In another plot almost identical with the above, except that it has been frequently burned, nearly all available ground cover except the logs had been destroyed. Six *Neoseps* were taken and 3 others seen here; this apparent abundance is probably a result of the burning of the ground cover and the subsequent concentration of the lizards under the logs.

(2) The plants of the other area consist of longleaf pine *(Pinus australis)* to the east and sand pine to the west, with small scrub oaks and saw palmettoes scattered in between. Rosemary is entirely absent. There is an abundance of logs and the area is fairly open, both of which make collecting much easier. Three *Neoseps* were caught in a 2-hour period on the first trip to this section.

Collecting *Neoseps* is extremely hot, tiring work. Rosemary scrub is probably the most xeric habitat in Florida, with air temperatures in the shade often above 100° F.

The author worked 3 days in the scrub without seeing a *Neoseps* and was just on the verge of giving up when one was found at a depth of approximately 3 inches under a large log. Only a momentary glimpse was vouchsafed me as it was tossed into the air by my rake, for upon striking the ground it seemed to slow up not one iota, but apparently traveled down through the sand with the same speed and ease with which it had traveled down through the air. Although the better part of an hour was spent searching the sand to a depth of 2 and 3 feet in all directions, the lizard made good its escape. The speed with which these animals burrow is amazing, and unless the collector is very fast the individual will be missed. Observations on this and others which I failed to catch lead me to believe that *Neoseps* travels almost straight down when violently disturbed.

All of the specimens were in moist soil, and the amount of moisture in the soil seems to play a large part in determining the local distribution of the animals. The most profitable collecting is done the day following a heavy rain, when the soil under the logs is still moist but the surrounding soil is dry. If several days have passed since the last rain and the soil even under the larger logs has become dry, no *Neoseps* can be found. It is presumed that under such conditions they go down far enough to reach the moist soil, a distance of 6 to 18 inches, depending on the rains. From an experiment performed in the laboratory, it appears that *Neoseps* may be just as intolerant of sand that is too moist as it seems to be of sand that is too dry. Sand that had been heated to remove all of the moisture was placed in a terrarium, and the sand in one-half was saturated with water while that in the other half was left dry. When a *Neoseps* was placed in the terrarium, it instantly burrowed in the dry sand. Its location in the sand was observed in the moist sand only once. This preference for the dry sand seems inconsistent with the field observations, but the sand in the terrarium contained much more water than the moist sand in which the specimens were found in the field. It may be that the dry sand in the terrarium was simply the lesser of two evils.

The most profitable collecting procedure is to turn one of the larger logs and rake the soil underneath parallel to the log, raking a little deeper with each stroke. The tool found most suitable for this purpose is a four-pronged potato rake. When the lizards are exposed they will burrow at once, and the collector must act exceedingly quickly, scooping up a double handful of sand in the hope that it will contain a specimen.

Undoubtedly these lizards spend most of their time underground, but they may at times come to the surface of the soil. One specimen was taken under a small piece of bark lying underneath a large log. With this exception, all taken in the wild were actually underground although several were only an inch or so below the surface. A specimen kept alive in captivity was seen occasionally to come to the surface and lie under a small piece of bark. S. R. Telford, Jr., informs me that one which he kept alive for several weeks was seen on the surface at night several times. It seems unlikely that an animal so modified for subterranean existence as *Neoseps* spends much time foraging above ground.

Because of its burrowing habits and restricted habitat, *Neoseps* probably lacks any significant predators. The only other species that were found occupying the same underground area were *Rhineura floridana* and *Eumeces onocrepis*. *Eumeces inexpectatus* is often found under the logs in the scrub but none were seen actually in the soil. The fact that some of the *Neoseps* have regenerated tails may or may not be significant as indicating predation. The only case observed of a species preying on *Neoseps* was on September 11, 1950, when a very small specimen (35 mm snout-to-vent length) was placed in the same jar with a large and a small *Eumeces inexpectatus*. The specimens were carried directly to the car but upon arrival the *Neoseps* was nowhere to be seen. The only evidence of a *Neoseps* was found in its stomach. The capture of the *Neoseps* and the *inexpectatus* and the return to the car took place within a 10 minute period. The specimen that was eaten was the smallest *Neoseps* captured and after removal from the stomach of the *Eumeces* showed quite a different color pattern than others observed. The skin between the scales was a brilliant blue, much the same color as the tails of young *Eumeces inexpectatus.* In fresh specimens of *Neoseps* the skin between the scales is white with no trace of blue. It is possible that the gastric juices of the *inexpectatus* may have been a contributing factor in this coloration.

Very little data were gathered on the breeding habits of the species except observations on the eggs and testes of adults. A female (56 mm snout-to-vent length) taken May 7, 1950, contained two well developed but unshelled eggs. The two eggs measured 9.3 mm by 5.2 mm. A female taken May 3, 1950 (54 mm snout-to-vent length) had spent oviducts. A female taken September 11, 1950 (54 mm snout-to-vent length) contained large ovarian eggs. A male taken September 4, 1950 (54 mm snout-to-vent length) had enlarged testes measuring 2.3 mm. More data are needed on the breeding activities before anything definite can be ascertained.

Several species of soft-bodied insects were placed with individuals in captivity but captive specimens could not be induced to eat. Specimens preserved immediately in the field were examined for stomach contents. The most abundant item in both bulk and number in the 4 stomachs containing food was termites. Also found were click beetle larvae, 1 dipterous larva, 1 pseudoscorpion pincer, 1 mandible of a neuropterous larva, unidentifiable insect remains, and sand and debris. Parasitic roundworms were in 3 of the stomachs. The main staple of the diet seems to be termites, which are common under the logs and wood debris in the scrub but have not been observed in the sand itself.

Two instances of skin shedding were observed and it was noted that the skin was cast off in large patches. A small specimen in captivity completely shed its skin in 4 days. One was captured September 11, 1950, with the posterior half of the old skin already shed, and it was noted that the specimen in captivity also shed its posterior skin first.

All the specimens were seen or captured during daylight hours. Two trips were made to the scrub at night but no *Neoseps* were seen on either occasion.

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THE PREVALENCE OF PINWORM INFECTION AMONG FIRST GRADERS OF TALLAHASSEE, FLORIDA, AND VICINITY

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The present study was made to discover the incidence of pinworm infection among young school children in Tallahassee and vicinity. It also seemed desirable to determine the effect of treatment carried out in the school instead of in the home.

For a number of years prior to 1941-1942, diagnosis of pinworm infection was made by the NIH swab (Hall, 1939). Hall's technique was superseded by a more effective method discovered by Graham (1941) and modified by Jacobs (1942). Graham and Jacobs advocated the use of adhesive cellophane tape to pick up the worm ova from the skin of the perianal region. In the present study a modification of this method was employed. Here, scotch tape, cut into ¾ inch squares, was touched to the perianal skin and then placed, adhesive side down, on glass slides and examined under the 16 mm objective. The ova with active embryos (larvae) were easily detected through the tape.

Since it was not feasible to offer free treatment to all infected children, the school with the highest incidence was chosen for further study and for modified treatment consisting of enteric coated gentian violet tablets administered in the school by the teacher under the supervision of the Leon County Health Physician. Two pre-treatment examinations were made on these children who were then examined at intervals of 1, 17, and 22 days after treatment.

RESULTS

Results of the first examination in the school chosen for treatment were:

Children	*Boys*	*Girls*	*Total*
Examined	43	49	92
Positive	27	16	43
Incidence	62.78%	32.44%	46.73%

Results of the second pretreatment examination in the same school were:

Children	*Boys*	*Girls*	*Total*
Examined	46	49	95
Positive	15	24	39
Incidence	32.60%	48.97%	41.05%

Results of the post-treatment examinations were:

1. On the day following conclusion of treatment:

Children	*Boys*	*Girls*	*Total*
Examined	14	21	35
Positive	4	2	6
Incidence	28.57%	9.52%	17.14%

2. Seventeen days after treatment:

Children	*Boys*	*Girls*	*Total*
Examined	14	22	36
Positive	3	5	8
Incidence	21.43%	22.72%	22.22%

3. Twenty-two days after treatment:

Children	*Boys*	*Girls*	*Total*
Examined	13	20	33
Positive	2	4	6
Incidence	15.38%	20.00%	18.18%

In regard to prevalence of the infection in first-grade children in all five elementary schools, the following results were obtained:

Children	*Boys*	*Girls*	*Total*
Examined	220	238	458
Positive	62	61	123
Incidence	28.18%	25.63%	26.85%

Discussion

The total incidence of infection in the five elementary schools surveyed (26.85%) is low when compared to that reported by investigators in other regions (Sawitz, *et al* 1939). Since most investigators believe that as many as seven negative tests are necessary in all cases before the subject can be declared free from infection, our figures for the single examination in four of the schools are probably too low.

Belding (1942) reports the incidence of infection in school children in the United States to be 37% - 57%. Cram and Reardon (1939) found the incidence among school children of Washington, D. C. to be 51%.

In the present study, although the incidence was considerably lower after treatment, there was still a significant infection (18%) among the children treated.

At present, the most acceptable and effective treatment consists of daily oral administration of gentian violet for one week, a week's interim, followed by another week of administration of gentian violet. In the interval between medicinal treatments, the person's surroundings including bedding, furniture, and clothing should undergo thorough cleaning to destroy the viable ova. In this case the treatment was given for only one-half the prescribed time and was accompanied by no thorough cleaning of homes or school rooms. Viable ova were found on the furniture of two classrooms in the school in which the more extended study was made. No check was made in the homes.

Because of its method of transmission, the swallowing of embryonated eggs obtained from soiled bed linen, clothing or objects in a room, pinworm infection is familial in nature; one infected member of a family is the source of infection for an entire group. Children in schools or other institutions are for the same reason more likely to acquire the infection than those living alone or in small groups.

During the examinations an attempt was made to observe, as accurately as possible, indications of the social and economic level as well as the hygienic practices in the homes from which the children came. From the data collected no positive correlation between family size, economic or social status, and worm infection was obvious.

Conclusions

1. Because fewer than the prescribed number of examinations were carried out, figures for incidence of pinworm infection in first grade pupils in the Tallahassee schools may be too low.

2. To be effective, treatment must extend over a period of three weeks and must be accompanied by a thorough cleaning of surroundings. Adequate treatment was not carried out in this study.

3. The adhesive tape method of detection of the presence of pinworm ova on the skin is dependable.

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RECORDS OF PLEISTOCENE REPTILES AND AMPHIBIANS FROM FLORIDA

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While examining the fossil Crotalids in the paleontological collections of the United States National Museum (U.S.N.M.), the American Museum of Natural History (A.M.N.H.), and the Florida Geological Survey (F.G.S.) other reptile and amphibian bones came to light and seem worthy of noting. This material comes from Late Pleistocene sites in Florida (see Cooke, 1945, for a discussion of the geology). All of the specimens have been compared with skeletons of living species in the U.C.L.A. or the writer's collection.

Most of the forms listed are identical with species living in Florida today. Many of the forms appear larger than skeletons of recent individuals. This would suggest, if Bergmann's rule (as modified for cold-bloods by Cowles, 1945) is operating, that these fossil animals inhabited a warm climate, either interglacial or late post-glacial.

The writer wishes to thank Dr. Herman Gunter, Florida Geological Survey; Dr. E. H. Colbert, American Museum of Natural History; and Dr. D. H. Dunkle and Dr. W. F. Foshag, U. S. National Museum for loan of specimens and Dr. Clark Read, University of California at Los Angeles, for suggestions and criticisms.

Amphibia

Amphiuma means (Garden)

F.G.S. V-2431, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 3 vertebrae.

F.G.S. V-3472, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 3 vertebrae.

F.G.S. V-2442, Stratum No. 2, Vero Beach, St. Lucie Co., Fla., 3 vertebrae.

F.G.S. V-4814, Wakulla Springs, Leon Co., Fla., 1 vertebra.

A.M.N.H. 6777, Seminole, Pinellas Co., Fla., 1 vertebra.

Two of the nine trunk vertebrae (F.G.S. V-4814, A.M.N.H. 6776) of Congo Eels are slightly larger than the others or than those from recent specimens. The centra in all specimens are amphicoelous. There is a bifurcated projection at the anterior ventral base of the centrum. The diapophyses is wide and bends slightly down. The neutral spine is well developed and a small ridge extends on the dorsal surface of the vertebra from the postzygapophyses to the anterior opening of the neural canal.

Bufo woodhousi Girard

F.G.S. V-3472, Stratum No. 3, Vero Beach, St. Lucie Co., Fla.

A large cervical vertebra from the above locality differs from recent skeletons of *B. w. fowleri* only in that it is larger and the neural spine extends anterior farther. On each side of the neural spine of the fossil there is a deep groove bordered laterally by a prominent process which extends posteriorly from the prezygapophyses.

Rana grylio Stejneger

Tihen (1952) records this species from Haile Pit, 4 miles northeast of Newberry, Alachua County, Florida.

Reptilia

Sceloporus undulatus (Latreille)

F.G.S. V-1530, Stratum No. 3, Vero Beach, St. Lucie Co., Fla.

Two *Sceloporus* dentaries from this locality are referred to *S. undulatus* due to the fact that the posterior teeth are trifid, the dentary is long and narrow, and there is no dorsal process at the posterior end of the dentary as in *Sceloporus woodi*. One dentary measures 12.8 mm. long and has 21 teeth or sockets and the other measures 12.4 mm. long and has 19 teeth or sockets. The teeth on the fossil dentaries are slightly larger than those of an adult male *S. u. undulatus* in the U.C.L.A. collection.

Eumeces sp.

F.G.S. V-1530, Stratum No. 3, Vero Beach, St. Lucie Co., Fla.

One dentary of *Eumeces* with 20 conical teeth measures 12.0 mm. long. It is not referred to a species due to the lack of comparative material.

Drymarchon corais (Daudin)

F.G.S. V-2413, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 2 vertebrae.

F.G.S. V-3492, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 2 vertebrae.

A.M.N.H. 7172, Seminole, Pinellas Co., Fla., 42 vertebrae.

In addition to those recorded by Gilmore (1938), Indigo snakes have been found in the above localities.

Coluber constrictor Linné

F.G.S. V-2413, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

A.M.N.H. 7173, Seminole, Pinellas Co., Fla., 42 vertebrae.

Lampropeltis doliata (Linné)

A.M.N.H. 7174, Seminole, Pinellas Co., Fla., 3 vertebrae.

This species is distinguished from *Lampropeltis getulus* by the fact that the ridge lateral to the sub-centrum keel is narrow and straight in *L. doliata* and wide and bulging as it approaches the ball of the centrum in *L. getulus*.

Lampropeltis getulus (Linné)

F.G.S. V-2413, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

A.M.N.H. 7175, Seminole, Pinellas Co., Fla., 46 vertebrae.

A.M.N.H. 6772, "Allen Cave" near Lecanto, Lecanto Co., Fla., 1 vertebra.

U.S.N.M. 13678, 2 miles W. of Melbourne, Brevard Co., Fla., 1 damaged vertebra.

Elaphe obsoleta (Say)

A.M.N.H. 7176, Seminole, Pinellas Co., Fla., 11 vertebrae.

Farancia abacura (Holbrook)

A.M.N.H. 7177, Seminole, Pinellas Co., Fla., 5 vertebrae.

In *Farancia* vertebrae there is a slight sub-centrum keel and there is a thin area extending posterior-medially from the prezygapophyses. Hay (1917) recorded this species from the Pleistocene of Florida from Stratum No. 3, Vero Beach, though Gilmore (1938) doubted the record as he could not find Hay's specimen. The discovery of *Farancia* vertebrae from Seminole suggests that Hay's record is possibly correct.

Pituophis melanoleuca (Daudin)

F.G.S. V-1630, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

A.M.N.H. 7178, Seminole, Pinellas Co., Fla., 21 vertebrae.

Natrix sp.

F.G.S. V-4814, Wakulla Springs, Leon Co., Fla., 2 vertebrae.

F.G.S. V-1621, Stratum No. 2, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-2455, Stratum No. 2, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-2431, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 2 vertebrae.

A.M.N.H. 7179, Seminole, Pinellas Co., Fla., 13 vertebrae.

U.S.N.M. 13678, 2 miles W. of Melbourne, Brevard Co., Fla., 2 vertebrae.

These are not referred to species due to the lack of comparative material.

Thamnophis sp.

F.G.S. V-4814, Wakulla Springs, Leon Co., Fla., 2 vertebrae.

A.M.N.H. 7180, Seminole, Pinellas Co., Fla., 1 vertebra.

These are not referred to species due to the lack of comparative material and the fact that it is probably impossible to distinguish the species of *Thamnophis* on vertebral characters.

Crotalidae

A summary of the fossil pit-viper material of North America will be presented elsewhere (Brattstrom, ms.). Most of the large Crotalids from Florida are *Crotalus adamanteus*. Occasionally specimens of *Agkistrodon piscivorous* are found (A.M.N.H. 6776). For reasons to be presented elsewhere the *Crotalus adamanteus* from the Pleistocene of Florida are to be described as a new subspecies; in addition a new fossil species of *Crotalus,* related to *C. adamanteus,* from Florida will be described. The following material is that which has come to light since Gilmore's work (1938).

Crotalus adamanteus Breauvois

F.G.S. V-471, Florida, locality unknown, 1 vertebra.

F.G.S. V-472, Stratum, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-2455, Stratum No. 2, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-3472, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-2413, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 6 vertebrae.

F.G.S. V-3492, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

F.G.S. V-1630, Stratum No. 3, Vero Beach, St. Lucie Co., Fla., 1 vertebra.

A.M.N.H. 6776, Seminole, Pinellas Co., Fla., many vertebrae.

A.M.N.H. 6778, "Allen Cave" near Lecanto, Lecanto Co., Fla., 6 vertebrae.

A.M.N.H. 7514, Florida, locality unknown, 17 vertebrae.

Crotalus sp.

A.M.N.H. 6772, "Allen Cave" near Lecanto, Lecanto Co., Fla., 2 vertebrae.

Agkistrodon piscivorus (Lacépède)

A.M.N.H. 7181, Seminole, Pinellas Co., Fla., 4 vertebrae.

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THE INFLUENCE OF CROTON OIL ON SKIN TUMORIGENESIS IN STRAIN C57 BROWN MICE [1]

Michael Klein

Numerous skin tumors are induced in mice exposed to one application of a carcinogen when croton oil subsequently is painted on the skin (Berenblum and Shubik, 1947; Bielschowsky and Bullough, 1949; Klein, 1952; Mottram, 1944; Shubik, 1950). None are obtained, however, when croton oil alone is applied (Berenblum, 1941; Berenblum and Shubik, 1947; Klein, 1952). It has been observed also that one application of a low dose of carcinogen to mice of mixed strain (Berenblum and Shubik, 1947), Swiss strain (Berenblum and Shubik, 1949), and strain DBA (Klein, 1952) produces only an occasional skin tumor. In contrast to this, it has been reported that many tumors are produced in strain C57 brown mice with one application of the carcinogen methylcholanthrene (Mider and Morton, 1939). Since this suggested a greater susceptibility, it was decided to investigate the influence of croton oil on skin tumorigenesis in the latter strain. The effect of a single low dose of methylcholanthrene on skin tumorigenesis also was examined. Answers were sought to these questions: 1. Would continued application of croton oil alone to the skin of a more susceptible strain lead to the development of visible skin tumors? 2. Also, in view of the greater susceptibility of C57 brown mice to skin tumorigenesis following one painting with methylcholanthrene, would this enhance the promoting influence of croton oil and be reflected in the production of a higher incidence of benign as well as malignant skin tumors?

Materials and Methods

Seventy-five young adult male mice from strain C57BR|cd JAX were included in this study. All were maintained on Purina Laboratory Chow pellets and received tap water *ad libitum*. The mice were divided into 3 groups of 25 each, and treated as follows:

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[1] A contribution from the Cancer Research Laboratory, University of Florida, Gainesville, Florida.

This investigation was supported by a research grant from the Damon Runyon Memorial Fund.

Group I—Painted once with 0.5 per cent 20-methyl cholanthrene [2] in olive oil.

Group II—Painted twice weekly for 25 weeks with 5 per cent croton oil [3] in olive oil.

Group III—Painted once with MCA as in Group I. Two weeks thereafter, the mice were painted twice weekly for 25 weeks with croton oil as in Group II.

Solutions were applied to the nape of the neck with one stroke of a No. 3 camel-hair brush. Following painting with MCA, the mice were isolated one to a cage for several days to minimize loss of the compound through licking and rubbing. All animals were housed in metal cages in an air-conditioned room (temp. 76-78° F.) no more than 10 to a cage. The mice were examined weekly for skin tumors. Only those growths which persisted at least 2 weeks and attained a minimum size of 1 mm. were considered as tumors. Most of the latter grew slowly to a maximum diameter of 2 to 3 mm., and were maintained at that size or regressed. Although several tumors grew progressively and attained a height of 7 mm., none developed into a malignant tumor. All surviving mice were sacrificed 2 months following the last painting with croton oil.

TABLE I

Promoting Influence of Croton Oil on Skin Tumorigenesis in Strain C57 Brown Mice.

Groups	Treatment	Effective Total Mice[1]	Total Mice with Tumors	Tumor Inci-dence	Average Applica-tions Croton Oil	Average Observa-tion Period, All Mice
		number	number	%	number	days
I	MCA once	24	5	21	0	220
II	Croton oil repeatedly	20	0	0	46	203
III	MCA once + croton oil repeatedly	21	14	67	45	197

[1] Survivors at time of first tumor in experiment.

[2] m.p., 179-180° C., hereinafter referred to as MCA.

[3] Obtained from Fisher Scientific Company, Eimer and Amend, N. Y., N. Y.

Results and Discussion

When MCA alone was applied to the skin of C57 brown mice, 5 of the animals (21 per cent) developed skin tumors (Group I, Table 1). This substantiates, in part, the earlier observation of Mider and Morton (1939) who reported a skin tumor incidence of 36 per cent when mice of this strain were painted once with MCA. However, 3 of the tumors they obtained became malignant whereas all the tumors in the present experiment remained benign disclosing no observable tendency to invade or to infiltrate the muscle tissue of the body wall. The rapid rate of proliferation and the frequent tendency to ulceration, characteristics associated with malignant skin tumors, also were not observed. The variation in response of the C57 brown mice to MCA in the present experiments and in those of Mider and Morton (1939) may well have been due to a difference in the dosage of carcinogen applied. In the latter experiments, a 0.5 per cent solution of MCA was applied with a No. 8 camel-hair brush while we employed a smaller brush (No. 3) and thus a smaller amount of carcinogen. It already has been observed that malignant skin tumors may be induced in Kreyberg white label mice with one large dose of MCA (Bielschowsky and Bullough, 1949). Mottram (1945) produced benign skin tumors in the mouse with one application of a carcinogen and repeated applications of croton oil. Many of these growths were transformed to malignant neoplasms but only following the addition of carcinogen to the benign tumors previously induced.

No skin tumors were observed among the mice in Group II (Table 1). Thus, as observed in less susceptible strains (Berenblum, 1941; Berenblum and Shubik, 1947; Klein, 1952), continued application of croton oil alone failed to induce skin tumors in C57 brown mice. Inasmuch as the latter are highly susceptible to skin tumorigenesis on the basis of their response to one application of MCA, this latest observation serves to emphasize the non-carcinogenicity of croton oil.

When C57 brown mice painted once with MCA were painted repeatedly with croton oil, the incidence of skin tumors increased to 67 per cent (Group III, Table 1). This agrees with the observations of others (Mottram, 1944; Berenblum and Shubik, 1947) that once the skin of mice has been exposed to a carcinogen, a non-carcinogen such as croton oil may be effectively substituted for the carcinogen in the development of visible tumors. In a previous experiment with a less susceptible strain (Dba), application of MCA and croton oil in comparable amounts and by the same techniques used in this investigation actually resulted in a higher incidence of skin tumors (79 as compared with 67 per cent) although the difference probably is not significant (Klein, 1952). Thus, despite the greater susceptibility of C57 brown mice to skin tumorigenesis with MCA, this appeared to have no effect on increasing tumor incidence. It should be emphasized that all the tumors induced with MCA and croton oil in the present experiment were benign. A similar lack of malignant skin tumors has been reported by others in comparable experiments (Allsopp, 1948; Bielschowsky and Bullough, 1949; Klein, 1952; Shubik, 1950). These results taken together demonstrate that while croton oil may promote the development of visible skin tumors when used in conjunction with one low dose of a carcinogen, few or none progress beyond the benign stage to become malignant even in a strain especially susceptible to skin tumorigenesis. Whether or not the non-carcinogen, croton oil, is capable of promoting the development of malignant skin tumors when higher doses of carcinogen are employed initially remains to be investigated.

Summary

Benign skin tumors were induced in strain C57 brown mice in response to one painting with a 0.5 per cent solution of methylcholanthrene, indicating that the skin in this strain is susceptible even to one low dose of a carcinogen. Some of the mice received no carcinogen but were painted continuously with croton oil. None of the latter animals developed a tumor. This demonstrates that even in an especially susceptible strain croton oil exerts no observable tumorigenic action on the skin. In another group, C57 brown mice were painted once with methylcholanthrene followed by continued painting with croton oil. A high proportion of these animals bore skin tumors indicating an effective promoting influence for croton oil. The incidence of skin tumors, however, was not increased over that previously observed in a less susceptible strain. Neither was the high susceptibility of the C57 brown strain to skin tumorigenesis reflected in an increased number of malignancies.

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MYXOMYCETES DEVELOPED IN MOIST CHAMBER CULTURE ON BARK FROM LIVING FLORIDA TREES; WITH NOTES ON AN UNDESCRIBED SPECIES OF COMATRICHA[1]

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In 1933 Gilbert and Martin reported that the fruiting bodies of a number of Myxomycetes developed on pieces of bark which they had collected from living trees and placed in a moist chamber a few days before. Some of the species which developed had been considered rare up to that time, a few never before having been found on this continent.

Since the publication of that report a number of investigators have used that technique, and it is now evident that many species of slime molds which are seldom collected, chiefly because of their minute size, and which are consequently believed to be rare, are, on the contrary, quite prevalent and widespread.

This technique has not been employed nearly as much as it deserves. Not only are unusual species developed on bark in moist chamber culture, but, as Gilbert and Martin note, this method is excellent for observing the developmental stages of fructification, at least in some species. The chief drawback of such studies is the fact that not rarely the number of fructifications which develop is very small. Quite often but a single sporangium will be found and will have to be mounted for identification. If it represents a rare or a new species, the situation is frustrating to say the least. For this reason it is well to treat every mount as a valuable one and to prepare it for permanent preservation. Hoyer's medium [2] is an excellent mounting medium for the minute Myxomycetes. It dries quickly, it preserves the specimens well and with a minimum of distortion, it is beautifully clear, and the mounts prepared with it last almost indefinitely.

MATERIALS AND METHODS.—The specimens of bark employed in these studies were collected in Florida, mostly on the east coast in the general vicinity of Hollywood Beach, in the latter part of

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[1] Contribution No. 53-12 from the Department of Botany and Plant Pathology, Michigan State College, East Lansing, Michigan.

[2] For formula and method of preparation see page 2 of Alexopoulos, Const. J., and E. S. Beneke, *Laboratory Manual for Introductory Mycology*. Burgess Publishing Co., Minneapolis. 1952. (Offset).

the summer of 1951, and near Crystal River on the west coast in September 1951 and in March 1953. Pieces of bark ranging in size from 2 to 60 square centimeters were chipped off living trees and sealed in locally purchased envelopes on which the collection data were noted. Bark was generally taken at a height of about four feet from the ground, but no attempt was made to insure uniformity as to position at which bark was obtained from the tree, or size of sample; the ease with which bark could be obtained determined, for the most part, the size of the collection. The envelopes with the bark samples were kept in a cardboard box and transported to East Lansing, Mich., where the bark was treated as follows: One or more pieces from a single collection were placed on filter paper in a clean Petri dish and saturated with distilled water. After 24 hours excess water was poured off and the Petri dishes were stacked on a shelf at room temperature for two weeks. At the end of this period all pieces of bark were thoroughly examined with a dissecting microscope and notes were made on any developments which had occurred. If the sporangia were mature one edge of the Petri dish cover was raised so as to permit the bark to dry gradually; if not, observations were continued daily until the fruiting bodies matured. All bark specimens on which slime molds had not developed were soaked again in distilled water and observations were continued for another two week period. At the end of this period the bark which had not yielded slime mold fruiting bodies was discarded.

For identification purposes specimens were mounted in Hoyer's medium. If the sporangia were replete with spores at the time of mounting, they were first dipped in a drop of absolute alcohol and the spores teased away carefully under the dissecting microscope. This was followed by 2% KOH for 1 minute, 70% alcohol for 1 minute, and Hoyer's medium. If, at the time of mounting, enough spores had been dispersed so that the capillitial characters were evident under the dissecting microscope the specimen was mounted directly in Hoyer's medium.

Results.—Of the 271 pieces of bark collected from 35 individual trees representing 16 species, 66 pieces yielded fructifications of Myxomycetes. These figures have no statistical significance because of the great variation in the size of sample and in the number of samples collected from individual trees; they do indicate, nevertheless, the importance of this technique in the study of the myxomycete "flora" of any given region, particularly because many of the species which develop are seldom collected in the field.

The 13 species of Myxomycetes listed below were developed in moist chamber culture on bark from living Florida trees. The names used are those accepted by Martin (1949). Specimens from all developments, either in their original form on the bark or as Hoyer's medium mounts or both are deposited in the cryptogamic herbarium of Michigan State College. Portions of the larger developments are also deposited elsewhere as noted. The numbers are those of my collection of Florida Myxomycetes.

No attempt was made to determine with certainty how many of the 13 species listed below are new to Florida. This would have necessitated a search of the major cryptogamic herbaria of the world. As West (1939) points out, "There are very few published records of the occurrence of Myxomycetes in Florida . . ." West's paper recording 79 species is the most comprehensive list of Florida slime molds available. Other Florida occurrences are mentioned by Hagelstein (1944), Lister (1925), Martin (1949), and Macbride and Martin (1934). Of the 12 previously known species recorded below, 5 are not listed as occurring in Florida in any of the above mentioned publications nor are they represented by Florida collections in the University of Florida Herbarium; two others are said to occur "throughout the United States and Canada" or to be "widely distributed throughout the United States" with no specific mention of Florida being made. The thirteenth species listed herein is probably new to science. Considering the very limited scope of this survey and the fact that the bark samples were collected entirely at random, these results are quite interesting and reveal the possibilities that future studies of this nature may have.

Family Liceaceae

Licea (?)*fimicola* Dearness & Bisby.

Fla-19, on rind of *Sabal palmetto*, 4 mi. so. of Crystal River, Sept. 18, 1951; Fla-28, Fla-31, Fla-36, same substratum and local., Mch. 29, 1953. Abundantly developed on most pieces of rind collected in March 1953, this species was identified tentatively as *L. fimicola* by Dr. G. W. Martin. The sporangia are minute, only .1 mm. in diameter, black by reflected, brown by transmitted light, and pulvinate rather than spindle-shaped. They generally bear a cone of debris which gives them an erect appearance not unlike that of a perithecium of the Fimetariaceae. *Licea fimicola* was heretofore known only from Winnipeg, Manitoba, its type locality. Specimens of Fla-36 deposited at the University of Florida, the State University of Iowa, and the New York Botanical Garden in addition to Michigan State College.

Licea kleistobolus G. W. Martin

Fla-6, on bark of *Pinus caribaea,* w. of Davey, Aug. 31, 1951; Fla-9, on bark of *Taxodium distichum,* Pan Am. St. Pk., Sept. 9, 1951; Fla-13, on bark of *Melaleuca leucadendron,* Route 84, w. of Ft. Lauderdale, Sept. 1, 1951. Fla-6 is a large development on several pieces of caribaean pine bark. Fla-9 and Fla-13 consist of very few sporangia in spite of the fact that the total area of *Melaleuca* bark collected was two-fifths greater than that of pine bark. Portion of Fla-6 deposited at the University of Florida. This species was previously known in the United States only from New York, Pennsylvania, Michigan, Iowa, and Colorado.

Family Cribrariaceae

Cribraria minutissima Schw.

Fla-8, on bark of *Taxodium distichum,* Pan Am. St. Pk., Sept 9, 1951; Fla-18, Fla-23, Fla-25, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Sept. 18, 1951; Fla-30, same substr.and local., Mch. 29, 1953; Fla-33 on bark of *Pinus caribaea,* same local. and date. This is one of the smallest of all species of *Cribraria.* In all cultures except two the cup is represented only by a minute disc or is entirely lacking. Other characters agree with the description of this species. Most developments are represented by several sporangia. Portion of Fla-8 deposited at the University of Florida.

Cribraria violacea Rex

Fla-7, on bark of *Taxodium distichum,* Pan Am. St. Pk., Sept. 9, 1951. A very small development of but two typical sporangia.

Family Trichiaceae

Arcyria cinerea (Bull.) Pers.

Fla-4, on bark of *Pinus caribaea,* w. of Davey, Aug. 31, 1951, occurring together with *Echinostelium minutum* and *Licea* *kleistobolus.* The characters of all the sporangia developed on several pieces of bark approach those of *A. pomiformis.* They are more ovoid than cylindrical, ochraceous rather than cinereous, and bear yellow capillitium and spores. A portion of this development is deposited at the University of Florida. Substratum ident. Charles Gilly.

Family Echinosteliaceae

Echinostelium minutum De Bary

Fla-5, on bark of *Pinus caribaea,* w. of Davey, Aug. 31, 1951; Fla-10, Fla-11, on bark of *Taxodium distichum,* Pan Am. St. Pk., Sept. 9, 1951; Fla-12, on bark of *Melaleuca leucadendron,* on Route 84, w. of Ft. Lauderdale, Sept. 1, 1951; Fla-16, on *Quercus* sp., Coral Gables, Sept. 11, 1951; Fla-17 on bark of *Pinus palustris,* Univ. of Miami Arboretum, Sept. 11, 1951; Fla-34, on bark of *Pinus caribaea,* 4 mi. so. of Crystal River, Mch. 29, 1953. There are three distinct forms of this species represented here: the pure white form, represented by a great many sporangia, predominates on the *Pinus caribaea* developments; a few sporangia of pink form constitute developments Fla-12 on *Melaleuca,* and Fla-17 on *Pinus palustris;* and a few sporangia of a dark, purplish-gray form, whose spores appear smoky under the microscope constitute the developments on *Taxodium* and *Quercus.* No correlation is implied here between species of bark and color of sporangia; overlapping of forms has been observed. The dark form is of particular interest, for it does not appear to be very common. We have never encountered it in my laboratory in any of the *Echinostelium* bark cultures from Michigan trees which we have been observing during the last two years, and we did not find it in the few bark cultures from Jamaican trees which yielded *Echinostelium* in 1952. To my knowledge, this form has never been reported before. All the standard taxonomic works on Myxomycetes describe *Echinostelium minutum,* the only species in this genus, as white or colorless. Martin (1949) also mentions the pink form, and Gilbert and Martin (1933) state that "Many collections are distinctly pinkish or brownish." Pine substr. ident. by Charles Gilly. Portion of Fla-5 deposited at the University of Florida.

Family Stemonitaceae

Enerthenema papillatum (Pers.) Rost.

Fla-22, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Sept. 18, 1951; Fla-37, same substr. and local., Mch. 29, 1953. Both consist of one sporangium each.

Comatricha cornea Lister & Cran

Fla-3, on bark of *Conocarpus erectus,* near Hollywood Beach, Aug. 31, 1951; Fla-14, Fla-15, on bark of *Melaleuca leucadendron,* w. of Ft. Lauderdale; Fla-29, Fla-32, Fla-35, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Mch. 29, 1953. These developments consist of from one to eight sporangia of a *Comatricha* which closely resembles *C. cornea,* but which lacks the typical collar at the base of the columella. The stalks of some of the sporangia are enveloped in a transparent sheath. Although not exactly typical of *C. cornea* the specimens at hand are not sufficiently different to regard them as anything more than an ecological variation of that species. *C. cornea* has previously been reported in the United States only from Iowa, Kansas, and Michigan. A Hoyer's medium mount of Fla-35 has been deposited at the University of Florida, and one of Fla-29 at the State University of Iowa.

Comatricha fimbriata Lister and Cran

Fla-21, Fla-24, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Sept. 18, 1951; Fla-38, same substr. and local., Mch. 29, 1953. Three very small developments typical of this species. Previously known in the United States only from Massachusetts, New York, Michigan, Iowa, and Kansas.

Comatricha sp. (Figs. 1, 2).

Fla-27, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Sept. 18, 1951. This development consisted of but a single sporangium which was mounted for identification. Since it did not seem to fit the description of any of the known species of *Comatricha,* it was sent to Dr. G. W. Martin for identification. Dr. Martin expressed the opinion that it is an undescribed species. Whereas all the known material in existence is represented by one mounted sporangium it is not deemed advisable to describe and name it as a new species at this time, but photographs of the sporangium and spores are being included in this paper to record this interesting *Comatricha.* The main features of this species are the abruptly tapering columella, the rhizoid-like hypothallus, and, particularly the banded-reticulate spores, measuring 6.5 - 8 μ, the reticulations of which are sometimes incomplete. The sporangium is ovoid and small, measuring .35 x .41 mm., the stalk is dark and short; the entire fructification is .9 mm. high. The peridium is entirely fugacious. An attempt was made to procure more material by returning to the same locality in the spring of 1953 and collecting rind from the same tree from which the original material had been obtained, and from neighboring palmetto trees, but none of the cultures yielded sporangia of the same species.

Fig. 1

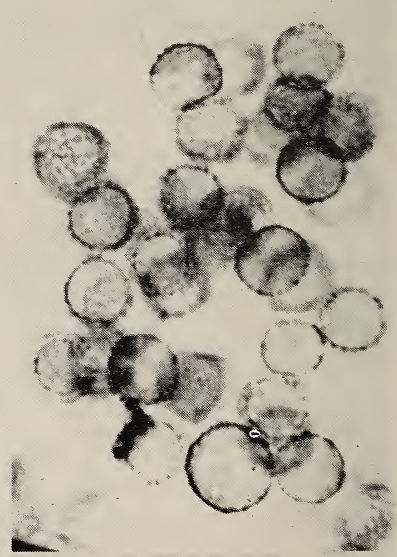

Fig.2

Figure 1.—Fructification of *Comatricha* sp., with most of the spores removed to show nature of colummella and capillitium. X 78.

Figure 2. Spores under oil immersion objective faintly showing banded reticulation. X 1400.

Clastoderma debaryanum A. Blytt.

Fla-1, on bark of *Casuarina equisetifolia,* near Hollywood Beach, Aug. 31, 1951. A fine development of several sporangia.

Family Didymiaceae

Diderma chondrioderma (De Bary & Rost.) G. Lister

Fla-2, on bark of *Ficus bengalensis,* near Hollywood Beach, Aug. 31, 1951. The few round, flattened fruiting bodies are pure white and crystalline. This species was previously known in the United States only from Iowa and California. Portion deposited at the University of Florida.

Family Physaraceae

Physarum nutans Pers.

Fla-20, Fla-26, on rind of *Sabal palmetto,* 4 mi. so. of Crystal River, Sept. 18, 1951. Fla-26 consists of a single sporangium.

Acknowledgments.—I wish to express my sincere thanks to Dr. G. W. Martin of the State University of Iowa for his identification of *Licea fimicola,* for examining material of *Comatricha* sp., and for his advice and help in many other ways; to Dr. D. P. Rogers of the New York Botanical Garden for the loan of various specimens for comparison, to Prof. Erdman West of the University of Florida for permission to examine the Myxomycete collection of the herbarium at Gainesville; to Dr. Charles Gilly of Michigan State College for identifying the species of pine from which bark was collected; to Mr. John E. Peterson, now of the University of Missouri for preparing the moist chamber cultures; and to Mr. Philip G. Coleman of the Michigan Agricultural Experiment Station for preparing the photomicrographs.

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A NEW FLORIDA JOURNAL

EVERGLADES NATURAL HISTORY. Volume 1, no. 1, pp. 1-38; Vol. 1, no. 2, pp. 39-86. Published quarterly by the Everglades Natural History Association, Box 275, Homestead, Florida. Edited by Joseph C. Moore. Subscription $2.00.—Here is a new journal which is devoted to the natural history of southern Florida. Although many of the contributors to these first two numbers are professional zoologists and botanists the articles are written for popular consumption. Each number to date contains seven or eight main articles, a section for natural history notes, a book review section and a short series of background notes about the authors.

The journal has an attractive cover and is printed on good quality enamel paper. The half-tones, which are used liberally, are in general good.

The magazine is apparently aimed at the throng of amateur naturalists who visit southern Florida in general and the Everglades National Park in particular. The content of the first two numbers is well balanced, comprising articles on various groups of animals and plants as well as one on the geology of the Miami Oolite. It is to be hoped that this balance continues so that the publication will not ultimately wind up as another local bird journal. I am told the demand for the first two numbers has been most gratifying and this should assure the publishers that a well balanced popular natural history journal has its place.

The first two numbers, although dated March and June, 1953, actually appeared only a few weeks apart in September, 1953. I believe that the difficulties causing this delay have been ironed out and prompt publication is to be expected in the future. This little journal seems to be practically unique in one respect—I understand its publishers have no particular financial worries!

All persons interested in Florida's natural history will want this journal and many of them will, I doubt not, become contributors to it. COLEMAN J. GOIN, University of Florida.

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