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I hereby certify that printed copies of the Proceedings for 1916 were mailed as follows:—

Pages	1–32	March	7, 1916.
"	33–64	March	15, 1916.
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"	197–314	May	23, 1916.
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"	475–538	November	21, 1916.
"	539–602	December	7, 1916.
"	603–618	January	29, 1917.

EDWARD J. NOLAN,
Recording Secretary.

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1916.

JANUARY 18.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Thirty-six persons present.

The death of Daniel Giraud Elliot, a member, December 22, 1915, was announced.

The Publication Committee announced the presentation of papers under the following titles:

"Revision of Cayuga Lake spiders," by Nathan Banks, December 2, 1915.

"Studies in the Dermaptera and Orthoptera of the Coastal Plains and Piedmont Region of the southeastern United States," by James A. G. Rehn and Morgan Hebard, January 17.

"Fossil birds' eggs," by Dr. R. W. Shufeldt, January 18.

PROF. WILLIAM P. MAGIE and DANIEL MOREAU BARRINGER made communications on the Meteor Crater of Arizona, illustrated by lantern slides. (No abstract.)

The following were elected members:

Walter Sonneberg.
William S. Huntington.
Samuel T. Bodine.
David Wilbur Horn, Ph.D.

The following was ordered to be printed:

THE SEXUAL EVOLUTION OF SARCOCYSTIS MURIS.

BY HOWARD CRAWLEY.

A number of years ago, at the University of Pennsylvania, an investigation of the early stages of the evolution of *Sarcocystis muris* in the intestinal cells of the mouse was undertaken. This investigation was interrupted for several years, but was resumed at the laboratory of the Zoological Division of the Bureau of Animal Industry, Washington, D. C., and the first definite results obtained were outlined in a preliminary note published in 1914 (Crawley, 1914).

In this note it was shown that following ingestion of the so-called spores of this parasite, penetration of the intestinal cells of the mouse was effected within about two hours. Once within the cells the spores rapidly underwent profound changes and after the lapse of about nine hours they had separated into two categories, which were interpreted to represent males and females. In the case of the supposed males, development took the form of a loss of most if not all of the cytoplasm, so that the parasite became reduced to a nucleus, which, however, was of considerably larger size than that of the original spore. Later, the chromatin of this nucleus became collected into a number of small rounded masses placed at the periphery. These masses, at first granular, later became solid and eventually transformed themselves into elongated, thread-like bodies, which were interpreted to be microgametes. This evolution was completed at the end of 18 hours.

Meanwhile others of the original spores went through a wholly different course of development, which was not at the time considered in detail. It was evident, however, that these elements retained their cytoplasm and eventually transformed themselves into oval cells, with rather dense cytoplasm and a vesicular nucleus containing a large karyosome. These, which were interpreted to be females, also reached the end of their development within 18 hours.

Finally, appearances suggesting fertilization were noted.

At the time when this preliminary notice was prepared, my material for the later stages, from 12 to 18 hours, was abundant and the conclusions as published were based on the findings in a number of mice. On the other hand, for the early stages only three mice were

available, these representing, respectively, the 2 to $2\frac{1}{2}$ hour, the 3 to $3\frac{1}{2}$ hour, and the 3 and 6 hour stages, the last being a mouse given two infecting feeds between which was an interval of 3 hours, and killed 3 hours after the second meal. It was therefore considered desirable to obtain more material for these earlier stages, and the results to be set forth herein are based upon the examination of a number of mice killed at periods of from one hour onward.

Material and Methods.

A list of the mice used, with appropriate explanatory matter, is placed at the end of the present section. During the entire course of the studies on sarcosporidiosis, every mouse obtained in whatsoever manner was given a number. In many cases these were trapped gray mice, or else white mice which had never been inoculated. Hence those used for the microscopical study of the evolution of the parasites in the cells represent but a portion of the entire series. It has been considered better, however, to retain the numbers originally given, since no confusion can possibly arise from such a procedure.

In the list appended the time in hours elapsing between the infecting meal and the death of the mouse has been placed immediately after the number of the mouse, since this is the most important datum. After this the fixing fluid is noted, and finally a statement with reference to the quantity of infectious material which the mouse ate is appended. The omission of these data in a number of cases indicates a failure to keep the record complete.

The list as given includes 38 mice, and the conclusions as set forth herein are thus based on this number of experimental animals. It is desired to lay emphasis on this point on account of the possibility of confusion with other intestinal Protozoa, such as Coccidia.

Erdmann (1914) endeavored to obtain mice in which the possibility of extraneous infection was excluded. The procedure was to raise mice from birth under as sterile conditions as possible. This, of course, is the ideal method, but, as Erdmann states, it is tedious and difficult. The other method is to use a large series of mice, which will presumably yield results that cannot be questioned. Thus, if, after feeding, parasites are found in the cells which are evidently *Sarcocystis* spores and if, as time passes, these intracellular elements undergo serial changes it would seem to be hypercritical to question their identity as stages in the evolution of *Sarcocystis muris*. For it would be necessary to assume that each experimental mouse harbored Coccidia in addition to the Sarcosporidia and that

in each and every case the Coccidia happened to be in precisely such a stage as to resemble the Sarcosporidia. The mathematical probability of this taking place diminishes with the number of mice used and when this number is large becomes a vanishing quantity.

Of course, since protozoan infections naturally tend to assume the epizoötic form, if one or two mice from a given cage were found to be infected with Coccidia, the surmise would be warranted that many or all of the others were so infected. But in the case of the series upon which the present studies were based, the mice were obtained from various sources and from various places and in many cases had never been in contact. It is therefore believed that the results as stated are valid, so far as concerns the possibility of confusion with Coccidia.

The mice selected for inoculation were deprived of food for 24 hours. This served a two-fold purpose. It rendered them more prone to eat the infectious material when given and it served to free the intestine of half-digested vegetable food, the presence of which interferes with sectioning. For the short periods, up to 18 hours or so, the mice were given a piece of infected muscle of what was regarded as an appropriate size. This was larger or smaller, according to the number of cysts it contained; and when these were abundant the portion given had a weight of the order of one-tenth of a gram.

When the mouse is given its infecting meal, any one of several things may happen. Some mice positively refuse to touch the meat, while others merely play with it for a time and then abandon it. More usually, however, the mouse feeds, and the customary method is for it to hold the food in its forepaws and nibble at it until it is all consumed. This procedure, however, may be interrupted by delays, but if the entire time required to finish the meal is short in comparison with that to elapse between feeding and death, the mouse may be used. Finally, in some cases the meal was bolted in the manner in which a dog feeds.

At the end of the proper period the mouse was chloroformed, opened, and the alimentary canal removed. In nearly all cases it was placed in the killing fluid entire, being neither cut into pieces nor slit open. The intestine of a mouse has such thin walls that the fluids have no difficulty in penetrating, and this procedure does away with the rough handling necessary in slitting the intestine. It moreover retained the intestinal contents, an obvious advantage, and a comparison with slit intestines showed that the fixation was equally accurate. The only disadvantage was that at times the penetration

of the fluids from the muscularis toward the epithelium resulted in the latter being torn loose from the underlying connective tissue. At least this phenomenon was not infrequently manifest and is presumably to be credited to the direction of entrance of the fluids.

Following fixation, each intestine was cut into pieces of a convenient length for embedding in paraffin. In general, the small intestine was cut into 25 to 30 pieces which were numbered, as a rule, from the anterior to the posterior end. Thus, int. 1 of a given mouse indicated the piece immediately following the stomach, the highest or last number that piece immediately in front of the cæcum. Sometimes, however, this process was reversed, the last piece of the intestine being designated as int. —1; the next to the last, int. —2, and so on, the negative signs serving to distinguish such cases from the more usual procedure. This, as already noted, is applicable to the small intestine alone, the cæcum and large intestine being given other designations. The procedure as outlined above was not, however, always followed.

The fixing fluids used were:

1. Hermann's fluid, stronger formula.
2. Zenker's fluid.
3. Picro-acetic acid, made by reducing a saturated aqueous solution of picric acid to one-half strength with water, and adding 1 per cent. glacial acetic acid.
4. An alcoholic-corrosive-acetic mixture, designated in the text as A. C. A. The formula for this is as follows:

Saturated aqueous solution of mercuric chloride	50 parts.
Alcohol, 95 per cent	50 parts.
Glacial acetic acid	5 parts.

Of these, Hermann's fluid and the picro-acetic mixture, the latter despite Lee's strictures, gave the most delicate fixation. Zenker's fluid is not to be recommended, since it leaves the tissues in poor condition for staining and is at best a mediocre fixative.

The A. C. A. fluid, while scarcely so accurate as Hermann's fluid, is none the less a very good fixative. It is, moreover, very convenient, since the tissues can be passed directly from it into alcohol, and it leaves the material in excellent condition for staining.

The material was stained both in bulk and on the slide. While there is a prejudice against the former method for delicate cytological work, Delafield's hæmatoxylin counterstained on the slide with alcoholic eosin or acid fuchsin dissolved in 95 per cent. alcohol, gives

results not far short of the best slide staining. The use of counterstains in alcohol is a great time-saving device, since the preparation has but to be passed from xylol, to absolute alcohol, to 95 per cent. alcohol, to the stain and back again to be ready for the Canada balsam. Moreover, if acid fuchsin be used, one quick dip in the stain is sufficient.

For slide staining, iron hæmatoxylin, Wright's and Giemsa stains and thionin were used either with or without counterstains. The blood stains used alone are unsatisfactory, since only the blue ingredients seem to take hold of the tissues. Wright's stain, counterstained with alcoholic eosin, however, gave very good results. The technique was as follows: The slide holding the sections was first treated as a blood smear and allowed to lie with the mixture of stain and water upon it for 10 to 15 minutes. It was then washed first in water and then in 95 per cent. alcohol until all of the precipitated stain had dissolved. It was then stained with eosin dissolved in absolute alcohol, next passed into clean absolute alcohol, and finally into xylol. Wright's stain comes out very rapidly in alcohol, but the whole procedure as above outlined can be completed in a very short time.

Thionin preparations counterstained in either alcoholic eosin or acid fuchsin in alcohol were largely used and gave in some respects the best results. Preparations so stained display beautifully sharp and clear-cut pictures, and they are very good when it is a question of bringing out the chemical qualities of different parts of the parasites. On the other hand, thionin fails to bring out certain granules in these Sarcosporidia which are perhaps significant, and slides stained in thionin are not permanent.

Accordingly, most of the slides were stained with iron hæmatoxylin. With material fixed in Hermann's fluid, a counterstain is not necessary, although it was often used. With the other fixatives a counterstain was necessary, and acid fuchsin was the one most generally employed.

The list of mice used follows:

Mouse	77	15 hours.		
	99	3 and 6 hours.		
	106	9 hours	A. C. A	Heavy meal.
	120	$10\frac{1}{2}$ and 17 hours		Heavy meal.
	121	$10\frac{1}{2}$ and 17 hours		Heavy meal.
	125	$2\frac{1}{4}$ hours	Hermann's fluid.	
	126	$3\frac{1}{4}$ hours	Piero-acetic.	
	132	$8\frac{1}{2}$ hours	Hermann's fluid	Heavy meal.
	133	9 hours	Hermann's fluid	Heavy meal.
	145	$11\frac{1}{4}$ hours	Hermann's fluid	Moderate meal.

146	$11\frac{1}{2}$ hours	Hermann's fluid	Moderate meal.
147	21 hours	Hermann's fluid	Moderate meal.
148	18 hours	Hermann's fluid	Moderate meal.
149	24 hours	Hermann's fluid	Moderate meal.
150	24 hours	Hermann's fluid	Moderate meal.
152	18 hours	Hermann's fluid.	
153	24 hours	Hermann's fluid	Heavy meal.
154	24 hours.		
175	$12\frac{1}{2}$ hours	Hermann's fluid.	
176	$13\frac{1}{4}$ hours	Hermann's fluid.	
177	$14\frac{1}{3}$ hours	Hermann's fluid.	
178	$15\frac{1}{6}$ hours	Hermann's fluid.	
179	$16\frac{1}{2}$ hours	Hermann's fluid.	
180	$17\frac{1}{2}$ hours	Hermann's fluid.	
181	$18\frac{1}{2}$ hours	Hermann's fluid.	
182	18 hours	Hermann's fluid.	
246	1 hour	A. C. A	Light meal.
247	4 hours	A. C. A	Heavy meal.
248	2 hours	A. C. A	Moderate meal.
249	3 hours	A. C. A	Moderate meal.
250	5 hours	A. C. A	Heavy meal.
251	$1\frac{1}{2}$ hours	A. C. A	Very light meal.
252	$2\frac{1}{2}$ hours	A. C. A	Very light meal.
253	6 hours	A. C. A	Heavy meal.
257	3 hours	Hermann's fluid	Moderate meal.
258	4 hours	A. C. A	Moderate meal.
261	4 hours	Hermann's fluid	Heavy meal.
262	5 hours	Hermann's fluid	Moderate meal.

Prior to taking up the description of the findings in the cells, it is desirable to call attention to a phenomenon first signalized by Erdmann (1910). This is the exfoliation of the intestinal epithelium which appears to follow ingestion of the spores of *Sarcocystis*. The natural inference would be that this was due to the invasion and subsequent destruction of the cells by the parasites, and such was my original idea (Crawley, 1913). No doubt a certain amount of exfoliation is to be accounted for in this way, but other factors are involved. Thus Erdmann found that the ingestion of an extract of *Sarcocystis* cysts, from which the spores themselves had been removed, was followed by exfoliation, and data that I shall now give show that the exfoliation takes place before any extensive invasion of the cells.

The intestines of a series of mice, all of which had been killed within 6 hours after feeding, were examined and the conditions presented by the epithelium in various parts of the intestine noted. The results of this examination are tabulated below. Where no exfoliation was demonstrable, the condition is indicated by the word "none." Where, however, it is in evidence it is designated as "slight," "moderate," or "severe," according to its degree.

Mouse 246, 1-hour Stage.

Int.	1	Exfoliation slight.
	3	Exfoliation moderate.
	5	Exfoliation none.
	7	Exfoliation slight.
	9	Exfoliation slight.
	11	Exfoliation moderate.
	13	Exfoliation severe.
	15	Exfoliation severe.
	17	Exfoliation slight.
	19	Exfoliation none.
	21	Exfoliation severe.
	23	Exfoliation slight.
	25	Exfoliation none.

Mouse 251, 1½-hour Stage.

Int.	1	Exfoliation none.
	3	Exfoliation none.
	7	Exfoliation none.
	9	Exfoliation none.

Mouse 248, 2-hour Stage.

Int.	3	Exfoliation slight.
	8	Exfoliation none.
	9	Exfoliation none.
	15	Exfoliation slight.
	21	Exfoliation slight.
	26	Exfoliation none.
	27	Exfoliation none.
	28	Exfoliation none.
	30	Exfoliation very slight.
	32	Exfoliation very slight.

Mouse 249, 3-hour Stage.

Int.	2	Exfoliation moderate.
	6	Exfoliation none.
	8	Exfoliation none.
	10	Exfoliation none.
	12	Exfoliation none.
	17	Exfoliation moderate.
	18	Exfoliation slight.
	19	Exfoliation slight.
	20	Exfoliation very slight.
	22	Exfoliation none.
	24	Exfoliation none.
	29	Exfoliation slight.
	30	Exfoliation none.
	31	Exfoliation none.

Mouse 261, 4-hour Stage.

Int.	—1	Exfoliation none.
	—3	Exfoliation slight.
	—5	Exfoliation slight.

Mouse 247, 4-hour Stage.

Int.	12	Exfoliation none.
	14	Exfoliation none.

16	Exfoliation slight.
18	Exfoliation slight.
19	Exfoliation slight.
30	Exfoliation slight.
31	Exfoliation very slight.

Mouse 262, 5 to 3-hour Stage.

Int. −1	Exfoliation none.
−2	Exfoliation slight.
−3	Exfoliation slight.
−4	Exfoliation severe.
−5	Exfoliation moderate.
−6	Exfoliation moderate.

Mouse 250, 5-hour Stage.

Int. 21	Exfoliation none.
22	Exfoliation none.
30	Exfoliation moderate.
31	Exfoliation moderate.
32	Exfoliation slight.
33	Exfoliation moderate.

Mouse 253, 6-hour Stage.

Int. 10	Exfoliation slight.
15	Exfoliation slight.
16	Exfoliation none.
19	Exfoliation questionable.
25	Exfoliation slight.
27	Exfoliation none.
28	Exfoliation none.
29	Exfoliation none.

As already stated, as a result of the method of fixing the mouse intestine, the epithelial row was at times torn loose from the subepithelial connective tissue. It thus results that in some cases the material presented a decidedly battered appearance. While, however, the epithelial row itself might thus be torn loose and more or less broken, the individual cells were not thereby injured and their appearance indicated an accurate fixation.

On the other hand, it was frequently possible to see that the cells at the tips of the villi were abnormal, this abnormality expressing itself in a loss of staining capacity on the part of the cytoplasm and an obvious degeneracy of the nuclei. This degeneracy, at first affecting only the cells at the tips of the villi, passes into a condition in which these cells have disappeared, while those lying along the sides of the villi are affected. This condition, in its turn, passes into one in which the villi are represented merely by stumps of connective tissue, the epithelium being present only in the regions between the bases of the villi. Finally a stage is reached in which the intestine is wholly denuded of epithelium. In the lists given

the term "slight" defines those conditions in which epithelial degeneration is just beginning to be manifest, and "moderate" conditions where the tips of the villi are seriously affected, and "severe" conditions where the destructive influence has gone further.

The data given in the above lists seem to establish the fact that exfoliation of the epithelium is correlated with ingestion of the spores of Sarcosporidia, but they are not consistent amongst themselves. Thus, mouse 248, a 2-hour stage, is not so badly affected as mouse 246, killed only one hour after feeding, whereas mouse 251, a $1\frac{1}{2}$-hour stage, shows no exfoliation at all, although in this last case observations were confined to only a small part of the intestine.

In the cases of Nos. 249 and 261, both 3-hour stages, and No. 247, 4-hour, exfoliation is not extensive, while No. 262, 5- to 3-hour, shows a considerable amount near the posterior end of the intestine, as does also No. 250, 5-hour. On the other hand, mouse 253, killed 6 hours after feeding, is but slightly affected. In view of the rather contradictory nature of the data, it is impossible to attempt any explanation of the *modus operandi* of loss of the epithelium.

Erdmann suggested that the destruction of the epithelium was an adaptation having for its purpose the easier penetration of the spores into the tissues of the mouse. Presumably this destruction is correlated with ingestion of the parasites, but if it be of any value to host or parasite it seems more plausible to regard it as a defensive move on the part of the former. In their attack upon the mouse the parasites first invade the epithelial cells and this they do within the first two or three hours. Obviously, then, the destruction of this epithelium, either before or after penetration by the parasites can only work to their disadvantage. Hence, while it is possible to look upon this exfoliation as an adaptation on the part of the host, there seems no good reason for so doing. It is a matter of observation that exfoliation follows the ingestion of sarcosporidian cysts, but it is also a matter of observation that such ingestion is practically always followed by infection of the muscles. Hence, the exfoliation is obviously not protective.

The matter is, however, one of minor importance and the data are merely given for what they are worth.

Evolution of the Parasites in the Cells.

The account of the findings in the cells may appropriately be begun with mouse 246, killed one hour after feeding. As indicated in the table on p. 8, slides were prepared from the alternate pieces

of the intestine from one end to the other. The anterior portions, Nos. 1 to 11, were wholly negative, there being no spores either in the lumen or in the cells. Beginning with int. 13, however, spores were present in the lumen, and they were seen in the cells in int. 19, 23, and 25. Their absence from int. 21 is to be credited to the severe exfoliation there present.

From int. 13, where the spores were first seen in the lumen, there was a rapid increase in their numbers in each successive piece, and in the lumina of int. 23 and 25 they were present in enormous numbers. From this it is evident that it requires but one hour for the ingested spores to reach the extreme posterior end of the small intestine, and as shown both by this and other mice, apparently the great majority of them reach this situation very quickly. While they have also been found in the cæcum in very early stages, they evidently do not pass from the small intestine into the cæcum as readily as they pass along the small intestine itself. This is evidenced by the fact that in the earlier stages—up to 9 hours or thereabouts—the last two or three centimeters of the small intestine always harbor spores free in the lumen.

There is thus brought about a state of affairs of some interest when the earlier stages of the evolution of the parasites is under consideration. It is evident that the spores pass along the small intestine very rapidly until the posterior end is reached. The length of time required for this stream of spores to pass a given point will obviously vary in the different mice. In those cases where, as a result of prolonged nibbling, the ingested meat reaches the stomach thoroughly comminuted, we may presume that its stay in the stomach is shortened and its movement along the small intestine more rapid. On the other hand, when the meal is swallowed in large pieces, the presumption is that it will remain in the stomach until it is softened and disintegrated, and in consequence its progress along the small intestine will be delayed. Nevertheless, digestion in mice of purely animal matter is rapid, and in general at the end of a few hours spores are scarce in the lumen of the upper and middle portions of the small intestine. If, as a pure guess, we may assume that the stream of spores requires one hour to pass a given point, then the spores within the cells in any particular part of the intestine (except the posterior end) will all have entered the cells within an hour of one another. On the other hand, as we have seen, great numbers of the spores reach the posterior part of the intestine within one hour, and remain there for several hours, as is shown by finding them in this

situation in 9-hour stages. During the whole of this time it cannot be questioned that individuals are constantly penetrating the cells.

Therefore it seems reasonable to assume that within certain limits, the intracellular spores in a given section of the upper or middle parts of the intestine will be in somewhat the same developmental stage. On the contrary, in the posterior part of the intestine, the intracellular spores will represent a series in the development, covering the greater part of the period of time elapsing between feeding and the death of the mouse. Thus, in a 9-hour mouse, the parasites in the cells of this extreme posterior part of the intestine might represent forms which had been in the cells from only a few minutes up to seven or eight hours, and in Nos. 132 and 133 it was evident that this was the case.

It further follows that in these posterior portions many more cells are parasitized than elsewhere, since there is here maintained for several hours a large supply of extracellular spores.

Returning to the conditions as found in mouse 246, intracellular spores in small numbers were found in int. 19, 23, and 25. These, of course, represented the very earliest stages in the development and in the main were not to be distinguished from those in the lumen. In some cases, however, development had begun, thus demonstrating the extreme rapidity with which these parasites go through with their evolution. The mounted material of this mouse, however, was prepared with a view of getting a general survey of the conditions rather than for detailed cytological study. Hence, no figures of the parasites as found here have been made.

Mouse 251.—Mouse 251 was killed $1\frac{1}{2}$ hours after feeding. According to the observations made at the time of the infecting feed, it received "a very light meal," but when the stomach and intestine were prepared for study the findings suggested that whereas relatively the meal may have been very light, positively such a definition seemed scarcely appropriate. In the stomach, from which the epithelium had largely disappeared, there were abundant cysts of the parasite, many of which were more or less intact and contained the greater number of the spores. In int. 1, 3, 5, and 7 there were abundant spores in the lumen, and in int. 9 they were present both in the lumen and in the cells.

Comparing the conditions found here with those in mouse 246, it is to be noted that in the latter the spores were further back toward the end of the intestine. In No. 246 the upper portions of the intestine were free of spores, whereas in 251 these same portions

contained them in considerable abundance. These differences are, as already suggested, probably to be accredited to differences in the manner in which the two mice fed.

Taking up now the evolution of the spores within the intestine of the mouse, we may advantageously use as a point of departure the spore as it occurs free in the lumen, for it is evident that development begins here.

Plate I, fig. 2, portrays such a spore and may be taken as the point of departure, although in all the early stages the spores in the lumen are identical with many of those in the cells. This particular case is from mouse 248, a 2-hour stage, but it is valid for any of the early stages.

The characteristics of this stage are as follows: The contours of the cell are sharp and clear cut, and there is a distinct bounding line or periplast. The cytoplasm, while obviously alveolar, is dense and ordinarily stains well. Granules may or may not be present. The nucleus, which is conspicuous, is round and gives the appearance as though in life it were turgid with nuclear sap. There is a distinct nuclear membrane and a more or less distinct nuclear net is always present.

With regard to its shape, the spore in the lumen may be a smooth oval, as, for examples, are the intracellular spores shown in Plate I, figs. 3 and 4, or it may have the sides more or less bulged out in the region of the nucleus. This latter phenomenon is due to the increase in size of the nucleus, a process initiated very shortly after the spore reaches the alimentary canal of the mouse.

The appearance of the spores in the intestine, whether they be in the lumen or in the cells, offers a considerable contrast to that of spores removed from the cysts. With regard to these latter, a description is herewith given, although they are familiar objects in the literature and have been described and figured a number of times.

Such spores are shown in Plate I, fig. 1. As is here indicated, one end of the spore is broader, the other end narrower, and the nucleus lies nearer the narrow end.

The internal structure is obscure. The nucleus is a clear-cut vesicle, and to all appearances is provided with a definitive membrane. No internal structure can be made out, and the staining reaction is feeble. In Giemsa preparations it stains a pale reddish color.

The cytoplasm with Giemsa stains a dense blue. Its structure can

scarcely be determined, but it may be inferred that it is alveolar. It is densest in the immediate vicinity of the nucleus. The broad end of the spore is frequently much less dense than elsewhere and at times shows a more or less well defined oval area. This appearance, however, is probably due merely to the fact that here the cytoplasm has a lower affinity for the stain than elsewhere.

The same phenomenon is shown by the spores of *Sarcocystis leporum* (Crawley, 1914). In the case of the rabbit parasite, as I have endeavored to show, one end of the spore seems to be differentiated into a sort of rostrum, the cytoplasm of which does not stain as densely as does that of the balance of the spore. We are probably dealing with the same thing in the case of *Sarcocystis muris*, but in this parasite the differentiation of the rostrum is not so sharp. It may furthermore be suggested that it is this clearer region in the spore which has given rise to the belief, expressed by some authors, that the sarcosporidian spore possesses a polar capsule.

Comparing the spores taken directly from a cyst with those in the intestine, the latter are broader, more oval bodies, and, although this is not shown by the figures, there has been a loss of the granules which are such a characteristic feature of the former. The most noteworthy change, however, concerns the nucleus, which has become larger, apparently much more turgid, and begins to show a nuclear net.

It is thus evident that evolution begins as soon as the spore reaches the intestine of the mouse, and apparently the most important step is a great increase in activity of the nucleus. This evolution, however, does not appear to be carried far unless the spore gains a resting place within a cell of the host.

The cells invaded are the cylinder cells. At least this is so in the vast majority of cases. Now and then, however, parasites are to be found in mucous cells, but since the presence of a parasite in a cell may result in mucoid degeneration, it is difficult to diagnose such instances. The parasite may have invaded a mucous cell or it may have caused mucoid degeneration of a cylinder cell. This question, however, appears to be of no great importance.

It is also well to emphasize the point that the spore is a naked mass of protoplasm and that the only differentiation displayed by the cytoplasm is the peripheral condensation into a periplastic layer. Statements to the effect that the spore opens and releases an amœbula are wholly without warrant, and polar filaments, either coiled up within one end of the cell or discharged, do not exist. Claims of

this sort, which have appeared in the literature from time to time, seem to be due to an unfortunate desire to correlate the Sarcosporidia with the Myxosporidia. These two groups may of course be closely related, but as yet there is no conclusive evidence on hand to show that they are.

Plate I, figs. 3 and 4 show spores in the cells of int. 9 of mouse 251, a $1\frac{1}{2}$-hour stage. It is to be noted that each of these lies in a vacuole. Probably they have not been in the cells for more than an hour. In both of them the cytoplasm is dense, compact, and deeply staining. In both of them, also, the nucleus has enlarged and is separated from the periplast only by very narrow strips of cytoplasm.

There is, however, a difference in the nature of the net in these two nuclei. In the case of fig. 3, the meshes in the centre are solidly filled with chromatin, whereas in that of fig. 4 the chromatin is divided into separate masses. In all of these early stages the chromatin has a low affinity for stains, and, following the rule which seems to hold generally true in Protozoa, takes the acid rather than the basic stains. On this account it results that these nuclei are rather difficult microscopical objects, and seen with powers of less than 1,000 diameters, a nucleus like that of fig. 3 looks like a vesicle containing only a central granule. But with a magnification of 1,500 to 2,000, and an intense artificial light, the structure as shown in the figure is brought out. As will be shown later, fig. 3 represents the more primitive condition, in which the chromatin is concentrated into a single mass, within which, however, the meshes of the nuclear net can be traced. In the case of fig. 4, the chromatin occurs in separate masses and the central meshes of the net are largely clear. Nuclei precisely like either of these may be seen in spores in the lumen.

Mouse 248.—Mouse 248 was killed two hours after feeding. Its intestine was cut into 32 pieces, int. 32 representing the extreme posterior portion. Observations were made on int. 3, 9, 15, 21, 27, and 32. In the upper portions there were scattered spores in the lumen and occasional specimens in the cells, but, following the general rule, parasitization was not extensive until the more posterior parts were reached.

Plate I, fig. 5, from int. 27, shows a parasite lying in the usual vacuole close to the free edge of the epithelium. The cytoplasm is dense, while the nucleus shows very distinctly a nuclear net supporting scattered chromatin granules. The nucleus, in this case, lies near one end of the cell. Fig. 6, from int. 30, also represents what is clearly a very early stage. The cytoplasm is dense and compact,

the cell contours are sharp and a periplast can be seen. The nucleus, however, shows merely as a faintly stained vacuole containing some formed substance, the details of which could not be made out. It may here be remarked that in most of the cell parasites the nucleus appears as a vesicle containing a nuclear net, and that in general this nuclear net is the only part of the nucleus that stains. Hence the net appears as though projected against a clear background. On the other hand, it is frequently to be observed in the spores free in the lumen, and much less frequently in those in the cells, that the nuclear sap as well as the nuclear net has taken the stain, thus obscuring the details of the latter. This condition is illustrated by fig. 6.

In the preliminary note it was stated that at least a portion of the intracellular spores rapidly underwent a change which expressed itself in a reduction of the cytoplasm and an increase in the size of the nucleus, the ultimate result of which was the production of a body which was apparently only the enlarged original nucleus, the cytoplasm having apparently all disappeared. This, it was stated, was interpreted to be the male form.

This evolution is illustrated in Plate I, figs. 7 to 11. Fig. 7 shows the nuclear enlargement with no great amount of cytoplasmic reduction. The nucleus is large and turgid, it causes the sides of the parasite to bulge and shows a distinct net. This net consists of a central aggregation from which strands run to the periphery. As already indicated in the discussion of figs. 3 and 4, whereas the appearance of this central aggregation differs considerably in the different specimens, its structure appears to be fundamentally the same throughout. It seems to be merely the close-meshed central part of the nuclear net, with the interspaces sometimes empty and sometimes filled in with faintly staining chromatin. The latter is the more primitive condition.

The parasite shown in fig. 7 was from int. 15, or about the middle of the intestine, and hence is presumably that of a parasite which has been within the cell for some little time. Except, however, for the notable enlargement of the nucleus, it has all the characteristics of a very early stage.

Fig. 8, from int. 30, represents a condition in which there has been as yet no great amount of nuclear enlargement, but a slight degree of cytoplasmic degeneration. In fig. 9 there is shown nuclear enlargement accompanied by a considerable degree of cytoplasmic degeneration, as is evidenced by the vacuolization and rough contours of the

cell. In fig. 10 the nucleus projects out from the sides of the cell, while the cytoplasm is reduced and shows uneven contours. In fig. 11 there is seen both nuclear enlargement and cytoplasmic reduction.

The initial steps in the evolution of the male element are illustrated by the figures just described. The details of this evolution vary greatly, and it is doubtless true that this variation in detail is the result not only of variations in the actual biological process itself, but is also dependent on the technique. Thus, in iron hæmatoxylin preparations there are always associated with the nucleus one or more intensely black granules which are either not visible at all or only faintly visible in Delafield or thionin preparations. Furthermore, in material stained in thionin the cytoplasm is frequently seen to be separated into two portions, as shown in Plate I, figs. 12, 13, and 14. Here the cytoplasm is broken up into a number of lumps or streaks either lying embedded in a faintly staining ground substance (figs. 12 and 14) or apparently lying free in the vacuole which the parasite always produces in the mouse cell (fig. 13). It is evident that one of these conditions is readily derivable from the other. Thus, in figs. 12 and 14, the cytoplasm has separated into a chromophil substance lying within an almost achromatic substance. This latter gradually disappears, producing the condition shown in fig. 13.

A high affinity for chromatin stains is characteristic of the by-products of protoplasm, and is especially well brought out by thionin. Thus, in material so stained, both degenerate nuclei and mucus are deeply stained. In the former case we are dealing with a pathological, in the latter with a physiological process, but in both with protoplasmic by-products. In the case of these Sarcosporidia, the great increase in the size of the nucleus seems to predicate a supply of pabulum, and the suggestion is at least permissible that this pabulum is supplied by the cytoplasm. If this were so, the presumption would be that the densely staining flecks, as noted in figs. 12, 13, and 14, represent the cytoplasmic debris remaining after the nucleus has robbed the cytoplasm of a part of its substance. It is of course to be understood that the above is put forth merely as a possibility, the matter being one scarcely open to a rigid demonstration.

Mouse 125.—As noted in the list given on p. 6, this mouse represents the conditions from 2 to $2\frac{1}{2}$ hours after feeding. These are in all essentials the same as those of mouse 248, as is evidenced by figs. 15, 16, and 17. In the case of fig. 17, Plate II, it is to be noted that

the cytoplasm is greatly reduced in quantity and is vacuolated, while in all three the nucleus is enlarged and shows the usual nuclear net.

Mouse 249.—This animal was killed three hours after feeding. Its intestine was cut into 31 pieces numbered from 1 to 31. Observations were made upon the stomach and upon int. 2, 6, 8, 10, 12, 18, 20, 22, 30, and 31. The stomach and the first five pieces of the intestine examined were negative. In int. 18 spores were present in the lumen; in int. 20, 22, 30, and 31 they were found both in the lumen and in the cells.

It has already been shown (p. 11) that in some of the mice the spores move along the intestine very rapidly, yet it is always to be remembered that the failure to find them in a few selected slides is not proof of their absence from the particular portions of the intestine from which these slides were made. In this mouse it seems unlikely that so much of the intestine was actually negative.

It is in mouse 249 that the differentiation into males and females first begins to be noticeable. In the case of the males, in which the characteristic changes consist of a great enlargement of the nucleus and a reduction of the cytoplasm, there is no confusion, since these changes are conspicuous and readily detected.

Thus, Plate II, figs. 18, 19, and 20 are all obviously males, since they all show nuclear enlargement and cytoplasmic reduction. A particularly good earmark of the males is the fact that the nucleus is not surrounded by cytoplasm, the parasites consisting (fig. 18) of an enlarged nucleus provided with two tongue- or cap-shaped masses of cytoplasm. The conspicuous black granule, mentioned above as appearing in iron hæmatoxylin stains, is to be seen in fig. 20, whereas fig. 19 shows a stage wherein the cytoplasm is nearly gone and the nucleus has reached a size equal to that of many of the entire parasites.

On the other hand, the differences between the female and the original spore are by no means so striking. The female is relatively shorter and broader, while the nucleus is sometimes larger and, as a rule, shows the chromatin concentrated into a single large karyosome. There is, however, no loss of cytoplasm. Moreover, with an exception to be noted below, the female undergoes no such conspicuous changes in the course of its evolution as does the male. In consequence, in these early stages it is always difficult and sometimes impossible to say whether a given parasite is a female or merely one which has been in the cell a short time.

Hence, it is only with much reserve that fig. 21, Plate II, may be pro-

nounced that of a female. It possesses, however, the rather densely staining cytoplasm characteristic for the females and the nucleus is too small for a male. The deeply staining granules present in iron hæmatoxylin material are here in evidence.

Fig. 22 probably also represents a female since it is a smoothly oval cell with dense cytoplasm, and the nucleus, while large, does not cause any protrusion of the sides of the cell. The radiate nuclear structure in this parasite is peculiar for such an early stage, and may represent a very precocious case of maturation (see p. 30).

Mouse 126.—This mouse was given the flesh of an infected animal at a stated time and required one-half an hour to complete its meal. It was killed three hours later and in consequence represents the conditions 3 to 3½ hours after inoculation. Figs. 23 and 24, Plate II, are from this mouse and show early male stages, as evidenced by the enlarged nuclei and the scanty quantity of cytoplasm present.

Mouse 261.—Mouse 261 was given a piece of infected muscle at 10 A.M. (Feb. 15, 1915). It began to eat at once and consumed a considerable quantity of the infected material, but did not then complete the meal. At 2 P.M. the mouse was chloroformed, the infected muscle having been eaten in the interim. Hence, it represents the conditions from 4 hours down to some shorter period. The only portions of the intestine examined in this case were int. —1 to int. —5, or the last five pieces. The intestine of this mouse was slit open prior to fixation and in consequence the spores in the lumen were lost.

Since the study here was confined to the last few centimeters of the intestine, a given intracellular spore might have been in its place anywhere from a few minutes to three hours or more, and hence it is impossible to pick out the early female stages with any degree of certainty. Thus, fig. 25 might be either that of an early female stage or of a parasite which had been in the cell for only a short time. It is perhaps the same with fig. 26 which represents a form difficult to classify satisfactorily. On the other hand, fig. 27 is an evident early male, and both this and fig. 26 are of interest in showing very clearly the nuclear structure.

In a few cases, in mouse 261, males were found in which the loss of cytoplasm was complete.

Mouse 247.—This mouse was killed four hours after feeding. Its intestine was cut into 34 pieces, from int. 1 to 34, and observations were made on int. 12, 14, 16, 19, 30, and 33.

The differentiation into males and females is here carried a little

further, although it is still difficult to get forms that can positively be diagnosed as females.

An evident female, however, is shown in fig. 28, Plate II. This is taken to be a female on account of its shape, its retention of the cytoplasm, and the character of its nucleus. This latter element, as is shown by the figure, is vesicular, with a sharply defined nuclear membrane and a central mass of chromatin from which strands radiate to the periphery. Fig. 29 shows another female. This figure is diagrammatic, but is essentially like fig. 28. Both of these figures were obtained from int. 14 of the mouse; that is, from the anterior half of the intestine, and hence the presumption is that both of the parasites drawn had been in the cells for some considerable time.

Fig. 30, from int. 19, may also be that of a female, although here the diagnosis is more doubtful, since the form rather suggests a parasite which has been in the cell for only a short time.

In addition to the females, characteristic early males were seen in the cells of this mouse.

Mouse 250.—This mouse was killed five hours after feeding. Its intestine was cut into 34 pieces, numbered from 1 to 34, and observations were made on int. 21, 22, and 32.

In this mouse it is much easier to distinguish between the males and females, since the two lines of development have become well separated. Thus, figs. 31 and 32, Plate II, represent males which have reached what might be termed the nuclear stage; that is, the stage in which the cytoplasm has nearly or quite disappeared.

Thus, in fig. 31, the cytoplasm has all disappeared except for a cap of degenerate-looking material at one end of the nucleus. The nucleus itself shows the usual net, associated with which are several black granules. Centrally there is an irregular mass of acidophil chromatin in which lies a large black granule. This probably represents the karyosome.

Fig. 32 also represents a male. There is here to be seen a well-defined net of rather broad strands and a number of black granules. The meshes of the net are in some places filled with faintly staining material. A karyosome does not appear to be present, although the large black granule may perhaps represent it. The crescent of staining substance at one end of the nucleus may represent the remnant of the spore cytoplasm, but more probably is a crescent of host tissue which not infrequently forms at the end of the vacuole in which the parasite normally lies. Its actual detachment from the parasite suggests it is the latter, and if this be so the cytoplasm of

the parasite has wholly disappeared and the vacuole in which the nucleus lies is the vacuole originally formed by the parasite.

Fig. 33, Plate II, represents a parasite from the same slide and same section of the intestine as figs. 31 and 32. It is clearly a female. The entire parasite is sharply outlined, and the cytoplasm is dense, although showing several vacuoles. The nucleus is clear cut and contains a large, rather faintly staining karyosome, together with two black granules. One of these granules lies within the karyosome, the other appears to be in the space between the karyosome and membrane, but it is possible that it actually lay upon the membrane itself. In this particular case, strands connecting the karyosome with the nuclear membrane could not be detected.

Fig. 34 was also obtained from the same slide as figs. 31, 32, and 33, but not from the same section. The parasite was clearly outlined. The cytoplasm, while not suggesting degeneration, was not homogeneous, but appeared to consist of a matrix in which were a number of poorly defined denser areas. This is an appearance frequently to be noted in the early female stages, but it has not been possible to work out its significance. The nucleus of this parasite was clear cut and contained a large, faintly staining karyosome. Little strands radiated from the karyosome, but these could not be traced to the nuclear membrane. Two black granules were present, one within or upon the karyosome, the other on the nuclear membrane.

The four parasites here figured and described typify conditions as found in mouse 250. They appear to furnish satisfactory evidence that the spores, after their invasion of the cells, separate into two groups, the later evolution of which indicates that they are to be regarded as males and females. This evolution, moreover, proceeds at such a rate that at the end of five hours at least a considerable number of the parasites can be separated into males and females. It is also believed that the cases herewith considered are the more convincing in that they were all taken from exactly the same place in the intestine. This was the twenty-second piece of an intestine cut into 34 pieces and therefore only two-thirds the way from the anterior end. This permits of the presumption that these four parasites had all entered the cells at somewhat the same time, and that this was perhaps four hours prior to the death of the mouse.

It is of course to be understood that in the whole intestine up to 6 hours, and in its extreme posterior portions up to 9 hours, the parasites are in general in all sorts of conditions and that only a portion are differentiated into males and females. Furthermore,

it is to be understood that the figures are, as is usual in such cases, more or less diagrammatic, since it is impossible to reproduce the exact appearances as found under the microscope.

Mouse 253.—This mouse was killed 6 hours after feeding and its intestine cut into 29 pieces, numbered from 1 to 29. Observations were made on int. 15, 19, 25, 27, and 29.

The conditions here are, of course, very much like those of mouse 250, the cells showing evident males and females along with a number of others which had not evolved far enough to permit of their being determined. Characteristic females are shown in figs. 35, 36, and, Plate III, 37. A male is shown in fig. 38, which was taken from int. 16. This, while differing somewhat from figs. 31 and 32, is nevertheless obviously a male, since the cytoplasm has wholly disappeared and the parasite consists of nothing more than the enlarged nucleus of the original spore.

Mouse 99.—This mouse was given two infective feeds separated by an interval of 3 hours and killed 3 hours after the second. It therefore represents the conditions at both 3 and 6 hours after inoculation and it is usually possible, in the case of any given parasite, to say to which of the two inoculations it belongs. Thus, fig. 39 is obviously that of a male and no doubt belongs to the 6-hour stage.

The Later Stages.

The Male.—The early stages of the evolution of *S. muris* have, as far as possible, been traced step by step as they occurred in mice killed from 1 to 6 hours after inoculation. At the outset the spores are apparently all alike, although it is possible that the dimorphism may be in evidence even for the spores in the cysts, as appears to be the case for the spores of *Sarcocystis colii* (Fantham, 1913). But whether this be so or not, by the end of 6 hours at least a considerable proportion of the parasites present are clearly separated into two categories.

For the later stages it is more convenient to follow these two lines of development separately, instead of considering what is found at the end of increasingly longer periods of time. For after the first eight or ten hours the time factor ceases to be of value, and both 9- and 18-hour mice, for instance, may show identical stages of evolution. The development of the male will first be considered.

As we have already seen, in the first few hours the male parasites lose most if not all of their cytoplasm and become reduced to an element which is obviously only the enlarged nucleus of the original

spore. Eventually the chromatin of these elements collects into a number of small aggregates which arrange themselves around the periphery of the parasite and transform themselves into what are evidently the microgametes. It may be assumed that the evolution of the male element, or microgametocyte, proceeds in an orderly manner, and hence it should be possible to obtain an orderly series from some such stage as that of fig. 31 (Plate II) to that of fig. 75 (Plate V). It is not, however, possible to give all of the steps of this evolution. The parasites are themselves small, ranging around 8μ in diameter and in consequence the details of their structure require the highest powers of the microscope. There is not a great deal of staining material within them, and the picture is confused by the fact that they lie embedded within the cells of the mouse in sectioned material. It is believed that in order to work out this evolution with precision it would be necessary to develop a technique which would permit of obtaining the parasites isolated, an end which could be gained either by cultural methods or by devising some means of getting the parasites out of the cells in which they had developed. The few attempts which have been made along these lines have as yet not met with any success. It is therefore to be understood that the details of the evolution of the microgametocyte as here set forth are presented with some reserve.

Taking up now this development of the male from the stage found in the 5- and 6-hour mice to that found at the end of 18 hours, the earlier phases of it are illustrated by figs. 40 to 53 (Plate III). As it happens, most of these are from mice 106 and 120, both of which gave especially favorable material. What is seen here, however, is confirmed by the findings in other mice of the same periods.

Evidently what is found in the 2- to 6-hour mice will represent conditions earlier than those found in mice killed 9 hours or more after feeding, and in these former the nuclear net is coarse and has a low affinity for chromatin stains (see figures of these stages). It is a matter of common knowledge that the chemical nature of chromatin varies with the physiological condition of the nucleus and that this is manifested by a varying staining reaction. Thus, in the so-called resting nuclei the chromatin has a relatively low percentage of nucleic acid, and this is indicated by a relatively low affinity for chromatin stains. On the other hand, as the nucleus prepares to divide, the percentage of nucleic acid increases, and as this takes place the chromatin displays a greater and greater affinity for chromatin stains. The percentage of nucleic acid is greatest at the time

when the chromatin is divided into chromosomes, and this is also the time when it stains most intensely.

In the case of Protozoa, the resting, or better the trophic, nucleus takes the plasma rather than the chromatin stains, a fact which may be ascribed to an extremely low content in nucleic acid at such times rather than to a fundamental difference between the chemistry of protozoan and metazoan nuclei. But when in division, the protozoan nucleus stains as does that of the Metazoa, and this same staining reaction is also displayed by certain of the products of this division, such as microgametes.

It is therefore permissible to suppose that in these early male forms of *Sarcocystis muris*, the coarseness of the threads of the nuclear net is due to the fact that the achromatic filaments are bearing a quantity of chromatin poor in nucleic acid. Besides being distributed along the achromatic filaments and upon the inner surface of the nuclear membrane, the chromatin may also occur in lumps, in masses which fill up the meshes of the net, and there is apparently normally present a larger mass or karyosome.

In the course of several hours, however, this type of nucleus transforms itself into a body such as is shown in figs. 66 and 67 (Plate IV). This is an oval element containing some achromatic stringy substance and showing around the periphery a series of granular clusters. The granules composing these clusters are extremely minute, but intensely chromophil, staining as do the chromosomes of a dividing metazoan cell. In spite of their minute size they are readily resolved.

We thus start with a nucleus having a considerable bulk of chromatin which has a low affinity for chromatin stains. Morphologically, this chromatin occurs as granules, irregular masses and bands, borne either by the nuclear net or upon the inner surface of the nuclear membrane. There is also usually present a central mass or karyosome. After several hours, however, the chromatin has diminished in bulk, has an intense affinity for chromatin stains, and is placed around the periphery in the form of clusters of minute granules. The conspicuous changes then consist in the taking on of a high affinity for basic stains, subdivision into minute granules and migration to the periphery.

The desire is to show the several steps in this transformation.

The earlier conditions are shown by figs. 31, 32, 38, and 39. Figs. 31 and 32 are from mouse 250, a 5-hour stage; fig. 38 from mouse 253 (6 hours), and fig. 39 from mouse 99 and presumably represents the 6-hour stage. These four figures show very distinctly the

variations with regard to what is interpreted to be the karyosome. In fig. 32 it is either absent or represented by the large black granule. In fig. 31 the irregular central mass provided with a black granule presumably represents this element. In fig. 38 it is a large irregular body, while in fig. 39 it is a large oval deeply staining granule, split nearly into two by a cleft. To some extent these differences are due to the technique employed, but in the main they represent actual differences in the morphology of the parasite itself.

Passing now to mouse 106, a 9-hour stage which yielded highly favorable material, we have figs. 40 and 41 (Plate III). Fig. 41 is very much like fig. 39, except for the staining reaction of the karyosome. Fig. 40 bears a general resemblance to figs. 31, 32, and 38. It is therefore apparent that figs. 40 and 41 represent the earlier of the stages present in mouse 106 and hence the starting point from which a number of these have arisen. For the parasites in a 9-hour mouse may have been in the cells anywhere from a very short time up to perhaps 8 hours. Hence, in passing from mouse 99, 250, or 253 to mouse 106, it is not necessary and would, indeed, be a mistake to assume that we had also passed over 3 or 4 hours of time spent in development. The period elapsing between the inoculation and death of the mouse, at least as far as concerns the periods up to 9 or 10 hours, is of value only as a high limit. A parasite of mouse 253 cannot be more than 6 hours old; one of mouse 106 cannot be more than 9 hours, and this is all that can be stated with absolute certainty. Nevertheless, the parasites of mouse 106 will in general be older than those of mouse 253, even though they will in a number of cases represent the same stages of development. It is therefore permissible to use parasites such as are shown in figs. 31, 32, 38, and 39, as well as figs. 40 and 41, in tracing the later stages as found in mouse 106.

It is easy to pick out conditions readily derivable from these. Thus, fig. 42 (upper cell) is a good deal like fig. 41. Fig. 43 is also very much like fig. 41, except for the strip of basophil chromatin which runs across the nucleus. Fig. 44 also displays a general resemblance to the earlier stages, but has developed a greater quantity of basophil chromatin present in the form of scattered granules. A similar state of affairs is seen in fig. 45, in which the somewhat quadrangular mass of acidophil chromatin situated in the centre may represent the karyosome. In figs. 46 and 47, we have parasites in which the chromatin is all basophil and occurs in a rather finely divided state. In the case of the two parasites shown in fig. 42,

while they are not wholly unlike morphologically, the chromatin of the one is acidophil, of the other basophil, and the fact that they lie side by side seems to preclude ascribing this difference to irregular action of the stain.

It is to be observed that all of the changes noted above point toward the production of finely divided and highly basophil chromatin.

As pointed out above, in the early stages, a karyosome may or may not be present. When it is present, its evolution appears to take place as follows: In figs. 31, 38, 40, 44, and 48 the karyosome is composed of acidophil chromatin, associated with which are one or more basophil granules. A karyosome of the type shown in figs. 40 and 48, consisting of a rounded acidophil mass bearing several sharply basophil granules, was quite common. In fig. 47 there is a ring of basophil granules, and figs. 46 and 49 show somewhat similar phenomena. We seem here to be dealing with the conversion of the karyosome from an acidophil mass into a group of basophil granules.

Resuming the account of the evolution of the entire parasite, fig. 53, from mouse 120, shows two parasites lying side by side. In the upper one the central body appears to represent the karyosome, here partly basophil and partly acidophil. In addition to this, the organism contains some acidophil material of irregular form together with a number of basophil granules, some of which are placed at the periphery. The lower parasite shows a central basophil mass and a number of basophil granules extending out from it. These parasites, from int. 8 of mouse 120, should represent later rather than earlier conditions, and they can be derived from what is shown in figs. 45, 47, and 48. The lower of the two, also, is very much like fig. 49.

It is always to be kept in mind that we are endeavoring to trace the development of a structure showing a typical nuclear net, and displaying both acidophil and basophil chromatin throughout its entire extent to one in which all the chromatin present is intensely basophil and occurs as clusters of minute granules around the periphery of the parasite. Biological processes never proceed with mathematical precision, and hence we cannot look to find these three processes taking place side by side. But it is entirely reasonable to assume that if we compare any two parasites and find one of them more advanced with reference to one or more of these three conditions that it represents the later stage. Thus the lower parasite of fig. 42 is older than the upper, and the same thing may be said of

fig. 53. Figs. 46, 47, and 49 represent later stages than figs. 40, 44, and 45. On the other hand, in figs. 44 and 48, while the chromatin is in part in the form of small basophil granules, the balance of it is acidophil. Hence, it would not be possible to say whether these represent older or younger stages than the lower parasite of fig. 42. Again, as between figs. 49 and 53, upper parasite, the chromatin of the former is all basophil, while that of the latter is showing a greater disposition to assemble at the periphery. The cases last given illustrate the irregularity with which the evolution proceeds.

Fig. 54 (Plate IV) is from mouse 120. It shows a parasite with an irregular central mass from which prolongations run toward the periphery. The staining reaction is partly basophil and partly acidophil. The basophil substance is partly in the form of granules and partly occurs as streaks and bands, but it is not improbable that these latter are composed of closely compacted granules, as is evidently the case, for instance, in the large aggregation of fig. 49. The central mass as shown in fig. 54 could have been derived from a karyosome of the type shown in fig. 44. Finally, in addition to the central mass shown here (fig. 54), there are four more or less well-defined clusters of chromatin granules, in two of which the granules are very minute.

The conditions shown in fig. 54 appear to be followed by those shown in figs. 55 and 56. In these latter there is a central mass sending out prolongations toward the periphery, but the chromatin is more completely basophil and more completely separated into granules. There is also the same tendency, at least in fig. 55, for the granules to be disposed in clusters. In these two parasites (figs. 55 and 56) there is very little achromatic material remaining, and this is in part only the fragments of the linin network. The parasite shown in fig. 57 appears also to belong to this stage of the evolution.

The development is carried further in the organisms shown in figs. 58 and 59. In these the arrangement of the chromatin granules into aggregates is more obvious. A comparison of figs. 54 and 55 with fig. 59 suggests that at least in some cases the *modus operandi* is for the chromatin to assume the form of a very irregular dendritic mass which later breaks up into smaller masses. Thus, in fig. 59 six of these small masses have already become individualized, and one more seems about to become free. In fig. 58, although the granules are very small, only three such masses have become independent.

The parasites shown in figs. 63 and 64 may belong in the above cycle. Although the central mass of fig. 64 is larger than that of fig. 54, its arrangement is not wholly different. Fig. 63, however, cannot very well be placed.

Figs. 60 and 61, from mouse 179, give slightly later stages than figs. 58 and 59. At least the central dendritic mass has disappeared and the chromatin is distributed throughout the entire nucleus, either in clusters or as separate granules. Furthermore, there is a marked disposition for the clusters to assume a peripheral position, especially well marked in fig. 61. The smaller size of the granular clusters in figs. 60 and 61 than in figs. 58 and 59 suggests that in these last the clusters are destined to subdivide before reaching a peripheral position, a suggestion supported by what is seen in figs. 62, 65, 66, and 67.

In figs. 60 and 61 all of the chromatin which could be seen by raising and lowering the focus was drawn, and hence some of the chromatin apparently central was actually peripheral. In fig. 62, only an optical section of the parasite is drawn. Here evolution has reached the stage where all of the chromatin is in the form of minute granules assembled in clusters that lie around the periphery. It is to be noted, however, that they are irregularly placed. The next stage is shown in fig. 66, where the clusters have come to lie in regular order around the periphery. Fig. 65 no doubt represents the same stage, but apparently shows only a part of the organism. In fig. 67 the clusters, which are the future microgametes or their nuclei, have begun to solidify. The further steps in this process are shown in figs. 68, 69, and 70, the last showing that the nuclei finally become rounded solid balls of highly basophil chromatin. Fig. 71 shows a condition intermediate between figs. 69 and 70.

Fig. 52 (Plate III) shows a parasite in which the chromatin is present in the form of solid balls more or less strung together. The form and solidity of the chromatin masses suggest the later stages such as are pictured in figs. 70 and 71, whereas their arrangement as well as the elongated oval form of the parasite recalls earlier conditions. At times, however, the parasite reaches the end of its development while still retaining this oval form (fig. 74, Plate V).

The final stages of the evolution of the microgametocyte are given in figs. 72 to 76 (Plate V). In fig. 72 the solid rounded elements are seen to be elongating, and this elongation is carried further in the case of fig. 73. Figs. 74 to 76 portray the microgametes. They always lie on the periphery, and fig. 76 gives the aspect as viewed in optical

section, whereas in the other two figures more than an optical section is shown. Figs. 75 and 76 are the more typical; in fig. 74 the parasite is unusually small for this stage, but is characteristic in showing very clearly the arrangement of the microgametes around the periphery.

The fully evolved male element or microgametocyte is a rounded or oval body, showing a stringy or amorphous residual mass and a series of microgametes disposed around the periphery. These latter are bodies about 2 to 2.5 microns long, broader at one end than the other and apparently composed wholly of intensely basophil chromatin. This is at least their appearance in sectioned material, it is not impossible that in life, or in material otherwise prepared, they may show more than is here evident. Analogy would lead us to suspect the existence of flagella.

This stage is apparently of short duration. Mouse 152, killed 18 hours after feeding, was heavily parasitized, but the exact stage shown in fig. 75 was comparatively scarce. This, however, is much as might be expected. The presumption is that the microgametes are motile elements, and once they are fully ripe they doubtless quickly abandon the situation in which they evolved, and without them the residuum would scarcely be recognizable.

In number they vary, following the counts made, from 13 to 17. Allowing both for an actual variation and for the practical difficulties in making an accurate determination, the supposition is plausible that the typical number is sixteen. It is a familiar biological phenomenon that in those cases where the number of elements ultimately produced is some power of two, we are dealing with the results of the repeated division of some one original element. In this case, however, the end appears to be attained in a less regular manner.

In the description of the later stages of the evolution of the male element, reference was confined to the conditions as found in mice 106, 120, 152, and 179, respectively, 9, $10\frac{1}{2}$ and 17, 18 and $16\frac{1}{2}$ hours. The first three of these gave particularly favorable material, all of them being heavily parasitized and none showing much destruction of the cells. The conditions seen here, however, were duplicated in other mice. Thus, Nos. 113, 132, and 133, all either $8\frac{1}{2}$- or 9-hour periods, showed many of the same stages as were seen in mouse 106, while the later stages in the evolution of the microgametes were seen in mice 121, 175, 177, 178, 180, and 182, representing periods ranging from $10\frac{1}{2}$ to 18 hours.

The Female.—It has already been shown that the female, in the 5- and 6-hour mice, is an oval cell with rather compact cytoplasm and a vesicular nucleus with a large central body, the karyosome. It is illustrated in figs. 33 to 37. The nuclear structure is comparatively simple and is portrayed well enough by the figures. The nuclear membrane is usually clear cut, and there is always present a large karyosome which takes the acid rather than the basic stain. The karyosome frequently has associated with it one or more sharply basophil granules, and may or may not show strands extending out toward the nuclear membrane.

It is difficult, however, to show the cytoplasm as it actually occurs, and in the main this has been done in the figures in a purely conventional manner. Its fundamental structure appears to be alveolar with the alveoles quite small and frequently tending to be variable in size. The picture, however, is greatly confused by the fact that in general both spongioplasm and hyaloplasm stain with much the same degree of intensity and both have a rather high affinity for plasma stains. Figs. 35, 77, 78, and 81 are attempts to show the conditions as they actually occur. In fig. 35 (Plate II) the alveolar structure is evident, although somewhat obscured, while it is seen much more clearly in fig. 81 (Plate V). Parasites in which the alveolar structure was as obvious as in fig. 81 could be found, but they were rare. Figs. 34, 77, and 78 show the cytoplasm to consist of an aggregation of poorly defined rounded bodies lying in a paler matrix. This was a frequent appearance. The black granules seen in some of the figures represent the black granules usually to be seen in material stained with iron hæmatoxylin. Frequently, also, the cytoplasm is vacuolated.

The general appearance here described does not undergo any great change. Thus, figs. 28 (mouse 247) and 79 (mouse 113), respectively 4- and 9-hour stages, are much alike, as are figs. 77 and 78, respectively, from 6- and 9-hour mice.

There is, however, one phenomenon presented which appears to be of interest. One phase of this is shown in figs. 81 and 82. In each of these the nucleus presents somewhat the appearance of a wheel. There is in each case a central acidophil karyosome which sends out strands to the periphery. Around the periphery are a number of basophil granules. This condition was not at all infrequent and appeared to be especially characteristic of the intermediate periods of 9 or 10 hours. It was, however, seen in mouse 77, a 15-hour stage. We also have the condition illustrated in fig. 83, where there is some basophil material outside of the nucleus.

The appearances suggest maturation, a suggestion which is strengthened by what is seen in figs. 84 to 87. In these the nucleus is the typical vesicle with its central karyosome, while the cytoplasm is more or less liberally provided with sharply staining granules. It seems permissible to suppose that we are here dealing with later stages in which the rejected chromatin has passed out into the cytoplasm.

Here it is apparently absorbed, since the fully mature macrogamete shows no indications of it. This phase of the life history of *S. muris* is protrayed by figs. 88 to 91, from mice 120, 145, and 152. The second of these was killed $11\frac{1}{4}$ hours after inoculation, and hence the macrogamete may reach the end of its development within this period of time.

Fertilization.

The earlier stages of the parasite are passed while within a cylinder cell of the intestinal epithelium in its proper place in the epithelial row. The parasite, however, has a deleterious influence on the cell it invades and apparently always destroys it in the end. It would then necessarily follow that the remnant of the cell, with its contained parasite, would, by pressure, be thrust out of its place in the epithelial row. In so far as the mechanics of the process are concerned, there does not seem to be any choice as to whether the dead cell would be pushed out into the lumen or beneath the row into the subepithelial tissue. It looks as though one contingency would be as likely to occur as the other.

Nevertheless, as early as 9 hours, but more particularly later, a considerable number of the parasites are to be found beneath the epithelium. This is more particularly the case with the macrogametes, which is further in accord with the probabilities. For the macrogametocyte is a rather compact, solid-looking element and presumably will retain its integrity even though subjected to mechanical stress. On the contrary, the microgametocyte, the bulk of which is obviously merely decadent residual matter, would presumably readily yield and break up if acted upon by pressure.

Here and there in the epithelium a ripe male cell occurs in which the microgametes appear to be streaming out into the subepithelial tissue. Conditions such as these may, of course, be interpreted in two ways: the microgametes may have reached their places beneath the epithelium either actively or passively. An examination of fixed material clearly sheds no light on such a question, but analogy

favors the view that such a movement is the result of an actual motility of the microgametes themselves. It may also be that in life the macrogametes are amœboid and gain their subepithelial situation through their own motility, but here the probabilities are the other way. Analogy is not in favor of a belief that the macrogamete is motile, nor do the macrogametes ever show amœboid outlines in the fixed material.

As to the actual situation of the parasites which occur beneath the epithelium, the fixed material does not give wholly conclusive evidence. They appear, however, to occur rather between the row of cells and the stroma than in the stroma itself.

We thus have obvious male elements and obvious female elements occurring beneath the row of epithelium cells. The production of male and female cells necessarily involves their union, and the environment in which they both occur offers no obstacle to such a procedure. It is evident that the proper demonstration of such a process should be made upon living material, since, in a situation such as has been indicated, the identification of a minute fragment of highly basophil matter as a microgamete is largely a matter of guess-work. It is easy enough to identify the thread-like bodies of figs. 75 or 76 as microgametes, since here their relationships with their surroundings can be established. But it is clear that an isolated microgamete cannot be identified when it occurs in a region presenting such a confused picture as does the subepithelial tissue of the mammalian intestine.

Nevertheless, when the macrogametes as they occurred in the subepithelial tissues of mouse 152 were studied, it was possible to separate them into two categories. A certain number were as figs. 88 to 91. Others were as fig. 93. These differ only that in the latter there was present in the cytoplasm a sharply basophil body. Also, conditions such as are illustrated in fig. 92 were found, where two elongated sharply basophil bodies are seen either lying upon or partly within the cytoplasm of a macrogamete. In consideration of the fact that it is axiomatic that the development of males and females involves fertilization, the indirect evidence here offered as to the actuality of the process seems satisfactory. Fig. 92 shows two supposed microgametes associated with the macrogamete, but it is safe to conclude that only one would have been successful in effecting union.

The three cells shown in fig. 93 have somewhat irregular outlines, this being the condition as found. Assuming that this is not an

artifact, it indicates that they are in no sense encysted, but are rather naked masses of cytoplasm. This irregularity of outline, however, is not necessarily associated with the supposed fertilization, since many of the macrogametes which showed the conspicuous chromatin body had maintained their smooth and regularly curved contours.

Discussion.

If the evolution of the macro- and microgametocytes of *S. muris*, as outlined above, be compared with that of *Coccidium schubergi*, as worked out by Schaudinn (1900) it will be seen that there is a very close resemblance. Thus, in both, the chromatin of the microgametocyte becomes divided into very small particles which collect in masses at the periphery and there condense to form the microgametes. This mode of division is designated by Minchin (1912) as chromidial fragmentation, the minute granules themselves being the familiar chromidia. Similarly, in both the sarcosporidian and the coccidian, the nucleus of the macrogametocyte discharges chromatic granules into the cytoplasm where they are apparently absorbed.

On the other hand, there are many marked differences. In the first place, in *S. muris* the male cell loses most if not all of its cytoplasm, the formation of the microgametes taking place in what is morphologically the nucleus. Hence, there is not only no increase in size of the parasite after it gains an entrance into a host cell, but actually a loss of substance. It is somewhat the same with the female cell which, while it gains in bulk, does so to a rather limited extent. This is in marked contrast to the phenomena displayed by *Coccidium schubergi*, in which the macro- and microgametocytes are many times bulkier than the merozoites from which they took origin.

The sarcosporidian runs through its sexual development within from 9 to 18 hours, while judging from the data given by Schaudinn (p. 217), the coccidian requires about two days.

The resemblances and differences between these two parasitic Protozoa are here merely pointed out. The resemblances are certainly very striking, but it seems premature to assign any significance to them. It is conceivable that they indicate a genetic relationship between the Sarcosporidia and Coccidia, but it is just as likely that we are dealing with phenomena broader than those suitable for connecting groups of the value of the Coccidia and Sarcosporidia. The problem is one that requires more evidence before any far-reaching conclusions are warranted.

Some of the features presented by the evolution of *S. muris*, however, when considered wholly by themselves, are worthy of attention. One of the most striking of these is the loss of cytoplasm displayed by the microgametocyte. So far as I am aware, no other protozoan displays a mode of development at all like this. Yet it is perhaps not so different from the usual procedure as it may at first seem. In all cases of the evolution of microgametes in Sporozoa the cytoplasm is largely or wholly inert. Thus, in the case used for comparison, that of *Coccidium schubergi*, the nuclear membrane dissolves and the chromidia collect in the cytoplasm where they eventually produce the microgametes. But there is nothing to show that the cytoplasm takes any active part in this development. It may function merely as a mechanical support for the microgametes. Furthermore, at the end of development the microgametes abandon the cytoplasmic mass, which is merely left behind.

This, indeed, is generally true. Throughout the entire group of the Sporozoa the fully developed microgametocyte consists of a number of microgametes associated with a residuum that represents unused cytoplasm. This residuum is always abandoned, and, so far as it is possible to see, it is always about equal in bulk to that of the original cytoplasmic mass. It may therefore be suggested that in the case of *S. muris*, the discarding of the cytoplasm merely takes place before the microgametes are developed instead of afterward.

The next peculiarity is the fact that there is either only a slight gain of substance, as in the females, or an actual loss, as in the males. This is probably correlated with the speed with which the development is effected. In general, parasitic Protozoa that live in cells enter these cells as very minute bodies which increase in size for a longer or shorter period, growing at the expense of the cell, and it is only after they have reached a certain size that they divide. That is, the host cells are the dwelling places of these parasites.

But in the case of *S. muris* in the intestinal epithelium of the mouse, the host cell appears to be used merely as a temporary lodging place. The parasites, although they appear usually to destroy the cells they invade, do not seem to feed upon them. No sooner do they come to rest than they proceed forthwith to evolve into the mature sexual stages, which are produced within 18 hours or less. It is apparent that the so-called spore possesses enough energy at the outset to carry on this development, and it seems much more plausible to look upon the granules which the spores contain as reserve food than as the so-called sarcocystin.

My studies do not extend beyond the formation of the zygote. In mice killed one to two days after feeding, oval cells resembling the zygotes, but larger, are quite frequent. These are most abundant in the villi beneath the epithelial row, but they also occur in the cells and occasionally free in the lumen. Their ultimate fate has not been followed, but Erdmann (1914) describes what seems to be schizogony in the cells and subepithelial tissues of mice killed several days after feeding, and it is not at all unlikely that the oval bodies mentioned above are schizonts.

One fact stands out clearly: the banana-shaped body of the Sarcosporidia is not a spore. There was never any reason to suppose that it was, even though this misleading designation has been used exclusively in the literature during recent years. Labbé (1899) designated it as a sporozoite, which, in view of its form, is far more plausible, and may indeed be a correct designation, so far as it is allowable to apply terms based on the conditions in the Telosporidia to stages of Sarcosporidia. For if the oval bodies occurring in one- and two-day mice give rise to the schizonts described by Erdmann, and if the products of this schizogony give origin to the familiar muscle cysts, then apparently the banana-shaped body is in some respects at least the analogue of the coccidian sporozoite.

As against this interpretation is the fact that in Coccidia, where there is both schizogony and sporogony, the sporonts are derived from merozoites. This would suggest that the banana-shaped sarcosporidian element is a merozoite. Obviously, however, the evidence at hand is not sufficient to warrant a conclusion. Accordingly, it has been considered best to follow recent custom and to retain the term spore, despite the fact that it is incorrect, for it is believed that this procedure is less confusing than to adopt a different designation which future discovery might show to be equally incorrect.

Summary.

(1) The spores of *Sarcocystis muris*, ingested by a mouse, may reach the posterior part of the small intestine within one hour.

(2) Invasion of the epithelium cells of the intestine may also take place within the same time.

(3) Upon reaching the lumen of the intestine, the spore rapidly undergoes changes. The nucleus becomes larger and more conspicuous, and a distinct nuclear net becomes evident. The granules characteristic of the spore as it occurs in the cyst either disappear or become much less evident. Further changes, however, do not take place unless the spore gains an intracellular situation.

(4) The spores are sexually differentiated, but it does not appear to be possible, at the outset, to distinguish between the males and females.

(5) Within the mouse cells the changes undergone by the males, or microgametocytes, begin to be evident at the end of 1½ to 2 hours.

(6) These changes are, first, a further increase in the size of the nucleus accompanied by a further development of the nuclear net, and, second, degeneration and ultimate disappearance of the cytoplasm. The cell contours become rough and irregular, vacuolization occurs, the cytoplasm becomes reduced to two masses of debris lying at the ends of the nucleus. These finally disappear, the entire process usually being completed at the end of 6 hours. The microgametocyte is thus reduced to its original nucleus, which, however, is of approximately the same size as the original spore.

(7) Conspicuous internal changes next take place, which modify both the morphology and chemistry of the parasite. They may be considered under three headings, but they all take place more or less simultaneously.

(*a*) The chromatin appears to suffer a loss in actual bulk, but alters in staining reaction from acidophil to basophil.

(*b*) From occurring in large irregular masses or distributed along the threads of the linin net in strips or bands, the chromatin is reduced to granules which become progressively smaller and smaller and at the same time display a greater and greater affinity for chromatin stains.

(*c*) These granules finally assemble in clusters around the periphery of the organism.

(8) The next step is the solidification of these granular clusters into rounded, solid balls. These balls next elongate and become minute, thread-like bodies, which are the microgametes. This stage may be found in mice killed from 9 to 18 hours after inoculation. It is very rare in the shorter of these two periods, but has apparently passed its acme at the end of 18 hours.

(9) The females go through with their development side by side with the males, but there are no such conspicuous changes and the early female stages are much like the spore which has just entered the cell.

(10) In the course of a few hours, however, the females can be picked out, appearing as broadly oval cells, relatively shorter and broader than the original spores. The cytoplasm is all retained and assumes a rather dense alveolar texture. The nucleus shows no

evident increase in size. The nuclear net does not develop as it does in the male parasite, but the chromatin concentrates into a single large karyosome which maintains an acidophil rather than a basophil staining reaction.

(11) In the 6- to 15-hour periods, phenomena are seen which seem best interpreted by regarding them as maturation. Irregular chromatin granules appear in close association with the nuclear membrane. Later these granules pass out into the cytoplasm, and finally disappear.

(12) The mature female, or macrogamete, may be found in mice killed from 11 to 18 hours after inoculation.

(13) Finally, in the 18-hour stages, macrogametes may be found which in some cases show minute, thread-like bodies upon their surfaces, and in others contain within their substances small solid chromatic bodies, one in each case. These appearances are regarded as warranting the interpretation that fertilization takes place.

Explanation of Plates I, II, III, IV, V.

The original figures were made by the author and later copied in ink by Mr. Haines, artist of the Bureau of Animal Industry. The greater number are from camera outlines, made on the table with a 2 mm. apochromatic objective and No. 18 eyepiece. This method yields a magnification of about 3,530 diameters. The remaining drawings are free-hand sketches of approximately the same enlargement. In reproduction, the drawings have been reduced in the ratio of 3 to 2, and hence are about 2,350 times larger than the objects themselves.

In order to show the relationships between the parasites and the cells, the latter have in some cases been drawn in outline. It was not, however, considered necessary to do this throughout.

Plate I.—Fig. 1.—Camera outline. Giemsa stain. Spores taken directly from a cyst. The cytoplasm stains a dense blue; the nucleus is a reddish vesicle with little or no internal structure. The spores are broader at one end than the other.

Fig. 2.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Spore free in lumen. Cell outlines clear cut; a periplast present; cytoplasm shows no signs of degeneracy. The nucleus shows a nuclear net and is somewhat enlarged, causing the cell edges to bulge.

Fig. 3.—Camera outline. Delafield and acid fuchsin. Mouse 251, 1½ hours, int. 9. Cytoplasm slightly degenerate, but staining deeply. Nucleus enlarged, about to cause bulging of the sides of the cell and showing a central mass joined to the nuclear membrane with strands.

Fig. 4.—Camera outline. Delafield and acid fuchsin. Mouse 251, 1½ hours, int. 9. Cytoplasm dense and staining deeply. Nucleus enlarged, with the central mass separated into granules.

Fig. 5.—Camera outline. Delafield. Mouse 248, 2 hours, int. 27. Cytoplasm dense with occasional clear spaces. Nucleus not enlarged. Chromatin in the form of small granules distributed throughout the net.

Fig. 6.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Cytoplasm very solid, staining deeply with the thionin and showing no signs of degeneracy. Nucleus is a vacuole which stains more or less homogeneously, apparently due to the fact that the nuclear sap has stained as well as the nuclear net and thus the latter is obscured. This is a frequent appearance, especially in parasites free in the lumen.

Fig. 7.—Camera outline. Delafield. Mouse 248, 2 hours, int. 15. Typical early male form. Nucleus greatly enlarged; cytoplasm reduced to two separate masses, one at each end of the parasite. Nuclear net distinct.

Fig. 8.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Early male stage. Cytoplasm beginning to show irregular outlines and to become vacuolated. Nucleus not greatly enlarged, but otherwise typical.

Fig. 9.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Early male stage. Shows very clearly the degeneration of the cytoplasm, evidenced by the rough outlines and vacuolization. Nucleus enlarged, with a distinct nuclear net.

Fig. 10.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Early male stage. Cytoplasm degenerate. Nucleus elongated transversely, a frequent appearance in the early stages. Nuclear net showing a single large central mass, in which is a vacuity.

Fig. 11.—Camera outline. Thionin and acid fuchsin. Mouse 248, 2 hours, int. 30. Early stage of male. Cytoplasm reduced in amount and degenerate in appearance. Nucleus greatly enlarged with a central aggregation differentiated into an acidophil mass beset with basophil granules.

Fig. 12.—Free-hand drawing. Thionin and eosin. Mouse 248, 2 hours, int. 30. Early male. Shows a method of degeneration of the cytoplasm frequently observed. The cytoplasm consists of a number of basophil masses lying in a faintly staining matrix. The nucleus was typical.

Fig. 13.—Free-hand drawing. Thionin and eosin. Mouse 248, 2 hours, int. 30. Early male stage. Shows mode of degeneration of cytoplasm, which at one end of the parasite is broken up into a mass of basophil lumps, apparently lying free in the host tissue. The nucleus was typical.

Fig. 14.—Camera outline. Thionin and eosin. Mouse 248, 2 hours, int. 30. Early male stage, probably slightly earlier than the form shown in fig. 13. The cytoplasm has separated into a number of denser masses, taking the thionin, which lie in an almost achromatic ground substance. The nucleus is typical.

Fig. 15.—Camera outline. Wright's stain. Mouse 125, 2 to 2½ hours. Early male stage, showing nuclear enlargement.

Fig. 16.—Camera outline. Wright's stain and eosin. Mouse 125, 2 to 2½ hours. Early male stage.

Plate II.—Fig. 17.—Camera outline. Wright's stain and eosin. Mouse 125, 2 to 2½ hours. Early male stage. Cytoplasm greatly reduced and degenerate. Nucleus much enlarged with a very distinct nuclear net.

Fig. 18.—Camera outline. Thionin and acid fuchsin. Mouse 249, 3 hours, int. 22. Two early males, both lying in the same vacuole. In both the nuclei are enlarged, and although the cytoplasm is reduced, it still retains its smooth outlines and is not vacuolated. Nuclei typical.

Fig. 19.—Camera outline. Thionin and acid fuchsin. Mouse 249, 3 hours, int. 22. Male. Cytoplasm reduced to a small cap at either end of the parasite. Nucleus greatly enlarged and showing the usual structure.

Fig. 20.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 249, 3 hours, int. 30. Early male stage. Cytoplasm somewhat reduced in quantity and showing signs of degeneration. Nucleus shows a net of the usual character and is provided with one large conspicuous granule. This kind of granule appears to require iron hæmatoxylin for its demonstration. The parasite lies in a partly emptied mucous cell.

Fig. 21.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 249, 3 hours, int. 30. Possibly an early female stage. Cytoplasm dense; nucleus clear cut with a central mass and three black granules on periphery.

Fig. 22.—Camera outline. Thionin and acid fuchsin. Mouse 249, 3 hours, int. 22. Probably an early female stage. Cytoplasm sharply delimited and dense. Nucleus enlarged, but not sufficiently so as to cause bulging of the cell boundaries. Within the nucleus is a round red body from which blue rays extend to the nuclear membrane.

Fig. 23.—Camera outline. Wright's stain. Mouse 126, 3 to 3½ hours. Early male form. The cytoplasm has nearly disappeared. The nucleus is typical.

Fig. 24.—Camera outline. Mouse 126, 3 to 3½ hours. Early male stage. Cytoplasm greatly reduced. Nucleus very large with a well-developed nuclear net.

Fig. 25.—Camera outline. Iron hæmatoxylin. Mouse 261, 4 hours,[1] int. −3. Early stage of doubtful sex. Cytoplasm sharply delimited and dense. Nuclear net obscured. A large black granule present.

Fig. 26.—Camera outline. Iron hæmatoxylin. Mouse 261, 4 hours, int. −3. Parasite lies in what seems to be a mucous cell. Cytoplasm dense and nearly homogeneous. Nucleus clear cut, showing a sharply marked karyosome and two conspicuous black granules. This parasite might be either a male or a female.

Fig. 27.—Camera outline. Thionin. Mouse 261, 4 hours, int. −3. Early male stage. Consists of an enlarged nucleus surrounded by a narrow strip of cytoplasm, with a quantity of degenerate material lying on one side. The parasite is probably cut obliquely. The nuclear net is well developed.

Fig. 28.—Free-hand drawing. Thionin and acid fuchsin. Mouse 247, 4 hours, int. 14. Early female stage. Cell outlines smooth and cytoplasm apparently not degenerate. Nucleus rather small with a clear-cut membrane and a central karyosome.

Fig. 29.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 247, 4 hours, int. 14. Early female stage. Cell boundaries sharp. The cytoplasm is neither degenerate nor has it suffered any loss in quantity. The nucleus does not cause any protrusion of the sides of the cell. A large, distinct karyosome is present. Figure diagrammatic.

Fig. 30.—Camera outline. Delafield and acid fuchsin. Mouse 247, 4 hours, int. 19. Form difficult to classify. The cytoplasm shows a distinct external boundary and, while vacuolated, is apparently not degenerate. Nucleus is a vesicle with a very large central mass.

Fig. 31.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 250, 5 hours, int. 22. Male. Cytoplasm has disappeared, except for a crescentic mass at one end. The nucleus is greatly enlarged and shows a well-developed net. The net itself is acidophil, the granules associated with it are basophil.

Fig. 32.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 250, 5 hours, int. 22. Male. Cytoplasm has apparently wholly disappeared. The nucleus is very large and shows an acidophil net beset with a number of sharply basophil granules.

Fig. 33.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 250, 5 hours, int. 22. Female. Cytoplasm dense and, while vacuolated, shows no signs of degeneration. Nucleus a vesicle with a large karyosome and two intensely black granules. Strands joining the karyosome with the nuclear membrane could not be made out.

Fig. 34.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 250, 4 hours, int. 22. Female. Cytoplasm shows no signs of degeneracy. It consists of a lighter ground substance in which are a number of poorly defined darker bodies. Nucleus a vesicle in which is a large karyosome. Little strands extend out from the karyosome, but they could not be traced the whole distance to the nuclear membrane. Two black granules present.

Fig. 35.—Camera outline. Delafield and acid fuchsin. Mouse 253, 6 hours, int. 19. Female. In this figure an attempt is made to indicate the alveolar character of the cytoplasm of the females. Nucleus a vesicle containing a large karyosome.

Fig. 36.—Camera outline. Delafield and acid fuchsin. Mouse 253, 6 hours, int. 19. Female. Cytoplasm rather dense, but liberally vacuolated. Nucleus a vesicle with a large karyosome.

Plate III.—Fig. 37.—Camera outline. Delafield and acid fuchsin. Mouse 253, 6 hours, int. 19. The figure shows two females which have invaded the same cell and developed side by side.

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[1] See the annotation with regard to mouse 261, on p. 19.

Fig. 38.—Camera outline. Thionin and acid fuchsin. Mouse 253, 6 hours, int. 16. Male. Parasite reduced to its nucleus which shows the nuclear net and a large central mass of chromatin.

Fig. 39.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 99, 3 and 6 hours. Male. The parasite, reduced to the nucleus, shows a well-developed nuclear net and a basophil karyosome nearly cut into two by a cleft.

Fig. 40.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. Parasite reduced to its nucleus, which shows the typical net and a large central aggregation in which are five basophil granules.

Fig. 41.—Camera outline. Delafield and eosin. Mouse 106, 9 hours. Typical male parasite.

Fig. 42.—Camera outline. Delafield and acid fuchsin. Mouse 106, 9 hours. The figure shows two male parasites lying in adjacent cells of the mouse, and it is instructive in that a marked contrast in staining reaction is to be seen, the upper cell being acidophil, the lower basophil.

Fig. 43.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 99, 3 and 6 hours. Male, doubtless belonging to the 6-hour period. The nuclear net is in the main acidophil, but a portion of it has taken on a sharply basophil staining reaction.

Fig. 44.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. Shows a typical nuclear net, a large acidophil karyosome and a number of basophil granules.

Fig. 45.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The nuclear material is partly acidophil, partly basophil.

Fig. 46.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin is basophil and finely divided.

Fig. 47.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin is basophil, and occurs as minute granules, except for the cluster of larger granules which is presumably derived from the karyosome.

Fig. 48.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin is partly acidophil, partly basophil.

Fig. 49.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. The chromatin is basophil and in a state of fine subdivision, except for the central mass which is probably derived from the karyosome.

Fig. 50.—Camera outline. Thionin and acid fuchsin. Mouse 106, 9 hours. Male. The parasite shows a delicate net provided here and there with basophil granules.

Fig. 51.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The parasite shows a delicate net provided with minute chromatin granules.

Fig. 52.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Male. The chromatin is extremely basophil and the bulk of it is concentrated into round balls. It is impossible to say to which of the two infective feeds this parasite belongs.

Fig. 53.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Shows two male parasites lying side by side. Instructive on account of the marked difference in staining reaction.

Plate IV.—Fig. 54.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Male. The central aggregation consists of sharply basophil substance between which is acidophil material. In the former rounded granules can be distinguished. This central mass is throwing out extensions into the balance of the nucleus where there are aggregates composed partly of sharply black granules and partly of acidophil material.

Fig. 55.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Male. The chromatin is black in the iron hæmatoxylin and occurs as minute granules. The general mass is showing a tendency both to form small clusters and to assemble upon the periphery.

Fig. 56.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, 10½ and 17 hours. Male. The chromatin occurs as small granules which appear to be migrating toward the periphery.

Fig. 57.—Camera outline. Wright's stain. Mouse 146, 11½ hours. Male. There is a large, irregular mass consisting of acidophil material which is liberally provided with punctiform basophil granules, and, in addition, a number of sharply staining elongated granules. It is difficult to determine just where in the development of the male parasite a form like this belongs.

Fig. 58.—Camera outline. Delafield and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin is in the form of minute basophil granules. There is a large irregular mass of these, and three rounded clusters near the periphery.

Fig. 59.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin is aggregated into clusters of fine granules, all of which are sharply basophil. Some of these clusters are wholly independent of one another; others are still united by strips of acidophil substance.

Fig. 60.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 179, 16½ hours, int. −1. Male. The chromatin occurs as minute basophil granules, either scattered or aggregated into clusters. A marked tendency toward the assumption of a peripheral situation is to be noted. The remnant of the linin network is omitted in the drawing.

Fig. 61.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 179, 16½ hours, int. −1. The chromatin is in the form of minute basophil granules which occur in clusters, most of which are peripheral. The remnant of the linin network is omitted from the drawing.

Fig. 62.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 179, 16½ hours, int. −1. Male. This figure portrays much the same conditions as are shown in fig. 61, but only an optical section of the parasite is shown. The granular clusters are thus seen to be exclusively peripheral.

Fig. 63.—Camera outline. Delafield and acid fuchsin. Mouse 120, 10½ and 17 hours. Form supposed to be a male.

Fig. 64.—Free-hand sketch. Iron hæmatoxylin and acid fuchsin. Mouse 120, 10½ and 17 hours. Supposed male.

Fig. 65.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. The chromatin occurs as clusters of minute granules.

Fig. 66.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours. Male. Optical section. The chromatin is in the form of minute, intensely basophil granules, aggregated in clusters that are arranged in a regular manner around the periphery.

Fig. 67.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Male. Optical section. The granular clusters, the forerunners of the microgametes, are seen to be arranged in a regular manner around the periphery. They are slightly more compact than in fig. 66.

Fig. 68.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Optical section. The clusters are becoming more and more solid.

Fig. 69.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. The microgamete nuclei have still further solidified. It is worthy of note that fig. 69, from a 9-hour mouse, represents later conditions than fig. 68, an 18-hour stage.

Fig. 70.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Optical section. The microgamete nuclei have become round solid balls.

Fig. 71.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Male. Condition intermediate between those shown in figs. 69 and 70.

Plate V.—Fig. 72.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Male. The solid nuclei are elongating to form the microgametes.

Fig. 73.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. The elongation continues.

Fig. 74.—Camera outline. Iron hæmatoxylin and eosin. Mouse 106, 9 hours. Male. Stage showing microgametes. The parasite is unusually small. This stage is very rare in periods as short as 9 hours.

Fig. 75.—Camera outline. Wright's stain. Mouse 152, 18 hours. Male. Stage showing microgametes.

Fig. 76.—Camera outline. Iron hæmatoxylin. Mouse 152, 18 hours, int. −1. Optical section of the same stage of development as shown in fig. 75.

Fig. 77.—Free-hand sketch. Thionin and acid fuchsin. Mouse 247, 4 hours, int. 14. Female, typical early stage.

Fig. 78.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Female. Cytoplasm mottled. Karyosome shows several black granules. This is possibly a very early stage of maturation.

Fig. 79.—Camera outline. Iron hæmatoxylin. Mouse 113, 9 hours. Typical female.

Fig. 80.—Free-hand sketch. Iron hæmatoxylin. Mouse 113, 9 hours. Female.

Fig. 81.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Female. Cytoplasm shows the alveolar structure which can frequently be made out in the females. Nucleus shows a ring of deeply staining granules lying around the membrane. These are taken to represent that part of the chromatin which is rejected during maturation.

Fig. 82.—Camera outline. Delafield and acid fuchsin. Mouse 106, 9 hours. Female, same phase as shown in fig. 83. The granules lying in the mouse cell are not believed to have anything to do with the parasite.

Fig. 83.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 106, 9 hours. Female. Later stage of maturation.

Fig. 84.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 145, $11\frac{1}{4}$ hours, int. −1. Female. Late stage of maturation.

Fig. 85.—Camera outline. Wright's stain. Mouse 146, $11\frac{1}{2}$ hours, int. −1. Female. Late stage of maturation.

Fig. 86.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Female, late stage of maturation.

Fig. 87.—Camera outline. Wright's stain. Mouse 146, $11\frac{1}{2}$ hours, int. −1. Female, late stage of maturation.

Fig. 88.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Mature female or macrogamete.

Fig. 89.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 120, $10\frac{1}{2}$ and 17 hours. Macrogamete.

Fig. 90.—Camera outline. Iron hæmatoxylin and acid fuchsin. Mouse 145, $11\frac{1}{4}$ hours, int. −1. Macrogamete.

Fig. 91.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Macrogamete.

Fig. 92.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Two microgametes are seeking to fertilize a macrogamete.

Fig. 93.—Camera outline. Wright's stain and eosin. Mouse 152, 18 hours, int. −2. Three macrogametes are shown, in each of which is a conspicuous chromatic element, taken to be the microgamete.

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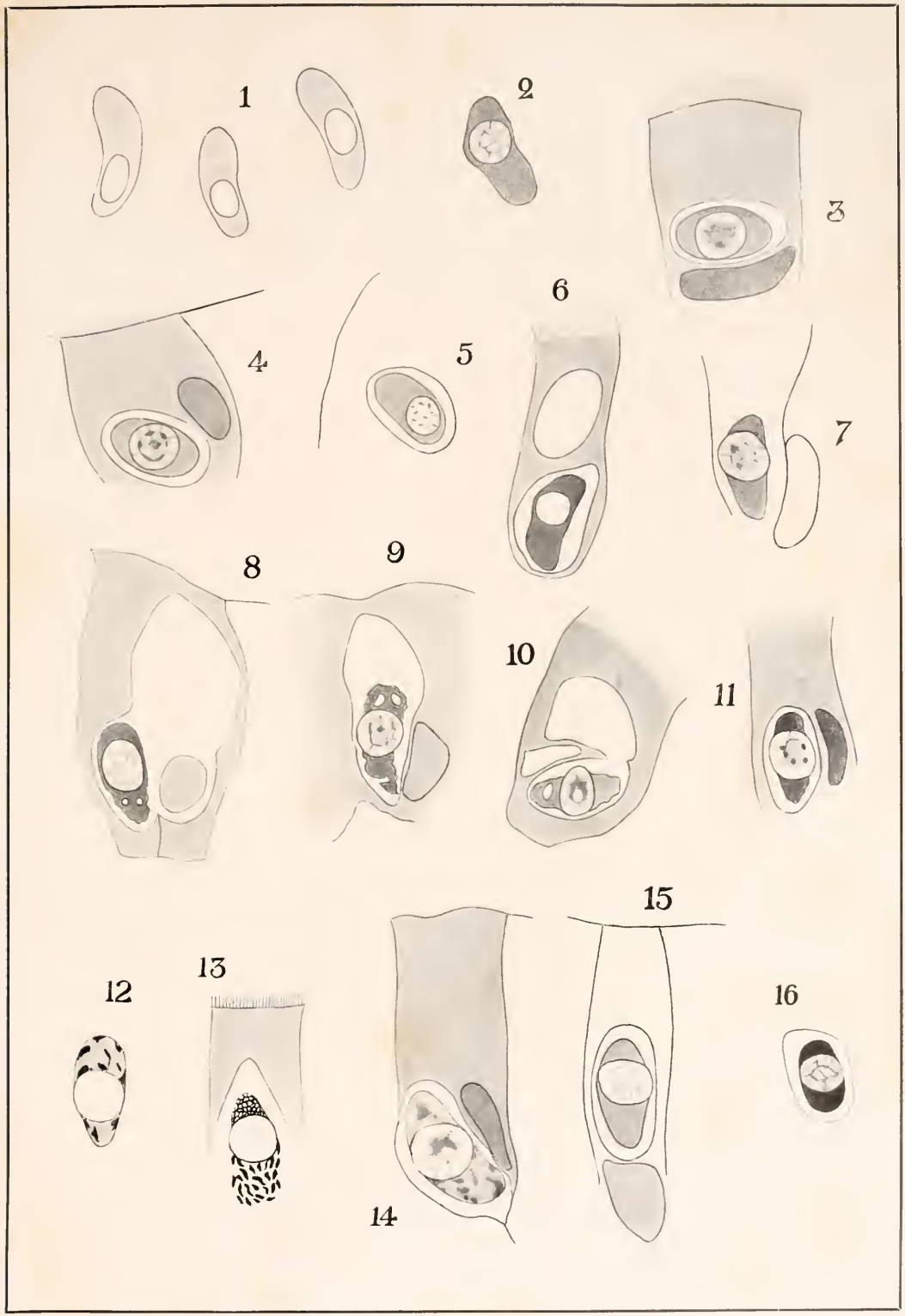

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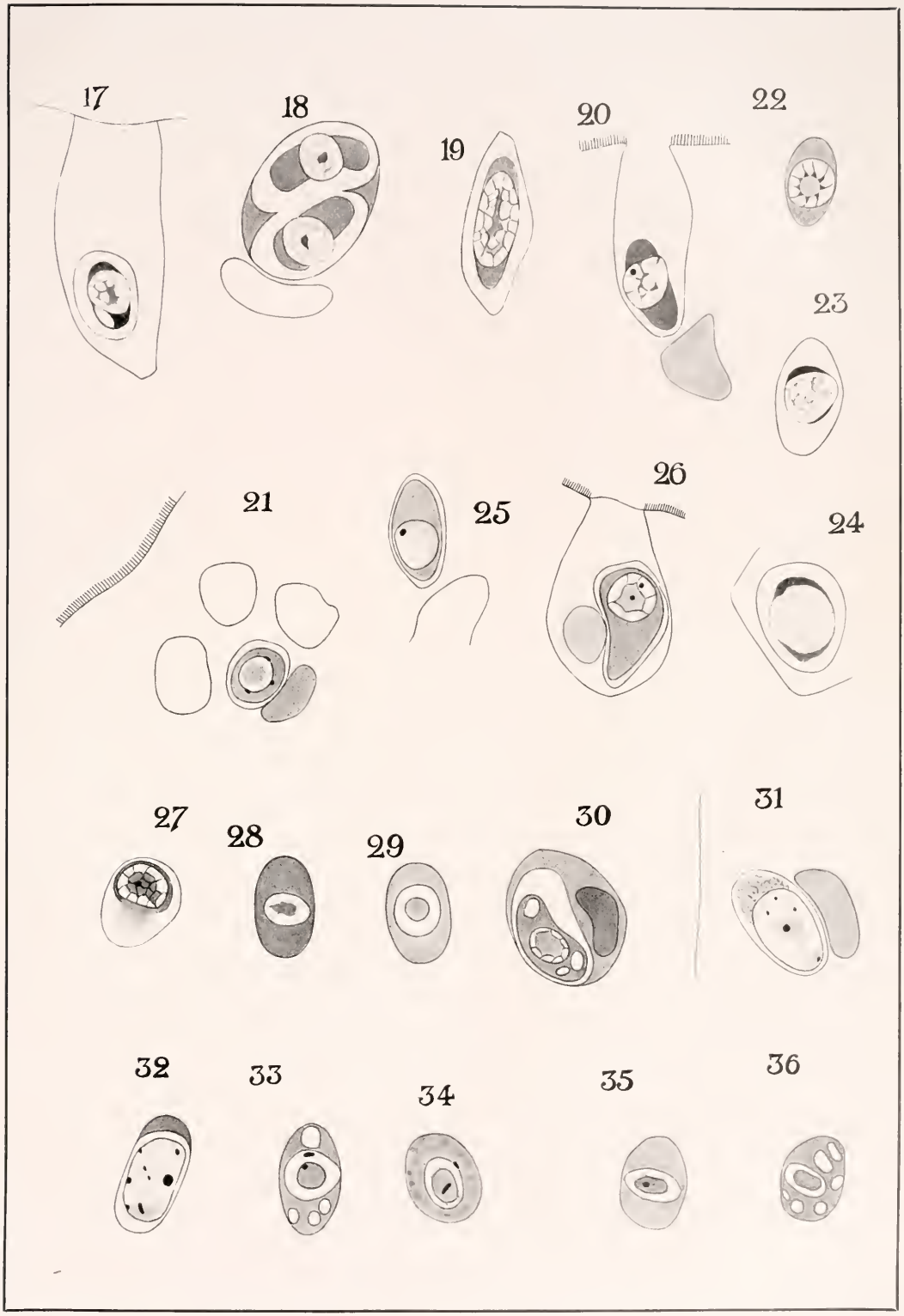

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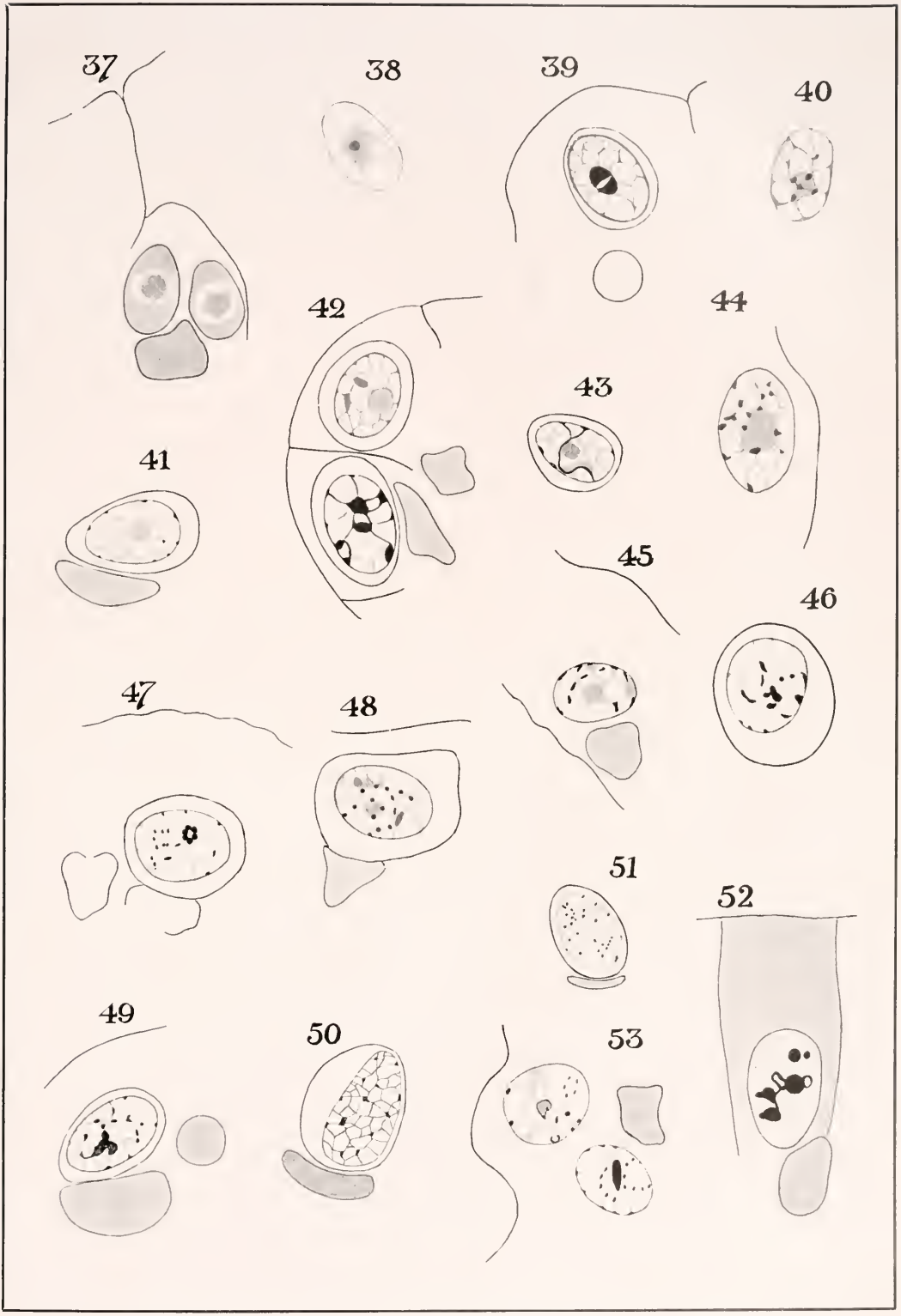

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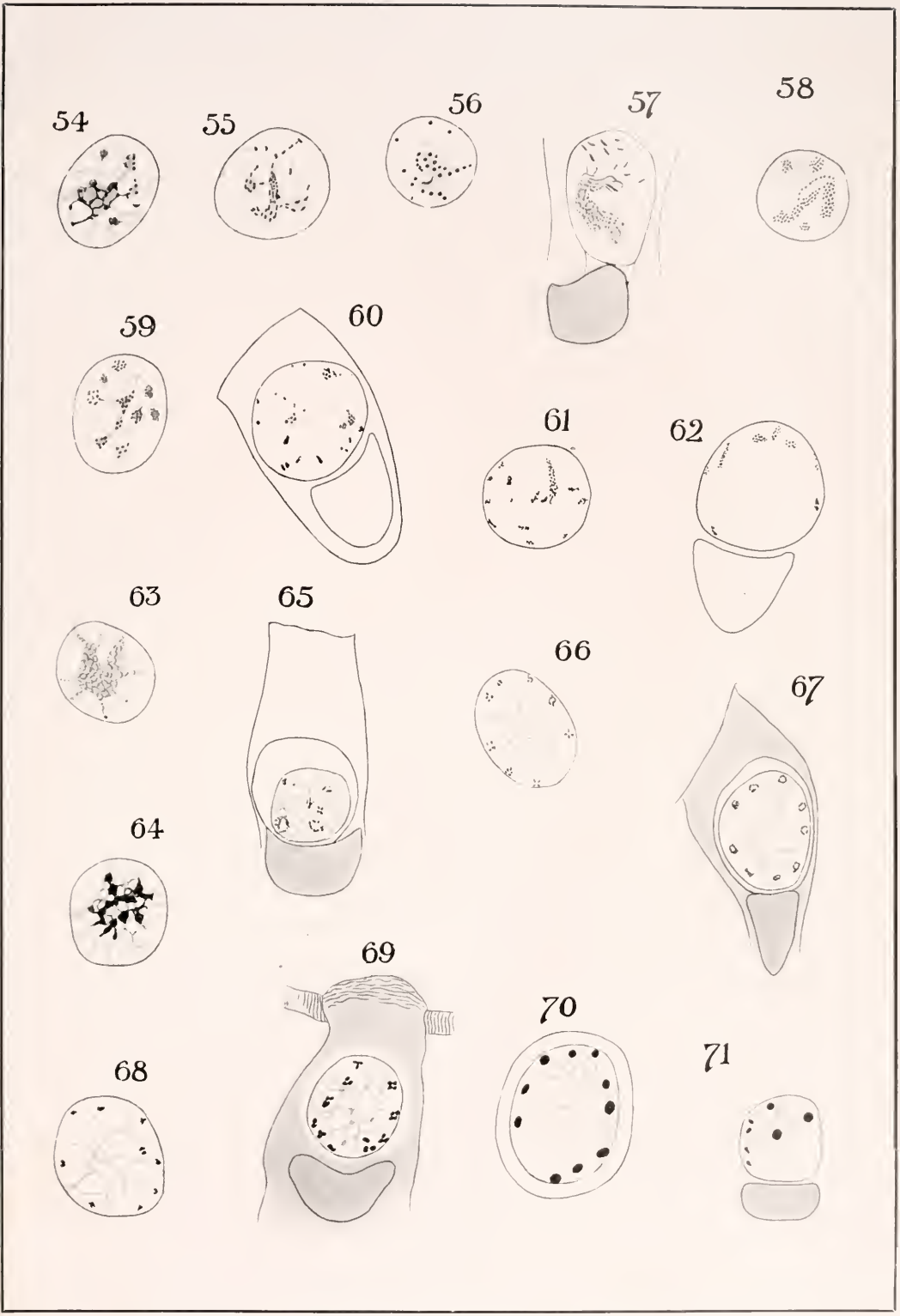

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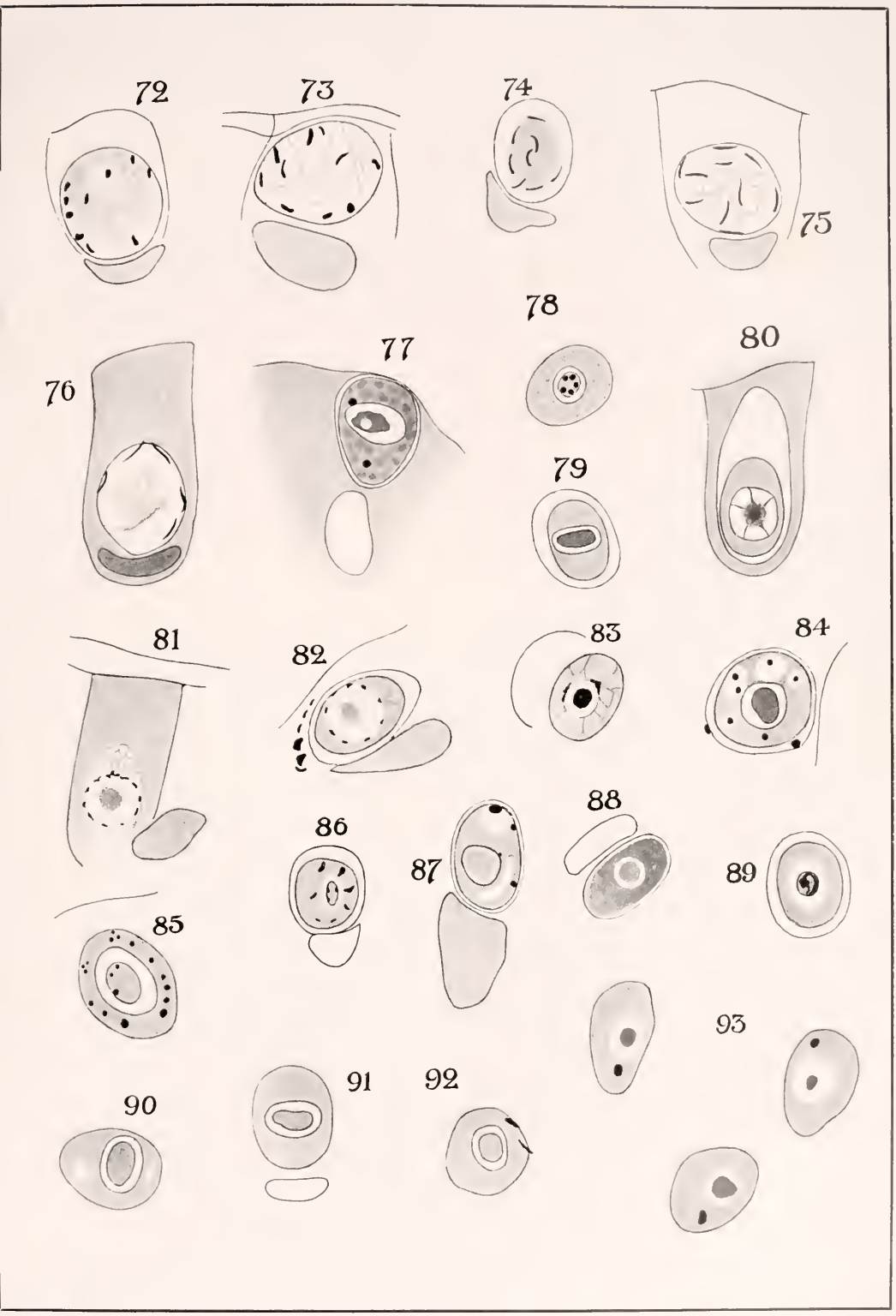

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February 15.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Fifty-nine persons present.

The Chair announced the deaths of Joseph R. Rhoads, March 7, 1915, and of Lincoln Godfrey, February 8, 1916, members.

The Publication Committee reported the presentation of papers under the following titles as contributions to the Proceedings:

"Hunting Mollusca in Utah and Idaho," by Junius Henderson and L. E. Daniels (January 19).

"Notes on the anatomy of Oreohelix, with a catalogue of species," by Henry A. Pilsbry (January 19).

Witmer Stone, Sc.D., made an illustrated communication on western birds and their haunts, being wayside observations on a journey across the continent.

The following was ordered to be printed:

CEPHALOPODA OF THE KERMADEC ISLANDS.

BY S. STILLMAN BERRY.

Introduction.

The Kermadec Islands comprise a small archipelago of volcanic origin, situated in the South Pacific Ocean northeast of New Zealand, to which politically they belong. Being off the beaten path of commerce, they have been rarely visited, and it is only very recently, through the activity of various antipodean investigators, that we are beginning to gain any extended knowledge of their fauna.

So far as cephalopods are concerned, the only species of the fauna known until the last year or two are the three octopods which the *Challenger* dredged from very deep water in the neighborhood in 1874, and which were therefore reported upon by Hoyle in 1885–'86.

In the spring of 1913 the present writer received from Mr. W. R. B. Oliver, of Auckland, a small, but what proved to be a very well-worth-while collection of cephalopods taken on Sunday Island, the most important member of the group, by Mr. Oliver himself, Mr. Tom Iredale, and Mr. R. S. Bell, in 1908 and 1910. At the request of the sender this collection was "worked up" and reported upon in the *Transactions of the New Zealand Institute* for June, 1914, but owing to certain exigencies of preparing and publishing the paper, it proved impossible to provide illustrations adequate to the material described.

Some months later and too late to be reported upon simultaneously with the earlier specimens, Mr. Oliver forwarded me another small vial of cephalopods, collected as were some of the most unusual species in the first lot, by Mr. R. S. Bell, in 1910. Being exceedingly anxious to secure additional material of the practically unique *Nematolampas regalis* and *Abraliopsis astrolineata* for further investigation, I overhauled the new specimens with eagerness. Though in this particular my quest was not fulfilled, the disappointment was more than tempered by finding two species of genera not represented in the first collection. In fact, the collections supplement one another in such an interesting way that a report upon the second necessarily involves a greater or less consideration of the first. The present paper, therefore, is practically a monograph of the cephalopod fauna

of the Kermadec Islands as known to date. I have so indicated in the title. At the same time the opportunity appears propitious for publishing a few sketches and other illustrations additional to those given in my earlier paper, and I trust the delay has not robbed them of value.

The new material reported comprises thirteen specimens, which I find to be referable to seven species and the same number of genera and families, as follows:

1 *Argonauta* species (young).
2 *Polypus* species (young).
1 *Onychoteuthis banksii* (Leach) (young).
1 *Lampadioteuthis megaleia* new genus and species.
1 *Abraliopsis* ? (young).
6 *Eucleoteuthis* species (young).
1 *Megalocranchia pardus*, new species.

The two species thus added to the previous list appear to be new to science. One of them is so divergent from anything we know that it is being made the type of a new genus and family. It is somewhat surprising to find this form similar in many superficial peculiarities to the wonderful *Nematolampas regalis* previously described from Mr. Oliver's material, and scarcely inferior in interest to its predecessor, even though the actual relationship of the two does not appear an especially close one. For further observations on these species of a somewhat general interest, I would refer the reader to the concluding remarks offered in connection with the description of *L. megaleia*.

Altogether the results of the exploration of the Sunday Island beaches by Messrs. Oliver, Iredale, and Bell have been without precedent, so far as the littoral capture of cephalopods is concerned, and inevitably causes one to ponder what ultimate harvest this wonderful region holds in store for the teuthologist, that a mere glimpse of wave-bound wrack from a single beach should prove so astonishing.

A complete list of all the cephalopods thus far known from the waters of the Kermadec Islands, with the number of specimens reported on, is given in the following table:

SYNOPSIS OF THE CEPHALOPODA OF THE KERMADEC ISLANDS.

	Depth in fathoms.	Hoyle 1885–86.	Iredale 1910.	Berry 1914.	Berry 1916.
Family CIRROTEUTHIDÆ—					
Stauroteuthis meangensis (Hoyle)	600	1	.....	.....	.....

	Depth in fathoms.	Hoyle 1885–86.	Iredale 1910.	Berry 1914.	Berry 1916.
Family AMPHITRETIDÆ—					
Amphitretus pelagicus Hoyle	520	1			
Family ARGONAUTIDÆ—					
Argonauta argo Linné			+		
Argonauta nodosa Solander			+		
Argonauta (species)				2	1
Family POLYPODIDÆ—					
Polypus oliveri Berry	shore			2	
Polypus kermadecensis Berry				1	
Polypus (young of various species)				3	2
Moschites challengeri Berry	630	1			
Family SPIRULIDÆ—					
Spirula spirula (Linné)			+		
Family ONYCHOTEUTHIDÆ—					
Onychoteuthis banksii (Leach)				6	1
Family LYCOTEUTHIDÆ—					
Nematolampas regalis Berry				2	
Family LAMPADIOTEUTHIDÆ—					
Lampadioteuthis megaleia Berry					1
Family ENOPLOTEUTHIDÆ—					
Abralia astrolineata Berry				1	
Abraliopsis (species)				1	1?
Family OMMASTREPHIDÆ—					
Sthenoteuthis bartramii (Lesueur)				3	
Eucleoteuthis (species)				3	6
Family CRANCHIIDÆ—					
Megalocranchia pardus Berry					1
Family NAUTILIDÆ—					
Nautilus pompilius Linné			+		
Nautilus macromphalus Sowerby			+		
Total specimens reported		3	5+	24	13

The fauna outlined in the table may conveniently be summarized as follows:

	Families.	Genera.	Species.	Species with photogenic organs.
OCTOPODA	4	5	7	0
MYOPSIDA	1	1	1	1?
ŒGOPSIDA	6	8	8	7
TETRABRANCHIATA	1	1	2	0
Total	12	15	18	8

New Terms Proposed.

The following taxonomic terms are used for the first time in the present paper:

Moschites challengeri, new name (for *Eledone verrucosa* Hoyle, 1886, in part, not of Verrill, 1881).
Lampadioteuthidæ, new family.
Lampadioteuthis megaleia, new genus and species.
Eucleoteuthis, new genus (for *Symplectoteuthis luminosa* Sasaki, 1915).
Megalocranchia pardus, new species.
Verrilliteuthis, new genus (for *Desmoteuthis* Verrill, December, 1881, in part, not of Verrill, February, 1881).

Systematic Review of the Species.

Order DIBRANCHIATA.

Suborder OCTOPODA.

Family CIRROTEUTHIDÆ.

Genus STAUROTEUTHIS Verrill, 1879.

1. Stauroteuthis meangensis (Hoyle, 1885).

1885. *Cirroteuthis meangensis* Hoyle, Ann. and Mag. Nat. Hist., (5), 15, p. 234.
1885. *Cirroteuthis meangensis* Hoyle, Proc. Roy. Soc. Edinb., 13, p. 111.
1886. *Cirroteuthis meangensis* Hoyle, Challenger Rep., p. 63, pl. 9, figs. 12, 13; pl. 11, figs. 1, 2; pl. 13, figs. 5, 6.
1904. *Stauroteuthis meangensis* Hoyle, Bull. Mus. Comp. Zool., 43, p. 5.

One young specimen was taken by the *Challenger* in 600 fathoms, north of the Kermadec Islands.

Family AMPHITRETIDÆ.

Genus AMPHITRETUS Hoyle, 1885.

2. Amphitretus pelagicus Hoyle, 1885.

1885. *Amphitretus pelagicus* Hoyle, Ann. and Mag. Nat. Hist., (5), 15, p. 235.
1885. *Amphitretus pelagicus* Hoyle, Narrative Chall. Exp., 1, p. 271, fig. 106.
1885. *Amphitretus pelagicus* Hoyle, Proc. Roy. Soc. Edinb., 13, p. 113, fig.
1886. *Amphitretus pelagicus* Hoyle, Challenger Rep., p. 67, pl. 9, figs. 7–9.

The type locality of this species is 29° 55′ S. Lat., 178° 14′ W. Long., off the Kermadec Islands. Here one specimen was dredged by the *Challenger* in 520 fathoms.

Family ARGONAUTIDÆ.

Genus ARGONAUTA Linné, 1758.

3. Argonauta argo Linné, 1758.

1758. *Argonauta Argo* Linné, Syst. Nat., ed. X, p. 708.
1910. *Argonauta argo* Iredale, Proc. Malac. Soc., 9, pp. 70, 72.
1915. *Argonauta argo* Oliver, Trans. N. Z. Inst., 47, p. 560.

Iredale and Oliver record a few shells of this species washed up on the beaches of Sunday Island. Comparison should probably be made with *A. pacifica* Dall and *A. grandiformis* Perry.

4. Argonauta nodosa Solander, 1786.

1786. *Argonauta nodosa* Solander, Portland Cat., p. 96, No. 2120.
1910. *Argonauta nodosa* Iredale, Proc. Malac. Soc., 9, pp. 70, 72.
1915. *Argonauta nodosa* Oliver, Trans. N. Z. Inst., 47, p. 560.

Both Iredale and Oliver state that animals and shells of this species are occasionally washed to land at Sunday Island.

Argonauta species. Pl. VI, fig. 1.

1914. *Argonauta* sp. Berry, Trans. N. Z. Inst, 46, p. 135.

A very small female without a shell [S. S. B. 420] collected by Bell in 1910 is presumably the same species as the specimens already reported in the paper cited. A photograph of one of the former specimens, showing the hectocotylus *in situ* within the mantle cavity of the female, is now given as fig. 1 on Plate VI.

Oliver (1915, p. 560) suggests that these specimens are to be referred to *A. nodosa* Solander.

Family POLYPODIDÆ.

Genus POLYPUS Schneider, 1784.

5. Polypus oliveri Berry, 1914. Pl. VI, fig. 2.

1914. *Polypus oliveri* Berry, Trans. N. Z. Inst., 46, p. 136.
1915. *Polypus oliveri* Oliver, Trans. N. Z. Inst., 47, pp. 560, 564.

As this species has not been figured, the matter is remedied by the photograph reproduced in the accompanying plate.

6. Polypus kermadecensis Berry, 1914.

1914. *Polypus kermadecensis* Berry, Trans. N. Z. Inst., 46, p. 138, pls. 7, 8.

Polypus species (Young).

Two very juvenile Polypi in the second collection cannot yet be determined [S. S. B. 434].

Genus MOSCHITES Schneider, 1784.

7. Moschites challengeri new name.

1886. *Eledone verrucosa* Hoyle, in part, Challenger Rep., p. 104 (not of Verrill, Bull. Mus. Comp. Zool., 8, p. 105).

One specimen was dredged off the Kermadecs in 630 fathoms by the *Challenger*, and reported by Hoyle as the Atlantic *M. verrucosa* (Verrill). I have long felt grave doubts as to the correctness of Hoyle's determination. The Kermadec Islands and the eastern coast of the United States are localities so extremely remote and isolated from one another, that such an anomalous distribution for a crawling, bottom-loving species of this sort seems *a priori* at least doubtful. Fortunately we have Hoyle's express statement that the *Challenger* specimen "has the extremity of the hectocotylized arm

formed like that of an *Octopus* rather than like that of an *Eledone*, as shown in Verrill's figure." In the light of our present knowledge that even relatively slight differences in the structure of the hectocotylus are important in distinguishing species, there is evidently available here a sufficient diagnostic character to separate the two forms. A new name therefore seems expedient for the Kermadec species.

Suborder DECAPODA.

Division **MYOPSIDA.**

Family **SPIRULIDÆ.**

Genus **SPIRULA** Lamarck, 1799.

8. Spirula spirula (Linné, 1758).

1758. *Nautilus spirula* Linné, Syst. Nat., ed. X, p. 710.
1910. *Spirula spirula* Iredale, Proc. Malac. Soc., 9, pp. 70, 72.
1915. *Spirula spirula* Oliver, Trans. N. Z. Inst., 47, p. 558.

Oliver states that dead shells are abundant on the Sunday Island beaches, occasionally with portions of the animal.

Division **ŒGOPSIDA.**

Family **ONYCHOTEUTHIDÆ.**

Genus **ONYCHOTEUTHIS** Lichtenstein, 1818.

9. Onychoteuthis banksii (Leach, 1817).

1817. *Loligo Banskii* Leach, Zool. Misc., 3, p. 141.
1826. *Onychoteuthis Banskii* Férussac, Annales Sci. Nat., (1), 7, p. 151.
1914. *Onychoteuthis banksii* Berry, Trans. N. Z. Inst., 46, p. 139.

A young specimen of this species is in the present collection [S. S. B. 422].

Family **LYCOTEUTHIDÆ.**

Genus **NEMATOLAMPAS** Berry, 1913.

10. Nematolampas regalis Berry, 1913. Pl. VII; Pl. VIII, fig. 5.

1913. *Nematolampas regalis* Berry, Biol. Bull., 25, p. 208, text fig. 1.
1914. *Nematolampas regalis* Berry, Trans. N. Z. Inst., 46, p. 140, text figs. 1–4, Pl. IX.

Sketches are now given of one of the curious hood-shaped suckers which appear along the distal regions of the arms, and also of a portion of the gladius (figs. 1–3).

The gladius of this species, as shown by a few fragments extracted from the poorly preserved paratype (S. S. B. 410), is exceedingly slender and consists of little but the narrow rhachis. The wings are narrow and set very obliquely, so that the ventral concavity is unusually narrow and deep. They finally terminate in a very small, delicate, spoon-shaped cone, which is supported by a small,

solid, distinctly bulbous swelling at the extreme base of the slender rhachis (figs. 2, 3).

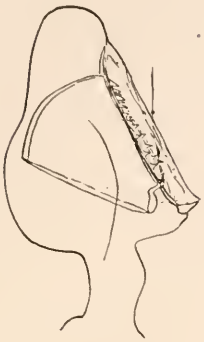


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1.—*Nematolampas regalis*, camera sketch of sucker from distal portion of right third arm [409], from mount in balsam, × 70.
Fig. 2.—*Nematolampas regalis*, oblique ventral view of posterior extremity of gladius [410], camera drawing, × 20.
Fig. 3.—Oblique dorsal view of same, same scale.

Family **LAMPADIOTEUTHIDÆ** new family.

Squids of small size, with terminal, sagittate fins. Arms with two rows of suckers. Tentacle clubs with four rows of suckers. No hooks present on either arms or tentacles. Buccal membrane eight-pointed. Gladius with lateral wings, but no terminal cone. Luminous organs present in the pallial chamber, on the eyeball, along the stalk of the tentacles, and at the base of the tentacles.

For the present the characters of the new family must be drawn from those of the type genus alone, so no doubt important emendation must later take place.

I would tentatively place the *Lampadioteuthidæ* between the *Lycoteuthidæ* on the one hand and the *Enoploteuthidæ* on the other. The group cannot be referred to the *Lycoteuthidæ* on account of the entirely different construction of the gladii. Some teuthologists may prefer to place it with the *Enoploteuthidæ*, but it seems to me that the complete lack of hooks or modified suckers on either tentacles or arms produces an anomaly fatal to this arrangement. Of course a fuller knowledge of the anatomy of all these forms than is now possible is as likely as not to bring about an entirely different classification, but I think the one adopted is for the meanwhile the most reasonable.

Genus **LAMPADIOTEUTHIS** new genus.

Body loliginiform. Fins broad, subsagittate, terminal; slightly surpassing the body posteriorly.

Arms with two rows of minute suckers, but no hooks. Tentacle clubs not expanded; armed with four rows of small suckers.

Buccal membrane eight-pointed, pale in color, but dotted with numerous dark chromatophores between the trabeculæ.

Photogenic organs richly developed; their distribution being as follows: 1. One at the extreme base of each tentacle and four along the stalk. 2. A longitudinal series of three large organs on the ventral side of the eyeball (of which the median is notably the smallest) and a single similar organ on the eyelid just back of the opening. 3. Five intrapallial organs, including 2 anal, 2 branchial (very large), and 1 abdominal organ. No luminous organs have been identified anywhere in the outer integument of the arms, head, or mantle.

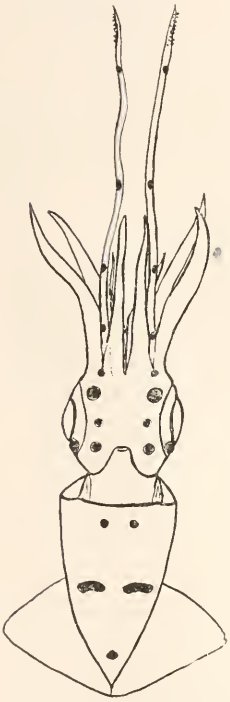


Fig. 4.—*Lampadioteuthis megaleia*, semi-diagrammatic representation of entire animal from the ventral aspect, to show the distribution of the photogeni organs, about natural size.

Gladius comprising a rapidly tapering rhachis, free in front, but with delicate, somewhat broadly angular wings along its posterior two-thirds.

Type.—The following species.

11. Lampadioteuthis megaleia new species. Pl. VIII, figs. 1–4.

Animal small. Mantle firm, fleshy, cylindro-conic in outline; in front rather flaring, thence tapering quickly to a point. Fins large and fairly thick in proportion to the small size of the body; slightly more than half as long as the mantle; each fin about a fifth longer than wide; strongly united in the median line posteriorly, where they extend slightly past the tip of the mantle; triangular, the posterior margins nearly straight and converging to a very obtuse point; anterior margins almost straight on the outward edges, but somewhat squarely arcuate in front, and thence descending toward the body so as to form small lobes.

Head large, almost as wide as the flaring mantle opening, and wider than the body is

near the middle; strongly compressed; flattened above, somewhat depressed below between the large, rounded eyes. Funnel broad, rather flat and short, not extending to the middle of the eyes; valved, the valve appearing as a very delicate, crescentic, pocket-like membrane on the inner dorsal wall a little way behind the aperture. Funnel organ not easily made out in the material available, although the A-shaped median organ of the dorsal wall is evident (fig. 6).

Funnel locking cartilages straight, simple, pointed anteriorly, but rounded truncate at the other end, and otherwise of nearly even width; grooves shallow, simple, straight; margins raised and reflexed (fig. 7). Slender ridges on the mantle correspond as usual.

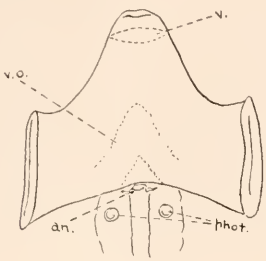


Fig. 6.

Fig. 7.

Fig. 6.—*Lampadioteuthis megaleia*, outline sketch of the funnel region [416], × 2½; an., anus; phot., anal photophores; v., valve; v.o., median pad of funnel organ.

Fig. 7.—*Lampadioteuthis megaleia*, camera outline of left funnel cartilage [416], × 8.

Sessile arms little attenuate, the longest over two-thirds as long as the mantle; unequal; somewhat mutilated in the specimen at hand, but the formula of relative length apparently 3 = 2, 4, 1; dorsal arms notably shorter and less robust than the remainder. Outer margin of ventral and third arms keeled, the second pair more obscurely so, and the dorsal pair merely angled. On all the arms except the dorsal pair the keel terminates in a very delicate, transparent carina of membrane. The third arms in particular bear a strongly trabeculate hyaline membrane along their ventral margins, though all the arms possess well-developed swimming membranes homologous with these. Sucker-bearing portion of arms compressed; the suckers

in two rows, minute on all the arms, but excessively so on the ventral pair. On a horny ring from one of the distal suckers of the left third arm, I count seven teeth along the upper margin, the central ones especially being long, slender, closely spaced, and rather bluntly pointed.

Tentacles cylindrical, over twice as long as the arms; robust at base, thence tapering rapidly to the slender club, which is scarcely or not at all expanded (Pl. VIII, fig. 3). Suckers of club in four much compressed rows; minute; basin-shaped; the horny rings of the largest armed with 9–13 slender acute teeth along the upper semi-circumference (figs. 8, 9).

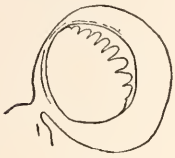


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8.—*Lampadioteuthis megaleia*, oral view of a median sucker from the left tentacle club of the type [416], × 70, camera outline from a mount in balsam.

Fig. 9.—*Lampadioteuthis megaleia*, nearly apical view of a similar sucker [416], × 70, camera outline from a mount in balsam.

Fig. 10.—*Lampadioteuthis megaleia*, optical section of second photophore from base of left tentacle of type [416], camera sketch from mount in balsam, × 15.

Buccal membrane eight-pointed; the lappets light colored, but the delicate intervening membranes dotted on the outside with dark, wine-colored to brownish chromatophores.

Fig. 5.

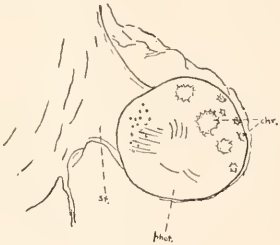


Fig. 11.

Fig. 5.—*Lampadioteuthis megaleia*, left eyeball, seen from below in outline, showing position of photophores, × $1\frac{1}{3}$.

Fig. 11.—*Lampadioteuthis megaleia*, basal photophore from left tentacle of type [416], seen in optical section, × 15, camera sketch from mount in balsam; chr., chromatophores; phot., photogenic organ; st., stalk of same.

Subocular photophores large, circular in outline, whitish; four in number on each eye; three, of which the median is somewhat the smallest, occupy the usual *situs* on the ventral periphery; the fourth is larger than any of these, and situated just within the boundary of the pupil, at a point almost exactly behind the centre of the lens (fig. 5).

A series of four large ovoid photophores appears embedded in the stalk of each tentacle below the club, the three proximal ones occupying the proximal half of the tentacle, the distal one somewhat isolated from the others and near the club. At the extreme base of the tentacle borne on a short stalk on its outer side appears a spherical photophore, which is almost wholly concealed in preserved specimens by the tentacular sheath. It is distinctly larger than even the most proximal of the organs just described, and judging from its outward appearance only I think it will prove to be entirely different in structure text fig. 11 (Pl. VIII, fig. 4).

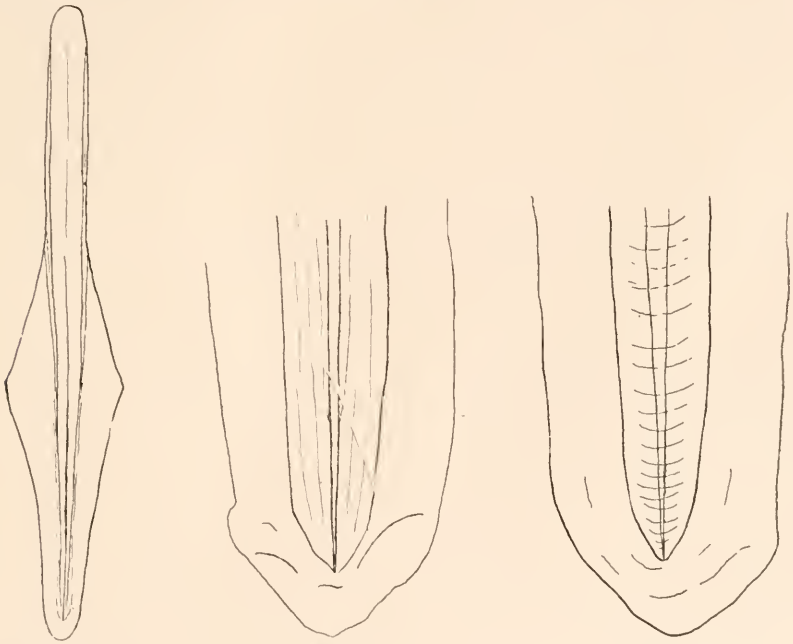


Fig. 12. Fig. 13. Fig. 14.

Fig. 12.—*Lampadioteuthis megaleia*, camera drawing of gladius of type [416], dorsal aspect, × 3.

Fig. 13.—*Lampadioteuthis megaleia*, ventral view of posterior extremity of gladius [416], × 18, camera sketch.

Fig. 14.—Dorsal view of same, same scale.

In addition to the above are the following intrapallial luminous organs: 1. A roundish, swollen, brownish organ on each side of the cavity, a little behind the anus. 2. A very large, elongate-pyriform, bright, silvery organ at the base of each gill, near the middle of the cavity. 3. A bright silvery tubercle, larger than the anal organs, but very much smaller than the branchial, situated behind the viscera in the medio-ventral line nearly at the tip of the body (fig. 4).

Gladius of simple Enoploteuthid structure, the rhachis free in front and broadest at the apex; thence tapering quite rapidly to a narrow point; wings thin and delicate, sharply angled in front of their middle, where each is about three times as wide as is the stem at the same level; they extend along the posterior two-thirds of the gladius, terminating around the point of the rhachis to form a slight posterior concavity, which is hardly spoon shaped, and is certainly not to be called a cone (figs. 12–14).

Color in alcohol: mantle brownish white, dotted with pale chromatophores; head and ventral aspect of the funnel darker, due to the more numerous dark chromatophores; eyes dark slate color, the lenses pearly white; arms and tentacles pale like the mantle.

Type.—A rather poorly preserved female (?) [S. S. B. 416]. It is minus one tentacle, and a little macerated, but is in good enough condition to be described as above.

Type Locality.—A beach on Sunday Island, where the single specimen was picked up by Mr. R. S. Bell in 1910.

Measurements.

	mm.
Total length	85
Length of mantle, dorsal	30
Tip of body to base of dorsal arms	39
Length of fins, extreme	17
Width of fin	14
Width across fins	30
Anterior width of mantle	15
Width of neck	7
Width across eyes	14
Length of head	10
Length of funnel	9
Length of right dorsal arm	17
Length of left dorsal arm	15+
Length of right second arm	13+
Length of left second arm	20+
Length of right third arm	16+
Length of left third arm	21+
Length of right ventral arm	22
Length of left ventral arm	22
Length of right tentacle	24+
Length of left tentacle	47
Length of club of left tentacle	7

Remarks.—In spite of its wholly dissimilar gladius, this little species reminds one more strongly of the two Lycoteuthid genera, *Lycoteuthis* and *Nematolampas*, than any other group, and this is probably due to the one fact, more than any other, that the photogenic complexes are so strikingly similar. That of the *L. megaleia* is accordingly summed up in the accompanying table, which also repeats the figures for *L. diadema* and *N. regalis* given in my earlier paper.

Position of Photophores.	*L. diadema.*	*N. regalis.*	*L. megaleia.*
On eyes:			
Ventral periphery	10	10	6
Lateral	.....	.....	2
On arms:			
Tips of dorsal arms	.....	2	.....
Tips of dorso-lateral arms	.....	2	.....
Ventro-lateral arms	.....	62+	.....
On tentacles:			
At base	.....	.....	2
Along the stalk	4	4	8
Within pallial chamber:			
Anal	2	2	2
Branchial	2	2	2
Abdominal[1]	4	4	1
Posterior extremity of body	.....	2	.....
Total	22	90+	23

Although in each of the three species subocular, tentacular, and intrapallial organs are well developed, the table helps to emphasize differences which may be more important than the similarities. Then again, although I have not yet had opportunity to work out the histology of any of these structures in *Lampadioteuthis*, the external appearance of its tentacular photophores is not at all like the deep-seated organs of the Lycoteuthids, while the curious organs protruding from the base of the tentacles fail to resemble anything known to me. The single pair of enormous silvery photophores at the base of the gills is also distinctive as contrasted with the belt of five smaller organs possessed by the Lycoteuthid genera.

The occasion is very tempting to add a little generalizing on the possible significance of such striking differences in the luminous pattern of cephalopods, especially since the constituent organs are so evidently polyphyletic in origin, but this had best be reserved for some future opportunity.

[1] I have followed prevailing usage in classifying the series of three organs situated between the branchial pair in *Lycoteuthis* and *Nematolampas* as abdominal, though it seems to me more rational to consider them in relation with the branchial organs than with the isolated posterior organ.

At any rate it is remarkable that the Sunday Island beaches should yield so extensive a series of bizarre types, and that with the exception of an ommastrephid every squid collected there is the possessor of systems of dermal organs which we must assume are photogenic.

Fig. 15.—*Abralia astrolineata*, inner face of right tentacle club of type [408], ×8, mainly a camera drawing.

Fig. 16.—*Abralia astrolineata*, lateral view of third hook from base of right tentacle club [408], × 30, camera drawing from mount in balsam.

Family **ENOPLOTEUTHIDÆ.**

Genus **ABRALIA** Gray, 1849.

12. Abralia astrolineata Berry, 1914.

1914. *Abralia astrolineata* Berry, Trans. N. Z. Inst., 46, p. 145, pl. 10.

An illustration of the tentacle club of this species is supplied in fig. 15, and of a hook therefrom in fig. 16.

The statement on p. 145 of the original description regarding the discrepancy in the number of hooks on the two tentacle clubs of the type specimen is just reversed; the right club shows a fifth hook, the left only the four large ones.

Genus **ABRALIOPSIS** Joubin, 1896.

13. ? Abraliopsis hoylei (Pfeffer, 1884). Pl. IX, fig. 1.

?1884. *Enoploteuthis Hoylei* Pfeffer, Ceph. Hamburg Mus., p. 17, fig. 22–22b.
?1896. *Abraliopsis Hoylei* Joubin, Bull. Soc. Sci. Ouest, 5, p. 33, etc.
1914. *?Abraliopsis hoylei* Berry, Trans. N. Z. Inst., 46, p. 148.

The specimen previously recorded [S. S. B. 400] is now figured on Pl. IX, fig. 1.

Abraliopsis (?) species. Pl. IX, fig. 3.

A small abralioid in the second collection offers some interesting peculiarities [S. S. B. 419], and I am not certain that it represents the same species as the preceding, though this will quite likely prove to be the case in the end.

The only doubtful character is that each arm of the ventral pair appears to terminate in a slender filament instead of the usual beaded photophores, but these filaments are quite badly damaged in the specimen so that their exact nature is difficult to make out. The two rows of hooks on the ventral arms persist even onto the

base of the filaments. Otherwise the specimen is a fairly typical *Abraliopsis*.

The tentacle club much resembles that of the preceding, as described in my former paper. There are four large slender hooks in the ventral row, and three (or four ?) small ones in the dorsal row, the latter being succeeded proximally by two minute suckers. The distal portion of the club is occupied by the usual four rows of small suckers. I can make out only two suckers in the fixing apparatus (figs. 17, 18).

Fig. 17.—*Abraliopsis* (?), inner face of right tentacle club of young specimen [419], × 15, free-hand sketch from mount in balsam. The arrangement and number of the distal suckers is only approximated.

Fig. 18.—*Abraliopsis* (?), lateral view of large hook from left tentacle club [419], × 30, camera drawing from mount in balsam.

The photogenic organs of the mantle are distributed longitudinally in bands and lines. There is a conspicuous, clearly defined space free of photophores along the medio-ventral line. Bounding this on either side is a roughly triserial, band-like aggregation of photogenic organs, the central members of which tend to be larger than the lateral ones. This band is succeeded laterally by a single series of large and small photophores, more or less in alternation. A weak series of small organs is then followed by a very distinct single line of photophores, beyond which the organs are scattering and less regular. There are eight rows on the ventral aspect of the head, and the rudiments of perhaps as many on the funnel. Each central arm bears two rows.

The two terminal photophores of the subocular group are conspicuously larger than the three median ones, and of the latter the central organ is in its turn a little the largest.

Family OMMASTREPHIDÆ.

Genus STHENOTEUTHIS Verrill, 1880.

14. Sthenoteuthis bartramii (Lesueur, 1821).

1821. *Loligo bartramii* Lesueur, Jour. Acad. Nat. Sci. Phila., 2, p. 90, pl. 7.
1880. *Sthenoteuthis Bartramii* Verrill, Trans. Conn. Acad. Sci., 5, p. 223.
1914. *Sthenoteuthis bartramii* Berry, Trans. N. Z. Inst., 46, p. 148.

Genus **SYMPLECTOTEUTHIS** Pfeffer, 1900.

[**Symplectoteuthis oualaniensis** (Lesson, 1830).]

1830. *Loligo oualaniensis* Lesson, Zool. Voy. Coquille, p. 240, pl. 1, fig. 2.
1900. *Symplectoteuthis oualaniensis* Pfeffer, Synops. Œgops. Ceph., p. 180.

It now appears that my reference of certain of the Kermadec squids to this species was premature (see further note below), despite the fact that the islands lie well within its probable range.

Genus **EUCLEOTEUTHIS** new genus.[2]

15. Eucleoteuthis species (young ?).

1914. *Symplectoteuthis oualaniensis* Berry, Trans. N. Z. Inst., 46, p. 148 (not *Loligo oualaniensis* Lesson, 1830).

With the exception of the smallest, which may prove to be a genuine *Symplectoteuthis,* six quite small and rather poorly preserved Ommastrephids in the second collection sent me [S. S. B. 421] are apparently referable here. A reëxamination of the similar specimens previously reported as *S. oualaniensis,* in the light of Sasaki's recent work (see appended footnote), shows that these likewise should be included in the newer genus. On all, with the single exception noted, the supposed photogenic tissue is evident as a pair of narrow whitish bands running along the ventral aspect of the body, much as in *E. luminosa,* though apparently not interrupted as in that species. In some of the specimens a pale oval macula may be made out near the mantle margin and just outside the line of the bands, but in no case have the maculæ at the base of the ventral arms been identified. Numerous other differences in the outline of the photogenic organs, their distribution, the shape of the fins and body, and the proportions

[2] In a recent paper ("On three interesting new œgopsids from the Bay of Sagami," *Jour. Coll. Agric.,* Tohoku Imper. Univ., Sapporo, v. 6, pp. 131–150, pl. 4), Madoka Sasaki describes and beautifully illustrates a very remarkable luminous squid from 700 fathoms, off Misaki, Japan, to which he attaches the name *Symplectoteuthis luminosa.* The creature is absolutely unique among described cephalopods in the fact that the principal photogenic organs, instead of being small spherical or ovoid cysts as in most œgopsids, take the form of a pair of narrow, zone-like bands, extending with but two interruptions along the ventral aspect of the mantle for nearly its entire length. A pair of smaller maculæ of similar character lie outside the terminal segments of the bands near the anterior margin, and a larger, ovoid, transverse organ appears at the base of each ventral arm. While the photogenic property of these curious structures does not appear to have been observed in the living animal, Sasaki infers such a function from their histology. It seems to me that these characters, coupled with several minor features, among which may be noted the unidentate horny rings of the larger tentacular suckers, are sufficient to quite preclude the proper reference of this species to *Symplectoteuthis,* a genus not known to possess any luminous properties, and in which the larger tentacular rings are multidentate. Having conveyed these opinions to Prof. Sasaki and ascertained that he has no present intention of altering his original disposition of the species, I now propose, with his courteous permission, the new genus *Eucleoteuthis,* with *S. luminosa* Sasaki as type.

of the arms are evident, so that it seems possible that an undescribed species of the genus is before us. The largest of the specimens, however, has a mantle length of only 41 mm., and since we know nothing of the younger stages of *E. luminosa*, while the condition of our own material leaves much to be desired, a more detailed consideration of the speciology will best be deferred for the present.

Family CRANCHIIDÆ.

Genus MEGALOCRANCHIA Pfeffer, 1884.

16. Megalocranchia pardus new species. Pl IX, fig. 2.

Small; elongate cask-shaped. Mantle thin, smooth, saccular, membranous, much inflated; its greatest circumference near the middle, thence tapering slightly anteriorly and more so behind, where it comes to an acute point between the fins; maximum width of mantle distinctly less than half the length. Fins small, about three-tenths as long as the body; thin; semicircular; barely continuous around the point of the mantle, which they exceed for about a third of their length; posterior cleft deep and very narrow. Anterior margin of the mantle trilobate, being conspicuously indented (almost cleft) in the dorso-median line, as well as to a less degree at either side of the funnel, the clefts marking the three points where the mantle is firmly attached to the head and funnel.

Head very short and broad, the length contained in the width (measured to include the eyes) nearly four times; width of head between the eyes less than the depth of the eyeball. Eyes very large and protruding; elevated on short, massive, slightly movable stalks; eyeball ovate in outline, projecting obliquely downward; lid opening of fair size, not puckered. The ventral surface of the eyeball is occupied by a large, semicircular, photogenic organ, which forms a bluntly conical projection toward one side; another smaller organ of crescentic outline lies within the concavity of the latter (fig. 19).

Funnel large, thin-walled; broad at base, extending well past the base of the ventral arms, and entirely covering the ventral surface of the head between the eyes; aperture ample. Funnel organ well developed; the large hepatiform medio-dorsal organ bears on each lobe a finger-like papilla, which bends inward at the base so that it lies almost transversely; the two smaller lateral organs are roughly circular, and each has a slight indentation on the front inner margin (fig. 20).

Arms short, robust, the longest but little more than a quarter as

long as the mantle; unequal, the order of length distinctly 3, 4, 2, 1. Umbrella wanting. Ventral arms with a frill-like keel on the outer angle; keel of third arms confined to distal portion, and obscure or

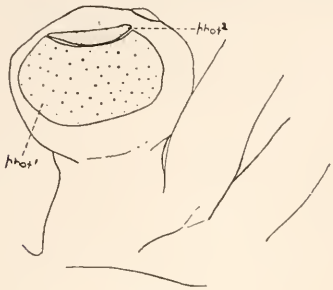


Fig. 19.

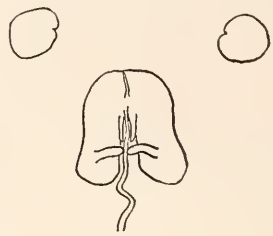


Fig. 20.

Fig. 19.—*Megalocranchia pardus*, part camera outline of right eye of type [415], ventral aspect, × 5½; phot.¹, phot.², photogenic organs.
Fig. 20.—*Megalocranchia pardus*, outline of funnel organ [415], much enlarged.

wanting on the two dorsal pairs. All the arms have a delicate trabeculate swimming membrane on either margin of the sucker-bearing area, but this attains much its best development on the third pair. Suckers biserial, closely placed in each row, but the series slightly separated from one another on all but the ventral arms, where they are relatively close together; number of suckers varying from 14 pairs on one of the dorsal arms to 16½ pairs on the ventral arms. Sucker apertures wide, the horny rings weakly dentate on the upper semicircumference and with only rudiments of teeth below; even at their best, the denticles appear rather as strong crenulations than teeth; about 18 were counted on a ring from one of the larger suckers of the right third arm (fig. 21).

Tentacles short, stout, the longer about a third again as long as the longest arms, or about two-fifths the length of the mantle; larger and thicker than any of the arms. Clubs slightly expanded; armed with four crowded rows of suckers, largest near the middle, but diminishing in size both distally and proximally, where they continue down the stalk a little more than half way to the base. A horny ring from one of the largest suckers on the club shows about 26 conical, round-pointed, sometimes curved teeth, which are smallest on the inferior margin (fig. 22).

Color of preserved specimen brownish cream; chromatophores brown; eyes bluish black; subocular photophores bronze, surrounded by a bluish ring. Chromatophores large, scattered, elongate

oval in outline, conspicuously spotting the entire mantle, though somewhat paler ventrally than dorsally; an underlying bilateral arrangement is evident, particularly in the case of the larger chro-

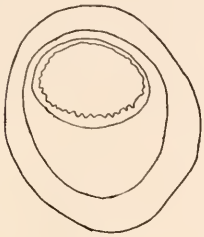


Fig. 21.

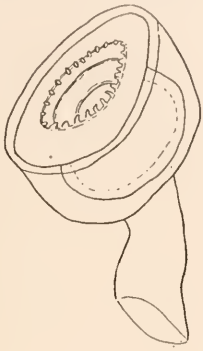


Fig. 22.

Fig. 21.—*Megalocranchia pardus*, sucker from right third arm of type [415], × 28, camera outline from mount in balsam.
Fig. 22.—*Megalocranchia pardus*, one of the larger suckers from the right tentacle club of the type [415], × 60, camera drawing from a mount in balsam.

matophores; there also seems to be a certain tendency to an arrangement in zigzag lines in a transverse direction, most apparent on the ventral aspect. There is a single series of chromatophores along the medio-dorsal line, exactly overlying the gladius, which appears as a translucent line beneath; 21 of the organs can be counted to the point where the translucent area expands.

Type.—The unique type [S. S. B. 415] is in an excellent state of preservation.

Type Locality.—A beach on Sunday Island, Kermadec Group (R. S. Bell, 1910).

Measurements.

	mm.
Total length	75
Length of mantle, dorsal	50
Extreme length of fins	14
Maximum width of mantle	22
Width across fins	13
Width across eyes	15
Length of head	4
Length of funnel	13
Length of right dorsal arm	7
Length of left dorsal arm	7.5
Length of right second arm	9
Length of left second arm	9
Length of right third arm	13
Length of left third arm	13

	mm.
Length of right ventral arm	10
Length of left ventral arm	10
Length of right tentacle	21
Length of right tentacle club	5
Length of left tentacle	16
Length of left tentacle club	5

Remarks.—The elucidation of the compact little group of squids, of which *M. pardus* is a typical example, has been for me one of the most difficult taxonomic problems encountered in the study of the cephalopoda. All the species are represented in collections by such scanty material, are so similar to one another, and the characters which separate them appear of such a trivial nature, that the described forms are in sore need of careful checking up by someone having access to the type specimens of the older species. At the same time, the species are quite well set apart from other Cranchiids, so that a synopsis of the genus would include only the following:[3]

1. *Megalocranchia maxima* Pfeffer 1884.
2. *Taonius abyssicola* Goodrich 1896.
3. *Helicocranchia fisheri* Berry 1909.
4. *Desmoteuthis pellucida* Chun 1910.
5. *Megalocranchia pardus* Berry 1915.

The second of these is little known, is unique in several respects, and may eventually prove to belong elsewhere. On the other hand, the first, third, and fourth are apparently not strongly differentiated, and it is with these that the present species requires special comparison to justify its separate recognition. The specimen most certainly represents a species different from *M. fisheri*, the only other *Megalocranchia* with which I have had opportunity for comparing it, but to Chun's *pellucida* it seems exceedingly close. The description and figures of the latter are not now available to me, but from my notes made therefrom a few years ago, I feel that the differences, though so slight, are nevertheless too great for uniting the species. In reaching this conclusion I place reliance upon the almost stalked eyes of *M. pardus*, the immense development of the funnel, and the denticulation of the horny rings.

[3] The species described as *Desmoteuthis tenera* Verrill (*Trans. Conn. Acad. Sci.*, 5, p. 412) now seems to me to be improperly grouped with the cask-shaped, round-finned forms cited above. As I have shown in a former paper (*Science*, N. S., 36, pp. 643–646), the genus *Desmoteuthis* falls into the absolute synonymy of *Taonius*, so can no longer be used here. I would therefore propose for the reception of *D. tenera* the new genus *Verrilliteuthis*. To name the group for the master of American teuthologists requires no excuse save possibly an apology for the resulting barbarism.

Order TETRABRANCHIATA.

Suborder NAUTILOIDEA.

Family NAUTILIDÆ.

Genus NAUTILUS Linné, 1758.

17. Nautilus pompilius Linné, 1758.

1758. *Nautilus Pompilius* Linné, Syst. Nat., ed. X, No. 283, p. 709.
1910. *Nautilus pompilius* Iredale, Proc. Malac. Soc., 9, p. 72.
1915. *Nautilus pompilius* Oliver, Trans. N. Z. Inst., 47, p. 558.

Oliver reports a broken shell washed up on the beach at Sunday Island.

18. Nautilus macromphalus Sowerby, 1848.

1848. *Nautilus macromphalus* Sowerby, Thes. Conch., p. 464, pl. 98, figs. 4, 5.
1910. *Nautilus macromphalus* Iredale, Proc. Malac. Soc., 9, p. 72.
1915. *Nautilus macromphalus* Oliver, Trans. N. Z. Inst., 47, p. 558.

Oliver reports a broken shell washed up on the beach at Sunday Island.

Bibliography of Kermadec Island Cephalopods.

Berry, S. Stillman. 1913. Nematolampas, a remarkable new cephalopod from the South Pacific. Biological Bulletin, Vol. 25, pp. 208–212, 1 text fig., August, 1913. (*Nematolampas regalis*, new genus and species.)

—— 1914. Notes on a collection of cephalopods from the Kermadec Islands. Transactions New Zealand Institute, Vol. 46, pp. 134–149, text figs. 1–4, pls. 7–10. June, 1914. (Gives notes on 9 species, including *Polypus oliveri*, *P. kermadecensis*, and *Abralia astrolineata*, new species.)

Hoyle, William E. 1885. Diagnoses of new species of Cephalopoda collected during the cruise of H. M. S. "Challenger."—Part I. The Octopoda. Annals and Magazine of Natural History (5), Vol. 15, pp. 222–236, March, 1885. (*Amphitretus pelagicus*, new genus and species.)

—— 1885*a*. Brief notice of the "Challenger" Cephalopoda. Narrative Challenger Expedition, Vol. 1, pp. 269–274, [1–7], figs. 106–109, 1885. (Figure of *Amphitretus pelagicus*.)

—— 1885*b*. Preliminary report on the Cephalopoda collected by H. M. S. "Challenger." Part I. The Octopoda. Proceedings Royal Society of Edinburgh, Vol. 13, pp. 94–114, cuts, August, 1885.

—— 1886. Report on the Cephalopoda collected by H. M. S. "Challenger" during the years 1873–1876. Voyage of the Challenger, Vol. 16, pp. i–vi, 1–246, 9 figs. in text, pls. 1–33, 1886. (Three species, *Cirroteuthis meangensis*, *Amphitretus pelagicus*, and *Eledone verrucosa*, reported from near the Kermadecs.)

Iredale, Tom. 1910. On marine Mollusca from the Kermadec Islands and on the Sinusigera apex. Proceedings Malacological Society, London, Vol. 9, pp. 68–79, March 1910. (List reprinted in Proc. N. Z. Inst., 1910, p. 57, *fide* Oliver; five species of shell-bearing cephalopods listed.)

Oliver, W. R. B. 1911. Notes on reptiles and mammals in the Kermadec Islands. Transactions New Zealand Institute, Vol. 43, 1910, pp. 535–539, July, 1911. (Mentions a fragment of an undetermined giant squid cast up on the beach, p. 536.)

—— 1915. The Mollusca of the Kermadec Islands. Transactions New Zealand Institute, Vol. 47, pp. 509–568, pls. 9–12, July, 1915. (Gives a *résumé* of previous records, the cephalopods on pp. 558–560.)

Explanation of Plates VI, VII, VIII, IX.

Plate VI.—Fig. 1.—*Argonauta* species, female. Mantle laid open to show the male hectocotylus *in situ* within the cavity [S. S. B. 403] (× $1\frac{1}{4}$).

Fig. 2.—*Polypus oliveri* Berry, female. Dorsal aspect of type [S. S. B. 405], about natural size.

Plate VII.—Fig. 1.—*Nematolampas regalis* Berry. Distal portion of right third arm of type [S. S. B. 409], photographed by reflected light from a mount in balsam (× 2).

Fig. 2.—*Nematolampas regalis.* Proximal portion of same preparation (× $8\frac{1}{2}$).

Fig. 3.—*Nematolampas regalis.* Median portion of the terminal filament of the right third arm (× $8\frac{1}{2}$), photographed from the same preparation.

Plate VIII.—Fig. 1.—*Lampadioteuthis megaleia* Berry. Dorsal aspect of type [S. S. B. 416] (× $1\frac{1}{4}$).

Fig. 2.—Ventral aspect of same, same scale.

Fig. 3.—*Lampadioteuthis megaleia.* Tentacle club of type, from mount in balsam (× 7).

Fig. 4.—*Lampadioteuthis megaleia.* Base of tentacle from same preparation (× 7), showing the two basal photophores.

Fig. 5.—*Nematolampas regalis* Berry. Subocular photophores from right eye of paratype [S. S. B. 410] (× 7); photograph of inner surface from mount in balsam.

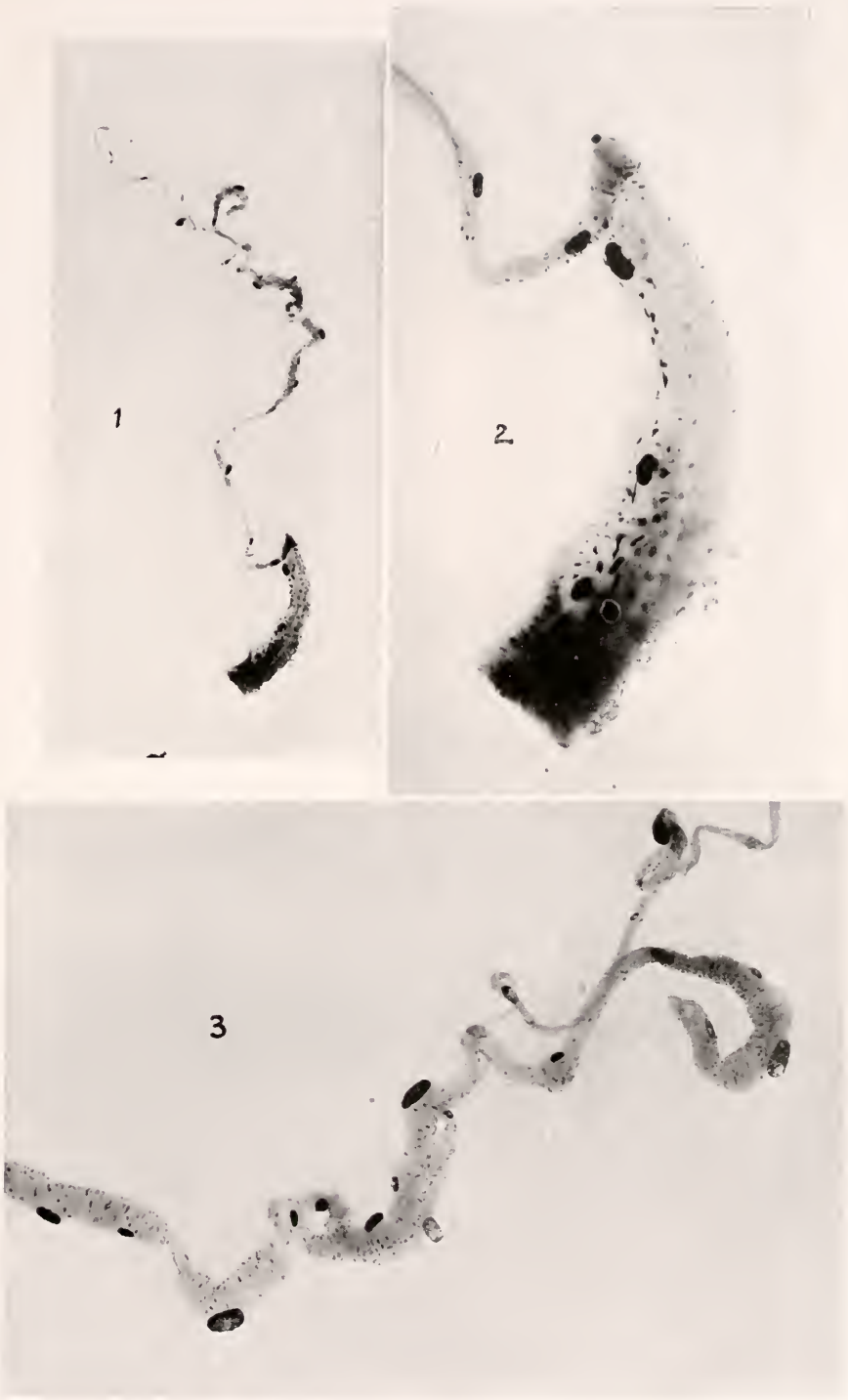
Plate IX.—Fig. 1.—*Abraliopsis hoylei* Pfeffer ?. Ventral aspect of immature female [S. S. B. 400] (× 2).

Fig. 2.—*Megalocranchia pardus* Berry. Ventral aspect of type [S. S. B. 415] (× 2).

Fig. 3.—*Abraliopsis* (?), species. Ventral integument of very young specimen [S. S. B. 419], showing the distribution of the photogenic organs; photographed by reflected light from a mount in balsam, stained with Delafield's hæmatoxylin (× 6).

Note.—I am indebted to my friends, Edward A. Cornwall and Leroy Childs, for most of the photographs used in the accompanying plates. Thanks are likewise due to both Messrs. Iredale and Oliver for many incidental favors.

BERRY: CEPHALOPODA OF THE KERMADEC ISLANDS.



BERRY: CEPHALOPODA OF THE KERMADEC ISLANDS

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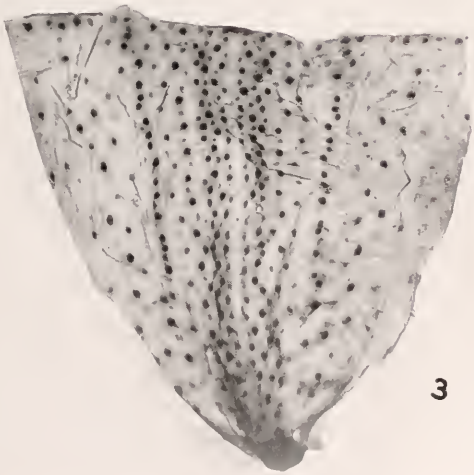


BERRY: CEPHALOPODA OF THE KERMADEC ISLANDS.

March 21.

The President, Samuel G. Dixon, M.D., LL.D., in the chair.

Seventy-eight persons present.

The death of John Thomson, A.M., a member, February 23, 1916, was announced.

The Publication Committee reported the reception of papers under the following titles as contributions to the Proceedings:

"The Germ Layers of Bdellodrilus," by George W. Tannreuther (February 23).

"Some Bees from Australia, Tasmania, and the New Hebrides," by T. D. A. Cockerell (March 6).

"A New Species of Onchidiopsis from Bering Sea," by William H. Dall (March 16).

"Evidence of a Saturation Point in Evolution," by Walter Sonneberg (March 20)

Dr. Edwin G. Conklin made an illustrated communication on his impressions and experiences during a trip to New Zealand and Australia.

The following was ordered to be printed:

REVISION OF CAYUGA LAKE SPIDERS.

BY NATHAN BANKS.

In The Proceedings of the Academy of Natural Sciences of Philadelphia for 1892, pp. 11–81, I gave a list of spiders collected in the vicinity of Ithaca, N. Y. It was the first important local list published in this country. Twenty-five years have passed since its preparation, and twenty-five years in any department of natural history produces many changes. A number of the new species have proved to be synonyms, a number have been redescribed by others since, and many species have had either their generic or specific name, or even both, changed since then.

It is the purpose of this paper to briefly review these changes and to give a few notes and figures of such forms as seem to have escaped collection in recent years.

The arrangement is the same as in the original work. Species not mentioned are unchanged.

DRASSIDÆ.

Micaria formicoides.

This is a dark specimen of *M. longipes*, with the femora darker than usual.

Prosthesima rufula.

Goes in *Zelotes*.

Prosthesima frigida.

Goes in genus *Zelotes*.

Prosthesima immaculata = *Zelotes rufula* Bks.

Prosthesima blanda.

Belongs to genus *Zelotes*.

Prosthesima atra.

Belongs in *Zelotes*.

Prosthesima depressa.

Belongs in *Zelotes*.

Prosthesima ecclesiastica.

Belongs in *Herpyllus*.

Prosthesima minima = *Zelotes blanda* Bks.

An immature specimen.

Pœcilochroa bilineata.

Belongs in *Cesonia*.

Gnaphosa brumalis.

This is immature and evidently *G. conspersa* Thor.

Gnaphosa humilis = *Gnaphosa brumalis* Thor.

Not quite mature.

Drassus saccatus.

Now known as *D. neglectus* Keys.

Drassus humilis = *D. neglectus* Keys.

CLUBIONIDÆ.

Thargalia agilis = *Castianeira cingulata* Koch.

Thargalia perplexa = *Castianeira longipalpis* Htz.

Thargalia fallax = *Castianeira descripta* Htz.

Thargalia bivittata.

Is known as *Castianeira cingulata* Koch.

Thargalia crocata.

Is *Castianeira descripta;* the true *T. crocata* is a southern form.

Clubiona obesa.

This is *C. crassipalpis* Keys., but I believe also Hentz's species.

Clubiona crassipalpis.

The female whose vulva is figured is *C. canadensis* Emer.

Clubiona canadensis.

These are young of *C. obesa* Htz.

Clubiona pygmæa.

Appears to be the female of *C. minuta* Emer., this name, however, is preoccupied by Nicolet for a Chilian species.

Clubiona rubra = *C. abbottii.*

Clubiona lenta.

Related to *C. pygmæa*, but I think distinct, the head and mandibles are not as dark as in that species; the eye region is broad as in *C. latifrons* Emer. I have seen another specimen from Washington, D. C., but do not yet know the male.

Clubiona americana = *C. riparia* Koch.

C. americana given to replace the preoccupied *C. ornata* Emer.

Clubiona excepta = *C. pallens* Htz.

Anyphæna incerta.

Now known as *Gayenna celer* Htz.

Anyphæna saltabunda.

Belongs to *Gayenna.*

Phrurolithus palustris = *P. alarius* Hentz (non Emer.).

Phrurolithus alarius (Bks. det.) = *P. borealis* Emer.

Agrœca ornata.

A. repens Emer. is a synonym.

AGALENIDÆ.

Cœlotes medicinalis.

Now placed in genus *Coras.*

Cœlotes fidelis.

This is related to *C. urbanus* Keys., but in male palpi the patella is not so prolonged at tip, and with two (instead of one) teeth; a figure is given (Pl. X, fig. 8).

Cœlotes longitarsus.

Is now called *C. calcaratus* Keys.

Cœlotes altilis.

These large females may be the females of *C. hybridus* Emer., otherwise they are new; a new figure of the epigynum is given (Pl. XI, fig. 24).

Cœlotes lineatus.

Based on an immature male, and doubtless belongs to one of the other forms, quite probably *C. calcaratus* Keys.

Cœlotes gnavus.

This may be the same as the female *C. longitarsus* Emer., but his male is another form (*C. calcaratus*); it, however, is much larger than *Cicurinia arcuata,* more heavily marked, more geniculate mandibles; the epigynum is figured (Pl. XI, fig. 22).

Cicurina complicata.

Is *C. arcuata* Keys., a large female.

Cicurina creber = *C. brevis* Emer.

The latter was described as a *Tegenaria.*

Cicurina placida.

Related to *C. brevis,* but a size larger; the posterior middle portion of the vulva is more narrow than in *C. brevis;* a figure is given (Pl. XI, fig. 26).

Hahnia bimaculata = *H. agilis* Keys.

DICTYNIDÆ.

Dictyna frondea.

An immature female, probably of *D. foliacea*.

Dictyna cruciata?

One female, does not now show any differences in markings from *D. foliacea*, but the vulvar openings are very much farther apart.

Dictyna minuta.

Two males, scarcely two millimeters long, belong here.

Dictyna foxii.

Belongs in genus *Prodalia*.

Dictyna volupis = *D. foliacea* Hentz.

Dictyna maxima.

Based on one female, whose large size and dorsal markings do not fit any other described form. Later I took males that appear to belong here; they are three millimeters long, and the tibia of palpus is long, curved, and with a very short projection at base as in figure (Pl. X, fig. 15).

Dictyna decorata.

Only females, which, although more strongly marked than usual, are probably *D. foliacea* (*D. volupis*); at least I have seen no males that might indicate another species.

Dictyna dubia = *D. frondea* Emer.

Amaurobius silvestris.

I consider it is *A. bennetti* Blk.

THERIDIIDÆ.

Mimetus epeiroides = *M. interfector* Htz.

Steatoda marmorata.

Belongs in *Enoplognatha*.

Steatoda guttata.

Belongs in *Crustulina*.

Steatoda triangulosa.

Belongs in *Teutana*.

Pholcomma hirsuta.

Belongs to *Ancylorrhanis*.

Ceratinella similis = *C. emertoni* Cb.

Ceratinella atriceps.

The only specimen I now have is the *Exechophysis plumalis* Crosby.

Ceratinella mœsta.

This belongs to the restricted genus *Lophocarenum.*

Ceratinella placida.

This is related to *C. emertoni,* but I believe distinct, the tibial process is much more slender, the style longer. I give figures of other views of the palpus (Pl. X, figs. 6, 11).

Ceratinella formosa.

This is peculiar in the position of the shield, and for it I later made the genus *Idionella;* it belongs to the true Theridiidæ.

Ceratinella annulipes.

I made a new genus, *Ceratinops,* for this, it belongs to the true Theridiidæ. I have seen it also from Poughkeepsie, N. Y.

Ceratinopsis interpres.

Now placed in a separate genus, *Notionella.*

Ceratinopsis nigriceps.

Not *nigriceps,* but the species Emerton later described as *C. auriculatus.*

Ceratinopsis frontatus.

Belongs to the genus *Maso,* and a description and figures are given by Emerton under name of *Caseola herbicola.*

Grammonota ornata.

Probably correct, but the abdomen is shrunken now, and does not show the markings.

Grammonota venusta.

Probably the female of *Tmeticus tridentatus,* but the epigynum (Pl. XI, fig. 18) shows the ridges more divaricate than usual; possibly the female of some allied species.

Spiropalpus spiralis.

Now considered to belong to genus *Cornicularia.*

Cornicularia communis.

Probably correct, but the epigynum does not project quite as far as in other specimens.

Cornicularia pallida.

An immature female, which agrees in markings and structure with adults from other localities.

Cornicularia formosa = *Gonatium rubens* Blk.

Cornicularia placida.

A female *Cornicularia,* and probably the female of some described species; the figure I gave of the epigynum is not broad enough,

I give a new one (Pl. XI, fig. 19). The posterior median eyes are scarcely their diameter apart, and as close to the plainly larger posterior side eyes.

Lophomma cristata.

A female, may belong to this species or to a *Lophocarenum;* the vulva (Pl. XI, fig. 29) is a broad opening, some distance in front of the rima. Sternum triangular, the hind coxæ separated by less than their diameter; tarsi I a little shorter than metatarsi; P. M. E. scarcely diameter apart, much further from the subequal P. S. E.

Lophocarenum castaneum.

Is a *Diplocephalus*, I think; the head shows no trace of elevation in these females; the sternum is broad, and the hind coxæ separated by more than width, tarsi I much shorter than metatarsi I; eyes of posterior row subequal, and less than diameter apart (Pl. XI, fig. 28).

Lophocarenum tristis.

Female of some species probably known in male, and may be *L. castaneum;* the eyes of posterior row are subequal, the P. M. E. about diameter apart, and a little further from the S. E.; sternum as broad as long, hind coxæ separated by less than their diameter.

Lophocarenum florens.

Belongs to *Hypselistes.*

Lophocarenum unimaculatum.

Evidently related to *L. florens,* which is now placed in *Hypselistes;* I have seen no further specimens, but the peculiar marking will distinguish it.

Lophocarenum miniatum.

This is a *Cornicularia* and apparently a dark female of *C. directa* Cb. (Pl. XI, fig. 23).

Lophocarenum venustum = *Gonatium rubens* Blk.

Lophocarenum montiferum.

Determination correct; it now goes in *Diplocephalus.*

Lophocarenum parvum.

Is *L. erigonoides* Emer.; as in *L. formosum* the tibial process has a deep incision near base not shown in Emerton's figures; it is also probably *Erigone percisa* Keys; it belongs to genus *Diplocephalus.*

Lophocarenum exiguum.

Is a *Diplocephalus,* and Emerton has given a description and figures in 1911 from a New England specimen.

Lophocarenum spiniferum.

Determination correct, but now placed in *Diplocephalus.*

Lophocarenum crenatum.

Determination correct, it now goes in *Diplocephalus.*

Lophocarenum crenatoideum.

Is *Diplocephalus crenatum,* a ♂ not fully colored, and apparently longer cephalothorax.

Lophocarenum erigonoides.

Is a *Diplocephalus;* the male is an immature specimen, and the female is also probably not mature or else belongs to a different species.

Lophocarenum formosum.

This is *L. erigonoides,* I believe, although the palpal organ does not fit Emerton's figure in some parts. I think it is also the *Erigone percisa* of Keyserling, his figure of palpus is not quite right, but the epigynum is the same as I have figured for *formosum* (Pl. X, fig. 4).

Lophocarenum arvensis = *Cornicularia communis* Emer.

Lophocarenum longior.

This is apparently a female *Cornicularia* and probably of *C. directa;* at least I find no differences.

Tmeticus unicorn.

This will go in the genus *Delorrhipis,* but is very different from *D. monoceros.* A new description is given by Crosby.

Tmeticus trilobatus.

Goes in *Gonglydium.*

Tmeticus obscurus.

The tarsi of palpi gone, but from the tibiæ it is quite probably *T. plumosus,* which has since been taken near Ithaca.

Tmeticus flaveolus.

Unchanged; a description, with figures, is given by Emerton in 1909 from New England material.

Tmeticus luxuosus.

This belongs to *Ceratinopsis* and is the species described by Emerton in 1909 as *C. alternatus.*

Tmeticus rusticus.

I cannot identify with any described form; I figure the long slender hook (Pl. X, fig. 10).

Tmeticus pallidus.

Unchanged, but goes in *Gonglylidium.*

Tmeticus humilis = *T. plumosus* Emer.

Now in the genus *Gonglyidium.*

Tmeticus mœstus = *Gonglydium trilobatus* Emer.

Tmeticus debilis.

Unchanged, a description, with figures, is given by Emerton in 1909 from New England specimens.

Tmeticus palustris = *Gongylidium trilobatus* Em.

Tmeticus distinctus.

I give a new figure of the epigynum (Pl. XI, fig. 27); this shows a great resemblance to that of *T. bidentatum* Emer. which Emerton figures in 1909, and probably it is that species. Crosby gives some notes under the genus *Tapinocyba.*

Tmeticus maculatus.

Crosby has given some notes on it; probably the female of *T. probatus;* Emerton in 1909 gave a new figure of the epigynum which shows two lobes as in my figure.

Tmeticus minutus.

Crosby has given notes under the genus *Gongylidiellum,* a new figure of palpus is here given (Pl. X, fig. 5).

Tmeticus gnavus.

New figures are given of the palpus (Pl. X, figs. 3, 7); it is in the *trilobatus* group.

Erigone longipalpis.

More properly placed under *E. persimilis* Cb.

Linyphia communis.

I place this in *Frontinella* Cambr.

Linyphia clathrata.

This belongs to *Neriene.*

Linyphia phrygiana var. **annulipes.**

This variation in color is hardly worthy of a name.

Linyphia variabilis.

Belongs to *Neriene.*

Linyphia conferta.

Belongs to *Neriene,* Emerton considers the true *conferta* to be a southern form, and has described this as *Linyphia maculata.*

Stemonyphantes bucculentus.

Is the type of the genus *Bolyphantes.*

Diplostyla pallida.

This is a very pale specimen of *nigrina.*

Diplostyla alboventris.

Unchanged; I figure the hook (Pl. XI, fig. 21).

Helophora insignis.

Is considered to be a true *Linyphia*.

Bathyphantes minuta.

Belongs to *Lepthyphantes*.

Bathyphantes nebulosa.

Belongs to *Lepthyphantes*.

Bathyphantes alpina.

These are *B. zebra*, not so strongly colored as normal.

Bathyphantes subalpina.

Determination correct.

Bathyphantes decorata.

Very similar to *B. zebra*, but smaller, paler, and few if any silvery spots on the basal part of the dorsum of abdomen; the male palpus differs a little in the hook and in shape of the outer process which is long and pointed, and with a comb of long hairs above; a new figure is given (Pl. X, fig. 13).

Bathyphantes argenteomaculata.

These are *B. zebra*, not quite mature.

Bathyphantes pallida.

I cannot place these females; the prominent epigynum is even more protuberant than figured, possibly near to *Tmeticus brunneus*, but more than one-half smaller.

Bathyphantes sabulosa.

These are *B. zebra*.

Bathyphantes umbratilis.

Not quite mature female, possibly of *Microneta olivacea* since the palpi are enlarged.

Bathyphantes complicata.

Not this species, but from the male palpus I cannot place it with any described form, though it may be near *Microneta longitubus*.

Bathyphantes unimaculata.

Related to *B. complicata;* the palpus has a broad band obliquely across as in that species, but the tube is slender and sharp.

Bathyphantes inornata.

The palpus figured is *B. angulata*, but others in lot are *B. unimaculata*.

Bathyphantes tristis.

The median rounded part of the epigynum shows two cavities on the posterior edge. Probably the female of some described *Microneta* or *Bathyphantes* (Pl. XI, fig. 17).

Microneta latens = *M. quinquedentata* Emer.

Microneta palustris.

This is a *Pedanostethus;* I give a figure of the other side of palpus (Pl. XI, fig. 16); this does not seem to agree with any described species; the epigynum of the females (Pl. XI, fig. 25) (collected after description was made) agrees very well with one of Emerton's figures of *riparius.*

Microneta luteola.

I give a figure of other side of palpus (Pl. X, fig. 2), it were probably better in *Bathyphantes,* and related to *B. calcaratus* Emer.; there are, however, no marks on the basal part of the abdomen, but several faint, whitish, transverse spots toward tip.

Microneta flaveola.

This is probably only a form of *Bathyphantes angulata;* the hook, however, is not as heavy as in that species, and there are several structures not shown on Emerton's figure. In the original figure a part of the median bilobed process was mistaken for a continuation of the upper limb of the hook (Pl. X, fig. 9).

Microneta complicata.

A figure is given of the back of the palpus (Pl. X, fig. 14); it is related probably to *Bathyphantes intricata* Emer., but distinct.

Microneta minutissima.

The size given was a little too small; it is about 1.1 mm. long (Pl. X, fig. 12).

Microneta frontata.

This is a *Pedanostethus,* and it agrees well in size, color, and epigynum with what Emerton figures as his female *P. pumilus,* and I believe it is the same.

Microneta gigantea.

This appears to be *Tmeticus brunneus* Emer., the female of which was figured in 1909. The low, broad head and small A. M. E. would seem to indicate a special genus.

Microneta distincta.

Perhaps better placed in *Tmeticus.* I give new figures (Pl. X, fig. 1) of the palpus; apparently not otherwise known.

EPEIRIDÆ.

Epeira cinerea = *E. cavatica* Keys.

Epeira sclopetaria.

Is same as *E. sericata* Cl. which has page precedence.

Epeira patagiata.

Is same as *E. ocellata* Cl. which has page precedence.

Epeira strix.

Has older name in *E. foliata* Koch.

Epeira marmorea.

Is the same as *E. gigas* Leach.

Epeira insularis = *E. gigas* Leach.

Epeira labyrinthea.

Is considered to form a separate genus, *Metepeira*.

Epeira placida.

Belongs to genus *Mangora*.

Epeira gibberosa.

Belongs to genus *Mangora*.

Epeira parvula = *E. prompta* Htz.

Epeira stellata.

Belongs in genus *Plectana*.

Epeira ithaca.

Is young of *E. gigas* Leach.

Singa maculata.

Name preoccupied, changed to *S. truncata*.

Acrosoma rugosa = *A. gracilis* Walck.

Argiope riparia = *A. aurantia* Lucas.

Argiope transversa = *A. trifasciata*.

Argyroepeira hortorum.

Goes in genus *Leucauge*.

TETRAGNATHIDÆ.

Tetragnatha vermiformis.

In genus *Eugnatha*.

Tetragnatha straminea.

In genus *Eugnatha*.

Tetragnatha caudata.

Belongs in genus *Eucta*.

Tetragnatha pallida.

The specific name was preoccupied and changed by F. O. P.

Cambridge to *pallescens*. McCook has published a description; it goes in genus *Eugnatha*.

Pachygnatha brevis.

This is the real *P. xanthostoma* of Koch.

Pachygnatha xanthostoma.

This is the *P. xanthostoma* of McCook, but not of Koch; I propose to call it *P. mccooki* n.n.

THOMISIDÆ.

Xysticus stomachosus.

Probably is *X. ferox* Htz.

Xysticus feroculus = *X. triguttatus* Keys.

Xysticus distinctus.

This is apparently a specimen of *X. stomachosus*, recently transformed, in which the parts of the vulva show more distinctly than usual.

Xysticus brunneus.

This is the female of the true *X. limbatus* Keys.

Xysticus crudelis = *X. brunneus* Bks.

Xysticus transversus = *X. stomachosus* Keys.

Xysticus lentus.

This is the male of *gulosus*, previously not described.

Xysticus nervosus.

Unchanged; Emerton has given additional description and figures.

Xysticus formosus.

Unchanged, Emerton has given additional description and figures.

Xysticus limbatus.

Unchanged; it is a male of the true *limbatus* of Keyserling; not the *limbatus* of Emerton.

Xysticus quadrilineatus = *X. luctans* Koch.

Xysticus maculatus.

Immature specimens, probably of *X. stomachosus*.

Oxyptila georgiana = *O. americana* Bks.

Oxyptila conspurcata.

Unchanged; the *O. georgiana* Keys. is the same species.

Misumena rosea = *Misumessus asperatus* Htz.

Misumena georgiana.

I consider this to be the *M. celer* of Hentz.

Misumena foliata = *Misumessus asperatus* Htz.

Misumena placida = *Misumessus asperatus* Htz.

Philodromus vulgaris = *P. pernix* Blk.

Philodromus prælustris

Immature specimens of *P. pernix* Blk.

Philodromus signifer.

This, I believe, is the same as *Ph. expositus* of Keyserling (*Ph. maculatus* Blk.).

Philodromus gracilis = *Ph. pernix* Blk.

Philodromus unicolor = *P. infuscatus* Keys.

Philodromus ornatus.

Unchanged, Emerton has given a description and figures.

Philodromus placidus.

Unchanged; related to *Ph. ornatus.*

Philodromus minutus.

In well-marked specimens the legs are lined behind with black, the hind pair on front edge; I think that *Ph. brevis* Emer. is the male of this species; I have taken *P. brevis* at Ithaca.

Philodromus minusculus.

This closely resembles *Ph. ornatus* and it is probably that species; but its very much smaller size induced me to describe it; I have no other specimens as small.

Philodromus exilis.

This differs from the other small species of the genus in elongate abdomen; I believe the *Ph. bidentatus* Emer. is the male of this species.

Philodromus rufus.

Unchanged; Emerton gives figures and description under name of *P. pictus.*

Philodromus laticeps.

This immature male is *Ph. pernix* Blk.

Philodromus aureolus.

These are young specimens; in appearance they agree with *Ph. lineatus* Emer., but one cannot be sure without adults.

LYCOSIDÆ

Lycosa nidicola = *L. helluo* Walck.

Lycosa communis = *L. avida* Walck.

Lycosa nigroventris.

This is the male of *L. frondicola.*

Lycosa similis = *L. pratensis* Emer.

Lycosa rufiventris = *L. avara* Keys.

Lycosa humilis = *Schizogyna gracilis* Bks.

Lycosa polita = *Trochosa rubicunda* Keys.

Lycosa scutulata = *L. rabida* Walck.

Lycosa vulpina = *L. aspersa* Htz.

Lycosa crudelis = *L. helluo* Walck.

Lycosa immaculata = *L. aspersa* Htz.

Lycosa exitiosa = *L. aspersa* Htz. ♂.

Lycosa oblonga = *L. aspersa* Htz.

Pardosa pallida.

Name preoccupied and changed by Chamberlin to *P. emertoni*, but I think it is *P. distincta* Blackw.

Pardosa annulata.

Is the female of *P. minima* Keys.

Pardosa venusta = *P. lapidicina* Emer.

Pardosa brunnea.

Is *P. glacialis* Thor., and I think is *P. modica* Blackw.

Pardosa gracilis.

This is a *Schizogyna*, *Lycosa relucens* of Montgomery is the same form.

Pardosa albopatella.

Now known as *P. minima* Keys.

Pardosa nigropalpis.

Is *P. flavipes* Keys., and I think also *P. canadensis* Blackw.

Pardosa montana = *P. xerampelina* Keys.

Pardosa mœsta.

Chamberlin has given a new description and figure in his Revision of the Lycosidæ. *P. diffusa* Em. is apparently the male of this species.

Pardosa obsoleta = *P. lapidicina* Emer.

Pirata montana.

These females are not *montana*, but agree with *aspirans* Chamber.

Pirata montanoides.

Female runs out to *P. aspirans*, and probably is that species, but the figure of the vulva of that species shows the tip flattened out instead of bent down as normally the case, so it appears different. *P. humicolus* is also close, the darker colors are of no specific value, at least not in allied *P. minuta* (Pl. XI, fig. 20).

Pirata agilis = *montana* Emer.

Pirata exigua = *P. minuta* Emer.

A very dark female, with black-banded legs and dark sternum; the vulva seems to be the same as in the pale form.

Pirata minuta.

A pale female with wholly pale, unbanded legs, and pale sternum.

Aulonia aurantia.

This is an immature *Pardosa*.

Ocyale undata.

Goes in the genus *Pisaurina*.

Dolomedes sexpunctatus.

Young specimens of *D. tenebrosus*.

Dolomedes scriptus.

Young specimens of *D. tenebrosus*.

ATTIDÆ.

Phidippus mystaceus = *P. electus* Koch, not Hentz's *mystaceus*.

Phidippus albomaculatus = *P. electus* Koch.

Phidippus rauterbergi = *P. audax* Htz.

Phidippus mccooki = *P. castrensis* Koch.

Phidippus tripunctatus = *P. audax* Htz.

Philæus princeps = *Phidippus putnami* Peck.

Philæus militaris.

Belongs to genus *Dendryphantes*.

Dendryphantes capitatus = *D. octavus* Htz.

Dendryphantes elegans.

Belongs to genus *Tutelina*.

Dendryphantes flavus.

Specimens immature, but agree in markings with adults.

Dendryphantes insignis = *D. octavus* Htz.

Dendryphantes ornatus = *D. octavus* Htz.

Dendryphantes exiguus = *D. flavipedes* Peck.

Specimens lack the dark mark on femora, normally present; the female had not been described.

Icius formosus.

Belongs to *Marpissa*, and is possibly the unknown male of *M. binus*.

Icius albovittatus = *Dendryphantes militaris*.

Icius palmarum.

Is now in the genus *Wala*.

Icius mitratus.

Also belongs to *Wala*.

Icius harti.

Is *I. fuligineus* Blackw.

Icius mœstus = *Dendryphantes militaris* Htz.

Icius elegans.

A young specimen, probably of *Wala*.

Eris octavus = *Dendryphantes octavus* Htz.

Eris nervosus.

Belongs in the genus *Zygoballus*.

Hasarius hoyi = *Pellenes falcata* Clerck.

Habrocestum latens = *Pellenes falcata* Cl.

Habrocestum cœcatum = *Pellenes borealis* Bks.

Habrocestum peregrinum.

Goes in the genus *Pellenes*.

Habrocestum splendens = *Pellenes decorus* Blackw.

Saitis pulex.

Is kept now in *Habrocestum*.

Astia vittata.

Now known as *Mœvia niger*.

Epiblemum scenicum.

Belongs in genus *Salticus*.

Admestina wheeleri.

I have elsewhere[1] shown this to be *tibialis* of Koch.

Marptusa familiaris.

I have elsewhere[1] shown this to be *Marpissa undata* De Geer.

Marptusa rupicola.

I believe it distinct from *familiaris* (*undata*); it also occurs at Great Falls, Va., under pieces of rocks.

Synageles picata.

Is now placed in genus *Peckhamia*.

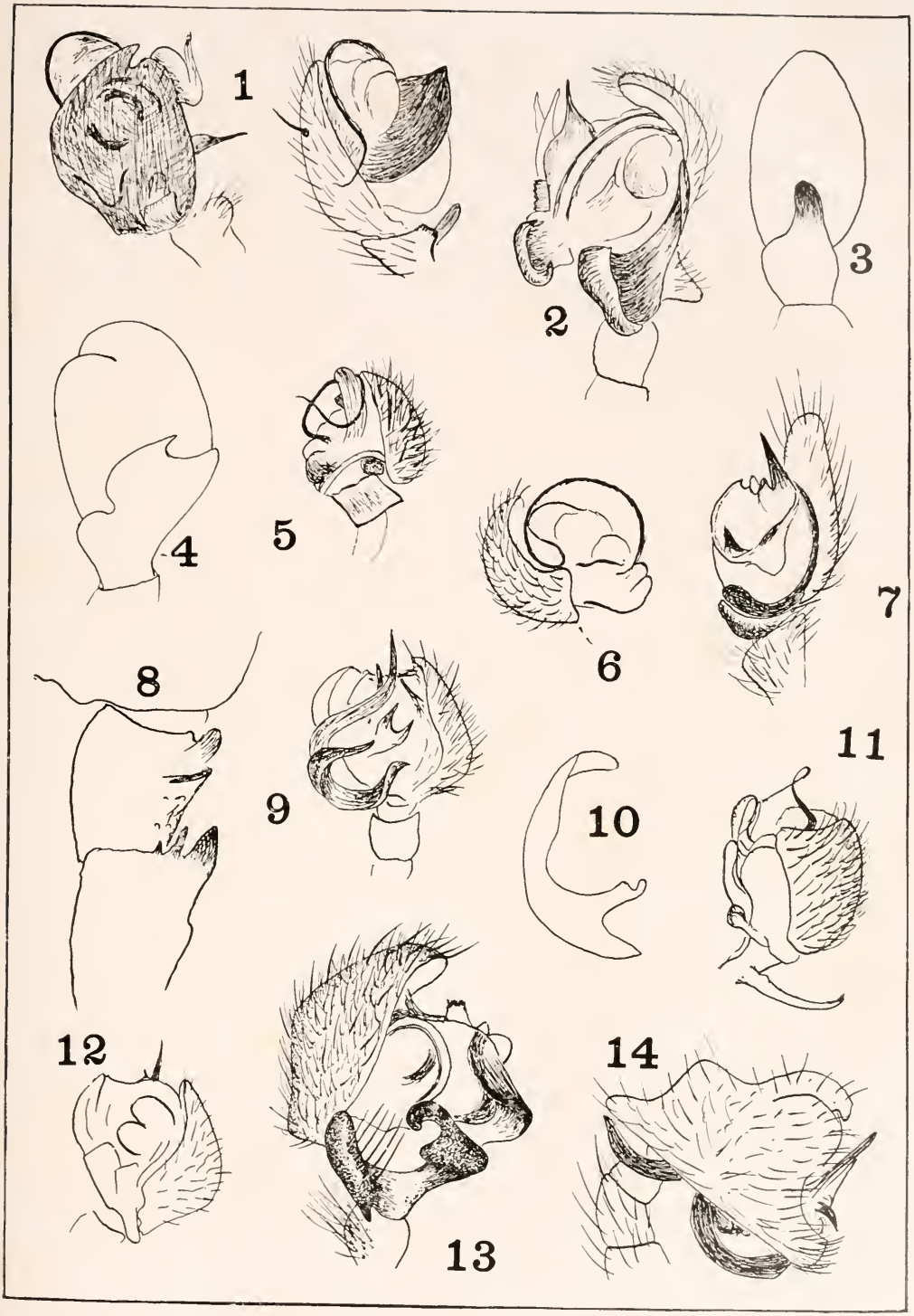
Explanation of Plates X and XI.

Plate X.—Fig. 1.—*Microneta distincta*, palpus.
Fig. 2.—*Microneta luteola*, palpus.
Fig. 3.—*Tmeticus gnavus*, palpus.
Fig. 4.—*Lophocarenum formosum*, palpus.
Fig. 5.—*Tmeticus minutus*, palpus.
Fig. 6.—*Ceratinella placida*, top of palpus.
Fig. 7.—*Tmeticus gnavus*, palpus.
Fig. 8.—*Calotes fidelis*, tibia and patella.
Fig. 9.—*Microneta flavcola*, palpus.

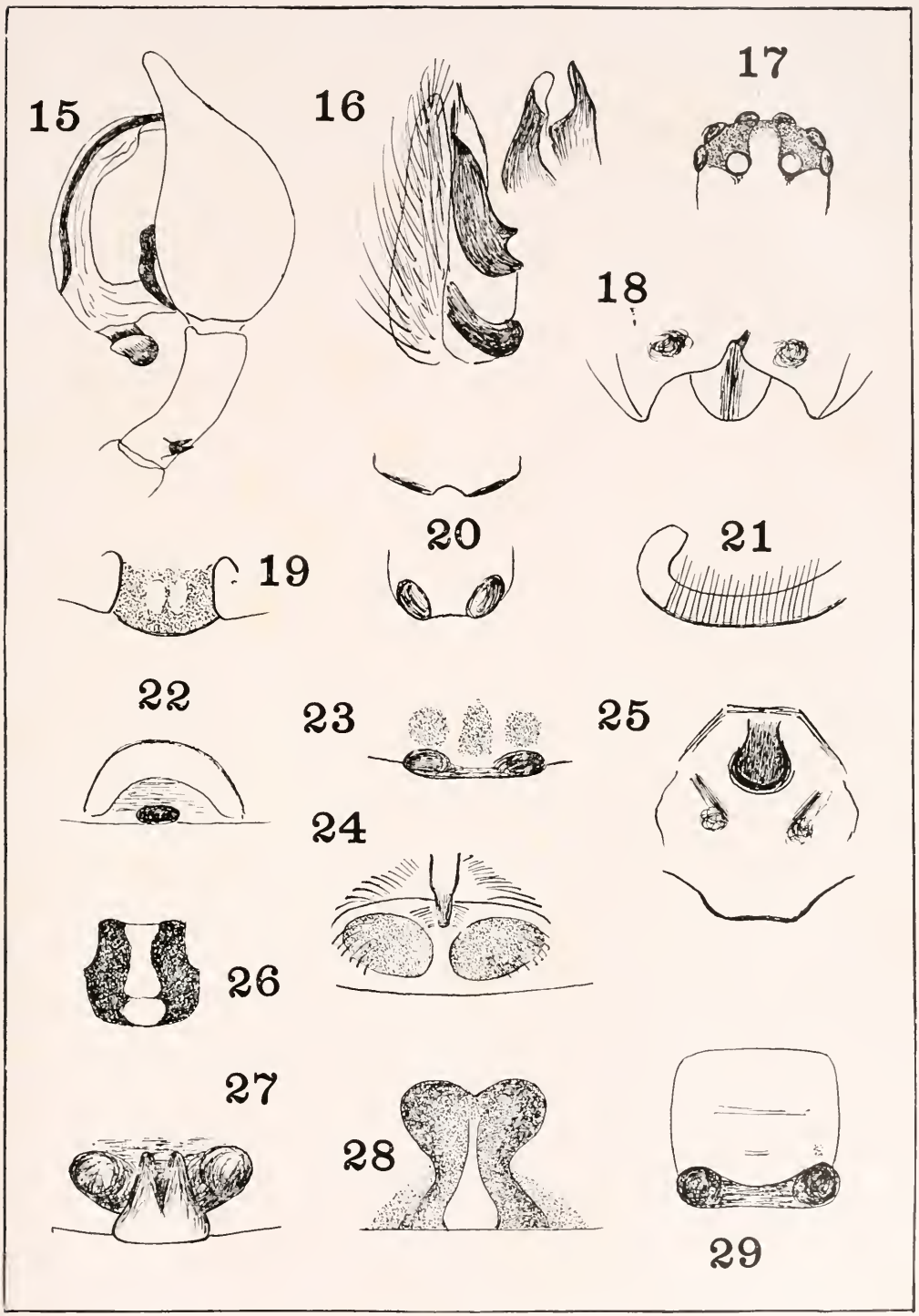
[1] *Ent. News*, IX, 142, 1898.

Fig. 10.—*Tmeticus rusticus*, hook.
Fig. 11.—*Ceratinella placida*, palpus.
Fig. 12.—*Microneta minutissima*, palpus.
Fig. 13.—*Bathyphantes decora*, palpus.
Fig. 14.—*Microneta complicata*, palpus.
Fig. 15.—*Dictyna maxima*, palpus.

Plate XI.—Fig. 16.—*Microneta palustris*, palpus.
Fig. 17.—*Bathyphantes tristis*, head.
Fig. 18.—*Grammonota venusta*, vulva.
Fig. 19.—*Cornicularia placida*, vulva.
Fig. 20.—*Pirata montanoides*, two vulvæ.
Fig. 21.—*Diplostyla alboventris*, hook.
Fig. 22.—*Cœlotes gnarus*, vulva.
Fig. 23.—*Lophocarenum miniatum*, vulva.
Fig. 24.—*Cœlotes altilis*, vulva.
Fig. 25.—*Microneta palustris*, vulva.
Fig. 26.—*Cicurina placida*, vulva.
Fig. 27.—*Tmeticus distinctus*, vulva.
Fig. 28.—*Lophocarenum castaneum*, vulva.
Fig. 29.—*Lophomma cristata*, vulva.



BANKS: CAYUGA LAKE SPIDERS.



BANKS: CAYUGA LAKE SPIDERS.

April 18.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Thirty-five persons present.

The deaths of the following members were announced:

Emlen Physick, March 21, 1916.
Charles Chauncey, April 3, 1916.
Norton Downs, April 15, 1916.

The Publication Committee announced the presentation of a paper entitled "Contributions to the Anatomy of Python reticulatus (Schneider)," by Joseph C. Thompson (April 8, 1916).

Temperature and the Activities of Animals.—Merkel H. Jacobs, Ph.D., remarked that the continued existence of living organisms is possible within a range of temperature of the order of magnitude of possibly one one-thousandth of that encountered in the universe. The majority of the activities of organisms occur within the region from slightly below 0° C. to about 45° C. For individual species the range is usually less—sometimes as little as 15° or even 6° C. A certain number of forms can exist for a short time in a more or less inactive condition through a range of 350° C. or more.

Even within the natural range for a species the effects of different temperatures is very striking. A rise of 40° C. may cause at least a 16-fold increase in the rate of most of the chemical reactions underlying the various manifestations of life. Since different processes are accelerated unequally by such a rise and since the point of equilibrium in reversible reactions is changed, the effect on the organism as a whole may be qualitative as well as quantitative. The use of high temperatures has been a favorable means of securing striking modifications of existing forms of life. A possible case of a heritable variation produced in this way is the three-vacuoled race of *Paramecium* which appeared sixteen months ago in the Zoological Laboratory of the University of Pennsylvania and which has remained constant ever since.

Different organisms are differently situated with respect to the daily and yearly changes of temperature they are called upon to meet. Many marine forms are subject to an average change of less than 1° C. a day and 2° or 3° a year. On the other hand, terrestrial forms and those living in small bodies of fresh water frequently endure a daily range of 30° C. or more. The rotifer *Philodina roseola* is subjected to especially severe conditions. Living in small pools

whose temperature in the springtime may drop almost to the freezing point at night and rise in the sunlight 10° C. above the air temperature, it frequently passes in the space of two or three hours from an arctic to a tropical environment and *vice versa*. In general, the forms that in their natural environment have to meet sudden temperature changes show greater powers of acclimatization than those living under more constant external conditions. A comparison of the powers of rapid acclimatization to high temperature of *Paramecium* or the tadpole which lives in fresh water pools, with starfish larvæ which live in the ocean, shows striking differences in this respect.

Many of the terrestrial animals have developed the power of maintaining a constant body temperature under widely varying external conditions. This power, however, is insufficient in most cases to make possible a strictly world-wide distribution. Man is able to supplement natural with artificial means of temperature control. Even he, however, is considerably affected by external temperatures, especially high ones. One factor in producing this result appears to be the effect of such temperatures on the circulation. The practical result of a more complete control of temperature by man would be the opening up of the enormously fertile tropical regions of the earth.

The following were ordered to be printed:

STUDIES IN THE DERMAPTERA AND ORTHOPTERA OF THE COASTAL PLAIN AND PIEDMONT REGION OF THE SOUTHEASTERN UNITED STATES.

BY JAMES A. G. REHN AND MORGAN HEBARD.

In the summers of 1911 and 1913, the present authors made extensive collections of, and field studies in, the Dermaptera and Orthoptera found in the southeastern States. About the time we were able to begin laboratory work on the first season's collecting, other series from the same general region were placed in our hands, since which time an increasing amount of data has become available bearing on the same subject. We feel the most advisable method of making available to workers the really great amount of distributional, synonymic and variational information now in hand, to be the publication of this single large paper. The authors' time has been given more or less regularly for a period of two years to the preparation of this paper and others made necessary by collections referred to herein. It should be borne in mind that the present paper is not a final one, but instead a contribution based on available material, although nearly all of the species known from the regions studied are treated.

In general, the geographic area covered by the collections here studied is, the Coastal Plain and Piedmont regions from the Potomac River south to north-central (non-peninsular) Florida, west to the western boundary of Georgia. In addition a fair amount of material from the higher elevations in Georgia, from certain localities in central Florida and also from Maryland and other more northern States has been included. Aside from the Georgia mountain region records, which are geographically very important, those from outside the main area covered by the paper have been included to place on record the extreme geographic limits of certain species, or to cite material used in the detailed discussion on the species.

In the study of certain genera here treated we have found it not only desirable, but necessary, to revise completely those groups as found within North America, in the course of which work practically all the available collections bearing on the subjects have been examined. These revisions consumed much time and involved some travel. The collections of the United States National Museum, the Museum of Comparative Zoology and the Georgia State Collection

and the private series of Mr. W. T. Davis and Prof. A. P. Morse have furnished a great amount of important data, although the greater portion of our information has been derived from our own collections. The genera which have required comprehensive revisionary study are *Cariblatta, Scudderia, Amblycorypha, Neoconocephalus, Orchelimum, Conocephalus, Atlanticus, Cycloptilum, Cryptoptilum, Gryllus* and *Miogryllus.*

Many data have been accumulated in the course of the studies here presented, which show the necessity of revisionary work in a number of other genera, but, unfortunately, either material or time is lacking at present to consider properly or thoroughly these groups; we have, however, given summaries of such general conclusions as we have reached in these cases, the contributions being presented as abstracts of detailed studies we have in preparation or contemplation, or as accumulations of important general conclusions for the use of other workers. Such contributions will be found under *Nomotettix, Neotettix, Tettigidea, Pardalophora, Hippiscus, Schistocerca, Melanoplus,* and the Group Anaxiphites with particular reference to *Anaxipha.*

The total number of specimens from the area under consideration examined in the preparation of this paper is 14,402, representing 251 species and geographic races, belonging to 100 genera. Of these species nine are here described as new, but a number of other new forms in the recently studied genera were based on material comprising portions of the series here recorded. In the text of this paper forty specific names and that of one genus have been placed in the synonymy, the completeness of the present material, with the consequent clearer appreciation of specific variation and character constancy, making the sinking of these names necessary. No synonymy has been established without several careful checkings of the evidence. Of the specimens examined, 7,294, or about one-half, were collected by the authors, chiefly in July, August and September, 1911 and 1913. The other principal sources of material, with the number of specimens examined from each, are as follows:

Collection of W. T. Davis	1,071
Georgia State Collection	877
Collection of A. P. Morse	784
United States National Museum Collection	703
Cornell University Collection	636
Hebard Collection (other than Rehn and Hebard collecting)	611
Academy of Natural Sciences of Philadelphia Collection (other than Rehn and Hebard collecting)	211

Smaller series have also been examined belonging to the North Carolina Department of Agriculture, the Museum of the Brooklyn Institute of Arts and Sciences, the Pennsylvania State Department of Zoology and the Museum of Comparative Zoology. The necessity of seeing the historic Scudder Collection in the latter institution, to which three visits were made while preparing the present paper, is always very pressing in work on the North American species of the Orthoptera.

In order to reduce the length of our entries and yet give complete data, we have used in the present paper, as in a number of previous ones, standard abbreviations for the sources of the material, or, in the case of the larger series which can be located by the collector's name we have considered the latter sufficient to place the specimens.

No location is given for material collected by Rehn and Hebard, jointly or individually, as it is understood it is in the Philadelphia collections, either the Academy of Natural Sciences or the Hebard Collection. Material in the collection of Mr. W. T. Davis, of New Brighton, New York, collected by himself, and that of Dr. A. P. Morse, of Wellesley, Massachusetts, collected by the same individual, has no location given for it, as it is understood such material is in their respective collections unless otherwise specified. Material collected by other individuals in the Davis and Morse Collections has the location indicated by the abbreviations given below. No location is given for material credited as collected by Dr. J. Chester Bradley, it being understood that is in the Georgia State Collection at Atlanta unless from localities in the Okeefenokee Swamp, in which case it is in the collection of Cornell University. From each of these collections a representation has been retained in the Philadelphia collections in return for the work of identification.

The abbreviations for the source of material used through the present paper are as follows:

A. N. S. P., for the Academy of Natural Sciences of Philadelphia.
B. I., for the Museum of the Brooklyn Institute of Arts and Sciences.
Cornell Univ., for the collection of Cornell University.
Davis Cln., for the collection of Mr. W. T. Davis, of New Brighton, Staten Island, New York.
Ga. St. Cln., for the Georgia State Collection, located at Atlanta.
Hebard Cln., for the Hebard Collection, in Philadelphia.
M. C. Z., for the Museum of Comparative Zoology, at Cambridge, Massachusetts.
Morse Cln., for the collection of Prof. A. P. Morse, of Wellesley, Massachusetts.

N. C. St. Dept. Agr., for the collection of the North Carolina State Department of Agriculture at Raleigh.
Pa. St. Dept. Zool. Cln., for the collection of the Pennsylvania State Department of Zoology at Harrisburg.
U. S. N. M., for the United States National Museum at Washington.

In the references to the authors as collectors they are indicated by the initials R. and H.

Localities.

To facilitate the placing of localities given in the body of the paper we have tabulated alphabetically under States the localities represented by fair series. The elevations given have been taken from Government topographical charts, official lists of elevations or our own aneroid determinations. In a few cases we have been unable to secure information on the elevation, in which case the fact is so stated. In addition, localities at or very near the sea-level have no elevation given. The dates given are those for the specimens examined and the location is that of the ownership of the same.

Virginia.

Arlington, Alexandria County, elevation about 200 feet. VII, 9, 1914. (H.)
Falls Church, Fairfax County, elevation 364 feet. V, 25, 1913. (A. N. Caudell.) [U. S. N. M.]
Fredericksburg, Spotsylvania and Stafford Counties, elevation about 10 to 250 feet. VII, 20, 1913. (R. & H.)
Lynchburg, Campbell County, elevation about 700 feet. VII, 22, 1913. (R. & H.)
Glencarlyn, Alexandria County, elevation 183 feet. IV, 27, 1913. (A. N. Caudell.) [U. S. N. M.]
Orange, Orange County, elevation 500 to 800 feet. VII, 21, 1913. (R. & H.)
Petersburg, Dinwiddie County, elevation about 100 feet. VII, 23, 1913. (R. & H.)

North Carolina.

Charlotte, Mecklenburg County, elevation 670 to 750 feet. VII, 27, 1913. (R. & H.)
Fayetteville, Cumberland County, elevation 100 to 150 feet. IX, 9, 1911. (R. & H.)
Goldsboro, Wayne County, elevation 110 feet. VII, 25, 1913. (R. & H.)
Greensboro, Guilford County, elevation 900 feet. VII, 26, 1913. (R. & H.)
Lake Waccamaw, Columbus County, elevation 60 feet. IX, 8, 1911. (R. & H.)
Murphy, Cherokee County, elevation 1,540 feet. VII, 25, 1903. (Morse.) [Morse Cln.]
Raleigh, Wake County, elevation 350 feet. Various dates, collectors and collections.
Southern Pines, Moore County, elevation 519 feet. XI, 1908 and 1905. (A. H. Manee.) [N. C. Dept. Agr.]
Tryon, Polk County, elevation 1,090 feet. (W. F. Fiske.) [U. S. N. M.]
Weldon, Halifax County, elevation 70 feet. VII, 24, 1913. (R. & H.)
Wilmington, New Hanover County. IX, 8, 1911. (R. & H.)
Winter Park, New Hanover County. IX, 7, 1911. (R. & H.)
Wrightsville, New Hanover County. IX, 7, 1911. (R. & H.)

South Carolina.

Ashley Junction, Charleston County. VIII, 15, 1913. (R.)
Columbia, Richland County, elevation 300 feet. VII, 28, 1913. (R. & H.)
Denmark, Bamberg County, elevation 257 feet. VIII, 15, 1903. (Morse.) [Morse Cln.]

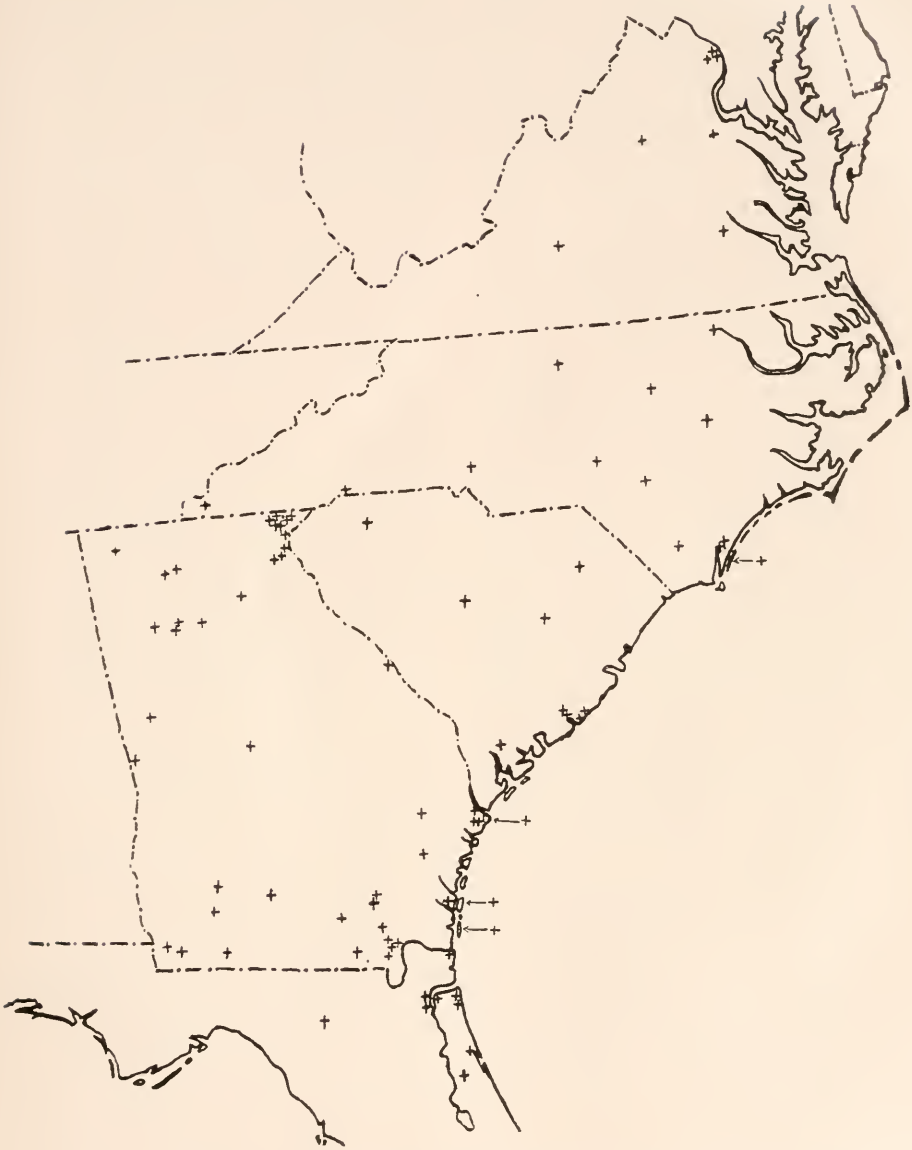


Fig. 1.—Outline map of the southeastern United States, showing the positions of the principal localities, represented by series, in the collections studied in connection with this paper.

Florence, Florence County, elevation 138 feet. IX, 6, 1911. (R. & H.)
Isle of Palms, Charleston County. VIII, 15, 1913. (R.)
Magnolia, Charleston County. IX, 5, 1911. (R. & H.)
Manning, Clarendon County, elevation 91 feet V, 1914. (Witmer Stone.) [A. N. S. P.]
Spartanburg, Spartanburg County, elevation 875 feet. VIII, 6, 1913. (H.)
Sullivan Island, Charleston County. IX, 5, 1911. (R. & H.)
Yemassee, Hampton and Beaufort Counties, elevation 18 to 40 feet. IX, 4, 1911. (R. & H.)

Georgia.

Albany, Dougherty County, elevation 184 feet. VIII, 1, 1913. (R. & H.)
Atlanta, Fulton County, elevation 900 to 1,050 feet. Numerous dates and collectors. [Ga. St. Cln.]
Augusta, Richmond County, elevation 140 to 200 feet. VII, 29, 1913. (R. & H.)
Austell, Cobb County, elevation 900 to 1,000 feet. VIII, 6, 1910. [Ga. St. Cln.]
Bainbridge, Decatur County, elevation 110 feet. Numerous dates. (J. Chester Bradley.) [Ga. St. Cln.]
Billy's Island, Okeefenokee Swamp, Charlton County. V and VI, 1912, IX and XII, 1913. (J. Chester Bradley.) [Cornell University.]
Black Rock Mountain, Rabun County, elevation 2,000 to 3,500 feet. V, 20 to 25, 1911. [Ga. St. Cln.]
Brunswick, Glynn County. II, 12, 1911. [Ga. St. Cln.] VII, 30, 1911. (R. & H.)
Buckhead, Fulton County, elevation 1,000 feet. IV, 16, 1911. [Ga. St. Cln.] VIII, 2, 1913. (R. & H.)
Burton, Rabun County, elevation 1,800 feet. V, 21, 1911. (J. Chester Bradley.) [Ga. St. Cln.]
Chase Prairie, Okeefenokee Swamp, Charlton County. IX, 5, 1913. (J. Chester Bradley.) [Cornell Univ.]
Clayton, Rabun County, elevation 2,000 to 3,700 feet. VI. (Davis.) [Davis Cln.]
Columbus, Muscogee County, elevation 200 to 350 feet. VII, 16, 1913. (J. Chester Bradley.) [Ga. St. Cln,]
Cornelia, Habersham County, elevation 1,500 feet. V, 28, 1906. [Ga. St. Cln.] VII, 1910. (Davis.) [Davis Cln.]
Cumberland Island, Camden County. VIII, 31, 1911. (R. & H.)
Currahee Mountain, Stephens County, elevation 1,700 feet. VIII, 5, 1913. (H.)
Dalton, Whitfield County, elevation 1,000 to 1,200 feet. VIII, 7, 1913. (R.)
De Witt, Mitchell County, elevation cannot be ascertained. VIII, 19, 1912. [Ga. St. Cln.]
Fargo, Clinch County, elevation 116 feet. VIII, 31, 1913. (J. Chester Bradley.) [Cornell Univ.]
Groveland, Bryan County, elevation cannot be ascertained. VII, 28, 1913. (J. Chester Bradley.) [Ga. St. Cln.]
Hebardville, Ware County, elevation about 150 feet. V, 15, 1915. (H.)
Homerville, Clinch County, elevation 176 feet. VIII, 27, 1911. (R. & H.)
Honey Island, Okeefenokee Swamp, Charlton County. VI, 1912. (J. Chester Bradley.) [Cornell Univ.]
Isle of Hope, Chatham County. IX, 3, 1911. (R. & H.)
Jesup, Wayne County, elevation 100 to 125 feet. IX, 1, 1911. (R. & H.)
Jasper, Pickens County, elevation 1,200 to 1,500 feet. VIII, 5, 1913. (R.)
Macon, Bibb County, elevation 350 feet. VII, 30 to 31, 1913. (R. & H.)
Mixon's Hammock, Okeefenokee Swamp, Charlton County. V, 16, 1915. (H.)
Okeefenokee Swamp (general label), Ware, Charlton and Clinch Counties: V, 1911. (J. Chester Bradley.) [Cornell Univ.]
Pinnacle Peak, Rabun County, elevation 4,100 feet. VIII, 20, 1913. (J. Chester Bradley.) [Ga. St. Cln.]
Rabun Bald, Rabun County, elevation 4,000 to 4,800 feet. VIII, 21, 1913. (J. Chester Bradley.) [Ga. St. Cln.]
Sandfly, Chatham County. IX, 3, 1911. (R. & H.)
Savannah, Chatham County. Various dates, collectors and collections.
Sharp Mountain, Pickens County, elevation 1,800 to 2,000 feet (barometric).[1] VIII, 6, 1913. (R.)

[1] This peak is about nine miles to the westward of Jasper and should not be confused with Sharp-top Mountain near the same place. The latter peak is higher than Sharp Mountain and is to the eastward of Jasper. Sharp-top Mountain was visited by Morse in 1903.

Spring Creek, Decatur County, elevation about 110 feet. Numerous dates. (J. Chester Bradley.) [Ga. St. Cln.]

Stone Mountain, De Kalb County, elevation 1,050 to 1,686 feet. Vicinity of same, elevation 950 to 1,050 feet. VIII, 3, 1913. (R. & H.)

St. Simon's Island, Glynn County, IV to V, 1911 and 1912. (J. Chester Bradley.) [Ga. St. Cln.] VIII, 30, 1911. (R. & H.)

Suwanee Creek, Lot 328, 12th District, Okeefenokee Swamp, Charlton County. VIII, 28, 1911. (R. & H.)

Tallulah Falls, Rabun County, elevation 1,630 feet. VIII, 1887. [U. S. N. M. and Hebard Cln.] VII, 1910. (Davis.) [Davis Cln.]

Thomasville, Thomas County, elevation 250 feet. Various dates. (H. and R. & H.)

Thompson's Mills, Jackson County, elevation cannot be ascertained. Various dates. (H. A. Allard.) [U. S. N. M.]

Tifton, Tift County, elevation 370 feet. IX, 8, 1910. [Ga. St. Cln.]

Toccoa, Stephens County, elevation 1,094 feet. VIII, 4, 1913. (H.)

Tuckoluge Creek, Rabun County, elevation 1,600 to 2,600 feet. VII, 1910. (Davis.) [Davis Cln.]

Tybee Island, Chatham County. IX, 2, 1911. (R. & H.)

Warm Springs, Meriwether County, elevation 850 to 1,200 feet. VIII, 9 to 10, 1913. (R.)

Waycross, Ware County, elevation 138 feet. VIII, 11, 1903. (Morse.) [Morse Cln.]

Wilson Gap, Mountain City, Rabun County, elevation cannot be ascertained. VIII, 22, 1913. (J. Chester Bradley.) [Ga. St. Cln.]

Florida.

Atlantic Beach, Duval County. VIII, 24 to 25, 1911. (R. & H.)

Fernandina, Nassau County. (W. H. Finn.) [U. S. N. M.]

Hastings, St. John County. Various dates. (A. J. Brown.) [Morse Cln.]

Indian River, Volusia and Brevard Counties. 1896. (T. J. Priddey.) [Hebard Cln.]

Jacksonville, Duval County. Various dates, collectors and collections. Examined by authors, VIII, 25, 1911.

Live Oak, Suwanee County, elevation 100 to 120 feet. VIII, 26, 1911. (R. & H.)

Ortega, Duval County. IX, 6, 1913. (Davis.) [Davis Cln.]

Pablo Beach, Duval County. IX, 5, 1913. (Davis.) [Davis Cln.]

South Jacksonville, Duval County. IX, 7, 1913. (Davis.) [Davis Cln.]

St. Augustine, St. John County. XI, 8, 1911. (G. P. Englehardt.) [B. I.]

Distributional Summary.

Two important influences or sets of factors quite evidently control the distribution of the Dermaptera and Orthoptera in the area studied, these influences being the same which largely control the character of the biota of any region. The two are: physiography and immediate environment; temperature and climatic regions or life-zones. The two influences share equally in controlling the distribution of certain species, but in numerous cases one and not the other is the governing factor. It seems best, therefore, to summarize our distributional generalizations separately under each of the main divisions. We must always bear in mind that a fauna is not a fixture, but a complex constantly changing and modifying, either through the evolution of its own living components or the modification of its own limitations by readjustment of its physical or climatic barriers. Of the first grouping the effect of immediate environment is best studied in a relatively circumscribed area and, other things being equal, the occurrence of the environment is controlled by the

more broadly influencing factor of the physiography of the land. The physiographic divisions we here use are those which are correlated with the distribution of groups of species of the orders studied.

Physiographic Regions.

The physiographic regions we find correlated with the distribution of the species found in Virginia, North Carolina, South Carolina, Georgia and northern Florida are:

a. High Appalachian summits.
b. Lower summits of the Appalachian uplift and higher valleys of the same area.
c. Piedmont.
d. Coastal Plain. This is divisible into two sections which we have for convenience called the Upper Coastal and the Lower Coastal.
e. Maritime and estuarine region.

These regions may be roughly delimited as follows:

High Appalachian Summits.—Only the highest peaks of the North Carolina and Virginia mountains are embraced in this term. Very few Orthoptera have been taken in this region.

Lower Summits and Valleys of the Appalachian Uplift.—Comprising the greater (remaining) portion of the Southern Appalachian system to its disappearance in Alabama, and the typical mountain valleys, as opposed to the broad intrusive Piedmont valleys, are grouped under this heading. The Georgia mountains, having in general a lower elevation than the major portion of the North Carolina mountain area, lack a number of the species found in the latter region, and also on their lower portions shelter species more typical of the Piedmont. Other species, which also occur in the Georgia mountains, penetrate the valleys of the North Carolina mountains, but do not frequent the main ridges in the latter State.

Piedmont.—This division includes the area of the Piedmont peneplain, or the region from the base of the Appalachians down to the fall-line, also embracing some of the larger and broader valleys which penetrate into the mountainous region proper. The fall-line extends in a curve from the vicinity of Washington, District of Columbia, to Columbus, Georgia.

Coastal Plain.—All the area situated below (*i.e.*, coastward of) the fall-line is embraced in this grouping. It is, from the Orthopteran evidence, distinctly divisible into two portions which may for convenience be called the Upper and Lower Coastal Plain regions. The Upper region covers all the territory of the Coastal Plain situated

to the north and inland of a line drawn from the vicinity of Newbern, North Carolina, to the vicinity of Albany, Georgia, passing a short distance inland of Wilmington, North Carolina, Charleston, South Carolina, and Savannah, Georgia. The territory on the coastal side of this line, except the very limited section included in the next

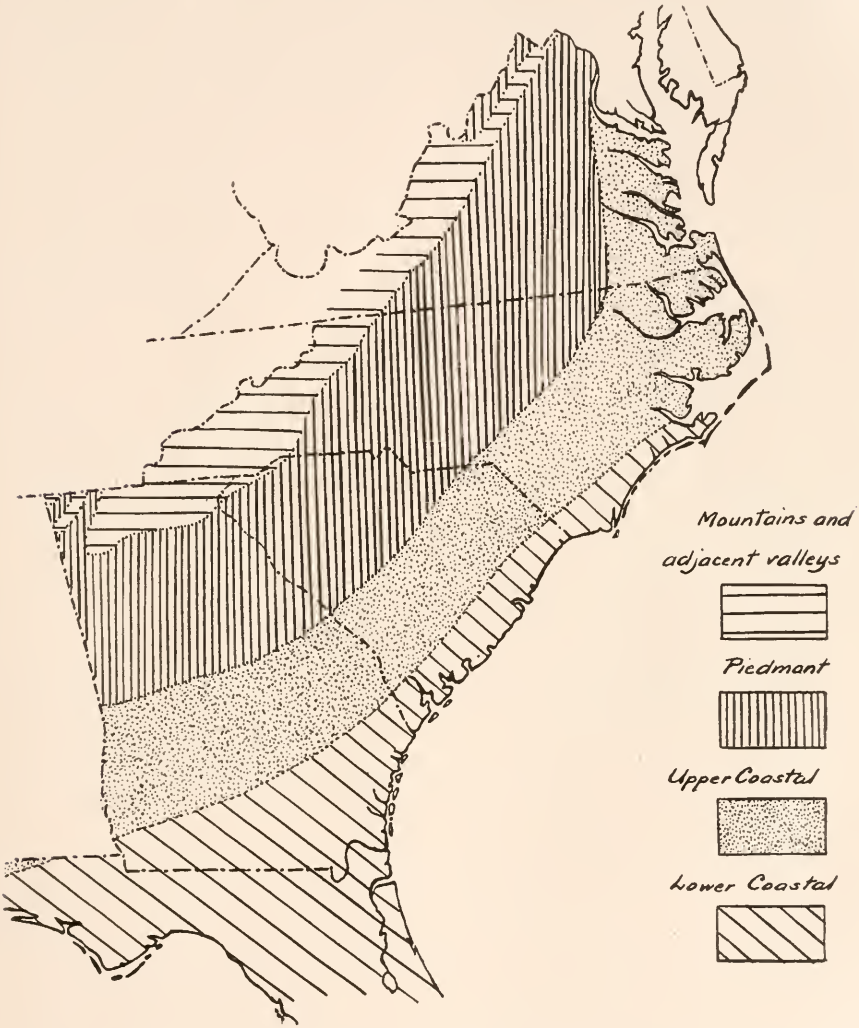


Fig. 2.—Outline map of the southeastern United States, showing the more extensive physiographic regions here discussed. The limited areas treated under "High Mountain Summits" and the very narrow "Sea-coast and Estuarine" region are not indicated.

area, we would consider the Lower Coastal Plain, which condition passes southward into peninsular Florida. The western boundary of the Lower Coastal Plain influence is not fixed as yet.

Maritime and Estuarine Region.—We include under this, barrier beach and coastal sand dunes, salt marshes and the extensive fresh marshes of the larger estuaries. The region is limited to a distance of a few miles from the coast-line, except in the case of the estuaries.

The following tabulations of species have been made on the basis of their distribution in relation to the physiographic features of the region studied.

I. General.

Labia minor (Probably introduced.)
Blattella germanica (Introduced.)
Blatta orientalis (Introduced.)
Nemobius carolinus carolinus

II. Appalachians (except high summits) to coast.

Neotettix femoratus (Up to 5,500 feet elevation in North Carolina.)
Paratettix cucullatus
Orphulella pelidna (Up to 5,000 feet in North Carolina.)
Arphia xanthoptera
Arphia sulphurea (Up to 5,700 feet in North Carolina.)
Dissosteira carolina (Up to 4,500 feet in North Carolina.)
Schistocerca serialis (Up to 5,700 feet in North Carolina.)
Scudderia furcata furcata (Up to 3,800 feet in North Carolina.)
Conocephalus fasciatus
Conocephalus brevipennis
Ellipes minuta
Myrmecophila pergandei
Gryllus assimilis (Up to 4,500 feet in North Carolina.)
Œcanthus angustipennis (Up to 4,000 feet in North Carolina.)
Œcanthus quadripunctatus (Up to 4,000 feet in North Carolina.)

III. Appalachian valleys and lower mountains in Georgia to coast.

Oligonyx scudderi
Tettigidea armata
Truxalis brevicornis
Amblytropidia occidentalis
Pardalophora phœnicoptera
Trimerotropis citrina
Œcanthus latipennis
Neoxabea bipunctata
Phylloscyrtus pulchellus

IV. High Appalachian summits only.

Nomotettix cristatus cristatus
Podisma glacialis variegata
Melanoplus divergens

V. Mountains only (summits and adjacent valley localities) in southeastern States.

Cryptocercus punctulatus
Diapheromera carolina
Acrydium hancocki
Chorthippus curtipennis (Northward occurring Piedmont and Coastal.)
Pardalophora apiculata
Paratylotropidia beutenmuelleri
Melanoplus similis
Melanoplus deceptus
Melanoplus sylvestris
Melanoplus walshii
Neoconocephalus ensiger (Northward occurring Piedmont and Coastal.)
Conocephalus allardi
Atlanticus monticola
Ceuthophilus lapidicola
Œcanthus nigricornis

VI. Mountains and Piedmont.

Anisomorpha ferruginea
Acrydium arenosum angustum (Northward occurring Coastal.)
Acrydium ornatum
Neotettix proavus
Eritettix simplex (Northward occurring Coastal.)
Orphulella speciosa (Northward occurring Coastal.)
Chlœaltis conspersa (Northward occurring Coastal.)
Encoptolophus sordidus (Northward occurring Coastal.)
Hesperotettix brevipennis (Northward occurring Coastal.)
Trimerotropis saxatilis
Melanoplus tribulus (Northward occurring Coastal.)
Melanoplus devius
Melanoplus decoratus
Melanoplus luridus luridus (Northward occurring Coastal.)
Melanoplus punctulatus punctulatus (Northward occurring Coastal.)
Amblycorypha rotundifolia rotundifolia (Northward occurring Coastal, passing at lower elevations in Southeastern States toward *A. r. parvipennis.*)
Pterophylla camellifolia camellifolia (Northward occurring Coastal.)
Conocephalus nemoralis
Atlanticus davisi
Ceuthophilus uhleri (Northward occurring Coastal.)
Ceuthophilus gracilipes
Nemobius fasciatus fasciatus (Occurring Coastal northward.)
Nemobius maculatus
Œcanthus niveus (Northward occurring Coastal.)

VII. Lower Mountains, Piedmont and Upper Coastal Plain.

Nomotettix cristatus compressus
Chortophaga viridifasciata (To Sullivan Island, South Carolina.)
Melanoplus carnegiei (To Yemassee, South Carolina.)
Melanoplus femur-rubrum femur-rubrum
Melanoplus femoratus
Orchelimum vulgare
Hapithus agitator agitator

VIII. Lower Mountains and Piedmont Region south to southwestern Georgia and adjacent northern Florida, absent from all or most of Carolinian and low Georgian Coastal.

Diapheromera femorata (To Monticello, Florida.)
Spharagemon bolli (To Tallahassee, Florida.)
Melanoplus scudderi scudderi (To Monticello, Florida.)
Melanoplus atlanis (To Marianna, Florida.)
Melanoplus impudicus (To Spring Creek, Georgia.)
Conocephalus saltans (To Thomasville and Spring Creek, Georgia.)
Atlanticus americanus (To Tallahassee and River Junction, Florida.)

IX. Piedmont Region.

Doru aculeatum
Ischnoptera pensylvanica pensylvanica (Occurring Coastal northward.)
Ischnoptera uhleriana uhleriana (Occurring Coastal northward.)
Ischnoptera insolita
Schistocerca damnifica damnifica (Occurring Coastal northward.)
Campylacantha olivacea (Macon, Georgia, only.)
Melanoplus impiger (Augusta, Georgia, only.)
Atlanticus testaceus (Occurring Coastal northward.)
Ceuthophilus latens
Ceuthophilus spinosus (Occurring Coastal northward.)
Ceuthophilus neglectus (Occurring Coastal northward.)
Nemobius griseus funeralis (Macon, Georgia, only.)
Nemobius bruneri
Nemobius confusus
Œcanthus exclamationis (Raleigh, North Carolina, only.)
Œcanthus pini (Raleigh, North Carolina, only.)

X. Piedmont and Coastal Plain only to extreme northern Florida.

Acrydium arenosum arenosum
Melanoplus strumosus (To De Funiak Springs, Florida.)
Hadenoecus puteanus
Anaxipha exigua
Cyrtoxipha columbiana

XI. Piedmont and Coastal Plain to peninsular Florida.

Vostox brunneipennis
Ischnoptera deropeltiformis
Ischnoptera johnsoni
Ischnoptera couloniana
Ischnoptera borealis
Ischnoptera bolliana (Northward only to Raleigh, North Carolina.)
Periplaneta americana
Chorisoneura texensis (Northward only to Tryon, North Carolina.)
Stagmomantis carolina
Tettigidea lateralis lateralis (At higher elevations and northward in Coastal Plain passing into *T. l. parvipennis.*)
Mermiria alacris (Northward only to Newbern, North Carolina.)
Syrbula admirabilis
Dichromorpha viridis
Romalea microptera (Northward only to central North Carolina.)
Leptysma marginicollis (Northward only to vicinity of Washington, District of Columbia.)
Melanoplus luridus keelcri (At higher elevations and northward passing into *M. l. luridus.*)
Paroxya clavuligera (Local in Piedmont.)
Scudderia texensis
Amblycorypha uhleri (Coastal alone northward.)
Microcentrum rhombifolium
Neoconocephalus robustus crepitans (Northward Coastal only and passing into *N. r. robustus.*)
Neoconocephalus triops
Orchelimum agile
Orchelimum minor (Northward Coastal only.)
Odontoxiphidium apterum (Extending as high as Sand Mountain and Blue Ridge, Georgia, but only north to Fayetteville, North Carolina.)
Camptonotus carolinensis
Gryllotalpa hexadactyla
Tridactylus apicalis (Data poor.)
Cycloptilum squamosum (North Carolina northward Coastal only.)
Nemobius ambitiosus (North only to Florence, South Carolina.)
Anurogryllus muticus (Northward Coastal only.)
Gryllus domesticus
Miogryllus verticalis
Orocharis saltator (Northward Coastal only.)

XII. Piedmont and Coastal Plain in northern area of Southeastern States only.

Melanoplus confusus (South to Havelock, North Carolina.)
Amblycorypha oblongifolia (South to Weldon, North Carolina, and Chattanooga, Tennessee.)
Amblycorypha floridana carinata (South of fall line in South Carolina and Georgia passing into *A. f. floridana;* northward Coastal only.)
Conocephalus strictus (South to Raleigh and Newbern, North Carolina.)
Atlanticus pachymerus (South to Havelock, North Carolina, and "South Carolina.")
Nemobius palustris (Only Coastal in region, south to Wilmington, North Carolina; Piedmont northward.)

XIII. Coastal Plain to peninsular Florida.

Anisolabis annulipes
Labidura bidens
Prolabia unidentata
Ischnoptera divisa
Ischnoptera uhleriana fulvescens (North only to southeastern Virginia.)
Cariblatta lutea lutea (North only to northern North Carolina.)
Manomera tenuescens (North only to northern North Carolina.)
Neotettix bolteri

Paxilla obesa (North only to eastern North Carolina.)
Tettigidea prorsa (To northern Florida.)
Radinotatum brevipenne brevipenne (North only to Yemassee, South Carolina; straggler into Piedmont in Georgia.)
Clinocephalus elegans (Maritime only northward.)
Spharagemon collare wyomingianum
Scirtetica marmorata picta (In northern North Carolina passing into *S. m. marmorata.*)
Psinidia fenestralis
Schistocerca obscura (North to Maryland; straggler in Piedmont.)
Schistocerca alutacea (In Tennessee drainage in western North Carolina.)
Schistocerca damnifica calidior (Passing at fall line and north of North Carolina into *S. d. damnifica.*)
Eotettix pusillus (North only to North Carolina; straggler into Piedmont in Georgia.)
Hesperotettix floridensis (North only to Augusta, Georgia; straggler in Piedmont in Georgia.)
Melanoplus decorus (Limited distribution in North Carolina.)
Melanoplus australis (Limited distribution in South Carolina and Georgia.)
Melanoplus attenuatus (Limited distribution, Georgia to North Carolina.)
Melanoplus hebardi (Limited distribution in Georgia.)
Melanoplus nubilus (Limited distribution in North Carolina.)
Melanoplus mirus (Limited distribution in North Carolina.)
Melanoplus stegocercus (Limited distribution in Georgia.)
Melanoplus scapularis (Limited distribution in Georgia.)
Melanoplus nigrescens (Limited distribution in North Carolina and Georgia.)
Melanoplus quercus (Limited distribution in Georgia.)
Melanoplus clypeatus (Limited distribution in Georgia.)
Melanoplus punctulatus arboreus (Passing in Georgia Piedmont and northward in Coastal Plain into *M. p. punctulatus.*)
Paroxya atlantica atlantica
Arethaea phalangium (North only to Augusta, Georgia.)
Scudderia cuneata (North only to Raleigh, North Carolina.)
Symmetroplcura modesta (North only to Raleigh, North Carolina.)
Pterophylla camellifolia intermedia (Passing in Georgia Piedmont and northward in Coastal Plain into *P. c. camellifolia.*)
Pyrgocorypha uncinata (North only to Raleigh, North Carolina.)
Neoconocephalus exiliscanorus (Straggler in Georgia Piedmont from Upper Coastal Plain.)
Neoconocephalus caudellianus
Neoconocephalus palustris
Orchelimum glaberrimum
Orchelimum laticauda (Straggler in Georgia Piedmont.)
Orchelimum militare
Orchelimum superbum (Virginia and New Jersey only.)
Conocephalus stictomerus (South only to Raleigh, North Carolina.)
Cryptoptilum antillarum (North only to Alamance County, North Carolina.)
Cryptoptilum trigonipalpum (North only to Petersburg, Virginia; straggler in Georgia Piedmont.)
Nemobius fasciatus socius (North only to Raleigh, North Carolina, northward and in southern Piedmont passing into *N. f. fasciatus.*)
Nemobius cubensis cubensis
Anaxipha pulicaria (North only to Raleigh, North Carolina.)
Falcicula hebardi (Straggler in North Carolina Piedmont.)

XIV. Lower Coastal Plain in the Carolinas, Georgia and extreme northern Florida.

Nomotettix cristatus arcuatus (Passing northward and higher into *N. c. compressus* and southward into *N. c. floridanus.*)
Melanoplus furcatus (Georgia and Florida only.)
Scudderia curricauda laticauda (Gradually intergrading northward and higher into *S. c. curvicauda.*)
Orchelimum bradleyi (North to Wilmington, North Carolina.)
Atlanticus dorsalis (North to "South Carolina.")
Atlanticus calcaratus (Georgia and Florida only.)
Scapteriscus vicinus (Georgia only.)
Scapteriscus acletus (Georgia only.)
Nemobius palustris aurantius (Georgia only.)

XV. Lower Coastal Plain into peninsular Florida.

Ischnoptera nigricollis (Not north of Georgia.)
Ceratinoptera diaphana (Not north of Georgia.)
Eurycotis floridana (Not north of Georgia.)
Periplaneta australasiae (Not north of Florida.)
Periplaneta brunnea (Not north of Georgia.)
Pycnoscelus surinamensis (Not north of Florida.)
Gonatista grisea (North to South Carolina.)
Thesprotia graminis (Not north of Georgia.)
Anisomorpha buprestoides (North to South Carolina.)
Paratettix rugosus (Not north of Georgia.)
Tettigidea spicata (Not north of Georgia.)
Mermiria bivittata
Arphia granulata
Chortophaga australior (North to Savannah, Georgia.)
Spharagemon crepitans (Not north of Georgia.)
Stenacris vitreipennis
Gymnoscirtetes pusillus (Not north of Georgia.)
Melanoplus rotundipennis (Not north of Georgia.)
Melanoplus femur-rubrum propinquus (Passing at the Georgia and South Carolina fall line into *M. f. femur-rubrum;* not typical north of Wilmington, North Carolina.)
Aptenopedes sphenarioides sphenarioides (Not north of Georgia.)
Aptenopedes aptera (Not north of Georgia.)
Belocephalus subapterus (North to South Carolina.)
Belocephalus davisi (Not north of Georgia.)
Neoconocephalus velox (Not north of Georgia.)
Atlanticus gibbosus (Straggler into Georgia Piedmont.)
Ceuthophilus latibuli (Not north of Georgia.)
Scapteriscus abbreviatus (Not north of Georgia.)
Anaxipha vittata (Not north of Georgia.)
Hapithus agitator quadratus (Inland and northward passing into *H. a. agitator.*)
Hapithus brevipennis (Not north of Georgia.)

XVI. Maritime and Estuarine Element.

Anisolabis maritima
Mermiria intertexta
Orphulella olivacea
Orphulella halophila (Southern Florida.)
Trimerotropis maritima
Orchelimum concinnum
Orchelimum fidicinium
Conocephalus aigialus
Conocephalus nigropleuroides
Conocephalus spartinæ

In table II, we have given as a matter of information the elevation of the upper limit of distribution, where this is exactly known. Table III covers forms occurring in the larger Appalachian valleys, as far north as North Carolina or the lower mountains in Georgia, or both, to the coast, exclusive of the Maritime and Estuarine Region. In table V appear species which considerably modify their physiographic distribution elsewhere in the eastern United States, and this fact is there, and in subsequent tables, indicated in parentheses. In table VIII, we have endeavored to express a peculiar type of distribution: one covering the lower mountains and Piedmont and, although absent from most or all of the Coastal Plain, extending south into southwestern Georgia or even into the adjacent portion of northern Florida.

The more interesting generalizations drawn from the physiographic summaries are the following. Northward numerous species, characteristic of the Piedmont in the area here treated, pass to the Coastal Plain of that region, frequently, or rather generally, leaving the Piedmont. The explanation of this is apparently temperature control and the distribution is typical of the Upper Austral life-zone. Toward the southern end of the Piedmont region numerous forms, characteristic of this section in the Carolinas, enter the lower mountains, doubtless as valley intrusions; this also can be explained by temperature control and is zonal in character. Along the coastal side of the Piedmont in Georgia, a number of Coastal Plain species penetrate the Piedmont for considerable distances to points such as Warm Springs, vicinity of Stone Mountain, Thompson's Mills, Toccoa and even to suitable situations on the slopes of Currahee Mountain, an outlying knob near Toccoa. This is quite marked in the case of Warm Springs, which has seven species of this category occurring there.[2] The extending influence of the larger river valleys, such as the Savannah, Oconee, Ocmulgee, Flint and Chattahoochee, is doubtless responsible for these intrusions, for such they are is evidenced by the known distribution of the species elsewhere and the generic habitat. The division of the Coastal Plain into two areas has abundant evidence in its favor in the Orthoptera, as the tabulations show. It is significant also that quite a few of the forms do not reach into peninsular Florida. Further studies on the distribution of central Florida forms of the orders will doubtless throw much additional light on the fixity of these limitations. It is possible that a lack of material may be partly responsible for the apparent restriction of these ranges. In the case of the divisions of the Coastal Plain, our material is sufficiently full to show the correlations very clearly.

Life Zones.

The life zones represented in the area studied are the following:

a. Boreal or Canadian.
b. Transition or Alleghanian.
c. Upper Austral or Carolinian.
d. Lower Austral or Austroriparian.
e. Basic Austral or Sabalian.[3]

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[2] These are: *Cariblatta lutea lutea* (also Thompson's Mills), *Radinotatum brevipenne brevipenne*, *Scirtetica marmorata picta*, *Eotettix pusillus*, *Hesperotettix floridensis*, *Atlanticus gibbosus* (also on Currahee Mountain) and *Cryptoptilum trigonipalpum* (also vicinity of Stone Mountain).

[3] For remarks on this zone see p. 104.

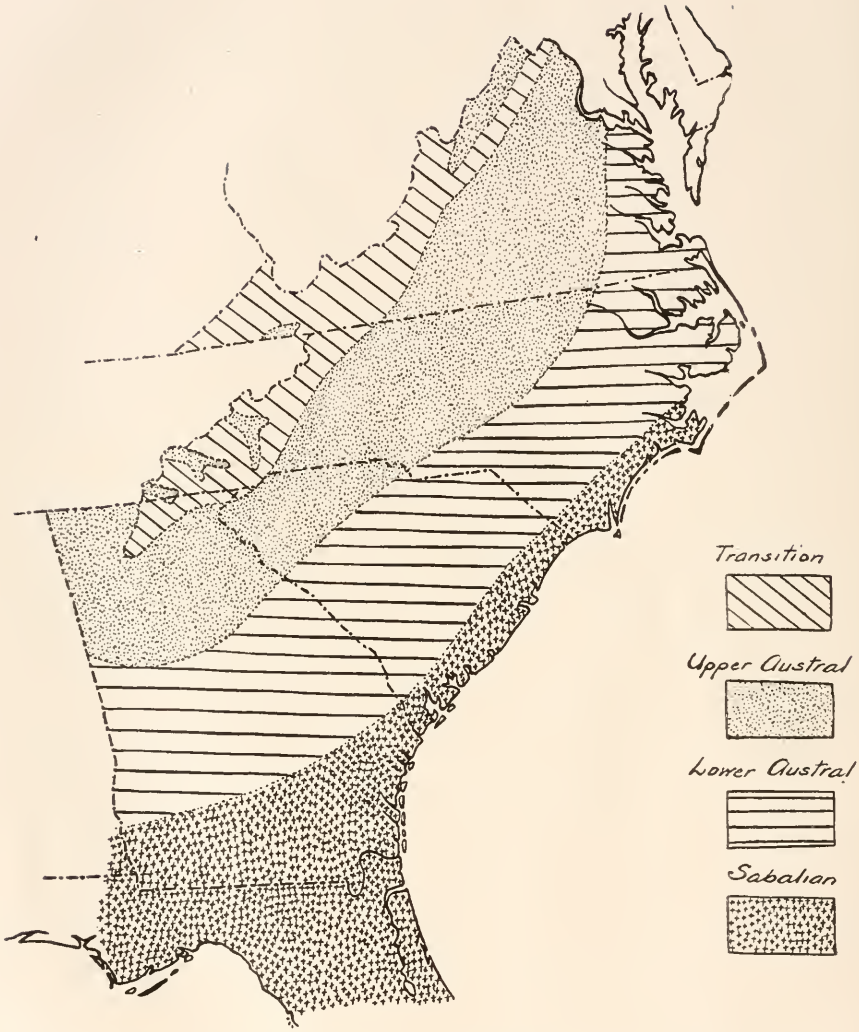

Fig. 3.—Outline map of the southeastern United States, showing the extent of the principal life zones. The circumscribed Boreal areas on the mountains of North Carolina and Virginia have not been indicated. For comments upon and definition of the Sabalian zone see the zonal distributional information in the introductory portion of this paper. The extent of the Sabalian, as well as the other zones to the west of the Georgia-Alabama line and the Chattahoochee River, has not been determined by us.

The zones may be briefly outlined as follows:[4]

Boreal or Canadian Zone.—This zone occupies the summits of the higher mountains in North Carolina and Virginia, such as the Black Mountains, Roan Mountain, Grandfather Mountain, Mt. Pisgah, Balsam Mountains, etc. This is the area of balsam forests within the territory studied. We do not feel that the zone has been sufficiently studied to consider the total number of species reported from it as a fair index of the Orthoptera therein.

Transition or Alleghanian Zone.—This zone comprises all the truly mountainous country below the Boreal summits; in Georgia, however, being largely restricted to the elevations greater than 1,500 feet. Slope exposure is largely responsible for the presence or absence of this element near its upper and lower margins. In North Carolina, large valleys of tributary streams of the Tennessee carry tongues of the Upper Austral for considerable distances into the otherwise solidly Transition country. The same appears to be true to a lesser degree in the Transition area of Georgia, which is in large part much tinctured with Upper Austral elements.

Upper Austral or Carolinian.—The area comprised in this zone extends from the lower border of the Transition zone down to a line roughly drawn from a short distance up stream of the mouth of the Potomac River, to Weldon, North Carolina, to Raleigh and Charlotte, North Carolina, traversing transversely the area between Spartanburg and Columbia, South Carolina, and crossing the State of Georgia in a southwesterly direction to the vicinity of Warm Springs, Georgia, then curving northwest into Alabama. As stated above, pronounced valley intrusions of this fauna enter western North Carolina from the Tennessee Valley, while in Georgia it apparently pushes its way well into and even up the lower slopes of the mountains, apparently in sharp competition with the Transitions forms occurring in the same region. The two elements will be governed in their distribution, at one of their points of contact, by slope exposure; at another, by the normal cover or by the burning-over of the land. As we have discussed above under Physiography, a number of distinctly Lower Austral forms occur within normally Upper Austral areas, at localities such as Currahee Mountain, Toccoa, vicinity of Stone Mountain and Thompson's Mills, and these extensions probably are, as suggested there, due to the extending influence of large river valleys, which provide

[4] For a careful presentation of the life zones of North Carolina, see Brimley, *Journ. Elisha Mitchell Scient. Soc.*, XXIX, pp. 19 to 27, (1913).

avenues of entrance to suitable environments in a region in general characterized by a different fauna. The fact that these extensions occur only, as far as known, at a few localities gives support to this explanation.

Lower Austral or Austroriparian.—This zone covers the area situated below (*i.e.*, in elevation) the Upper Austral, down to a line extending from the southern portion of Pamlico Sound, North Carolina, to Lake Waccamaw, North Carolina, to Yemassee, South Carolina, then swinging in a curve to Albany, Georgia, and the Chattahoochee River west of the last-mentioned locality. A few forms, which we would consider more representative of the Upper Austral zone, occur as stragglers within this area at localities such as Goldsboro and Fayetteville, North Carolina, Sumter and Florence, South Carolina, Augusta and Macon, Georgia. It is possible that future work may show these forms to be equally characteristic of the Lower Austral; a very questionable possibility to our minds. In these cases, the interdigitation which we have mentioned as occurring at the upper limit of the Lower Austral is probably repeated in the reverse direction, but physiographic control features are probably responsible for these intrusions.

Basic Austral or Sabalian.—The present zone, which is co-extensive with the physiographic area called Lower Coastal by us, we find is so decidedly characterized by a considerable number of species, which extend southward to southern or at least to central or north-central Florida, that we have been compelled to give it a name. We have found no term in the literature which we could use, so we here propose the name Sabalian. The name has been derived from the technical name of the cabbage palmetto (*Sabal palmetto*), which is probably the most striking tree of the region named, and whose distribution is co-extensive with that area.

The Sabalian zone is characterized by at least six species, outside of those occurring only in central and southern Florida, which are also West Indian in distribution or extremely close to West Indian species.

The zone extends from the coast-line inland to the lower boundary of the Lower Austral, given above in defining that region, north to the region of Pamlico Sound and south into Florida. It is narrow in the Carolinas, but becomes broad in Georgia and its exact extent to the westward remains to be worked out. The exact line where this same influence gives way to the Tropical in southern Florida has not been critically mapped, owing to the need of more information

from the central and south-central portions of the peninsula. The information from the Tropical area of southern Florida is relatively full.

The zonal distribution of the species treated in the present paper is tabulated below. In some cases it is known that the species, in certain regions of North America, occur in zones other than those here checked, but, unless this has a distinct bearing on the possible occurrence of the species in the same zone in the region here studied, we have not indicated its presence other than as found in the southeastern States. In a few cases where species will in all probability be found in a certain zone in the southeastern States, judging by the analogy of other regions, or where the form is found in two zones, but by defect of the record is not known from one situated between these two, we have inserted a check for that life zone with a brief qualification.

DERMAPTERA.	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
LABIDURIDÆ.					
Anisolabis annulipes			1 (part)	1	1
Anisolabis maritima			1	1	1
Labidura bidens				1	1
LABIIDÆ.					
Vostox brunneipennis			1	1	1
Labia minor	Introduced-range nearly general.				
Prolabia unidentata				1	1
FORFICULIDÆ.					
Doru aculeatum			1		
ORTHOPTERA.					
BLATTIDÆ.					
Ischnoptera deropeltiformis			1	1	1
Ischnoptera nigricollis					1
Ischnoptera johnsoni			1	1	1
Ischnoptera p. pensylvanica		1	1		
Ischnoptera divisa			1 (part)	1	
Ischnoptera couloniana			1	1	1
Ischnoptera u. uhleriana			1		
Ischnoptera u. fulvescens				1	1
Ischnoptera borealis			1	1	1
Ischnoptera bolliana			1	1	1
Ischnoptera insolita			1		
Blattella germanica	Introduced-range general.				
Ceratinoptera diaphana					1
Cariblatta l. lutea				1	1
Eurycotis floridana					1
Blatta orientalis	Introduced-range general.				
Periplaneta americana			1	1	1
Periplaneta australasiae					1

	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
Periplaneta brunnea					1
Pycnoscelus surinamensis					1
Chorisoneura texensis			1	1	1
Cryptocercus punctulatus		1	1 (straggler)		
MANTIDÆ.					
Stagmomantis carolina			1	1	1
Gonatista grisca					1
Oligonyx scudderi			1	1	1
Thesprotia graminis				1	1
PHASMIDÆ.					
Diapheromera femorata		1	1	1 (part)	1 (part)
Manomera tenuescens				1	1
Anisomorpha buprestoides					1
Anisomorpha ferruginea			1	1	
ACRIDIDÆ.					
Nomotettix c. cristatus	1	1			
Nomotettix c. compressus			1		
Nomotettix c. arcuatus				1	1
Acrydium a. arenosum				1	1
Acrydium a. angustum		1	1		
Acrydium ornatum		1	1		
Neotettix proavus			1		
Neotettix femoratus		1	1	1	1
Neotettix bolteri				1	1
Paratettix rugosus					1
Paratettix cucullatus		1	1	1	1 (part)
Paxilla obesa				1	1
Tettigidea prorsa				1	1
Tettigidea spicata					1
Tettigidea l. lateralis			1 (part)	1	1
Tettigidea armata			1	1	1
Radinotatum b. brevipenne				1	1
Truxalis brevicornis			1	1	1
Mermiria alacris			1 (part)	1	1
Mermiria intertexta				1	1
Mermiria bivittata				1	1
Syrbula admirabilis			1	1	1
Eritettix simplex			1		
Amblytropidia occidentalis			1	1	1
Orphulella pelidna		1	1	1	1
Orphulella olivacea			1	1	1
Orphulella speciosa		1	1		
Dichromorpha viridis			1	1	1
Clinocephalus elegans				1	1
Chloealtis conspersa	1	1	1 (part)		
Chorthippus curtipennis	1	1			
Arphia xanthoptera		1	1	1	1
Arphia granulata				1	1
Arphia sulphurea		1	1	1	1
Chortophaga viridifasciata		1	1	1	1 (part)
Chortophaga australior					1
Encoptolophus sordidus		1	1		
Pardalophora phœnicoptera			1	1	1
Hippiscus rugosus			1	1	1
Dissosteira carolina		1	1	1	1

	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
Spharagemon crepitans					1
Spharagemon bolli		1	1	1	1 (part)
Spharagemon collare wyomingianum				1	1
Scirtetica marmorata picta				1	1
Psinidia fenestralis				1	1
Trimerotropis maritima		1 (part)	1 (part)	1 (part)	1 (part)
Trimerotropis citrina			1	1	1
Trimerotropis saxatilis		1	1		
Romalea microptera				1	1
Stenacris vitreipennis					1
Leptysma marginicollis			1	1	1
Schistocerca obscura			1	1	1
Schistocerca alutacea			1 (part)	1	1
Schistocerca serialis		1	1	1	1
Schistocerca d. damnifica			1		
Schistocerca d. calidior				1 (part)	1
Gymnoscirtetes pusillus					1
Campylacantha olivacea			1	1	
Eotettix pusillus				1	1
Eotettix signatus					1
Hesperotettix floridensis				1 (part)	1
Hesperotettix b. brevipennis			1		
Hesperotettix b. pratensis					1 (part)
Paratylotropidia beutenmuelleri		1 (location provisional)			
Melanoplus similis		1			
Melanoplus deceptus		1			
Melanoplus decorus					1
Melanoplus australis					1
Melanoplus attenuatus				1	1
Melanoplus hebardi					1
Melanoplus nubilus				1	
Melanoplus tribulus			1		
Melanoplus devius		1	1		
Melanolpus decoratus		1	1		
Melanoplus rotundipennis					1
Melanoplus stegocercus					1
Melanoplus mirus				1	
Melanoplus scapularis					1
Melanoplus strumosus			1 (part)	1	1
Melanoplus sylvestris		1			
Melanoplus carnegiei		1	1	1 (part)	
Melanoplus s. scudderi			1	1	1 (part)
Melanoplus walshii		1	1 (part)		
Melanoplus nigrescens					1
Melanoplus querneus					1
Melanoplus atlanis	1	1	1	1	1 (part)
Melanoplus f. femur-rubrum	1	1	1	1 (part)	
Melanoplus f. propinquus				1 (part)	1
Melanoplus impudicus			1	1	
Melanoplus impiger				1	
Melanoplus confusus			1	1	1 (part)
Melanoplus l. luridus		1	1 (part)		
Melanoplus l. keeleri			1 (part)	1	1
Melanoplus femoratus		1	1 (part)	1 (part)	
Melanoplus furcatus					1
Melanoplus clypeatus					1

	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
Melanoplus p. punctulatus			1		
Melanoplus p. arboreus				1	1 (part)
Paroxya a. atlantica			1 (part)	1	1
Paroxya clavuligera			1	1	1
Aptenopedes s. sphenarioides					1
Aptenopedes aptera					1
TETTIGONIIDÆ.					
Arethaea phalangium				1 (part)	1
Stilpnochlora marginella					1
Scudderia c. curvicauda-c. laticauda			1		
Scudderia c. laticauda				1	1
Scudderia texensis			1	1	1
Scudderia f. furcata		1	1	1	1
Scudderia cuneata				1	1
Symmetropleura modesta				1	1
Amblycorypha oblongifolia			1		
Amblycorypha f. floridana					1
Amblycorypha f. carinata			1	1	
Amblycorypha uhleri			1	1	1
Amblycorypha r. rotundifolia		1	1 (part)		
Amblycorypha r. r.-r. parvipennis			1 (part)	—	1 (part)
Microcentrum rhombifolium			1	1	1
Microcentrum retinerve			1	1	1
Pterophylla c. camellifolia		1	1		
Pterophylla c. intermedia				1	?
Belocephalus subapterus					1
Belocephalus davisi					1
Pyrgocorypha uncinata				1	1
Neoconocephalus exiliscanorus			1		
Neoconocephalus robustus crepitans			1	1	1
Neoconocephalus caudellianus					1
Neoconocephalus velox					1
Neoconocephalus retusus			1	1	1
Neoconocephalus triops			1	1	1
Homorocoryphus malivolans				1 (part)	1
Orchelimum agile			1	1	1
Orchelimum glaberrimum				1	1
Orchelimum vulgare		1	1	1 (part)	
Orchelimum laticauda			1	1	1
Orchelimum minor			1	1	1
Orchelimum concinnum			1 (part)	1 (part)	1 (part)
Orchelimum fidicinium				1 (part)	1 (part)
Orchelimum militare				1	1
Orchelimum bradleyi					1
Orchelimum superbum				1 (part)	
Conocephalus allardi		1			
Conocephalus f. fasciatus	1	1	1	1	1
Conocephalus brevipennis		1	1	1	1
Conocephalus nemoralis			1		

	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
Conocephalus strictus			1 (part)	1 (part)	
Conocephalus stictomerus			1 (part)	1 (part)	
Conocephalus aigialus				1 (part)	1 (part)
Conocephalus nigropleuroides				1 (part)	1 (part)
Conocephalus spartinae				1 (part)	1 (part)
Conocephalus saltans			1	1	1 (part)
Odontoxiphidium apterum			1 (part)	1	1
Atlanticus testaceus		1 (not in region)	1 (part)		
Atlanticus pachymerus			1 (part)	1	
Atlanticus davisi		1 (part)	1 (part)		
Atlanticus monticola	1	1			
Atlanticus americanus		1	1	1 (part)	
Atlanticus gibbosus			1 (part)	1	1
Atlanticus dorsalis					1
Atlanticus calcaratus					1
Camptonotus carolinensis			1	1	1
Hadenoecus putcanus		1	1	1	1
Ceuthophilus uhleri		1	1		
Ceuthophilus latibuli					1
Ceuthophilus gracilipes		1	1		
Ceuthophilus lapidicola		1	1		
Ceuthophilus latens			1		
Ceuthophilus sallei					1
Ceuthophilus spinosus			1		
Ceuthophilus neglectus			1		
GRYLLIDÆ.					
Gryllotalpa hexadactyla		1 (?)	1	1	1
Scapteriscus vicinus					1
Scapteriscus acletus					1
Scapteriscus abbreviatus					1
Tridactylus apicalis		1 (elsewhere)	1 (elsewhere)	1	1
Ellipes minuta		1	1	1	1
Myrmecophila pergandei		1	1	1	1
Cryptoptilum antillarum				1	1
Cryptoptilum trigonipalpum				1	1
Cycloptilum squamosum			1	1	1
Nemobius f. fasciatus		1	1		
Nemobius f. socius				1	1
Nemobius maculatus		1	1		
Nemobius griseus funeralis				1	
Nemobius ambitiosus			1 (part)	1	1
Nemobius bruneri			1		
Nemobius c. cubensis			1	1	1
Nemobius p. palustris			1 (part)	1 (part)	1 (part)
Nemobius p. aurantius					1
Nemobius c. carolinus	1	1	1	1	1
Nemobius confusus			1		
Anurogryllus muticus			1	1	1
Gryllus assimilis		1	1	1	1
Gryllus domesticus			1	1	1
Miogryllus verticalis			1	1	1
Occanthus niveus		1	1		
Occanthus exclamationis			1		
Oecanthus angustipennis		1	1	1	1
Oecanthus quadripunctatus		1	1	1	1
Oecanthus nigricornis		1	1 (elsewhere)		

	Boreal.	Transition.	Upper Austral.	Lower Austral.	Sabalian.
Oecanthus pini			1		
Oecanthus latipennis			1	1	1 (part)
Neoxabea bipunctata			1	1	1
Anaxipha exigua			1	1	1
Anaxipha pulicaria				1	1
Anaxipha vittata					1
Falcicula hebardi			1	1	1
Cyrtoxipha columbiana			1	1	1
Phylloscyrtus pulchellus			1	1	1
Hapithus a. agitator			1 (part)	1 (part)	
Hapithus a. quadratus				1 (part)	1
Hapithus brevipennis					1
Orocharis saltator			1	1	1

Physiographic and Zonal Factors Compared.

When the physiographic and zonal correlations are contrasted, we find that in Virginia the two factors are largely governed by the same boundaries, the Lower Austral alone not extending up the valley of the Potomac as far as the fall-line, which is the Piedmont-Upper Coastal Plain line. In North Carolina, the increased temperature effect of lower latitudes is evident, as the upper line of the Lower Austral, after following the fall-line, crosses it and ascends to higher country, this tendency increasing in Georgia, where the upper boundary of the same zone is in places as high as a thousand feet above sea level. Conversely, this crossing of the physiographic boundaries by zonal boundaries is found to the northward of the area here treated, where the entire Coastal Plain section of New Jersey and all or at least the greater portion of the Coastal Plain eastern peninsula of Virginia, Maryland and Delaware, is Upper Austral. It has been found in the Middle Atlantic States that many Upper Austral species are limited to southern New Jersey, not occurring above the fall-line. This restriction is probably due to the fact that the southern portion of New Jersey has a more equable winter climate (and consequently a higher sum total annual temperature) than the Piedmont of Pennsylvania, an Upper Austral region. There is also in southern New Jersey an extension of certain elsewhere Lower Austral species, although in the great majority of the forms the region is clearly Carolinian. The control governing the distribution of these species is probably environment, as the sands and gravels of southern New Jersey are in general similar to those of the Coastal Plain to the south.

Origin of the Orthopterous Fauna of the Southeastern States.

We have made some tabulations bearing on the probable origin

of the Orthopterous fauna of the region studied. It is essential, however, for a proper understanding of the subject, to have similar data on the fauna of the Gulf Coast and Texas, in order to make definite or conclusive generalizations. The material from which such data can be obtained is now available, but it will be some years before our studies will permit us to make the desired tabulations. In consequence any expressions on the question of origin would be premature and certainly require amplification, if not revision, within a relatively short time, as the Gulf Coast can be expected to supply much of the really vital information on origin and dispersal. We propose, therefore, to discuss at a later date, as a whole, the information on this subject for the Southern States.

Systematic Treatment of Species.

DERMAPTERA.

LABIDURIDÆ.

Anisolabis annulipes (Lucas).

North Carolina.

Raleigh, XI, 25, 1904, (C. Pinkus), 1 ♂, [U. S. N. M.].
Wrightsville, IX, 7, 1911, (R. & H.), 1 ♂, 1 ♀.

South Carolina.

Camden, II, 15 to 25, 1 ♂, [M. C. Z.].
Columbia, VII, 28, 1913, (R. & H.), 1 ♀; VIII, 16, 1903, (A. P. Morse), 1 ♀.
Charleston, 1 ♀, [M. C. Z.].

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♀, 4 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.
Bainbridge, (J. C. Bradley), 1 juv. ♀.
Billy's Island, VI, 12, 1912, (J. C. Bradley), 1 ♀.
St. Marys, II, 6 to IV, 16, 1896, (O. Bangs), 2 ♀, [Hebard Cln.].

Florida.

Atlantic Beach, VIII, 25, 1911, (R. & H.), 1 ♀.
Jacksonville, (T. J. Priddey), 1 ♂, 1 ♀, [Hebard Cln.]; III, 1900, 1 ♂, [U. S. N. M.].
Indian River, 1896, (T. J. Priddey), 1 ♀, [Hebard Cln.].

We have before us a male specimen taken by the senior author at Philadelphia, on August 9, 1902, in the back yard of the Academy; there is also a female from Washington, District of Columbia, in the National Museum without further data. The species is doubtless widely distributed by commerce; it has in recent years been found to have an extensive distribution throughout the Lower Austral and Subtropical Zones of the southeastern United States.

At two localities the species was found under signs, on oak (Albany) and sweet gum (Augusta). The majority of the above series was found under debris on the ground.

Anisolabis maritima (Géné).

Virginia.

Fortress Monroe, 2 juv. ♀, [U. S. N. M.].

North Carolina.

Newbern, (A. S. Bickmore), 1 ♂, (M. C. Z.].

South Carolina.

Charleston, 1 ♀, [M. C. Z.].

Georgia.

St. Simon's Island, IV–V, 1911–12, (J. C. Bradley), 3 ♀, 1 juv. ♀; VIII, 30, 1911, (R. & H.), 1 juv. ♀.

Florida.

Fernandina, (W. H. Finn), 1 juv. ♀, [U. S. N. M.].
Jacksonville, (T. J. Priddey), 1 juv. ♀, [Hebard Cln.].
St. Augustine, (C. W. Johnson), 1 ♀, 1 juv. ♂, [Morse Cln.].
Crescent City, 1 juv. ♀, [U. S. N. M.].
Cedar Keys, 1 juv. ♀, [U. S. N. M.].
Indian River, 1896, (T. J. Priddey), 1 ♀, [Hebard Cln.].

Labidura bidens (Olivier).

South Carolina.

No further data, (A. Agassiz), 1 ♂, [M. C. Z.].

Georgia.

Brunswick, V. 2, 1911, (J. C. Bradley), 1 ♂, 1 ♀.
Bainbridge, IX–X, 1910, (J. C. Bradley), 1 ♂, 6 ♀, 3 juv. ♀.
Spring Creek, VI, 7–22, 1911, (J. C. Bradley), 1 juv. ♀; VIII, 26–28, 1913, (J. C. Bradley), 1 ♂, 2 ♀.

Florida.

St. Augustine, (C. W. Johnson), 1 juv. ♀, [Morse Cln.].

LABIIDÆ.

Vostox brunneipennis (Serville).

Maryland.

Baltimore, 1 ♀, [M. C. Z.].

North Carolina.

Tryon, (W. F. Fiske), 1 ♂, [U. S. N. M.].

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂.
Cave Spring, 1 juv. ♀, [Ga. State Cln.].
Savannah, (W. F. Fiske), 1 ♂, [U. S. N. M.].
Atlanta, VIII, 28, IX, 5, 1910, 2 ♂, 1 ♀, [Ga. State Cln.].
Okeefenokee Swamp, V, 9, 1911, (J. C. Bradley), 1 ♀.

Florida.

St. Augustine, (C. W. Johnson), 2 ♀, [Morse Cln.].
Palatka, II, 1868, 1 ♂, 1 juv. ♀, [M. C. Z.].
Ormond, 1 ♀, 1 juv. ♀,]M. C. Z.].
Enterprise, V, 17, 1 ♀, [U. S. N. M.].

The normal type in males of this species is one which has a single inner tooth situated at the end of the proximal third of the forceps; one of the males from Atlanta has the inner enlargement of the forceps continued to a point a little distad of the middle, terminating there in a double tooth. At Tryon and Savannah the species was found on oak.

Labia minor (Linnæus).

Atlanta, Georgia, XI, 5, 1910, 2 ♂, [Ga. State Cln.].
Unadilla, Ga., VI, 25, 1910, (J. C. Bradley), 1 ♀.

Prolabia unidentata (Beauvois).

North Carolina.

Wilmington, IX, 8, 1911, (R. & H.), 1 ♂.

Wrightsville, IX, 7, 1911, (R. & H.), 5 ♂, 2 ♀.

Lake Waccamaw, IX, 8, 1911, (R. & H.), 5 ♂, 1 ♀, 1 juv. ♀.

Georgia.

Vienna, VI, 30, 1 ♀, 1 juv. ♀, [Ga. State Cln.].

Spring Creek, VI, 1911, (J. C. Bradley), 1 ♀; VIII, 26–28, 1913, (J. C. Bradley), 3 ♂.

Billy's Island, VI, 1912, (J. C. Bradley), 1 ♂, 5 ♀, 2 juv. ♀; IX, 1–5, 1913, (J. C. Bradley), 1 ♂, 4 ♀, 1 juv. ♂.

Brunswick, II, 12, 1911, 1 ♂, 4 ♀, 1 juv. ♀, [Ga. State Cln.]; VIII, 30, 1911, (H.), 1 ♂, 2 ♀.

Florida.

Jacksonville, XI, 3, 1911, (W. T. Davis), 1 ♀.

Appalachicola, (Thaxter), 1 ♂, [M. C. Z.].

Volusia County, II, 10, 1869, (J. A. Allen), 4 ♂, 2 ♀, [Scudder Cln.].

Indian River, 1896, (T. J. Priddey), 1 ♂, 3 ♀, [Hebard Cln.].

Silver Springs, (G. P. Englehardt), 1 ♂, [B. I.].

In the series of males recorded above, we find nine having the forceps with inner teeth both proximad and distad, three having but one arm furnished with a proximal and no distal teeth, two having both arms furnished with proximal but with no distal teeth and one having no teeth whatever, the forceps of this latter specimen, which is from Wilmington, being much like those of the female in contour and curvature but much more slender.

The previous North Carolina records for the species are Raleigh and Boardman, these being the most northern localities at which it has been found. Though usually found under the bark of pine logs, the series from Lake Waccamaw was found under the bark of a prostrate, decaying sweet gum trunk.

FORFICULIDÆ.

Doru aculeatum (Scudder).[5]

North Carolina.

Morganton, VII, 20, 1903, (A. P. Morse), 1 ♀, 3 juv. ♀.

Georgia.

Clayton, VI, 1909, (W. T. Davis), 1 ♂, 7 ♀.

Burton, V, 21, 1911, 1,800 feet, (J. C. Bradley), 1 ♂, 2 ♀.

Austell, VIII, 6, 1910, 1 ♀, [Ga. State Cln.].

Silver Lake, VIII, 10, 1913, (J. C. Bradley), 1 ♀.

Atlanta, VII, 1 ♀, [Ga. State Cln.].

Buckhead, IV, 16, 1911, 1 ♂, 2 ♀ and 2 other adults, (damaged), [Ga. State Cln.]; VIII, 2, 1913, (R. & H.), 1 ♀, 1 juv. ♀.

The only specimens we have taken (Buckhead) were beaten from a heavy growth of high weeds growing along a wet depression.

[5] See Rehn and Hebard, *Jour. N. Y. Ent. Soc.*, XXII, pp. 93 to 95, figs. 5 and 7, (1914).

ORTHOPTERA.

BLATTIDÆ.

Ischnoptera deropeltiformis (Brunner).

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 3 juv.

Georgia.

Clayton, 2,000 ft., V, 18–26, 1911, (J. C. Bradley), 2 ♂; VI, 1909, (W. T. Davis), 1 ♂, 1 ♀.
Cornelia, V, 28, 1906, 1 ♂, [Ga. State Cln.].
Macon, VII, 30–31, 1913, (R. & H.), 1 ♀.
Warm Springs, 850–1,200 ft., VIII, 9–10, 1913, (R.), 1 ♀.
St. Simon's Island, VI, 8, 1911, 1 ♂; [Ga. State Cln.]; IV, 22–V, 12, 1911, (J. C. Bradley), 1 ♂.
Hebardville, V, 15, 1915, (H.), 1 ♀.

The males of this species show considerable variation in size, certain individuals examined since the previous minimum measurements were given by us[6] being considerably smaller than those cited. The two smallest males seen measure as follows:

	Length of body.	Length of pronotum.	Greatest width of pronotum.	Length of tegmen.	Greatest width of tegmen.
Key West, Fla.	12.2 mm.	3.2 mm.	4.0 mm.	12.6 mm.	3.7 mm.
St. Simon's Island, Ga.	11.8 "	3.2 "	4.1 "	13.2 "	4.0 "

From an examination of fifty specimens of the species, the specimens of minimum size appear to be found only in Florida and the coastal region of Georgia, the individuals from higher elevations being uniformly larger. Specimens of similar size to those found in the more elevated regions of Georgia, Virginia and the Carolinas occur, however, in the area where the minimum individuals are found. All of the present adult individuals have pale femora.

The above specimens taken by us were found under dead oak leaves (Macon), running on the ground in pine and oak woods (Warm Springs) and under debris in garden (Hebardville).

Ischnoptera nigricollis Walker.

Georgia.

Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 1 ♀.

Florida.

Sanford, (S. B. Fraser), 2 ♂, [Hebard Cln.].

The exact relationship of this form to *I. deropeltiformis* is still somewhat problematical. It seems possible that it may be a "saltation" from the *deropeltiformis* stock, developing in Florida and southern Georgia, but apparently nowhere else. Whatever the origin of *nigricollis* may be, its distinctive coloration almost always permits its ready recognition.

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[6] Proc. Acad. Nat. Sci. Phila., 1910, p. 415, (1910).

The Spring Creek record is the first exact one for the species from Georgia.

Ischnoptera johnsoni Rehn.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 ♂, 3 ♀.

Alabama.

Pyriton, Clay County, (H. G. Hubbard), 1 ♂, [U. S. N. M.].

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 2 ♀.

Atlanta, VI, 23, 1910, 1 ♂, [Ga. State Cln.].

St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀.

The remarks previously made by us[7] on the apparent decrease in size southward in specimens of this species are not substantiated by the more extensive series now available, the lack of sufficient material in 1910, there suggested as a possibility, accounting for our change of view.

The species was taken from under damp dead leaves on the edge of forest (Fredericksburg) and among dry leaves under live oaks (St. Simon's Island).

Ischnoptera pensylvanica pensylvanica (De Geer).

Fredericksburg, Virginia, VII, 20, 1913, (R. & H.), 1 ♀.

Pennington Gap, Va., 1 ♀, [M. C. Z.].

Spartanburg, South Carolina, VIII, 6, 1913, (R. & H.), 1 ♀, 5 juv.

Clayton, Georgia, 2,000 ft., V, 18–26, 1911, (J. C. Bradley), 2 ♂; VI, 1909, (W. T. Davis), 2 ♀.

The evidence of the present collections strengthens our previously formed conclusion regarding the distribution of this species and of *I. divisa*. Apparently the areas occupied by the two are quite distinct, only localities along the line of impingement being represented by both forms. The two Clayton males and one female from the same locality are very deeply colored, but do not appreciably approach *I. pensylvanica inæqualis*.

The above-listed material taken by us was found under signs on trees (white oaks at Fredericksburg).

Ischnoptera divisa Saussure and Zehntner.

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 20 ♀, 11 juv., 4 oöthecae.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 juv.

Goldsboro, VII, 25, 1913, (R. & H.), 1 juv.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 4 ♀, 5 juv.

Albany, VIII, 1, 1913, (R. & H.), 1 ♀.

The present form is clearly a derivative of the *I. pensylvanica* stock, representing an adaptation of that type in the lower country

[7] Proc. Acad. Nat. Sci. Phila., 1910, p. 419, (1910).

of the southeastern States as *I. pensylvanica inæqualis* is in the central States. The difference is, however, that positive intergradation is known to exist between *pensylvanica* and *p. inæqualis*, while *divisa* and *pensylvanica* do not intergrade as far as known, both occurring in typical condition at localities where the ranges meet. The northern and western limit of the known range of *divisa* in the southeastern States can be represented by a line extending from Anglesea, Cape May County, New Jersey, to Plummer's Island, Maryland, thence to Augusta and Albany, Georgia, and finally to Rives in northwestern Tennessee. West of the Mississippi we know nothing of the species beyond the North Mexico record of Saussure and Zehntner. Apparently this form trespasses but little into the Piedmont region of the southeastern States and is a distinctly coastal type.

The tegminal characters of the female of this species, previously described by us, are typically represented in all the adult material, although a few specimens have the tegminal apices more rounded than in others. In all, however, the general form of the tegmina is sublanceolate, and the three to five distal segments of the abdomen are always exposed. The pronotal disk varies considerably in depth of coloration in the Petersburg series, being hardly at all infuscate in some specimens and again as solidly so as in *pensylvanica* in others. The division of the disk color is more clearly marked in some of the young than in the adults, and is obsolete in a large proportion of the specimens. All of the adult specimens are within the measurement extremes previously given by us.[8]

All of the above series were taken from under signs, on long-leaf pine (Albany), short-leaf pine and sweet gum (Augusta) and red oak and short-leaf pine (Petersburg). At the latter locality immature individuals were about as plentiful as adults; only one adult was found on pine, the species, at that place at least, preferring the red oak.

Ischnoptera couloniana Saussure.

North Carolina.

Charlotte, VII, 27, 1913, (R. & H.), 1 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♀, 1 juv.
Winter Park, IX, 7, 1911, (R. & H.), 1 juv.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 9 juv.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 2 ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 ♀.
Florence, IX, 6, 1911, (R. & H.), 1 juv.

[8] Proc. Acad. Nat. Sci. Phila., 1910, p. 432, (1910).

Georgia.

Clayton, VI, 1909, (W. T. Davis), 1 ♂.
Atlanta, VII, 29, 1910, 1 ♂, 3 ♀, [Ga. State Cln.].
Stone Mountain, VIII, 16, 1913, (J. C. Bradley), 1 ♀.
Egypt, (W. H. Finn), 1 ♀, [U. S. N. M.].
Macon, VII, 30–31, 1913, (R. & H.), 1 ♀.
Bainbridge, (J. C. Bradley), 1 ♀.
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 1 ♂, 2 ♀.

Florida.

Ortega, IX, 6, 1913, (W. T. Davis), 2 ♀.

The Spring Creek male has the disk of the pronotum decidedly rufescent mesad and moderately infuscate laterad, well contrasted with the clear ochraceous lateral sections of the pronotum. The range of the species is now known to extend northward as far as Anglesea, New Jersey (1 ♂; Acad. Nat. Sci. Phila. Cln.), its limits in that direction being much the same as those of *I. divisa*, but in the southeastern States it apparently ranges higher, crossing the Piedmont region and entering the mountainous section (Clayton, Georgia, Sulphur Springs and Tryon, North Carolina).

The specimens listed above secured by the authors were taken from under the bark of dead short-leaf pine (Goldsboro and Florence) and sweet gum logs and stumps (Lake Waccamaw) and from under signs on red oak (Charlotte).

Ischnoptera uhleriana uhleriana Saussure.

Arlington, Virginia, VII, 9, 1914, (H.), 2 ♂, 2 ♀.
Clayton, Georgia, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 2 ♂.

The Clayton specimens are typical *uhleriana* and the locality is the most southern from which true *uhleriana* is known. This is also the first record of typical *uhleriana* from Georgia. The Arlington individuals were taken at night on road and resting on woods foliage.

Ischnoptera uhleriana fulvescens Saussure and Zehntner.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♀.

Georgia.

Macon, VII, 30–31, 1913, (R. & H.), 2 ♀, 1 juv.
Vienna, VI, 5, 1910, 1 ♂, [Ga. St. Cln.].
Brunswick, VIII, 30, 1911, (R. & H.), 1 ♂.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀.
Billy's Island, VI–VII, 1912, (J. C. Bradley), 1 ♂, 2 juv.
Honey Island, June 1, 1912, (J. C. Bradley), 4 ♂, 2 ♀, 3 juv.
Bainbridge, IX, 3, (J. C. Bradley), 1 ♀.
Spring Creek, VI, 7–23, VII, 16–29, 1912, (J. C. Bradley), 1 ♂, 1 ♀.

Florida.

Ortega, IX, 6, 1913, (W. T. Davis), 1 ♀.
Atlantic Beach, VIII, 25, 1911, (R. & H.), 1 ♂, 5 ♀.
Pablo Beach, IX, 5, 1913, (W. T. Davis), 2 ♀, 2 juv.

The personally collected material listed above was secured from under bark of a pine log (Brunswick), among dead leaves under

live oaks (St. Simon's Island), under same on edge of oak and short leaf-pine woods (Macon) and from under refuse (Atlantic Beach).

Ischnoptera borealis Brunner.

Goldsboro, *North Carolina.* VII, 25, 1913, (R. & H.), 2 ♀.

Georgia.

Clayton, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 1 ♀.

Rabun County, VII, 1910. (W. T. Davis), 3 ♀.

Atlanta, VII, 31, 1910, 1 ♂, [Ga. St. Cln.].

These records are the first for the species from Georgia. At Goldsboro it was found under debris in dead short-leaf pine needles.

Ischnoptera bolliana Saussure and Zehntner.

Clayton, Georgia, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 1 ♂.

Rabun County, Ga., VII, 1910, (W. T. Davis), 1 ♀.

Ischnoptera insolita Rehn and Hebard.

Spartanburg, South Carolina, VIII, 6, 1913, (H.), 1 ♀.

This specimen is perfectly typical of this very rare and little-known species. The tegmina surpass the apex of the abdomen by nearly the pronotal length. Tryon, North Carolina and Spartanburg are the only localities east of the Appalachians at which the species has been taken. The present specimen was secured from under a sign on a tree.

Blattella germanica (Linnaeus).

Atlanta, Georgia, IX, 5, 1910, 1 ♂, [Ga. St. Cln.].

Waycross, Georgia, IX, 10, 1910, 1 ♀, [Ga. St. Cln.].

Ceratinoptera diaphana (Fabricius).

Billy's Island, Georgia, VII, 1912, (J. C. Bradley), 1 juv. ♀.

Floyd's Island, Ga., XII, 27–30, 1913, (J. C. Bradley), 1 ♀.

Newberry, Florida, XI, 19, 1911, (W. T. Davis), 1 juv. ♂, 1 juv. ♀.

The immature specimens are easily determinable, as the distinctive color pattern of the young of this species makes recognition certain. The Billy's Island individual is much more immature than the others, being but little more than half their size.

These records are the most northern ones for this beautiful type, which was previously known from within the United States only from Gainesville, Key West and Long Key, Florida.

Cariblatta lutea lutea (Saussure and Zehntner).

North Carolina.

Roanoke Island, VII, 25, (G. P. Englehardt), 1 ♀, [B. I.].

Fayetteville, IX, 9, 1911, (R. & H.), 1 juv.

Wrightsville, IX, 7, 1911, (R. & H.), 1 juv.

Georgia.

Warm Springs, VIII, 9–10, 1913, (R.), 1 ♀, 1 juv.
Thompson's Mills, (H. A. Allard), 1 ♂, 1 juv. ♀, [U. S. N. M.].
Macon, VII, 31, 1913, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.
Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 3 ♂, 5 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♀.
St. Simon's Island, IV, 22–V, 12, 1911, (J. C. Bradley), 2 ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 2 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 ♀.

Florida.

Jacksonville, (T. J. Priddey), 1 ♂, 3 ♀, [Hebard Cln.].
Atlantic Beach, VIII, 25, 1911, (R. & H.), 1 juv. ♂.

The adults in this series exhibit considerable variation in the length of the tegmina. Warm Springs is the highest elevation at which this species has been taken.

The insect was found hiding under dead oak leaves (Fayetteville and Macon), under dead needles in long-leaf pine woods (Albany), in wire grass (Suwannee Creek), under refuse (Atlantic Beach) and was beaten from undergrowth in pine and oak woods (Warm Springs).

Eurycotis floridana (Walker).

Georgia.

St. Simon's Island, IX–X, 1910, [Ga. St. Cln.]; VIII, 30, 1911, (R. & H.), 1 ♂, 3 ♀, 1 juv.
Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 1 ♀.
St. Marys, III, 6 to IV, 18, 1896, (O. Bangs), 2 ♂, [M. C. Z.].

Florida.

Fernandina, (W. H. Finn), 1 ♀, [U. S. N. M.].
Jacksonville, XI, 3, 1911, (W. T. Davis), 1 ♂, 1 juv.
Ortega, IX, 6, 1913, (W. T. Davis), 1 ♂, 1 ♀, 5 juv.
Inverness, Citrus County, 1892, (C. M. Weed), 1 juv., [Hebard Cln.].

The three Georgia records are the first from that State for the species, these also constituting the most northern points from which the species is known. In some of the young the pale lateral margins of the pronotum and mesonotum are decided, but in all of the adults these areas are of the general color.

The present authors found the species under the dead bark of a live oak tree on St. Simon's Island, while the Jacksonville specimens are labelled "in log."

Blatta orientalis Linnaeus.

Washington, District of Columbia, (Caudell; Pratt), 1 ♂, 1 ♀, [U. S. N. M.].
Atlanta, Georgia, VII, 7, 1910, VIII, 30, 1913, 2 ♂, 1 ♀, [Ga. St. Cln.].

Periplaneta americana (Linnaeus).

Atlanta, Georgia, XI, 6, 1909, 1 ♂, [Ga. St. Cln.].

Periplaneta australasiae (Fabricius).

Fernandina, Florida, (W. H. Finn), 1 juv., [U. S. N. M.].
Enterprise, Fla., V, 16, 1 juv., [U. S. N. M.].

Periplaneta brunnea Burmeister.

Georgia.

Brunswick, VIII, 31, 1911, (R. & H.), 2 ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 1 ♀.
Thomasville, I, 3, 1908, (H.), 3 ♂, 2 ♀, 3 juv.

Florida.

Fernandina, (W. H. Finn), 1 ♂, [U. S. N. M.].
Jacksonville, (T. J. Priddey), 2 ♀, [Hebard Cln.]; IX, 28, 1913, (W. T. Davis), 1 ♀.

All of these specimens belong to "var. *a.*" of Saussure and Zehntner, except the Billy's Island female, which approaches "var. *c.*" There is, however, some variation in the depth of the castaneous general coloring in several of the Thomasville specimens, this also being present in series from other localities in the collections at hand, and is not due to geographic or sexual difference.

The northern limit of distribution of the present species as now known is marked by Bainbridge, Thomasville, Billy's Island and Brunswick, Georgia, but doubtless it is being constantly extended northward by coastwise shipping.

At Brunswick we found this form running on the hotel veranda and at Thomasville it was taken from under signs on oaks.

Pycnoscelus surinamensis (Linnaeus).

Jacksonville, Florida, (T. J. Priddey), 1 ♀, [Hebard Cln.].
Cedar Keys, Fla., (E. Palmer), 1 juv. [M. C. Z.].
New Smyrna, Fla., III, 1905, (A. N. Caudell; bred, adult XI, 1905), 1 ♀, [U. S. N. M.].

Chorisoneura texensis Saussure and Zehntner.

1904. *Chorisoneura plocea* Rehn, Ent. News, XV, p. 164. [Coast of South Carolina.]

North Carolina.

Tryon, VI, 19, 2 ♂, [U. S. N. M.].

Georgia.

St. Simon's Island, IV, 22–V, 12, 1911, (J. C. Bradley), 3 ♂, 2 ♀.

Florida.

Atlantic Beach, VIII, 25, 1911, (R. & H.), 1 ♂, 1 ♀.
Orlando, VI, 7, 1907, 1 ♀, [U. S. N. M.].

Texan series compared with sixteen specimens now before us from the southeastern United States show *plocea* to be a synonym of *texensis*. Rehn, in the absence of Texan material, was led, by ambiguity in the description of *texensis* and confusion in the names of the tegminal veins, to suppose the specimen before him to be different.

The above specimens were taken at light (Tryon), in nests of webworm (Orlando) and beaten from bushes of bayberry, *Myrica cerifera*, growing in and along the edge of pine woods (Atlantic Beach).

The Tryon record is the most northern as well as the most elevated for the species.

Cryptocercus punctulatus Scudder.

Maryland.

Meadow Mountain, Garrett County, VIII, 1911, (W. Stone), 3 adults, 2 juv., [A. N. S. P.].

Virginia.

Hinton, (W. P. Hay), 1 adult, [U. S. N. M.].
Stone Mountain, (Pollock), 1 adult, [U. S. N. M.].
Cumberland Mountains, Lee County, VIII, 1879, (H. G. Hubbard), 1 adult, [M. C. Z.].

Georgia.

Black Rock Mountain, 3,000 feet, V, 20–25, 1911, 1 juv., [Ga. St. Cln.].
Wilson Gap, Mountain City, VIII, 22, 1913, (J. C. Bradley), 6 adults.
Clayton, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 4 adults, 2 juv.

North Carolina.

Pisgah Forest, VIII, 12, 1908, 2 adults, 1 juv., [U. S. N. M].
Blowing Rock, VII, 19, 1903, (A. P. Morse), 5 adults, 1 juv.; VIII, 13, (G. P. Englehardt), 6 adults, [B. I.].
Linville, VII, 18, 1903, (A. P. Morse), 1 adult, 10 juv.
Balsam, VII, 23, 1903, (A. P. Morse), 1 adult.

The present records aid very materially in mapping the areal and vertical distribution of this very interesting and peculiar genus and species. The known data from the southeastern States show that it descends as low as from 700 to 1,500 feet (vicinity of Rome, Georgia), while it has been taken as high as 5,500 feet (Old Baldy Mountain, North Carolina).

MANTIDÆ.

Stagmomantis carolina (Johansson).

1896. *Bactromantis virga* Scudder, Can. Ent., XXVIII, p. 213. [Sanford, Florida.]

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 2 juv. ♂.
Petersburg, VII, 23, 1913, (R. & H.), 1 juv. ♀.
Newport News, IX, 16, 1907, (B. Long), 1 ♀, [A. N. S. P.].

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 juv. ♂.
Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♂.
Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 6 ♀.
Charlotte, VII, 27, 1913, (R. & H.), 2 juv. ♀.
Winter Park, IX, 7, 1911, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 juv. ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♂, 2 juv. ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♂, 2 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 5 juv. ♂, 3 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 4 ♂ 2 ♀.

Georgia.

Cornelia, VII, 1910, (W. T. Davis), 1 juv. ♂.
Stone Mountain vic., VIII, 3, 1913, (R. & H.), 1 juv. ♂.
Augusta, VII, 29, 1913, (R. & H.), 2 juv. ♂.

Warm Springs, VIII, 9–10, 1913, (R.), 1 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 3 juv. ♀.
Savannah, (A. Oemler), 1 ♀, [U.S.N.M.].
Isle of Hope, IX, 3, 1911, (R. & H.), 1 juv. ♀.
Sandfly, IX, 3, 1911, (R. & H.), 2 juv. ♀.
Tybee Island, IX, 2, 1911, (H.), 1 ♂.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀, 1 juv. ♂.
Brunswick, VIII, 30, 1911, (H.), 1 ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♂, 1 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 juv. ♀.
Homerville, VIII, 27, 1911, (R. & H.), 1 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 3 juv. ♂, 2 juv. ♀.

Florida.

Jacksonville, (T. J. Priddey), 1 ♂, 1 ♀, [Hebard Cln.]; VIII, 25, 1911, (R. & H.), 1 juv. ♀; IX, 5–27, 1913, (W. T. Davis), 3 ♀, 2 juv. ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 juv. ♂, 1 juv. ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 juv. ♂.
Sanford, (S. B. Frazer), 1 juv. ♂, TYPE of *Bactromantis virga* Scudder, [Scudder Cln.].

It is surprising to find the unique type of Scudder's *Bactromantis virga* merely a large immature individual of the present species and of the usual type of coloration for its sex. There is no question but that the specimen is Scudder's type, for it bears his label and agrees perfectly with his description in size and coloration. The glaring misstatement in the original description, "apterous female," can only be attributed to carelessness involving the consequent erection of another synonym. The specimen is indeed "apterous," but the wing pads may be seen readily with the naked eye and the most casual examination of the apex of the abdomen shows that it is not a female. As *virga* is the type by monotypy of the genus *Bactromantis*, that genus falls in the synonymy under *Stagmomantis*.

In the above series we find the majority of immature males dark in general coloration, but having the median and caudal limbs green, only two immature examples of this sex are wholly green or greenish. All of the immature females are of this latter phase of coloration.

Gonatista grisea (Fabricius).

Morris Island, Charleston Harbor, South Carolina, 1 ♂, [Scudder Cln.].
Savannah, Georgia, (A. Oemler), 1 ♀, [U. S. N. M.].
Fort George, Florida, (R. S. Turner), 1 ♀, [U. S. N. M.].
McDonald, Fla., IX, 6, 1905, (C. H. Baker), 1 juv. ♀, [U. S. N. M.].

The specimen from McDonald was taken on a long-leaf pine. The present species is found in moderate numbers throughout the subtropical region of southern Florida and to a much less degree in the Sabalian or Basic Austral zone of the southeastern United States; records to the north of the limits of this zone are surely those of individuals accidentally introduced.

Oligonyx scudderi Saussure.

1877. *Oligonyx uhleri* Stål, Bih. till K. Svensk. Vet. Akad. Handl., IV, No. 10, p. 66. [Louisiana.]

South Carolina.

Yemassee, IX, 4, 1911, (H.), 1 juv. ♂.

Georgia.

Dalton, 1,200 feet, VIII, 7, 1913, (R.), 1, lost.
Sharp Mountain, 1,900 feet, VIII, 6, 1913, (R.), 1 juv. ♂.
Buckhead, VIII, 2, 1913, (R. & H.), 1 juv. ♀.
Warm Springs, 900 feet, VIII, 10, 1913, (R.), 1 juv. ♂.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.
Waycross, VIII, 11, 1903, (A. P. Morse), 1 juv. ♀.

Florida.

Crescent City, 1 ♂, [U. S. N. M.].
Punta Gorda, XI, 14, 1911, 1 ♂, [Davis Cln.].

A study of the literature on the genus *Oligonyx* has brought to light several interesting features. In 1870, Saussure briefly described *Oligonyx scudderi*,[9] giving North America as the locality; this is explained by his remark the following year[10] under this species: "Habite. Probablement l'Amérique méridionale (Etiquetée de Georgie, sans doute par erreur)." Later knowledge of the species' distribution shows conclusively that Saussure's type was very probably correctly labelled. In 1877, Stål recorded as this species specimens from Texas, which belong to the western type discussed below, and described *Oligonyx uhleri* from Louisiana as new, stating that this species is "extremely near *scudderi*, something larger, tegmina and wings more obscure, distinctly infuscated, limbs longer." None of these characters are of sufficient importance in this insect to be considered of specific value, for the size and limb length are shown to be variable in the series of 43 adult males before us, and the individuals from the dryer western localities differ only from eastern examples in having the tegmina and wings less darkened and in a few other minor respects. Stål named the more eastern representative, and hence his name falls as an absolute synonym of *O. scudderi*. Saussure and Zehntner have described representatives from Dallas, Texas, and Northern Mexico as *Oligonyx bollianus*,[11] hence the western type, if sufficiently distinct to warrant racial separation, would be called *O. scudderi bollianus* S. and Z.

The species was found running on bare ground (Dalton, Sharp Mountain), on ground in pine and oak woods (Warm Springs), in oak woods (Buckhead), in swampy spot in short-leaf pine woods (Yemassee) and was beaten from wire grass and undergrowth of long-leaf pine woods (Albany).

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[9] *Mitt. Schw. Ent. Gesellsch.*, III, p. 239, (1870).
[10] *Mem. l'Hist. Nat. Mex.*, Mant. Amer., p. 121, (1871).
[11] *Biol. Cent.-Amer.*, Orth., I, p. 173, (1894).

Thesprotia graminis (Scudder).

Georgia.

Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 2 ♀, 1 juv. ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♂, 3 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.

Florida.

Jacksonville, IX, 28, 1913, XI, 3, 1911, (W. T. Davis), 3 juv. ♂; VIII, 25, 1911, (R. & H.), 1 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♂, 4 ♀.
Live Oak, VIII, 10, 1903, (A. P. Morse), 1 ♂, 3 juv.; VIII, 26, 1911, (R. & H.), 1 ♂, 1 ♀.
Crescent City, 1 ♂, 1 ♀, [U. S. N. M.].
Newberry, XI, 18, 1911, (W. T. Davis), 1 ♀.

The largest female before us, 52.4 mm. in length, is from Atlantic Beach. This species is found generally distributed, but never in numbers, in the undergrowth of the pine forests of Georgia and Florida in decided Sabalian (see preface) surroundings. Isle of Hope is the most northern locality recorded for the species, but it will doubtless be found in southern South Carolina and as far northwestward in Georgia as the limit of the Sabalian element. The male from Live Oak was taken when flying through the pine woods, its feeble fluttering flight resembling that of a myrmelion. At Atlantic Beach several specimens were found in a tangle of raspberry vines and other plants, under cabbage palmettoes in the "hammock."

PHASMIDÆ.

Diapheromera femorata (Say).

Virginia.

Great Falls, IX, 28, 1913, (C. T. Greene), 2 ♂, 1 ♀, [Hebard Cln.].
Orange, VII, 21, 1913, (R. & H.), 1 ♂, 2 juv. ♀.

North Carolina.

Topton, VIII, 21, 1903, (A. P. Morse), 1 ♂.

South Carolina.

Greenville, 1887, 1 ♀, [A. N. S. P.].
Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♂.

Georgia.

Clayton, VI, 1909, (W. T. Davis), 2 juv. ♂.
Toccoa, VIII, 4, 1913, (H.), 1 juv. ♀.
Dalton, VIII, 7, 1913, (R.), 2 juv. ♀.
Sharp Mountain, VIII, 6, 1913, (R.), 1 juv.
Jasper, VIII, 5, 1913, (R.), 4 juv. ♂, 3 juv. ♀.
Sand Mountain, VIII, 26, 1903, (A. P. Morse), 1 ♂, 1 juv. ♀.
Buckhead, VIII, 2, 1913, (R. & H.), 1 juv. ♂, 3 juv. ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 3 juv. ♂, 1 juv. ♀.
Warm Springs, VIII, 9, 1913, (R.), 2 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 3 juv. ♂, 2 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 2 ♂, 2 juv. ♂, 3 juv. ♀.
Lakeland, Decatur County, 1 ♂, [Ga. St. Cln.].

Specimens from southern Georgia are very large, the largest male (Albany) is 84.5 mm. in length; however, no racial characters exist. The species has not been taken south of the fall line in the southeastern United States until extreme western Georgia and north-

western Florida is reached. The material recorded by us from the above localities was all taken in the undergrowth of pine and oak woods.

Manomera tenuescens (Scudder).

1913. *Manomera orthostylus* Caudell, Proc. U. S. Nat. Mus., XLIV, p. 612, fig. 27. [Orlando, Florida.]

North Carolina.

Selma, VII, 7, 1903, (A. P. Morse), 1 juv. ♀.
Winter Park, IX, 7, 1911, (R. & H.), 3 ♀.

South Carolina.

Denmark, VIII, 15, 1903, (A. P. Morse), 1 ♀.

Georgia.

Augusta, VII, 29, 1913, (R.), 1 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 1 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 10 ♂, 5 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♀.

Series before us of adults and immature examples of both this species and *M. brachypyga*,[12] prove that *M. orthostylus* of Caudell, the unique type of which is before us, is an absolute synonym of the present insect, based on a male in the instar preceding maturity. The relative proportions of the distal abdominal segments in both sexes, which readily separate adults of *tenuescens* and *brachypyga*, as readily separate immature individuals of the two species. Until the adult condition is reached, the male cerci of both species are straight, pilose and delicate in structure; those of *tenuescens* being decidedly shorter than the disto-dorsal abdominal segment and those of *brachypyga* slightly longer than that segment.

In the dog fennel, *Eupatorium compositifolium* Walt., at Cumberland Island, a climbing vine, *Bradburya virginiana* (L.) Kuntze, was frequently encountered; the elongate green pods of this vine, resting in the dog fennel, bore a remarkable resemblance to the bodies of the female walking-sticks there found.

The species is decidedly a Lower Austral and Sabalian type, previously known only from Florida. The material before us was found about a sink hole surrounded by a few gum trees in low weeds and plants and scant grasses (Winter Park), in bunch grass in a sandy scrub-oak area just above the fall line (Augusta), on dark wet ground covered with low swamp plants (Homerville), in dog fennel in long-leaf pine woods (Cumberland Island, Jacksonville) and in the low undergrowth of the long-leaf pine woods (Live Oak).

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[12] Proc. Acad. Nat. Sci. Phila., 1914, p. 384, figs. 1 to 4, (1914).

Anisomorpha buprestoides (Stoll).

South Carolina.

Yemassee, IX, 4, 1911, (R. & H.), 1 ♂, 1 ♀, 2 juv. ♀.

Georgia.

Sandfly, IX, 3, 1911, (R. & H.), 1 ♂, 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 juv. ♀.
Billy's Island, V, 1912, (J. C. Bradley), 1 ♀; VI, 1912, (J. C. Bradley), 1 juv. ♂, 2 juv. ♀; IX, 1–5, 1913. (J. C. Bradley), 3 ♂, 4 ♀; XII, 20, 1913, (J. C. Bradley), 1 juv. ♂.
Albany, VIII, 1, 1913, (R. & H.), 2 ♂, 3 juv. ♂, 13 juv. ♀.

Florida.

Jacksonville, IX, 7, XI, 3, 1913, (W. T. Davis), 5 ♂, 8 ♀.
Ortega, IX, 6, 1913, (W. T. Davis), 1 ♂, 1 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 80 ♂, 62 ♀, 15 juv. ♀.
St. Augustine, (C. W. Johnson), 1 ♂, [A. N. S. P.].
Eustis, III, 1892, (H. J. Webber), 1 ♂, 1 ♀, [Hebard Cln.].
Volusia County, 1 ♂, 1 ♀, [A. N. S. P.].
Warrington, VIII, 4, 1903, (A. P. Morse), 2 ♂, 1 ♀, 1 juv. ♀.

Alabama.

Mobile, (Dr. Corson, Dr. Jackson), 1 ♂, 2 ♀, [A. N. S. P.].

The present species is peculiar to the Sabalian and Tropical Zones of the southeastern United States where it is found, at times in large numbers, in the forest undergrowth. The large series from Atlantic Beach was taken in such surroundings on the edge of a swamp; the entire series was found collected in two clusters in tall weeds, the majority of the specimens in coitu; we have a pair from this series still connected, of which the female is in the instar preceding maturity. Immature individuals were found locally numerous in tall weeds in the long-leaf pine woods along the river at Albany.

The most northern, as well as the most western, definite records for the species are given above.

Anisomorpha ferruginea (Beauvois).

South Carolina.

Aiken, 1 ♂, [M. C. Z.].

Georgia.

Wilson Gap, Mountain City, VIII, 22, 1913, (J. C. Bradley), 12 ♂, 1 ♀, 9 juv. ♀.
Tallulah, VIII, 1887, 2 ♂, 1 ♀, [U. S. N. M. and Hebard Cln.].
Toccoa, VIII, 5, 1913, (H.), 1 juv. ♂.
Jasper, VII, 25, 1903, (A. P. Morse), 1 ♂.
Stone Mountain, VII, 28, 1903, (A. P. Morse), 1 juv. ♂.
Warm Springs, 850–1,200 feet, VIII, 9–10, 1913, (R.), 2 ♂, 2 juv. ♂, 2 juv. ♀.

Louisiana.

Arcadia, Bienville Parish, X, 15, 1885, (L. Johnson), 1 ♀, [U. S. N. M.].

The much smaller size, different facies, different and less striking coloration and somewhat more slender and straighter limbs readily separate adults of this species from adults of *A. buprestoides;* the young of that species are, however, frequently obscurely colored and often in these stages closely resemble the present insect. The difficulty in ascertaining whether a specimen is adult increases the

perplexities of the student, and the records of *ferruginea* from Florida are either due to a misconception of the present species or are referable to the young of *A. buprestoides.*

Caudell, in his paper on the Walkingsticks of the United States,[13] has given, among other State records, Florida and Pennsylvania for the present insect. The first of these records applies to *A. buprestoides*, while the second is due to a mistake caused by a "Tallulah, Ga.," label appearing to be "Tallulah, Pa."

The present authors in an earlier study of *A. buprestoides*,[14] confused nearly mature and differently colored specimens of that species with the present insect; at that time *A. ferruginea* was not represented in their collections, its definite distribution was quite unknown and the early descriptions of the two species were and are by no means convincing.

The distribution of *A. ferruginea* apparently extends from just north of the Ohio River south over the Mississippi Valley to the Gulf States, west to extreme southeastern Nebraska and eastward through the Appalachians in Virginia and in the high portions of the Carolinas and Georgia.

The series taken at Wilson Gap was found under the bark of a single log.

ACRIDIDÆ.

On the Races of Nomotettix cristatus (Scudder).

A study of the series of over four hundred and fifty-eight specimens of the present species before us from the eastern United States and Canada offers convincing proof that but one known species of *Nomotettix* exists in this portion of North America. This species is divided into five geographic races which are typical over certain areas, but which intergrade so gradually that series of specimens from numerous localities between those where the typical forms are found show intermediates of every degree. The following key gives characters which are by no means decided; it attempts to define racial characters as found in typical series.

A.—Vertex moderately projecting in front of eyes, angular excavation beneath it moderately deep in lateral aspect. (Vertex in lateral aspect blunt and very broadly rotundato-acute-angulate, dorsal surface of head weakly

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[13] *Proc. U. S. Nat. Mus.*, XXVI, p. 882, (1903).
[14] Proc. Acad. Nat. Sci. Phila., 1907, p. 284, (1907).

fossulate on either side of median carina of vertex which is weakly elevated; eyes prominent; margins of median femora very weakly sinuate; pronotum rugoso-scabrous, cephalic margin of dorsum weakly produced over head, median carina with height above humeral angles much as in *N. c. floridanus;* antennæ shorter than in the other races.) ..... *Nomotettix cristatus borealis* E. M. Walker.

AA.—Vertex strongly projecting in front of eyes, angular excavation beneath it very deep in lateral aspect.

B.—Vertex in lateral aspect broadly rotundato-acute-angulate, dorsal surface of head moderately fossulate on either side of median carina of vertex which is strongly elevated; eyes moderately prominent; margins of median femora with scarcely any sinuation; pronotum minutely scabrous.

C.—Pronotum with median carina less compressed, moderately arcuate with that portion between the humeral angles often distinctly flattened, height above humeral angles 1.2 to 1.7 mm.,[15] cephalic margin of dorsum moderately produced over head with sides straight or weakly concave. *Nomotettix cristatus cristatus* (Scudder).

CC.—Pronotum with median carina strongly compressed, strongly and usually evenly arcuate, height above humeral angles 1.6 to 2 mm., cephalic margin of dorsum more strongly produced over head with sides more or less strongly concave. *Nomotettix cristatus compressus* Morse.

BB.—Vertex in lateral aspect more sharply rotundato-acute-angulate, dorsal surface of head more strongly fossulate on either side of median carina of vertex which is but moderately elevated; eyes very prominent; margins of median femora weakly sinuate; pronotum rugoso-scabrous.

C.—Other pronotal characters (see C and CC under B) nearly intermediate between those of *N. c. cristatus* and *N. c. compressus,* height of median carina above humeral angles 1.3 to 1.8 mm. ..... *Nomotettix cristatus arcuatus* Hancock.

CC.—Other pronotal characters (see parentheses under A) of the *N. c. borealis* type, height of median carina above humeral angles 1. to 1.4 mm.[16] (The rugoso-scabrous condition of the pronotum more

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[15] The males of the present species are usually somewhat smaller than the females and, as would be expected, the majority of the sex measure nearer the minimum of the dimension here given than do the females.

[16] The types of this race, from Port Orange and Enterprise, Florida, do not represent the extreme development and show decided tendencies toward *N. c. arcuatus* Hancock.

decided than in *N. c. arcuatus*, much as in *N. c. borealis*.)

Nomotettix cristatus floridanus Hancock.

The race of the Middle States, *N. c. compressus*, shows the greatest development of the vertex and its median carina, the median carina of the pronotum, and the production of the cephalic margin of the pronotum. The two races in distribution furthest removed from this insect, *N. c. borealis* in the north and *N. c. floridanus* in the south, show the greatest divergence from this type, which divergence has taken place along parallel lines in a number of characters (pronotal and femoral) but in others separates these two races most widely of all.

Nomotettix cristatus borealis E. M. Walker.

Through Dr. Walker's great kindness, we have before us the type (his figured ♀, here selected) and paratype (♀) of this insect, the only specimens known, which were taken at Diamond Lake, Temagami District, Ontario, September 7, 1903, by Dr. Walker and were described most satisfactorily by him.[17]

The difference given in the pronotal arcuation when compared with *N. c. cristatus* is of no value as a character, that insect exhibiting frequently such irregularity as described. The present race, however, is the most strongly defined and, as Dr. Walker suggests, the northernmost of the races of the present species.

Nomotettix cristatus cristatus (Scudder).

1862. *Batrachidea carinata* Scudder, Bost. Journ. Nat. Hist., VII, p. 479. [Massachusetts.]

Ontario.

Go Home Bay, VI, 1908, (E. M. Walker), 2 ♀, [Univ. Toronto Cln.].

New Hampshire.

Warren, (P. W. Whiting), 4 ♂, 35 ♀, 1 juv. ♀, [A. N. S. P. and Hebard Clns.].

Massachusetts.

Tyngsboro, (P. W. Whiting), 10 ♂, 22 ♀, 1 juv. ♀, [A. N. S. P. and Hebard Clns.].

North Saugus, VI, 16, 1906, (E. A. Back), 2 ♂, 1 ♀, [U. S. N. M.].

Wellesley, (P. W. Whiting), 7 ♂, 3 ♀, [A. N. S. P. and Hebard Clns.].

Forest Hills, V, 10 and 11, 1912 and 1913, (P. W. Whiting), 1 ♂, 1 ♀, [A. N. S. P. and Hebard Clns.].

Blue Hill, Suffolk County, (P. W. Whiting), 6 ♂, 5 ♀, [A. N. S. P. and Hebard Clns.].

Mt. Holyoke, VI, 24, 1898, (F. Knab), 1 ♂, [U. S. N. M.].

Marion, VIII, 30, 1905, (H.), 1 ♀, 1 juv. ♂.

Connecticut.

Lyme, VIII, 21, 1910, (B. H. Walden), 2 ♀, [Hebard Cln.].

New Haven, VI, 1, 1910, (H.), 1 ♂.

New York.

Forrest Park, L. I., VI, 15, 1902, 1 ♂, [Hebard Cln.].

Mosholu, VI, 22, 1902, 1 ♂, [Hebard Cln.].

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[17] *Can. Ent.*, XLI, p. 173, pl. 7, figs. 1 and 1*a*, (1909).

New Jersey.

Lakehurst, V, 26, 1903, 1 juv. ♂, [Hebard Cln.].
Whitings, IX, 28, 1906, (B. Long), 1 ♂, [A. N. S. P.].
Pemberton, V, 2, 1913, (H. B. Scammell), 2 ♀, [U. S. N. M.].
Stafford's Forge, VIII, 26–31, 1907, (R.), 1 ♀, 1 juv. ♂, 1 juv. ♀; IX, 16, 1905, (H.), 5 ♂, 4 ♀; IX, 31, 1908, (R.), 1 ♂, 1 juv. ♀.
Parkdale, VII, 30, 1911, (R. & H.), 1 ♂.
Da Costa, V, 17, 1903, (E. Daecke,) 1 ♂, [Hebard Cln.].

Pennsylvania.

South Sterling, IX, 17, 1906, (B. Long), 1 ♂, [A. N. S. P.].
Laanna, Pike County, VIII, 31, 1906, (B. Long), 1 ♀, [A. N. S. P.]. (Long pronotum.)
Tobyhanna, 2,000 feet, IX, 1–3, 1903, (H.), 1 ♀.
Pocono Lake, VI, 16, 1907, (B. Long), 2 ♀, [A. N. S. P.].
Tyrone, IV, 3, 1 ♂, 2 ♀, [Pa. St. Dept. Zool. Cln.].

Maryland.

Jennings, 2,000 feet, middle of VIII, 1911, (W. Stone), 1 juv. ♀, [A. N. S. P.].

North Carolina.

Mount Pisgah, 4,500 feet, X, 1, 1904, (H.), 1 juv. ♀.

Scudder's name *carinata* is based upon the form of the present insect having a long pronotum.

This insect, the genotype of *Nomotettix*, is typical in Massachusetts;[18] south of that State individuals show a tendency toward *N. c. compressus*, which in the series recorded above is strongest in the specimens from New Jersey.[19] The specimens from Go Home Bay, Ontario, are very similar to those from Lyme, Connecticut, neither of which series is perfectly typical.

We have found the species in the undergrowth of the pine barrens of New Jersey, but have never taken it in numbers, possibly because no examinations of this region have been made in June, during which month *N. c. compressus* reaches its greatest abundance on the barren serpentine outcrops near Philadelphia, Pennsylvania.

Nomotettix cristatus compressus Morse.

1903. *Nomotettix cristatus atavus* Blatchley, Orth. of Indiana, p. 219. [No locality given.]

New Jersey.

Clementon, V, 6, 1905, 1 ♀, [A. N. S. P.].
North Woodbury, IX, 18, 1905, (H. L. Viereck), 1 ♀, [A. N. S. P.].

Pennsylvania.

Dauphin, VII, 4, 1 ♂, 2 ♀, (Pa. St. Dept. Zool. Cln.].
Rockville, (Fort Hunter P. O.), X, 16, 1 ♀, [Pa. St. Dept. Zool. Cln.].

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[18] We have a typical series of this insect from numerous Massachusetts localities (see above); other previously recorded material before us from New Haven, Connecticut, and Atsion, New Jersey, shows tendencies toward *N. c. compressus* Morse.

[19] In fact, although the series recorded above from Stafford's Forge, New Jersey, certainly belongs here, as the majority of the specimens show much the closer affinity to the present insect, there are two females in the series which are intermediates individually closer to *N. c. compressus* Morse.

Enola, V, 5, 1 juv. ♂, [Pa. St. Dept. Zool. Cln.].
Brandsville, VII, 14, 1910, (H. B. Kirk), 1 ♂, [Pa. St. Dept. Zool. Cln.].
Carlisle Junction, IV, 27, 1910, (W. R. Walton), 1 ♀, [Pa. St. Dept. Zool. Cln.].
Pequea, VI, 9, 1 ♀, [Pa. St. Dept. Zool. Cln.].
Valley Forge, VI, 27, 1908, (H.), 1 ♀.
Pink Hill, Newtown Square, VI–VII, 15, 1908–11, (R. & H.), 31 ♂, 26 ♀, 4 juv. ♀.
Fern Hill, Chester County, IX, 19, 1908, (R. & H.), 1 ♂, 1 ♀.
Germantown, V, 5, 31, 1912–13, (E. R. Casey), 3 ♂, 2 ♀, [Casey Cln.].
Mount Airy, IX, 15, 1903, (H.), 1 ♀.
Collegeville, VIII, 28, 1913, (E. R. Casey), 1 juv. ♂, [Casey Cln.].
Penn Station, (Brugger), 1 ♂, [A. N. S. P.].
Beatty, V, 3, 1905, (Brugger), 1 ♀, [A. N. S. P.].

Ohio.

Cleveland, VII, 3, 1910, (H.), 1 ♂.

District of Columbia.

Washington, IX, 1883, 1 ♀, [Hebard Cln.].

Virginia.

Rosslyn, X, 22, 1900, (R.), 1 ♀.
Falls Church, V, 25, 1913, (A. N. Caudell), 1 ♂, [U. S. N. M.].

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 juv. ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂, 2 ♀, 1 juv. ♂, 3 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 2 ♀.

Georgia.

Black Rock Mountain, 3,500 feet, V, 20–25, 1911, (J. C. Bradley), 1 ♀.
Clayton, 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 2 ♀.
Jasper, 1,550 feet, VIII, 5, 1913, (R.), 2 juv. ♀.
Toccoa, 1,094 feet, VIII, 5, 1913, (H.), 1 juv. ♂.

In the material before us, the series from eastern Pennsylvania to Virginia shows the extreme, and what may be considered typical, development of this race. It may be noted that this race is found along the Delaware in New Jersey, while *N. c. cristatus*, though not typical, is distributed over the northern portion of the State and the pine barrens. But two specimens having the extremely long pronotum are before us; both are females, one from Beatty, Pennsylvania, the other from Virginia; this form of the present race has been named *atavus* by Blatchley.

About Philadelphia this form is very occasional excepting upon the barren serpentine outcrops, where in June adults may be found in numbers. In July and September it was found very scarce in the forest undergrowth of eastern North Carolina; at which former time half of the specimens were in the immature condition.

Nomotettix cristatus arcuatus Hancock.

1906. *Nomotettix cristatus denticulatus* Morse, Psyche, XIII, p. 119. [Caddo, Haileyville, South McAlester, Indian Territory; Denison, Texas.]

North Carolina.

Wilmington, IX, 8, 1911, (R. & H.), 1 juv. ♂, 2 juv. ♀.
Winter Park, IX, 7, 1911, (R. & H.), 2 ♂, 1 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 3 juv. ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 8 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 1 ♂, 1 juv. ♂, 2 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 9 ♂, 8 ♀, 5 juv. ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♀ juv.
Sandfly, IX, 3, 1911, (R. & H.), 3 ♂.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀, 2 juv. ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 21 ♂, 13 ♀, 7 juv. ♀.
Hebardville, V, 15, 1915, (H.), 4 ♂, 3 ♀, 2 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 3 ♂, 1 ♀, 2 juv. ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 2 juv. ♂, 1 juv. ♀; VII, 1912, (J. C. Bradley), 16 ♂, 19 ♀, 2 juv. ♀; IX, 1–5, 1913, (J. C. Bradley), 1 ♂, 1 juv. ♀.
Homerville, VIII, 27, 1911, (R. & H.), 25 ♂, 17 ♀, 3 juv. ♀.

Florida.

Jacksonville, (T. J. Priddey), 1 ♀, [Hebard Cln.].
Baldwin, III, 7, 1879, (E. A. Schwarz), 1 ♀, [U. S. N. M.].
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 ♂, 2 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♀.

Mississippi.

Biloxi, IV, 23, (F. M. Jones), 1 ♀, [A. N. S. P.].

A gradual diminution of the pronotal crest is noticeable in the distribution from north to south of the present race, the other characters which distinguish this race becoming in like manner more pronounced. The material from southern Georgia may be considered typical. The series of twenty-three specimens from San Pablo, Pablo Beach and Gainesville, Florida, which we have recorded as *N. cristatus*,[20] belong to the present race.

This race is peculiar to the Sabalian and a portion of the Lower Austral zones of the southeastern United States. It is widely distributed and sometimes abundant in the undergrowth of the long-leaf pine woods, particularly where the ground is low, sandy and water-soaked (Yemassee, Homerville, Hebardville). It has also been found abundant in low spots covered with short green grasses in the midst of saw-palmetto flats (Brunswick). Our material indicates that this race appears adult in the largest numbers later in the season than do the more northern races of the species.

We find Morse's *N. cristatus denticulatus*,[21] to be merely the western development of the present race showing a decided tendency toward *N. c. compressus*. The insects, however, though not typical, are decidedly nearer the present race and we have consequently placed Morse's name in the synonymy here.

Nomotettix cristatus floridanus Hancock.

Twelve specimens at hand, recorded by the authors[22] from Lakeland, Fort Myers and La Belle, Florida, show the extreme develop-

[20] Proc. Acad. Nat. Sci. Phila., 1907, p. 284, (1907).
[21] Morse questions the racial validity of this phase in his original description.
[22] *Jour. N. Y. Ent. Soc.*, XXII, p. 102, (1914).

ment of the present type, which race is founded merely on an intensification of the characters which constitute the race *N. c. arcuatus.*

This geographic race is known only from central and southern Florida, in the northern portion of its range gradually intergrading with *N. c. arcuatus.*

Acrydium arenosum arenosum (Burmeister).

North Carolina.

Charlotte, VII, 27, 1913, (R. & H.), 3 ♂, 2 ♀, 1 juv. ♂, 1 juv. ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 11 ♂, 1 ♀, 3 juv.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 10 ♂, 9 ♀, 4 juv.

Georgia.

Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂.
Vienna, VI, 5, 1910, 2 ♂, 2 ♀, [Ga. St. Cln.].
Waycross, V, 8, 1911, 1 ♀, [Ga. St. Cln.].
Billy's Island, VI, 1912, (J. C. Bradley), 1 ♂.
Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 10 ♂, 6 ♀.
Spring Creek, VI, 7–23, 1911; VII, 16–29, 1912, (J. C. Bradley), 2 ♂, 4 ♀.

Florida.

Jacksonville, (T. J. Priddey), 1 ♂, [Hebard Cln.].

Of this series but three of the adults are of the strongly abbreviate pronotum phase, namely, a male from Lake Waccamaw, one from Mixon's Hammock and the single Jacksonville specimen. All of the other individuals have a more or less distinctly caudate pronotum. In coloration we have five principal unit types of pattern, all varying individually in tone and also in degree of combination. A large percentage of the specimens are of a uniform coloration of variable tone without markings.

From a study of the available material of this species group, it is evident that *A. arenosum, angustum* and *blatchleyi* are merely geographic races, limited to definite areas and probably grading into one another in equally definite areas. We have not evidence enough to demonstrate this in regard to *blatchleyi,* but that it is merely an exaggeration of the *arenosum* type is evident from an examination of a female from Deep Lake, Florida, clearly referable to *blatchleyi.* The intergradation of *arenosum* and *angustum,* however, is well established by our material, specimens from Raleigh, North Carolina, previously referred by us to *obscurum* (=*angustum*),[23] being intermediate in character. The principal differences between the two forms have already been set forth by Hancock, the more rugose and striate character of the dorsum of the pronotum of *a. arenosum,* however, being more evident than any of the other differential features.

From the evidence in hand we find that *A. arenosum arenosum* does

[23] Proc. Acad. Nat. Sci. Phila., 1910, p. 622, (1911).

not exhibit the fluctuations in pronotal structure that *A. arenosum angustum* does, there being no exact parallel to the type occurring in the latter race to which Hancock gave the name *gibbosus*. There is no valid reason for recognizing the latter condition by name, unless one is naming what are at most but formative saltations.

As a considerable portion of the references given for this form are based wholly or in part on individuals of *A. arenosum angustum*, it is at present quite difficult to mark off definitely from the literature the areas occupied by the two forms, but from the material in hand we can say that at least as far northward as Charlotte, Wrightsville and Lake Waccamaw, North Carolina, the specimens are *arenosum arenosum*, the Raleigh individuals being intermediate, as is the case with a female from Cedar Bluffs, Nebraska, while the Stone Mountain representative shows a tendency toward *A. a. angustum*, although nearer the southern form.

The material collected by us was taken on sandy shores (Lake Waccamaw), on a sandy spot at the edge of a bog (vicinity of Stone Mountain), on wet clay along a "branch" in pine woods (Charlotte) or on dry, sandy soil in open forest of short-leaf pine (Wrightsville).

Acrydium arenosum angustum (Hancock).

Maryland.

Laurel, V, 6, 1911, (E. B. Marshall), 1 ♂, [U. S. N. M.].
Plummer's Island, IX, 29, 1912, (H. L. Viereck), X, 13, 1912, (J. D. Hood), 1 ♂, 1 ♀, [U. S. N. M.].
Washington, D. C., (A. N. Caudell), 1 ♂, [U. S. N. M.].

Virginia.

Glencarlyn, IV, 27, 1913, (A. N. Caudell), 1 ♂, [U. S. N. M.].
Washington, VI, 5, 1909, (A. K. Fisher), 1 ♂, [U. S. N. M.].
Luray, IX, 2, 1906, (F. Knab), 1 ♀, [U. S. N. M.].

North Carolina.

Tryon, V, 18, (W. F. Fisher), 1 ♀, [U. S. N. M.].

Tennessee.

Clarksville, III, 31, 1909, IV, 9 and 17, 1910 and 1911, (S. E. Crumb; on tobacco seed bed and hibernating [III, 19] in leaves), 2 ♂, 5 ♀, [U. S. N. M.].

Georgia.

Clayton, 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 2 ♂.
Black Rock Mountain, 2,000–3,500 feet, V, 20–25, 1911, (J. C. Bradley), 1 ♂.

For comments on this form see above under *Acrydium a. arenosum*. We are using the name *angustum* in place of the synonymic but generally used *obscurum*, as *angustum* has page priority. The above north Georgia localities are the most southern from which we have examined the race. In general character the Clayton and Black Rock Mountain specimens are similar to Asheville individuals and all have the pronotum caudate. The Tryon specimen is equally typical of this race, but the Clarksville, Tennessee, individuals show some little tendency toward *arenosum arenosum*.

Acrydium ornatum (Say).

Chevy Chase Lake, Maryland, IV, 7, 1904, (F. D. Conden), 1 ♀, [U. S. N. M.].
Washington, District of Columbia, IV, 18, 1914, (A. N. Caudell), 1 ♂, 1 ♀, [U. S. N. M.].
Cranberry, North Corolina, X, 1, 1907, (F. Sherman), 1 ♀, [U. S. N. M.].

The Cranberry specimen has the pronotum and wings of medium length, *i.e.*, but little exceeding the apices of the caudal femora.

On the Southeastern Species of Neotettix.

For the past four years the problems presented by the genus *Neotettix* have been seriously considered by us, but previous to this writing we never felt sufficiently well equipped with material to make any final statements regarding the relationship of the "species" which have been described under this genus. Before us at this writing we have considerably over six hundred specimens from the eastern States, or more properly from the region east of the Alleghanies from New Jersey and Pennsylvania to Georgia and peninsular Florida. The following "species" from the eastern United States have been referred to or described in this genus:

Tettix femoratus Scudder, Trans. Amer. Entom. Soc., II, p. 306, (1869). [Maryland.]
Neotettix bolivari Hancock, Entom. News, IX, p. 139, pl. VII, figs. 2–2*d*, (1898). [Opelousas, Louisiana; Tifton, Georgia.]
Neotettix bolivari longipennis Hancock, Tettig. N. Amer., p. 165, (1902). [Columbus, Texas.]
Neotettix rotundifrons Hancock, Entom. News, IX, p. 139, pl. VIII, figs. 3, 3*a–d*, (1902). [Jacksonville, Florida.]
Neotettix variabilis Hancock, Tettig. N. Amer., p. 165, (1902). [Cocoanut Grove, Florida.]
Neotettix bolteri Hancock, Entom. News, IX, p. 139, pl. VIII, figs. 1, 1*a–e*, (1898). [Jacksonville, Florida.]
Neotettix coarctatus Hancock, Tettig. N. Amer., p. 165, (1902). [New Mexico (error for Dade County, Florida[24]); Cocoanut Grove, Florida.]
Neotettix hancocki Blatchley, Orth. of Ind., p. 226, (1902). [Knox County, Indiana.]
Apotettix minutus Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1905, p. 34, pl. I, figs. 3 and 4, (1905). [Miami, Florida.]

Morse[25] first synonymized *rotundifrons* under *bolivari* and suggested the probability of the latter being synonymous with *femoratus*. The present authors described *minutus* in 1905, basing it on the then

[24] *Vide* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1912, p. 245, footnote, (1912).
[25] Carnegie Inst. Wash., Publ. No. 18, p. 25, (1904).

unknown male of one of the forms of the present genus, but later,[26] after more study of the genus *Apotettix*, they placed *minutus* in the synonymy under *coarctatus*, considering it to be the caudate type of the male. In 1911, the present authors expressed their belief that Morse was correct in his disposition of *rotundifrons* and also endorsed the probability of *bolivari* and *femoratus* being the same,[27] the type of the latter, which was unknown to Hancock, being before them. In 1912, Rehn and Hebard,[28] after examining the types of *coarctatus* and *variabilis* in the United States National Museum, stated that *coarctatus* was "very close to *N. bolteri* Hancock, being probably a southern geographic race of the same," while of *variabilis* they remarked that it is "very close to *N. femoratus* (Sc.)," and that "more material may show this to be a geographic race of *N. femoratus*."

A very careful analysis has been made of the descriptions of the "species" listed above and the following comments are also based on exhaustive examinations of the large series before us, which, representing as it does fifty-five localities, we feel is sufficient for conclusive deductions. The possession of the type of *femoratus* (a female from Maryland) enables us to speak with positiveness regarding that species, which is the crux of the whole question, as Hancock, who is chiefly responsible for the specific names listed above, was entirely unacquainted with its identity. The synonymy of *bolivari* and *rotundifrons* can be clearly demonstrated by the examination of almost any extensive series from a single locality, the supposedly differential characters being purely individual. A comparison of Georgia and north Florida material, which is topotypic and in character perfectly typical of "*bolivari*" and "*rotundifrons*," with the type of *femoratus* shows they are certainly inseparable specifically or even varietally, while the desirability or even advisability of naming the long pronotum form of "*bolivari*" (*b. longipennis* Hancock) is not at all evident to us, unless we intend in similar fashion to multiply names by describing all of the color phases of polychromatic species.

Hancock's *bolteri* we find is a distinct species, typically very different from *femoratus*, but peculiarly losing some of its definition in central and southern Florida, individuals from which region are often hard to separate from *femoratus*. Numerous comparisons have

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[26] Proc. Acad. Nat. Sci. Phila., 1912, p. 244, (1912).
[27] *Ibid.*, 1910, p. 622, (1911).
[28] *Ibid.*, 1912, p. 244, (1912).

shown us that *coarctatus* is merely this southern *bolteri* somewhat modified from the typical more northern material, but so slightly that there now appears no valid reason for retaining the name, even in a racial sense. Curiously enough, however, it is in south and central Florida only that long-pronotum individuals of the *bolteri* type have been taken. Hancock's *variabilis* we find is merely a very faintly emphasized type of *femoratus*, certainly too poorly defined to be entitled to a name. In the *femoratus* type in south and central Florida we find the nearest approach seen in that species to the *bolteri* series, the two lines seeming to vary toward one another in that area in a fashion not found in our series from northern Florida northward. This fluctuation apparently expresses a certain amount of instability of the forms in that region, a probable breaking up along other lines being under way, but as far as taxonomy is concerned it is undesirable, and in fact impossible, to attempt to express or define the minute shades of difference seen, although they can be appreciated in certain specimens. From the sum total of specimens examined it is evident that some few specimens of "*coarctatus*" and "*variabilis*" stand out from *bolteri* and *femoratus*, respectively, with some degree of distinction, but the vast majority, into which the distinctive specimens blend, cannot be separated unless one sorts by localities. In consequence of the fluctuations of these Florida specimens, the construction of a key separating *femoratus* and *bolteri* has not been easy. A character which we suggested as diagnostic in 1912,[29] *i.e.*, subscutellate or regularly diverging frontal forks, we now find to be unstable in both forms, although diagnostic in the greater proportion of the specimens. In consequence the present key for separating *femoratus* and *bolteri* is almost entirely comparative, but we feel it will serve the purpose of separating two species which over by far the greater portion of their ranges are clearly defined.

Of Blatchley's *hancocki* we now have, through the kindness of the author, a topotype (♀; Knox County, Indiana, VII, 1, 1913, W. S. Blatchley) before us. This specimen shows that the species is inseparable from *N. bolteri*, the individual in hand being indistinguishable from east coast material, of which, it will be seen, we have a sufficient quantity to realize the extent of intra-specific variation.

Quite apart from the relationship of the previously known forms of this genus from the southeastern States, we find in the present series five specimens referable to this genus which are quite note-

[29] Proc. Acad. Nat. Sci. Phila., p. 244, (1912).

worthy in a number of ways. The first is, that, although the median carina of the pronotum is as highly cristate as in the average of the genus *Nomotettix*, they lack the characters of the fastigium and of the frontal costa found in that genus. The second is, that the frontal costa is more widely scutellate between the antennal bases than in the other forms of *Neotettix*, the width of the same being about one-half that of the very broad fastigium. The third and most striking is, that while the specimens in general size and character of integument are fully adult, they lack the usual bisinuate form of the caudal margin of the lateral lobes of the pronotum of the adult. That the material is adult is proven, however, by the presence of distinctly developed tegmina and wings in the female sex and wings only in the male sex, entirely or partially hidden under the pronotum. This very remarkable condition, *i.e.*, the retention of an immature pronotal type into the adult condition, has, however, been found to exist in species of the genus *Acrydium*, for a discussion of which see the comments of the senior author on the African *A. dasynotum* and *virunganum*.[30] A similar condition in *Acrydium kraussi*, from Sweden, has recently been described by Haij as variety *paradoxa*. That this condition is deep seated in the subfamily is quite apparent, and it is equally evident that it is characteristic of certain species and again occurs as a variant in species normally of the usual type.

Key to the Southeastern Species of Neotettix.

A.—Lateral lobes of the pronotum with caudal margin unisinuate. Tegmina absent (♂) or present but almost entirely hidden under the pronotum (♀). Pronotal median carina strongly arcuate and sublamellate (much as in *Nomotettix*).....*proavus* n. sp.

AA.—Lateral lobes of the pronotum with usual bisinuate caudal margin. Tegmina always present and entirely exposed. Pronotal median carina not strongly arcuate or sublamellate.

B.—Form more slender. Dorsum of pronotum thickly and finely granuloso-tuberculate and (occasionally) weakly rugose, without distinct strumose rugæ. Median carina of pronotum fine, more distinct from the dorsal surface of the pronotum. Caudal femora with ridges of dorso-lateral face and external pagina less strumose.....*femoratus* (Scudder).

BB.—Form more robust. Dorsum of pronotum with elevato-strumose ridges and "bosses," particularly between

[30] Wissensch. Ergeb. Deutsch. Zent.-Afr.-Exp., 1907–1908, V, p. 66, (1914).

the humeral angles, more pronounced in the female, the protuberances usually paired and regular, but occasionally varying in intensity. Median carina of pronotum coarser, less distinct from the dorsal surface of the pronotum. Caudal femora with ridges of dorso-lateral face and external pagina more strumose.....*bolteri* Hancock.

Neotettix proavus new species. Pl. XII, figs. 1, 2.

The differential characters of this very striking species have been summarized under the generic discussion and in the key for the species.

TYPE: ♀; Macon, Bibb County, Georgia. July 30–31, 1913. (Rehn and Hebard.) [Hebard Collection, Type No. 11.]

Description of Type.—Size rather large (for the genus); form compressed; surface ruguloso-tuberculate. Head with the greatest transverse width through the cheeks; median carina of the occiput and fastigium distinct but not high, regularly arcuate into the line of the face when seen from the side, transverse carinæ of the fastigium moderately arcuate, the fastigium about twice as wide as one of the eyes, moderately produced cephalad of the same, surface of the fastigium distinctly fossulate on each side near the eye; outline of the face when seen from the side regularly arcuate into the fastigial outline dorsad, very faintly and broadly arcuate between the paired and median ocelli; frontal costa with the forks strongly diverging ventrad to the antennal bases, thence subparallel to the median ocellus, the interspace very broad, nearly one-half that of the fastigium, scutellate, sulcate, very strongly so dorsad (fig. 2); eyes moderately prominent, very faintly flattened; antennæ short, not equal to the depth of the head, twelve jointed. Pronotum strongly compressed, in section acute tectate with a sublamellate crest, in profile the crest is well arcuate to the humeral region, thence moderately and regularly subarcuate declivent to the caudal extremity of the pronotum, height of crest above humeral angle very slightly greater than the depth from that point to the ventral angle of the lateral lobes; cephalic margin of the pronotal disk obtuse-angulate with the arms of the angle concave, this angle reaching cephalad over the head only to the middle of the eyes; cephalic carinæ very slightly converging cephalad, humeral angles very obtuse, dorso-lateral carinæ distinct, arcuate dorsad, regularly converging to the blunt, weakly emarginate caudal apex of the pronotum; surface of the dorsum of the pronotum with indications of longitudinal elevated ridges between the shoulders; lateral lobes of the pronotum having only the ventral sinus

indicated on the caudal margin, the tegminal sinus represented by only a faint notch (fig. 1). Tegmina reduced in size, vestigial, about as long as the eye, normally hidden under the pronotum. Wings abbreviate, reaching only to the caudal third of the pronotum. Ovipositor jaws strongly compressed, decidedly dentate. Cephalic femora with the dorsal margin entire, ventral margin weakly undulate. Median femora with dorsal margin very faintly, and ventral margin weakly, undulate. Caudal femora moderately robust, in length very slightly more than two-thirds that of the pronotum, greatest width of the femora contained slightly more than twice in the length, no distinct genicular tooth indicated on dorsal margin, pattern of the pagina of the dorso-lateral face well defined and moderately elevated; caudal metatarsi distinctly exceeding the remaining tarsal joints in length, distal metatarsal pulvillus equal to the two proximal ones in length.

Allotype: ♂; Same data as type. [Hebard Collection.]

Description of Allotype.—Differing from the type in the following features. Size somewhat less than in the female sex; form similar; surface identical in character. Head with the fastigium very faintly narrower than in the female, but otherwise similar. Pronotum as in the female. Tegmina absent. Wings proportionately less developed than in the female. Limbs as in the female.

The coloration varies from a type of uniform fuscous black with weakly indicated velvety black posthumeral triangles on the dorsal surface of the pronotum (allotype), to an opposite extreme with verona brown on the caudal half of the pronotum, greater portion of lateral lobes of the pronotum and greater portion of dorsal and lateral faces of the caudal femora, with a heavy saddle of fuscous black covering the remainder of the pronotum, abdomen, limbs, ventral surface and head (type). The Jasper male is similar to the allotype but more fuscous and with the black triangles very faint, while the Buckhead female approaches bone brown with distinct triangles and a generally more mottled coloration. The sixth specimen examined, mentioned more fully below, is almost uniform natal brown. The limbs are more or less variegated in the contrastingly colored specimens, the caudal femora particularly so, the ventral face of the latter, however, more solidly blackish than any other aspect of the limbs. The antennal joints are narrowly annulate with verona brown on fuscous black, the distal extremity largely of the former color. The eyes vary from cameo brown to vandyke brown, mottled.

Measurements (in millimeters).

	Length of body.	Length of pronotum.	Depth of pronotal crest to humeral angle.	Length of caudal femur.
♀ Macon, Georgia. TYPE	10.4	8.5	1.8	6.
♀ Buckhead, Georgia	9.9	8.6	1.9	6.
♂ Macon, Georgia. *Allotype*	8.1	7.3	1.5	5.
♂ Jasper, Georgia	8.2	7.5	1.6	5.
♂ Murphy, North Carolina	8.5	7.8	2.	5.3
♂ Unknown locality	8.2	7.4	1.4	5.3

In addition to the type and allotype we have before us the specimens measured above. The data for the Buckhead specimen is August 2, 1913, (H.); for the Jasper individual, elevation 1,550 feet, August 5, 1913, (R.); for the Murphy specimen, July 25, 1903, (A. P. Morse). These three specimens can be considered paratypes. The specimen without locality belongs to the Hebard Collection ex Bruner and bears a label "Schaum's Collection."

The males show no trace of tegmina, but the wings are developed in all, though varying somewhat in length. In the two females, however, the tegmina are evident, although mere pads.

The specimens taken by us were all on the ground in woodland, composed of short-leaf pine (Macon), mixed pine and oak (Jasper) or oak alone (Buckhead). At Macon the species occurred among pine needles and at Buckhead it was on quite sandy soil.

Neotettix femoratus (Scudder).

Neotettix bolivari Hancock.
Neotettix bolivari longipennis Hancock.
Neotettix rotundifrons Hancock.
Neotettix variabilis Hancock.

Pennsylvania.

Willow Grove, Montgomery County, V, 18, 1912, (E. R. Casey), 1 juv. ♀. [Casey Cln.]

Pink Hill, Delaware County, VI, 19, 1908, (R. & H.), 1 ♀.

New Jersey.

Atsion, X, 8, 1903, (H.), 1 juv. ♀.

Delaware.

Millsboro, (B. Long), 1 ♂. [A. N. S. P.].

Maryland.

No further data. 1 ♀, TYPE, [A. N. S. P.].

Plummer's Island, VI, 20, 1909, (W. L. McAtee), 1 ♀, [U. S. N. M.].

River View, VI, 29, 1898, (F. C. Pratt), 1 ♀, [U. S. N. M.].

Virginia.

Orange, VII, 21, 1913, (R. & H.), 1 ♂, 1 ♀.

Fredericksburg, VII, 20, 1913, (R. & H.), 5 ♂, 4 ♀.

North Carolina.

Hendersonville, VI, 1907, (F. Sherman), 1 ♀, [U. S. N. M.].

Greensboro, VII, 26, 1913, (R. & H.), 9 ♂, 14 ♀, 1 juv. ♀.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂, 1 ♀.

Goldsboro, VII, 25, 1913, (R. & H.), 9 ♂, 3 ♀.

Winter Park, IX, 7, 1911, (R. & H.), 4 ♂, 1 ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♀.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♀.
Manning, V, 23, 1914, (Witmer Stone), 1 ♂, [A. N. S. P.].
Ashley Junction, VIII, 15, 1913, (R.), 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 8 ♂, 8 ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 10 ♂, 10 ♀.
Rabun Bald, 4,000–4,800 feet, VIII, 21, 1913, (J. C. Bradley), 1 ♀.
Black Rock Mountain, 3,500 feet, V, 20–25, 1911, (J. C. Bradley), 1 juv. ♀.
Pinnacle Peak, VIII, 20, 1913, (J. C. Bradley), 1 ♂.
Toccoa, VIII, 4–5, 1913, (H.), 1 ♀.
Thompson's Mills, X, 1909, (H. A. Allard), 2 ♂, [U. S. N. M.].
Buckhead, VIII, 2, 1913, (R. & H.), 5 ♂, 4 ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 2 ♂.
Macon, VII, 30–31, 1913, (R. & H.), 9 ♂, 1 ♀.
Augusta, VII, 29, 1913, (R. & H.), 6 ♂, 3 ♀, 1 juv. ♂, 2 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♀.
Brunswick, VIII, 30, 1911, (R. & H.), 14 ♂, 7 ♀.
Honey Island, VI, 1, 1912, (J. C. Bradley), 2 ♀.
Billy's Island, VI–VII, 1912, (J. C. Bradley), 11 ♂, 4 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 ♂.
Hebardville, V, 15, 1915, (H.), 17 ♂, 4 ♀, 2 juv. ♀.
Homerville, VIII, 27, 1911, (R. & H.), 6 ♂, 11 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 4 ♀, 1 juv. ♂.
Spring Creek, VI, 7–23, 1911, VII, 16–29, 1912, VIII, 26–28, 1913, (J. C. Bradley), 5 ♂, 8 ♀, 1 juv. ♀.

Florida.

Jacksonville, IV, 1885, (Ashmead); VIII, 25, 1911, (R. & H.), 3 ♂, 3 ♀.
St. Augustine, XI, 8, 1911, (G. P. Engelhardt), 1 ♂.
Live Oak, VIII, 26, 1911, (R. & H.), 6 ♂, 3 ♀, 3 juv. ♀.

The comments made in the prefatory remarks on this genus explain the synonymy given above. An analysis of the present material for the ratio of individuals with abbreviate and those with caudate pronota shows the larger series, as a rule, contain a greater percentage of the caudate type and that geographically the difference has no significance. Morse[31] has noted that in a series of one hundred and fifty-two specimens from Waycross, Georgia, the two phases were present in "equal numbers; but the usual proportion of long-winged examples is much lower, ranging from 5 to 20 per cent." The largest series examined by us from the region under consideration show the following: Sulphur Springs, N. C., 27 specimens, 7 caudate; Thomasville, Ga., 24 specimens, 6 caudate; Hebardville, Ga., 21 specimens, 2 caudate; Brunswick, Ga., 21 specimens, 2 caudate; Rabun County, Ga., 20 specimens, 2 caudate; Greensboro, N. C., 19 specimens, 1 caudate; Homerville, Ga., 17 specimens, 2 caudate; Yemassee, S. C., 16 specimens, 1 caudate; Billy's Island, Ga., 15 specimens, 2 caudate. From these series it will be seen that Morse's general figures hold true. Rather curiously, the nine specimens

[31] Carnegie Inst. Wash., Publ. No. 18, p. 25, (1904).

from Live Oak, Florida, have six of their number with the pronotum caudate. It is quite probable that immediate environment is the governing factor in the production of the two types, and we have here an interesting field for experimental work.

In size such variation as is found is, apparently, in the main individual or environmental, while the rugosity of the dorsum of the pronotum is another variable feature in all probability dependent on environment. The fluctuations in the latter respect are considerable, but in no case are they sufficient to cause confusion with *N. bolteri*.

The variation in the form of the frontal costa is quite appreciable, and of one hundred and ninety-six specimens examined for this character, one hundred and fifty-six have the interantennal section scutellate or "flask-shaped," nine show a slightly different type, twenty-three are more strongly divergent and three have the lateral margins of the costa regularly divergent ventrad as in the majority of *N. bolteri*. These three aberrant individuals are from widely separated localities—Fredericksburg, Virginia; Homerville, Georgia, and Live Oak, Florida—and in no other respect do they approach *bolteri*.

In coloration we find this species to be more uniform than most of our common nearctic grouse-locusts, by far the greater portion of the material being brownish, with or without triangular blackish posthumeral areas. The variation consists of a more or less complete "pepper and salt" effect, rarely a pale "saddle," a pale outline of the median carina of the pronotum and very infrequently paired pale areas on the dorsal surface of the caudal femora. In addition to these rather infrequent differences, numerous specimens are strongly infuscate, occasionally almost black, while quite rarely they are almost uniform cinereous. The general tone is undoubtedly a response to the environment, those from sandy or clayey soils, as at Homerville, Live Oak, Greensboro and Fredericksburg, showing the paler shades, but this is not absolute, as individuals from Jacksonville taken on bare white sandy soil are very dark. Apparently the degree of moisture in the soil produces no response in color, as the material from Augusta, which was taken in open, moderately dry pine woods, averages darker than that from Homerville which was taken on damp sandy ground.

From the mapped distribution of this species it will be seen that the northern boundary of its range is in the Upper Austral zone, probably being the upper boundary of that area, southward the

form extending over the Lower Austral, Sabalian and Subtropical zones and in the southern Alleghanies working up into the Transition, where it occurs as high as 5,500 feet on Roan Mountain, North Carolina, and 4,000–4,800 feet on Rabun Bald, Rabun County, Georgia. In detail its known distribution extends from Staten Island, New York, Jamesburg, New Jersey, and Willow Grove and Pink Hill, Pennsylvania, south to southern Florida (Miami and Cocoanut Grove), west to central Iowa (Ames), east-central Oklahoma (South McAlester) and east-central Texas (Columbus). Ames, Iowa, and Bloomington, Indiana, are the most northern known localities in the Mississippi Valley region.

The species is generally distributed in a variety of environments, these varying from distinctly saturated soil to sandy loams and bare white sand areas, from bare humus and sand to areas of short green grasses, dry wire grass to low bushes and foot-high grasses. It also occurs in open meadowy areas, palmetto flats and again under long-leaf and short-leaf pines and gums.

Neotettix bolteri Hancock.

Neotettix hancocki Blatchley.
Neotettix coarctatus Hancock.
Apotettix minutus Rehn & Hebard.

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 12 ♂, 9 ♀.

North Carolina.

Goldsboro, VII, 25, 1913, (R. & H.), 6 ♂, 4 ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂.

South Carolina.

Manning, V, 23, 1914, (Witmer Stone), 1 ♂, 1 ♀, [A. N. S. P.].
Sullivan Island, IX, 5, 1911, (R. & H.), 10 ♂, 10 ♀, 1 juv. ♂, 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 1 ♂.

Georgia.

Tybee Island, IX, 2, 1911, (R. & H.), 1 ♀.
St. Simon's Island, IV, 22–V, 12, 1911, (J. C. Bradley), 1 juv. ♀.
Hebardville, V, 15, 1915, (H.), 1 ♂.
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 3 ♀.
Fort Reed, IV, 20, 1876,[32] 1 ♀, [Hebard Cln.].

The remarks made under the generic treatment will explain the above synonymy. We find that none of the specimens of the species taken from northern Florida northward are of the form with the caudate pronotum, but that the series from south and central Florida (Hancock's *coarctatus*) show about 20 per cent. of the caudate type.

[32] This specimen is labelled "*Batrach. cristata* Harris" on one of Scudder's labels in his handwriting. Probably all of the material reported by Scudder from that locality under that name (*Proc. Bost. Soc. Nat. Hist.*, XIX, p. 90, (1877).) should be referred to *bolteri*.

In the latter lot the proportionate difference in this respect between the sexes is slight. Here, as in *femoratus*, it is possible that immediate environment is the responsible factor for the development of the caudate type or the alternative abbreviate one.

In south and central Florida this species varies away from the more northern type in the slightly more compressed form, the breaking up of the usually linear, strumose pronotal ridges into less elongate scabrosities, while in the abbreviate individuals the caudal process of the pronotum is more acute. The importance, even relatively, of these differences is discounted when we examine the entire series before us and find that specimens from Sullivan Island, South Carolina, and Wrightsville, North Carolina, are as compressed as the south Florida individuals, while representatives from other Carolina localities are no more strongly strumose, and just as angulate caudad on the pronotum, as in the south and central Florida material. The width of the fastigium and the tegminal length and width vary so individually in a series from any locality, that no diagnostic weight can be placed upon any of these features. In the strongly accentuated condition this species occurs in northern Florida and southern Georgia, north and south of which a certain portion of the material is less strikingly marked, although a large part or the larger part is decidedly typical of the species, but in all of the specimens examined the recognition of the material is not difficult, except in the case of south and central Florida individuals. With these, however, we feel that the characters given in the key will enable the student to separate *bolteri* from *femoratus*. Doubtless environment is responsible for most of the differences mentioned above, as it probably is to a degree for size difference, but in this there is much of an individual character, as material from the same environment at the same locality shows.

The variation in the form of the frontal costa found in *femoratus* is parallelled in the present species, the regularly diverging type being the normal form, the scutellate type the exception. The coloration varies as in *femoratus*, but as a rule to a lesser degree.

The range of this species in the southeastern States is now known to extend from Petersburg, Virginia, south to Key West, Florida, west to Pensacola Bay (Warrington and Fort Barrancas), Florida, and inland as far as Spring Creek, Georgia, and Fayetteville, North Carolina. It is thus seen to be limited to the Lower Austral, Sabalian and Subtropical zones, probably ranging to eastern Texas and certainly up the Mississippi Valley as far as southwestern Indiana. Previous to this writing *bolteri* was only known from Florida.

This species occurs in as great a variety of habitats as *femoratus*, having been taken in marshy sink holes, among grasses in marshy spots near streams and lakes (Petersburg and Fayetteville), in wet weedy spots and among low undergrowth in short-leaf pine woods (Goldsboro and Yemassee), in heavy palmetto and live-oak jungle (Atlantic Beach), among undergrowth on dunes and in bare spots on barrier beaches (Tybee and Sullivan Islands and Wrightsville).

Paratettix rugosus (Scudder).

St. Simon's Island, Georgia, IV, 22–V, 12, 1911, (J. C. Bradley), 1 ♀.

Jacksonville, Florida, (T. J. Priddey), 3 ♂, 4 ♀, [Hebard Cln.].

We have also examined a pair from Fort Reed, Florida, determined as this species by Scudder. All of the specimens of the present series have the pronotum caudate.

Tybee Island and St. Simon's Island are the most northern points in the eastern States from which the species is known.

Paratettix cucullatus (Burmeister).

Virginia.

Orange, VII, 21, 1913, (R. & H.), 2 ♂.
Fredericksburg, VII, 20, 1913, (R. & H.), 8 ♂, 9 ♀, 8 juv.

North Carolina.

Tryon, V, 21 to 31, (W. F. Fiske), 2 ♂, 2 ♀, [U. S. N. M.].
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂, 1 ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 2 ♂, 3 ♀.
Tallulah Falls, VII, 1910, (W. T. Davis), 1 ♀.
Toccoa, VIII, 22, 1909, 1 ♂, [Ga. State Cln.].
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 4 ♂, 3 ♀.
Spring Creek, VI, 7–23, 1911; VII, 16–29, 1912; VIII, 26–28, 1913, (J. C. Bradley), 22 ♂, 22 ♀, 1 juv.
Bainbridge, IX, 3–7, 1910; IX, 17–X, 19, 1910, (J. C. Bradley), 2 ♂, 5 ♀, 1 juv.

From this material it is evident that *cucullatus* varies individually quite a little in general size in both sexes, and also to an appreciable degree in the rugosity of the dorsum of the pronotum. The general color varies considerably in tone, through brownish blacks and browns to dull ochre shades, with mottled individuals rather infrequent and "collared" specimens quite rare. The posthumeral paired triangular velvety black areas are not strongly indicated in the greater proportion of the specimens and absent in a considerable number.

The Thomasville specimens previously recorded by us as *texanus*[33] we find on re-examination and comparison to be *cucullatus*.

At Fredericksburg the species was found to be rather scarce along the sandy edge of a stream near the Rappahannock River. At

[33] Proc. Acad. Nat. Sci. Phila., 1904, p. 782, (1905).

Lake Waccamaw it occurred on the sandy shore of the lake and at Albany on eroded limestones and sand bars along the Flint River, at the former locality associated with *Acrydium a. arenosum.*

Paxilla obesa (Scudder).

North Carolina.

Wilmington, IX, 8, 1911, (R. & H.), 1 juv. ♀.

South Carolina.

Yemassee, IX, 4, 1911, (R. & H.), 20 ♂, 17 ♀, 4 juv. ♂, 8 juv. ♀.

Georgia.

Hebardville, V, 15, 1915, (H.), 2 ♂; VIII, 28, 1911, (H.), 2 ♀, 2 juv. ♀.
Billy's Island, VIII, 31, 1913, (J. C. Bradley), 1 juv. ♀.
Fargo, VIII, 31, 1913, 1 juv. ♀, [Ga. St. Cln.].
Homerville, VIII, 27, 1911, (R. & H.), 6 ♂, 10 ♀, 6 juv. ♂, 13 juv. ♀.

Florida.

Jacksonville, IV, 1885, (W. H. Ashmead), 2 ♀, (T. J. Priddey), 2 ♂, [all Hebard Cln.].
Hastings, (A. J. Brown), 33 ♂, 38 ♀ 6 juv. ♀, [Morse Cln.].

It is interesting to note that at the two localities where large series of the present insect were found by us, the only two large series of *Tettigidea prorsa* were taken. The present species appears to be entirely confined in distribution to the Sabalian and Tropical zones where it is further restricted to low, blackish, water-soaked ground covered with low bog plants (sun-dews, pitcher plants, etc.), in pine woods (long-leaf pine at all of the localities except Yemassee, where the forest was composed of the short-leaf species which is sometimes found in this region near swamps), so that even in its limited range its distribution is markedly discontinuous. This species has been recorded northward as far as New Berne, North Carolina, and southward to Detroit, Florida, while De Funiak Springs, Florida, is the most westerly published record.

All but two of the series taken at Homerville were captured in an area a few yards in diameter, where the peculiar vegetation described above flourished, wide search through the swampy undergrowth of the pine woods elsewhere revealed only two young.

Tettigidea prorsa Scudder.

1895. *Tettigidea prorsa elongata* Morse, Jour. N. Y. Ent. Soc., III, p. 16. [Georgia.]

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 1 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 2 juv. ♂.

South Carolina.

Yemassee, IX, 4, 1911, (R. & H.), 27 ♂, 9 ♀, 23 juv. ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♀.
Hebardville, V, 15, 1915, (H.), 1 ♂.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 ♂.
Homerville, VIII, 27, 1911, (R. & H.), 6 ♂, 7 ♀, 3 juv. ♀.

This aberrant species appears to be a primitive form, as immature

examples of *T. lateralis* showing a somewhat closer structural similarity to this species than do adults of that insect. Morse's name *elongata* was proposed for the individuals of this species having a caudate pronotum; three males and one female from Yemassee, South Carolina, are of this phase.

The majority of the adults have the dorsal surface of the pronotum somewhat lighter brown in coloration than the lateral lobes of the same, only seven individuals are unicolorous and darker, while but one female (Homerville) has the dorsal surface of the pronotum unusually pale and tawny-olive in tone.

The present insect has been found from Beach Haven, New Jersey, to extreme southern Georgia. Its distribution is discontinuous, though not to the degree of that of *Paxilla obesa*, for while it has been found to prefer areas in the pine woods of low, blackish, water-soaked ground covered with low bog plants (Wilmington, Yemassee, Homerville), it has also been taken in various low grasses near "hammock" land (Augusta, Hebardville, Suwannee Creek, Homerville) and in swamp grasses along a wooded stream (Fayetteville). The specimen from Augusta was taken just below the fall line among long-leaf pines.

Tettigidea spicata Morse.

Florida.

Florida, (Morrison), 6 ♀, TYPE, *paratype* and series taken with these, [Hebard Cln.].
Jacksonville, (T. J. Priddey), 2 ♀, [Hebard Cln.].
Pablo Beach, IV, 8, (P. Laurent), 1 ♀, [Hebard Cln.].

Alabama.

Alabama, (Morrison), 2 ♂, 4 ♀, [Hebard Cln.].

Louisiana.

New Orleans, (Coleman), 2 ♀, [Hebard Cln.].

Morse in his original description gives "intermediate in structure of vertex between *apiculata* and *armata*, but more nearly allied to the latter." This is true in respect to the vertex, but in the total of characters the relationship to *apiculata* is much more decided, the present insect being apparently a less strongly developed form of a common stock. The more arcuate character of the dorsum of the pronotum in transverse section between the humeral angles is one of the most apparent characters to distinguish this species from *T. armata*, from which insect it further differs in the characters given by Morse.[34]

Specimens referred to this species by the authors from the vicinity

[34] *Jour. N. Y. Ent. Soc.*, III, p. 108, (1895).

of Thomasville, Georgia, are in the present paper correctly placed under *T. armata*.

A peculiar color type, in which the pronotum has a pale mediolongitudinal marking which is narrowest between the shoulders, is found in the Pablo Beach specimen. This type of coloration is not found in the races of *T. lateralis*.

In the Sabalian zone the present insect is one of the scarcer species. For the southeastern United States, "Georgia" was the most western locality hitherto known.

Tettigidea lateralis lateralis (Say).

1838. *T[etrix] polymorpha* Burmeister, Handb. Entom., II, Abth. 2, Pt. 1, pp. 659–660. [South Carolina.]

1902. *Tettigidea medialis* Hancock, Tettig. N. Amer., p. 152. [Southern Illinois; Missouri; Tennessee; Louisiana.]

New Jersey.[35]

Ortley, IV, 16, 1903, (H. L. Viereck), 1 ♂, [A. N. S. P.].
Stafford's Forge, IX, 16, 1905, (H.), 2 ♂, 4 ♀.
Atsion, X, 8, 1903, (H.), 2 ♀.
Ocean City, IV, 19, 1903, (H. L. Viereck), 3 ♀, [A. N. S. P.].
Cape May, VII, 4, 1908, (H. L. Viereck), 1 ♂, [A. N. S. P.].

Delaware.

Rehoboth, VI, 8, 1908, (B. Long), 1 ♂, [A. N. S. P.].

Maryland.

Chestertown, VIII, 18, 24, 27, 1899, (E. G. Vanatta), 1 ♂, 2 ♀, 1 juv. ♀, [A. N. S. P.].
Hyattsville, VIII, 14, (A. N. Caudell), 1 juv. ♀, [U. S. N. M.].
Washington, D. C., IV, IX, 1883–84, 13 ♂, 14 ♀, [Hebard Cln.].

Virginia.

Franklin City, VI, 24, 1907, (B. Long), 5 ♂, [A. N. S. P.].
Fredericksburg, VII, 20, 1913, (R. & H.), 5 ♂, 4 ♀, 2 juv. ♂, 3 juv. ♀.
Orange, VII, 21, 1913, (R. & H.), 1 ♂, 2 ♀, 3 juv. ♀.
Petersburg, VII, 23, 1913, (R. & H.), 6 ♂, 6 ♀, 1 juv. ♀.
Lynchburg, VII, 22, 1913, (R. & H.), 1 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂, 1 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 7 ♂, 3 ♀, 4 juv. ♀.
Greensboro, VII, 26, 1913, (R. & H.), 3 ♂, 2 ♀.
Fayetteville, X, 9, 1911, (R. & H.), 2 ♂, 1 ♀, 3 juv. ♀.
Charlotte, VII, 27, 1913, (R. & H.), 3 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 2 ♂, 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 1 ♂.
Wrightsville, IX, 7, 1911, (R. & H.), 3 ♂.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 34 ♂, 20 ♀, 8 juv. ♂, 8 juv. ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 ♂.
Florence, IX, 6, 1911, (R. & H.), 1 ♀.
Columbia, VII, 28, 1913, (R. & H.), 2 ♂.
Manning, V, 23, 1914, (W. Stone), 1 ♀, [A. N. S. P.].
Sullivan Island, IX, 5, 1911, (R. & H.), 2 ♀.
Ashley Junction, VIII, 15, 1913, (R. & H.), 1 ♂, 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 10 ♂, 6 ♀, 2 juv. ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 3 ♂, 6 ♀, 4 juv. ♂, 5 juv. ♀.
Clayton, V, 18, 26, 1911, 2,000 feet, (J. C. Bradley), 1 ♂, 1 ♀.
Atlanta, V, 15, 1911, (J. C. Bradley), 1 ♂.

[35] The series of intermediates from Ortley, Atsion and Ocean City have been recorded as *T. parvipennis* by Rehn, *Ent. News*, XV, p. 326, (1904).

Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂, 1 ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 7 ♂, 7 ♀, 1 juv. ♂.
Augusta, VII, 29, 1913, (R. & H.), 1 juv. ♂.
Summerville, 1 ♀, [Ga. State Cln.].
Macon, VII, 30–31, 1913, (R. & H.), 2 ♂, 1 ♀.
Columbus, VII, 16, 1913, (J. C. Bradley), 1 juv. ♂.
Jesup, IX, 1, 1911, (R. & H.), 6 ♂, 3 ♀, 1 juv. ♀.
Brunswick, VIII, 30, 1911, (R. & H.), 2 ♂, 4 ♀, 3 juv. ♀.
Hebardville, V, 15, 1915, (H.), 2 ♂, 1 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 2 ♂, 2 ♀.
Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 4 ♂, 3 ♀, 1 juv. ♂.
Homerville, VIII, 27, 1911, (R. & H.), 7 ♂, 8 ♀, 5 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 2 ♂, 4 ♀.
De Witt, VIII, 19, 1912, 1 ♀, [Ga. State Cln.].
Bainbridge, VII, 15, 1912, (J. C. Bradley), 1 ♀.
Spring Creek, VI, 7–23, VII, 16–29, 1911–12, (J. C. Bradley), 5 ♂, 5 ♀, 1 juv. ♂, 1 juv. ♀.

Florida.

Jacksonville, (T. J. Priddey), 5 ♂, 10 ♀, [Hebard Cln.]; IX, 7, 1913, (W. T. Davis), 1 ♂.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 8 ♂, 2 ♀, 2 juv. ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 juv. ♀.
St. Augustine, XI, 8, 1911, (G. P. Englehardt), 1 ♀, [B. I.].

Burmeister's name *polymorpha* has long been known to be a synonym of Say's *lateralis*, but since he described two forms, the caudate and abbreviate phases of the present insect, efforts have been made to retain this name for one of these. The uselessness of employing names for such phases has already been commented upon in the present paper.

Examination of extensive northern series of the present insect convinces us that they belong to a valid geographic race, *Tettigidea lateralis parvipennis* (Harris),[36] which is exceedingly close to the southern insect, but typical material from northern New England[37] may be separated from typical material of *T. lateralis lateralis*, described from Georgia and East Florida, by the following characters: form more robust; antennæ heavier, joints not more than twice as long as broad; frontal costa heavier; outline of dorsum of pronotum more decidedly broken cephalad of humeral angles, these angles more pronounced. Under this geographic race falls the name given for its caudate phase *T*[*ettigidea*] *parvipennis pennata* Morse.[38]

The large series before us show conclusively that, as the races approach one another in distribution, their differential characters become less and less appreciable; the material before us from the pine barrens and adjacent coastal strip of New Jersey, from Delaware, Maryland and northern Virginia, the series which we have recorded

[36] Morse discusses this question in *Jour. N. Y. Ent. Soc.*, III, p. 109, (1895).
[37] Material from numerous localities in Pennsylvania and from the Delaware River strip of New Jersey, now before us, is practically typical of the northern race.
[38] *Jour. N. Y. Ent. Soc.*, III, p. 109, (1895).

previously from Sulphur Springs (2,000 feet) and Mount Pisgah (4,500 feet), North Carolina, and the high country of northern Georgia, is all intermediate in character. Hancock has based his "variety" *Tettigidea medialis* on such material from southern Illinois, Missouri, Tennessee and Louisiana. We strongly question the Louisiana material being intermediate, for the material before us from that State is typical of *T. lateralis lateralis.* The uselessness of a name for intermediates between weakly defined geographic races does not require comment.

Material taken in heavy forest near streams or in swampy places shows a strong predominance of the abbreviate phase (Weldon and Lake Waccamaw, North Carolina; Thomasville, Georgia[39]). A female before us from Charlotte, North Carolina, has the wings abnormally produced, reaching 3.8 mm. beyond the caudate pronotum and 14 mm. in total length. The present insect is distributed everywhere through grasses and herbage of meadow, forest, swamp and marsh, usually found most numerous in and about damp situations. Of typical series before us 90.6% is caudate, this percentage excluding the three series discussed at the beginning of the paragraph. Besides the 367 individuals of the present species recorded above, we have before us 223 other specimens previously recorded from the southeastern United States and from as far west as Louisiana.

The largest series of intermediates before us (Washington, District of Columbia; Asheville, North Carolina) include a majority of specimens having the dorsal surface of the pronotum paler in coloration than the lateral lobes, ranging in different specimens from snuff brown and russet through clay color to cream color. Three of these specimens have the caudal femora broadly banded, four have a large spot in a similar position, while a number have the entire caudal femora of the same shade of the dorsum of the pronotum. Nearly half of the remaining large series of the present insect are unicolorous blackish brown, while almost all of the other specimens have the dorsum of the pronotum only slightly paler, usually unicolorous but occasionally somewhat mottled, and the caudal femora wholly uniform or inconspicuously marked. All of the males have the face and ventral portion of the lateral lobes of the pronotum nearly or quite clear white.

Tettigidea armata Morse. Pl. XII, figs. 3, 4, 5.

1895. *Tettigidea armata depressa* Morse, Jour. N. Y. Ent. Soc., III, p. 107. [Vigo County, Indiana; Jacksonville, St. John's River and Ft. Reed, Florida; New Orleans, Louisiana].

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[39] Recorded in part by Hebard as *Tettigidea lateralis* form *polymorpha. Ent. News*, XX, p. 115, (1909).

1908. *Tettigidea davisi* Morse, Psyche, XV, p. 25. [Perth Amboy and Jamesburg, New Jersey; Staten Island, New York.]

New York.

Staten Island, IV, 4, VI, 5, IX, 1897–1900, (W. T. Davis), 2 ♂, 2 ♀, paratypes of *T. davisi* Morse.

New Jersey.

2 ♂, [A. N. S. P.].

Perth Amboy, V, 31, (W. T. Davis), 1 ♂, 1 ♀, paratypes of *T. davisi* Morse.

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 1 juv. ♀.

Wrightsville, IX, 7, 1911, (R. & H.), 4 ♂.

Lake Waccamaw, IX, 8, 1911, (R. & H.), 14 ♂, 13 ♀., 2 juv. ♂, 4 juv. ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 11 ♂, 9 ♀, 6 juv. ♂, 10 juv. ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂.

Clayton, 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 1 ♂.

Groveland, VII, 28, 1913, (J. C. Bradley), 1 ♂.

Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 3 ♂, 6 ♀.

Waycross, V, 8, 1911, (J. C. Bradley), 1 ♂.

Thomasville, II, 29, III, 29, IV, 1, 9, XII, 14, 1903–04, (H.), 6 ♂, 8 ♀.

Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, IV, 1885, (W. H. Ashmead), 1 ♂, paratype of *T. armata depressa* Morse, [Hebard Cln.].

Louisiana.

New Orleans, (Coleman), 4 ♀, 1 paratype of *T. armata depressa* Morse; (Saltan), 2 ♂, 2 ♀, [all Hebard Cln.].

As *Tettigidea armata depressa* is based solely on the abbreviate form of *armata*, the name is placed in the synonymy here.

Morse's *Tettigidea davisi*, referred to in his original description as "an undescribed form or species of this genus, related to *armata* Morse," was separated by "the customary lack of a cuspidate point on the front margin of the pronotum . . . . occasionally showing variations toward a cuspidate condition" and also slightly different tegmina, in other respects being typical of *armata*.

The series before us shows that the cuspidate condition of the cephalic margin of the dorsum of the pronotum is variable in the present insect; the following table of percentages gives the degree in the larger series we have examined.

	Strongly cuspidate (fig. 5).	Moderately cuspidate (fig. 4).	Weakly cuspidate.	Angulate, no cusp (fig. 3).
New Jersey	6	0	0	94
North Carolina	84	10	4	2
South Carolina	76	18	2	4
Georgia	70	28	2	0
Louisiana	100	0	0	0

The above figures show that, although there are indications of an incipient division in the present species, no valid geographic race yet exists. The table does not mean that four types of this species occur, for every shade of intergradation exists and the four columns

are solely for the convenience of the student; thus in the New Jersey series noticeable variation toward a weakly cuspidate condition is discernible, while in the material from Louisiana, though all are of the strongly cuspidate condition, the degree differs individually. Were it not for the fact that large series taken in restricted localities show in several instances forms typical of both *armata* and *davisi*, we would be led to consider the latter a valid geographic race. The only other characters given for *davisi*, tegminal abbreviation and size of the tegminal spot, are even more variable in the present species than the character discussed above, and we are consequently obliged to place *davisi* in the synonymy under the present species.

The abbreviate condition in the present species is more common than the caudate phase; this is constant throughout the insect's distribution and is very probably due to immediate environment. The degree of cuspidation of the cephalic margin of the pronotum is found to vary least in caudate individuals, none of these lacking the usual cuspidation.

The species has been found in scant swamp-grasses along "branch" (Fayetteville), common on bare, black swamp soil (Lake Waccamaw), occasional on grassy edges of swamp (Lake Waccamaw), in low, wet, sandy spots along streams (Florence, Wrightsville, Thomasville) and occasional on sandy soil covered with scant grasses and dead oak leaves (Mixon's Hammock). This insect prefers much more swampy situations than does *T. lateralis*, and the larger series here recorded were only secured by long and careful search in favorable and always much restricted areas. At Florence the following field note was made: "The Tettigideæ would often jump into the water and drift down with the current, quite motionless until they would strike a twig or root to which they would cling. Their appearance was exactly like a bit of twig or bark floating down stream." The species has been recorded from Staten Island, New York, south to extreme southern Florida and westward as far as Riverside, Illinois; Howe, Oklahoma, and Dallas, Texas.

Radinotatum brevipenne brevipenne (Thomas).

South Carolina.

Yemassee, IX, 4, 1911, (R. & H.), 2 juv. ♂, 4 juv. ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 5 juv. ♂, 3 juv. ♀.

Warm Springs, 850–1,200 feet, VIII, 9–10, 1913, (R.), 5 juv. ♂, 9 juv. ♀.

Macon, V, 1 ♂, 1 ♀, [U. S. N. M.]; VII, 30, 1913, (R. & H.), 1 ♂, 2 juv. ♂, 2 juv. ♀.

Isle of Hope, IX, 3, 1911, (R. & H.), 4 juv. ♂.

Sandfly, IX, 3, 1911, (R. & H.), 2 juv. ♂.

Jesup, IX, 1, 1911, (R. & H.), 2 juv. ♂, 1 juv. ♀; XII, 1908, (H.), 1 juv. ♂, 1 juv. ♀.

Brunswick, VIII, 30, 1911, (H.), 1 juv. ♀.
Homerville, VIII, 27, 1911, (R. & H.) 2 juv. ♂, 5 juv. ♀.
Hebardville, V, 15, 1915, (H.), 6 ♂, 7 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 2 juv. ♂, 2 juv. ♀
Billy's Island, VI, VII, 1912, 2 ♂; IX, 1–5, 1913, 1 juv. ♂, (all J. C. Bradley).
Honey Island, VI, 1, 1912, (J. C. Bradley), 2 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♂, 4 juv. ♀.
Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, V, 1885, (W. H. Ashmead), 1 ♀, [Hebard Cln.]; VIII, 25, 1911, (R. & H.), 1 juv. ♂, 1 juv. ♀; XI, 3, 5, 1913, (W. T. Davis), 1 ♀, 1 juv. ♂, 1 juv. ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 juv. ♂.
Pablo Beach, XI, 4, 1911, (W. T. Davis), 1 juv. ♂, 1 juv. ♀.
Live Oak, VIII, 26, 1911, (R. & H.), few very small juv. seen.
Cedar Keys, VI, 1 ♂, [U. S. N. M.].

The immature examples before us taken in August and September are almost all in the instar in which females are 17–18 mm. in length, excepting those from Augusta, Warm Springs, Macon and Albany, Georgia, in which series females average 13 mm. and five from Augusta and Albany average 8 mm. The majority of young from Georgia and northern Florida taken in November and December show little increase in size over those taken in August, females measuring 20–21 mm. in length, though the following instars are also represented by females measuring 26 and 32 mm., respectively. It is in these later stages of development that the insects remain, and are active except on the coldest days, throughout the winter in southern Georgia and northern Florida, adults beginning to appear toward the middle of April. The presence in the series of an adult female taken in November shows that occasional mature individuals continue even into the early winter, but evidence shown by past and present study gives convincing proof that the species appears adult over the greater part of its range in late April and mature individuals have become scarce as early as August. In central Florida, however, the species passes the winter in the adult condition.

An interesting feature in the development of the male subgenital plate is demonstrated by the present series. Immature males, until they have reached a length of 12.5 mm., have this plate very short, not projecting beyond the apex of the abdomen, with caudal margin acute-angulate emarginate; in the following instar (length 18 mm.) the attenuate and greatly produced subgenital plate of the type of the adult insect appears.

In the large series of immature examples before us, those of the brown color phase are somewhat more numerous than those marked with green.

The species within its range is widely distributed throughout the undergrowth of the long-leaf pine forests and has sometimes been observed to frequent somewhat damp situations. It has also been found in short grass of waste land (below fall line, Augusta), in sandy tract of scrub oaks (just above fall line, Augusta), in mixed oak and pine woods suggesting New Jersey pine barrens (Warm Springs) and in sandy field of short grass (Atlantic Beach). In central Florida the species intergrades with its geographic race *R. brevipenne peninsulare;* north of that State the previous known records for the species were Savannah, Waycross and Thomasville, Georgia, and Greenville, Alabama.

Tryxalis brevicornis (Linnæus).

Maryland.

Chestertown, VIII, 16–27, 1899–1902, (E. G. Vanatta), 4 ♂, 9 ♀, [A. N. S. P.].
Queen Anne County, VIII, 7, 1902, (E. G. Vanatta), 1 ♂, [A. N. S. P.].
Washington, D. C., IX, 1883, 2 ♂, [Hebard Cln.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 2 ♂, 2 juv. ♂.
Natural Bridge, IX, 12–13, 1907, (B. Long), 1 ♀, [A. N. S. P.].
Petersburg, VII, 23, 1913, (R. & H.), 1 juv. ♀.

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 1 ♂, 2 ♀.
Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 juv. ♂.
Florence, IX, 6, 1911, (R. & H.), 4 ♂.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂, 1 juv. ♂.
Thompson's Mills, X, 1908–09, (H. A. Allard), 2 ♂, 2 ♀, [U. S. N. M.].
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂, 2 ♀.
Atlanta, VII, 29, 1910, 1 ♂, [Ga. State Cln.].
Silver Lake, VIII, 10, 1913, 1 juv. ♀, [Ga. State Cln.].
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂.
Savannah, VIII, 7, 1878, (Grote), 1 ♂, [U. S. N. M.].
Columbus, VII, 16, 1913, (J. C. Bradley), 1 ♂.
Chase Prairie, Okeefenokee Swamp, IX, 5, 1913, (J. C. Bradley), 1 ♂.

Alabama.

Decatur, (Shimek), 1 ♀, [Hebard Cln.].

Florida.

Atlantic Beach, VIII, 24, 1911, (R. & H.), 4 ♂.

Material from the Atlantic coast shows a slight increase in size southward, the more robust individuals from southern Georgia and from Florida have somewhat larger eyes and a broader vertex. Males measure in length as follows: Anglesea, New Jersey, 19–22 mm.; Asheville, North Carolina (2,000 feet), 19.7–22.8; near Atlanta, Georgia (1,000 feet), 19.2–21.6; Florence, South Carolina, 21.7–23; Atlantic Beach, Florida, 24.3–25.3 mm.

Five specimens are in the brown phase, two males and two young from Fredericksburg and one female from Fayetteville; all of the other specimens are of the more usual coloration.

The present insect is very locally distributed in marshland. At Fredericksburg it was found in high wet grasses in an upland depression. The species has been recorded from Long Island, New York, and Point Pelee, Ontario, south to the Argentine Republic.

Mermiria alacris Scudder.

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.; scarce in gallberry and wire-grass under scattered short-leaf pines), 5 ♂.

Southern Pines, early XI, 1908, (A. H. Manee), 1 ♂, 1 ♀; 1905, 2 ♂, 1 ♀, [all N. C. Dept. Agr.].

Wilmington, IX, 8, 1911, (R. & H.; in long-leaf pine woods), 1 ♂.

Winter Park, IX, 7, 1911, (R. & H.; common in pine woods), 11 ♂, 12 ♀.

Wrightsville, IX, 7, 1911, (R. & H.; in grasses in short-leaf pine woods), 1 ♂, 1 ♀.

Lake Waccamaw, IX, 8, 1911, (R. & H.; in short-leaf pine woods undergrowth), 1 ♂.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.; in grass bunches on bare area), 2 juv. ♀.

Ashley Junction, VIII, 15, 1913, (R.; in tall brush in long-leaf pine woods), 1 ♂.

Yemassee, IX, 4, 1911, (R. & H.; in undergrowth in short-leaf pine woods), 1 ♂.

Georgia.

Toccoa, VIII, 4–5, 1913, (H.; in grass, vines and oak sprouts in clearing), 1 juv. ♀.

Augusta, VII, 29, 1913, (R. & H.; in grasses in sandy scrub-oak area and in short grasses in old overgrown fields), 1 ♂, 8 juv. ♂, 1 juv. ♀.

Macon, VII, 30–31, 1913, (R. & H.), 4 juv. ♂, 4 juv. ♀.

Jesup, IX, 1, 1911, (R. & H.; in pine woods undergrowth), 4 ♂.

Billy's Island, VI and VII, 1912, (J. C. Bradley), 1 ♂, 5 juv. ♂, 3 juv. ♀.

Albany, IX, 1910, 1 ♀, [Ga. State Cln.]; VIII, 1, 1913, (R. & H.; in undergrowth of pine woods), 2 ♂.

Bainbridge, (J. C. Bradley), 1 ♂, [Ga. State Cln.].

Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 2 ♂, 3 juv. ♂, 1 juv. ♀, [Ga. State Cln.].

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.; in undergrowth of pine and among scrub oak on very sandy soil), 20 ♂, 7 ♀; (T. J. Priddey), 1 ♂, [Hebard Cln.]; VIII, 1885 and 1886, (W. H. Ashmead), 1 ♂, 2 ♀, [Hebard Cln.]; IX, 28, 1913, (W. T. Davis), 1 ♂ and 1 ♀ in coitu, [Davis Cln.].

Titusville, XI, 8, 1911, (W. T. Davis), 1 ♀, [Davis Cln.].

We have examined, in the Scudder Collection, two males and three females of the original series of two males and four females on which Scudder founded his *Mermiria vigilans*. In consequence we can fully endorse Morse's synonymy of *vigilans* under the present species.[40] At a later date we will speak in more detail of the variability of this interesting dry-land form.

The known distribution of *alacris* in the eastern States extends from east-central and central (Salisbury, on the basis of immature individuals not seen by us) North Carolina and northern Georgia (Toccoa), south to central Florida (Cedar Keys, Sanford and Titusville).

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[40] Carnegie Inst. Wash., Publ. 68, p. 27, (1907).

Mermiria intertexta Scudder.

Virginia.

Ocean View, VIII, 9, (A. N. Caudell), 4 ♂, 1 ♀, [U. S. N. M.].

North Carolina.

Wrightsville, IX, 7, 1911, (R. & H.; in salt marsh vegetation), 1 ♂.

Smith Island, X, 1906, (F. Sherman), 2 ♀, [N. C. Dept. Agr.].

South Carolina.

Coast of South Carolina, 1 ♂, [Hebard Cln.].

Isle of Palms, VIII, 15, 1913, (R.; in shin oak, bayberry, palmetto and briar thickets among dunes), 1 ♂, 1 ♀.

Georgia.

Tybee Island, IX, 2, 1911, (R. & H.; fairly plentiful in high grasses growing in water on edge of salt marsh), 27 ♂, 12 ♀; VII, 26, 1913, 1 juv. ♀, [Ga. State Cln.].

Florida.

Jacksonville, (T. J. Priddey), 2 ♂, [Hebard Cln.].

South Jacksonville, IX, 7, 1913, (W. T. Davis), 5 ♂, 2 ♀, [Davis Cln.].

Atlantic Beach, VIII, 24, 1911, (R. & H.; fairly common in high saw grass and reeds in marsh), 11 ♂, 8 ♀.

Pablo Beach, IX, 3–17, 1913, (W. T. Davis), 7 ♂, 5 ♀, [Davis Cln.].

Long Boat, Sarasota Key, 1 ♂, [Ga. State Cln.].

Useppa Island, Charlotte Harbor, V, 17–19, 1915, (H.), 1 juv. ♂, [Hebard Cln.].

This is the species recorded by us from Pablo Beach and Cedar Keys, Florida, as *vigilans*.[41] It is distinctly a hygrophilous species, found in both fresh and salt marsh situations, but occasionally straying into adjacent dune vegetation.

Mermiria bivittata Serville.

Billy's Island, Georgia, VII, 1912, (J. C. Bradley), 1 ♀, [A. N. S. P.].

In addition to this specimen, we have before us six males and two females labelled, "Georgia. H. K. Morrison," from the Scudder Collection and that of the United States National Museum, those from the former having been correctly determined as this species by Scudder. The male from Fort Barrancas, Florida, correctly recorded by Morse,[42] is also before us. The single male specimen from Pablo Beach, Florida, recorded by the present authors as *intertexta*,[43] belongs to this species, the exact relationship of which has never been clearly determined. In the near future we intend to critically study this genus in its entirety.

The present species is only known in the southeastern States, *i.e.*, east of Alabama, from the localities mentioned above and from Havelock, North Carolina (Sherman and Brimley).

Syrbula admirabilis (Uhler).

Virginia.

Arlington, VII, 9, 1914, (H.), 1 juv. ♂.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 ♂, 1 juv. ♂, 4 juv. ♀.

Orange, VII, 21, 1913, (R. & H.), 1 ♂, 1 ♀, 2 juv. ♂.

Lynchburg, VII, 22, 1913, (R. & H.), 2 ♂, 1 juv. ♂, 2 juv. ♀.

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[41] Proc. Acad. Nat. Sci. Phila., 1907, p. 286, (1907).

[42] Carnegie Inst. Wash., Publ. 18, p. 29, (1904).

[43] Proc. Acad. Nat. Sci. Phila. 1907 p. 286, (1907).

Petersburg, VII, 23, 1913, (R. & H.), 1 juv. ♂.
Virginia Beach, IX, 15, 1907, (B. Long), 1 ♀, [A. N. S. P.].

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 5 ♂, 1 ♀, 1 juv. ♂.
Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♂, 3 juv. ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂, 1 juv. ♂, 2 juv. ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♂, 2 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 2 ♂, 3 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 2 ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 1 ♂.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 ♂, 1 juv. ♂.
Florence, IX, 6, 1911, (R. & H.), 8 ♂, 2 ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 ♂, 1 juv. ♂, 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 2 ♂, 2 ♀.

Georgia.

Dalton, VIII, 7, 1913, (R.), 2 juv. ♀.
Toccoa, VIII, 4–5, 1913, (H.), 3 ♂, 1 ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 1 ♂, 2 ♀.
Thompson's Mills, X, 1909, (H. A. Allard), 2 ♂, [U. S. N. M.].
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (Bradley, R. & H.), 4 ♂, 1 ♀.
Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂, 1 ♀.
Augusta, VII, 29, 1913, (R. & H.), 2 ♂, 5 juv. ♂.
Warm Springs, VIII, 9–10, 1913, (R.), 1 ♂.
Macon, VII, 30–31, 1913, (R. & H.), 8 ♂, 3 ♀, 2 juv. ♀.
Columbus, VII 16, 1913, (J. C. Bradley), 1 ♂.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♂, 2 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 4 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 8 ♂.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 ♂.
Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 1 ♂.
Albany, VIII, 1, 1913, (R. & H.), 6 ♂, 1 ♀, 2 juv. ♀.
Bainbridge, IX, 17–X, 19, 1910, (J. C. Bradley), 1 ♂.
Spring Creek, VI, VII, VIII, 1911–13, (J. C. Bradley), 10 ♂, 6 ♀, 1 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 10 ♂, 8 ♀; IX, 7, 1913, (W. T. Davis), 2 ♂.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 4 ♂, 1 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 2 ♂.

A decided increase in size is found in the southward distribution of the present species. A female from North Woodbury, New Jersey, is exceptionally large for material from that State. Length of females: West Creek, New Jersey, 32.7–33.4; North Woodbury, N. J., 40.4; Asheville, N. C. (2,000 feet), 32.5–35; Fayetteville, N. C., 37.5–39; Jacksonville, Fla., 38.5–40; Miami, Fla., 45.2 mm.

In the entire series of this species nearly all the adult males are in the brown phase, very few showing any trace of green or greenish coloration. In these few specimens this color is obscure and confined to the head and lateral lobes of the pronotum. Of the adult females before us, eleven are of the brown phase, the paler tegminal markings alone suffused with greenish in several of these, ten are intermediate between the brown and green phases, while sixty-eight are of the green phase. It is interesting to note that in

the present series of young, twenty-five are of the green phase and fourteen are of the brown, irrespective of sex.

The species was found most abundant on sandy soil overgrown with wire-grass and other low plants in areas of scrub oak and pine (Jacksonville), but was also found widely distributed through the undergrowth of pine and mixed forests and in fields and weedy areas, particularly in somewhat damp situations. The insect is known on the Atlantic coast from Medford, New Jersey, south to Miami, Florida, and is found in the Appalachian valleys as high as 2,000 feet; north of Maryland the species is decidedly scarce, and it is known from southern Florida from but a single specimen.

Eritettix simplex (Scudder).

Maryland.

Laurel, V, 14, VI, 4, 1911, (Marshall), 21 ♂, 9 ♀, [U. S. N. M.].
Glen Echo, VII, 10, 1914, (H.), 1 ♀.
Pineypoint, VI, 17, (Pergande), 1 ♀, [U. S. N. M.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 3 juv. ♂, 1 juv. ♀.
Orange, VII, 21, 1913, (R. & H.), 3 juv. ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 2 juv. ♂, 1 juv. ♀.
Petersburg, VII, 23, 1913, (R. & H.), 2 juv. ♂.

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), 3 juv. ♂, 2 juv. ♀.
Black Mountain, VI, 1912, (W. Beutenmüller), 1 ♀, [Davis Cln.].

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♂.

Georgia.

Clayton, VI, 1909, (W. T. Davis), 1 ♂.
Thompson's Mills, IV, 1910, (H. A. Allard), 2 ♂, 1 ♀, [U. S. N. M.].
Buckhead, VIII, 2, 1913, (R. & H.), 2 juv. ♂, 2 juv. ♀.
Augusta, VII, 29, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.

The series of young from Fredericksburg, Orange and Petersburg average about 6.5 mm. in length, those from Lynchburg and Greensboro 7.2, while the remainder average about 8.4 mm. In such very early stages we find supplementary carinæ weakly indicated on the pronotum in five of the seventeen smallest specimens, and somewhat more strongly but to varying degrees in five of the seven larger young, while one of the latter has these carinæ very weakly continued on the head. All of these immature examples are of the more normal color forms, excepting one male from Atlanta which has the dorsal surface of head and pronotum uniformly black. These young individuals have the median pronotal stripe present in the specimens which have indications of supplementary carinæ; examination of the series of one hundred and fifty-nine adults of the present species in the collections before us shows that the individuals having a strongly defined median stripe have strongly defined supplementary carinæ, while those having the dorsum of the pronotum unicolorous wholly lack supplementary carinæ.

The present series of very small young all have short, flattened antennæ with apices weakly clavate.

The southeastern limits of the known distribution of the species are defined by some of the records given above.

The present material was taken in campestral surroundings; in short grasses, usually on uplands, but on the flat country just below the fall line at Augusta. The young were abundant at Greensboro, elsewhere they were occasional or very scarce.

Macneillia obscura Scudder.

Live Oak, Florida, VIII, 26, 1911, (R. & H.), 2 ♀, 2 juv. ♂.
Gotha, Fla., 1 ♂, [U. S. N. M.].

Both of the above females are vandyke brown in general coloration, one has the dorsal median section of the pronotum between the supplementary carinæ (which in this specimen are distinct) and the corresponding portion of the head clay color; the other specimen is unicolorous, the lateral carinæ alone outlined in clay color, and has no indication whatever of supplementary carinæ.[44] Study of the series of forty-five adults and young of this rare species in the collections before us, shows that the supplementary carinæ, when present, become more decided as a median stripe becomes more prominent. Specimens having a wholly unicolorous dorsum of the pronotum entirely lack supplementary carinæ; we find this to be likewise true in the species of the genus *Eritettix*.

The specimens from Live Oak, the most northern locality at which this insect has been found, were taken on the side of a depression near a sink hole, where the deforested ground was covered with wire-grass and clumps of a dwarf oak growing knee-high.

Amblytropidia occidentalis (Saussure).

North Carolina.

Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 2 juv. ♂, 3 juv. ♀.
Lake Ellis, V, 14, 1906, 1 ♂, [U. S. N. M.].
Wilmington, IX, 8, 1911, (R. & H.), 1 juv. ♂.
Winter Park, IX, 7, 1911, (R. & H.), 3 juv. ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 juv. ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 juv. ♀.
Florence, IX, 6, 1911, (R. & H.), 2 ♂, 2 juv. ♂, 7 juv. ♀.
Columbia, VII, 29, 1913, (R. & H.), 1 juv. ♀.
Manning, V, 28, 1914, (W. Stone), 3 ♂, 1 ♀, [A. N. S. P.].
Ashley Junction, VIII, 15, 1913, (R.), 9 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 4 juv. ♂, 1 juv. ♀.

[44] Unfortunately the authors in speaking of such unicolorous specimens used "lateral carinæ" where "supplementary carinæ" was meant. Proc. Acad. Nat. Sci. Phila., 1912. p. 251, (1912).

Georgia.

Toccoa, 1,094 feet, VIII, 4–5, 1913, (H.), 2 juv. ♀.
Vicinity of Stone Mountain, 1,000 feet, VIII, 3, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 2 juv. ♀.
Warm Springs, 850–1,200 feet, VII, 9–10, 1913, (R.), 1 juv. ♂, 1 juv. ♀.
Augusta, VII, 29, 1913, (R. & H.), 4 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 2 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 2 juv. ♂, 2 juv. ♀.
Sandfly, IX, 3, 1911, (R. & H.), 2 juv. ♂, 2 juv. ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 juv. ♂; XII, 1908, (H.), 1 ♂, 2 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 1 juv. ♂.
Hebardville, V, 15, 1915, (H.), 1 ♂.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 2 juv. ♀.
Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 1 ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 4 ♂, 2 ♀.
Honey Island, VI, 1912, (J. C. Bradley), 3 ♂, 3 ♀.

Florida.

Jacksonville, VIII, 1885, (W. H. Ashmead), 3 juv. ♂, 2 juv. ♀, [Hebard Cln.].
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 juv. ♂.
Live Oak, VIII, 26, 1911, (R. & H.), 1 juv. ♀.
Daytona, XI, 11, 1911, (G. P. Englehardt), 2 ♀, [B. I.].

There is little individual and almost no geographic variation in size in the adults of the above series, the specimens from Billy's and Honey Islands being of similar dimensions to individuals from Raleigh, North Carolina.

The usual polychromatism is noticed in the adults. The smaller young show both green and brown phases, the presence of the former phase, which is never found in the adult condition, apparently pointing to the greater primitiveness of this type of coloration. In the earlier stages immature examples show a decided multilineate coloration accompanied by an infuscation of the face, which is quite distinctive, little suggestive, however, of the coloration of the adult. As growth progresses the browns become more evident, and in the third instar preceding maturity the greens have largely disappeared. In the second instar preceding maturity such peculiarities as the black edgings of the median carina of the pronotum, occasionally found in adults, become evident.

While generally taken in grass and brush in pine or pine and oak woods, the young of this species are occasionally found in oak groves.

Orphulella pelidna (Burmeister).

Maryland.

Glen Echo, VII, 10, 1914, (H.), 1 ♂.

Virginia.

Arlington, VII, 9, 1914, (H.), 1 juv. ♀.
Fredericksburg, VII, 20, 1913, (R. & H.), 14 ♂, 16 ♀.
Lynchburg, VII, 22, 1913, (R. & H.), 5 ♂, 3 ♀.
Petersburg, VII, 23, 1913, (R. & H.), 5 ♂, 5 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 ♂, 4 ♀.
Greensboro, VII, 26, 1913, (R. & H.), 5 ♂, 3 ♀.
Charlotte, VII, 27, 1913, (R. & H.), 3 ♂, 2 ♀.

Fayetteville, IX, 9, 1911, (R. & H)., 2 ♂, 4 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 10 ♂, 10 ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 2 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂, 4 ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 ♂, 3 ♀.
Florence, IX, 6, 1913, (R. & H.), 3 ♂, 7 ♀.
Sumter, V, 30, 1914, (W. Stone), 1 ♀, [A. N. S. P.].
Manning, V, 23 to 30, 1914, (W. Stone), 1 ♂, 1 ♀, 4 juv. ♀, [A. N. S. P.].
Isle of Palms, VIII, 15, 1913, (R.), 3 ♂, 3 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 12 ♂, 12 ♀.

Georgia.

Clayton, 2,000–3,700 feet, VII, 1910, (W. T. Davis), 1 ♀.
Toccoa, VIII, 4–5, 1913, (H.), 3 ♂, 2 ♀.
Currahee Mountain, 1,700 feet, VIII, 5, 1913, (H.), 1 ♂, 1 ♀.
Dalton, VIII, 7, 1913, (R.), 1 ♂, 1 juv. ♀.
Jasper, VIII, 5, 1913, (R.), 2 ♂, 2 ♀.
Austell, VIII, 6, 1910, 1 ♂, [Ga. State Cln.].
Atlanta, VI, 26, 1913, 1 ♂, 1 ♀, [Ga. State Cln.].
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂, 1 ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 4 ♂, 5 ♀.
Thompson's Mills, X, 1909, (H. A. Allard), 2 ♂, 8 ♀, [U. S. N. M.].
Macon, VII, 30–31, 1913, (R. & H.), 6 ♂, 7 ♀.
Augusta, VII, 29, 1913, (R. & H.), 4 ♂, 11 ♀.
Monticello, VIII, 2, 1905, (Titus), 1 ♂, [U. S. N. M.].
Warm Springs, VIII, 9–10, 1913, (R.), 2 ♂, 7 ♀.
Albany, VIII, 1, 1913, (R. & H.), 5 ♂, 8 ♀.
Tifton, IX, 8, 1910, 1 ♀, [Ga. State Cln.].
Bainbridge, VII, 15, 1912; IX, 3–7, IX, 17–X, 19, 1910, (J. C. Bradley), 6 ♂, 7 ♀.
Spring Creek, VI, 7–23, 1911, VII, 16–29, 1912, VIII, 26–28, 1913, (J. C. Bradley), 18 ♂, 20 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 13 ♂, 6 ♀.
Waycross, V, 11, 1910, 1 ♂, [Ga. State Cln.].
Hebardville, V, 15, 1915, (H.), 1 ♂, 1 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 5 ♂, 4 ♀.
Billy's Island, V, 28–VII, 1912, IX, 1–5, 1913, (J. C. Bradley), 56 ♂, 37 ♀, 2 juv. ♂, 1 juv. ♀.
Jordans, Billy's Island, VIII, 31, 1913, (J. C. Bradley), 2 ♂, 1 ♀, 1 juv. ♀.
Honey Island, VI, 1, 1912, (J. C. Bradley), 1 ♂, 1 ♀, 1 juv. ♀.
Mixon's Hammock, VI, 16, 1912, (J. C. Bradley), 1 ♂.
Fargo, VIII, 31, 1913, (J. C. Bradley), 1 juv. ♀.
Jesup, IX, 1, 1911, (R. & H.), 3 ♂, 7 ♀.
Tybee Island, IX, 2, 1911, (R. & H.), 4 ♂, 2 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 3 ♂, 3 ♀.
Sandfly, IX, 2, 1911, (R. & H.), 2 ♂, 2 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 ♂, 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 7 ♂, 8 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 7 ♂, 3 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 6 ♂, 4 ♀; XI, 3 and 5, 1911, (W. T. Davis), 2 ♂, 4 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 6 ♂, 19 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 3 ♂, 6 ♀.
Lakeland, V, 4, 1912, XI, 8, 1911, (W. T. Davis), 5 ♂, 5 ♀.
Punta Gorda, XI, 11–16, 1911, (W. T. Davis), 3 ♂, 5 ♀.
Fort Myers, III, 30 and IV, 24, 1912, (W. T. Davis), 1 ♂, 1 ♀.
La Belle, IV, 27, 1912, (W. T. Davis), 1 ♀.
South Bay, Lake Okeechobee, V, 1 and 2, 1912, (W. T. Davis), 1 ♂, 1 ♀.
Everglade, IV, 5, 1912, (W. T. Davis), 1 ♀.
Deep Lake, IV, 13, 1912, (W. T. Davis), 1 ♂.

The present series of five hundred and thirty-five specimens exhibits the almost endless variation in size, the numerous structural and proportional modifications and all the pure and compound color phases found in this extremely plastic species. In the matter of wing length we find both one of the most abbreviate females and the most macropterous one of the same sex in the Lynchburg series. The macropterous one of these measures 22.5 mm. in length of body and 21.5 mm. in length of tegmen, while the abbreviate one has the same proportions, 21.5 and 17.4, respectively. The only noteworthy color modification is seen in the Isle of Palms series, which, taken among the dunes of a barrier beach, is prevailingly grayish, two of the females having almost no distinct markings, in this respect much resembling *O. olivacea*, with which this species was there associated.

Certain specimens from Punta Gorda, Florida, particularly one female, show a tendency toward the new *O. halophila* occurring in the same general region, but this is purely one of general resemblance and not of close affinity. This apparent divergence from the basic type is not true of all the individuals from that locality, as others are perfectly typical of *pelidna*.

As to the synonymy of *Orphulella pratorum* Scudder with the present species, it seems only necessary to say that the more material seen by us the more certain are we of the correctness of the association.

This species was found over the whole region treated in the present paper, frequenting the greatest variety of habitats, from salt marsh grass (in company with *olivacea* at Tybee Island and Wrightsville), to barren hillsides (Fredericksburg) and mountain slopes under timber in a luxuriant undergrowth of grasses, vines and oak sprouts (Currahee Mountain). The undergrowth in pine woods, *i.e.*, gallberry, bunch and wire-grass, seems to be more preferred than campestrian situations. At Isle of Palms this species and *olivacea* were found in the dry hollows of dunes among vegetation composed of bayberry, *Myrica cerifera*, scrubby oak, briars and cabbage palmetto, *Sabal palmetto*.

Orphulella olivacea (Morse).

Virginia.

Franklin, Accomac County, IX, 22, 1907, (B. Long), 1 ♀, [A. N. S. P.].

North Carolina.

Wrightsville, IX, 7, 1911, (R. & H.), 2 ♀.

South Carolina.

Isle of Palms, VIII, 15, 1913, (R.), 1 ♂.

Georgia.

Tybee Island, IX, 2, 1911, (R. & H.), 14 ♂, 18 ♀.

Sandfly, IX, 3, 1911, (R. & H.), 1 ♂.

Florida.[45]

Pablo Beach, VIII, 12, 1905, (R. & H.), 1 ♂.

Cedar Keys, VIII, 15, 1905, (R. & H.), 11 ♂, 12 ♀.

Texas.

Galveston, VII, 19–21, 1912, (H.), 11 ♂, 5 ♀.

Virginia Point, VII, 21, 1912, (H.), 8 ♂, 12 ♀, 1 juv. ♀.

Corpus Christi, VII, 29, 1912, (H.), 2 ♀.

The study of the present series of this and the following species, as well as material of *olivacea* from New England and New Jersey brings out three points of interest. First, that *olivacea* increases in size southward, the Tybee Island and Cedar Keys specimens being appreciably larger than New England and New Jersey individuals. Second, the range of this species covers the coastal marshes and portions of the beaches from southern New England (Norwich, Connecticut) south to north Florida (Pablo Beach), also along the Gulf coast from Cedar Keys, Florida, to Texas, as far south as Corpus Christi, the two portions of the range being completely separated. Third, that in similar environment in south-central and southern Florida and southern Texas, north to Corpus Christi, *olivacea* is replaced by an allied species, which does not intergrade with the more northern form and is found associated with it at Corpus Christi.

A critical examination of all of our material from fifteen localities extending from Connecticut to Texas shows a regular size increase in both sexes as one proceeds southward to northern Florida, the size increase being accompanied by a broadening and blunting of the fastigium, specimens from Greenwich, Connecticut, and Cedar Keys, Florida, being quite different in the latter feature. Considering the Texan material, it is seen that the beach specimens (Galveston and Corpus Christi) are somewhat smaller than individuals taken in the salt marsh of the bays (Virginia Point), the series from the latter place averaging as large as the Cedar Keys specimens taken in the same environment. Measurements (in millimeters) of average individuals and pairs from a number of localities are as follows:

	Greenwich, Conn. (Paratypes).		Atlantic City, N. J.		Franklin City, Va.
	♂	♀	♂	♀	♀
Length of body	17.	21.5	17.8	24.3	26 5
Length of pronotum	3.2	3.9	3.7	4.3	5.
Length of tegmen	14.6	16.8	15.	19.8	21.4

[45] These specimens have been recorded by the authors (Proc. Acad. Nat. Sci. Phila., 1907, p. 287, (1907)) as *O. pelidna?* These individuals are extremely large *olivacea*, differing also, as here shown, from northern specimens of the species in having the fastigium somewhat aberrant.

	Wrightsville, N. C.	Isle of Palms, S. C.		Tybee Island, Ga.	
	♀	♂		♂	♀
Length of body	27.8	17.4		19.3	26.2
Length of pronotum	4.9	3.4		4.	5.
Length of tegmen	21.9	15.7		16.7	21.5
	Pablo Beach, Fla.	Cedar Keys, Fla.		Galveston, Tex.	
	♂	♂	♀	♂	♀
Length of body	20.3	20.	27.	18.5	23.7
Length of pronotum	4.1	4.1	5.	3.8	4.5
Length of tegmen	18.1	16.9	22.8	16.3	18.6
		Virginia Point, Tex.		Corpus Christi, Tex.	
		♂	♀	♀	
Length of body		21.1	27.5	26.8	
Length of pronotum		5.2	5.3	5.	
Length of tegmen		17.5	23.4	20.8	

The Isle of Palms male was taken among the dunes of a barrier beach, entirely away from the true salt-marsh habitat, which may account for the small size of the specimen. The specimens from the vicinity of salt pans with *Salicornia* and similar vegetation, a type of situation where the species occurred at Galveston and Corpus Christi, exhibit, as the measurements above show, a somewhat depauperate form when compared with specimens from the salt marsh, which is the typical habitat of the species. Apparently the action of environment is seen in these beach specimens in the reduction of wing length and to a certain degree in the coloration, both of which are similar to the condition found in the allied *O. halophila*, which as far as known invariably frequents the vicinity of salt pans. Tegminal length as a general thing is a somewhat variable factor in *O. olivacea*, the Tybee series showing one female with a body length of 33.3 mm. and a tegminal length of 25, while in this respect almost as much variation either way from the measured specimen is found in the same sex in the Virginia Point series. The general bulk and pronotal length, however, follow the rule laid down above, the influence of a somewhat changed environment on the beaches and flats resulting there in a general size reduction, accompanied by a tegminal abbreviation much as in *O. halophila* which frequents the same habitat.

The range of this species, so far as known, does not extend south of Cedar Keys, Florida, and Corpus Christi, Texas, at the latter locality the species occurring with *O. halophila* (see below), which replaces it southward. Texan *olivacea* are inseparable from eastern coast specimens, and similarly south Florida and south Texas *halophila* are inseparable.

At Wrightsville, Tybee Island, Sandfly and Virginia Point, this species was found in salt marsh, associated with *O. pelidna* at the first two localities, while at Galveston and Corpus Christi it frequented the flats and pans with *Salicornia* and similar vegetation.

Orphulella halophila new species. Pl. XII, figs. 6, 7, 8.

1912. *Orphulella pelidna* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1912, p. 253. (In part.) [Records from Key West, Boot Key and Key Vaca refer in part to *halophila*.]

Allied to *O. olivacea* (Morse), but differing in the more robust form, the never strongly elongate tegmina, the shorter pronotum, the more arcuate lateral carina of the pronotum and more inflated caudal femora.

Type: ♀; Key West, Monroe County, Florida. July 3–7, 1912. (Rehn and Hebard.) [Hebard Collection, Type No. 31.]

Description of Type.—Size medium; form moderately robust, subcompressed. Head with occiput and interocular region regularly arcuate when seen from the side, width of the interocular space hardly narrower than the greatest fastigial width; fastigium much broader than long (from cephalic margin of eyes), rectangulate in outline, moderately impressed in a rather narrow subarcuate area but little removed from the margin (fig. 7); when seen from the side the fastigio-facial angle is moderately rounded, lateral foveolæ very elongate trigonal, well impressed; facial outline regularly though but moderately oblique; frontal costa narrow at juncture with fastigium, regularly widening ventrad, weakly sulcate dorsad of the median ocellus; eyes one and one-half times as deep as the infraocular sulcus is long, subovoid in shape, but moderately prominent when seen from the dorsum; antennæ slightly depressed proximad, faintly tapering distad, considerably shorter than the head and pronotum together. Pronotum with the greatest width across ventral portion of the lateral lobes subequal to the greatest dorsal length of the disk; lateral carinæ moderately converging caudad to the second transverse sulcus, thence diverging caudad, both sections slightly arcuate (fig. 7); cephalic margin of disk subtruncate, caudal margin of disk obtusely arcuate; median carina of pronotum well and evenly elevated, severed by the principal transverse sulcus slightly caudad of the middle. Tegmina just reaching the tips of the caudal femora, apex broadly rounded, when seen from the lateral aspect and in repose the costal margin and the dorsal line of the tegmen subparallel except for the slight proximal lobe; ulnar area completely divided in two by a longitudinal spurious vein and in

consequence with a double series of cells; discoidal area faintly narrowing distad, with irregularly arranged small cells and showing but faint indications of an intercalary vein. Interspace between the mesosternal lobes quadrate, slightly longitudinal; interspace between the metasternal lobes small, narrowed caudad, subcuneate. Caudal femora moderately robust, the greatest depth contained four times in the length; caudal tibiæ with eleven spines on the external margin.

Allotype: ♂; same data as type. [Hebard Collection.]

Description of Allotype.—Differing from the description of the type in the following particulars, aside from the usual sexual differences. Size small. Head with impressed area of the fastigium more extensive caudad; fastigio-facial angle more obtuse-angulate, facial outline when seen from lateral aspect slightly more oblique; frontal costa nearly subequal in width between the antennal bases and the median ocellus, sulcate throughout, but more distinctly so dorsad; eyes nearly twice as deep as the infra-ocular sulcus is long, while prominent still slightly compressed when seen from the dorsum; antennæ in length very faintly exceeding that of the head and pronotum together. Pronotum very slightly narrower; lateral carinæ subobliterated between the first and second transverse sulci. Tegmina slightly surpassing the tips of the caudal femora; ulnar area with large but irregular cells, without a distinct spurious vein; discoidal area as in female. Interspace between mesosternal lobes distinctly longitudinal; metasternal lobes attingent caudad. Caudal femora with the greatest depth contained three and one-half times in the length; caudal tibiæ with eleven spines on the external margin.

The coloration of this species runs through the whole gamut of units or phases found in certain other members of the genus, as *O. pelidna*, showing much greater diversity than in the more closely allied *O. olivacea*. It seems unnecessary to more than summarize the more striking of these units, between all of which there seem to be regular intermediates. The males are much more uniform in their coloration than is the case in the female sex. The green extreme unit has the base color clear dull green-yellow (Ridgway) to chalcedony yellow, running to apple green and even rejane green, the discoidal area of the tegmina with quadrate maculations of fuscous, a distinct postocular suffusion present on head, dorsal portion of lateral lobes and caudo-lateral portions of pronotal disk, the ventral portions of the lateral lobes with or without fuscous linings and hoary tints, the accessory lines on the occiput and femoral bars also

variable in presence or absence and solidarity. The brown extreme is heavily mottled and suffused fuscous on a tawny-olive ground, the dark markings around the lateral carinæ of the pronotum strikingly velvety black, the markings of the lateral lobes, tegmina and femora not pronounced. Between these two extremes runs a series of about five phases, each sufficiently distinct to the eye to be readily recognizable. In one the color is uniform honey-yellow with almost no markings, another is similar with the dark markings around the lateral carinæ velvety black and a narrow postocular bar fuscous, with faint indications of tegminal maculations and a faint greenish wash on the dorsum of the pronotum. Another has the whole pattern, *i.e.*, femoral markings, linings on lobes and pleura, dark areas about carinæ and very weak occipital lines and tegminal maculations, indicated, but also entirely washed with ochraceous-salmon. Another phase, apparently unusual, as it is seen only in males from Point Isabel and a female from Boot Key, has the markings similar, but is unsuffused and the base color is quite pale, in fact light buff. The last of these phases is near the brown extreme, but it has the tegminal markings decided and the base color somewhat paler. In addition there crops out in three of the phases that peculiar washing of all or parts of the tegmina, and occasionally part or all of the pronotum, with rich purple seen in a number of the species of this very variable group. The type belongs to the green extreme and the allotype is of a brownish phase which predominates in the male sex.

Correlating the material by locality for possible color relation to environment is productive of little positive data, as the more extreme color phases are usually from localities represented by uniques or very small series, while the extensive Key West series (thirty-four specimens) shows very great diversity in itself. The pale markings on the lateral carinæ of the pronotum, frequently broken mesad, are the most striking constant color feature of the species.

Measurements (in millimeters).

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Key West, Fla., *Allotype*	17.5	3.5	13.4	9.5
Key West, Fla., Paratype	18.7	3.7	15.	10.5
Key West, Fla., Paratype	19.	3.5	14.2	10.6
Key West, Fla., Paratype	18.	3.5	14.4	10.
Corpus Christi, Tex	18.8	3.8	15.5	11.2
Corpus Christi, Tex	17.5	3.5	15.	11.5
Corpus Christi, Tex	18.2	3.5	14.3	11.5

♀	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Key West, Fla., TYPE	24.5	4.7	18.	13.9
Key West, Fla., Paratype	24.3	4.5	16.9	12.9
Key West, Fla., Paratype	21.5	4.5	17.	13.
Key West, Fla., Paratype	25.6	4.8	20.	14.2
Corpus Christi, Tex	23.3	4.3	19.2	14.1
Corpus Christi, Tex	26.3	5.1	20.7	15.5
Corpus Christi, Tex	26.	4.8	20.	15.2

It will be seen from the above measurements that the Texan material has slightly longer femora in both sexes, but the difference is extremely slight. The fastigium varies considerably in the degree of angulation, particularly in the male sex, occasionally being distinctly acute-angulate in that sex, while in the female it sometimes is faintly obtuse-angulate. The lateral carinæ of the pronotum vary much as they do in *O. olivacea*, being more inbowed in some specimens than in others, in fact almost subparallel cephalad in occasional individuals, while very frequently in the males and less frequently in the females they are distinctly subobsolete between the first and second transverse sulcus. The individual variation in tegminal length is less than usual in the present genus.

We have before us a series of seventy-one specimens of this interesting species. The localities represented and data on the material are as follows:

Punta Gorda, Florida, XI, 16, 1911, (W. T. Davis), 1 ♀.
Marco, Fla., IV, 17 and 20, 1912, (W. T. Davis), 1 ♂, 3 ♀.
Key Vaca, Fla., III, 14, 1910, (H.), 1 ♂.
Boot Key, Fla., III, 14, 1910, (H.), 1 ♂, 1 ♀.
Big Pine Key, Fla., VII, 6, 1912, (R. & H.), 1 ♂.
Key West, Fla., I, 20, 1904, (H.); III, 15–16, 1910, (H.); VII, 3–7, 1912, (R. & H.), 12 ♂, 22 ♀, TYPE, *allotype* and paratypes.
Corpus Christi, Texas, VII, 29, 1912, (H.), 9 ♂, 12 ♀, 1 juv. ♀.
Point Isabel, Tex., VIII, 2, 1912, (H.), 3 ♂.
Tampico, Tamaulipas, Mexico, XII, 1906, 1 ♂, 2 ♀, [Hebard Cln.].

The above localities show that the range of this species is discontinuous, the two regions in which it occurs being separated by an area, *i.e.*, the greater portion of the Gulf coast of the United States, where *O. olivacea* replaces it in the same environment. We can only speculate as to the centre in which the species originated, but in view of the accumulating evidence bearing on the Mexican origin of certain south Florida Orthoptera it is not at all impossible that this species in the past reached the eastern portion of its present distribution from Mexico, and possibly by way of Yucatan.

It is evident from the data in hand that the species occurs throughout the entire year, material being before us taken every month in the year except February, May, June, September and October.

It seems probable to us that the present species is the one referred to as *O. zapoteca* (Saussure) by Scudder,[46] his specimens having been from Corpus Christi Bay, Texas; Mexico; Venis Mecas, Mexico; San Mateo del Mar, Tehuantepec, Mexico; Guatemala, and Realejo, Nicaragua. Our material runs to this species in his key and the three exact localities given by him with which we are familiar, or can locate, are in the maritime region frequented by this species. The use of Saussure's name, however, does not appear warranted, as, while the description is brief, it appears to apply more satisfactorily to one of the peculiarly Mexican forms of the genus.

The habitats frequented by the species were all quite similar; at Key West individuals being common in *Salicornia* and other halophytes growing on almost bare coral rock in the mangrove region at the east end of the island, on Big Pine Key the species was taken among mangroves, while on Key Vaca and Boot Key it occurred under much the same conditions as at Key West. At Corpus Christi and Point Isabel the species frequented saline adobe flats with low halophytic vegetation.

Orphulella speciosa (Scudder).

Glen Echo, Maryland, VII, 10, 1914, (H.), 2 ♂, 2 ♀.
District of Columbia, VIII, 11, 1883, 1 ♂, [Hebard Cln.].
Fredericksburg, Virginia., VII, 20, 1913, (R. & H.), 18 ♂, 31 ♀.

At Fredericksburg this northern type was fairly abundant and widely distributed, especially in short grasses on the uplands bordering the valley of the Rappahannock. These are portions of the rounded escarpment of the Piedmont region, and it seems probable that in Virginia this species does not occur on the coastal plain. The present form is more distinctly a species of short-grass areas than *O. pelidna*.

Dichromorpha viridis (Scudder).

Virginia.

Arlington, VII, 9, 1914, (H.), 2 juv. ♂.
Fredericksburg, VII, 20, 1913, (R. & H.), 9 ♂, 8 ♀.
Orange, VII, 21, 1913, (R. & H.), 2 ♂, 3 ♀, 1 juv. ♀.
Petersburg, VII, 23, 1913, (R. & H.), 4 ♂, 3 ♀, 1 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 ♂, 1 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♂, 3 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 4 ♂, 3 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 3 ♂, 3 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♂.
Manning, V, 23 and 30, 1914, (W. Stone), 1 juv. ♂, 1 juv. ♀, [A. N. S. P.].

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[46] *Can. Ent.*, XXXI, p. 180, (1899).

Yemassee, IX, 4, 1911, (R. & H.), 2 ♂, 3 ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 4 ♂.
Columbus, VII, 16, 1913, 1 ♂, [Ga. State Cln.].
Oglethorpe, Macon County, VII, 1 and 31, 1910, (J. C. Bradley), 1 ♂, 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 5 ♀, 1 juv. ♀.
Tifton, IX, 8, 1910, (J. C. Bradley), 1 ♂.
Spring Creek, VIII, 26–28, 1913, (J. C. Bradley), 1 ♀.
Bainbridge, V, 31–VI, 1, 1911; VII, 15, 1912; IX, 17–X, 19, 1910, (J. C. Bradley), 3 ♂, 6 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 2 ♂, 4 ♀.
Billy's Island, VI–VII, 1912; IX, 1–5, XII, 20, 1913, (J. C. Bradley), 8 ♂, 10 ♀, 1 juv. ♀.
Jordan's, Billy's Island, VIII, 31, 1913, (J. C. Bradley), 1 ♂.
Jesup, IX, 1, 1911, (R. & H.), 4 ♂, 5 ♀; XII, (H.), 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀; IX–X, 1910, 1 ♂, 1 ♀, [Ga. State Cln.].
Cumberland Island, VIII, 31, 1911, (R. & H.), 4 ♂, 2 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♀; VIII, 1885, (W. H. Ashmead), 10 ♂, 8 ♀, [Hebard Cln.]; XI, 5, 1911, (W. T. Davis), 1 ♂, 2 ♀.
South Jacksonville, IX, 7, 1913, (W. T. Davis), 1 ♂, 2 ♀.
Ortega, Duval County, IX, 6, 1913, (W. T. Davis), 1 ♂.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 8 ♂, 12 ♀.
Pablo Beach, IX, 5 and 27, 1913, (W. T. Davis), 5 ♂, 7 ♀.
Live Oak, VII, 26, 1911, (R. & H.), 3 ♂.

An examination of the above series and material from the northeastern States shows that as a rule the fastigium is blunter in the more southern specimens, particularly in the female sex. Occasional individuals from Georgia localities have the angle of this same region similar to that found in Pennsylvania and New Jersey specimens, but by far the majority show a distinct broadening of the fastigium. The size varies individually in any considerable series and there appears to be no geographic tendency in this feature.

There is a slight preponderance of the green phase, while the brown individuals show a maculate, a simply punctulate and a plain form. The green phase males show a decided amount of variation in the infuscation of the lateral aspect, this being almost blackish in certain specimens (Oglethorpe, Billy's Island, Pablo Beach and Atlantic Beach), paling until, in two Lake Waccamaw males, there is no infuscation except the carinal lines and their tegminal continuations.

In the present series no specimens are macropterous, the tegmina falling short of the apex of the abdomen in all.

The species is a lover of weedy spots, grassy fields and damp overgrown depressions, occurring frequently in abundance. It is occasionally found in grasses in pine woods (Weldon, Goldsboro and Jacksonville).

Clinocephalus elegans Morse.

1905. *Clinocephalus pulcher* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1905, p. 36. [Miami, Florida.]

Maryland.

Piney Point, VIII, 12, 1880, 1 ♀, [Hebard Cln.].

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 11 ♂, 3 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 11 ♂, 7 ♀, 1 juv. ♀.
Wilmington, IX, 8, 1911, (R. & H.), 11 ♂, 5 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 27 ♂, 30 ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 3 ♂, 7 ♀.

South Carolina.

Ashley Junction, VIII, 15, 1913, (R.), 3 ♂, 2 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 23 ♂, 35 ♀.

Georgia.

Tybee Island, IX, 2, 1911, (R. & H.), 9 ♂, 9 ♀.
Sandfly, IX, 3, 1911, (R. & H.), 11 ♂, 5 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 ♂, 1 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 juv. ♀.
Jesup, IX, 1, 1911, (R. & H.), 21 ♂, 9 ♀.
Billy's Island, VII, 1912; IX, 1–5, 1913, (J. C. Bradley), 2 ♀, 2 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 2 ♂, 2 ♀.
Hebardville, VIII, 28, 1911, (H.), 1 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 22 ♂, 7 ♀, 1 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 2 ♂, 2 ♀.
South Jacksonville, IX, 7, 1913, (W. T. Davis), 3 ♂, 1 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 12 ♂, 12 ♀, 1 juv. ♀.

Texas.

Webster, Harris County, VII, 19, 1912, (H.), 2 ♂.
Dickinson, Galveston County, VII, 20, 1912, (H.), 3 ♂.

A critical examination of this material shows that in the southern part of its range the species varies away from the more northern type, much as do *Orphulella olivacea* and *Chortophaga viridifasciata*, the general size, as a rule, increasing southward and the fastigium there becoming appreciably broader and blunter. Material from Miami, Florida, has been separated from true *elegans* by the authors, who first considered it to represent a full species, *Clinocephalus pulcher*, and later regarded it as a geographic race of *elegans*.[47] Specimens from as far north as St. Simon's Island, Georgia, were considered representative of *pulcher*, the characters of which were also analyzed on the basis of Florida material.[48] In the light of the additional collections now available, it seems best to place this name unreservedly in synonymy. The characters are not decided or constant enough in our opinion to justify the retention of the name, the recognition of a geographic race requiring, it appears to us, more uniformity in, and more significance to, its differential characters over at least the greater portion of its range. The gradual increase in size and the broadening and bluntening of the fastigium

[47] Proc. Acad. Nat. Sci. Phila., 1910, p. 588, (1911).
[48] *Ibid.*, 1907, p. 287, (1907).

southward are features shared by a number of species, which differences, uncorrelated with other characters, we do not feel are sufficiently clear cut to constitute racial criteria, the two extremes in this case grading gradually into one another instead of showing uniformity over definite areas and intergradation over relatively smaller ones.

The previous analysis of the characters of *pulcher* covered the supposedly diagnostic features, *i.e.*, size, tegminal length, fastigial form, frontal costa and color. A re-examination of these features shows that the general size as a rule follows the usual increase in size southward, but that in the series from Lake Waccamaw, Winter Park, Yemassee, Jesup, Tybee Island and Sandfly we find individuals of both sexes which are similar in this respect to New Jersey, and others to southern Florida, specimens. Regarding the relative length of the tegmina, we find no specimens in the present material with tegmina as long as south Florida representatives, but each series shows a considerable degree of individual variation in this respect in both sexes. The four females from Jacksonville all have the tegmina very short, not surpassing the middle of the third abdominal segment, lanceolate and acute. The form of the fastigium shows a general uniform broadening southward, but, like the length measurement, occasional individuals of both sexes have it as narrow and as much angulate as in New Jersey specimens. The sulcation of the frontal costa varies greatly in degree, to a certain extent geographically, but to a greater one individually.

As we have said before, the more southern specimens exhibit color patterns not observed in more northern individuals. This statement holds true in the light of the present material, the extreme trilineate form being suggested in but a few individuals, these from southern Georgia, although blackish or largely blackish specimens are present in the Wilmington, Lake Waccamaw, Yemassee, Sandfly, Homerville, Jacksonville and Atlantic Beach series. These blackish specimens are females and without exception they were taken on wet black ground in swampy situations.

The Texas specimens are inseparable from Georgia individuals and the range of the species is considerably extended by these records. In the southern States the species is found at greater distances from the coast line than is the case to the northward, but nowhere has the species been found above the fall line; Fayetteville, North Carolina, being the farthest inland locality from which it is known. The range extends from western Long Island, New York

(Ravenswood), south to Key West, Florida, west to eastern Texas (Webster and Dickinson), extending inland as far as Fayetteville, North Carolina, Homerville, Georgia, and Flomaton, Alabama.

The species always occurs in moist areas, and in the region here treated often in woodland, generally among bracken, reeds or grasses, but occasionally on black water-soaked ground covered with low swamp plants. The vicinity of a wet depression or the tangled border of a swampy tract of pine or cypress is particularly frequented.

Chlœaltis conspersa Harris.

Glen Echo, Maryland, VII, 10, 1914, (H.; luxuriant grasses and other vegetation on hill slopes covered with low scattered pines), 6 ♂, 6 ♀.

Arlington, Virginia, VII, 9, 1914, (H.; area of *Andropogon* and other grasses), 1 ♂, 1 ♀.

The present records extend considerably the known range of this northern species southward near the Atlantic Coast; in the Appalachians it is found at high elevations as far south as North Carolina. The series here considered is composed of large individuals and the females are all of the normal condition with greatly reduced tegmina and wings.

Arphia xanthoptera (Burmeister).

District of Columbia.

Washington, IX, 23, 1883, 1 ♀, [Hebard Cln.].

Virginia.

Orange, VII, 21, 1913, (R. & H.), 2 juv. ♂.

Lynchburg, VII, 22, 1913, (R. & H.), 1 juv. ♀.

Petersburg, VII, 23, 1913, (R. & H.), 3 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 juv. ♂, 1 ♀.

Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♂.

Charlotte, VII, 27, 1913, (R. & H.), 1 ♂, 1 juv. ♂, 1 juv. ♀.

Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♂.

Fayetteville, IX, 9, 1911, (R. & H.), 2 ♂.

Wilmington, IX, 8, 1911, (R. & H.), 1 ♂, 2 ♀.

Winter Park, IX, 7, 1911, (R. & H.), 5 ♂, 3 ♀.

Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 5 ♂, 2 ♀.

Columbia, VII, 28, 1913, (R. & H.), 3 ♂, 1 juv. ♀.

Ashley Junction, VIII, 15, 1913, (R.), 1 ♂.

Yemassee, IX, 4, 1911, (R. & H.), 4 ♂, 5 ♀.

Georgia.

Jasper, 1,550 feet, VIII, 5, 1913, (R.), 2 juv. ♂.

Toccoa, VIII, 4–5, 1913, (H.), 2 juv. ♂, 1 juv. ♀.

Currahee Mountain, VIII, 5, 1913, (H.), 2 juv. ♀.

Thompson's Mills, X, 1909, (H. A. Allard), 2 ♂, [U. S. N. M.].

Buckhead, VIII, 2, 1913, (R. & H.), 1 juv. ♀.

Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂; IX, 12, 1913, (J. C. Bradley), 1 ♀.

Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.

Augusta, VII, 29, 1913, (R. & H.), 4 ♂, 4 juv. ♂, 3 juv. ♀.

Macon, VII, 30–31, 1913, (R. & H.), 2 ♂, 1 juv. ♂, 2 juv. ♀.

Warm Springs, VIII, 9–10, 1913, (R.), 1 ♂, 1 ♀, 1 juv. ♀.

Isle of Hope, IX, 3, 1911, (R. & H.), 4 ♂.

Jesup, IX, 1, 1911, (R. & H.), 2 ♂, 3 ♀; XII, 1908, (H.), 1 ♀, 1 juv ♂.

Brunswick, VIII, 30, 1911, (H.), 3 ♂.

Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀.
Bainbridge, IX, 3–7, 1910, (J. C, Bradley), 1 ♂.
Spring Creek, VI, VII, 1911–12, (J. C. Bradley), 1 ♂, 1 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 4 ♂, 5 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 2 ♂.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♀.

Scarcely any size variation is apparent over the distribution of the present species. Males in the series before us range in length from 21.5 to 27 mm., females from 31.5 to 40 mm. Several specimens from southern Georgia show a considerable reduction in the pronotal crest, which might confuse them with *A. granulata*, were other differential characters, which separate these two distinct species, not carefully observed. The height of this crest, measured vertically from the dorso-caudal angle of the pronotum, is variable in all of the series now under consideration, extremes measuring as follows: males, 2 to 2.7 mm., females, 2.3 to 3.4 mm. The great majority of specimens approach more closely the maximum in this measurement.

The specimens of palest coloration have the ventral surface of the body very dark, which portion of the body is almost black in the normal type of this insect; in *A. granulata*, this surface is normally very pale, only occasionally weakly suffused with brown.

The present species was found in dry situations, particularly in more open woodlands (long-leaf and short-leaf pine, pine and oak or only deciduous trees), in fields along the edge of forests and occasionally in grassy fields; on Stone Mountain, Georgia, a single specimen was found on the bare granite rock surface at the summit.

South of northern Florida, the species is known from but one record, Orange City Junction, Florida.

Arphia granulata Saussure.

South Carolina.

Sumter, V, 30, 1914, (W. Stone), 2 ♂, [A. N. S. P.].
Manning, V, 28, 1914, (W. Stone), 1 ♂, [A. N. S. P.].

Georgia.

St. Simon's Island, VIII, 30, 1911, (R. & H.), 6 ♂, 5 ♀.
Brunswick, VIII, 30, 1911, (H.), 2 ♂, 3 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 2 ♂, 2 ♀.
Hebardville, V, 15, 1915, (H.), 5 ♂, 3 ♀; VIII, 28, 1911, (H.), 2 ♀.
Homerville, VIII, 27, 1911, (R. & H.) 1 ♂, 1 ♀.
Mixon's Hammoek, Okeefenokee Swamp, V, 16, 1915, (H.), 1 ♂.
Billy's Island, VI, IX, 1–5, 1912–13, (J. C. Bradley), 7 ♂, 5 ♀, 1 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♂; (T. J. Priddey), 8 ♂, 2 ♀, [Hebard Cln.].
Atlantic Beaeh, VIII, 25, 1911, (R. & H.), 3 ♀.
Ortega, IX, 6, 1913, (W. T. Davis), 1 ♂.
Indian River, (T. J. Priddey), 1 ♂, [Hebard Cln.].

In the present species the height of the pronotal crest, measured vertically from the dorso-caudal angle of the pronotum, is moderately variable in all of the material in our collections, the extremes measuring as follows; males 1.4–2 mm., females 1.5–2 mm. The minimum of this measurement is approached by the majority of specimens.

The present species is widely distributed through the pine woods of Florida and extreme southern Georgia and is an inhabitant of low, flat country. On Mixon's Hammock a specimen was taken on the edge of an oak grove. The insect is known from localities extending from Wilmington, North Carolina, and Waynesville, Georgia, westward as far as Thomasville, Georgia, and south to Key West, Florida.

Arphia sulphurea (Fabricius).

Maryland.

Chesapeake Beach, 1 ♂, [Davis Cln.].
Glen Echo, VII, 10, 1914, (H.), 1 ♂, 1 ♀.
Washington, D. C., VIII, 1883, 2 ♂, [Hebard Cln.].

Virginia.

Great Falls, VI, 26, 1914, (W. T. Davis), 1 ♀.
Fredericksburg, VII, 20, 1913, (R. & H.), 1 ♀, 1 juv. ♂.
Orange, VII, 21, 1913, (R. & H.), 1 ♀, 1 juv. ♀.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♀.

North Carolina.

Manteo, V and VI, 1903, 1 ♂, 1 ♀, [Davis Cln.].
Weldon, IV, 20, 1908, (B. Long), 1 ♂, [A. N. S. P.]; VII, 24, 1913, (R. & H.), 1 ♀.
Greensboro, VII, 26, 1913, (R. & H.), 2 juv. ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♀.
Lake Toxaway, V, (Mrs. A. T. Slosson), 1 ♀, [Davis Cln.].

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 juv. ♀.

Georgia.

Clayton, 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 2 ♂; VI, VII, 1909–10, (W. T. Davis), 3 ♂, 5 ♀.
Pinnacle Peak, VII, 21, 1910, (W. T. Davis), 1 ♂.
Black Rock Mountain, 3,500 feet, V, 20–25, 1911, (J. C. Bradley), 1 ♂.
Tuckoluge Creek, Rabun County, VII, 1910, (W. T. Davis), 1 ♂.
Jasper, 1,550 feet, VIII, 5, 1913, (R.), 1 ♂.
Currahee Mountain, 1,700 feet, VIII, 5, 1913 (H.), 1 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 2 ♂.

Mature individuals of the present insect appear in the early spring, while the above records show that desultory adults are still present as late as early August.

The most southern definite record for the species is Leon County, Florida, near the Georgia State line.

Chortophaga viridifasciata (De Geer).

Maryland.

Glen Echo, VII, 10, 1914, (H.), 1 ♂.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 2 ♂; 2 ♀, 2 juv. ♂, 2 juv. ♀.
Orange, VII, 21, 1913, (R. & H.), 1 ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂, 1 juv. ♂, 1 juv. ♀.
Montgomery County, 4 ♀, [Hebard Cln.].
Petersburg, VII, 23, 1913, (R. & H.), 2 ♂, 1 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂.
Greensboro, VII, 26, 1911, (R. & H.), 1 ♀, 1 juv. ♂, 1 juv. ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♂, 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 1 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂, 1 ♀.
Sullivan Island, IX, 5, 1911, (R. & H.), 1 ♂.

Georgia.

Clayton, 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 2 ♂; VI, 1909, (W. T. Davis), 5 ♂, 4 ♀.
Pinnacle Peak, VIII, 20, 1913, (J. C. Bradley), 2 ♂.
Black Rock Mountain, 3,000 and 3,500 feet, V, 20–25, 1911, (J. C. Bradley), 1 ♂, 1 ♀.
Tuckoluge Creek, Rabun County, VII, 1910, (W. T. Davis), 3 ♀.
Jasper, 1,550 feet, VIII, 5, 1913, (R.), 1 ♂.
Toccoa, 1,094 feet, VIII, 4, 1913, (H.), 1 ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 1 ♂.
Thompson's Mills, spring 1909, (Allard), 1 ♂, 1 ♀, [U. S. N. M.].
Rome, VIII, 21, 1910, 1 ♂, 1 ♀, [Ga. State Cln.].
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂, 2 ♀, 2 juv. ♂.
Stone Mountain, 1,600 feet, VIII, 3, 1913, (R. & H.), 2 ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂, 1 ♀.
Gainesville, IV, 12, 1911, (J. C. Bradley), 1 ♀.
Augusta, VII, 29, 1913, (R. & H.), 3 ♂, 7 ♀, 2 juv. ♂.
Macon, VII, 30–31, 1913, (R. & H.), 3 ♂, 8 ♀, 1 juv. ♀.

In the series before us a perceptible increase in robustness is found southward in the distribution at low elevations of the present species; this is accompanied by an appreciable reduction in the pronotal crest and a moderate broadening of the vertex. Material from altitudes of 3,000 feet or over in the mountains of North Carolina and Georgia is quite similar to material from Massachusetts, but the pair before us from elevations of 3,000 and 3,500 feet on Black Rock Mountain, Georgia, are very large, more attenuate, with higher crest and more compressed vertex, the dorsal surface of which is excavate.

Although material of the present species from the country adjacent to that in which *C. australior* is found shows certain characters more like those found in that species, no intergradation whatever exists, and *C. australior* shows definitely a more recent common ancestry with *C. cubensis*, as has already been observed. The southeastern limits of the present insect's distribution define sharply the northwestern limits of the range of *C. australior*, which throughout its range appears to wholly supplant *C. viridifasciata*.

Male immature examples in the earliest instars have the subgenital plate scoop-shaped, in the larger young this plate is much as in the adult condition. In the above series there are very small young from Lynchburg, Virginia; Greensboro and Charlotte, North Carolina, and Augusta, Georgia, which afford decided evidence that the insect

is particularly a spring species over the entire portion of its range treated in the present paper, as adults are usually found to be scarce as early as the middle of July. At about this time the young were found quite numerous in Virginia and North Carolina.

We have never seen specimens of the present insect showing any indication of a reddish suffusion, which is so striking in occasional specimens, particularly those in the green phase, of *C. australior*. In the present series eighteen males and nine females are of the brown phase, seven males and twenty-two females are of the green phase, while one female is brown suffused with green.

This species prefers upland surroundings where it thrives in the open in areas of short grasses; it is also found along the borders of woodlands (Weldon and Greensboro, North Carolina; Jasper, Georgia) and was found scarce in bunch-grass growing on granite slopes (Stone Mountain, Georgia).

On the Atlantic coast the insect is known as far south as Sullivan Island, South Carolina, inland the most southern records are Florence, South Carolina; Augusta, Marshallville and West Point, Georgia, and Flomaton, Alabama.[49] The species is found far south of this latitude in Texas, and we have specimens before us from as far east on the Gulf coast as Biloxi, Mississippi.

Chortophaga australior Rehn and Hebard.

Georgia.

Savannah, (A. Oemler), 1 ♂, [U. S. N. M.].
Tybee Island, VII, 26, 1913, (J. C. Bradley), 1 ♂, 1 ♀; IX, 2, 1911, (H.), 1 ♂.
Jesup, IX, 1, 1911, (R. & H.), 2 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 3 ♂, 9 ♀, 1 juv. ♂.
Brunswick, VIII, 30, 1911, (H.), 1 ♂, 1 ♀.
Cumberland Island, IV, 29, 1 ♀, [Ga. State Cln.]; VIII, 31, 1911, (R. & H.), 1 ♂, 4 ♀.
Hebardville, V, 15, 1915, (H.), 1 ♂.
Billy's Island, VI, VII, IX, 1912–13, (J. C. Bradley), 8 ♂, 6 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀.
Tifton, IX, 8, 1910, (J. C. Bradley), 1 ♂, 1 ♀.
Bainbridge, IX, 3–X, 19, 1910, (J. C. Bradley), 3 ♂, 6 ♀.
Spring Creek, VI, 7–VIII, 28, 1911, 13, (J. C. Bradley), 8 ♂, 6 ♀.

Florida.

Fernandina, (Fenn), 1 ♂, [U. S. N. M.].
Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♀, 1 juv. ♂; IX, 7, 1913, (W. T. Davis), 1 ♂; XI, 5, 1911, (W. T. Davis), 2 ♂, 5 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 5 ♂, 12 ♀, 1 juv. ♀.
Pablo Beach, IX, 5, 27, 1913, (W. T. Davis), 3 ♂, 4 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 3 ♀.
St. Vincent Island, XI, 1, 1910, (W. L. McAtee), 2 ♂, 1 ♀, [U. S. N. M.].
St. Augustine, XI, 8, 1911, (G. P. Englehardt), 1 ♀, [B. I.].
Cedar Keys, VI, 9, 1 ♀, [U. S. N. M.].
Sanford, III, (A. N. Caudell), 1 ♀, [U. S. N. M.].
Indian River, 1896, (T. J. Priddey), 1 ♂, 1 ♀, [Hebard Cln.].

[49] See under *C. australior*, Morse's records of this insect which apply properly to that species.

Scarcely any geographic variation is found in the present species, individuals from southern Florida are, however, as a rule slightly more robust than those from Georgia.

In the above series two males and eight females have a more or less decided reddish suffusion on the dorsal surface of head, pronotum and caudal femora. The series contains twenty-three males and eleven females in the brown phase, and six males and twenty-eight females in the green phase. As is true in *C. viridifasciata*, the majority of males are of the former color phase, while the majority of females are of the latter, a very much greater diversity in tone and intensity of shade and marking is, however, found in the present insect.

The species is found abundant in colonies in very short grass of fields, along roads and in uncultivated spots in and about towns. When one specimen is flushed often a dozen or twenty will fly up, then frequently others will not be seen for many yards. The flight of this species is swift and is accompanied by quite a loud buzzing sound. In sandy fields overgrown with short grasses on St. Simon's Island, Georgia, and at Atlantic Beach, Florida., the insects were present in great numbers. The species is known to be present in the adult condition throughout the year over its entire range.

The distribution of the present insect ranges from the Dry Tortugas, Florida, northward to Savannah, Georgia, the most northwestern localities at which it has been found being Tifton, Albany and Spring Creek, Georgia, and Ft. Barrancas, Florida.[50]

Encoptolophus sordidus (Burmeister).

District of Columbia.

Washington, IX, 1883, 1 ♂, [Hebard Cln.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 juv. ♀.

Orange, VII, 21, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), colony of very small young found.

Charlotte, VII, 27, 1913, (R. & H.), 1 juv. ♀.

A very few immature examples are all the specimens of the present species which were found by the authors in the southern Piedmont region in late July; Morse secured but few examples of this insect when working in this region in late August and early September. Charlotte, North Carolina, is the most southern record for the present insect, which is very scarce over all but the most northern portion of

[50] Morse's records of *C. viridifasciata* from Savannah, Tybee Island and Waycross, Georgia, and Carrabelle, Warrington and Fort Barrancas, Florida, are properly referable to the present species.

the territory at present under consideration. The distribution of the present species is known to extend westward to the Great Plains in the latitude of Nebraska; south of this the most western records are eastern Kentucky and Roan Mountain Station, Tennessee. Scudder's Florida record is based upon a misidentification of *C. australior*. Saussure's records for Georgia and Florida likewise cannot be credited to this species, while Coquillett's Californian record applies to a western species.

Pardalophora[51] **phœnicoptera** (Burmeister).

1892. *Hippiscus* (*H*[*ippiscus*]) *texanus* Scudder, Psyche, VI, pp .267, 286. [Dallas and San Antonio, Texas.]

Maryland.

Queen Anne County, VIII, 15, 1902, (E. G. Vanatta), 1 ♀, [A. N. S. P.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 6 ♂, 2 ♀.
Orange, VII, 21, 1913, (R. & H.), 1 ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂.
Petersburg, VII, 23, 1913, (R. & H.), 2 ♂.
Suffolk, (C. W. Johnson), 1 ♀, [A. N. S. P.].

North Carolina.

Weldon, VII, 24, 1913, (R. & H)., 3 ♂, 3 ♀.
Hertford County, VI, 9, 1895, 1 ♂ [A. N. S. P.].
Charlotte, VII, 27, 1913, (R. & H.), 1 ♂.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 2 ♂.
Manning, V, 30, 1914, (W. Stone), 6 ♂, [A. N. S. P.].

Georgia.

Clayton, VI, 1909, (W. T. Davis), 4 ♂, 2 ♀.
Black Rock Mountain, V, 20–25, 1911, (J. C. Bradley), 1 juv. ♀.
Toccoa, VIII, 4–5, 1913, (H.), 2 ♂.
Currahee Mountain, VIII, 5, 1913, (H.), 1 ♀.
Sharp Mountain, VIII, 6, 1913, (R.), 1 ♀.
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♀.
Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 2 ♀.
Augusta, VII, 29, 1913, (R. & H.), 2 ♂, 1 ♀.
Warm Springs, VII, 18, 1913, (J. C. Bradley), 1 ♀; VIII, 9–10, 1913, (R.), 1 ♂.
Groveland, VII, 28, 1913, (J. C. Bradley), 1 ♀.
Cumberland Island, IV, 29, 1911, 1 ♂, [Ga. State Cln.].
Hebardville, V, 15, 1915, (H.), 3 ♂, 3 ♀, 1 juv. ♀.
Billy's Island, IV, 1912, (J. C. Bradley), 1 ♂, 1 ♀.
Bainbridge, V, 30–VI, 1, 1911, (J. C. Bradley), 1 ♀.
Spring Creek, VI, 7–VII, 29, 1911, (J. C. Bradley), 5 ♂, 2 ♀.

Florida.

Jacksonville, V, 1885, (W. H. Ashmead), 2 ♀; (T. J. Priddey), 4 ♂, 4 ♀, [all Hebard Cln.].
Enterprise, IV, 24, 1903, 1 juv. ♀, [U. S. N. M.].

An examination of the material upon which Scudder based his *H. texanus* shows that name to be an absolute synonym of the present species. In Scudder's key that portion which separates these two

[51] In the resurrection of this name we follow Kirby, *Synon. Catal. Orth.*, III, p. 206, (1910). This genus offers more important characters to separate it from true *Hippiscus* than is the case with numerous other recognized Œdipodine genera.

(e^1 and e^2) is diagnostically worthless; such variation as is noted in tegminal markings is found everywhere in the eastern series before us which belong unquestionably to the same species; it is impossible to separate Scudder's series of *texanus* from the present insect by means of tegminal contour, while the "sharp" and "not very sharp" lateral carinæ of the pronotum are intangible. The g^2 portion of the key serves fully as well to separate *phœnicopterus* from *haldemanii*.

Scarcely any geographic variation in size is found in the present species over that portion of its range here considered; however, material from the low-land portions of Georgia, from Florida and Texas, shows a somewhat greater robustness of the caudal femora accompanied by an appreciable increase in the lamellation of the ventral margins of the same. The tegminal length in the present series is variable irrespective of geographic distribution, extremes of the present series measure as follows; males 27.5–32 mm., females 33–43 mm. The specimens from Texas are as large as the largest specimens here recorded and have tegmina which, in the majority of such specimens before us, very slightly exceed in length the maximum in the present series.

In the present series are five males and two females with head, pronotum and caudal femora greenish. Specimens from the low-land of Georgia and from Florida are somewhat more brilliantly colored and show a greater diversity of coloration than do those which compose the remainder of the series; among these are several females and one male with head, pronotum and caudal femora paler than usual and almost immaculate, while the tegminal markings are considerably reduced in number. A female from Augusta, Georgia, is nearly immaculate, but darker in coloration than these specimens.

The present insect appears adult in the early spring, and by the first of August few survivors remain. South of the northern portion of Florida the species is known from but four specimens, two males captured at Lakeland, a female from Cleveland and an immature female from Southside, Miami.[52]

Hippiscus rugosus (Scudder).

1892. *Hippiscus* (*H*[*ippiscus*]) *compactus* Scudder, Psyche, VI, pp. 268, 288. [Carolina; south shore of north Potomac, Maryland.]
1892. *Hippiscus* (*H*[*ippiscus*]) *variegatus* Scudder, Psyche, VI, pp. 268, 301. [Pennsylvania; Maryland; Washington, D. C.; Georgia; Indiana; southern Illinois; Topeka, Kansas.]

[52] These specimens show a maximum development of the robustness of the caudal femora and the increase in the lamellation of the ventral margins of the same.

1892. *Hippiscus* (*H*[*ippiscus*]) *suturalis* Scudder, Psyche, VI, pp. 268, 301. [Moline, Illinois.]
1901. *Hippiscus citrinus* Scudder, Can. Ent., XXXIII, p. 88. [Alabama.]
1906. *Hippiscus immaculatus* Morse, Psyche, XIII, p. 119. [Clarendon, Texas.]

Maryland.

Marshall Hall, VIII, 9, 1883, 1 ♀, [Hebard Cln.].
Washington, D. C., VIII, 1883, 1 ♀, [Hebard Cln.].

Virginia.

Arlington, VII, 9, 1914, (H.), 1 juv. ♂.
Fredericksburg, VII, 20, 1913, (R. & H.), 12 ♂, 4 juv. ♂, 3 juv. ♀.
Orange, VII, 21, 1914, (R. & H.), 1 ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂, 1 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 3 ♂, 4 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 1 ♂, 2 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 6 ♂, 10 ♀.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 6 ♂.

Georgia.

Thompson's Mills, X, 1909, (H. A. Allard), 3 ♂, 1 ♀, [U. S. N. M.].
Toccoa, VIII, 4–5, 1913, (H.), 2 juv. ♀.
Buckhead, VIII, 2, 1913, (R. & H.), juv. numerous.
Stone Mountain, VIII, 3, 1913, (R. & H.), 1 juv. ♂.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂.
Augusta, VII, 29, 1913, (R. & H.), 1 ♀, 1 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♂, 1 ♀, 3 juv. ♂.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀.
Bainbridge, VII, 15–27, 1909, (J. C. Bradley), 4 ♀.
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 5 ♂, 1 ♀, 1 juv. ♂.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 8 ♂, 5 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂, 1 ♀.

Three of the species described by Scudder in 1892, *H. compactus*, *variegatus*[53] and *suturalis*, are inseparable from *H. rugosus;* though particularly based upon color pattern, not even sufficient color differences exist to enable one to choose various color forms such as are to be found in numerous other species of Orthoptera, where, however, names for these cannot be used owing to their multiplicity, intergradations and lack of specific importance. Other characters given to separate these "species" by Scudder are without exception worthless, this is due to their variability or to the fact that they are based upon differences which are so slight as to be unappreciable.

The specimen described, in 1901, by the same author as *H. citrinus,* is merely a very dark specimen of the present species, no other characters are given nor do any exist to further distinguish the specimen.

Morse has described a single male from Clarendon, Texas, as *H. immaculatus.* This insect is but a very pale individual of the present species. The normal tegminal marking of *H. rugosus* is absent, the

[53] This name has already been correctly synonymized by Blatchley, *Orth. of Indiana*, p. 270, (1903).

only remaining maculations suggesting those of *Pardalophora apiculata* (*H. tuberculatus* of authors), but much less distinct. This specimen, which shows the greatest amount of recession in color pattern of any individual of the present species we have seen, has in consequence, as is often true in such cases, a decidedly different facies, since the normal tegminal markings are all but obliterated.

In the present species minor differences exist in every large series in robustness, rugosity of the pronotum and angulation of the caudal margin of the same, length of tegmina, number and size of tegminal maculations and wing length. None of these differences are, however, of any geographic importance. The extremes in tegminal length of the material at present under consideration are as follows: males, 23.2 to 28 mm., females 28.8 to 35 mm. A number of the specimens before us of the present species from Nebraska exceed the maximum of these measurements, as is also true of western specimens of *Pardalophora phœnicoptera*.

The specimens before us exhibit much variation in the number and situation of the tegminal maculations, varying from a type in which the tegmina are covered with small and more or less disconnected maculations, to one in which these markings are much fused, forming five or six broad irregular transverse bands.

All of the adult specimens from above the fall line and north of Winter Park, North Carolina, have the disk of the wings primrose yellow, varying much less frequently to wax yellow. Southward nearly one-half the specimens from localities below the fall line have this portion of the wings peach red to orange pink,[54] while the remainder vary from light orange yellow to citron yellow. As in the last species treated, the width of the wing band varies considerably.

This species begins to appear adult about the middle of July, and by late August and early September is found mature in the largest numbers over that portion of its range treated in the present paper. The species is widely distributed and common through upland fields (Virginia localities), in fields near woods and through the undergrowth, particularly of pine woods (other records), while at Stone Mountain, Georgia, it was found in bunch-grass growing on otherwise bare granite slopes. In southern Georgia and northern Florida it is usually rather uncommon, only seldom being found abundant locally (Spring Creek, Georgia; Jacksonville, Florida). The records given above are the most southern for the species in Florida.

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[54] These specimens are distributed through the present series as follows: Winter Park, 4 ♂, 5 ♀; Columbia, 1 ♂; Bainbridge, 2 ♀; Spring Creek, 2 ♂; Jacksonville, 5 ♂, 1 ♀; Live Oak, 1 ♂.

Dissosteira carolina (Linnæus).

Maryland.

Glen Echo, VII, 10, 1914, (H.), 1 ♀.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♀.
Orange, VII, 21, 1913, (R. & H.), 2 ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂.
Montgomery County, (E. A. Smyth Jr.), 1 ♂, [Hebard Cln.].
Petersburg, VII, 23, 1913, (R. & H.), 1 ♂.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), "common as usual in dusty places."
Greensboro, VII, 26, 1913, (R. & H.), 1 ♂, 1 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 ♂.
Florence, IX, 6, 1911, (R. & H.), fairly common.
Magnolia, IX, 5, 1911, (R. & H.), occasional.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂, 2 ♀.
Dalton, VIII, 7, 1911, (R.), 1 ♂.
Thompson's Mills, (H. A. Allard), 1 ♂, [U. S. N. M.].
Silver Lake, VIII, 10, 1913, (J. C. Bradley), 1 ♂.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♀.
Augusta, VII, 29, 1913, (R. & H.), 1 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), occasional.
Billy's Island, XI, 1912, (J. C. Bradley), 2 ♂, 5 ♀.
Bainbridge, IX, 3–7, 1910, (J. C. Bradley), 1 ♂, 2 ♀.

No geographic variation appears to exist in the present series of this very widely distributed and ubiquitous species. Extremes in tegminal length are as follows: males, 29.3 to 33 mm., females, 32.5 to 40 mm. The species is everywhere to be found along dusty roads and on more or less bare spots in waste land. It is not nearly as abundant below the fall line south of central North Carolina, however, as in the Piedmont region, and has not been taken anywhere south of Enterprise, Florida. Sufficient work has been done in southern Florida to warrant the statement that the species is not to be found in that region.

Spharagemon crepitans (Saussure). Pl. XII, figs. 9, 10.

Georgia.

St. Simon's Island, VIII, 30, 1911, (H.), 1 ♂, 3 ♀.
Brunswick, VIII, 30, 1911, (H.), 3 ♂, 3 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 5 ♂, 3 ♀.

Florida.

Jacksonville, (T. J. Priddey), 2 ♀, [Hebard Cln.].
Atlantic Beach, VIII, 24, 1911, (H.), 4 ♂.
Pablo Beach, VIII, 11, 12, 1905, (R. & H.), 2 ♂, 4 ♀.
Cedar Keys, VIII, 15, 1905, (R. & H.), 1 ♂, 1 ♀.

The present insect may be separated from its nearest ally, *S. bolli*, by the following characters: form more attenuate; cephalic margin of pronotum more produced mesad and with margin of crest of prozona usually straight and horizontal throughout; tegmina with proximal lobe of costal margin more pronounced; wings with disk

usually a more obscure shade of yellow and with distal section more generally, but nowhere as strongly, suffused; caudal tibiæ with proximal whitish portion suffused with brown, adjacent black band not as sharply defined, remaining distal portion uniform, but in different specimens varying from cinnamon-buff to vinaceous-rufous; general coloration much more uniform (figs. 9 and 10). The present series shows clearly that the caudal tibiæ are never as highly colored as in *S. bolli*, and are in the majority of specimens cinnamon-buff.

The authors unfortunately once confused the species with *S. bolli*, the last two records given above having been referred to that species.[55]

This beautiful insect was found abundant at Cumberland Island, Georgia, on the sandy soil of a live oak "hammock" near the shore, but a thunder storm and limited time preventing the capture of a large series; it was found very scarce in a similar environment at St. Simon's Island and occasional at Brunswick, Georgia, and Atlantic Beach, Florida. The specimens taken at Pablo Beach and Cedar Keys, Florida, were found in open palmetto scrub and in palmetto scrub in pine woods, respectively.

The species has never been found far inland from the ocean (Davis has recorded a specimen from Gainesville, Florida, in the Agricultural Experiment Station Collection; in this case we feel sure that an error has been made in labelling); it was described originally from Georgia, and the only definite locality other than those given above at which the species has been taken is Key West, Florida, though examination of the specimen, recorded as *S. bolli* from Carrabelle, Florida, by Morse, shows it to be this species.

Spharagemon bolli (Scudder).

Virginia.

Arlington, VII, 9, 1914, (H.), 1 juv. ♀.
Fredericksburg, VII, 20, 1913, (R. & H.), 3 ♂, 5 ♀.
Orange, VII, 21, 1913, (R. & H.), 5 ♂, 2 ♀.
Lynchburg, VII, 22, 1913, (R. & H.), one colony.
Petersburg, VII, 23, 1913, (R. & H.), 3 ♂, 1 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 3 ♂, 5 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂, 2 ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♂, 3 ♀.
Greensboro, VII, 26, 1913, (R. & H.), 1 ♂.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♂, 2 ♀.
Black Mountain, VII and VIII, 1912, (W. Beutenmüller), 3 ♂, 6 ♀, [Davis Cln.].

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂.
Spartanburg, VIII, 6, 1913, (H.), 7 ♂, 1 ♀, 1 juv. ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 ♂.
Manning, V, 28, 1914, (W. Stone), 3 juv. ♂, 1 juv. ♀.

Georgia.

Dalton, VIII, 7, 1913, (R.), occasional.

[55] Proc. Acad. Nat. Sci. Phila., 1907, p. 290, (1907).

Jasper, VIII, 5, 1913, (R.), 2 ♂, 2 ♀.
Sharp Mountain, VIII, 6, 1913, (R.), 1 ♂, 2 ♀.
Rabun County, VII, 1910, (W. T. Davis), 2 ♂, 2 ♀.
Toccoa, VIII, 4–5, 1913, (H.), 2 ♂.
Currahee Mountain, VIII, 5, 1913, (H.), 1 ♂, 1 ♀.
Thompson's Mills, X, 1909, (H. A. Allard), 1 ♀, [U. S. N. M.].
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 ♂.
Buckhead, VIII, 2, 1913, (R. & H., Bradley), 8 ♂, 5 ♀.
Warm Springs, VIII, 9–10, 1913, (R.), 4 ♂, 7 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 3 ♀.

No geographic variation is shown in the present material, but individuals of many series vary greatly in size, tegminal length, general coloration and intensity and recession of color pattern. The extremes of tegminal length are as follows: males 22.6 to 28 mm., females, 27.8 to 33 mm.

The majority of specimens are of different shades of brown, moderately maculate and with caudal femora weakly thrice banded with a darker shade. A very few females are considerably paler, nearly immaculate, with the bands on the caudal femora greatly obscured, while a number of the males and two females are nearly black in general dark coloration, but have the color pattern nearly always decidedly intensified. None of these variations indicate any geographic significance, as all of the larger series include specimens of the palest as well as darkest coloration.

The present insect is widely distributed and abundant in upland situations, particularly in and about oak or mixed oak and pine woods of the Piedmont region. In the lower country it is found common in pine and oak woods as far south as Weldon, North Carolina; south of this in the lower country it is rarely met with and always in very few numbers (Goldsboro and Fayetteville, N. C., Florence, S. C., Thomasville, Ga.). The species has not been found southeast of Florence and Denmark, South Carolina; Macon and Thomasville, Georgia, and Tallahassee, Florida.

Spharagemon collare wyomingianum (Thomas).

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 1 ♂, 1 ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♂.
Billy's Island, VI, 1912, (J. C. Bradley), 3 ♂.
Bainbridge, IX, 3–7, 1910, (J. C. Bradley), 1 ♀.
Spring Creek, VI–VII, 1911–12, (J. C. Bradley), 1 ♂, 1 ♀.

Florida.

Live Oak, VIII, 26, 1911, (H.), 1 ♂, 1 ♀.

Previously recorded specimens from Thomasville, Georgia, and Fernandina and Gainesville, Florida, are inseparable from the present series; this is also true of one male recorded by the authors as *S.*

cristatum[56] from Albany, Georgia. The latter specimen is, however, somewhat larger, with longer tegmina and greater pronotal dimensions than any other specimen in the present series.

All of the material here studied belongs to one and the same geographic race of *S. collare*, but agrees perfectly with none of the known races as Morse has defined them. Taking Morse's differential characters[57] the series falls under *S. c. wyomingianum* in having a head which in facial aspect is nearly subequal in width, with more prominent eyes and in the proximal fuscous bands on the inside of the caudal femora being but faintly or not at all connected; in respect to size, however, the series agrees with the larger *S. c. scudderi*; the pronotal crest is very high, suggesting a very strong tendency toward *S. cristatum*. The increase in size of this series over New England individuals of *S. c. wyomingianum*, with accentuation of pronotal cristation, may be due to geographic variation, but the specimens before us from Virginia show no such variation, agreeing with material from Florida. Study of the genus, with large series from all portions of its distribution, can alone determine the validity and distributional extent of the races of the present species.

Measurements (in millimeters).

♂	Length of body.	Length of pronotum.	Height of pronotal crest.	Length of tegmen.	Length of caudal femur.
Petersburg, Va.	23.3	6.9	2.4	26.	14.7
Augusta, Ga.	23.9	6.2	2.2	25.1	14.4
Billy's Island, Ga.	22.5–23.9	6.–6.2	2.1–2.3	24.–25.3	13.4–14.
Albany, Ga.	26.2	7.1	2.5	28.	14.7
Thomasville, Ga.	21.–23.	6.1–6.5	2.–2.2	21.2–25.4	11.6–14.
Live Oak, Fla.	23.2	6.6	2.1	24.7	14.
♀					
Petersburg, Va.	30.5	7.3	2.5	28.8	16.3
Thomasville, Ga.	24.8–28.3	6.9–7.9	2.2–2.4	25.5–27.	15.–15.7
Bainbridge, Ga.[58]	28.2–29.9	7.4–8.3	2.5–2.9	27.8–29.3	15.3–16.
Gainesville, Fla.	26.	7.1	2.4	25.4	15.8

The present ammophilous species was found very scarce in a sandy field overgrown with scattered low weeds (Petersburg), only one specimen was found in a sandy scrub oak area (Augusta), while a pair were discovered in a sandy cotton field (Live Oak).

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[56] Proc. Acad. Nat. Sci. Phila., 1910, p. 593, (1911).

[57] *Psyche*, VII, p. 295, (1895).

[58] As Spring Creek is but a few miles from Bainbridge, we have here included the measurements of the female from that locality.

Scirtetica marmorata picta (Scudder).

North Carolina.

Southern Pines, 1906, 1 ♀, [U. S. N. M.].
Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂.
Winter Park, IX, 7, 1911, (R. & H.), 5 ♂, 1 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂.
Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♂, 2 juv. ♂.
Warm Springs, VIII, 9–10, 1913, (R.), 1 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂, 1 ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♂, 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 2 ♂, 6 ♀.
Brunswick, VIII, 30, 1911, (H.), 6 ♂.
Cumberland Island, IV, 29, 1911, (J. C. Bradley), 1 ♂; VIII, 31, 1911, (R. & H.), 1 ♀.
Spring Creek, VI–VIII, 1911–13, (J. C. Bradley), 6 ♂, 1 ♀.

Florida.

Jacksonville, V, 1885, (W. H. Ashmead), 1 ♂, [Hebard Cln.]; VIII, 25, 1911, (R. & H.), 4 ♂, 3 ♀; IX, 5, 1911, (W. T. Davis), 2 ♂.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 5 ♂, 2 ♀.
Enterprise, V, 11, 1 ♂, [U. S. N. M.].
Gotha, 1 ♂, [U. S. N. M.].

The intergradation between this geographic race and *S. m. marmorata*, shown by the material recorded above from southern North Carolina, has recently been fully treated by the present authors.[59]

The general coloration in the present series ranges from clove brown to ferruginous, often more or less strongly washed with gray.

The present insect is also ammophilous and is found usually in small colonies scattered through the woods in the more sandy situations. It was found above the fall line, but near its very edge at Columbia, "on sand among black jack oaks," and at Augusta, "in sandy tract covered with scrub oaks," at which localities long search revealed but five specimens, of which four were immature. These localities indicate the extreme northwestern distribution of the insect, which is found in the largest numbers in the low country through the more sandy portions of the pine forests, in which situations frequent scrub oaks are usually to be found as well. On the Gulf of Mexico the insect has been taken as far west as Gulfport, Mississippi.

Psinidia fenestralis (Serville).

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂.
Beaufort, end of VII, 1909, (F. Sherman Jr.), 1 ♂, [N. C. Dept. Agr.].
Wrightsville, IX, 7, 1911, (R. & H.), 1 ♂, 3 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 3 ♂, 3 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂, 1 ♀.

[59] Proc. Acad. Nat. Sci. Phila., 1912, p. 254, (1912). See also Morse, Carnegie Inst. Wash., Publ. No. 18, p. 37, (1904).

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 5 ♂, 2 ♀.
Columbia, VII, 28, 1913, (R. & H.), 2 ♂, 1 ♀.
Sumter, V, 30, 1914, (W. Stone), 1 ♂, [A. N. S. P.].
Isle of Palms, VIII, 15, 1913, (R.), 16 ♂, 22 ♀.
Sullivan Island, IX, 5, 1911, (R. & H.), 1 ♀.
Ashley Junction, VIII, 15, 1913, (R.), 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 1 ♂, 2 ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♂, 1 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂, 2 ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♀; XII, 1908, (H.), 1 ♂.
Offerman, IV, 22, 1911, 1 ♀, [Ga. State Cln.].
Brunswick, VIII, 30, 1911, (H.), 1 ♂, 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 4 ♂, 14 ♀.
Cumberland Island, IV, 29, 1911, (J. C. Bradley), 2 ♂; VIII, 31, 1911, (R. & H.), 2 ♂, 4 ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 4 ♂, 1 ♀.
Oglethorpe, VII, 1, 1910, (J. C. Bradley), 1 ♀.
Unadilla, 1 ♂, [Ga. State Cln.].
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.
Bainbridge, IX, 1910, (J. C. Bradley). 7 ♂, 3 ♀.
Spring Creek, VI–VIII, 1911–13, (J. C. Bradley), 28 ♂, 31 ♀, 1 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 2 ♂, 6 ♀; XI, 5, 1911, (W. T. Davis), 2 ♂, 1 ♀.
Ortega, IX, 6, 1913, (W. T. Davis), 2 ♂, 1 ♀.
Pablo Beach, VI, 25, 1912, (J. C. Bradley), 1 ♂, 1 ♀; IX, 5, 1911, XI, 4, 1913, (W. T. Davis), 1 ♂, 2 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 10 ♂, 7 ♀.

Much variability in size and wing length is shown by the above material, but this has apparently no geographic significance. The specimens from the Isle of Palms are as a whole large and show the greatest variation of any series in tegminal length, the extremes in that dimension measuring as follows: males, 19.5 to 23.6 mm.; females, 22.4 to 26.8 mm.

The species shows three pronounced types of alar disk coloration; yellow, orange and pink. In the series of specimens from localities south to New Jersey such coloration is found to be baryta yellow (yellow value), light jasper red (pink value) and occasionally bittersweet pink or pale yellow orange, showing that in this region the yellow and pink color forms exist, while occasional specimens of the two types are found with an orange tinge. The more southern series above listed shows no specimens in which this coloration is yellow, as in this series it is found to be light jasper red (pink value), flame scarlet (orange value) and frequently bittersweet pink or bittersweet orange, showing that in the southeastern United States the pink and orange color forms with intergradients exist. We have the pink type from as far south as the Isle of Palms, South Carolina; all of the Georgia and Florida material belongs either to the orange type or to that type with a slight pinkish suffusion.

In the present series a great number of specimens have the distal

portion of the wing beyond the wing-band heavily suffused, leaving only a nearly circular hyaline spot; this varies to individuals which have this portion of the wing wholly hyaline. In the paler series the majority of specimens show this latter condition, but great variation everywhere exists.

In coloration the present material shows all phases of intensification and recession of color pattern, tegmina ranging from those which are nearly immaculate to a much mottled and speckled type, and individuals which are in general coloration very pale to others which are very dark. In the present species the color pattern is most pronounced in dark individuals and is often almost obsolete in very pale specimens.

This ammophilous species is found everywhere in sandy situations over the coastal plain of the southeastern United States; it was taken at the fall line (Petersburg, Weldon, Columbia, Augusta), but has not been definitely recorded from the Piedmont plateau. The range of the species extends far northward, and, south of the fall line, far westward of the region treated in the present paper.

Trimerotropis maritima (Harris).

Plumpoint, Maryland, VIII, 10, 1913, (W. T. McAtee), 2 ♂, 1 ♀, 1 juv. ♀; VII, 7, 1912, X, 18, 1912, 1 ♂, 6 ♀, [all U. S. N. M.].

Piney Point, Md., VII, 4, 1879, 1 ♀; VIII, 12, 1878, 1 ♀, [U. S. N. M.].

Cedar Island, Virginia, VII, 13, 1914, (H. G. Dyar), 2 ♂, [U. S. N. M.].

Fortress Monroe, Va., VI, 8, 1884, 1 ♂, [Hebard Cln.].

Oceanview, Va., VIII, 9 and 10, 1904, (A. N. Caudell), 6 ♂, 1 ♀, [U. S. N. M.].

Beaufort, North Carolina, end of VII, 1909, (F. Sherman Jr.), 2 ♂, 1 ♀, [N. C. Dept. Agr.].

Wilmington, N. C., VII, 1906, (R. S. Wolgum), 4 ♂, 1 ♀, [N. C. Dept. Agr.].

Smith Island, N. C., X, 1906, (F. Sherman Jr.), 5 ♂, 1 ♀, [N. C. Dept. Agr.].

Atlantic Beach, Florida, VIII, 25, 1911, (R. & H.; on strand), 1 ♂, 1 ♀.

As previously stated by the authors, two of the six females recorded from Cape Henry, Virginia, have the caudal tibiæ showing a pinkish suffusion. No intergradation whatever with *T. citrina* is to be found, the hypothesis that hybridization with that species occurred,[60] being due to the fact that it was not recognized that both red and yellow tibiæ are found in *maritima*. It is true that over the greater portion of the range of the present insect, individuals of the species have yellow tibiæ, but from Cape May, New Jersey, southward, specimens are sometimes met with having reddish tibiæ. Of the series here recorded one male (Oceanview) and one female (Plumpoint) have the caudal

[60] Morse, Carnegie Inst. Wash., Publ. No. 18, p. 38, (1904). See also Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1910, p. 631, (1911).

tibiæ suffused with reddish. Numerous specimens from south of Virginia have the wing-band unusually broad and solid for the species, reaching a maximum width on the radiate field of 6 mm. in some males and 7 mm. in some females.

This species is a native of the sand dunes and sandy strand of the Atlantic coast; it has, however, been found some distance inland in areas of loose sand. It has been previously correctly recorded from as far south as the coast of North Carolina.

Trimerotropis citrina Scudder.

Pennsylvania.

Philadelphia Neck, VII, 29, (H. W. Wenzel), 1 ♀, [A. N. S. P.].

Maryland.

Chesapeake Beach, IX, 17, 1914, (A. N. Caudell), 2 ♂, 1 ♀, [U. S. N. M.].

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 5 ♂, 3 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♂.
Wrightsville, IX, 7, 1911, (R. & H.), 1 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 4 ♂, 2 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 ♂, 2 ♀.
Sullivan Island, IX, 5, 1911, (R. & H.), 1 ♂, 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 3 ♂, 1 ♀.

Georgia.

Clayton, 2,000 feet, VI, 1909, (W. T. Davis), 1 ♀.
Tallulah Falls, VII, 1910, (W. T. Davis), 1 ♂.
Thompson's Mills, (H. A. Allard), 2 ♀, [U. S. N. M.].
Atlanta, VIII, 30, 1913, (J. C. Bradley), 1 ♀.
Silver Lake, VIII, 10, 1913, (J. C. Bradley), 1 ♂.
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂.
Vicinity of Stone Mountain, VIII, 3, 1913, (J. C. Bradley, R. & H.), 3 ♂, 1 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 2 ♀.
Tybee Island, IX, 2, 1911, (H.), 1 ♂.
Jesup, IX, 1, 1911, (R. & H.), 1 ♂.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♂, 2 ♀.
Brunswick, VIII, 30, 1911, (H.), 3 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 4 ♂, 11 ♀.
Hebardville, V, 15, 1915, (H.), 1 juv. ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 1 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 4 ♂.
Thomasville, XII, 1908, (H.), 1 ♂.
Unadilla, VI, 25, 1910, (J. C. Bradley), 2 ♂, 2 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀; IX, 1, 1910, (J. C. Bradley), 1 ♀.
Bainbridge, IX–X, 1910, (J. C. Bradley), 4 ♂, 5 ♀.
Spring Creek, VIII, 26–28, 1913, (J. C. Bradley), 1 ♂.

Florida.

Jacksonville, IX, 7, 1913, (W. T. Davis), 1 ♀; XI, 5, 1911, (W. T. Davis), 1 ♂.
Atlantic Beach, VIII, 25, 1911, (R. & H.), 4 ♂, 1 ♀.
Pablo Beach, IX, 27, 1913, (W. T. Davis), 1 ♂.
Daytona, XI, 11, 1911, (G. P. Englehardt), 1 ♂, [B. I.].
St. Vincent Island, XI, 1, 1910, (W. L. McAtee), 2 ♀, [U. S. N. M.].

Little variation of any kind is shown by the great majority of specimens in the present series. Morse's supposition that

this insect hybridizes with *T. maritima* is explained under that species.[61]

Although the present species is essentially a midsummer insect, material from southern Georgia shows that adults are not scarce in that region as late as October, and that battered individuals are found there, though rarely, as late as December. This ammophilous insect is found in sandy situations over its range, from the ocean beaches (where, however, it is rarely found and in few numbers) to the waste land and river borders of the southern mountain valleys and Piedmont region and far west of the area treated in the present paper. It is most abundant, however, in the low country south of North Carolina, and is everywhere to be found in the sandy regions of southern Georgia and northern Florida. In extreme southern Florida the species is decidedly scarce, a few specimens having been recorded only from Key West. The most northeastern localities at which the species has been found are Philadelphia Neck, Pennsylvania, and Maryland, though the occurrence of the species north of southern Virginia is very exceptional.[62]

Trimerotropis saxatilis McNeill.

Highlands, North Carolina, IX, 1906, 2 ♂, 2 ♀, [U. S. N. M.].
Rabun Bald, Georgia, 4,000–4,800 feet, VIII, 21, 1913, (J. C. Bradley), 1 ♂, 1 ♀.
Stone Mountain, Georgia, 1,000–1,686 feet, VIII, 3, 1913, (Bradley, R. & H.), 83 ♂, 70 ♀.

The following notes were taken from observations made on Stone Mountain, Georgia, a granitic knob rising abruptly 686 feet above the surrounding Piedmont peneplain, which in this vicinity has a mean elevation of 1,000 feet. "*T. saxatilis* found on bare granite slopes where areas of lichens were the only vegetation to be found. The northern face of the mountain is precipitous. The species was plentiful about the gently rising slopes at the south base of the mountain where the bare rock surfaces were first encountered, particularly so in areas of rock fragments near the adjacent bunch grass vegetation. On ascending further the species was found less numerous, becoming quite infrequent upon the bare rock areas on the slopes clothed with open pine woods, but at the summit, where large bare rock areas occupy the greater portion of the surface, the insect was again

[61] See Hebard, *Ent. News*, XXVI, p. 403, (1915). The south Florida species, *Trimerotropis acta*, is there described and compared with *maritima* and *citrina*. The misidentifications of that species, as *maritima* by Caudell, from Palm Beach, and as *citrina* by Davis, in part, from Ocean Beach near Miami, are there corrected.

[62] The record of this species from Lehigh Gap, Pennsylvania, applies to *Spharagemon saxatile planum* Morse. See Rehn, *Ent. News*, XIII, p. 311, (1902).

found in considerable numbers. The flight of the species is distinctive; taking wing with great rapidity, individuals fly very low for a short distance, but evince great wariness and often have to be approached a number of times before it is possible to come within striking distance. Only infrequently was the flight accompanied by a sound, this being a faint clicking whirr like that occasionally produced by individuals of the western *T. cyaneipennis.* The granite surfaces were for the greater part stained to a blackish hue and the majority of specimens were exactly of this coloration, a few were paler, matching similar areas of rock surface, while occasional specimens were mottled with greenish and these exactly blended with the lichenose areas of rock."

The disk of the wings varies in the present species from light dull green-yellow to the palest green-yellow.

Except for the color variation mentioned above, little variation is to be found in the present series. Extremes of tegminal length measure as follows: males 18.6 to 21.4 mm., females 22.8 to 27.2 mm.

In Georgia the species is known only from White Oak Gap and Flat Rock on Sand Mountain, outside of the localities given above. The distribution of this species is highly discontinuous, as it is confined to bare rock surfaces; it has not been taken in the Appalachians north of Highlands, North Carolina.

Romalea microptera (Beauvois).

1839. *Romalea marci* Serville, Hist. Nat. Ins., Orth., p. 623. [Near South Carolina.]

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♂.

Georgia.

Social Circle, X, 18, 1907, (J. F. Lewis), 1 ♂, [U. S. N. M.].

Bainbridge, VI, 2, 1911, (J. C. Bradley), 1 juv. ♀.

Waycross, V, 8, 1911, 1 juv. ♂, 1 juv. ♀, [Ga. State Cln.].

Hebardville, late V, 1915, (Wm. Walker), 1 juv. ♂, 2 juv. ♀, [Hebard Cln.].

Isle of Hope, IX, 3, 1911, (R. & H.), 2 ♂, 2 ♀.

Florida.

Warrington, (A. H. Gale), 3 juv. ♀, [Hebard Cln.].

Jacksonville, VIII, 25, 1911, (R. & H.), 1 ♀.

South Jacksonville, IX, 28, 1913, (W. T. Davis), 1 ♂.

Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 ♂.

St. Petersburg, IV, 10, 1908, 1 juv. ♂, [A. N. S. P.].

Rockledge, 1 ♀, [A. N. S. P.].

Melbourne, (A. C. Sirdefield), 1 ♀, [U. S. N. M.].

Capron,[63] 1 juv. ♀, [Hebard Cln.].

Cocoanut Grove, VIII, 19, 1911, (J. W. Harshberger), 1 ♀, [A. N. S. P.].

Turners, (G. W. Morrill), 1 ♂, [U. S. N. M.].

There can be no question but that *Romalea marci* of Serville is

[63] This locality is the abandoned Fort Capron, situated near the present town of Viking.

based on the melanistic color phase of this species. The name should be synonymized, once and for all, under *microptera*.

These specimens exhibit the usual amount of individual variation in size. The Columbia and Social Circle males are typical of the melanistic phase, while all of the Isle of Hope specimens and that from South Jacksonville have decided tendencies in the same direction, the dorsum of the head, pronotum and abdomen, as well as the tegmina and limbs, showing much more blackish than usual in the yellow phase.

The range of this species is now known to extend north in the South Atlantic States as far as Cabarrus County, North Carolina (Sherman and Brimley).

The species was taken in pine woods undergrowth (Jacksonville and Isle of Hope), in palmetto "hammock" (Atlantic Beach) and in grass in waste field (Columbia).

Having personally quite carefully examined the more austral portions of both Carolinas, as well as the greater portion of the State of Georgia, it seems very certain to us that the locality given by Serville in his original description of *Acridium coloratum*[64] (*Chromacris colorata* of present-day nomenclature) is erroneous. His remarks are "Donné par M. Marc du Havre, qui l'a reçu d'une partie de l'Amérique, voisine de la Caroline du Sud." We are convinced that the specimen he had did not come from the eastern United States, but probably was of Mexican origin, as the species is so striking, and so universally secured by collectors who encounter it, that it must make itself quite in evidence in its native habitat.

Stenacris vitreipennis (Marschall).

North Carolina.

Lake Ellis, V, 14, 1906, 1 ♂, 1 ♀, [U. S. N. M.].
Wilmington, VIII, 1, 1909, 2 ♂, 2 ♀, [B. I.].

Georgia.

Jesup, IX, 1, 1911, (R. & H.), 1 ♂.
Blackshear, V, 10, 1911, 1 ♀, [Ga. State Cln.].
Thalman, IV, 28, 1911, 1 ♀, [Ga. State Cln.].
Mixon's Hammock, V, 16, 1915, (H.), 1 ♂.
Billy's Island, VII, 1912, (J. C. Bradley), 1 ♀.
Chase Prairie, IX, 5 and 15, 1913, (J. C. Bradley), 3 ♂, 5 ♀, 1 juv. ♂.

Florida.

Jacksonville, V and VIII, 1885, (W. H. Ashmead), 1 ♂, 1 juv. ♂; (T. J. Priddey), 1 ♂, [all Hebard Cln.].
South Jacksonville, IX, 3, 1913, (W. T. Davis), 1 ♂.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀.

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[64] *Hist. Nat. Ins.*, Orth., p. 675, (1839).

Daytona, XI, 11, 1911, 1 ♂, 1 ♀, [U. S. N. M.].
Silver Spring, XI, 25, 1911, 1 ♂, [U. S. N. M.].
Enterprise, V, 13 and 15, 1 ♂, 1 ♀, [U. S. N. M.].
Rockledge, II, 5, 1880, 1 ♂, [U. S. N. M.].
Melbourne, III, 1 ♂, [A. N. S. P.].

Six specimens, the Jesup male, two males from Chase Prairie, a Jacksonville male and the Atlantic Beach pair, have the pale lateral line on the head, ventral margin of the lateral lobes and pleura distinctly indicated, faint and incomplete traces of it existing in several other specimens. The Jesup male is the only one having the dorsal surface of the head, pronotum and tegmina faintly brownish, the others, unless by evident discoloration, having this area at least in part green. The three young all show a narrow dark mediolongitudinal line on the head, pronotum and attingent edges of the undeveloped tegmina and wings. The antennæ in these are similar in form to those of the adults.

The range of this species is much more restricted than is the case with the frequently associated *Leptysma marginicollis*. The most northern record known is from Lake Ellis, North Carolina (Sherman and Brimley), while southward it is unknown from any localities more elevated than Waycross and Thomasville, Georgia. The species is thus seen to extend over but a portion of the coastal plain and southward it has been taken as far as Miami, Florida, the most western known point of its occurrence being Appalachicola.

All of the material taken by us was secured in high grasses or rushes in or around swamp or marsh land, except in the Okeefenokee Swamp where the species was everywhere to be found in the dense green undergrowth of small saplings growing out of water in the almost impenetrable swamp forest.

Leptysma marginicollis (Serville).

Maryland.

Piney Point, VIII, 9, 1913, (W. L. McAtee), 1 juv. ♂, [U. S. N. M.].
Washington, D. C., 1 juv. ♀, Hebard Cln.].

Virginia.

Alexandria, V, 27, (G. S. Miller), 1 ♂, 2 ♀, [U. S. N. M.].
Dismal Swamp, VII, 22, (G. P. Englehardt), 1 ♂, [B. I.].

North Carolina.

Roanoke Island, VII, 25, (G. P. Englehardt), 1 ♀, [B. I.].
Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♂, 7 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 2 ♂.
Wilmington, IX, 8, 1911, (R. & H.), 1 ♂.
Lake Ellis, V, 16, 1906, 1 ♀, [U. S. N. M.].

South Carolina.

Ashley Junction, VIII, 15, 1913, (R.), 6 juv. ♂, 7 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 1 juv. ♂, 1 juv. ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 juv. ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂.

Billy's Island, V, 16, 1915, (H.), 1 ♀; VI–VII, 1912, (J. C. Bradley), 1 ♂, 1 ♀.
Honey Island, VI, 1, 1912, (J. C. Bradley), 1 ♀.
Chase Prairie, IX, 5, 1913, (J. C. Bradley), 1 juv. ♀.

Florida.

Jacksonville, VIII, 1885, (W. H. Ashmead), 1 ♂, (T. J. Priddey), 1 ♀, [all Hebard Cln.].
South Jacksonville, IX, 7, 1913, (W. T. Davis), 1 ♀.
Ortega, Duval County, IX, 6, 1913, (W. T. Davis), 1 ♀, 1 juv. ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 6 ♂, 3 ♀, 1 juv. ♂, 4 juv. ♀.
Pablo Beach, IX, 5, 1913, (W. T. Davis), 1 ♂.
Baldwin, III, 7, 1879, (E. A. Schwarz), 1 ♂, [U. S. N. M.].
Enterprise, V, 24 and 25, 2 ♂, [U. S. N. M.].

The usual increase in size southward is less marked in this species than is generally the case, and then only in the female sex. In both sexes any geographic size tendencies are discounted by the very great individual size variation, the extreme males of the Atlantic Beach series, for instance, measuring as follows:

Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
28.7 mm.	4.6 mm.	23.6 mm.	12.5 mm.
31. "	5.2 "	28. "	14.6 "

The angle of the fastigium, while individually variable, is as a rule more acute in the more southern specimens than in the others, say from Raleigh, North Carolina. The young from Ashley Junction represent the four instars preceding maturity, while those from Greensboro lack the last two stages. From the evidence in hand it seems that, over at least a considerable portion of its range, this species occurs in an adult condition throughout the year.

The greenish color phase is more in evidence in the young than in adults, but the Honey Island females are quite greenish, the Billy's Island females similar, but to lesser degree. A medio-longitudinal line of purplish or pinkish is indicated more or less distinctly in the greater portion of the young.

This marsh and swamp-loving species generally frequents tall grasses and reeds in the situations preferred by it, but occasionally has been taken (Wilmington) in high bushes on the edge of a gum swamp. The wet spots in pine woods are much frequented by it.

Individual Variability and Dimorphism in Schistocerca alutacea and obscura.

The authors have in their hands a series of over five hundred specimens belonging to these two species as understood by them. The form for which Scudder used the name *obscura*[65] is well separated

[65] *Proc. Amer. Acad. Arts and Sci.*, XXXV, p. 465, (1899).

from *alutacea*, except in the case of brown-phase females, regarding which see below under *obscura*. The other species has been the cause of considerable difference of opinion, two names, *alutacea* Harris and *rubiginosa* Scudder, the first based on striped individuals, the other one on brown or reddish brown unstriped specimens, being involved. The present authors have individually and collectively expressed their opinions regarding the specific identity of these forms,[66] and in the light of the present material we see no necessity for changing, or in any way modifying, our former conclusions.

In both species we find developed two color phases: one olivaceous or deep wine color, having a medio-longitudinal yellow stripe on the head, pronotum and anal area of the tegmina, the other being of a more or less uniform brown or red brown color without any distinct medio-longitudinal line. Correlated with these color differences we usually find readily perceived structural differences in both *obscura* and *alutacea*, the striped phase typically having the pronotum more tectate, more compressed and appreciably narrowing cephalad, and the head narrower with the fastigium more produced. The brownish phase typically has the pronotum less tectate, more robust and less narrowing cephalad, while the head is broader with the fastigium blunted, broader and more declivent. The first of these forms in *alutacea* is *alutacea* s.s., the second is *rubiginosa*, regarding the distinctness of which Morse says,[67] "typically these two species differ in color, structure and haunts." Later the same author modifies his first statement, restricting it to New England material[68] as follows: "It is very probable that some so-called species are but forms of one which varies greatly in color and structure. In New England the two forms known as *alutacea* and *rubiginosa* seem to be constantly different structurally, though *rubiginosa* has a color-variety resembling *alutacea*. Southward and westward the structural gap between the two seems to be bridged, and both vary much in size, color, form, and proportions of parts." If we were called upon to deal only with typical material, it would be an extremely simple matter to consider the two phases as species, but unfortunately a very considerable portion of our series is not typical, but apparently, and when carefully studied actually, intermediate not only in color but so, more rarely, however, in structure and proportions. The

[66] *Ent. News*, XIII, p. 89, (1902); *Ibid.*, p. 312, (1902); Proc. Acad. Nat. Sci. Phila., 1907, pp. 292, 293, (1907).
[67] Carnegie Inst. Wash., Publ. 18, p. 39, (1904).
[68] Carnegie Inst. Wash., Publ. 68, pp. 43–44, (1907).

yellow line narrows and finally dies out, the fastigium broadens out and the pronotum and head become more robust toward the "*rubiginosa*" type in the intermediates in certain extensive series. We have such series of *alutacea* from a number of localities in New Jersey, South Carolina and Georgia. The proportionate depth of the caudal femora in general is greater in the *rubiginosa* type, but this is by no means an absolute rule, as some series of that phase show all sorts of variation in this respect. The "*alutacea*" phase, however, is more uniform in having the femora more slender. The number of scutes in the paginal pattern on the caudal femora also varies greatly and without phase correlation.

We have examined a number of New England specimens of "*alutacea*" and "*rubiginosa*" determined by Morse, and the remarks he has made about their differences hold true, but when material from New Jersey southward is considered the inter-relation of the two forms becomes so complicated that they cannot be separated when large series are considered.

Taking up the question from the standpoint of habitat, it is true that as a rule the striped types prefer moist areas with bracken, etc., while the brown forms are more at home in dry woods and brush, old fields and among dune thickets, although numerous specimens of each phase have been taken in the habitat preferred by the other. It is highly probable that the near future will show similar environmental preferences by other forms of this genus now considered of specific rank, but doubtless of no more standing relatively than the phases of *obscura* and *alutacea*. Sufficient field observations have been made, outside of those in the eastern United States, to convince us that in the genus *Schistocerca* color *per se* is, as a rule, a poor specific criterion, while sufficient laboratory experience has been had to convince us equally well that, in this genus, certain structural features are quite plastic, and in consequence to be used with caution and discrimination in diagnostic work.

The principle of dimorphism, which plays such an important part in the Orthoptera, satisfactorily explains to us the problem here considered. In the present cases the color differences are quite decided, with a fair number of non-typical specimens nearer one type than the other and a relatively smaller number really intermediate. The structural differences, generally correlated with the color differences, are typically quite appreciable, but their constancy fluctuates in different localities. Color dimorphism is known to exist in certain genera not distantly related to *Schistocerca* and

structural dimorphism, aside from the subject of macropterism and brachypterism, is found in certain Dermaptera and in the Orthoptera in certain groups of Phasmidæ, very frequently in the Acrydiinæ, in certain Truxalinæ (*Eritettix*, *Macneillia*, etc.) and in species of *Gryllus*.

The final word on this very perplexing question can be said only after careful breeding experiments have been made. As far as examination of dry material and field observations are concerned, we feel that little additional information, except purely statistical data, can be secured. We have had this problem in mind for over ten years and have utilized every opportunity to secure data bearing upon it, with the results here summarized.

Schistocerca obscura (Fabricius).

Delaware.

Dover, (Macomber), 1 ♀, [A. N. S. P.].

North Carolina.

Wrightsville, IX, 7, 1911, (R. & H.), 5 ♂, 5 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♂, 1 ♀.

Ashley Junction, VIII, 15, 1913, (R.), 1 ♂.

Florida.

Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♀.

South Jacksonville, IX, 7 and 28, 1913, (W. T. Davis), 1 ♂, 1 ♀.

Ortega, Duval County, IX, 6, 1913, (W. T. Davis), 1 ♀.

Georgia.

Thompson's Mills, X, 1909, (H. A. Allard), 1 ♀, [U. S. N. M.].

Augusta, VII, 29, 1913, (R. & H.), 1 ♀.

Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 2 ♀.

Savannah, VIII, 7, 1878, (Grote), 1 ♀; VIII, 22, 1881, (Howard), 1 ♀, [both U. S. N. M.].

Tybee Island, IX, 2, 1913, (R. & H.), 2 ♂, 4 ♀.

Sandfly, IX, 3, 1911, (R. & H.), 1 ♀.

Cumberland Island, VIII, 31, 1911, (R. & H.), 5 ♂, 11 ♀.

The different form of the subgenital plate of the male is a constant and readily perceived diagnostic character for this species when compared with *alutacea*, to which it is closely related. The presence of dark bars on the dorsal surface of the caudal femora, and the general dark purplish or blackish color of the caudal tibiæ, we find to be variable, the former, however, being generally distinctly indicated in striped specimens of both sexes of this species and frequently absent or very faint in brownish individuals. In consequence brown females, having the femora without dark bars on the dorsal surface, are with difficulty separated from similarly colored females of *alutacea*, the greater size of *obscura* being the best means of discrimination in such cases, as no constant differential structural features exist, as far as we can determine. We have before us one striped male from Wrightsville, North Carolina, which has the usual femoral bars practically absent, while of the "*rubiginosa*" type we have

four females of which but two have distinct indications of these bars, which are entirely absent in one (Tybee Island). The color of the caudal tibiæ varies in the extent to which olivaceous green replaces part of the blackish purple, in the "*rubiginosa*" specimens warm browns replacing the olivaceous green. All of the Wrightsville series is striped, as is the case with the material from Florence, Ashley Junction, Augusta, Albany, Sandfly, Atlantic Beach, South Jacksonville and Ortega; the series from Tybee Island includes one brownish female and that from Cumberland three brown females. The latter all have the tegmina more or less distinctly multi-maculate with fuscous, while the similar phase female from Tybee Island is almost entirely plain.

The structural differences between the color phases follow the lines discussed in the preceding summary, while the extremes in size in the two sexes measure as follows:

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂ Detroit, Fla.	33.4 mm.	7.5 mm.	30.5 mm.	20.4 mm.
♂ Key Largo, Fla.	42. "	8.8 "	37.5 "	22.1 "
♀ Tybee Island, Ga.	49.5 "	10.2 "	44. "	27.8 "
♀ Tybee Island, Ga.	61.3 "	12.9 "	49.3 "	32. "

It will be seen from this that such size variation as is found can be considered purely individual and not geographic. All of the measured specimens are in the extreme striped condition, except the maximum male, which has the stripe stopping at the caudal margin of the pronotum and the general color quite brownish.

The range of this striking species in the southeastern States is chiefly confined to the country below the fall line, *i.e.*, the sands and gravels of the coastal plain and peninsular Florida, as it is apparently rare and local in the Piedmont region (Thompson's Mills, Georgia, and Druid Hill Park, Baltimore, Maryland).

On Tybee and Cumberland Islands and at Wrightsville the species was found among strand bushes and the low oaks, palmettoes, etc., there growing; at Florence, Augusta and Albany it frequented high weeds in or near fields, generally of cotton, and at Ashley Junction it occurred in long-leaf pine woods. It was common only occasionally, being generally but few in number and very frequently associated with *alutacea*.

Schistocerca alutacea (Harris).

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂.
Wilmington, IX, 8, 1911, (R. & H.), 8 ♂, 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 10 ♂, 8 ♀.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♂.
Isle of Palms, VIII, 15, 1913, (R.), 1 ♂, 1 ♀.
Ashley Junction, VIII, 15, 1913, (R.), 15 ♂, 10 ♀, 1 juv. ♂.
Yemassee, IX, 4, 1911, (R. & H.), 14 ♂, 7 ♀.

Florida.

Jacksonville, (Priddey; Ashmead), 2 ♂, 3 ♀, [Hebard Cln.]; XI, 5, 1911, (W. T. Davis), 1 ♂; VIII, 25, 1911, (R. & H.), 5 ♂, 4 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 28 ♂, 27 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♀.
Tybee Island, IX, 2, 1911, (R. & H.), 2 ♂.
Isle of Hope, IX, 3, 1911, (R. & H.), 6 ♂, 2 ♀.
Sandfly, IX, 3, 1911, (R. & H.), 8 ♂, 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 juv. ♂.
Brunswick, VIII, 30, 1911, (H.), 8 ♂, 4 ♀.
Jesup, IX, 1, 1911, (R. & H.), 5 ♂, 6 ♀.
Groveland, Cannoche River, VII, 28, 1913, (J. C. Bradley), 1 ♂.
Billy's Island, VI–VII, 1912, IX, 1–5, 1913, (J. C. Bradley), 10 ♂, 6 ♀, 2 juv. ♂, 2 juv. ♀.
Jordan's, Billy's Island, VIII, 31, 1913, (J. C. Bradley), 3 ♂, 2 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 17 ♂, 2 ♀.
Homerville, VIII, 27, 1911, (R. & H.), 6 ♂.
Albany, VIII, 1, 1913, (R. & H.), 3 ♂, 2 ♀.
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 8 ♂, 7 ♀, 1 juv. ♀.

Regarding this species, it seems most desirable to give under localities a summary of the color conditions, as well as the principal uncorrelated variational features, found in the adults of this extensive series. We have restricted ourselves to those features which bear upon the supposed distinctness of *alutacea* and *rubiginosa*.

Weldon. One, *rubiginosa* phase.

Wilmington. Seven, *alutacea* phase. Two, *rubiginosa* phase. Males. Considerable variation in head width in six *alutacea* phase, this feature not typical in most, one specimen has head as wide as similarly sized or even larger *rubiginosa* phase males. Frontal costa width not typical in all striped specimens.

Winter Park. Eighteen, all *rubiginosa* phase. Frontal costa and head width very variable, as much as the extremes of the two phases. One female has head and pronotum width typical of *alutacea* phase, but frontal costa and caudal femora typical of *rubiginosa* phase.

Columbia. One, *rubiginosa* phase.

Isle of Palms. Two, *rubiginosa* phase, but with head and pronotum decidedly (♂) or weakly (♀) striped.

Ashley Junction. Twenty-three, *alutacea* phase. Three, showing *rubiginosa* tendencies. Two, *rubiginosa* phase.

Yemassee. Eleven, *alutacea* phase. Two, practically intermediate in color. Eight, *rubiginosa* phase; the males (six) show considerable variation in head width, fastigium and frontal costa width and depth of caudal femora.

Augusta. One, intermediate in color and structure.

Tybee Island. Two, *rubiginosa* phase.

Isle of Hope. One, *alutacea* phase. Three, intermediate in color. Four, *rubiginosa* phase. The males (six) show no other structural intermediates, but specimens intermediate in color have deep femora.

Sandfly. Five, *alutacea* phase. Four, *rubiginosa* phase.

Brunswick. Eleven, *rubiginosa* phase. One, *alutacea* phase.

Jesup. Seven, *rubiginosa* phase. Four, *alutacea* phase. Males show little, and then connected, difference in fastigial width; costal width variation very considerable, but connected.

Groveland. One, *rubiginosa* phase.

Billy's Island. Fourteen, *rubiginosa* phase. One, intermediate. One, *alutacea* type.

Jordan's. Four, *rubiginosa* phase. One, *alutacea* phase.

Suwannee Creek. Eighteen, *rubiginosa* phase. One, *alutacea* phase. The latter (♂) has the frontal costa no narrower than in numerous decided *rubiginosa* phase individuals.

Homerville. Five, *rubiginosa* phase. One, *alutacea* phase. Structural differences in fastigium in these but little and connected, extremes decided, as in the case of femoral depth.

Albany. Four, *alutacea* phase. One, *rubiginosa* phase. Males (three) all *alutacea*, one has frontal costa typical, others have this very much broader.

Spring Creek. Fifteen, *rubiginosa* phase.

Jacksonville. Eleven, *rubiginosa* phase. Four, *alutacea* phase. Those collected by ourselves (seven *rubiginosa*, two *alutacea*) show no marked structural differences in fastigium in striped and unicolorous individuals. Head width little variable and apparently with extremes connected. Femoral depth difference appreciable.

Atlantic Beach. Thirty-two, *rubiginosa* phase. Two, intermediate (maculate tegmina type). Twenty-one, *alutacea* phase. Specimens of *alutacea* phase have the frontal costa of usual *rubiginosa* width.

Live Oak. One, *alutacea* phase.

We also have before us from New Jersey alone, one hundred and twenty-eight specimens collected in southern New Jersey by Dr. Henry Fox,[69] a series of twenty-two from Stafford's Forge with exact habitat data, another of twelve from Taunton and a considerable

[69] Recorded by that author as "*S. alutacea* (Typical race); *S. rubiginosa* (= *rubiginosa* phase of *alutacea*), and *S.* sp. cf. *obscura* (= unicolorous phase of *obscura*)." Proc. Acad. Nat. Sci. Phila., 1914, pp. 507–509, (1914).

number from the State secured by various collectors at numerous localities. These all bear out our above-expressed general conclusions. The Taunton series form a particularly interesting illustration of intergradation, which is also marked in the other lots where the series are of sufficient size. The only exception to the latter statement seems to be that the *alutacea* phase is very rare on the barrier beach coastal dunes, as we have seen but one individual (♀) of that phase which was taken in a strand habitat (Seaside Park, New Jersey). The Isle of Palms individuals also show a tendency toward *alutacea* in the indication of an incomplete stripe.

We have examined a series of Key West, Florida, individuals of both sexes, all being *rubiginosa* phase, and these show great variation in the width of the head.

The generally greater size of the individuals from the barrier beaches of New Jersey and longer tegmina of the same, when compared with material from the interior pine-land of the State, a point to which we have already called attention,[70] loses some of its apparent significance when the large series from that State now available are considered. The tegminal length is now known to be individually variable in both the pine-land and beach specimens. Southward the difference between the strand and more interior material is less pronounced than in New Jersey, although the largest individuals from a general region are, as a rule, from the beaches. This is not invariable, as Winter Park, North Carolina; Yemassee, South Carolina; Isle of Hope and Brunswick, Georgia, and Jacksonville, Florida, all localities removed from the strand proper, are represented by very large individuals. The Isle of Palms specimens, which are from typical strand situations, are of but average size.

Measurements (in millimeters) of extremes of the series here examined are as follows:

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂ Ashley Junction, S. C. (*alutacea*)	28.2	6.1	24.3	17.
♂ Brunswick, Ga. (*rubiginosa*)	28.3	6.7	25.5	16.1
♂ Albany, Ga. (*alutacea*)	27.5	6.	25.5	16.5
♂ Tybee Island, Ga. (*rubiginosa*)	36.2	8.4	32.	19.4
♂ Billy's Island, Ga. (*rubiginosa*)	36.	7.9	32.5	19.8

[70] Proc. Acad. Nat. Sci. Phila., 1907, p. 293, (1907).

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂ Atlantic Beach, Fla. (*rubiginosa*)	39.3	8.5	32.8	20.5
♀ Winter Park, N. C. (*rubiginosa*)	46.5	10.	35.	22.3
♀ Sandfly, Ga. (*alutacea*)	47.2	9.2	35.6	23.
♀ Live Oak, Fla. (*alutacea*)	45.	8.3	34.5	21.9
♀ Yemassee, S. C. (*rubiginosa*)	50.6	11.2	40.3	25.9
♀ Atlantic Beach, Fla. (*rubiginosa*)	60.8 (abdomen distended)	11.3	41.8	26.8
♀ Atlantic Beach, Fla. (*rubiginosa*)	56.	11.1	43.8	25.8

The Atlantic Beach and Jacksonville series average large, the Ashley Junction series shows widely different extremes in size, but the average is medium, while the Yemassee, Winter Park, Wilmington and Brunswick representations are very variable individually in this respect. The Billy's Island specimens average large but vary greatly, particularly in the male sex. The Albany specimen is average, while the two Tybee individuals (♂) are very large.

In the southeastern States the range of this species does not extend above the fall line except where the insect has penetrated a short distance up a broad river valley or, in the western part of the States, has pushed in from the Mississippi valley drainage by way of the Tennessee valley.

The species was taken in a variety of habitats: in hammock and in marsh about edge of same (Atlantic Beach), also in pine woods at the same locality; in pine woods, both long- and short-leaf, (Jacksonville, Sandfly, Isle of Hope, Yemassee, Winter Park, Weldon, Ashley Junction and Albany); along the edge of short-leaf pine woods (Columbia); in marshy land on the edge of hammock (Homerville); in high bushes and "bracken" along edge of swamp (Suwannee Creek); in tidal marsh (Tybee Island); in high bushes on edge of swampy depression filled with gums (Wilmington); in high bushes along drain near pine woods (Augusta) and from dune vegetation, *i.e.*, bayberry, oak, briars and palmetto (Isle of Palms). By comparison of these data with the information given above on the phases in each series, evidence concerning the habitat association of the color forms can be obtained.

Schistocerca serialis (Thunberg).[71]

Schistocerca americana of authors.

[71] This name has already been discussed by Hebard, *Ent. News*, XXVI, p. 406, (1915).

Virginia.

Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂.
Petersburg, VII, 23, 1913, (R. & H.), 2 ♂.

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 1 ♂.
Wrightsville, IX, 7, 1911, (R. & H.), 1 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂.
Manning, V, 27 and 30, 1914, (W. Stone), 2 ♂, 1 ♀, [A. N. S. P.].
Isle of Palms, VIII, 15, 1913, (R.), 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 4 ♂.

Georgia.

Clayton, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 1 ♀.
Thompson's Mills, spring, (H. A. Allard), 1 ♀, [U. S. N. M.].
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♂, 3 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♀.
Billy's Island, V, 16, 1915, (H.), 1 ♂; VI, 12, 1912, (J. C. Bradley), 3 ♂.
Jesup, IX, 1, 1911, (R. & H.), 1 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂.
Tybee Island, IX, 2, 1911, (R. & H.), 1 ♂, 2 ♀.
Savannah, VIII, 7, 1878, (Grote), 1 ♀, [U. S. N. M.].

Florida.

Jacksonville, (T. J. Priddey), 2 ♂, 2 ♀, [Hebard Cln.]; IX, 3, 1911, (W. T. Davis), 1 ♀.
South Jacksonville, IX, 7, 1913, (W. T. Davis), 1 ♂, 1 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♀.

Drury, in 1775, described and figured this species as *Libell*[*ula*] *americanus; Ill. Nat. Hist.*, I, p. 128, Pl. XLIX, fig. 2, name in index. This is preoccupied by *Libellula americana* of Linnæus; *Syst. Nat.*, ed. X, p. 545, (1758). The next name to apply to Drury's *L. americanus* is *Gryllus serialis* of Thunberg; *Mém. Acad. Imp. Sci. St. Pétersbourg*, V, p. 241, (1815); described from St. Bartholomew, British West Indies, which name consequently must be used for this species.

The present series shows considerable variation in size and some in color, but both features are individual in this material. The three immature females from Macon are in different instars, the most developed having just started the ecdysis passing into the imagal condition. The species was also seen but not taken at Orange, Virginia, July 21, 1913.

This ubiquitous species occurred in a variety of habitats, more generally, however, in pine woods. At no point visited by us was it present in sufficient numbers to be an economic menace.

Schistocerca damnifica damnifica (Saussure).

Maryland.

Great Falls, II, 26, 1905, (H. Barber), 1 ♂, [U. S. N. M.].
Washington, D. C., IX, 1883, 1 ♂, [Hebard Cln.].

Virginia.

Glencarlyn, V, 6, 1903, (A. N. Caudell), 1 ♂, [U. S. N. M.].
Virginia Beach, XI, 1907, (Hopkins), 1 ♀, [U. S. N. M.].

North Carolina.

Tryon, IV, 29, (Fiske), 1 ♀, [U. S. N. M.].

Georgia.

Clayton 2,000 feet, V, 18–26, 1911, (J. C. Bradley), 1 ♂.
Gainesville, IV, 2, 1911, (J. C. Bradley), 1 ♂.

The Clayton male is similar to the Gainesville and Atlanta specimens already commented upon by us.[72]

Schistocerca damnifica calidior Rehn and Hebard.

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 2 ♂, 1 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 1 ♂.
Winter Park, IX, 7, 1911, (R. & H.), 3 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂.
Manning, V, 23, 1914, (W. Stone), 1 ♂, [A. N. S. P.].
Yemassee, IX, 4, 1911, (R. & H.), 7 ♂, 4 ♀.

Florida.

Jacksonville, IV and VIII, 1885, (W. H. Ashmead), 2 ♀, [Hebard Cln.]; VIII, 25, 1911, (R. & H.), 1 ♂; XI, 3, 1911, (W. T. Davis), 2 ♂, 1 ♀.
South Jacksonville, IX, 7 and 28, 1913, (W. T. Davis), 2 ♂, 1 ♀.
Fort George, Duval County, 1 ♂, [U. S. N. M.].
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 2 ♂.
Newberry, XI, 19, 1911, (W. T. Davis), 1 ♂.
Archer, III, 1882, 1 ♂, 1 ♀, [Hebard Cln.].
Daytona, XI, 11, 1911, 1 ♂, 1 ♀, [U. S. N. M.].
Rockledge, II, 5, 1880, 1 ♀, [U. S. N. M.].

Georgia.

Tybee Island, IX, 2, 1911, (R. & H.), 1 ♂.
Isle of Hope, IX, 3, 1911, (R. & H.), 4 ♂.
Sandfly, IX, 3, 1911, (R. & H.), 2 ♂.
St. Catharine's Island, XI, 1878, (Grote), 1 ♂, 1 ♀, [U. S. N. M.].
St. Simon's Island, VIII, 30, 1911, (R. & H.), 3 ♂; IV, 22–V, 12, 1911, (J. C. Bradley), 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 juv. ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♂.
Jesup, IX, 1, 1911, (R. & H.), 2 ♂, 2 ♀; XII, 1906, (H.), 2 ♂, 1 ♀.
Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 1 ♀.
Billy's Island, V, 28–VI, 2, VII, 1912, (J. C. Bradley), 2 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 ♂.
De Witt, IV, 23, 1912, 1 ♀, [Ga. State Cln.].
Bainbridge, IX, 17–X, 19, 1910, (J. C. Bradley), 1 ♂.

The majority of the above records have been quoted as bare localities under the description of the race.[73]

As previously stated, material from Raleigh, North Carolina, and Atlanta, Georgia, is true *damnifica* with a tendency toward *d. calidior*, while individuals from the region about Wilmington and Fayetteville, North Carolina, and Florence, South Carolina, while representing *d. calidior*, show decided tendencies toward the northern form. Specimens from Chester and Albany, Georgia, are not fully typical of *calidior*, although decidedly nearer it than *d. damnifica*.

From the evidence in hand, this species, both typical and the race *calidior*, occurs two-brooded throughout the greater portion of its range, as material before us from New Jersey localities extends in dates from April to mid-November, while we have it taken every month in the year in southern Georgia. The material from Fayette-

[72] Proc. Acad. Nat. Sci. Phila., 1912, pp. 261, 262, (1912).
[73] Proc. Acad. Nat. Sci. Phila., 1912, pp. 261, 262, (1912).

ville, North Carolina, taken September 9, was recorded in our field notes as recently moulted, while the single specimen taken at Brunswick, Georgia, on August 30, is not quite mature.

The species occurred in pine woods among the wire-grass and other dry carpeting vegetation (Jacksonville and Live Oak), in mixed oak and pine woods (Winter Park), on sandy knolls and slopes with scattered pines and low oaks (Yemassee), in brushy clearings (Suwannee Creek) and in palmetto flats (Brunswick).

Gymnoscirtetes pusillus Scudder.

Georgia.

Jesup, IX, 1, 1911, (R. & H.), 6 ♂, 8 ♀, 2 juv. ♂, 3 juv. ♀.
Brunswick, VIII, 30, 1911, (H.), 6 ♂, 5 ♀.
Hebardville, V, 15, 1915, (H.), 1 juv. ♂, 2 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 20 ♂, 18 ♀, 2 juv. ♂, 6 juv. ♀.
Homerville, VIII, 27, 1913, (R. & H.), 23 ♂, 28 ♀, 2 juv. ♂, 3 juv. ♀.
Chase Prairie, Okeefenokee Swamp, IX, 5, 1913, (J. C. Bradley), 1 ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 1 ♂, 1 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 15 ♂, 15 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 3 ♂, 6 ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 3 ♂.

The female specimens from Atlantic Beach are exceptionally large, the series from that locality measures in length as follows: males, 14. to 14.8 mm., females, 20.2 to 22.6 mm. The rest of the very large series here recorded shows no unusual variation in size or other characters. In length the males measure from 12.5 to 16. mm., females from 17.3 to 19.4 mm.

The larger series listed above were captured by beating, and with little difficulty, as in southeastern Georgia and northeastern Florida the species is frequently exceedingly plentiful, locally in the heavier undergrowth of the long-leaf pine forests (Jesup, Hebardville, Jacksonville), in like surroundings everywhere where the ground is very low (Suwannee Creek, Homerville). It was also found fairly abundant in wire-grass and other low plants on palmetto flats (Brunswick).

The known northern boundaries of the present species are considerably extended by the above records; in Florida it is known from as far south as Lakeland and as far west as De Funiak Springs.

Campylacantha olivacea Scudder.

Macon, Georgia, VII, 31, 1913, (R. & H.), 1 ♂, 14 juv. ♂, 11 juv. ♀.

The previous most eastern records for this species are Fayetteville and Van Buren, in northwestern Arkansas. The intrusion of this essentially Sonoran genus as far east as central Georgia is of peculiar interest. The present species will probably be found at numerous

localities between those given above, when the intervening territory is carefully investigated.

This insect was found occasional everywhere in the thick grasses and weeds along the edge of the woods at the Idle Hour Club, a few miles outside of Macon. Vigorous and long-continued search for adults resulted in the taking of a single mature male, still soft from its last moult, and a considerable series of immature examples. These latter could be readily distinguished from other Locustid young by their striking whitish antennæ annulate with dark brown; these colors have greatly faded in the dried specimens.

Eotettix signatus Scudder.

Jacksonville, Florida, VIII, 25, 1911, (R. & H.), 1 ♂.
Atlantic Beach, Fla., VIII, 24, 1911, (R. & H.), 12 ♂, 10 ♀.
Pablo Beach, Fla., IX, 5, 1913, (W. T. Davis), 1 ♂.

The specimens recorded above from Atlantic Beach are very large, their length measuring as follows: males, 18.8 to 21.4 mm.; females, 27. to 30.6 mm. Specimens of this species from southern Florida show that an extreme reduction in size southward is to be found in this insect.[74]

The species was found at Atlantic Beach to be moderately numerous in marshy land on the edge of a "hammock," where high saw-grass and reeds mingled with much low green marsh vegetation and occasional cypress shoots. It is known from the above localities southward to Lakeland and Homestead, Florida.

Eotettix pusillus Morse.

North Carolina.

Fayetteville, IX, 9, 1911, (H.), 2 ♂, 4 ♀.

South Carolina.

Florence, IX, 6, 1911, (H.), 1 ♀.
Yemassee, IX, 4, 1911, (H.), 1 ♂, 1 ♀, 2 juv. ♀.

Georgia.

Warm Springs, 1,000 feet, VIII, 9–10, 1913, (R.), 1 ♂.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀.
Spring Creek, VII–VIII, 1912–13, (J. C. Bradley), 2 ♂, 1 ♀, 1 juv. ♀.
Hebardville, V, 15, 1915, (H.), 2 ♂, 2 juv. ♂, 2 juv. ♀.
Homerville, VIII, 27, 1911, (H.), 1 ♂.

Florida.

Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂, 1 ♀.

The present singularly striking insect is distinguished by its compact and abbreviate form, with short pronotum, the dorsum of which is distinctly convex in longitudinal aspect, and by its distinctive coloration; this latter is due to a peculiar metallic sheen which suffuses the entire insect and is particularly striking in life.

All of the immature specimens before us have the median carina

[74] See Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1914, p. 396, (1914).

of the dorsum of the pronotum more strongly raised and arcuate than in the adults.

The immature examples before us range in size from a very early stage of development to the instar preceding maturity. These specimens are very singularly colored, being blackish overlaid with mars orange, the latter color forming a pale stripe on the post-ocular portion of the head and strongly indicated over the face and the constricted distal portion of the caudal femora. One of these specimens, which has apparently best retained its coloration, has the face nopal red. In life these specimens have a striking metallic, velvety lustre, which in the dried examples is still weakly indicated.

A very slight increase in size southward in individuals of the species is shown by the present series. Females from Fayetteville are among the smallest before us (length 15.5 to 16. mm.), while the specimen of that sex from Live Oak is the largest (length 20. mm.). In the series from Spring Creek the female is rather large, but the males are as small as any in the present series (length 10. to 11. mm.). The majority of specimens of this species have the abdomen decidedly upcurved, which makes the measurement for the insects shorter than would otherwise be the case.

We have noticed that this species is rather sluggish in its actions and was found to cling tenaciously to the stems of wire-grass, for which plant it showed a decided preference. The species was found in this wire-grass in short-leaf pine and oak woods (Fayetteville, Florence, Yemassee, Warm Springs), and in the same plant in moist but not swampy places in long-leaf pine woods (Albany, Hebardville, Homerville, Live Oak), at the latter locality being found also in wire-grass and oak sprouts on the sides of a sink which apparently had been recently deforested. The six specimens taken at Fayetteville, after long and diligent search in a restricted area, constitute the only series from a single locality we have yet been able to secure of this rare insect, which was previously known only from Denmark, South Carolina, and Waycross and Thomasville, Georgia. It is interesting to note that its range is not confined to the coastal plain and that it has not been found within the range of *E. signatus*.

Hesperotettix floridensis Morse.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀.
Warm Springs, VIII, 9, 1913, (R.), 1 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 4 ♂, 1 ♀.
Homerville, VIII, 27, 1911, (R.), 1 ♂.

The present insect is much more nearly related to *H. speciosus*

than to any other species of the genus, the most striking difference in this insect being the abbreviate, rotundate tegmina.

Little variation is shown by the above series of this very rare insect. In coloration the adults from Augusta and Warm Springs differ from the others in having the median carina of the pronotum outlined in pompeian red.

This species acts in an unusual manner when pursued, hiding on the underside of the leaves of small plants, with only feet, antennæ and eyes showing from above. It was taken among low plants, huckleberry, strawberry and many other varieties, in a sandy scrub-oak area just above the fall line (Augusta), in heavy tangled undergrowth of pine and oak woods (Warm Springs), on low open land covered with wire-grass and many low bushes and saw palmettoes on the edge of high bushes and bracken along the border of the Okeefenokee Swamp (Suwannee Creek) and in a very similar situation to the last, where, however, a heather-like plant, *Kalmia hirsuta*, was predominant (Homerville). The discovery of this insect just above the fall line at Augusta and on the Piedmont plateau at Warm Springs was rather surprising, as it was hitherto known only from Waycross, Georgia, and Pablo Beach, San Pablo and Hastings, Florida.

Hesperotettix brevipennis brevipennis (Thomas).

Arlington, Virginia, VII, 9, 1914, (H.; asleep at night in *Andropogon* sp.), 1 ♀.
Currahee Mountain, Georgia, 1,200 to 1,700 feet, VIII, 5, 1913, (H.), 5 ♂, 4 ♀.

Occasional specimens of this species were found from the edge of the pine woods on the upper portion of the lower gradual slopes of Currahee Mountain, to its summit. The specimens were taken in bunch-grass, *Cyperus* sp., particularly where this was plentiful on open slopes, and in the luxuriant mountain undergrowth of grasses, vines and oak sprouts, under a low forest, predominant in black-jack oak.

In the southeastern United States this species was previously known only from Sand Mountain, Georgia, and Lookout and Chehawhaw Mountain and its vicinity in Alabama.

Hesperotettix brevipennis pratensis (Scudder).

Live Oak, Florida, VIII, 26, 1911, (R. & H.), 1 ♂, 3 ♀.

It seems impossible to consider this insect other than a western geographic race of *H. brevipennis*. Material from the type locality, Dallas, Texas, shows hardly any structural differences outside of wing length, and the present series is nearly intermediate between such specimens and typical *brevipennis*. Such intermediates were found and

so recorded by Morse from Magazine Mountain, Arkansas.[75] The tegminal length of the present series of intermediates is as follows: male, 12.; females, 12.5 to 12.7 mm. For the series of *H. brevipennis* s.s. from Currahee Mountain, Georgia, the tegminal length is: males, 8.4 to 9.8; females, 10 to 11.3 mm.

The present insect is known to be distributed eastward along the Gulf Coast as far as Live Oak, Florida, though from the country intervening between coast and mountains in Georgia and Alabama the species has not been recorded, while in the southern mountains typical *H. brevipennis* is found to intergrade with the present race far to the westward of this longitude. The very local nature of its distribution, and the scarcity of the species in the east, creates considerable difficulty when efforts to define its exact range are made. One of the specimens recorded above was taken on sandy soil among wire-grass and other low plants, the three others were found in a somewhat similar environment, but in small clumps of oaks about two feet in height on the border of a sink.

Paratylotropidia beutenmuelleri Morse.

We have before us two topotypic females of this remarkable insect, taken by W. Beutenmüller near Black Mountain, North Carolina, July, 1912. These specimens are in the Davis Collection and that of the Academy of Natural Sciences of Philadelphia.

The Gracilis Group of the Genus Melanoplus.

We find that *M. gracilis, sylvaticus, similis, viridipes* and *deceptus* form a group in the present genus which may be termed the Gracilis Group, the species in relationship following the order given above, of which *gracilis* is more widely separated from the others than they are from each other.

Scudder's placing of *gracilis* in his Plebejus Series and *viridipes* in his Inornatus Series is wholly illogical.

Melanoplus similis Morse.

Bluemont, Virginia, VII, 1, 1914, (J. D. Hood), 1 ♀, [Hebard Cln.].
Clayton, Rabun County, Georgia, VI, 1909, (W. T. Davis), 1 ♂, 1 ♀.
Rabun Bald, Rabun County, Ga., VII, 1910, (W. T. Davis), 1 ♂.
Tuckoluge Creek, Rabun County, Ga., VI, 1909, (W. T. Davis), 2 ♀.

The present specimens agree very well with Morse's description, the cerci are slightly more slender than in the drawing given by that author.[76] One of the females taken on Tuckoluge Creek was found in a bush.

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[75] Carnegie Inst. Wash., Publ. No. 68, p. 45, (1907).
[76] Carnegie Inst. Wash., Publ. No. 18, p. 46, fig. 6, (1904).

Melanoplus viridipes Scudder.

1897. *Melanoplus juvencus* Scudder, Proc. Amer. Philos. Soc., XXXVI, p. 14. Proc. U. S. Nat. Mus., XX, pp. 129, 266, Pl. XVIII, fig. 1. [No locality for described type.[77]]

The above synonymy is due to a most unusual confusion of material. Scudder, apparently by accident, placed a specimen of *M. viridipes* without data in his series of *M. puer*. Later, finding it to be different from that species, he had the specimen figured and described it as *M. juvencus*. This specimen is now in the Scudder collection, marked Scudder's type *M. juvencus* and "drawn"; it has been selected as the single type, for it is the specimen which furnished the original description and figure of *juvencus*. It was necessary to select a single type, for although, with the description Scudder figured and described but one specimen, he derived the data given there, "Fort Reed, Orange County, Florida, April 8; Comstock," from another male specimen of the type series of *M. puer*, which specimen he also marked Scudder's type *M. juvencus*. His work was apparently done carelessly and at different times, other explanation for such an occurrence being incomprehensible.

Melanoplus deceptus Morse.

Black Mountain, North Carolina, VI, 1912, (W. Beutenmüller), 2 ♂, 3 ♀, [Davis Cln.].

Clayton, Rabun County, Georgia, VI, 1909, (W. T. Davis), 1 ♂.

The Decorus Group of the Genus Melanoplus.

Five species of this group are found in the Sabalian or Basic Austral zone of the southeastern United States, which are all closely related and are among the more formative elements of the plastic genus *Melanoplus*. No intergradation between the forms is shown by the material before us, but in every large series a certain slight amount of variation often gives evidence of the derivation of the members of the group. It is our opinion that five valid species exist in the known material of the group and that no geographic races are represented.

Of these five species Scudder placed *decorus* in his Inornatus Series, and *attenuatus* in his Fasciatus Series, both of which series are anomalous aggregations of widely separated forms. The senior author in describing *hebardi* placed it in the genus *Eotettix*, since Scudder chiefly separated that genus from *Melanoplus* by the male subgenital plate having a distinct subapical tubercle and the pronotum having the median carina well developed and percurrent.

[77] This specimen has been fixed as single type by the present authors, Proc. Acad. Nat. Sci. Phila., 1912, p. 84, (1912).

These characters apply as well to the species of the Decorus Group as they do to the genus *Eotettix*, which genus is, however, valid, as it possesses other excellent characters. Morse correctly placed *australis* beside *attenuatus*, and the fifth species was hitherto undescribed. Morse states that *M. decoratus* is closely related to *M. decorus* and compares the two species in his original description; in reality the two species belong to very distinct groups.

The following analysis gives the important characters, found principally in the male genitalia, of the present group.

Important Color Characters.—The post-ocular fuscous stripe is usually strongly, sometimes weakly continued, but always present on the metazona in *decorus*, in the other species this stripe stops abruptly at the principal sulcus. In the male sex of *australis* it is very infrequently interrupted on the prozona by narrow oblique fasciæ of the general color of the insect,[78] this species is the only one of the group which has the sides of the abdomen wholly immaculate. In *nubilus* the males have the dark markings on the sides of the abdomen very large and the dorsum of the abdomen very dark.

Furcula.—(Figured for all the species.) In *decorus* normally widely divergent, slender, evenly tapering, acuminate and slightly over one-third as long as supra-anal plate; in *australis* broad at base, tapering to slender digitate tips which are due chiefly to an abrupt mesal shoulder on the inner margins, one-third as long as supra-anal plate and weakly divergent; in *attenuatus* weakly divergent, slender, evenly tapering, acuminate and scarcely one-fourth as long as supra-anal plate; in *hebardi* small knob-like plates with divergent angulate apices, scarcely one-fifth as long as supra-anal plate; in *nubilus* usually subparallel, scarcely tapering but very slender fingers, less than one-third as long as the short supra-anal plate.

Supra-anal Plate.—(Figured for all the species.) In *decorus* and *australis* elongate, shield-shaped with sides meso-distad evenly convex, the narrow percurrent median sulcus lying between sharp but not high walls in the proximal portion of the plate, beyond which are a pair of more distant, short, blunt ridges, which are evenly convergent and almost join near the apex in *decorus* and at the apex of the plate in *australis*, near the base of the plate on each margin are very weak indications of a marginal plication. This plate is of similar general structure in the other species, but shows the following

[78] Females of *australis* have this interruption almost always present, in some specimens it is very pronounced, leaving only traces of a fuscous band; such an interruption is also found in this sex of *M. nubilus*.

striking differences: in *attenuatus* not as long, with sides in more than distal half straight convergent, the distal ridges are weakly convergent distad, while the marginal plications near the base of the plate are developed into heavy, broadly rounded, dentate folds, which are very striking; in *hebardi* the plate is elongate with sides in more than distal half straight convergent, its surface very decidedly flattened with median sulcus less pronounced and the distal convergent ridges subobsolete, the marginal plications near the base of the plate are, however, developed into heavy knobs not as decided as in the preceding species, but still prominent; in *nubilus* the plate is decidedly shorter, with the distal ridges subparallel, the other characters as given for the first two species of the group similar, but all somewhat intensified.

Cercus.—(Figured for all the species.) In *decorus* composed of a moderately broad, rapidly tapering, slightly tumid basal portion, about one-third of the whole, and a very slender, subequal, gently arcuate, incurved and apically faintly expanding portion, hardly more than a third as broad as the base, with apex slightly expanded, broadly rounded dorsad and slightly produced, more narrowly rounded ventrad, reaching a little beyond the apex of the supra-anal plate. In the other species the cerci are in general similar, but differ in the following respects: in *australis* with apex very slightly broader, spatulate, roundly symmetrical, sometimes very slightly emarginate; in *attenuatus* with apex a little more than half as broad as base, expanding ventrad more than dorsad, the distal margin distinctly emarginate mesad so that the apex appears faintly bifid, reaching the tip of the supra-anal plate; in *hebardi* and *nubilus* the cercus shows this latter condition and at the apex is weakly but distinctly bifid, in *hebardi* the emargination of the distal margin being ventral, the apex not quite reaching the apex of the supra-anal plate. In *nubilus* this specialization is further continued in the dorsal lobe of the apex of the cercus being apically flattened, thus giving the apex of the cercus in this insect an almost trifid appearance.

Subgenital Plate.—In all of the species small, greatly tapering so as to be very narrow at the tip. In *decorus* the apex is strongly but delicately tuberculate; the other species have the apical margin well rounded and the plate faintly and broadly tuberculate subapically, this tuberculation somewhat more decided in *nubilus* than in any other of the latter species.

We have not discussed the tegmina, for in every large series of

these species they are found to vary in size, width, separation and truncation, though always having their apices rounded.

Melanoplus decorus Scudder. Pl. XIII, figs. 1, 2.

Wilmington, North Carolina, IX, 8, 1911, (R. & H.), 48 ♂, 17 ♀.
Winter Park, N. C., IX, 7, 1911, (R. & H.), 20 ♂, 12 ♀.
Lake Waccamaw, N. C., IX, 8, 1911, (R. & H.), 26 ♂, 8 ♀.

The large series before us shows no striking size or structural variation, adhering closely to the characters given in the above analysis. The four males previously recorded by the authors from Newbern, North Carolina, have the furcula somewhat broader in varying degrees, and in two specimens considerably less divergent than in the types or in the present series; they are otherwise perfectly typical.

In coloration individuals range from empire yellow through all shades of that color to medal bronze, the females showing more variation than the males which are usually more brightly colored. A very few melanistic females are before us, in which specimens the general coloration is bone brown much suffused with black. In all of the specimens the post-ocular fuscous stripe is present on the metazona, it is very pronounced in nearly all of the males, but in some specimens of this sex and in numerous females it is much weaker than on the prozona. The blackish coloration of the tubercle of the subgenital plate of the male is confined to its dorsal surface. In life the species is very brilliantly and strikingly colored, but, as in the other species of this delicately colored group, the dried specimens have the yellow tones much faded and discolored in the majority of specimens. A great similarity to the brilliantly colored individuals of *Paroxya atlantica* from this region was noted.

No great size variation is found in the material before us, the extremes in length being as follows: males 17. to 20., females 20.5 to 25.3 mm.

The species was found very locally distributed in low plants and scant grasses about a swampy depression in pine woods in which were a few black gum trees (Winter Park), in heavy undergrowth of almost swampy pine woods (Lake Waccamaw) and common in the wet mucky border of a swampy tract which was covered thickly with grasses, bog plants, such as pitcher-plants and venus' fly-traps, and dotted with low bushes (Wilmington).

Outside the above localities the species is known only from Pungo Bluff and Newbern, North Carolina.

Melanoplus australis Morse. Pl. XIII, figs. 3, 4.

Yemassee, South Carolina, IX, 4, 1911, (R. & H.), 54 ♂, 6 ♀.
Sandfly, Georgia, IX, 3, 1911, (R. & H.), 65 ♂, 43 ♀.
Isle of Hope, Ga., IX, 3, 1911, (R. & H.), 41 ♂, 4 juv. ♀.

The large series of the present species shows no striking structural variation. The insect is larger and more attenuate than *M. decorus* and probably very similar to *M. attenuatus* in this respect. The extremes in length in the present series are as follows: males 16.4 to 22., females 23. to 27. mm. The males average in length about 19. mm.

In coloration individuals range from lemon chrome, frequently suffused with greenish or orange, to army brown, usually showing traces of a yellowish suffusion. The species is the most brilliantly colored of the group, individuals in life being very striking. The distinctive differences in color pattern are discussed in the analysis of the group.

It was noted at Sandfly that the very brightly colored, yellow or greenish yellow, individuals were taken on green plants, while the dull yellow or brownish specimens were found among the yellowing and brown fronds of the bracken. The males were active, but not alert and were easy to capture; the females were much less active and were usually met with in the heavier undergrowth where much greater concealment was afforded. Females from Isle of Hope are represented by four immature individuals only, indicating that adults of the species had been present but a very short time.

The species was found not unusual through the low bushes, grasses and low swamp-loving plants on low wet ground through the short-leaf pine woods (Yemassee), very common in tall, rank, succulent undergrowth in somewhat swampy gray-bark pine woods (Sandfly, Isle of Hope); at the latter locality it was particularly numerous in patches of yellow and brown bracken.

The species was previously known from the single type specimen, a male from Savannah, Georgia.

Melanoplus attenuatus Scudder. Pl. XIII, figs. 5, 6.

Sullivan Island, South Carolina, IX, 5, 1911, (R. & H.), 1 ♂.
Magnolia, Charleston County, S. C., IX, 5, 1911, (H.), 9 ♂.
Ashley Junction, S. C., VIII, 15, 1913, (R.), 3 juv. ♂, 3 juv. ♀.
Augusta, Georgia, VII, 29, 1913, (R. & H.), 3 juv. ♂, 1 juv. ♀.

The striking dentate plications on each side of the supra-anal plate near its base, are more pronounced in the specimen from Sullivan Island than in those from Magnolia. The extremes in length in the adult males before us are 18.5 and 20.6 mm.

In general coloration the insects are empire yellow much suffused

with brown. The post-ocular fuscous stripe is as heavy on the prozona as in the most decidedly marked males of the series of *M. australis* before us.

A single specimen was found on the somewhat marshy, sandy ground covered with low vegetation (Sullivan Island), but the species was found fairly numerous in moist places in the pine woods in the low heavy undergrowth of plants and scrub oaks less than a foot in height (Magnolia). A thunder storm prevented the accumulation of a large series at the latter locality. In mid-August the young alone were to be found in a depression overgrown with tall grasses in long-leaf pine woods (Ashley Junction), and in late July a few small young were found in short grasses in a somewhat swampy spot in similar woods of the flat country just below the fall line (Augusta).

The species was previously known from the three male type specimens from Smithville, at the mouth of the Cape Fear River, in extreme southeastern North Carolina, and from one male and three young from Denmark, South Carolina.

Melanoplus hebardi (Rehn). Pl. XIII, figs. 7, 8.

1906. *Eotettix hebardi*, Ent. News, XVII, p. 234. [Tyty Plantation, Thomas County, Georgia.]

Albany, Georgia, VIII, 1, 1913, (R. & H.), 2 juv. ♂, 2 juv. ♀.

The most important characters which separate this species from the others of the present group are given in the preceding analysis. The figures of the genitalia, which accompany the original description, are faulty and misleading. The type, which is 22 mm. in length, is as large as the largest male of *M. australis*, which species averages considerably less than this measurement. The type of the present species remains the unique adult.

The above series of about half-grown young was taken in the heavy undergrowth of the long-leaf pine forest along the Flint River.

Melanoplus nubilus new species. Pl. XII, fig. 11; pl. XIII, figs. 9, 10.

More closely related to *M. australis*, *attenuatus* and *hebardi* than to *M. decorus*, differing decidedly in the characters given in the analysis on pages 212 to 215. Females are scarcely separable from dark females of *M. decorus*, though the males show wide differences in the two species.

Type: ♂; Fayetteville, Cumberland County, North Carolina. September 9, 1911. (Rehn and Hebard.) [Hebard Collection, Type No. 107.]

Description of Type.—Size smaller than in *M. attenuatus;* form slightly more attenuate, with pronotum less ample and head slightly more prominent. Tegmina abbreviate, rotundate.[79] The important genital characters, of which the form of the supra-anal plate (fig. 9) and cercus (fig. 10) are the most decided, are given in the preceding analysis, while the abdominal coloration, also given there, is distinctive in this sex.

Allotype: ♀. Same data as the type. [Hebard Collection.]

Description of Allotype.—The vertex is found to be less depressed mesad and the facial costa still more weakly sulcate than in females of *M. decorus*, while the dorsum of the pronotum narrows even less than in that species and has, in consequence, the cephalic and caudal width nearly subequal.

The usual variation found in the two species, however, makes it often impossible to separate females by the above characters, and we are obliged to admit that we are unable to find definite differential characters for females of the two species.

Measurements (in millimeters).

	♂♂		♀♀	
	TYPE.	Paratypes.	*Allotype.*	Paratypes.
Length of body	16	15.8–16.8	24.7	21.2–25*
Length of pronotum	3.8	3.7– 4.1	4.9	4.9– 5.3
Length of tegmen	2.9	2.6– 3.8	4.4	3.8– 4.5
Greatest width of same	2	1.8– 2.4	2.8	2.6– 3
Length of caudal femur	9.9	9.3–10.1	13	12.4–13.1
Greatest width of same	2.2	2.2– 2.4	2.8	2.7– 3

The furcula of the present insect vary somewhat from the normal regular and parallel form to one in which the sides are less regular and the fingers divergent, the cerci also show some individual variation, two of the males have the ventral expansion of the tip of the cercus decidedly produced and sharply acute-angulate.

In coloration the series of specimens before us is quite uniform, much resembling dark individuals of *M. decorus*, except that the post-ocular fuscous stripe is abruptly terminated on the lateral lobes of the pronotum at the principal sulcus and the males have the dark markings on the sides of the abdomen much more pronounced with the dorsum of the same very dark. Half of the females have the post-ocular fuscous stripe on the prozona interrupted by narrow oblique pale fasciæ as in *M. australis*. The dark males have a

[79] The tegmina show almost as much individual variation in this species as in the others of this group.

lacquered appearance in which a brownish and greenish suffusion is apparent, the females range in general coloration from pecan brown to warm sepia with markings of a darker shade.

All of the material before us was taken in short-leaf pine woods around a mill pond at Fayetteville, North Carolina. The males were occasional in gall-berry and other bushes and were found usually two or three feet from the ground, "sitting up warily or jumping away," while the females were decidedly less abundant and less active and by hiding sometimes eluded pursuit.

Specimens Examined.—20; 13 males, 6 females and 1 immature female.

Fayetteville, Cumberland County, North Carolina, IX, 9, 1911, (R. & H.), 13 ♂, 6 ♀, 1 juv. ♀, TYPE, *allotype* and paratypes.

The Tribulus Group of the Genus Melanoplus.

The present group contains *M. obovatipennis, morsei, tepidus, tribulus, tribuloides, devius* and *decoratus;* the species in relationship following the order given above, of which the first three species are very closely related, the next three likewise, while the last species is the most aberrant of the group. Scudder placed *obovatipennis* in his anomalous Fasciatus Series, the relationships of the other species, which are all more recent in description, have been correctly though indefinitely given with the descriptions of the same, excepting *M. decoratus*, which species Morse considered more nearly related to *M. decorus.*

Melanoplus tribulus Morse.

Pennsylvania.

Pink Hill, Newtown Square, VI, 19, 1908, (R.), 1 ♂; VII, 15, 1911, (H.), 1 ♀.

Maryland.

Beltsville, VII, 4, 1912, (J. D. Hood), 1 ♂, [Hebard Cln.].

Plummer's Island, IX, 30, 1906, (A. K. Fisher), 1 ♀, [U. S. N. M.].

Virginia.

Green Dell Farm near Pohick, VIII, 25, 1912, (A. N. Caudell), 1 ♂, [U. S. N. M.].

North Carolina.

Weldon, VII, 24, 1913, (H.), 1 ♂.

Georgia.

Clayton, VI, 1909, (W. T. Davis), 1 ♂.

Rabun County, VII, 1910, (W. T. Davis), 1 ♀.

Toccoa, VIII, 4–5, 1913, (H.), 1 juv. ♂.

Dalton, VIII, 7, 1913, (R.), 1 juv. ♂, 1 juv. ♀.

Jasper, VIII, 5, 1913, (R.), 1 juv. ♂.

Sharp Mountain, VIII, 6, 1913, (R.), 3 ♂, 1 juv. ♀.

Buckhead, VIII, 2, 1913, (R. & H.), 2 juv. ♂, 1 juv. ♀.

Vicinity of Stone Mountain, VIII, 3, 1913, (H.), 1 juv. ♀.

Lost Mountain, Cobb County, VII, 13, 1913, (J. C. Bradley), 1 ♀.

Males of this insect are almost inseparable from males of *M. devius,* for the characters which Morse gives in his original descriptions do not hold. Females of the present species, however, differ greatly

from females of *devius* in being less robust, with narrower vertex of the fastigium and narrower ovipositor jaws, and in having the lateral lobes of the pronotum less deep and the post-ocular fuscous stripe there pronounced, narrow and sharply defined from the pale ventral portion of the lateral lobes.

The males and young recorded above from Georgia could not be assigned to this species were it not quite certain that *M. devius* is found in Georgia only at the highest elevations in the Appalachians.

Specimens before us from New York, New Jersey and Pennsylvania are rather small and the males have the subgenital plate and preceding ventral abdominal segments wholly immaculate; this coloration is found in but a single southern male which is from Clayton, Georgia.

The northernmost specimens here recorded were taken along the edge of a deciduous forest adjacent to a barren serpentine outcrop (Pink Hill) and among low bushes on sandy soil (Beltsville). In Georgia the species was found very locally in the undergrowth of forests composed chiefly of deciduous trees, particularly on hillsides.

The species was previously known from Staten Island, New York, Stafford's Forge, New Jersey, and Sharptop Mountain, Georgia.

Melanoplus devius Morse.

Jefferson, North Carolina, VIII, 1907, (F. Sherman), 1 ♂, [U. S. N. M.].
Charlotte, N. C., VII, 27, 1913, (R. & H.), 3 ♂, 13 juv. ♂, 13 juv. ♀.
Spartanburg, South Carolina, VIII, 6, 1913, (H.), 1 ♀, 12 juv. ♂, 11 juv. ♀.
Wilson's Gap, Mountain City, Georgia, VIII, 22, 1913, (J. C. Bradley), 1 ♀.

The difficulty of separating males of this species from those of *M. tribulus* is remarkable, considering that the females of the two are very different, in *devius* being more robust, with broader fastigium of the vertex and broader ovipositor jaws, with lateral lobes of the pronotum deeper and the post-ocular fuscous stripe not sharply outlined there, the lateral lobes being wholly infuscated with the dorsal portion broadly darkened.

The series from Charlotte and Spartanburg were found by careful search in local areas of the rather scant undergrowth of the heavy deciduous forest. The species was previously known from Wytheville, Virginia, and Topton, Asheville and Mount Pisgah, North Carolina.

Melanoplus decoratus Morse.

Orange, Virginia, VII, 21, 1913, (R. & H.), 1 ♂, 5 ♀, 1 juv. ♂.
Clayton, Georgia, VI, 1909, (W. T. Davis), 1 ♂.
Macon, Ga., VII, 31, 1913, (H.), 1 ♀.

The present insect may be readily separated from its allies by the very peculiar subgenital plate of the male, which has a greatly devel-

oped apical tubercle, and by the very strongly protuberant vertex in both sexes.

Adults of the insect were found scarce in the undergrowth of a heavy chesnut forest on Southwest Mountain (a hill near Orange), and among oak sprouts in a tangle of other plants and vines in pine woods (Macon). The above records extend the known range of the species both northward and southward.

The Puer Group of the Genus Melanoplus.

The following species belong to the present group, *M. puer, rotundipennis, stegocercus, mirus, scapularis* and *strumosus.* In all of these species both sexes have the prosternal spine prominent and very broad, flattened cylindric with apex transversely excised, the sides rounded; the caudal tibiæ are glaucous, often more or less flavescent at base and tip, with spines black or black-tipped. The species are properly associated as listed above, no one of them shows very close affinity to any of the others, however, as each has one or several decided and unusual characters peculiar to itself.

Scudder's association of the then known species, *puer* and *rotundipennis,* is of no value, the situation in regard to the latter is discussed below. Morse, at the time he described *strumosus,* did not discuss its relationship.

Melanoplus rotundipennis Scudder.

1897. *Melanoplus inops* Scudder, Proc. Amer. Philos. Soc., XXXVI, p. 16; Proc. U. S. Nat. Mus., XX, pp. 130, 329. [Florida.]

Georgia.

Brunswick, VIII, 30, 1911, (H.), 2 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 9 ♂, 7 ♀, 1 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (R.), 1 ♂.
Billy's Island, V, 15, 1915, (H.), 1 ♂, 3 juv. ♂, 2 juv. ♀; VI, VII, IX, 1912–13, (J. C. Bradley), 7 ♂, 8 ♀, 1 juv. ♀.
Honey Island, VI, 1, 1912, (J. C. Bradley), 4 ♂, 4 ♀.
Thomasville, XI, 30, XII, 1, 1903, (H.), 2 ♀.
Metcalfe, IX, 17, 1903, (for Hebard), 1 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 11 ♂, 6 ♀; IX, 7, 1913, XI, 5, 1911, (W. T. Davis), 4 ♂.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 ♂, 2 ♀.
Live Oak, VIII, 26, 1911, (R. & H.) 9 ♂, 9 ♀.

Examination of the types of *M. rotundipennis* and *M. inops* shows that the two are absolutely synonymous. The figures of the type of *inops* in Scudder's Revision are very poor, the furcula indeed being wholly overlooked; the figure of *rotundipennis* is, however, quite satisfactory, though the base of the cercus in lateral aspect is drawn much too wide.

Females of this species constitute the basis for Scudder's record

of *M. puer* from Jacksonville, Florida, in his Revision.[80] A series of sixty-nine specimens from northern Florida have been referred by the present authors to the synonymous *inops*, while the three females mentioned above from Thomasville and Metcalfe, Georgia, were unfortunately recorded by us as *M. sylvestris*,[81] females of which species may at once be roughly separated by their red caudal tibiæ.

Scudder's placing of the present species is most unsatisfactory, as it is a development of the *M. puer* type; his opinion that the synonymous *inops* belonged to a widely different group demonstrates amply his own uncertainty in the matter.

A certain amount of size variation is appreciable, the series from the Okeefenokee Swamp and Jacksonville averaging larger than the others.

Measurements (in millimeters) of extremes.

	Length of body.		Least width between tegmina.	
	♂♂	♀♀	♂♂	♀♀
Cumberland Island, Ga....	13.6–16.7	17.8–20.5	.6–1	1.4–1.9
Jacksonville, Fla.....	17–17.9	20.4–23.3	.8–1.1	1.1–1.7
Live Oak, Fla.....	14–16.1	18–20.3	.9–1	1.3–1.7

The greatest tegminal separation is shown in a Thomasville female, where the least intervening width is 2.4 mm.

The general coloration of the species varies from fuscous to orange cinnamon. All of the males have the dorsal portion of the lateral lobes of the pronotum shining black, but more than half of the females have this marking abruptly discontinued at the metazona. The caudal femora range from an immaculate type of coloration to one in which they are heavily twice banded with fuscous, the immaculate type being found more often in the males.

The species was found, usually locally distributed, in the undergrowth of the long-leaf pine woods, but was also sometimes met with in the undergrowth of mixed pine and oak woods (Live Oak), and on palmetto flats (Brunswick). As Morse has noted, the differences in general coloration of specimens were found to correspond with the color of the surrounding soil or dead leaves in which individuals were taken.

The present species has a very limited distribution, northward being known from Brunswick west to Thomasville in Georgia, and southward as far as Lakeland in central Florida, in which latitude it appears

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[80] *Proc. U. S. Nat. Mus.*, XX, p. 253, (1898).
[81] Proc. Acad. Nat. Sci. Phila., 1904, p. 791, (1905).

to be very scarce. From the latter region, southward on the mainland of peninsular Florida, *M. puer* replaces the present insect.

Melanoplus stegocercus[82] new species. Pl. XII, fig. 12; pl. XIII, figs. 11, 12, 13.

Related to *M. rotundipennis*, but differing very greatly in the male genitalia. The female sex is unknown.

TYPE: ♂; Cannoche River at Groveland, Bryan County, Georgia. July 28, 1913. (J. C. Bradley.) [Acad. Nat. Sci. Phila., Type No. 5273.]

Description of Type.—Size and form similar to *M. scapularis*, but somewhat heavier; cephalic and median femora somewhat swollen as in *M. rotundipennis*, and with dorsum of pronotum having the lateral carinæ weakly and regularly diverging caudad as in that species. Tegmina similar to those of *scapularis*, but not attingent (least width between same 1 mm.). Extremity of abdomen broadly and decidedly produced, tumid, but not at all upcurved; supra-anal plate much as in *scapularis*, but with angles of lateral margins less distal, furcula likewise absent (fig. 11); cerci broad at base, thence expanding evenly to the truncate distal margin, dorsal margin weakly arcuate to the scarcely evident disto-dorsal angle, ventral margin straight to the sharply rounded subrectangulate disto-ventral angle, the cercal shafts regularly flexed so that the disto-dorsal portion of the cerci is horizontal (though its surface is swollen and uneven), and the margins of the same when in normal position overlap in this plane dorsad of the distal portion of the supra-anal plate (pl. XIII, fig. 12); disto-ventral abdominal segment with caudal margin very weakly produced mesad, subgenital plate roundly and rather broadly produced (length 2 mm.), with proximal lateral portions of plate and adjacent portion of preceding segment subcompressed, extending beyond the apex of the supra-anal plate one-half the length of the same (fig. 13). The soft integument between the supra-anal and subgenital plates is almost wholly covered by the distal portions of the cerci and does not rise above the dorsal margin of the subgenital plate.

Measurements (in millimeters) of TYPE.

Length of body	17.5	Greatest width of tegmen	2.4
Length of pronotum	3.9	Length of caudal femur	11.1
Length of tegmen	3.1	Greatest width of caudal femur	3.1

The specimen is larger than the type of *scapularis*, but not as much so as the body length would lead one to believe, the uncurved

[82] From στέγω, *to cover closely*, and κέρκος; *cercus*. In allusion to the remarkable cerci, which cover closely the caudal portion of the supra-anal plate.

abdominal extremity adding to the length measurement of the present insect.

In coloration the specimen closely resembles the more brilliantly colored males of *rotundipennis* and has the caudal femora heavily twice banded with fuscous. The general coloration is orange cinnamon with dorsal surfaces of head and pronotum walnut brown. The sides of the abdomen are marked with fuscous as in the males of all the species of the present group.

The type is unique.

Melanoplus mirus[83] new species. Pl. XII, fig. 13; pl. XIII, figs. 14, 15, 16.

The present insect is a development of the *M. puer* type, showing a very striking specialization of the male subgenital plate, which is even more produced and compressed than in *M. strumosus*. Males of the present species have, however, a very simple supra-anal plate, much as in *M. puer*, while the pronotum, noticeably broader caudad than cephalad, shows further affinity to that species and also to *M. rotundipennis*. The entire absence of furcula is, however, found elsewhere in the group only in *M. stegocercus* and *M. scapularis*.

Type: ♂; Weldon, Halifax County, North Carolina. July 24, 1913. (Hebard.) [Hebard Collection, Type No. 110.]

Description of Type.—Size and form similar to moderately large south Florida males of *M. puer*. Limbs, absence of furcula and character of supra-anal plate all agreeing with *M. scapularis*. Tegmina much as in *M. rotundipennis*.[84] Extremity of abdomen tumid, greatly produced and upcurved; supra-anal plate simple as in *scapularis*, but with lateral margins very weakly convex and converging evenly caudad (fig. 14), furcula absent; cerci moderately broad at base, narrowing sharply to half this width mesad, thence after a sharp inward flexion of the shaft expanding distad to a width as great as the base, from which point narrowing, again with an even curvature, to the sharp disto-ventral apex, all of the narrowing and widening is due to the curvature of the dorsal margin, the ventral margin is almost straight,[85] the apices of the two cerci are attingent just beyond the distal extremity of the supra-anal plate (fig. 15); disto-ventral abdominal segment produced mesad in a very small sharp point, subgenital plate greatly produced, compressed, stela-

[83] In allusion to the remarkable genitalia of the male sex.

[84] The size, shape and degree of separation of the tegmina vary considerably in the present series.

[85] In consequence the outline of the distal enlargement of the cerci bears a close resemblance to the outline of a duck's head.

form conical, with apex sharply rounded (length 2.6 mm.) (fig. 16).

Allotype: ♀; Same data as the type. [Hebard Collection.]

Description of Allotype.—Closely resembling in size and form moderately large south Florida females of *M. puer*, but with principal sulcus somewhat more decided on dorsum of pronotum; color pattern and tegmina (though extremely variable) much as in *M. rotundipennis*. When compared with this latter species the insect is found to be smaller and much more compact with shorter and more robust limbs.

Measurements (in millimeters).

	♂♂			♀♀		
	TYPE.	Paratypes.		*Allotype.*	Paratypes.	
Length of body	16.2	15.5	15.8	18.8	20	19.5
Length of pronotum	3.6	3.7	3.8	4.2	4.1	4.7
Length of tegmen	3.7	3	3.4	4.3	3.7	3.9
Greatest width of same	2.3	2.2	2.4	2.9	2.8	2.9
Length of caudal femur	9.7	9.4	9.8	10.8	10.6	11.2
Greatest width of same	2.7	2.6	2.7	2.8	2.8	2.7

The specimens have the caudal margin of the dorsum of the pronotum extremely weakly emarginate mesad, so weak indeed as to be scarcely appreciable to the naked eye except in one female. This character is often found in species of the present group, but nowhere as decided as in *M. puer*.

A more or less noticeable truncation of the tegminal apex is present in all of the material before us, with the exception of a single paratypic male.

In coloration the species generally resembles *M. rotundipennis*, except that the males differ decidedly in having the ventral margins of the caudal femora sharply pale and quite striking, this marking broader proximad. The females are similarly marked, but to a much less and usually inconspicuous degree.

The species was found very scarce in scattered woods of low pines and oaks, with a typical ammophytic undergrowth of huckleberry and other low bushes and plants. The species was recognized as new and several hours were spent in minute search before the six examples were taken, all of these being found in an area not one hundred feet in diameter. The insects were wary, but were found to hide constantly, so that by careful approach and guarding with the net the majority were picked up with ease. The species does not jump vigorously.

Specimens Examined.—6; 3 males and 3 females.

Weldon, North Carolina, VII, 24, 1913, (H.), 3 ♂, 3 ♀, TYPE, *allotype* and paratypes.

Melanoplus scapularis[86] new species. Pl. XII, fig. 14; pl. XIII, figs. 17, 18.

Closely related to *M. rotundipennis*, but differing very greatly in the male genitalia. Females of the two species are very similar, but those of the present insect are separable by the more nearly attingent tegmina, which are also more ample and more nearly rotundate.

TYPE: ♂; Jesup, Wayne County, Georgia. September 1, 1911. (Rehn & Hebard.) [Hebard Collection, Type No. 111.]

Description of Type.—Size and form similar to *M. rotundipennis*, but somewhat more compact; cephalic and median femora less swollen, the caudal femora slightly shorter and a little deeper in proportion to their length. Tegmina abbreviate, rotundate, but very little longer than broad, attingent. The tegminal length much more nearly approximates the breadth of the same than in *rotundipennis*. Extremity of abdomen tumid, strongly upcurved; supra-anal plate decidedly longer than in *rotundipennis*, but otherwise similar (fig. 17), furcula absent; cerci broad at base, distal portion broadly expanding into a lamellate plate resembling a scapula, greatest width at distal extremity hardly greater than length of cercus, dorso-distal angle rotundato-rectangulate, disto-ventral angle acute angulate, distal margin obtusely emarginate (fig. 18). The soft integument between the supra-anal and subgenital plates does not rise above the dorsal margin of the latter plate in the present insect.[87]

Allotype: ♀; Same data as the type. [Hebard Collection.]

Description of Allotype.—Very similar to females of *M. rotundipennis*, but may be separated by the tegminal characters given above. (All of the females before us have the tegmina either attingent or separated by the scantiest interspace, the extreme separation being shown by a female from Isle of Hope in which the least width between the tegmina is .3 mm.) In structure *scapularis* is a little more compact with shorter and heavier caudal femora.

Measurements (in millimeters).

	♂♂		♀♀	
	TYPE.	Paratypes.	*Allotype.*	Paratypes.
Length of body	15	16–16.7	22.2	19.7–21
Length of pronotum	3.9	3.8– 3.9	5.1	4.8– 4.9
Length of tegmen	3	3– 3.2	4.2	3.8– 3.9
Greatest width of same	2.4	2.2– 2.6	3.1	2.9– 3.1
Length of caudal femur	10	9.7–10.2	12.5	11.6–11.9
Greatest width of same	2.9	2.7– 2.9	3.7	3– 3.2

[86] In allusion to the scapuliform cerci.

[87] In *M. rotundipennis* this integument is produced upward in an acute protuberance, which rises conspicuously above the distal margin of the subgenital plate.

The other specimens of the species before us agree fully with the above measurements.

In coloration the present species closely resembles *rotundipennis*, but the series before us is all rather dark and, in all but two females from Isle of Hope, the dorsal portion of the lateral lobes of the pronotum including the metazona is blackish.

The present species was found in a restricted area of a sandy tract covered with various low bushy plants, such as *Myrica pumila*, *Quercus minima*, gall-berry bushes and saw palmettoes (Jesup), and in scant undergrowth of the slightly more elevated portions of the flat almost swampy gray-bark pine woods (Sandfly, Isle of Hope). The species was very scarce, long-continued and thorough search being made for it at each locality where it was found.

Specimens Examined.—15; 5 males, 8 females and 2 immature specimens.

Sandfly, Chatham County, Georgia, IX, 3, 1911, (H.), 1 ♂, 1 ♀, (in coitu.)

Isle of Hope, Chatham County, Ga., IX, 3, 1911, (R. & H.), 4 ♀, 1 juv. ♂.

Jesup, Wayne County, Ga., IX, 1, 1911, (R. & H.), 4 ♂, 3 ♀, 1 juv. ♀, TYPE, *allotype* and paratypes.

Melanoplus strumosus Morse. Pl. XIII, figs. 19, 20, 21.

North Carolina.

Fayetteville, IX, 6, 1911, (H.), 1 ♀.
Ivanhoe, VII, 1907, (L. M. Smith), 1 ♀, [U. S. N. M.].

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♀.
Yemassee, IX, 4, 1911, (H.), 1 ♂, 1 ♀.

Georgia.

Tallulah Falls, VIII, 5, 1909, (J. C. Bradley), 1 ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 6 ♂, 2 ♀.
Spring Creek, VI, 7–23, 1911, VII, 26–28, 1913, (J. C. Bradley), 2 ♀.

This insect, which may be said to be the most aberrant of the Puer Group, differs from all other species in this group in the shape of the male supra-anal plate and furcula, which have been well figured and described by Morse.[88]

A certain similarity to *M. stegocercus* in the form of the male subgenital plate is apparent, but in the present insect this plate distad narrows considerably more and is also deflected dorsad, which gives the apex of the abdomen a very different appearance (fig. 21). The cerci suggest in contour those of *M. mirus*, but are decidedly smaller, less flexed and more simple in outline (fig. 20). It is interesting to note that while *stegocercus*, *mirus* and *strumosus* show a common an-

[88] Carnegie Inst. Wash., Publ. No. 18, pp. 51–53, figs. 12, 13, (1904).

cestry, and all have a peculiar and very decided development of the subgenital plate, *stegocercus* is particularly remarkable in cercal characters, *mirus* in the greatest specialization of the subgenital plate combined with very peculiar cerci, while *strumosus* has quite similar cerci to *mirus*, though these are much smaller, but is very different from all other members of the present group in the characters of the supra-anal plate and furcula (fig. 19).

The females of the present species would be almost indistinguishable from females of *M. rotundipennis*, were it not for the fact that in the latter species the cephalic width of the dorsum of the pronotum is less than the caudal width of the same to a degree not found in the present insect.

The variation in size of the present species does not appear to be geographically correlated in any way. The five Currahee Mountain males range in length from 16 to 17 mm., while the largest females are from Tallulah Falls and Spring Creek, 23.5 and 26.2 mm., respectively. The smallest female before us is also from Spring Creek, in length 20.1 mm. Though usually wide, the interspace between the tegmina is decidedly variable in the present species.

In coloration the majority of the series before us have the caudal femora showing scarcely any traces of fuscous bars, one female from Florence, however, has these bars weakly indicated, while the Yemassee female and the two Spring Creek individuals of the same sex have these bars heavy and very pronounced.

The species was found very scarce on the ground among oak sprouts (Fayetteville, Florence), in underbrush on higher ground, just above where the short-leaf pines disappeared, and in oak sprouts in long-leaf pine woods (Yemassee), while on Currahee Mountain it was found very local on the mountain summit in the luxuriant mountain undergrowth of grasses, vines and oak sprouts (particularly about the latter), in a forest predominantly black-jack oak.

The Mancus Group of the Genus Melanoplus.

Of the five species originally included in his "Mancus Series" by Scudder, one only properly belongs to it, this being *mancus*. *Scudderi* belongs to a group of which it is the best known representative, while the other three species should be distributed over three other groups which show natural relationships. With *mancus*, however, should be associated *M. islandicus* Blatchley and *celatus*, *sylvestris* and *divergens* Morse, the proper sequence apparently being *divergens*, *mancus*, *islandicus*, *celatus* and *sylvestris*.

Melanoplus sylvestris Morse.

North Carolina.

Black Mountain, VII, 1912, (W. Beutenmüller), 2 ♀, [Davis Cln.].

Georgia.

Clayton, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 1 ♂.
Rabun County, VII, 1910, (W. T. Davis), 1 ♀.
Tuckoluge Creek, Rabun County, VII, 1910, (W. T. Davis), 1 ♀.
Pinnacle Peak, Rabun County, VIII, 20, 1913, (J. C. Bradley), 2 ♀.
Rabun Bald, Rabun County, 4,000–4,800 feet, VIII, 21, 1913, (J. C. Bradley), 1 juv. ♀.

This form is clearly an offshoot of *M. islandicus* as stated by Morse, probably being but a geographic race. The male here listed shows an even greater elongation of the cercus than seen in the figure given by Morse, but this is not surprising, the types being from central western North Carolina. The Georgia material from a more extreme geographic point could be expected to show a greater development of the features which differentiate the form.

The species is only known from the localities given above, and Blowing Rock, Linville, Lovering's and Pineola, North Carolina (Morse).[89]

The Scudderi Group of the Genus Melanoplus.

We have placed *M. carnegiei* and *scudderi* in a group which is easily distinguished from the "Mancus Series" in which *scudderi* was previously placed.

Melanoplus carnegiei Morse.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 ♂, 5 juv. ♂, 10 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 18 ♂, 14 ♀, 2 juv. ♀.

Georgia.

Pinnacle Peak, Rabun County, VIII, 20, 1913, (J. C. Bradley), 4 ♂.
Toccoa, VIII, 4–5, 1913, (H.), 25 ♂, 3 juv. ♂, 10 juv. ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 22 ♂, 12 ♀, 5 juv. ♂, 2 juv. ♀.
Jasper, VIII, 5, 1913, (R.), 2 ♂, 4 juv. ♂, 3 juv. ♀.
Sharp Mountain, VIII, 6, 1913, (R.), 8 ♂, 6 ♀, 3 juv. ♀.
Silver Lake, Fulton County, VIII, 10, 1913, (J. C. Bradley), 1 ♂.
Buckhead, VIII, 2, 1913, (R. & H.), 2 ♂, 5 juv. ♂, 5 juv. ♀.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 5 juv. ♂, 4 juv. ♀.
Warm Springs, 850–1,200 feet, VIII, 9–10, 1913, (R.), 7 ♂, 1 ♀, 2 juv. ♂, 5 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♂, 11 juv. ♂, 15 juv. ♀.
Augusta, VII, 29, 1913, (R. & H.), 1 ♂, 5 juv. ♂, 5 juv. ♀.

Available data show that *carnegiei* has a fairly extended range through diverse conditions in the southeastern States, this extending from Sulphur Springs, North Carolina, Pinnacle Peak and Blue Ridge,

[89] The record of this species from Thomasville and Metcalfe, Georgia, made by the authors (Proc. Acad. Nat. Sci. Phila., 1904, p. 791, (1905)), is erroneous, that reference instead relating to *M. rotundipennis*, a species then unknown to them.

Georgia, south and east as far as Warm Springs and Macon, Georgia, and Yemassee, South Carolina. The material shows a great amount of individual variation in size, both sexes exhibiting this in material from the same locality, collected in the same environment. Certain individuals, particularly of the female sex, show a general lightening of the entire coloration, while very rarely (one adult and certain nymphs) the pronotum is washed with pinkish. The adult male from Augusta is very pale and quite ochraceous, with the dorsal femoral markings very decided, solid and regular. These markings vary appreciably in individuals of relatively the same color depth. There is some variation in both sexes in the form of the tegmina, the distal section being more rounded and less subangulate in certain specimens than in others.

From the available evidence we find that the species occurs adult as early as July 25 (Blue Ridge, Georgia; Morse) and as late as October 7 (Sulphur Springs, North Carolina; Rehn & Hebard), few adults having appeared as late as August 4 (Toccoa).

This form is always sylvan in habitat, occurring on the ground under oaks and in mixed oak and pine woods. On one occasion it was found about low scrub oak scattered over a sandy area (Augusta).

Melanoplus scudderi scudderi (Uhler).

Virginia.

Orange, VII, 21, 1913, (R. & H.), 1 juv. ♂.
Lynchburg, VII, 22, 1913, (R. & H.), 2 juv. ♂, 2 juv. ♀.
Natural Bridge, IX, 12 and 13, 1907, (B. Long), 1 ♀.
Petersburg, VII, 23, 1913, (R. & H.), 2 juv. ♂.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 juv. ♂, 3 juv. ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♂.
Fayetteville, IX, 9, 1911, (R. & H.), 17 ♂, 4 ♀, 1 juv. ♂, 5 juv. ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 3 juv. ♂, 3 juv. ♀.
Florence, IX, 6, 1911,(R. & H.), 8 ♂, 3 ♀, 6 juv. ♀.

Georgia.

Thompson's Mills, X, 1910, (H. A. Allard), [U. S. N. M.].
Austell, VIII, 27, 1911, 2 ♂, [Ga. State Cln.].
Albany, VIII, 1, 1913, (R. & H.), 6 juv. ♂, 5 juv. ♀.
Bainbridge, IX, 7–X, 19, 1910, (J. C. Bradley), 1 ♀.

From a study of the material before us from the eastern and southeastern States, it is evident that southwards both sexes show a gradual broadening of the tegmina and rounding of the distal margin of the same. This feature is similar to that found in the Texan form, *scudderi texensis* Hart, of which we have typical material, but that race also has the general form more compressed in both sexes, the furcula longer, the subgenital plate less produced and some features of the coloration different. The relationship of the material

seen from all of Georgia (Austell south to Thomasville) and from the Carolinas is clearly with Middle States and New England *s. scudderi*, although showing a parallelism to one of the features of *s. texensis*, but representative of the typical form in all the other characters.

Individual size variation in this species is considerable, but there is also an average southward increase in the general bulk.

The earliest date we are acquainted with on which adults have been taken in the southeastern States is August 24 (Chattanooga, Tenn.; Morse), while we have secured material as late as December 14 (Thomasville, Ga.; Hebard).

The species was taken in sylvan surroundings, the undergrowth of pine and oak woods being its favorite situation.

The Fasciatus Group of the Genus Melanoplus.

A tentative study of the species which have been referred to this division shows that a recasting of the whole aggregation is necessary, but our collated information is not sufficiently extensive to say more than that *fasciatus, querneus, franciscanus, nigrescens* and *walshii* are certainly, and *inconspicuus* probably, members of this assemblage. We can state definitely that *attenuatus, borealis, cockerelli, obovatipennis, rotundipennis, morsei* and *tepidus* are not to be included in the same category. Of these *attenuatus* is a member of the Decorus Group, *obovatipennis, morsei* and *tepidus* are members of the Tribulus Group and *rotundipennis* belongs to the Puer Group, while *amplectens* is a synonym of *walshii* and *juvencus* equals *viridipes*, a member of the Gracilis Group. Scudder's *saltator* belongs to another category, including *ascensus* and other species.

The species of this group apparently form a transition to the constantly long-winged forms of the genus, the relationship being chiefly, however, with the short-winged forms. The sequence of species known to belong to this division appears to us to be as given above.

Melanoplus querneus new species. Pl. XIV, figs. 1, 2, 3.

1905. *Melanoplus nigrescens* Rehn and Hebard (not of Scudder), Proc. Acad. Nat. Sci. Phila., 1904, p. 791. [Thomasville, Georgia.]

A member of the *fasciatus* group and more nearly related to *M. walshii* and *nigrescens* than to any of the other members of the genus. In general structure and coloration the new species is practically identical with the two older forms, but it differs from both in the slightly longer tegmina in both sexes, the broader sublamellate male

cerci, which are subconstricted mesad, and in the rounded and hardly produced apical margin of the subgenital plate of the same sex. The females of the three species are very similar, but the constantly longer tegmina and slightly less bicolored character of the same in *querneus* enable one to distinguish it.

TYPE: ♂; Thomasville, Thomas County, Georgia. November 30, 1903. (Morgan Hebard.) [Hebard Collection, Type No. 116.]

Description of Type.—Size large; form moderately robust. Head as in *nigrescens* except for the frontal costa failing to reach the clypeal suture; antennæ very long, slightly longer than the pronotum and tegmina together. Pronotum as in *nigrescens.* Tegmina almost or quite reaching the region of the furcula when the abdomen is in the usual somewhat recurved position, appreciably longer than in *nigrescens,* considerably exceeding the combined length of the head and pronotum, subacuminate, the apices narrowly rounded; sutural margins moderately arcuate. Prosternal spine similar to that of *nigrescens;* interspace between the mesosternal lobes slightly broader and less decidedly longitudinal than in *nigrescens;* interspace between the metasternal lobes subattingent, but not contiguous as in *nigrescens.* Abdomen subcompressed proximad, with a fairly distinct and moderately elevated medio-longitudinal carina; furcula merely the briefest of points projecting from the disto-dorsal abdominal segment, poorly indicated on the surface of the segment as broad, rounded areas, between which the segment is emarginate; supra-anal plate as in *nigrescens,* but the proximal medio-longitudinal sulcus and its marginal carinæ are more decided and the median transverse carina is more strongly indicated (fig. 3); cerci broad, sublamellate, the greatest distal width hardly more than half the length, broad at base, somewhat narrowing to the middle, the whole dorsal margin arcuato-emarginate, the disto-dorsal angle rotundato-rectangulate, distal margin arcuato-truncate and gently rounding into an obliquely truncate disto-ventral section, which latter passes by a very slight angle into the ventral margin, distal section with surface faintly tumid and separated from distal margin by an arcuate impression (fig. 1); subgenital plate distinctly broader than long, the apical margin semi-elliptical in shape when seen from the dorsum, when seen from the side moderately emarginate with a faintly produced extremity (fig. 2). Cephalic and median limbs slightly more elongate than in *nigrescens.* Caudal femora similar to those of *nigrescens,* but dorsal outline more concave distad; caudal tibiæ with external spines ten to eleven in number.

Allotype: ♀; Same data as type but taken December 3, 1903. [Hebard Collection.]

Description of Allotype.—Differing only from the same sex of *nigrescens* in the average larger size, actually as well as proportionately, longer antennæ, longer tegmina and more robust and less attenuate ventral valves of the ovipositor. The tegmina are distinctly longer than the head and pronotum together. The ventral jaws of the ovipositor are well decurved at the apex and have the proximal tooth strongly indicated, these being more slender, straighter and with a weaker tooth in *nigrescens*, while in *walshii* the valves, though nearly as straight as in *nigrescens*, are heavier and nearer in form to those of *querneus*.

Measurements (in millimeters).

Thomasville, Ga.	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂ XI, 30, 1903. Type	22.5	6.2	10	15.8
♂ XI, 12, 1902. Paratype	27.1	6.5	11.7	16.7
♀ XII, 3, 1903. *Allotype*	32.2	6.7	11.6	17.3
♀ XII, 10, 1903. Paratype	32.8	7.9	12.5	18.3

In size there is some little variation, particularly in the male sex, the type and allotype being about the minimum for each sex, the maximums being measured above. The males show practically no individual variation at all in the form of the appendages, there being but a scarcely perceptible amount in the relative depth of the cercus, while the females show no noteworthy structural variation.

Color Notes.—Detailed color descriptions made from life have already been published for this species (see above). In consequence we will only comment on the differences noted from those descriptions. The general coloration is diluted or brightened in certain individuals, the pale tones becoming cinnamon buff on the dorsum of the head, pronotum, anal field of tegmina, pleural streak and caudal femora, while rarely the deepening of the coloration has resulted in a general benzo brown to fuscous tone, with the dark markings fuscous black to shining black. The caudal tibiæ occasionally show no trace of maroon or poppy red, but are largely dull honey yellow with the usual proximal suffusion. The less bicolored condition of the tegmina in this species, when compared with *walshii* and *nigrescens*, is due to the more pronounced breaking up into small maculations of the blackish fuscous of the discoidal and marginal fields, while in *nigrescens* and *walshii* these areas are more uniformly

colored and consequently more contrasted with the almost invariably paler anal area. We have but one specimen of *querneus*, a male, which shows little or no contrast between the two sections of the tegmina, this being the very dark individual mentioned above.

In addition to the type and allotype, we have before us a series of ten males and thirteen females, taken at Thomasville on dates extending from November 30 to December 13, 1902–1903, all of which may be considered paratypic.

Before we were able to examine specimens of undoubted *nigrescens* we referred to this species by that name, but now with Scudder's species in hand it is quite evident that the two are distinct.

This species was found frequenting the vicinity of scrub oaks in the pine and oak woods. Extensive notes on the habits of the species have been previously published (*vide supra*).

Melanoplus nigrescens (Scudder).

Lake Waccamaw, North Carolina, IX, 8, 1911, (R. & H.), 1 ♂.

St. Simon's Island, Georgia, VIII, 30, 1911, (R. & H.), 4 ♂, 11 ♀.

The above records, with those of Scudder from "Georgia" and Smithville, North Carolina, form all the information we have on the range of this species, as the record of *nigrescens* from Thomasville, Georgia, made by the authors[90] we now find to have been based on the allied but distinct new species, *M. querneus*, which is described above. We find on comparison that *nigrescens* is closely related to *walshii*, differing chiefly in details of the dorsum of the pronotum, in the peculiar offset or twist of the distal section of the male cercus and in the more pronounced apex of the subgenital plate of the same sex. The females are almost indistinguishable, the more delicate median carina of the pronotum, the straighter ovipositor jaws (particularly ventral) and the more subequal and less distinctly tapering prosternal spine being about all the really tangible characters in *nigrescens* to separate that sex from *walshii*. In coloration the two species are almost identical, each varying to about the same degree individually, although on the whole *nigrescens* has the dorsal aspect generally paler. There can be no question but that both species are members of the same species group.

The size shows but little variation in the series and this is slightly more pronounced in the female than in the male sex.

From the records the species seems to be restricted to the lower portion of the Coastal Plain within the Sabalian or Basic Austral Zone.

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[90] Proc. Acad. Nat. Sci. Phila., 1904, p. 791, (1905).

The Lake Waccamaw specimen was taken in heavy undergrowth of bushes in short-leaf pine woods, while on St. Simon's Island the species occurred in very few numbers among dead leaves under live oaks. In the latter situations there was practically no ground vegetation owing to the constant shade of the oak groves. A particular search was made for the species elsewhere as well as on St. Simon's Island and all seen were secured. The date for the Smithville record given by Scudder is November 22, so the species is seen to be present, where found, from late August to the latter part of November.

Melanoplus walshii Scudder.

1897. *Melanoplus walshii* Scudder, Proc. U. S. Nat. Mus., XX, p. 235, pl. XV, fig. 10.
1897. *Melanoplus amplectens* Scudder, *ibid.*, p. 260, pl. XVII, fig. 7.
1897. *Melanoplus blatchleyi* Scudder, *ibid.*, p. 322, pl. XXI, fig. 10.

North Carolina.

Black Mountain, VII and VIII, 1912, (W. Beutenmüller), 4 ♂, 11 ♀, [Davis Cln.]

Georgia.

Rabun Bald, Rabun County, VII, 1910, (W. T. Davis), 1 ♂, 1 ♀.

Currahee Mountain, 1,700 feet, VIII, 5, 1913, (H.), 9 ♂, 4 ♀.

Sharp Mountain, 1,800–2,000 feet, VIII, 6, 1913, (R.), 3 ♂, 3 ♀.

Dalton, 850–1,200 feet, VIII, 7, 1913, (R.), 1 ♀.

The above synonymy is evident after examining all the typical material involved,[91] the individual and to an extent geographic variation found in the species probably being responsible for Scudder's confusion. The general size, form of the cerci, furcula, supra-anal and subgenital plates, caudal femora and tegmina, as well as certain features of the coloration, are found to be variable in the series of eighty-one specimens from seventeen localities before us. The largest specimens are from the Missouri valley region, but the variation in this respect at any locality represented by a series is seen to be very considerable. It is quite possible that the acquisition of more material from the Mississippi and Missouri valleys will show the desirability of recognizing two races of this species, one a western one to which the name *blatchleyi* (proposed to replace Bruner's preoccupied *Pezotettix occidentalis*, described from Omaha, Nebraska) should be limited, and the other to which typical *walshii*, with *amplectens* as a synonym, would be applied. There can be no question but that these forms, if recognizable, are but races of one species, for which the name *walshii* must be used. At present we

[91] Morse has already placed *blatchleyi* in the synonymy under *amplectens*. Carnegie Inst. Wash., Publ. No. 18, p. 50, (1904).

lack sufficient material to enable us to test out satisfactorily the geographic value of characters suggested by our series.

We have before us the typical material on which Bruner's *occidentalis*, the basis of *blatchleyi*, was founded and have examined all the types of both *walshii* and *amplectens*, hence the above synonymy has been established by reference to the basic material.

That Scudder was in great difficulty with this variable species is evidenced by his treatment of the synonymic names. The first, *walshii*, he placed in his *rusticus* series, the second, *amplectens*, in his *fasciatus* series and the third, *blatchleyi*, in his *texanus* series. In our opinion the species clearly belongs to the Fasciatus Group; that is, it should be placed in the general vicinity of *fasciatus*, for while the genitalia are different in some respects, a number of other features are very similar.

The extremes in size in the present series are as follows:

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂ Rabun Bald, Ga.	19.1 mm.	5 mm.	6.2 mm.	11.5 mm.
♂ Currahee Mtn., Ga.	25.2 "	5.7 "	7.2 "	14.2 "
♀ Rabun Bald, Ga.	25.2 "	5.7 "	8 "	13.9 "
♀ Currahee Mtn., Ga.	29.8 "	6.5 "	8.2 "	15.9 "

The Currahee Mountain and Sharp Mountain series show considerable individual variation in size, the minimum of the female sex from Currahee Mountain being hardly larger than the minimum measured above, while the Sharp Mountain lot shows even greater variation in the male than is found in the same sex in the Currahee Mountain representation. There is very little variation in color, the most apparent being the degree of infuscation of the anal area of the tegmina, the presence or absence of the pale spot proximo-dorsad on the external pagina of the caudal femora and the absence or presence, depth and extent of a dark pregenicular annulus on the caudal tibiæ.

All of the specimens taken by us were secured in the normal sylvan habitat of the species; on Currahee Mountain on the upper slopes of the mountain, among the heavy undergrowth of vines, oak sprouts and grasses in a forest composed chiefly of black-jack oak, being only occasional on the slopes and fairly abundant on the summit; on Sharp Mountain under similar conditions in a forest of coniferous and deciduous trees and all seen were taken, while at Dalton one was secured on a steep slope under deciduous trees.

Long-winged Species of the genus Melanoplus.

Melanoplus atlanis (Riley).

Maryland.

Glen Echo, VII, 10, 1914, (H.), 1 ♂.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 ♂, 4 ♀.
Orange, VII, 21, 1913, (R. & H.), 1 ♂, 4 ♀.
Natural Bridge, IX, 12–13, 1907, (B. Long), 1 ♂, [A. N. S. P.].
Lynchburg, VII, 22, 1913, (R. & H.), 2 ♀.
Petersburg, VII, 23, 1913, (R. & H.), 2 ♀.

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), 1 ♂.
Weldon, VII, 24, 1913, (R. & H.), 1 ♂, 1 ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♂.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 2 ♀.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♂.
Sumter, V, 30, 1914, (W. Stone), 1 ♀, [A. N. S. P.].
Manning, V, 23 to 30, 1914, (W. Stone), 5 ♂, 4 ♀, 1 juv. ♀, [A. N. S. P.].

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 2 ♂, 5 ♀.
Clayton, 2,000–3,700 feet, VI, 1909, (W. T. Davis), 3 ♂.
Buckhead, VIII, 2, 1913, (R. & H.), 1 ♂.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♂.

The present species is relatively infrequent in the Coastal Plain south of North Carolina and the lower Gulf drainage of southern Georgia, in addition having never been definitely recorded from peninsular Florida. That from Thomasville (Rehn & Hebard) is the only known south Georgia record and Marianna (Morse) is the only definite Florida locality.

The present representation shows considerable individual variation in general size and in tegminal length, while the coloration shows the usual variability of this plastic species. One of the Rabun County males has the caudal tibiæ pale glaucous clouded with brownish proximad and distad.

The above specimens secured by us were all taken in cultivated or waste fields, being common nowhere except at Orange and Petersburg, while generally very scarce.

Melanoplus impudicus Scudder.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 1 ♀.

Georgia.

Currahee Mountain, VIII, 5, 1913, (H.), 2 ♂, 6 ♀.
Dalton, VIII, 7, 1913, (R.), 1 ♀.
Lost Mountain, Cobb County, VII, 13, 1913, 1 ♂, [Ga. State Cln.].
Warm Springs, VIII, 9–10, 1913, (R.), 2 ♀.
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 1 ♀.

The present material, when compared with a New Jersey series before us, is found to have the tegmina and wings somewhat longer, these slightly surpassing the tips of the caudal femora in the majority

of southern specimens, while the coloration is more uniform and much as in the least maculate of the New Jersey specimens. The few specimens before us from Indiana agree perfectly with New Jersey material, but are all of the less maculate type of coloration.

Occasional small, dark and exceptionally compact females of *M. luridus*, having abbreviate tegmina, might easily be confused with examples of the same sex of the present species. Examination, however, reveals the fact that the ovipositor jaws in that species are longer, with their narrowed distal portions much longer and less curved. Further examination shows that such examples of *M. luridus* have larger, more protuberant and darker eyes, a less trim pronotum, heavier limbs and other characters by which they can be distinguished. Typical females of *M. luridus* are very different, even in superficial appearance, from typical females of the present species.

The series here recorded was taken in a pine forest on a hillside (Columbia), in a heavy tangle of pine and oak woods undergrowth (Dalton, Warm Springs) and on Currahee Mountain very few were found at the summit (1,700 feet) in the heavy mountain undergrowth of a low forest predominantly black-jack oaks, while in the undergrowth of the pine woods at the upper limit of the gradual slopes (1,300 feet) other specimens were taken.

This insect is known to be an Austral species of localized distribution. It has been recorded from Jamesburg, southward at other localities in the pine barrens of New Jersey; Murphy, North Carolina; Denmark and Spartanburg, South Carolina; Blue Ridge, Chickamauga and Sand Mountain, Georgia, and Monticello, Mississippi. Further west it is known from numerous counties in northwestern Arkansas, and in the upper Mississippi valley region from Gibson County, Indiana, and Havana and Ozark Ridge, Illinois.

Melanoplus femur-rubrum femur-rubrum (De Geer).

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 ♂.
Orange, VII, 21, 1913, (R. & H.), young.
Lynchburg, VII, 22, 1913, (R. & H.), 1 ♂.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂.
Clayton, VII, 1910, (W. T. Davis), 1 ♀.
Stone Mountain, VIII, 3, 1913, (R. & H.), 3 ♂, 2 ♀, 4 juv. ♂.
Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.), 1 juv. ♂, 3 juv. ♀.

Immature specimens of the species were found in great numbers at all of the localities in Virginia listed above. The insect is very abundant everywhere in the upland grass-lands of Virginia, but south of this region it is much less numerous and less generally distributed.

At Stone Mountain, Georgia, adults were occasional and the young fairly abundant in the frequent areas of bunch-grass on the mountain.

Specimens from high elevations in Georgia are typical of the species. Those from Stone Mountain and its vicinity show a slight approach toward the southeastern race.

The present form is found southward on the Atlantic coast as far as southern Virginia, south of this its southeastern distribution does not extend down from the Appalachians as far as the fall line. Its range probably extends eastward along the Gulf Coast from Texas as far as Alabama, for in that State, Morse secured intermediates between it and the southeastern race at Flomaton. Material previously recorded by us from Newbern, North Carolina,[92] is really intermediate and shows a closer affinity to the southeastern race.

Melanoplus femur-rubrum propinquus Scudder.

North Carolina.

Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂.
Winter Park, IX, 7, 1911, (R. & H.), 2 ♂, 3 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂.

South Carolina.

Columbia, VII, 28, 1913, (R. & H.), 2 ♂, 4 ♀.
Isle of Palms, VIII, 15, 1913, (R.), 3 ♂, 1 ♀.
Sullivan Island, IX, 5, 1911, (R. & H.), 1 ♂.
Yemassee, IX, 4, 1911, (R. & H.), 4 ♂, 3 ♀.

Georgia.

Augusta, VII, 29, 1913, (R. & H.), 2 ♂, 2 ♀.
Tybee Island, IX, 2, 1911, (R. & H.), 2 ♂, 2 ♀.
Jesup, IX, 1, 1911, (R. & H.), 2 ♂, 1 ♀; XII, 1908, (H.), 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 1 ♂.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 3 ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 4 ♂, 1 ♀.
Hebardville, V, 15, 1915, (H.), 1 ♂.
Billy's Island, VI, VII, 1912, (J. C. Bradley), 7 ♂, 18 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 5 ♂, 4 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂.
Bainbridge, IX–X, 1910, (J. C. Bradley), 1 ♀.
Spring Creek, VII, 1912, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, V, VIII, 1885, (W. H. Ashmead), 3 ♂, 2 ♀, [Hebard Cln.]; IX, XI, 1911–13, (W. T. Davis), 12 ♂, 17 ♀.
Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 2 ♂, 1 ♀.
St. Augustine, XI, 8, 1911, (G. P. Englehardt), 1 ♀, [B. I.].
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂, 1 ♀.
Newberry, XI, 19, 1911, (W. T. Davis), 3 ♂.
Tampa, I, 17, 1904, (H.), 1 ♀.

We find the specimens from Wrightsville and Winter Park to be intermediate between the present geographic race and *M. femur-rubrum*. We have typical examples of the present insect from as far north as Lake Waccamaw. Scudder includes specimens from Pungo Bluff, North Carolina, in his typical material of the present insect, but these specimens are intermediates. Differences in the male

[92] Proc. Acad. Nat. Sci. Phila., 1910, p. 635, (1911).

genitalia, somewhat analogous to those found in *Aptenopedes s. sphenarioides* and *A. s. clara*, alone separate the present races.

The coloration of the caudal tibiæ of the present race normally varies from carrot red to flesh color, three specimens in the series before us have the reddish hue nearly obsolete (maize yellow, very faintly suffused with pink dorsad), while a single unusually pale specimen, taken in a weedy field near the strand on Cumberland Island, has the caudal femora pale glaucous (light turtle green), shading to pale chalcedony yellow on the proximal and distal portions of the ventral surface.

The insect has very similar habits to typical *femur-rubrum*, being found particularly in grassy and weedy spots in the open. This geographic race is distributed over the southern coastal plain from extreme southern North Carolina, through South Carolina and Georgia, as far west as Flomaton, Alabama, and over entire peninsular Florida, though scarce south of the central portion.

Melanoplus impiger Scudder.

Augusta, Georgia, VII, 29, 1913, (R. & H.), 10 ♂, 7 ♀, 1 juv. ♂, 1 juv. ♀.

This is the first record of the species from east of Texas. The specimens here listed have been compared with the type and cotypes in the Hebard Collection ex Bruner and found to be identical. In size there is considerable individual variation, particularly in the male, the extremes from Augusta measuring (in millimeters) as follows:

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂	21.5	5.1	20.2	13.6
♂	28.3	6.2	22.2	15.8
♀	24.2	5.3	20.8	14.5
♀	26.8	6.1	22.7	16.5

In coloration the Georgia individuals are less contrastingly colored than Texan specimens, the pale colors being duller ochraceous and the tegmina more fuscous, while the external paginæ of the caudal femora generally have the usual bars more or less fused into a blackish fuscous area covering the dorsal section of the pagina. The color of the caudal tibiæ ranges as dark as dark orient blue in the glaucous condition and as decidedly red as nopal red in the other type.

The species was found in moderate numbers in a sandy area scatteringly covered with scrub oak.

Melanoplus confusus Scudder.

Melanoplus minor of authors.

Fredericksburg, Virginia, VII, 20, 1913, (R. & H.), 5 ♂, 2 ♀.
Havelock, Craven County, North Carolina, late V, 1907, and VI, 19–24, 1905, (F. Sherman), 4 ♂, 2 ♀, [N. C. State Dept. Agr.].

We find that *Caloptenus minor* of Scudder[93] (*Melanoplus minor* of authors) is preoccupied by *Caloptenus minor* of Walker.[94] Scudder's *Melanoplus confusus*,[95] described from Munson's Hill and Newport, Kentucky, is, however, the same as his *minor* and the name must be used for the present species. Caudell, finding that Scudder's name *minor* was preoccupied, but misquoting the original generic position as *Pezotettix*, has recently proposed the name *Melanoplus mutatus*[96] for the present species; this name naturally falls in the synonymy under *Melanoplus confusus*.

The specimens from the latter locality listed above were kindly loaned to us by Mr. Sherman, in response to our request to see some of the material on which the record of this species from eastern North Carolina was based.[97] These individuals are perfectly typical of *confusus*, and Havelock is the most southern locality in the east from which the species has been reported.

At Fredericksburg the species was found in short grass on rather barren hillsides bordering the valley of the Rappahannock on the south.

Melanoplus luridus luridus (Dodge).

Black Mountain, North Carolina, VIII, 7, 1912, (W. Beutenmüller), 1 ♂, [Davis Cln.].
Pinnacle Peak, Rabun County, Georgia, VIII, 20, 1913, (J. C. Bradley), 1 ♂, 3 ♀, 1 juv. ♂, 1 juv. ♀.
Tuckoluge Creek, Rabun County, Ga., VII, 1910, (W. T. Davis), 1 juv. ♀.

The present insect is widely distributed over the northern United States, extending in southward distribution along the Atlantic coast at least as far as southern New Jersey. In the Appalachians, however, the distribution of the insect is carried southward at considerable altitudes to the most southern portion of these mountains, as the material recorded above demonstrates. In size and robustness the present individuals are much as in the average of material before us from Connecticut. The junior author's record of *M. deletor* from that State[98] applies wholly to the present insect, as do the senior author's records of *M. keeleri* from New Jersey.[99] Both of these

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[93] *Proc. Bost. Soc. Nat. Hist.*, XVII, p. 478, (1875).
[94] *Cat. Dermapt. Saltat. Br. Mus.*, IV, p. 699, (1870).
[95] *Proc. U. S. Nat. Mus.*, XX, p. 339, pl. XXII, fig. 10, (1898). We have examined the male lectotype of *confusus* from Munson's Hill, Kentucky, and find no valid character to separate it from *minor* of Scudder. The lectotype and other material has shrivelled from immersion in alcohol and as a result, we have differences in the form of the cerci due solely to distortion.
[96] *Proc. U. S. Nat. Mus.*, XLIX, p. 30, (1915).
[97] Sherman and Brimley, *Ent. News*, XXII, p. 389, (1911).
[98] *Ent. News*, XXI, p. 184, (1910).
[99] Rehn in Smith, *Ins. of New Jersey*, p. 184, (1910).

errors were due to the fact that in these portions of the range of typical *luridus*, frequent females are met with which are larger and decidedly heavier than specimens of the same sex from further north. This must be attributed to variation in *l. luridus*, for the southern race differs in all important respects from such material quite as decidedly as it does from typical *luridus*.

The great amount of variation in the present species is partially shown by the following table of measurements of the extremes of various series before us.

Measurements (in millimeters).

♂♂.	Length of body.	Caudal width of pronotum.	Length of tegmen.	Length of caudal femur.
Aweme, Manitoba.....(2)[100]	18–19.1	2.5–2.8	16–16.4	10.8–11.1
Pequaming, Michigan.....(1)	17	2.4	13.7	10
Cape Cod, Massachusetts(2)	17.4–18.3	2.5–2.6	12.4–13.1	10.2–10.5
New Haven, Connecticut(5)	18.5–19.5	2.8–3.1	12.7–15.4	11.7–12
Stafford's Forge, N. J.....(11)	17–20	2.7–3	12.9–15	10.5–12
Mount Pisgah, N. C.....(8)	18.5–18.8	2.7–2.8	13.8–14.6	10.7–11.6
Pinnacle Peak, Ga.....(1)	19.2	3	14.9	12.3
♀♀				
Aweme, Manitoba.....(2)	20.2–21.7	3.2	16–16.3	11–11.7
Pequaming, Mich.....(8)	19.6–20.3	3.1–3.4	15.9–17.8	10.8–11.6
Cape Cod, Mass.....(2)	23.5–25	3.5–3.7	15.7–15.8	12.9–13.3
New Haven, Conn.....(7)	23.7–27.4	3.5–4	15.2–17	13.2–15.3
Stafford's Forge, N. J.....(8)	22.5–25.2	3.4–4	11–16	11.8–14
Mount Pisgah, N. C.....(7)	22.4–24	3.4–4	13.4–16.9	12.5–13.2
Pinnacle Peak, Ga.....(3)	24.8–25	3.4–3.8	16.7–18	14.3–15.3

It would be difficult to imagine individuals, without even racial significance, differing more greatly in general appearance than do the long-winged slender examples from the northwestern portion of this insect's range, from the heavy shorter-winged type which is often found in Connecticut and New Jersey southward through the Appalachians. This is particularly true of the female sex; northwestern material bearing a strong superficial resemblance to *M. atlanis*, while the southeastern material is vastly heavier with a very different general appearance. Intergradation between these types is, however, almost everywhere to be found and no valid reason exists for separating eastern and western material as geographic races.

Melanoplus luridus keeleri (Thomas).

Virginia.

Petersburg, VII, 23, 1913, (R. & H.), 1 ♂, 1 juv. ♂.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 juv. ♂, 3 juv. ♀.

[100] The figures in parentheses indicate the number of specimens measured from each locality.

Charlotte, VII, 27, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 7 ♂, 10 ♀, 1 juv. ♂.
Wrightsville, IX, 7, 1911, (R. & H.), 3 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 3 ♂.
Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♂, 3 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 2 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 12 ♂, 9 ♀.

Georgia.

Toccoa, VIII, 4, 1913, (H.), 3 juv. ♂, 2 juv. ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 8 ♂, 3 ♀, 2 juv. ♂, 1 juv. ♀.
Sharp Mountain, VIII, 6, 1913, (R.), 1 juv. ♂, 1 juv. ♀.
Buckhead, VIII, 2, 1913, (R. & H.), 2 juv. ♂.
Augusta, VII, 29, 1913, (R. & H.), 2 juv. ♂, 5 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 3 ♂, 4 juv. ♂, 4 juv. ♀.
Warm Springs, VIII, 9–10, 1913, (R.), 3 ♂, 3 juv. ♂, 1 juv. ♀.
Tybee Island, IX, 2, 1911, (H.), 3 ♂, 2 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 14 ♂, 3 ♀, 1 juv. ♂, 1 juv. ♀.
Sandfly, IX, 3, 1911, (R. & H.), 1 ♂, 3 ♀.
Jesup, IX, 1, 1911, (R. & H.), 4 ♂, 4 ♀.
Waynesville, (J. C. Bradley), 1 ♀.
Brunswick, VIII, 30, 1911, (H.), 6 ♂, 2 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 5 ♂, 3 ♀, 1 juv. ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 4 ♂, 1 ♀.
Billy's Island, IX, XII, 23, 1911, (J. C. Bradley), 2 ♂.
Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♂.
Spring Creek, VII, VIII, 1912–13, (J. C. Bradley), 1 juv. ♂, 1 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 5 ♂, 4 ♀; XI, 5, 1911, (W. T. Davis), 2 ♂, 1 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 10 ♂, 8 ♀.
Daytona, XI, 11, 1911, (G. P. Englehardt), 2 ♀, [B. I.].
Live Oak, VIII, 26, 1911, (R. & H.), 2 ♂, 1 ♀.

The present geographic race is the southern development of *M. luridus*, and is found along the Atlantic coast as far north as Petersburg, Virginia. In the extreme southern Appalachians it is met with up to an elevation of about 2,000 feet, above which typical *luridus* is found.

This southern race is distinguished from *luridus* s.s. by its greater size, more attenuate form and smoother structure, by the subgenital plate of the male being longer in proportion to its width and by the ventral valves of the ovipositor of the female having the distal portions much longer and less curved, in fact nearly straight. Scudder gave the character of the subgenital plate in his description of *keeleri*, but wrongly contradicted himself in his key.

A much greater amount of genital variation, particularly in the shape of the cerci, is found in the present species than is usual in the genus *Melanoplus*. There is also much variation in size and coloration. The conclusion that the species increased regularly in size in southward distribution[101] must be somewhat modified, for although

[101] Proc. Acad. Nat. Sci. Phila., 1907, p. 297, (1907).

this is true to a moderate degree, the large amount of material now at hand shows that environmental differences have a more decided effect. The table of measurements gives the normal dimensions of material from different portions of the range of this race; certain series before us are decidedly smaller than is usual, this differentiation being apparently due to environmental conditions, this size reduction is shown by material from Macon, St. Simon's and Cumberland Islands, Georgia, and to a less extent in the series from Tybee Island, Georgia. In these series males average about 22 mm. and females about 26 mm. in length.

Measurements (in millimeters).

		Length of body.	Caudal width of pronotum.	Length of tegmen.	Length of caudal femur.
♂♂					
Winter Park, N. C.	(6)[102]	23.5–25.7	2.9–3	18–19.4	12.8–14.8
Currahee Mountain, Ga.	(8)	20.1–23.8	3–3.3	18–19.2	13.6–14
Jesup, Ga.	(4)	22.3–23	2.8–3	18.2–19.9	13.7–14.3
Atlantic Beach, Fla.	(10)	19.4–27.2	2.8–3.4	18–21.4	13–15.1
Miami, Fla.	(13)	23–24.9	3.1–3.3	21.2–22.8	15–15.3
Dallas, Texas	(1)	25	3.3	20	15.2
Houston, Tex.	(1)	25.6	3.3	19	14.8
♀♀					
Winter Park, N. C.	(11)	28.2–32.5	3.8–4.1	20–22.3	15–17.7
Currahee Mountain, Ga.	(3)	25.8–28.7	4–4.2	19.4–21.7	15.8–16.8
Jesup, Ga.	(4)	26.3–30.3	3.8–4.6	20.4–24	15.4–17.4
Atlantic Beach, Fla.	(8)	29–29.9	4–4.5	21.7–23	17.5–18.2
Miami, Fla.	(13)	29.6–35.5	4.1–4.4	23.5–26	17.3–18.8
Houston, Tex.	(1)	30.7	4.3	21.4	16.9

The synonymy of Scudder's *M. deletor* with the present insect has been discussed and established by the authors.[103]

Many of the specimens here recorded are very dark in general coloration, with the lighter areas of the caudal femora cinnamon color and very striking; the series from Winter Park, North Carolina, composed wholly of such specimens, is particularly brilliantly marked. A few pale brown specimens have the markings of the caudal femora subobsolete and suggest in appearance large and very heavy specimens of *M. femur-rubrum.*

Melanoplus furcatus Scudder.

Billy's Island, Georgia, VI–VII, 1912; IX, 1–5, 1913, (J. C. Bradley), 1 ♂, 4 ♀, 2 juv. ♂.

Jordan's, Billy's Island, Ga., VIII, 31, 1913, (J. C. Bradley), 1 juv. ♀.

Honey Island, Ga., VI, 1912, (J. C. Bradley), 1 juv. ♂.

[102] The figures in parentheses indicate the number of specimens measured from each locality.

[103] Proc. Acad. Nat. Sci. Phila., 1907, p. 296, (1907).

In addition to the above specimens we have before us the previously unique male and female, from Jacksonville, Florida, on which the species was based. The Okeefenokee females are of similar size to the Jacksonville one, but the single Billy's Island male is somewhat smaller than the type, its measurements being: length of body, 30 mm.; length of pronotum, 7.3; length of tegmen, 19.2; length of caudal femur, 17.8. In coloration there is considerable individual variation in the pale areas, one female having these more ochraceous than the others, while one of the same sex has the same areas appreciably rufous brown. The male and one of the females from Billy's Island were taken in coitu. The single immature example from Billy's Island taken in June, and that from Honey Island taken the same month, are in the same instar, while those from Billy's Island taken in July and Jordan's, August 31, are in a more advanced stage. The forking of the male cerci is indicated in all of the young, although the difference between the two stages is in this respect very appreciable. The July immature specimen is quite generally blackish, but the June and August ones are of a strongly contrasted pattern with the pale areas on the dorsum of the head and pronotum quite rufescent.

Melanoplus clypeatus Scudder.

Sandfly, Georgia, IX, 3, 1911, (R. & H.), 2 ♂, 2 ♀.

This rare species was found in the heaviest undergrowth in gray-bark pine woods, in more or less swampy situations. Specimens were very scarce, even when thorough search was made for them. The males, when disturbed, jumped or flew several feet, but the females were more sluggish.

In size the series before us, three males and five females, shows little individual variation, while in color we find one condition much paler and more ochraceous than another. This pale condition is represented by one of the original "Georgia" males, now in the Hebard Collection ex Bruner, a female from Thomasville, Georgia, and one of the same sex from Sandfly. The degree of paleness of the anal area of the tegmina is about equal in this species and *furcatus*, varying somewhat in each. The females of these two species are rather difficult to distinguish, but the more robust and less elongate caudal femora of *clypeatus* will serve to separate the two.

Sandfly and Thomasville, Georgia, are the only exact localities from which the species is known, it originally having been described from Georgia without more exact information.

Melanoplus femoratus (Burmeister).

Maryland.

Glen Echo, VII, 10, 1914, (H.), 1 ♂.
Washington, D. C., VIII, 6, 1 ♂, [Hebard Ch.].

Virginia.

Arlington, VII, 9, 1914, (H.), 6 ♂.
Fredericksburg, VII, 20, 1913, (R. & H.), 2 ♂, 3 ♀.
Lynchburg, VII, 22, 1913, (R. & H.), 2 ♀.
Petersburg, VII, 23, 1913, (R. & H.), 2 ♂, 2 ♀.

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), 2 ♀.
Charlotte, VII, 27, 1913, (R. & H.), 1 ♀.

The range of this species is now known to extend eastward to the coast in Virginia (Virginia Beach), but in North Carolina it has not been taken lower than Raleigh, while in Georgia it is only known from elevated localities in the northern part of the State (Sand Mountain and Blue Ridge).

The species was scarce everywhere and was found in the moist situations usually frequented, while at Fredericksburg it was also encountered on rather barren hillsides.

Melanoplus punctulatus punctulatus (Scudder).

Maryland.

Cabin John Run, VIII, 1907, (W. Palmer), 1 juv. ♂, [U. S. N. M.].
Near Plummer's Island, X, 31, 1915, (W. Stone; in oak woods, few pines), 1 ♂, 1 ♀, [A. N. S. P.].
Washington, District of Columbia, IX, 23, 1908, (A. N. Caudell), 1 ♂, [U. S. N. M.].

Virginia.

Falls Church, X, 13, 1 ♂, 1 ♀, [U. S. N. M.].

Georgia.

Thompson's Mills, X, 1909, (H. A. Allard), 1 ♂, [U. S. N. M.].

Through the kindness of Mr. Franklin Sherman Jr., we have been able to examine previously recorded material of this form from Blantyre (IX, 1906; R. Woglum, 1 ♂) and Raleigh (X, 1907–XI, 1908; F. Sherman Jr., 1 ♂, 1 ♀), North Carolina. The Blantyre specimen is perfectly typical *punctulatus*, while the Raleigh material shows a faint approach toward *punctulatus arboreus* in the slightly greater thickening of the tubercle of the male subgenital plate. The Raleigh specimens are, however, clearly true *punctulatus*. We have made a careful study of all the available material of *punctulatus* and *arboreus*, some thirty-five specimens in all, and are convinced that Scudder's suggestion that *arboreus* might be only a geographic race of *punctulatus* is correct. Aside from the larger size of the southern specimens, the only constant, easily appreciated character which we can find to separate the two forms is, that in *p. punctulatus* the tubercle of the male subgenital plate is smaller, less produced and thinner, while in *p. arboreus* the same structure is larger, more distinctly produced and thicker and more inflated. The metazona of the pro-

notum, particularly in the male sex, is apparently more transverse and less distinctly longitudinal in *p. arboreus* than in *p. punctulatus*, and the caudal margin of the same area is more broadly obtuse-angulate. The exact form of the male cerci shows so much variation in the available males of *punctulatus punctulatus*, that we do not feel justified in attempting to give the differences in this structure between the series of the typical form and the very few male individuals of *p. arboreus*. The form of the subgenital plate, however, is quite constant as far as the material before us goes.

The following measurements (in millimeters) show the regular increase in size southward in typical *punctulatus* and the race *arboreus:*

M. p. punctulatus.	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂				
De Grassi Point, Ontario	18.5	4.6	16.4	11.3
Bellasylva, Pennsylvania	21.5	5	18	12
Blantyre, N. C.	24.6	5.3	22	13.3
Raleigh, N. C.	24	5.5	17	13
♀				
De Grassi Point, Ont.	29.5[104]	5.6	18.8	11.9
Bellasylva, Pa.	27.6	5.5	19.3	12.8
Stafford's Forge, New Jersey	29	6	20	14.4
Virginia		6.3	21.3	14.8
Raleigh, N. C.	35.3	6.1	21.9	14.9
M. p. arboreus.				
♂				
Lake Drummond, Va.	29.4	6.3	26.2	15.6
Dallas, Texas	27.2	6.2	22.3	15
♀				
Lake Drummond, Va.	27.4[105]	6.9	19.5	15.3
Lake Drummond, Va.	36	8.9	30	19.3
Southern Pines, N. C.	38.7	8.5	26.6	18.5
Walton County, Florida	35.5	8.2	26	18.4

The distribution of typical *punctulatus*, in the east at least, seems to be restricted to the Boreal, Transition and Upper Austral zones, intergrading with *p. arboreus*, which is an Austroriparian form. The Blantyre and Raleigh records are the most austral known to us from the eastern States.

Melanoplus punctulatus arboreus Scudder.

Virginia.

Lake Drummond, Dismal Swamp, X, 29, 1906, (H. S. Barber), 1 ♂, 2 ♀, [U. S. N. M.].

Georgia.

Vicinity of Stone Mountain, VIII, 3, 1913, (J. C. Bradley), 1 juv. ♀, [Hebard Cln.].

Florida.

Walton County (taken from stomach of turkey killed in pine forest), 1 ♀, [U. S. N. M.].

[104] Abdomen greatly extended in this specimen.
[105] Abdomen greatly shrunken in this specimen.

These records and that from Southern Pines, North Carolina, given by Sherman and Brimley,[106] of which the material is now before us, are the only ones known for the race from east of the Mississippi. The Lake Drummond male is perfectly typical of the form, one of the females is very small, in addition with its abdomen greatly contracted, but we should consider it referable to *p. arboreus*, while the other female is extremely large, in fact on the whole the largest specimen from the east we have seen. It is possible that difference of environment is responsible for the variation in these two females, or the occasional instability of a form near the margin of its range. The Dismal Swamp locality being so peculiar in itself, representing nearly the extreme Austroriparian district in the east, as well as a strongly marked accentuation of the same type of environment, we may find an explanation of this variation in the supposition that the smaller individual would represent the normal-sized insect for the geographic position of the locality, considering the regular increase in size southward of the species, while the larger ones would represent a decided response to the abnormally pronounced tendencies of the region.

The Stone Mountain individual is quite suffused with rufescent, which strongly colors the pale areas. It was taken in a dusty road bordered on each side by heavy pine woods.

Paroxya atlantica atlantica Scudder.

1898. *Paroxya scudderi* Blatchley, Can. Ent., XXX, p. 59. [Millers, Lake County and Tolleston, Indiana.]

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♀.
Wilmington, IX, 8, 1911, (R. & H.), 1 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 8 ♂, 5 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 13 ♂, 6 ♀.
Sumter, V, 30, 1914, (W. Stone), 3 ♂, 1 ♀, 1 juv. ♂, [A. N. S. P.].
Manning, V, 23 and 28, 1914, (W. Stone), 2 ♂, 4 juv. ♂, [A. N. S. P.].
Sullivan Island, IX, 5, 1911, (R. & H.), 1 ♂, 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 10 ♂, 8 ♀.

Georgia.

Tybee Island, IX, 2, 1911, (H.), 4 ♂, 2 ♀.
Sandfly, IX, 3, 1911, (R. & H.), 2 ♂, 1 ♀.
Jesup, IX, 1, 1911, (R. & H.), 10 ♂, 2 ♀; XII, 1908, (H.), 1 ♂.
Brunswick, VIII, 30, 1911, (H.), 2 ♂, 2 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 2 ♂, 1 ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 1 juv. ♀.
Mixon's Hammock, Okeefenokee Swamp, V, 16, 1915, (H.), 1 ♂, 1 ♀.
Billy's Island, VI, VII, 1912, (J. C. Bradley), 5 ♂, 4 ♀, 3 juv. ♂, 1 juv. ♀.

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[106] *Ent. News*, XXII, p. 389, (1911).

Homerville, VIII, 27, 1911, (R. & H.), 4 ♂, 3 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 4 ♂; IX, 7, 1913, XI, 5, 1911, (W. T. Davis), 1 ♂, 2 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 9 ♂, 2 ♀.
Pablo Beach, IX, 5, 27, 1913, (W. T. Davis), 3 ♂, 3 ♀.
Indian River, (T. J. Priddey), 1 ♀, [Hebard Cln.].

In conjunction with the above material, we have carefully studied the very large series of the species already recorded and in our collections, representing localities from Indiana and New Jersey to extreme southern Florida.

Examination of paratypes of *P. scudderi* and study of Blatchley's original description of that insect show that the most important characters given by Blatchley to separate *scudderi* from *atlantica* are size, antennal and cercal length and shape of the furcula. The first three of these characters are shown by the appended table of measurements to be decidedly variable in the species, and too unstable to be considered of even racial significance, while the shape of the furcula is shown by the material before us to afford no recognizable differences.

Blatchley's species consequently falls, for although the present insect shows that other geographic races are probably in the process of formation, none of these, excepting *P. a. paroxyoides*, has as yet reached a sufficient differential development to be conscientiously recognized. An effort to describe the more pronounced of these formative races would only create unnecessary confusion. Many other species, among which are *Clinocephalus elegans*, *Chortophaga viridifasciata* and *Pardalophora phœnicoptera*, demonstrate incipient racial development which has not as yet reached a stage where such can be properly recognized and geographic races described.

Measurements (in millimeters) of extremes.

♂	Length of body.	Length of antenna.	Length of pronotum.	Length of tegmen.
Lake County, Indiana	17–17.4	8.5–8.8	4.2–4.6	11–12.2
Stafford's Forge, New Jersey	18.8–19.6	9.5–10	4.5–4.6	11–11.2
Winter Park, N. C.	20.4–21.7	10–13.2	4.7–5.1	13.2–14.7
Jesup, Ga.	21.8–24	10.7–11.5	4.9–5.6	14.5–17.4
Atlantic Beach, Fla.	21.2–25	11–12.8	5–5.8	15.3–18.3
Miami, Fla.	15.7–19	8.4–10	3.6–4.4	13–15.9

♂	Width of tegmen.	Length of caudal femur.	Width of caudal femur.	Length of cercus.
Lake County, Indiana	2.2–2.3	10.8–11	2.4–2.5	1.6–1.8
Stafford's Forge, New Jersey	2.2–2.4	10.2–10.6	2.5–2.6	1.5–1.8
Winter Park, N. C.	2.7–3	11.7–14.7	2.9–3.3	1.7–1.8
Jesup, Ga.	3–3.2	12.5–14.2	3–3.4	1.9–2
Atlantic Beach, Fla.	2.8–3.5	12.9–14	3.3–3.4	1.8–2
Miami, Fla.	2.1–2.4	10.6–11.5	2.6–3	1.5–1.7

The females show a similar variability, which demonstrates that examples from the most northern localities in the distribution of the insect are smaller, with shorter tegmina and wings, the increase in size in the southward distribution reaching its maximum in southern Georgia and northern Florida. Southward in Florida a considerable decrease in size, accompanied by a general attenuation of form, is found, specimens from the mainland of extreme southern Florida being the smallest and most attenuate of any before us, with proportionately the longest tegmina and wings. A well-defined geographic race, *P. a. paroxyoides,* occupies the Florida Keys.

Although dark individuals are present in all of the series before us, we find the material from the coast of the Carolinas and Georgia to be more yellow in general coloration than is usual in specimens from other portions of the range of the species. Such specimens were noticed to be particularly brilliant in life, and showed a very close parallelism in color and markings to *Melanoplus australis,* with which insect the present species was often found. In life *Melanoplus australis* is one of the most brilliantly colored species of that very large genus.

This insect prefers moist spots, usually in forest undergrowth or on the margins of swamps and marshes. It was found common in an open glade covered with grasses over a foot in height (Florence), particularly in the drier portions of the salt-marsh margin (Tybee Island), about the edges of a wet depression in pine woods (Winter Park, Jesup), at the first of these localities associated with *Melanoplus decorus,* and in a heavy tangle of vegetation in a cabbage palmetto "hammock" (Atlantic Beach). The species was occasional in swamp grasses along a heavily wooded "branch" (Fayetteville) and scarce in strand plants (Cumberland Island), in low bog vegetation through the long-leaf pine woods (Homerville), in low vegetation and grasses near swamp (Mixon's Hammock) and in a cypress swamp (Jacksonville).

The present species is known on the Atlantic coast from Jamesburg and Lakehurst, New Jersey, southward to the extreme southern por-

tion of the mainland of Florida. Its westward distribution does not extend as far inland as the fall line, but south of this barrier in Georgia and the Gulf States and along the Gulf coast it is found west of the area treated in the present paper and has been taken in the Mississippi valley region within half a mile of the shores of Lake Michigan.

Paroxya clavuliger (Serville).

Paroxya floridiana of Thomas and authors.

Washington, D. C., VIII, 1883, 2 ♂, 1 ♀, [Hebard Cln.].

Virginia.

Petersburg, VII, 22, 1913, (R. & H.), 1 juv ♂, 1 juv. ♀.
Newport News, IX, 16, 1907, (B. Long), 1 ♀, [A. N. S. P.].

North Carolina.

Fayetteville, IX, 9, 1911, (R. & H.), 3 ♂, 2 ♀.
Wrightsville, IX, 7, 1911, (R. & H.), 2 ♂, 3 ♀.

Georgia.

Buckhead, VIII, 2, 1913, (R. & H.), 2 ♂, 2 juv. ♀.
Augusta, VII, 29, 1913, (R. & H.), 1 juv. ♀.
Warm Springs, VII, 18, 1913, (J. C. Bradley), 1 ♂.
Tybee Island, IX, 2, 1911, (H.), 5 ♂, 1 ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 ♂, 2 juv. ♀.
Hebardville, V, 15, 1915, (H.), 1 small juv. ♂, 2 small juv. ♀.
Mixon's Hammock, V, 16, 1915, (H.), 1 small juv. ♂.
Billy's Island, VI, 1912, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, IX, 1913, (W. T. Davis), 3 ♂, 2 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 ♂, 8 ♀.
Pablo Beach, IX, 27, 1913, (W. T. Davis), 1 ♀.

It is much to be regretted that Serville's description and figures of *Acridium clavuliger*[107] have so long been overlooked. There is not the least doubt that the present insect is the species which he described, and Thomas' *Caloptenus floridianus*, described in 1874,[108] has consequently been placed in the synonymy here.

Blatchley did not compare his *P. hoosieri* with the present species, to which it is very closely related. *P. clavuliger* differs in having the furcula less heavy and usually more widely separated, and the subgenital plate with the lateral portions of the caudal margin decidedly less elevated; still other differential characters appear to exist.

The material here recorded fully bears out the authors' previous assertion that the present species shows a marked increase in size southward in its distribution.[109] The distribution of the species is, to a certain degree, discontinuous, as it is scarcely ever met with except in boggy, swampy or marshy surroundings; it is particularly partial to such locations when situated in the open or along the borders of woods.

[107] *Hist. Nat. Ins.*, Orth., p. 676, pl. XIV, figs. 11a–b, (1839). [North America.]
[108] Bull. U. S. Geol. and Geogr. Surv. Terr., I, p. 68, (1874). [Florida.]
[109] Proc. Acad. Nat. Sci. Phila., 1907, p. 298, (1907).

The insect is found everywhere in favorable situations on those portions of the coastal plain treated in the present paper. It is uncommon on the Piedmont plateau and in that region has been found only at Appomattox, Virginia, and at Buckhead, Stone Mountain and Warm Springs, Georgia.

Aptenopedes sphenarioides sphenarioides Scudder.

1877. *Aptenopedes rufovittata* Scudder, Proc. Bost. Soc. Nat. Hist., XIX, p. 85. (In part.) [Fort Reed, Florida.]

Georgia.

Jesup, IX, 1, 1911, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♀; XII, 1906, (H.), 3 ♂, 2 ♀, 1 juv. ♂.
Brunswick, VII, 30, 1911, (H.), 6 ♂, 3 ♀.
St. Simon's Island, VII, 30, 1911, (R. & H.), 1 juv. ♀.
Cumberland Island, VII, 31, 1911, (R. & H.), 5 ♂, 1 juv. ♂.
Suwannee Creek, VII, 28, 1911, (R. & H.), 2 juv. ♀.
Billy's Island, VI, 1912, (J. C. Bradley), 3 ♂, 1 juv. ♀; XI, 5. 1913, (J. C. Bradley), 2 ♀, 1 juv. ♂, 2 juv. ♀.
Jordan's, Okeefenokee Swamp, VIII, 31, 1913, (J. C. Bradley), 1 ♀.
Homerville, VII, 27, 1911, (R. & H.), 1 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀.
Albany, VIII, 1, 1913, (R. & H.), 2 juv. ♀.
Bainbridge, IX–X, 1910, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 4 ♂, 1 ♀; VIII, 1885, (W. H. Ashmead), 3 ♂, 2 ♀, 1 juv. ♀, [Hebard Cln.]; XI, 3, 1911, (W. T. Davis), 7 ♂, 6 ♀.
Atlantic Beach, VIII, 24, 1911, (R. & H.), 32 ♂, 8 ♀, 1 juv. ♂, 3 juv. ♀.
Pablo Beach, IX, 5, 1913, (W. T. Davis), 2 ♂, 2 ♀, 1 juv ♂, 1 juv. ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♀, 1 juv. ♂, 1 juv. ♀.
Daytona, XI, 11, 1911, (G. P. Englehardt), 1 ♂, 1 ♀, [B. I.].

Disassociation of the sexes caused Scudder to describe three, instead of two, species at the time he erected the present genus. After describing *sphenarioides*, he described *rufovittata*, and then *aptera* from a single female. The second species is a combination of four adult males of *aptera* and three immature females of *sphenarioides*. We here select as single type of *A. rufovittata*, the only immature female of the type series of that species in the Scudder Collection (the others, from the Cornell University, having also been seen by us), and in consequence we place *rufovittata* in the synonymy under *sphenarioides*.

The specimens from Pablo Beach are the largest we have seen of the present form, being in length as follows: males 17–21.8, females 24.5–28 mm. This size is greatly exceeded in the southern race, *A. s. clara*. The smallest individuals before us are from Brunswick (male 15.4, female 20 mm.), the specimens from Jesup taken in December are also unusually small.

In the latitude of southern Georgia the species appears adult in the largest numbers not earlier than late August, and is found numerous in both adult and immature condition throughout the winter.

It is our opinion that although the majority of adults appear in the late fall, there are young reaching maturity in every month of the year.

The distribution of the present insect is known to extend from Savannah, Georgia, westward to Bainbridge, Georgia and De Funiak Springs, Florida, and southward to central Florida, where the southern race, *A. s. clara*, takes its place.

Aptenopedes aptera Scudder.

Georgia.

Jesup, IX, 1, 1911, (R. & H.), 5 ♂, 6 ♀, 2 juv. ♀.
Brunswick, VIII, 30, 1911, (H.), 4 ♂, 2 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 2 ♂, 1 ♀, 1 juv. ♂, 4 juv. ♀.
Homerville, VIII, 27, 1911, (R. & H.), 4 ♂, 7 juv. ♂, 7 juv. ♀.
St. Marys, III to IV, 1896, (O. Bangs), 1 ♀, [M. C. Z.].

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 3 ♂, 3 ♀, 4 juv. ♀; VIII, 1885, (W. H. Ashmead), 1 ♂, 2 ♀, [Hebard Cln.]; XI, 5, 1911, (W. T. Davis), 1 ♀.
Atlantic Beach, VIII, 24, 25, 1911, (R. & H.), 3 ♂, 7 juv. ♀.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂.
Newberry, IX, 18, 1911, (W. T. Davis), 1 ♀.
Archer, 1882, 1 ♀, [Hebard Cln.].

This insect appears earlier in the year than does *A. sphenarioides*, though in different years its appearance seems to vary, as in mid-August of 1905 adults were found numerous in northern Florida, while in late August of 1911 adults were few but young numerous in the same region.

This species, like *A. sphenarioides*, is found widely distributed throughout the pine woods over its entire range; in Georgia and northern Florida these pines being usually of the long-leaf species, while in southern Florida they are the antillean pine, *Pinus caribæa*. At Brunswick it was found occasional in the adult condition on palmetto flats, while at Homerville immature individuals were very common but adults rare in a low area in the pine woods overgrown with a low heather-like plant, *Kalmia hirsuta*.

The present insect is known from Jesup to Homerville, Georgia, southward over peninsular Florida and on the keys at Big Pine Key.

TETTIGONIIDÆ.

Arethæa phalangium Scudder.

Hebardville, Georgia, V, 15, 1915, (H.; undergrowth in pine woods), 1 juv. ♀.

This very scarce species is further represented in the series now under consideration by a single male from Augusta, Georgia, which specimen has recently been studied in a revisionary paper on the present genus.[110]

[110] See Rehn and Hebard, *Trans. Am. Ent. Soc.*, XL, pp. 146, 147, 148, (1914).

Stilpnochlora marginella (Serville).

Sanford, Florida, XI, 28, 1911, (G. P. Englehardt), 1 ♀, [B. I.].

Fort Myers and Lake Worth, Florida, are the most northern localities previously recorded for this species.

SCUDDERIA Stål.

We have recently fully treated the material of this genus in the present collections.[111] The localities for the collections here being studied are as follows:

Scudderia curvicauda laticauda Brunner.

Typical material. Wilmington and Winter Park, North Carolina; Yemassee, South Carolina; Mixon's Hammock, Billy's Island, Albany and Spring Creek, Georgia, and Jacksonville and Atlantic Beach, Florida.

Material approaching *S. curvicauda* s.s. Petersburg and Orange, Virginia; Weldon, Charlotte and Fayetteville, North Carolina; Spartanburg and Columbia, South Carolina, and Jasper, Currahee Mountain, vicinity of Stone Mountain, Warm Springs and Macon, Georgia.

Scudderia texensis Saussure and Pictet.

Wrightsville and Winter Park, North Carolina; Yemassee, South Carolina; Tybee Island, Jesup, Billy's Island, Honey Island, Tifton, Albany and Bainbridge, Georgia, and Jacksonville, Atlantic Beach and Live Oak, Florida.

In addition we now have 1 juv. ♂, Manning, South Carolina, V, 28, 1914, (W. Stone), [A. N. S. P.].

Scudderia furcata furcata Brunner.

Washington, District of Columbia; Fayetteville, Wrightsville and Lake Waccamaw, North Carolina; Yemassee, South Carolina; Rome, Stone Mountain, Isle of Hope, Albany and Spring Creek, Georgia, and Jacksonville, Florida.

A female of this species from Highlands, North Carolina, is now before us, which specimen has been incorrectly recorded as *S. cuneata* by Sherman and Brimley.

Scudderia cuneata Morse.

Fayetteville, Lake Waccamaw and Wrightsville, North Carolina; Florence, South Carolina; Sandfly, Brunswick and Billy's Island, Georgia, and Jacksonville, Florida.

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[111] *Trans. Am. Ent. Soc.*, XL, pp. 271–314, (1914).

Symmetropleura modesta Brunner.

North Carolina.

State record, 1 ♂, [Hebard Cln.].
Raleigh, VIII, 8, 1905, 1 ♀, [U. S. N. M.].

Georgia.

Billy's Island, VI, 1912, (J. C. Bradley), 1 ♂.
Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 2 ♂.

Florida.

Fernandina, (W. H. Finn), 1 ♂, [U. S. N. M.].
Atlantic Beach, VIII, 25, 1911, (R.), 2 ♀.
Crescent City, VI, 1 ♂, [U. S. N. M.].
Enterprise, V, 25, 1 ♂, [U. S. N. M.].

Quite decided size variation is shown by the material of this very scarce species now before us. The specimens from southeastern Georgia and northwestern Florida are exceptionally large, a condition which has been noted in material of numerous other species from that region.

The species was found in reeds in a marshy spot and was beaten from bayberry bushes, *Myrica cerifera*, at Atlantic Beach, while the specimen from Crescent City was found on orange trees.

The known distribution of the species is considerably extended by the above records.

AMBLYCORYPHA Stål.

The material of this genus found in the present collections has recently been fully studied by the authors.[112] The localities for the present collections are as follows:

Amblycorypha oblongifolia (De Geer).

Weldon, North Carolina.

Amblycorypha floridana floridana Rehn and Hebard.

Typical material. Jacksonville and Atlantic Beach, Florida.

Material intermediate between *floridana* s.s. and *floridana carinata*. Jacksonville, Florida; Billy's Island, Honey Island, Spring Creek and Isle of Hope, Georgia, and Yemassee and Ashley Junction, South Carolina.

The following specimens now before us probably represent the immature condition of such intermediates between the races of the present species:

Hebardville, Georgia, V, 15, 1915, (H.; undergrowth in pine woods), 1 juv. ♂.

Mixon's Hammock, Ga., V, 16, 1915, (H.; hammock undergrowth), 1 juv. ♀.

Amblycorypha floridana carinata Rehn and Hebard.

Petersburg, Virginia, and Silver Lake, Georgia.

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[112] *Trans. Am. Ent. Soc.*, XL, pp. 315–340, (1914).

Amblycorypha uhleri Stål.

Fredericksburg, Virginia; Weldon, Goldsboro and Lake Waccamaw, North Carolina; Columbia and Yemassee, South Carolina; Currahee Mountain, Toccoa, Jasper, Buckhead, Stone Mountain, Augusta, Isle of Hope, Sandfly, Brunswick, Macon, Albany and Spring Creek, Georgia, and Jacksonville, Florida.

Amblycorypha rotundifolia rotundifolia (Scudder).

Typical material. Spartanburg, South Carolina, and Tuckoluge Creek in Rabun County, Toccoa and Currahee Mountain, Georgia.

In addition we now have 1 ♂, Black Mountain, North Carolina, VII, 1912, (W. Beutenmüller), [Davis Cln.].

Intermediates between *rotundifolia* s.s. and *rotundifolia parvipennis*. Winter Park, North Carolina, and Macon and Warm Springs, Georgia.

Microcentrum rhombifolium (Saussure).

Delaware.

Delaware, 1 ♀, [A. N. S. P.].

Maryland.

Chestertown, VIII, 2–23, 1899–1909, (E. G. Vanatta), 6 ♂, 5 ♀, [A. N. S. P.].

Virginia.

Near Washington, D. C., IX, 2–X, 1, 1883, 1 ♂, 1 ♀, [Hebard Cln.].

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♀.

Ashley Junction, VIII, 15, 1913, (R.), 1 ♂.

Georgia.

Austell, VIII, 27, 1910, 1 ♂, [Ga. State Cln.].

Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂, 1 ♀.

Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♂.

Spring Creek, (J. C. Bradley), 1 ♀, [Ga. State Cln.].

At Florence this insect was taken in an open area covered with grasses, while at Ashley Junction and Isle of Hope it was beaten from heavy undergrowth in pine woods, and secured in the same fashion from bayberry, *Myrica cerifera*, on Cumberland Island.

Microcentrum retinerve (Burmeister).

Maryland.

Plummer's Island, VIII, 28 to X, 13, 1904 to 1906, (Caudell; McAtee; Fisher), 19 ♂, [U. S. N. M.].

Washington, District of Columbia, IX, 24 to XI, 3, 1906 and 1907, (A. N. Caudell), 3 ♂, [U. S. N. M.].

Virginia.

Near Washington, D. C., X, 13, 1883, 1 ♂, 1 ♀, [Hebard Cln.].

Georgia.

Thompson's Mills, X, 1910, (H. A. Allard), 1 ♂, [U. S. N. M.].

Bainbridge, (J. C. Bradley), 1 ♀, [Ga. State Cln.].

Pterophylla camellifolia camellifolia (Fabricius).

Cyrtophyllus perspicillatus of authors.

1906. *Cyrtophyllus elongatus* Caudell, Jour. N. Y. Ent. Soc., XIV, figs. 37, 40. [Crawford and Fountain Counties, Indiana.]

Maryland.

Chestertown, VIII, 24, (E. G. Vanatta), 1 ♀, [A. N. S. P.].

Plummer's Island, VII, 16 to X, 1, 1905 to 1915, (Barber; Schwarz; Clemons; Fisher; McAtee), 9 ♂, 9 ♀, [U. S. N. M.].

District of Columbia.

Washington, IX, 15, 1909, (H. E. Ausherman), 1 ♂, [U. S. N. M.].

Piney Branch, VIII, 15, 1905, (D. H. Clemons), 1 ♂, [U. S. N. M.].

North Carolina.[113]

Blowing Rock, 1902, (J. Willar), 1 ♀, [A. N. S. P.]; VIII, 1907, (F. Sherman, Jr.), 1 ♀, [N. C. State Dept. Agr.].

Winston, VIII, 1906, (R. S. Wolgum), 1 ♀, [N. C. State Dept. Agr.].

Alamance County, VII, 1905, (F. Sherman), 1 ♀, [N. C. State Dept. Agr.].

Georgia.

Mountain City, VIII, 19, 1913, (J. C. Bradley), 2 ♂.

Thompson's Mills, (H. A. Allard), 1 ♂, [U. S. N. M.].

The name *Pterophylla* has been revived by W. F. Kirby,[114] and an examination of the original place of publication of the name[115] shows that it was proposed by W. Kirby for five species, one of which was *Locusta camellifolia* of Fabricius.[116] W. F. Kirby has selected this species as the type of the genus.

The names *camellifolia* and *perspicillata*, one based on the female sex and the other on the male sex, were proposed by Fabricius on the same page, the former having line priority. In consequence it is necessary to use the name standing first.

Pterophylla camellifolia intermedia (Caudell).

Cyrtophyllus intermedius of Caudell.

Examination of the types and a single male before us from South Carolina leads us to believe that Caudell's *intermedius* is the southern race of *camellifolia*. The specimen from South Carolina is nearly intermediate in character between the two conditions, the ventral fork of the cercus not being as short, and the mesal production not as decided, as in the types of this race. In this specimen the tegmina are long and the enlargement of the distal portion of the subgenital plate is greater than in *camellifolia* s.s. (greatest width 2.6 mm.).

In the heavily forested areas bordering the rivers of the southeastern United States we have at night often heard a species of the present genus. The song was much quicker and sharper than that of the

[113] Although all of the specimens from this State here recorded are females, we have before us previously recorded males from Raleigh, which show the material from this region, at least from above the fall line, to be typical *camellifolia*.

[114] *Syn. Cat. Orth.*, II, p. 343, (1906).

[115] Kirby and Spence, *Introd. Ent.*, II, p. 218, (1828).

[116] *Syst. Ent.*, p. 283, (1775).

northern insect, and these individuals probably belonged to the present form.[117]

Belocephalus subapterus Scudder.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂, 2 juv. ♂, 1 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 1 juv. ♀.
Yemassee, IX, 4, 1911, (R. & H.), 4 ♂, 2 juv. ♂, 7 juv. ♀.

Georgia.

Savannah, VIII, 14, 1903, (A. P. Morse), 1 juv. ♂.
Isle of Hope, IX, 3, 1911, (R. & H.), 2 ♂, 3 ♀, 1 juv. ♀.
Sandfly, IX, 3, 1911, (R. & H.), 2 ♂, 1 ♀, 2 juv. ♀.
Jesup, IX, 1, 1911, (R. & H.), 1 juv. ♂.
Brunswick, VIII, 30, 1911, (H.), 1 juv. ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 juv. ♂.
Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 1 juv. ♂; XII, 23, 1913, (J. C. Bradley), 8 ♂.
Homerville, VIII, 27, 1911, (R. & H.), 1 juv. ♀.
Thomasville, XII, 18, 1908, (H.), 2 ♂.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 1 juv. ♀; XI, 6, 1911, (G. P. Englehardt), 1 ♀, [B. I.].
Atlantic Beach, VIII, 24, 1911, (R. & H.), 2 ♂, 2 ♀, 2 juv. ♂, 1 juv. ♀.
Hastings, (A. J. Brown), 3 ♂, 3 ♀, 1 juv. ♂, 1 juv. ♀.
Williston, I, 9, 1893, (M. H. Barton), 1 ♂, [U. S. N. M.].
Sanford, X, 24, 1889, (W. A. Gould), 1 ♀, [U. S. N. M.].
Orlando, (A. Haden), 1 ♀, [Hebard Cln.].
Fort Drum, 1 ♀, [Hebard Cln.].
Live Oak, VIII, 26, 1911, (H.), 1 ♀.
Tallahassee, VIII, 8, 1903, (A. P. Morse), 1 juv. ♂.

Measurements (in millimeters) of extremes.

♂	Length of body.	Production of vertex beyond eye.	Ventral length of fastigium of vertex.	Length of pronotum.	Length of caudal femur.
Florence, S. C.	25.3	2.9	1.9	6.9	14.7
Yemassee, S. C.	24.6–26.3	2.7–2.8	1.7–2	6.5–6.9	13.3–14.3
Sandfly, Ga.	27.4–29.7	3 –3.2	2.4–2.2	7–7.2	15–15.1
Billy's Island, Ga.	23.8–27.3	2.5–3	1.7–2.1	6.2–7.7	13.1–15.8
Thomasville, Ga	24.5–24.7	2.4–2.6	1.6	6.3–7.3	13.5–15.1
Atlantic Beach, Fla.	32.3–36.1	3.3–4	2.3–3.2	7.8–8.3	16.1–18.8
♀					
Live Oak, Fla.	37.3	4	3.1	8.7	18.8

These measurements show that scarcely any size variation may be correlated with the northern and southern distribution of this insect. Material from the region about Jacksonville (including Atlantic Beach and Pablo Beach) is the largest we have ever seen; this has been found to be true in the case of a number of other species and is apparently due to environmental conditions. The series from the not distant Billy's Island in the Okeefenokee Swamp

[117] Caudell records a specimen of what he considered *elongatus*, which we find to be a synonym of *camellifolia*, as taken when stridulating "a higher quicker note." The unquestionable status and full distribution of *intermedia* will only be known when much larger collections of these insects have been made.

averages the smallest of any before us, the average being nearer the minimum measurements given above.

The material before us shows the vertex to be variable in the present insect, both in degree of production and shape. The vertex ranges from a produced form in which the apical spine is long and nearly straight, to one in which the vertex is decidedly less produced with the apical spine short and strongly uncinate. The former type is most decided in material before us from Live Oak and the region about Jacksonville, while the specimens from Thomasville represent the most decided development of the latter type.

The majority of specimens before us are, apparently irrespective of sex, of the green color phase. In the brown color phase the latero-dorsal lines of the pronotum are more pronounced.

The present species is one of the latest to appear; in southern Georgia adults are present in the greatest numbers probably early in December, at which time the first killing frosts usually occur. Davis has found the closely related *B. rehni* apparently hibernating in winter in northeastern peninsular Florida.

The above records considerably extend the known range of the species both northward and southward. The material before us was taken in an open spot in the pine woods covered with high grass (Florence), in wet spot in pine woods (Ashley Junction), in gray-bark pine woods in heavy undergrowth of green plants and vines (Isle of Hope and Sandfly), on a young cabbage palmetto (Thomasville), in a palmetto "hammock," in a tangle of raspberry and grape vines and other plants (Atlantic Beach), in a small clump of ground oak on the side of a sink hole (Live Oak) and on pineapple (Orlando).

Belocephalus davisi new species.

The present species, which we take pleasure in naming after the devoted student of this genus, Mr. William T. Davis, is related more closely to *B. sabalis* and *B. sleighti* than to the other species of the genus. It is a large insect, nearly as robust as the two species mentioned above, but agrees with the otherwise very different *B. subapterus* in having similar black markings on head, antennæ and pronotum.

Nearest affinity to *sabalis* and *sleighti* is shown by the supra-anal plate, which in these species only is very deeply emarginate mesad. This deep emargination is usually constant in form and distinctive in these species; in *sabalis* it has the sides straight with angle acute, the lateral productions formed by this emargination have evenly converging sides with acute apex situated mesad;

in *sleighti* this emargination is extremely deep and has the sides concave with angle not acute, but rather narrowly rounded, the lateral productions thus formed have sharply acute apices, which, however, are situated on their outer margins, due to the convexity of their inner margins; in *davisi* the emargination is not quite as deep as in *sleighti*, with the sides convex and angle very broadly rounded, the lateral productions formed by this emargination have evenly converging sides with blunt and sharply rounded apex situated mesad. The supra-anal plate in the other species of the genus, with distal margin very broadly and shallowly concave, is very distinct.

TYPE: ♂; Billy's Island, Okeefenokee Swamp, Georgia. September 1–5, 1913. (J. C. Bradley.) [Hebard Collection, Type No. 156.]

Description of Type.—Size large for the genus, form robust, but not as decidedly robust as in *sabalis* and *sleighti*. Head in form much as in those species, but with ventral portion not as broad; not immaculate as in those species, but agreeing with the other species of the genus in having the ventral margin of the face above the clypeus broadly banded with black, and with the base of the antennæ margined ventrad, and the dorsal surface of the fastigium of the vertex lined laterad, with the same color. Antennæ with proximal joints marked with black, these markings becoming fainter distad and disappearing at the end of the proximal third. Pronotum with dorsum more constricted than in *sabalis* and *sleighti* and striped latero-dorsad with black. Tegmina as in those species. Supra-anal plate deeply emarginate mesad with sides convex and angle broadly rounded, the lateral productions formed by this emargination having evenly converging sides, but with apex blunt and sharply rounded. Cerci and subgenital plate as in *sabalis* and *sleighti*, limbs and armament of the same similar, but decidedly less robust; unlike in those species the limbs are marked with fine black punctæ on the more exposed surfaces.

Allotype: ♀; Same data as the type, but taken on December 28, 1913. [Hebard Collection.]

Description of Allotype.—Size somewhat larger than type, form similar. Head broader, more inflated than in females of *subapterus;* antennæ similar. Pronotum more inflated than in type, but, as in the other species of the genus, the latero-dorsal stripes are in this sex no further separated caudad than cephalad. Tegmina very small and pad-like and wings not visible, as in females of the other species of the genus. Supra-anal plate triangularly produced with sides concave and apex acute. Ovipositor slightly shorter than

caudal femur, heavy proximad and tapering gently, and with a very weak dorsad curvature, to the sharp, unarmed apex. Subgenital plate large, lateral margins produced in long, slender spines which are subparallel and lie along the shaft of the ovipositor. General color brown with black markings as in the type.

Ten paratypic males bearing the same data as the type are before us.

Measurements (in millimeters).

	TYPE. ♂	Paratypic ♂♂	*Allotype.* ♀
Length of body	34.3	32.9–40.3	36
Length of vertex	3.8	3.7– 4.5	4.1
Vertex from tooth to apex	2.6	2.6– 3.6	3.4
Length of pronotum	8.3	7.9– 8.9	8.1
Length of tegmen	6	5.6– 7.1	2.3
Length of caudal femur	16.4	16.7–18.8	18.4
Length of ovipositor	.....	.....	19.2

As in the other species of the genus of which we have a number of specimens, a considerable amount of size variation is present in this insect. There is also a decided amount of variation in the shape of the supra-anal plate in the above examples, though material of *sleighti* and *sabalis* is constant in this respect, and, although in none of the paratypes is the median emargination as deep as in *sleighti*, the form of this emargination, and of the lateral productions thus formed, is in one of the paratypes similar to the type found in that species, and in several others is intermediate in character.

Four male paratypes and the female allotype are of the brown color phase, the other six specimens, male type and paratypes, are green.

The males were taken at night by Dr. Bradley, when they were found in numbers stridulating in the undergrowth of the pine woods.

In addition to this material we have before us a dried alcoholic pair taken by R. A. Mills at Chuluota, Florida, and now in the United States National Museum.

Pyrgocorypha uncinata (Harris).

Arkansas.

Hot Springs, IV, 1906, (C. S. Hebard), 1 ♂, [Hebard Cln.].

Georgia.

Thompson's Mills, IX, 1909, (H. A Allard), 1 ♀, [U. S. N. M.].
Bainbridge, (J. C. Bradley), 1 ♀.

The specimen from Hot Springs was taken in a hotel where it had been attracted by the lights at night, with it several examples of *Neoconocephalus triops* (*mexicanus* of most authors) were taken.

NEOCONOCEPHALUS Karny.

The authors have recently studied the species of this genus found in North America north of the Mexican boundary.[118] The material from the region at present under consideration is there treated in full. We give below the localities for this material.

Neoconocephalus exiliscanorus (Davis).

Washington, District of Columbia, and Rosslyn and Clarendon, Virginia.

The species has also been recorded in the region under consideration from Raleigh, North Carolina, and Thompsons Mills, Georgia.

Neoconocephalus melanorhinus (Rehn and Hebard).

Ocean City, Maryland.

Neoconocephalus robustus crepitans (Scudder).

Chesapeake Beach, Somerset Heights, Plummer's Island, Maryland; Washington, District of Columbia; Herndon, Clarendon, Oceanview and Virginia Beach, Virginia; Tarboro, Raleigh, Salisbury, Southern Pines and Wrightsville, North Carolina; Columbia and Denmark, South Carolina; Atlanta, Augusta, Tybee Island and Albany, Georgia, and Atlantic Beach and Hastings, Florida.

Neoconocephalus caudellianus (Davis).

Yemassee, South Carolina, and Billy's Island, Georgia.

Neoconocephalus velox Rehn and Hebard.

Billy's Island, Georgia.

Neoconocephalus retusus (Scudder).

Laurel and Plummer's Island, Maryland; Washington and Anolostan Island, District of Columbia; Rosslyn, Falls Church and Roanoke, Virginia; Fayetteville, Wrightsville and Winter Park, North Carolina; Florence, South Carolina; Atlanta, Albany, Bainbridge and Fargo, Georgia, and South Jacksonville and Daytona, Florida.

Neoconocephalus triops (Linnæus).

Conocephalus mexicanus and *fusco-striatus* of recent authors.

Washington, District of Columbia; Hampton and Virginia Beach, Virginia; Fayetteville, North Carolina; Florence and Yemassee, South Carolina; Atlanta, Jesup, St. Simon's Island, Cumberland Island, Billy's Island, Thomasville and Bainbridge, Georgia, and Jacksonville, Hastings and Daytona, Florida.

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[118] *Trans. Am. Ent. Soc.*, XL, pp. 365–413, (1915).

Homorocoryphus malivolans (Scudder).

Tappahannock, Virginia, VII, 13 to VIII, 18, 1915, (H. Fox), 29 ♂, 12 ♀, [Fox Ch.].

Wilmington, North Carolina, VIII, 1, (G. P. Englehardt), 1 ♀,[119] [U. S. N. M.].

From the area covered by the present paper, the species has previously been recorded only from the single specimen from Wilmington, North Carolina. It, however, probably occurs in the tidal marshes of the Atlantic coast, from southern Florida northward as far as the Virginia locality given above.

This interesting species was found by Dr. Fox quite frequent in the dense growth of tall reeds, *Spartina cynosuroides*, in a tidal marsh.

ORCHELIMUM Serville.

The material of this genus in the collections before us has recently been fully treated by the present authors.[120] The localities from the collections here being studied are as follows:

Orchelimum agile (DeGeer).

Chestertown, Cedar Point and Hyattsville, Maryland; Washington, D. C.; Rosslyn, Addison, Appomattox and Virginia Beach, Virginia; Hamlet, Wilmington, Winter Park, Wrightsville and Lake Waccamaw, North Carolina; Yemassee, South Carolina; Thompson's Mills, Stone Mountain, Savannah, Jesup, Tybee Island, Cumberland Island, Hebardville and Albany, Georgia, and Jacksonville, South Jacksonville, Ortega, Atlantic Beach, Pablo Beach, Live Oak, Carrabelle, Marianna, Quincy, Hastings and Sanford, Florida.

Orchelimum glaberrimum (Burmeister).

Virginia Beach and Cape Henry, Virginia; Raleigh, Goldsboro, Fayetteville, Smithville, Wilmington, Wrightsville and Lake Waccamaw, North Carolina; Florence, Ashley Junction and Yemassee, South Carolina; Macon, Savannah, Tybee Island, Groveland, Jesup, Billy's Island, Homerville and Albany, Georgia, and South Jacksonville, Atlantic Beach, Pablo Beach, Hastings and La Grange, Florida.

Orchelimum vulgare Harris.

Chestertown, Maryland; Washington, D. C.; Falls Church, Dryden, Norfolk and Wytheville, Virginia; Edenton, Raleigh, Blowing Rock, Blantyre and Linville, North Carolina, and Thompson's Mills, Georgia.

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[119] This specimen has been previously recorded, as the synonymous *hoplomachus* Rehn and Hebard, by Sherman and Brimley.

[120] *Trans. Am. Ent. Soc.*, XLI, pp. 11–83, (1915).

Orchelimum laticauda Redtenbacher.

Tolchester, Hyattsville, Plummer's Island and Montgomery County, Maryland; Washington and Anolostan Island, D. C.; Rosslyn and Fredericksburg, Virginia; Weldon, Newbern and Lake Waccamaw, North Carolina; Florence, South Carolina; Thompson's Mills, Jesup and Billy's Island, Georgia, and Jacksonville, South Jacksonville, Ortega, Atlantic Beach and Sanford, Florida.

Orchelimum minor Bruner.

Maryland opposite Plummer's Island; District of Columbia; Raleigh and Sulphur Springs, North Carolina, and Thompson's Mills, Hoschton and Thomasville, Georgia.

Orchelimum concinnum Scudder.

Chestertown, Maryland; Oceanview and Virginia Beach, Virginia; Wrightsville and Smith Island, North Carolina; Tybee Island, Georgia, and Warrington and Fort Barrancas, Florida.

Orchelimum fidicinium Rehn and Hebard.

Oceanview, Virginia; Wrightsville, North Carolina; coast of South Carolina; Savannah, Tybee Island and Cumberland Island, Georgia.

Orchelimum militare Rehn and Hebard.

Winter Park and Lake Waccamaw, North Carolina; Florence, South Carolina; Jesup, Waycross, Jordan's on Billy's Island, Homerville, Tifton and Bainbridge, Georgia, and Jacksonville, Atlantic Beach and Hastings, Florida.

Orchelimum bradleyi Rehn and Hebard.

Wilmington, North Carolina; Chase Prairie in Okeefenokee Swamp, Georgia, and Jacksonville and Tallahassee, Florida.

Orchelimum superbum Rehn and Hebard.

Tappahannock, Essex County, Virginia, VII, 27 to 28, 1915, (H. Fox, in tidal marsh on *Scirpus americanus*), 4 ♂, [U. S. N. M.; A. N. S. P. and Fox Cln.].

Dr. Fox has kindly permitted us to include this record in the present paper. The species was previously known only from southern New Jersey. Two of the specimens have the outer genicular lobe of the caudal femora bispinose.

CONOCEPHALUS Thunberg.

The American material of this genus in the collections before us has also recently been fully treated by the present authors.[121] The

[121] *Trans. Am. Ent. Soc.*, XLI, pp. 155–224, (1915); *ibid.*, pp. 225–290.

localities represented in the collections here being considered, are as follows:

Conocephalus allardi (Caudell).

Wytheville, Virginia, and Rabun County, Georgia.

Conocephalus fasciatus fasciatus (De Geer).

Chestertown and Island Creek, Maryland; Washington, D. C.; Fredericksburg, Norfolk, Virginia Beach, Hickory, Appomattox and Wytheville, Virginia; Eure, Selma, Winter Park, Lake Waccamaw, Greensboro, Salisbury, Roan Mountain, Linville, Morganton, Balsam, Governors Island and Topton, North Carolina; Denmark and Yemassee, South Carolina; Trenton, Marietta, Atlanta, Augusta, Savannah, Tybee Island, Isle of Hope, Jesup, St. Simon's Island, Brunswick, Cumberland Island, Waycross, Billy's Island, Macon, Westpoint, Columbus, Albany and Bainbridge, Georgia, and Jacksonville, South Jacksonville, Atlantic Beach, Pablo Beach, Live Oak, Tallahassee, Marianna and Cedar Keys, Florida.

In addition we have before us 1 ♀, Daytona, Fla. XI, 11, 1911, (G. P. Englehardt), [Bklyn. Inst. A. & S.].

Conocephalus brevipennis (Scudder).

Plummer's Island, Cabin John and Marshall Hall, Maryland; Washington and Anolostan Island, D. C.; Rosslyn, Falls Church, Appomattox, Wytheville, Cape Henry, Norfolk and Virginia Beach, Virginia; Fayetteville, Roan Mountain, Linville, Saluda, Governors Island, Wilmington and Lake Waccamaw, North Carolina; Spartanburg, Florence and Yemassee, South Carolina; Atlanta, Savannah, Sandfly, Billy's Island and Homerville, Georgia, and South Jacksonville and Atlantic Beach, Florida.

Conocephalus nemoralis (Scudder).[122]

Sharpsburg and Plummer's Island, Maryland; Washington, D. C., and Luray, Virginia.

Conocephalus strictus (Scudder).

Washington, D. C.; Arlington, Falls Church, Norfolk, Virginia Beach and Appomattox, Virginia, and Newbern, North Carolina.

Conocephalus stictomerus Rehn and Hebard.

Chestertown, Maryland; Churchland, Virginia, and Raleigh, North Carolina.

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[122] A specimen from Bogotá, Colombia, recently recorded as this species by Bruner (*Ann. Carneg. Mus.*, IX, p. 375, (1915)) is certainly not this form or is erroneously labelled.

Conocephalus aigialus Rehn and Hebard.

Cape Henry and Oceanview, Virginia; Wrightsville, North Carolina; Tybee Island, Georgia, and Jacksonville, South Jacksonville and Pablo Beach, Florida.

Conocephalus nigropleuroides (Fox).

Oceanview, Virginia; Wrightsville, North Carolina; Cumberland Island, Georgia, and Cedar Keys, Florida.

Conocephalus spartinæ (Fox).

Oceanview and Virginia Beach, Virginia; Wrightsville, North Carolina, and Tybee Island, Georgia.

Conocephalus saltans (Scudder).

Somerset Heights and Cabin John Run, Maryland; Washington, D. C.; Fayetteville, Wilmington, Winter Park, Wrightsville and Lake Waccamaw, North Carolina; Florence and Yemassee, South Carolina; Atlanta, Stone Mountain and Spring Creek in Decatur County, Georgia.

Odontoxiphidium apterum (Morse).

North Carolina.

Fayetteville, IX, 9, 1911, (H.), 1 ♂.
Winter Park, IX, 7, 1911, (R. & H.), 6 ♂.

South Carolina.

Florence, IX, 6, 1911, (H.), 2 ♂.
Ashley Junction, VIII, 15, 1913, (R.), 8 ♂, 4 ♀, 2 juv. ♀.
Denmark, VIII, 15, 1903, (A. P. Morse), 6 ♂, 8 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 13 ♂, 6 ♀, 1 juv. ♀.

Georgia.

Blue Ridge, VII, 25, 1903, (A. P. Morse), 1 juv. ♀.
Dalton, VIII, 7, 1913, (R.), 1 ♀.
Sand Mountain, VIII, 25, 1903, (A. P. Morse), 3 ♂, 1 juv. ♀.
Toccoa, VIII, 5, 1913, (H.), 1 ♀.
Currahee Mountain, VIII, 5, 1913, (H.), 7 ♂, 1 ♀, 3 juv. ♀.
Stone Mountain, VIII, 3, 1913, (H.), 1 ♂.
Vicinity of Stone Mountain, VIII, 3, 1913, (H.), 1 ♀.
Warm Springs, VIII, 9–10, 1913, (R.), 5 ♀, 1 juv. ♂, 2 juv. ♀.
Macon, VII, 30–31, 1913, (R. & H.), 9 ♂, 4 ♀, 1 juv. ♂, 3 juv. ♀.
Tifton, IX, 8, 1910, (J. C. Bradley), 4 ♂.
Albany, VIII, 1, 1913, (R. & H.), 10 ♂, 6 ♀, 6 juv. ♀.
Bainbridge, IX, 3–7, 1910, (J. C. Bradley), 1 ♂.
Spring Creek, VII–VIII, 1912–13, (J. C. Bradley), 3 ♂, 1 juv. ♀.
Augusta, VII, 29, 1913, (R. & H.), 2 ♂, 1 ♀, 4 juv. ♀.
Savannah, VIII, 14, 1903, (A. P. Morse), 5 ♂.
Sandfly, IX, 3, 1911, (R. & H.), 10 ♂, 5 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 21 ♂, 16 ♀.
Groveland, VII, 28, 1913, (J. C. Bradley), 1 ♂.
Jesup, IX, 1, 1911, (R. & H.), 7 ♂, 2 ♀.
Brunswick, VIII, 30, 1911, (H.), 10 ♂, 4 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♀.
Cumberland Island, VIII, 31, 1911, (R. & H.), 3 ♂, 3 ♀.
Waycross, VIII, 11, 1903, (A. P. Morse), 2 ♂, 2 juv. ♀.
Hebardville, V, 15, 1915, (H.), 1 juv ♂.
Suwannee Creek, VIII, 28, 1911, (R. & H.), 3 ♂, 4 ♀.
Billy's Island, V, 16, 1915, (H.), 1 juv. ♀; VI, VII, IX, 1912, (J. C. Bradley), 15 ♂, 3 ♀.
Honey Island, VI, 1, 1912, (J. C. Bradley), 1 adult.
Homerville, VIII, 27, 1911, (R. & H.), 4 ♂, 6 ♀, 2 juv. ♀.

Florida.

Jacksonville, VIII, 25, 1911, (R. & H.), 11 ♂, 20 ♀, 5 ♀ n.; XI, 3, 1911, (W. T. Davis), 2 ♂, 1 ♀.

South Jacksonville, IX, 7, 28, 1911, (W. T. Davis), 5 ♂, 4 ♀.

Atlantic Beach, VIII, 24–25, 1911, (R. & H.), 10 ♂, 9 ♀.

Pablo Beach, IX, 5, 1913, (W. T. Davis), 1 ♂, 1 ♀.

Live Oak, VIII, 10, 1903, (A. P. Morse), 5 ♂, 6 ♀; VIII, 26, 1911, (R. & H.), 12 ♂, 7 ♀, 1 juv. ♀.

The material from the region about Jacksonville averages the largest of any recorded above; there appears, however, to be little size variation correlated with northern and southern distribution in the present large series, and the specimens taken at Jacksonville in November are as small as any examples we have seen. These latter specimens, when compared with the largest from that locality, give the following extremes of measurement: length of body, ♂ 9.9–14.3, ♀ 12–16.3; length of ovipositor, 11.2–15.4 mm.

The stridulation of this curious species is a very faint and intermittent zip-zip-zee-zee-zee zip-zee-zee, etc. The males when stridulating often climb high up in the undergrowth; we have frequently found them three or four feet from the ground.

Throughout the low country of the Carolinas, Georgia and Florida, this is one of the most ubiquitous species in the undergrowth of the pine woods and also on palmetto flats. At a number of localities the insects were found particularly numerous about oak shoots in such situations. In the high country of Georgia the species was found scarce in level woods (Dalton), everywhere abundant in luxuriant mountain vegetation of grasses, vines and oak sprouts under a forest predominantly black-jack oak (Currahee Mountain), in a patch of mint in a bunch-grass area under pines (on Stone Mountain) and among oak shoots in undergrowth of mixed forest (Toccoa, vicinity of Stone Mountain, Warm Springs).

ATLANTICUS Scudder.

The species of this genus have recently been studied by the authors.[123] A full treatment of the material from the region under consideration is there presented. We here give the localities of the material before us belonging to the eight species found in the area at present treated.

Atlanticus testaceus (Scudder).

A. pachymerus of most authors.

Plummer's Island, Cabin John Run and Glen Echo, Maryland; Washington, D. C.; Arlington, Virginia.

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[123] *Trans. Am. Ent. Soc.*, XLII, pp. 33–100, (1916).

Atlanticus pachymerus (Burmeister).

Greensboro, Raleigh, Goldsboro, Lake Ellis (Havelock) and Southern Pines, North Carolina.

Atlanticus davisi Rehn and Hebard.

Meadow Mountain at 3,000 feet elevation, Conowingo, Laurel, Beltsville and Glendale, Maryland; Rock Creek, D. C.; Arlington, Fairfax County, Great Falls, Falls Church, Green Dell Farm two miles west of Pohick in Fairfax County, Orkney Springs, Stony Man Mountain, Orange, Hot Springs and Addison, Virginia.

Atlanticus monticola Davis.

Washington County, Virginia; Linville, Black Mountains, Valley of Black Mountains, Jones' Knob, Balsam Mountains and Lake Toxaway, North Carolina; Pinnacle Peak and Clayton, Georgia.

Atlanticus americanus (Saussure).

A. dorsalis of most authors.

Cabin John Run and Plummer's Island, Maryland; Washington, D. C.; Arlington, Clarendon, Falls Church, Seven Mile Ford, Orange and Roanoke, Virginia; Greensboro, Sulphur Springs, Waynesville, Lake Toxaway, Topton, Andrews and Murphy, North Carolina; Clayton, Tuckoluge Creek, Rabun Bald, top of Pinnacle Peak, Tallulah Falls, Sand Mountain, Jasper and Lost Mountain, Georgia.

Atlanticus gibbosus Scudder.

Florence and Magnolia, South Carolina; Currahee Mountain, Warm Springs, Sandfly, Billy's Island and Spring Creek, Georgia; Crestview, Lake City, Jacksonville, Atlantic Beach, Pablo Beach and Hastings, Florida.

Atlanticus dorsalis (Burmeister).

Billy's Island and Thomasville, Georgia; Jacksonville, Florida.

Atlanticus calcaratus Rehn and Hebard.

Billy's Island, Georgia, and Hastings, Florida.

Camptonotus carolinensis (Gerstaecker).

Delaware.

Dover, (Miss Lillian Hall), 1 ♀, [A. N. S. P.].

Virginia.

Near Washington, D. C., X, 13, 1883, 1 ♀, [Hebard Cln.].

Orange, VII, 21, 1913, (R. & H.; beaten from low herbage), 4 juv. ♂.

North Carolina.

Charlotte, VII, 27, 1913, (R. & H.; beaten from wild grape vines on ground in short-leaf pine woods), 1 juv. ♂.

Georgia.

Thompson's Mills, X, 1909, (H. A. Allard), 1 ♂, [Hebard Cln.].

Spring Creek, VI, 7–23, 1911, (J. C. Bradley), 1 juv. ♀.

Florida.

St. Augustine, (C. W. Johnson), 1 ♂, [A. N. S. P.].

Two consecutive instars are represented in the four immature males from Orange, both earlier than that exemplified by the Charlotte specimen, which is in the instar preceding maturity. The records from Spring Creek and St. Augustine are the most southern known for the species in the Atlantic coast States.

Hadenœcus puteanus Scudder.

North Carolina.

Sunburst, late May, 1912, (C. S. Brimley), 2 juv. ♀, [Brimley Cln.].

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 2 juv. ♂, 2 juv. ♀.

Thompson's Mills, X, 1909, (H. A. Allard), 2 ♂, 6 ♀, 3 juv., [U. S. N. M. and Hebard Cln.].

Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 2 ♂, [Cornell Univ.].

The immature females show that the dentations of the internal valves of the ovipositor are not appreciably indicated until the adult condition is reached. We have had before us for comparison a cotype from North Carolina, received from Scudder by Bruner, in whose series it was.

The above Georgia localities in a measure connect up the two previously known records of the species from the southern States, *i.e.*, North Carolina and Monticello, Mississippi.

Ceuthophilus uhleri Scudder.

Maryland.

Cabin John Run, IX, 1911, (W. T. Davis; trapped in molasses jar), 14 ♂, 34 ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 3 ♂, 3 ♀.

Clayton, VIII, 18, 1 juv. ♀, [Ga. State Cln.].

Pinnacle Peak, VIII, 20, 1913, (J. C. Bradley), 1 juv. ♂.

We have examined authentic material of this species and of *C. blatchleyi* Scudder and, apparently, the supposed differential features are too variable for reliance. However, we do not care to synonymize the latter name, as our material is not sufficiently conclusive to warrant such action at this time.

This species varies greatly in size in both sexes, the extremes (in millimeters) of undoubtedly adult material of both sexes from Cabin John Run being:

	♂	♂	♀	♀
Length of pronotum	4.8	6	5	5.3
Length of cephalic femur	6.5	8	6.5	7
Length of caudal femur	14.3	18	14	14.5
Length of caudal tibia	15.3	19.9	15.6	16.2
Length of ovipositor			8.9	9.9

The surface of the body is never polished in the male, always being dull and at times almost velvety in appearance. In the female sex this condition is present, but not as a rule, the majority of the individuals of that sex having the surface weakly polished. The males show a very appreciable amount of individual variation in the lamellate development of the ventro-external margin of the caudal femora, as well as in the number, disposition and size of the spines on the same margin.

The species is known to range from the vicinity of the city of New York to northeastern Georgia; in addition to these given above, the only definite record of its occurrence in the southeastern States is that from Raleigh, North Carolina (Brimley).

Ceuthophilus latibuli Scudder.

1905. *Ceuthophilus virgatipes* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1904, p. 798. [Thomasville, Georgia.]

Bainbridge, Georgia, VII, 15–27, 1909, (J. C. Bradley), 1 ♂.
Clearwater, Florida, VI, 27, 1 juv. ♀, [Cornell Univ.].
Jupiter, Fla., V, 2, 1903, (D. M. Castle), 1 ♂, 10 juv. ♂, 1 juv. ♀, [A. N. S. P.].

The species *virgatipes*, when described, was compared with *secretus* and *varicator*, with which it has, however, no relationship. This erroneous comparison was due to Scudder's key, which ran adults to the vicinity of the above-mentioned species, while *latibuli* was placed by him in another section, in which authentic material examined by him at that time, and now before us, would not fall. The type (male) of *virgatipes* is in the instar preceding maturity, but the allotype (female) is fully adult. It is evident that the full development of the caudal spurs and calcaria is not acquired until the adult condition is reached, these being relatively shorter in the nearly adult specimens than in the mature individuals. There is also some individual variation in the length and development of the spurs and in the length of the different calcaria. The more subdued general coloration of the *virgatipes* material is in part due to discoloration. The color pattern is seen to vary greatly in intensity and consequently in the relative extent of the pale and dark areas.

The species has been reported from "gopher" holes at Crescent City and Enterprise, Florida, and from "Georgia," in addition to the localities mentioned above.

Ceuthophilus gracilipes (Haldeman).

1894. *Ceuthophilus grandis* Scudder, Proc. Amer. Acad. Arts and Sci., XXX, pp. 24, 38. [Chattanooga, Tennessee.]
1894. *Ceuthophilus heros* Scudder, *ibid.*, pp. 26, 54. [North Carolina.]

Maryland.

Garrett County, last week of July, (W. Stone), 2 ♀, [A. N. S. P.].
Cabin John Run, IX, 1911, (W. T. Davis; trapped in molasses jar), 7 ♂, 9 ♀, 3 juv. ♂.
District of Columbia, VI, 1910, (W. T. Davis; trapped in molasses jar), 1 juv. ♂, 1 juv. ♀.

Virginia.

Alexandria County, VI, 1910, (W. T. Davis; trapped in molasses jar), 11 juv. ♂, 6 juv. ♀.

North Carolina.

Black Mountain, IX, 6, 1 ♂, [B. I.].

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 2 ♂, 4 juv. ♀.
Wilson Gap, Rabun County, VIII, 22, 1913, (J. C. Bradley), 3 ♂, 7 ♀.
Clayton, 2,000–3,000 feet, VI, 1909, (W. T. Davis), 1 juv. ♀.

We have carefully studied the original descriptions of the two species here synonymized, and we are unable to separate them from typical *gracilipes* by the presence of any invariable character or characters. We have also had before us a paratype of *heros*, labelled as such in Scudder's handwriting.

The species *gracilipes* is a very variable one in certain features, *i.e.*, size, relative elongation and depth of the caudal femora and spination of the same, character of the caudal tibiæ and coloration. The size variation, as seems to be the rule in the genus, is very considerable, the extremes (in millimeters) of adults of both sexes from Cabin John Run being:

	♂	♂	♀	♀
Length of pronotum	5.1	6.7	6.2	7.2
Length of cephalic femur	8.6	11.9	10	11.1
Length of caudal femur	17.9	24.2	19.8	22.8
Greatest depth of caudal femur	4.4	6.4	5	5.6
Length of caudal tibia	20.6	26.4	22.2	25.2
Length of ovipositor	.....	.....	10.2	14.2

The caudal femora seem to show some geographic correlation in the variation of comparative depth to length, specimens from northern Georgia showing the greatest relative depth, while more northern individuals generally have the caudal femora distinctly more slender, but this is by no means a rule, as northern specimens frequently have as robust femora as more southern material. The male paratype of *heros* from North Carolina has the caudal femora relatively quite slender. The spination of the ventro-external margin of the caudal femora of the male is extremely variable in character, ranging from the relatively heavier, basally tumid, spines of typical *grandis* to the weak and relative short type found in the paratype of *heros*. Between these extremes we find all intermediates in the strength of the spines, while the number of the same varies from as few as eight to as many as sixteen.

The caudal tibiæ are generally somewhat valgate proximad, but

are frequently straight. The exact thickness (*i.e.*, section) of the tibia varies somewhat, in one male from Blocton, Alabama (reported by Scudder and determined by him as *gracilipes*, the locality, however, being erroneously given as "Blocton, Florida"), being greater than in any other individual seen. The depth of the general body coloration varies appreciably, but there is generally an approximate uniformity in material from the same locality. As a rule, northern adult material shows a more transverse disposition of the color pattern and southern material a more longitudinal one. The two tendencies are to be seen in many forms of this genus, sometimes both the longitudinal and transverse being developed in the same individual, in others one at the expense of the other and again a general suffusion tones all to a deeper uniformity. The scalariform pattern of the caudal femora is weaker in northern than in southern specimens, as is also generally the case with the infuscation of the distal femoral portions and the presence of the pale pregenicular annulus on the caudal femora. These two latter features are rarely indicated in northern adults, but distinct in all the southern specimens.

Immature specimens from all localities, however, have a decidedly contrasted color pattern, made up of longitudinal and transverse elements, much as in the southern States adults, with darkened femoral apices and distinct pale pregenicular annuli on the caudal femora.

Ceuthophilus lapidicola (Burmeister).

North Carolina.

Grandfather Mountain, above 4,000 feet, VII, 21, 1904, (G. M. Bentley), 1 juv. ♂, [N. C. State. Dept. Agr.].
Black Mountain, 1 ♀, [B. I.].
Sunburst, Haywood County, late May, 1912, (C. S. Brimley), 1 juv. ♂, 1 juv. ♀, [Brimley Cln.].
Andrews, VIII, 19, 1904, (F. Sherman Jr.), 1 ♀, [N. C. State Dept. Agr.].

We have also a pair of specimens labelled "North Carolina, (Morrison)," determined and recorded as this species by Scudder. At the present time it is not possible to determine the correctness of Scudder's assignment of Burmeister's name to this species, the description of which is quite inadequate to place positively the name, but it seems quite probable that his action was correct. In addition to this North Carolina material, we have before us quite a few specimens from the northeastern States. Through the kindness of Dr. E. M. Walker, we have been able to examine four male and three female paratypes of that author's *C. pallidipes*, described from five localities in Ontario.[124] This is the northern extreme of the

[124] *Can. Ent.*, XXXVII, p. 115, pl. IV, figs. 2–2c, (1905).

species for which we use the name *lapidicola;* the specimens are much reduced in size, but inseparable from individuals from more southern localities. The description of *pallidipes,* in its analysis of the differential characters, is a decided aid to an understanding of the species.

The specimens recorded by Sherman and Brimley,[125] from Andrews and Grandfather Mountain, North Carolina, as *C. tenebrarum,* belong to this species, as an examination of the material shows. From Andrews there is a small adult female, from Grandfather Mountain a nearly adult quite small male minus the caudal limbs. The Southern Pines record was based on a minute immature specimen which we would not care to determine. At this writing we cannot make any statement on the status of Scudder's *tenebrarum.* The Sunburst pair recorded above is not quite mature, but clearly represents the present species.

The species was described from Virginia and South Carolina, but previously we have had no exact record from the southeastern States.

Ceuthophilus latens Scudder.

Alexandria County, Virginia, VI, 1910 and 1914, (W. T. Davis; trapped in molasses jar), 36 ♂, 24 ♀, 2 juv. ♀, [Davis Cln.].

We are using for comparison certain specimens from Ithaca, New York, in the collection of Cornell University, and a female from Vigo County, Indiana, in the Hebard Collection, which were determined as this species by Scudder. The series here recorded is of considerable interest, as it shows to what extent individual variation is present in this striking and beautiful species.

In size the usual amount of variation is present, the extremes (in millimeters) being:

	♂	♂	♀	♀
Length of pronotum	4.8	5.5	5	5.9
Length of cephalic femur	5.8	6.8	5.4	6
Length of caudal femur	12.9	14.7	12.1	14.9
Length of caudal tibia	13.4	15.9	12.9	15.3
Length of ovipositor	.....	.....	8.1	9.2

The color pattern of this species is probably more uniformly constant than in any other species of the genus of which we have seen a considerable series. The broad pale dorsal line and the broad bordering dark lines are always indicated on the thoracic segments and their variation in width is relatively small, while the abdominal markings and the clouding of the caudal femora are characteristic of this species and *lapidicola,* and vary only in depth.

[125] *Ent. News,* XXII, p. 311, (1911).

The pale base color is more orange-ochraceous in some individuals than in others, the extremes being pale clay color and burnt sienna.

This species and *lapidicola* are very closely related, the females particularly being extremely hard to separate. Of the few differences shared by both sexes may be mentioned the narrower mediolongitudinal pale bar in *lapidicola*, which also has a greater irregularity of its margins, and a frequent breaking up of the dark lateral bars. The males of the two species can, in addition, be separated by the more robust caudal femora in the present species and the form of the supra-anal plate, which has the distal margin submembranous in *latens* and chitinous in *lapidicola*, the plate also more elevated distodorsad in *lapidicola* than in *latens*.

The immature specimens of *latens* listed above have the thoracic pattern essentially as in the adults.

Ceuthophilus sallei Scudder.

De Funiak Springs,[126] Florida, 1 ♂, 1 ♀, 1 juv. ♀, [Cornell Univ.].

We have compared these specimens with a paratype from New Orleans and find no important or constant differences. The color pattern is seen to vary in intensity to such a degree that occasionally (in the adult female) the thoracic pattern is obsolete, although the abdominal section is weakly indicated and the femoral pattern typical, but not very decided.

The authors' *C. peninsularis*,[127] from southern Florida, is a close relative of this species, but just how close cannot be determined until the female sex of the more recent form is known.

The distribution of the species is here extended somewhat to the eastward of the type and only previously known locality—New Orleans.

Ceuthophilus spinosus Scudder.

Cabin John Run, Maryland, IX, 1911, (W. T. Davis; trapped in molasses jar), 1 ♀, [Davis Cln.].

Washington, D. C., IV, 20, 1 ♀, [Hebard Cln. ex Bruner.].[128]

District of Columbia, VI, 1910, (W. T. Davis; trapped in molasses jar), 3 ♂, 2 ♀, [Davis Cln.].

Arlington, Virginia, VII, 9, 1914, (H.; taken at night with light), 1 ♀.

Raleigh, North Carolina, II, 9, 1904, (Brimley; under log in pine woods), 1 ♀, [Hebard Cln.].

Atlanta, Georgia, VIII, 18, 1912, 3 ♀, [Ga. State Cln.].

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[126] These specimens are merely labelled "Funiak, Fla." but as there seems to be no locality of that name, we feel little doubt of their reference to the well-known locality given above.

[127] Proc. Acad. Nat. Sci. Phila., 1914, p. 408, (1914).

[128] In Scudder's original series of *C. neglectus*, a specimen from Washington, D. C., in the Bruner Collection, is listed. This record refers to the above specimen, which can be separated from the other paratypic females of *neglectus* from the Bruner Collection, by the more slender caudal femora and the fewer (four instead of five) teeth on the internal valves of the ovipositor.

We have no authentic material of this striking species and our determination rests on the agreement of our very extensive series with the original description. We have, in addition to the specimens here listed, larger series from the northeastern States, which we will treat in detail at a later date.

This species appears to be typical of a distinctive group of the genus, characterized in the male sex by the broad linguiform produced supra-anal plate. The form of the subgenital plate, which bears a cordiform callose pattern, is quite peculiar, while the general type of the caudal femora is different from that of any species of the genus found in the eastern States with which we are acquainted. There is a slight development of the fastigial ridge, less decided, however, than in the *uhleri* group. The internal valves of the ovipositor bear but four teeth, which are strongly developed, instead of the more usual five or six teeth. The distal extremity of the external ovipositor valves is obliquely truncate, with the spiniform dorso-distal point very well developed and directed at an angle of about fifty degrees to the longitudinal axis of the ovipositor.

There is a great amount of individual variation in size and robustness of the whole body, and in the male this variational feature of the caudal femora is very pronounced, and rather disproportionately so. The number of teeth on the ventro-external margin of the caudal femora and the character of the same are quite variable in the male sex. At a later date we intend to give additional information on these points from the other material we now have.

In the southern States the species appears to be one of the Piedmont region, the lowest elevation from which we have definite records being Raleigh and Southern Pines (Sherman and Brimley), North Carolina, and Atlanta, Georgia.

Ceuthophilus neglectus Scudder.

Cabin John Run, Maryland, IX, 1911, (W. T. Davis; trapped in molasses jar), 34 ♂, 38 ♀, [Davis Cln.].

District of Columbia, VI, 1910, (W. T. Davis; trapped in molasses jar), 22 ♂, 33 ♀, [Davis Cln.].

Alexandria County, Virginia, VI, 1910, (W. T. Davis; trapped in molasses jar), 51 ♂, 73 ♀, 9 juv. ♂, [Davis Cln.].

Orange, Va., VII, 21, 1913, (R. & H.), 3 juv. ♂.

We have before us three male and three female paratypes of *neglectus*, one of the females of which, as we have already shown, belongs to *spinosus*. We have also male and female paratypes of *terrestris*, these being the pair recorded by Scudder from Chateaugay Lake, Adirondack Mountains, New York. As stated by Walker,[129]

[129] *Can. Ent.*, XXXVII, p. 118, (1905).

certain of the specimens considered to be *terrestris* by Scudder, in his description of the latter, are really *neglectus*. This is true of the two specimens from Chateaugay Lake, which, while quite small, are distinctly *neglectus*. Just how much of the original series of *terrestris* belongs to *neglectus* we cannot say at the present writing, but, as Walker has shown, the few adult males in the Scudder Collection represent the latter species.

As Walker has said in explanation of his figure of the subgenital plate of the male of this species,[130] the type there shown is that of the immature male. This portion of the adult male is different, having no distal projections and with the free margin arcuato-truncate or weakly emarginate, the plate entire or undivided, a median fold or sulcus frequently present distad, but this is not a true division of the plate. The supra-anal plate of the adult is elongate, trigonal-linguiform, taken with the shape of the adjacent dorsal abdominal segments and the subgenital plate being characteristic of the species.

The ovipositor of the female bears five, or more rarely six, teeth on the internal valves.[131] The individual size variation in adults of the species is very great, so much so that the extremes might not be recognized as the same species, as the larger specimens, by their bulkiness, have a different general appearance. In the Alexandria County series the extremes in size (in millimeters) are as follows:

	♂	♂	♀	♀
Length of pronotum	4.8	6	4.9	6
Length of cephalic femur	5.6	6.9	5	5.6
Length of caudal femur	12.5	16	10.4	13.6
Length of caudal tibia	12.8	15.5	10.8	13.4
Length of ovipositor	.....	.....	5.9	7.4

The coloration is quite variable in the depth of the pattern, which in the paler specimens has a decided medio-longitudinal pale line on the thoracic segments, and a closely tessellate abdomen, which in the darker individuals has the median line subobsolete and the tessellations reduced in number, although but little in intensity. The caudal femoral scalariform pattern, which is generally moderately indicated, frequently strongly marked, is relatively poor in contrast in the darker individuals.

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[130] *Can. Ent.*, XXXVII, p. 117, pl. V, figs. 3*b*–3*c*, (1905).

[131] In very rare instances, only two females from Alexandria County, Virginia, out of one hundred and seventy-five examined for this character, we find but four teeth present on these valves, but in these individuals the usual two distal teeth are fused and the form of the caudal femora and margins of the same correctly associate the specimens.

The species appears to be one of the more abundant, if not the most abundant, of the genus found in the eastern United States. In the southeastern States it has, as far as known, a very limited distribution, not having been taken south of Orange, Virginia.

GRYLLIDÆ.

Gryllotalpa hexadactyla Perty.

1838. *Gr[yllotalpa] borealis* Burmeister, Handb. Entom., II, Abth. II, pt. 1, p. 740. [North America.]

Maryland.

Bohemia Bridge, Cecil County, V, 30, 1914, (H. W. Fowler), 3 ♀, [A. N. S. P.], brachypterous.

District of Columbia.

Washington, IV, 20, 1 ♀, [Hebard Cln.], brachypterous.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 3 juv.[132]

Lavender, 1 ♂, [Ga. State Cln.], brachypterous.

Marietta, VII, 27, 1903, (A. P. Morse), 1 ♀.

Atlanta, VI, 26 to VIII, 28, 1909 to 1912, 3 ♀, 1 juv., [Ga. State Cln.], 2 brachypterous.

Billy's Island, Okeefenokee Swamp, VI, 1912, (J. C. Bradley), 1 ♀, brachypterous.

Florida.

Enterprise, IV, 17, (P. Laurent), 1 ♂, [Hebard Cln.], brachypterous.

Lake City, 1 ♀, [Hebard Cln.], brachypterous.

After careful examination of material from many localities in America, extending from the United States southward to the southern borders of tropical South America, we find that there is no valid ground for separating Burmeister's *borealis* from *hexadactyla* of Perty, described in 1832 from Minas Geraes, Brazil.[133] Few comparisons are to be found between these supposedly distinct forms, Saussure and Scudder giving as differences the somewhat smaller size of *hexadactyla* and the more rounded projection at the base of the second lateral dactyl of the cephalic tibiæ. The series before us show that the insect attains its greatest size development in the United States, but that little constancy exists is also demonstrated, as specimens from the same locality in several cases show almost the maximum difference in size found in the entire series before us, which numbers considerably over one hundred specimens. The rounded chitinous projection at the base of the second lateral dactyl of the cephalic tibiæ is normally rounded, but is often worn down to a more or less angulate condition and is naturally valueless as a character in this respect. No other differences exist between North and South American examples, and *borealis* as a result falls into the above

[132] Two of these individuals are in the very early stages and the smallest of these has three, instead of four, tibial dactyls. In three other specimens in the same instar before us, this remarkable feature is also found.

[133] *Delect. Anim. Art. Brasil.*, p. 119, pl. 23, fig. 9, (1830–34).

synonymy. Previously the following names have been found to be synonyms of *borealis: americana* Harris, 1835; *brevipennis* Serville, 1839; *longipennis* Scudder, 1862, and *columbia* Scudder, 1869.

In the present species some variation is shown in the shape of the ocelli and in the tegminal venation.

Material from Florida and southern Georgia averages somewhat smaller than material from more northern points; the smallest adult specimen of the species we have ever seen is that from Billy's Island, Georgia, the measurements of which are: length of body 20.4, of pronotum 7.2, of tegmen 6.4, of caudal femur 6, and greatest width of pronotum 5.7 mm.

Females of the species have been taken much more frequently than males and the brachypterous condition is more frequently found in both sexes in the region at present under consideration.

Scapteriscus vicinus Scudder. Pl. XIV, figs. 4, 5, 6, 7.

1869. *Scapteriscus agassizii* Scudder, Mem. Peabody Acad. Sci., I, p. 13. [Switzerland (introduced from Central America?).]

Georgia.

Waycross, X, 20, 1914, (W. Tatum, Jr.), 1 juv., [U. S. N. M.].

Hebardville, V, 15, 1915, (H.; in sandy soil in garden, associated with *S. acletus*, but very scarce), 2 ♂, 2 ♀.

St. Simon's Island, IV, 22 to IX, 8, 1909 to 1911, (J. C. Bradley), 3 ♂, 4 ♀, 4 juv.; (W. V. Reed), 9 ♂, 3 ♀, 1 juv., [Hebard Cln.].

St. Simon's, St. Simon's Island, III, 18, 1912, (W. V. Reed), 6 ♀, [U.S. N. M.].

Brunswick, II, 5, 1903, (S. W. Goodyear), 3 ♂, 1 ♀, 1 juv., [U. S. N. M. and Hebard Cln.]; IV, 18, 1912, (W. V. Reed), 1 ♂, 4 ♀, [U. S. N. M.]; XI, 1907, 1 ♂, [Ga. State Cln.].

Cumberland Island, VIII, 31, 1911, (H.; under log on strand), 1 juv.

White Oak, IX, 1904, (A. S. Barnwell), 1 ♂, [U. S. N. M.].

After careful consideration of very large series, representing every species of the present genus, we are satisfied that the species found abundantly in the southeastern United States, the West Indies and portions of South America, and which has been frequently recorded as *S. didactylus*, represents instead *vicinus* of Scudder. This species is very closely related to *didactylus* of Latreille (described from Surinam and found elsewhere in South America and northward to Costa Rica), but is somewhat heavier, with the width of the pronotum distinctly greater in proportion to its length and with the basal width between the tibial dactyls averaging somewhat less. The species is, however, not nearly as distinct as Scudder believed, for the characters of the but little dissimilar ocelli, slightly different terminal tarsal joints of the caudal tibiæ and other differences which he gives in the original description are practically valueless.

The species, *agassizii*, described by that author on the following

page of the same work, is a synonym of *vicinus*, based on minor differences in these characters, which in each of the many series before us show some such slight differentiation.

This species is a serious pest in portions of the State of Georgia; at Darien, in 1906, the insects destroyed a great portion of the grass on the golf course.[134]

Scapteriscus acletus[135] new species. Pl. XIV, figs. 8, 9, 10, 11.

Closely related to *S. mexicanus*,[136] differing[137] in the shorter dactyls and spines of the limbs, normally fewer spines of the dorso-internal margins of the caudal tibiæ,[138] shorter limbs and much less compressed terminal tarsal joints of the caudal tibiæ (in this species no wider than the caudal metatarsus, in *mexicanus* distinctly wider with dorsal portion decidedly compressed). The present species and *mexicanus* agree, however, in the wide separation of the tibial dactyls, the elongate pronotum and decidedly elongate lateral ocelli, which characters readily distinguish them from *S. vicinus*, from which species the present insect also differs greatly in color pattern of the pronotum, general coloration in life and narrower terminal tarsal joint of caudal tibiæ.

Considering *S. abbreviatus*, the remaining species of the genus found within the boundaries of the United States, we find it to be readily distinguishable from *vicinus*, *acletus* and *mexicanus* by the distinctive coloration (which gives the insect a strongly mottled appearance), small round lateral ocelli and extremely reduced tegmina and wings. The elongate and widely separated tibial dactyls, and spatula with distal portion of ventral margin briefly chitinous and with disto-ventral angle nearly rectangulate and sharply rounded in *abbreviatus*, serve further to indicate that in linear arrangement *vicinus* comes first, followed by *didactylus*, *acletus*, *mexicanus* and *abbreviatus*.

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[134] Noted by Hebard, *Ent. News*, XX, p. 179, (1909).

[135] From ἀ = not, and κλητός = welcome; in allusion to the destructive habits of this insect.

[136] Described by Burmeister, *Handb. Entom.*, II, Abth. II, pt. 1, p. 740, (1838). [Alvarado, Mexico.]

[137] These comparisons are made with an apparently typical female of *mexicanus* (pl. XIV, figs. 12, 13, 14 and 15) from Durango, Mexico, in the Hebard Collection, the measurements (in millimeters) of which are: length of body, 36, of pronotum 11.4, of tegmen 19.2, of wing 26.6, of longest tibial dactyl 5.1, of caudal femur 12.5, of terminal tarsal joint of caudal tibia 3.4; width of pronotum 8.3, of terminal tarsal joint of caudal tibia 1.6. Two other similar females are before us bearing only the data "Mexico."

[138] In *mexicanus* these spines are described as 5–5 in number, and this is true for the specimens of that species before us.

TYPE: ♂; Hebardville, Ware County, Georgia. May 15, 1915. (M. Hebard; in garden.) [Hebard Collection, Type No. 406.]

Description of Type.—Size medium, form rather slender. Head with lateral ocelli over twice as long as broad, in direction convergent meso-distad, separated at nearest point by a space twice the length of one ocellus. Eyes somewhat more elongate than in *vicinus.* Tegmina similar to *vicinus,* but with veins not as heavy and cross-veinlets fewer. Wings reaching slightly beyond apex of abdomen. Limb proportions much as in *vicinus.* Dactyls of cephalic tibiæ separated by a space equal to basal width of one of these dactyls. Spatula with distal half of ventral margin chitinous, straight, the disto-ventral angle nearly rectangulate and sharply rounded. Median tibiæ armed interno-distad with four heavy spurs. Caudal tibiæ with ventro-internal margins each bearing four long spines, the last situated very slightly proximad of the three long distal spurs, disto-external margin armed with three short spurs, the dorsal widely separated from the other two. Distal joint of caudal tarsus slender, no wider than metatarsus, with dorsal margin not noticeably compressed. Coloration distinctive.

Allotype: ♀; Same data as type. [Hebard Collection.]

Description of Allotype.—Similar to type in characters common to both sexes. Tegmina similar to *vicinus,* but, as in male, with veins not as heavy and cross-veinlets fewer. Wings reaching slightly beyond apex of abdomen.

In addition to the type and allotype, we have before us a series bearing the same data and material taken at the same locality from May 15 to 31, 1915, by William Walker; these specimens, 26 ♂, 25 ♀, may be considered paratypes.

This paratypic series shows that the species exhibits considerable size variation, the average of the majority of specimens, however, approximates the types in this respect. Both intensive and recessive color patterns are developed, and the tegminal veins and veinlets are sometimes heavier than in the typical condition. Decided uniformity is found in the shape of the lateral ocelli, length and separation of the tibial dactyls and form of distal joint of caudal tarsus. In eighty uninjured specimens the number of spines of the dorso-internal margins of the caudal tibiæ are as follows:

Number of spines	3–4	4–4	4–5	5–5
Number of specimens	1	66	8	5

In one specimen having 5–5 spines, one of these spines is bifurcate.

Slight differences in ocellar form, occasional appearance of an accessory spine on one or both of the dorso-internal margins of the caudal tibiæ and slight differences in the separation of the tibial dactyls and in the width of the distal joint of the caudal tarsus, cannot be used as features to separate species of this genus, as discussed above in the treatment of *vicinus*.

Measurements (in millimeters).

	♂		♀	
	TYPE.	*Paratypes.*	*Allotype.*	*Paratypes.*
Length of body	28.7	26.4–34.4	29.7	26.5–35.5
Length of pronotum	9.3	8.8–11.3	9.3	8.5–10.3
Width of pronotum[139]	7.3	6.4– 8.9	7.1	6.6– 8.3
Length of tegmen	14.7	14.6–17.8	15.2	15–19.2
Length of wing	19.6	19.6–24.3	21.7	20.5–26.1
Longest tibial dactyl	3.6	3.3– 4	3.1[140]	3.1– 4.1
Length of caudal femur	10.3	10–11.7	10.6	10.2–12
Length of terminal tarsal joint of caudal tibia	2.6	2.3– 2.7	2.7	2.6– 2.8
Width of same	.8	.7– 1	.8	.8–.9

Coloration.—Normal condition (*type, allotype*). General coloration pinkish buff. Head with occiput including raised portion of inter-ocular space blackish brown, a brief space of the same color back of the eyes, but separated from them by a narrow interval of the pale general coloration. Pronotum with dorsum marked with an oval of blackish brown, this interrupted cephalad and mesad by rounded incursions from each side of the general pinkish buff coloration, these cephalic indentations weakly connected, the margins of the dark area concave in their caudal fifth. Tegmina and wings buffy with veins darker. Caudal femora of general coloration, but with all except the proximal fourth of dorso-external portion suffused with a darker shade. Abdomen dark above, pale below (in life shining grayish below, contrasting strongly with *vicinus*, which in life has this portion of the body shining cinnamon buff).

An intensive coloration is found in numerous specimens in which the darker markings are all deeper and more extensive, the whole dorsal surface of the pronotum being blackish brown, with the exception of four small pale spots in apposition to the rounded incursions of paler coloration as found in the normal condition.

[139] Owing to the impossibility of determining the lateral margins of the dorsum of the pronotum in the present genus, this measurement indicates the absolute width of the pronotum.

[140] The minimum measurements for these dactyls represent specimens in which these claws are worn down and blunted by much use. This is true of the present specimen.

All gradations are found, however, to a recessive condition in which the dark markings are much reduced, the incursions of pale coloration being considerable, leaving only narrow projections of the dark color laterad between them.

The large series of immature examples taken with the typical series are, with few exceptions, in the instars immediately preceding maturity. In these the coloration averages slightly more recessive than in the adults.

Biological Notes.—At the type locality the species was found in great numbers in sandy soil. Tunnels recently made were everywhere apparent. Digging into these and the flooding of such areas revealed few examples, but a row of lettuce in a dying condition was investigated, and beneath the wilted leaves, resting on the ground at the base of these plants, many specimens were found. The roots of the lettuce and other garden plants, such as tomatoes and beets, were found to have been extensively damaged by the present insect, in many cases all but the main tap root having been completely devoured.

When disturbed individuals always sought, if possible, to escape under the ground, disappearing in the sandy soil with astonishing rapidity; on the surface they could run very nimbly, occasionally giving a short hop, but not attempting to fly. There is no doubt, however, that both this species and *vicinus* can fly vigorously, and during migrations, which undoubtedly occur, probably resort almost wholly to this method of locomotion.

At night the rich gutteral "grrrrr" of the insect could be heard on all sides, but no individuals were found on the exposed surface of the ground.

Specimens Examined: 83; 28 males, 30 females and 25 immature individuals.

Jesup, Georgia, V, 15, 1915, (H.; in burrow under board in grassy field), 1 ♀; X, 1, 1910, 1 ♀, [Ga. State Cln.].

Hebardville, Ga., V, 15, 1915, (H.; in sandy soil of garden), 19 ♂, 18 ♀, TYPE, *allotype*, paratypes, 13 juv.; V, 15 to 31, 1915, (Wm. Walker), 7 ♂, 9 ♀, paratypes, 12 juv., [all Hebard Cln.].

White Oak, Ga., III, 23 and IV, 1904, (A. S. Barnwell), 2 ♂, 1 ♀, [U. S. N. M. and Hebard Cln.].

Scapteriscus abbreviatus Scudder. Pl. XIV, figs. 16, 17, 18, 19.

White Oak, Georgia, IV, 1904, (A. S. Barnwell), 1 ♂, 1 ♀, [U. S. N. M. and Hebard Cln.].

Lemon City, Florida, (E. J. Brown), 2 juv., [U. S. N. M.].

The specimens from Georgia, in addition to three from the same locality previously recorded by us,[141] constitute the only record of this species from the United States outside of extreme southern Florida.

Tridactylus apicalis Say.

1862. *T[ridactylus] terminalis* Scudder, Bost. Jour. Nat. Hist., VII, p. 425. [Cambridge, Massachusetts; Maryland; southern Illinois.]

District of Columbia.

Washington, IX, 1883, 1 ♂, [Hebard Cln.].

Rock Creek, 1 ♀, [U. S. N. M.].

Virginia.

Stafford County opposite Fredericksburg, VII, 20, 1913, (R. & H.; wet sand near Rappahannock River), 3 juv.

Georgia.

Bainbridge, IX, 17 to X, 19, 1910, (J. C. Bradley), 1 ♂.

Spring Creek, Decatur County, V, 7 to 23, 1911, 1 ♀, 3 juv.; VII, 16 to 29, 1912, 74 ♂, 31 ♀, 5 juv.; VIII, 26 to 28, 1913, 1 ♂, 1 ♀, (all J. C. Bradley).

We are convinced, after study of the literature and all of the material in our collections, that *terminalis* of Scudder is an absolute synonym of the present species, based solely upon large specimens of pale coloration. We are also satisfied that Scudder has correctly synonymized under these two names the following: *tibialis* Guérin, 1844; *Xya mixta* Haldemann, 1853; *illinoiensis* Thomas, 1863; *fissipes* Saussure, 1874, and *incertus* Saussure, 1896. The great variation in the form of the cephalic limbs in the males of the species discussed by Morse has in part caused this multiplicity of synonyms.

The large series of males before us from Spring Creek, Georgia, shows the same variability of the cephalic tibiæ which Morse has remarked, and we find every gradation between the extremes; roughly grouped, sixteen have the tibiæ of the normal (♀) form, eight have them very slightly cleft; sixteen have them decidedly and thirty-five very strongly bifurcate. A further interesting feature is apparent in this series, for with scarcely an exception the specimens having these tibiæ least specialized are the smallest (averaging in length 7 mm.), and throughout the series a distinct size increase accompanies the greater specialization of the tibiæ to its maximum development (these specimens averaging in length 9 mm.).

When compared with the males, the females of this series are found to average noticeably paler in general coloration.

The material before us shows that the wings normally reach a little beyond the apex of the abdomen; occasional series have the wings falling slightly short of this point.

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[141] Proc. Acad. Nat. Sci. Phila., 1912, p. 272, (1912).

Ellipes minuta (Scudder).

District of Columbia.

Washington, (Aldrich), 3 ♀, [Hebard Cln.].

Virginia.

Stafford County opposite Fredericksburg, VII, 20, 1913, (R. & H.; wet sand near Rappahannock River), 1 ♂, 2 ♀, 1 juv.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.; on ground in heavy forest near stream), 1 ♀.
Goldsboro, VII, 25, 1913, (R. & H.; damp ground in short-leaf pine woods), 1 ♂.
Greensboro, VII, 26, 1913, (R. & H.; on wet and almost bare clayey ground), 2 ♂, 5 ♀, 4 juv.
Balsam, VII, 23, 1903, (A. P. Morse), 2 adults.

South Carolina.

Spartanburg, VIII, 10, 1903, (A. P. Morse), 1 adult, 2 juv.
Manning, V, 30, 1914, (W. Stone), 1 ♂, 1 ♀, [A. N. S. P.].

Georgia.

Burton, 1,800 feet, V, 21, 1911, (J. C. Bradley), 1 ♀.
Rabun County, VII, 1910, (W. T. Davis), 1 ♀.
Jasper, VII, 25, 1903, (A. P. Morse), 1 adult.
Vicinity of Stone Mountain, VIII, 3, 1913, (H.; few on damp sand at edge of bog at base of cliff), 1 juv.
Waycross, VIII, 11, 1903, (A. P. Morse), 1 adult.
Albany, VIII, 1, 1913, (R. & H.; swampy spot on edge of Flint River), 1 ♀.
Spring Creek, Decatur County, VII, 16 to 29, 1912, (J. C. Bradley), 2 ♂.

We are certain that Scudder has correctly synonymized *Tridactylus histrionicus* and *T. histrio* of Saussure, 1896, under the present species. All of the large series before us show the presence or absence of minute subapical natatory lamellæ on the dorsal margins of the caudal tibiæ to be due to individual variation. The maximum number of these in the present species is two on the external and one on the internal margin, a feature noted by Saussure in his description of *histrio,* while his *histrionicus* represents material lacking these rather rudimentary appendages; *minuta* was at that time overlooked by Saussure.

But one specimen in the series here recorded, from Spring Creek, Georgia, is macropterous; the larger series before us show occasional specimens in this condition, some which are semi-macropterous, while many, as in the present series, have the wings wholly concealed by the tegmina.

This insect is found on wet sand near water, often in great numbers, over the entire territory at present under consideration.

Myrmecophila pergandei Bruner.

Retreat, North Carolina, VIII, 6, (H. G. Hubbard), 1 ♂, [U. S. N. M.].
Balsam, N. C., VII, 23, 1903, (A. P. Morse), 1 ♂, 1 juv. ♀; 4,500 to 5,700 feet, VII, 24, 1903, (A. P. Morse), 1 ♂, 1 ♀.
Clayton, Georgia, VI, 1909, (W. T. Davis), 1 juv. ♂, 1 juv. ♀.
Crescent City, Florida, 1 juv ♂, [Hebard Cln.].

This species was described from the "Atlantic States, from Maryland southward," it has since been recorded from Washington, District of Columbia, and Georgia, over the area here considered.

The study of the present genus by Schimmer[142] is by far the most complete work on the subject to be found in the literature.

Paratypes from Washington were taken with *Cremastogaster lineolata* Say and *Formica pallidefulva* Latreille. The specimens from Balsam were with *Camponotus herculeanus* Linnæus subspecies *pennsylvanicus* De Geer, and those from Clayton with *Cremastogaster lineolata* Say variety near *pilosa* Pergande.[143]

Cryptoptilum antillarum (Redtenbacher).

South Carolina.

Isle of Palms, VIII, 15, 1913, (R.; beaten from bayberry, *Myrica cerifera*), 1 ♂, 1 ♀, 2 juv. ♀.

Georgia.

Montgomery, VII, 27, 1913, (J. C. Bradley), 1 ♂.

Tybee Island, VII, 26, 1913, (J. C. Bradley), 11 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀.

St. Simon's Island, VIII, 5, 1912, (J. C. Bradley), 1 ♂.

Billy's Island, V, 28 to VII, 2, 1912, (J. C. Bradley), 1 ♂.

This species has been fully treated by the present authors;[144] in that paper the records from Miami (under bark of fallen trees) and Lake Worth (on sand), Florida,[145] were overlooked.

Cryptoptilum trigonipalpum Rehn and Hebard.

Virginia.

Petersburg, VII, 23, 1913, (R. & H.; undergrowth in heavy oak woods), 1 juv. ♂.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 juv. ♀.

South Carolina.

Columbia, VII, 28, 1913, (H.; beaten from heavy green undergrowth in short-leaf pine forest on hillside), 1 juv. ♀.

Georgia.

Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.; beaten from tangled undergrowth of short-leaf pine forest), 2 juv. ♀.

Augusta, VII, 29, 1913, (R. & H.; beaten from undergrowth near stream in flat short-leaf pine woods), 3 juv. ♀.

Savannah, VIII, 14, 1903, (A. P. Morse), 1 ♂, 3 ♀.

Warm Springs, 850 to 1,200 feet, VII. 9 and 10, 1913, (R.), 2 juv. ♂, 4 juv. ♀.

Albany, VIII, 1, 1913, (R. & H.; rather common in tangles of small bushes and vines in open forest along banks of Flint River), 4 juv. ♂, 6 juv. ♀.

Spring Creek, VIII, 26 to 28, 1913, (J. C. Bradley), 3 ♂, 1 ♀.

Billy's Island, IX, 1 to 5, 1913, (J. C. Bradley), 2 ♀.

The known distribution of the present species is carried considerably inland, westward and northward, by the above records.

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[142] *Zeitschr. Wissensch. Zool.*, XCIII, pp. 409–534, (1909).

[143] The identifications of the ant hosts given here have been most kindly furnished by Professor Wm. M. Wheeler. Bruner, with the original description of the present species, gives the ant hosts as *Camponotus pennsylvanicus*, *Formica rufa* and *Cremastogaster lineolata*. His *Formica rufa* determination is based on the specimens correctly recorded above as *Formica pallidefulva*.

[144] Proc. Acad. Nat. Sci. Phila., 1912, pp. 196–201, figs. 5–8, (1912).

[145] Mrs. A. T. Slosson, as *Mogosoplistus slossoni*. *Ent. News*, XII, p. 11, (1901).

The insect reaches maturity about the middle of August over a large portion of its range.

Cycloptilum squamosum Scudder.

North Carolina.

Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.; undergrowth of mixed deciduous and pine forest), 2 juv. ♀.

Columbia, VII, 28, 1913, (R. & H.; immature individuals very abundant among pine needles in long-leaf pine woods), 1 juv. ♂, 2 juv. ♀.

Georgia.

Toccoa, 1,094 feet, VIII, 4–5, 1913, (H.), 2 juv. ♀.

Jasper, 1,550 feet, VIII, 5, 1913, (R.; undergrowth of pine woods), 1 juv. ♀.

Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.; beaten from tangled undergrowth of pine forest), 1 juv. ♂.

Macon, VII, 30–31, 1913, (R. & H.; few immature individuals in oak leaves on edge of oak and short-leaf pine woods), 2 juv. ♂, 1 juv. ♀.

Warm Springs, 850 to 1,200 feet, VIII, 9–10, 1913, (R.; beaten in pine and oak woods), 1 ♂, 3 ♀, 2 juv. ♀.

Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♂.

This species has been fully treated by the present authors,[146] it is now known to range northward to East Marion, Long Island, New York.[147]

NEMOBIUS Serville.

The species of the present genus found in North America north of the Isthmus of Panama have been fully treated by the present junior author.[148] In that paper nearly all of the material in the collections now before us, taken previous to 1913, was recorded. The localities for these series are first given below, then the subsequent records are given in full with whatever comments appear of interest.

Nemobius fasciatus fasciatus (De Geer).

Chestertown, Beltsville, Montgomery County, Plummer's Island and Hyattsville, Maryland; Washington, District of Columbia; Fairfax County, Falls Church, Rosslyn and Bayville, Virginia; Jefferson, Cranberry, Grandfather Mountain, Blowing Rock, Black Mountain, Asheville, Mount Pisgah, Balsam and Waynesville, North Carolina, and Atlanta and Thompson's Mills, Georgia.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 5 ♂, 7 ♀, 2 juv. ♂.

Orange, VII, 21, 1913, (R. & H.), 1 juv. ♂.

Lynchburg, VII, 22, 1913, (R. & H.), 1 juv. ♂.

Petersburg, VII, 23, 1913, (R. & H.), 1 juv. ♀.

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[146] Proc. Acad. Nat. Sci. Phila., 1912, pp. 209–214, figs. 17–19, (1912).
[147] Davis, *Jour. N. Y. Ent. Soc.*, XXII, p. 171, (1914).
[148] Proc. Acad. Nat. Sci. Phila., 1913, pp. 394–492, (1913).

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), 2 juv. ♂.

Charlotte, VII, 27, 1913, (R. & H.), 1 ♂, 1 ♀.

South Carolina.

Spartanburg, VIII, 6, 1913, (H.), 1 juv. ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 juv. ♀.

Toccoa, VIII, 4–5, 1913, (H.), 1 juv. ♀.

Jasper, VIII, 5, 1913, (R.), 1 ♀, 1 juv. ♂.

Atlanta, VIII, 2 and 6, 1913, (Bradley and R. & H.), 3 ♂. 1 ♂ macropterous.

In late July, 1913, immature individuals of the species were found everywhere very numerous in fields in the Piedmont region of Virginia and North Carolina.

Immature individuals of the races of this species are easily separable from those of other southeastern species of the genus, as they alone have a medio-longitudinal dorsal dark stripe on the abdomen, down the centre of which an often well-defined very narrow pale line is usually found. In addition, the lateral lobes of the pronotum are usually heavily marked with a broad dark band, which is often continued on the sides of the abdomen.

Nemobius fasciatus socius Scudder.

Raleigh, Newbern, Fayetteville, Hamlet, Lake Waccamaw, Wilmington, Winter Park, Southport and Smith Island, North Carolina; north end of Sullivan Island and Yemassee, South Carolina; Tybee Island, Brunswick, Cumberland Island, Billy's Island, Homerville, Thomasville and Bainbridge, Georgia, and Atlantic Beach, Pablo Beach and Jacksonville, Florida.

Goldsboro, North Carolina, VII, 25, 1913, (R. & H.), 1 ♂, 1 ♀.

Augusta, Georgia, VII, 29, 1913, (R. & H.; common, untilled field among grasses), 3 ♀.

Macon, Ga., VII, 30–31, 1913, (R. & H.), 1 ♂, 4 ♀.

Albany, Ga., VIII, 1, 1913, (R. & H.), 5 ♂, 2 ♀, 1 juv. ♂. 1 ♂ macropterous.

Nemobius maculatus Blatchley.

Cabin John Run and Plummer's Island, Maryland; Washington, District of Columbia; Fairfax County, Alexandria County, Cherrydale and Dead Run, Virginia, and Raleigh, North Carolina.

Cabin John Run, Maryland, IX, 1911, (W. T. Davis), 1 ♀, [Hebard Cln.].

Fredericksburg, Virginia, VII, 20, 1913, (R. & H.), 1 juv. ♂, 2 juv. ♀.

Petersburg, Va., VII, 23, 1913, (R. & H.), 4 juv. ♂, 1 juv. ♀.

Weldon, North Carolina, VII, 24, 1913, (R. & H.), 1 juv. ♂.

Pinnacle Peak, Rabun County, Georgia, VIII, 20, 1913, (J. C. Bradley), 1 ♀.

Vicinity of Stone Mountain, Ga., VIII, 3, 1913, (H.), 1 juv. ♀.

Immature individuals of this species are readily separable from those of other forms found in this territory. They are brownish, somewhat mottled with a paler color, and have the lateral lobes of the pronotum occasionally darkened. Confusion with material of the early instars

of *N. carolinus* would alone be possible, and the unequal dorsal pair of distal spurs of the caudal tibiæ readily separates them from these.

The series recorded above was found scarce on banks of stream in woods (Fredericksburg), not scarce in boggy spot of grasses in woods (Petersburg), along stream in heavy forest (Weldon) and in bog at foot of precipice (vicinity of Stone Mountain).

The species was not previously correctly recorded[149] from the southeastern United States south of the vicinity of Washington, except from Raleigh, North Carolina.

Nemobius griseus funeralis Hart.

Macon, Georgia, VII, 30, 31, 1913, (R. & H.), 1 ♀.

It is with great satisfaction that we find a specimen of this distinctive insect, known previously from the unique female type taken at College Station, Texas, in the material from Georgia before us. We find, moreover, a male, taken at Winslow, Arkansas, September 3, 1905, by Morse, in the Morse Collection.

Measurements (in millimeters).

	♂ Winslow, Ark.	♀ Macon, Ga.
Length of body	8.9	9.2
Length of pronotum	2	1.9
Caudal width of pronotum	2.6	2.4
Length of tegmen	5.8	3.8
Length of caudal femur	6.6	6
Greatest width of caudal femur	2.3	2
Length of ovipositor	.....	4.4

Nemobius ambitiosus Scudder.

Florence, South Carolina; Thompson's Mills, Jesup, Spring Creek, Thomasville, Homerville, Suwannee Creek, Billy's Island, Honey Island, St. Simon's Island and Cumberland Island, Georgia, and Jacksonville, Atlantic Beach, Pablo Beach, San Pablo, Live Oak and Georgia State Line of Leon County, Florida.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 ♂.

Toccoa, VIII, 4–5, 1913, (H.), 2 juv. ♂.

Hebardville, V, 15, 1915, (H.), 1 ♂, 1 ♀, 1 juv. ♂.

Mixon's Hammock, V, 16, 1915, (H.), 1 ♀.

Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 2 ♀.

Albany, VIII, 1, 1913, (R. & H.), 5 ♂, 6 ♀.

Spring Creek, VIII, 26–28, 1913, (J. C. Bradley), 2 ♂, 1 ♀.

Florida.

Ortega, IX, 6, 1913, (W. T. Davis), 1 ♀.

[149] Specimens of *N. fasciatus* from Jefferson, North Carolina, now before us, were incorrectly recorded by Sherman and Brimley as *N. maculatus* (*Ent. News*, XXII, p. 391, (1911)).

A female from Billy's Island and one from Albany are black in general coloration. Immature individuals are brown in general coloration, often tinged with reddish and flecked with darker brown; the distinctive cephalic markings are as well defined as in the adult condition.

The series recorded above was found in the undergrowth of the long-leaf pine woods (Hebardville, Albany), in dry leaves under live oak (Mixon's Hammock) and immature individuals were found occasional in oak leaves (Toccoa).

The records given above include the northernmost localities known for the species.

Nemobius bruneri Hebard.

Cabin John Run and Plummer's Island, Maryland; Washington, District of Columbia, and Glencarlyn, Virginia.

Virginia.

Rosslyn, X, 14, (A. N. Caudell), 3 ♂, [U. S. N. M.].
Arlington, VII, 9, 1914, (H.), 1 juv. ♂, 1 juv. ♀.
Fredericksburg, VII, 20, 1913, (R. & H.), 4 juv. ♂, 2 juv. ♀.
Orange, VII, 20, 1913, (R. & H.), 2 juv. ♂.

North Carolina.

Greensboro, VII, 26, 1913, (R. & H.), 2 juv. ♂.
Charlotte, VII, 27, 1913, (R. & H.), 4 juv. ♂.

Immature individuals of this species are very striking, being pale reddish brown in general coloration speckled with much darker brown, by which dark color the lateral lobes of the pronotum and first and fifth abdominal segments are heavily suffused. These latter markings give a distinctive barred appearance in very young individuals, which becomes less strongly defined in successive instars to those preceding maturity, in which these markings are not strongly indicated.

The species was found abundant in damp leaves in and along the border of a deciduous woodland on high ground near a stream (Fredericksburg) and scarce in leaves on edge of a deciduous forest (Orange).

No other records, other than those given above, have been published for the species in the territory at present under consideration.

Nemobius cubensis cubensis Saussure.

Montgomery County, Maryland; Washington, District of Columbia; Raleigh, North Carolina; Florence, South Carolina; Jesup, Georgia, and Jacksonville, Florida.

Albany, Georgia, VIII, 1, 1913, (R. & H.), 2 ♂, 2 ♀. All brachypterous.
Bainbridge, Ga., VII, 15–27, 1909, (J. C. Bradley), 1 ♂. Macropterous.

The species was found occasional in swampy spots (Albany).

The above records include all the localities known for the species over the territory at present considered. The species has been found as far north as Staten Island, New York, and southward appears to reach its greatest abundance in the United States in peninsular Florida.

Nemobius palustris palustris Blatchley.

Washington, District of Columbia, and Fayetteville, Lake Waccamaw and Wilmington, North Carolina.

These, the southernmost-known records for this insect, include all the localities known for it over the area now being studied.

Nemobius carolinus carolinus Scudder.

Cabin John Run and Plummer's Island, Maryland; Washington, District of Columbia; Alexandria County, Dead Run, Rosslyn, Fairfax County and Falls Church, Virginia; Raleigh, Blowing Rock, Newton, Black Mountain, Balsam, Highlands, Fayetteville and Lake Waccamaw, North Carolina; Florence, Swansea and north end of Sullivan Island, South Carolina; Thompson's Mills, Brunswick, Thomasville and Bainbridge, Georgia, and Daytona, Florida.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 2 juv. ♂.

North Carolina.

Jefferson, IX, 1912, (F. Sherman), 1 ♂, [N. C. State Dept. Agr. Cln.].
Grandfather Mountain, 4,000–5,000 feet, IX, 1915, 1 ♂, [Hebard Cln.].
Blowing Rock, IX, 1915, (F. Sherman), 1 ♂, [N. C. State Dept. Agr. Cln.].
Charlotte, VII, 27, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 2 ♂, 3 ♀.

Georgia.

Pinnacle Peak, VIII, 20, 1913, (J. C. Bradley), 2 ♀.
Jasper, VIII, 5, 1913, (R.), 1 juv. ♂.
Billy's Island, IX, 1–5, 1913, (J. C. Bradley), 1 ♂.
Spring Creek, VII, 16 to VIII, 26, 1912 and 1913, (J. C. Bradley), 1 ♂, 3 ♀.

Immature individuals of this species and of *N. confusus* are more glabrous in general appearance than any others found in the area here considered. The general color is dark brown, the four rows of large pale spots on the dorsal abdominal segments first appearing in the instars immediately preceding maturity.

The present common insect is found everywhere over the region now being studied.

Nemobius confusus Blatchley.

Cabin John Run and Plummer's Island, Maryland; Dead Run, Falls Church and Alexandria County, Virginia, and Raleigh, North Carolina.

Rabun County, Georgia, VII, 1910, (W. T. Davis), 2 juv. ♂, 1 juv. ♀.
Buckhead, Ga., VIII, 2, 1913, (H.; undergrowth in mixed oak and pine forest), 1 juv. ♀.

The very dark general coloration of immature examples of this species and the bone white maxillary palpi, make them readily separable from those of any other species found in the regions here treated.

In the southeastern United States the species was not previously known except from Raleigh, North Carolina.

A single immature specimen was found in woods of oak and pine (Buckhead).

Anurogryllus muticus (DeGeer).[150]

New Jersey.

Ocean View, VI, 11 and 17, 1911 and 1912, (H. Fox), 2 ♂, [A. N. S. P.].

District of Columbia.

Washington, (Chittenden), 2 ♀, [U. S. N. M.].

Virginia.

Clarendon, VI, 8, 1914, (H. A. Allard), 4 ♂, [U. S. N. M.].
Falls Church, VIII, 1 ♀, [U. S. N. M.].
Charlottesville, V, 26, 1914, (H. Fox), 1 ♂, [Hebard Cln.].

North Carolina.

Raleigh, V, 30, 1905, 1 ♂, [U. S. N. M.]; VI, 1911 to 1915, (C. S. Brimley), 4 ♂, 1 ♀, [Brimley Cln. and N. C. State Dept. Agr.].

South Carolina.

Beech Island, V, 14, 1903, (Hammond), 1 ♀, [U. S. N. M.].[151]

Georgia.

Hebardville, V, 15, 1915, (H.), 4 ♂.

Florida.

Jacksonville, IV, 1885, (W. H. Ashmead), 1 ♀, [Hebard Cln.]; winter of 1880–1881, (W. H. Ashmead), 1 ♀, [U. S. N. M.].
Lawtey, X, 12 and 28, 1886, (M. Venickerbocker), 2 juv. ♂, 3 juv. ♀, [U. S. N. M.].
Gulf Hammock, Levy County, IV, 7, 1903, (P. Laurent), 3 juv. ♀, [Hebard Cln.].
De Land, 2 juv. ♀, [U. S. N. M.].

Alabama.

Auburn, V, 6, 1911, (W. E. Hinds), 1 ♀, [U. S. N. M.].
Daphne, VI, 9, 1894, (L. Sauterre), 2 ♀, [U. S. N. M.].

Louisiana.

Jena, La Salle Parish, V, 7, 1887, (M. Dempsey), 1 ♀, [U. S. N. M.].[152]

Texas.

Victoria, IV, 24, 1915, (J. D. Mitchell), 2 ♀, 1 juv. ♀, [U. S. N. M.].

This insect is one of the very plastic and widely distributed American species of the group Gryllites. We find not only *guadeloupensis, angustulus* and *caribeus* to be synonyms of this species, as indicated by Kirby,[153] but also *Gryllodes clarazianus* of Saussure,[154] which form was later placed in the present genus by its author. This Argentinian variant, of which we have material before us, has been

[150] This species has twice been recorded by Caudell from the United States in error as *A. antillarum*. See footnote 152 and *Proc. Entom. Soc. Wash.*, VI, p. 49, (1904), [Southern United States].

[151] Correctly recorded by Hammond (Bull. 44, Bur. of Entom., U. S. Dept. of Agr., p. 94, (1904)).

[152] Recorded as *antillarum* with Florida, South Carolina, Virginia and Alabama state records by Caudell (Bull. 44, Bur. of Entom., U. S. Dept. of Agr., p. 88, (1904)).

[153] *Syn. Cat. Orth.*, II, p. 24, (1906).

[154] *Miss. Sci. Mex.*, Rech. Zool., VI, p. 412, pl. VIII, fig. 31, (1874). [Bahia Blanca, Argentina.]

separated from *muticus* as found in the Guianas,[155] by the head being marked with four pale longitudinal lines and the caudal metatarsus being shorter and broader with dorsal margin more distinctly arcuate. The head marking appears often, though usually not strongly defined, being particularly apparent in immature examples or adults of pale general coloration, over nearly the entire distribution of the species.[156] Various series show that the metatarsal length and heaviness is extremely variable in the species, though often uniform in large series from the same general region.[157] Variations in tegminal and wing length, and in the caudal metatarsus, are principally the cause of the above synonymy, though other variations, decidedly puzzling without large series being available for comparison, also occur.

Within the boundaries of the United States the species shows appreciable differences from material from the Guianas; these differences due, in our opinion, to an adaptation to the differences in environment and climate, but, considering the plasticity of the species, neither sufficiently constant or well marked to warrant the recognition of a geographic race. The most noteworthy of these are: the somewhat more evenly rounded and protuberant occiput; slightly weaker inter-antennal protuberance; slightly less prominent eyes; more nearly quadrate dorsum of the pronotum, with caudal margin straight or weakly convex (never weakly bisinuate as in typical *muticus*); color frequently decidedly paler, with the pale marking at the ventro-cephalic angle of the lateral lobes of the pronotum (usually conspicuous in typical *muticus*) subobsolete.

Along the Atlantic coast of the United States the species is usually found to have the metatarsus very slightly longer than is typical, but of similar proportions; specimens from Alabama westward, however, have the metatarsus distinctly shorter and slightly heavier.

The examples from Victoria, Texas, have the occiput more distinctly striped than in any but Argentinian material before us. Great variation in intensity of coloration is shown in the series here recorded; although these specimens average decidedly paler than tropical material of the species, the four adults from Hebardville,

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[155] A large series now before us from British Guiana appears to be in every way typical.

[156] This marking being less apparent in adults of intensive coloration, it is not surprising to find few of these in tropical series which are usually dark in general coloration.

[157] We are able to ascertain this fact from very large series now before us from the West Indies, Central and South America.

Georgia, are as dark as any specimens before us, but have the lateral lobes of the pronotum entirely pale.

In the United States the males have the tegmina reaching to, or falling slightly short of, the apex of the abdomen; the females have the tegmina never less than half the abdominal length, frequently about two-thirds that length, though more variable than the males in this feature. Of the above series two females (Washington) are macropterous, one female (Victoria) has a single caudate but imperfect wing, while one female (Falls Church) has long tegmina but aborted wings.

It might seem that geographic races could be recognized, but careful study, of this and much larger tropical American series, shows that variation such as discussed above occurs in an endless complexity, and that intermediates of every sort occur between conditions which might easily be supposed, without sufficient material for comparison, to represent geographic races or even closely related species. The form of the male titillatores is the same in all of the material of the species examined.

In the United States adults of the species appear in April, May and June, later than this individuals are scarcely ever encountered.

The present insect has long been known to be very destructive in the southeastern United States, damaging cotton, tobacco, sweet and white potatoes, strawberries, peas and other farm products. The series here recorded was taken: in fence corner and in truck patch (Ocean View), in cotton field (Beech Island and Auburn), on fences and walls of yard of bermuda grass, stridulating at dusk (Hebardville) and injuring strawberries (Lawtey).

The records given above define the known range of the species in the United States.

Gryllus assimilis Fabricius.

Recent studies have shown this to be the only native representative of the genus found in America.[158] Great variation, however, exists and we have found the variants to be best represented by symbols.[159] Of these, the following four are found in the regions at present under consideration:

B, suffused Z, (normally d or e, w), (45 to 2, the latter weakly 0); *scudderianus*.

AU, (normally ax), 4; *neglectus*.

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[158] Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1915, pp. 293–322, (1915).
[159] See Proc. Acad. Nat. Sci. Phila., 1915, pp. 299, 300, (1915).

AV, (normally a or b but ranging to f, x but often u), 3; *pennsylvanicus.*

AW, (normally d but ranging from a to f, w but often u), 3; *luctuosus.*

Of these, *scudderianus* is apparently an adaptation to an arenaceous surrounding, it is found locally as far north as Indiana, at the more northern points showing an average less robust form and smaller size (such material constituting the bases of the names *scudderianus*, *rubens* and *arenaceus*), while in southern Florida and on the Gulf coast an average more robust form and larger size is developed (upon such material *firmus* was in part founded).

The other three variants intermingle more generally, though individuals of each occasionally show the transition toward the *scudderianus* variant. The darkest of these, *neglectus*, is found in the north, only appearing well defined, in the area here considered, in the Appalachian mountains south as far as their highest points in north Georgia. Over the entire region *pennsylvanicus* appears generally, but is the most frequent condition met with on the Piedmont plateau, while *luctuosus* is the normal condition everywhere on the coastal plain in the regions here considered.[160]

Material can be grouped for convenience under these variant designations, but in such treatment it must be remembered that nearly every specimen of each series will show different degrees of coloration, femoral and ovipositor length and every other feature, excepting those diagnostic qualities common to all of the variants of *G. assimilis.*

In the paper in which these facts are fully treated, the exact condition of the material from the collections at present being studied is given,[161] the localities being: Chestertown, Glen Echo and Jennings, Maryland; Washington, District of Columbia: Roslyn, Virginia; Winter Park and Lake Waccamaw, North Carolina; Florence, Sullivan Island and Yemassee, South Carolina; Rabun Bald, Black Rock Mountain, Tuckoluge Creek, Clayton, Atlanta, vicinity of Stone Mountain, Augusta, Jesup, Waycross, Hebardville, Billy's Island, St. Simon's Island, Cumberland Island, Fargo, Chester, Bainbridge and Spring Creek, Georgia, and Atlantic Beach, Pablo Beach, Burnett's Lake and Live Oak, Florida.

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[160] It is this condition which the present authors had frequently recorded as *G. rubens* from the southeastern United States.

[161] Proc. Acad. Nat. Sci. Phila., 1915, pp. 305–307, (1915).

Gryllus domesticus Linnæus.

This species, accidentally introduced by man from Europe, has been recently recorded by us[162] from "Carolina" and Roswell, Albany and Thomasville, Georgia, within the territory at present under consideration.

Miogryllus verticalis (Serville).

The American species of this genus have recently been fully studied and reported upon by the junior author.[163]

Material from the present collections from College Park and Plummer's Island, Maryland; Washington, District of Columbia; Falls Church, Virginia; Raleigh and Goldsboro, North Carolina; Columbia, South Carolina; Clayton, Sand Mountain, Trenton, Augusta, Tybee Island, Mixon's Hammock in Okeefenokee Swamp and Billy's Island, Georgia, and Jacksonville, Atlantic Beach and Marianna, Florida, is treated in that paper. In addition we now have the following specimens:

Raleigh, North Carolina, late VI, 1911, (C. S. Brimley), 2 ♀, 1 macropterous,[164] [Brimley Cln.].

Hebardville, Georgia, V, 15, 1915, (H.), 1 juv. ♀, 1 very small juv. ♀.

Billy's Island, Ga., V, 16, 1915, (H.), 1 juv. ♀.

Gryllodes sigillatus (Walker).

Though not as yet known from Florida as far north as the region treated in the present paper, this species is apparently rapidly extending its distribution northward.

It has been reported by Davis from as far north in Florida as Lakeland, and recently the junior author found it widely distributed in that town, particularly about grocery stores, where, on May 21, 1915, a single male was taken to verify this observation.

Œcanthus niveus (DeGeer).

Cranberry, North Carolina, VIII, 1896, (H. Skinner), 1 ♂, [A. N. S. P.].

This species has been very widely discussed in past literature, principally owing to its economic importance, but very general confusion with both *O. exclamationis* and *O. angustipennis* prevents the use of the majority of these records in distributional studies.

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[162] Proc. Acad. Nat. Sci. Phila., 1915, pp. 320–322, (1915).

[163] *Jour. N. Y. Ent. Soc.*, XXIII, pp. 101–121, (1915).

[164] This specimen is of particular interest in being the first macropterous example of the species to be reported from temperate regions. Four other macropterous specimens are known from the tropics, the type and three individuals of the series of one hundred and twenty-two examples which were before the junior author at the time the genus was revised. In the present example the internal face of the cephalic tibiæ bears a but weakly defined tympanum; the measurements are: length of body 13.7, of pronotum 2.3, of tegmen 6, of wing 16.7, of caudal femur 9, of ovipositor 10.3 mm.

We know it to be found on the Atlantic coast as far north as Windsor, Connecticut. Thompson's Mills, Georgia, is the only previous definite record for the southeastern United States. The species is both dendrophilous and thamnophilous, appearing usually in greatest numbers in shrubs with pithy branches, in which the females deposit their eggs.

Œcanthus angustipennis Fitch.

North Carolina.

Raleigh, X, 18, 1905, 1 ♀; XI, 2, 1904, (G. M. Bentley), 1 ♀, [both N. C. Dept. Agr. Cln.].
Southern Pines, XI, 1908, (A. H. Manee), 2 ♀, [N. C. Dept. Agr. and Hebard Cln.].
Mount Airy, XI, 16, 1904, (G. M. Bentley), 1 ♀, [N. C. Dept. Agr. Cln.].
Saluda, VIII, 17, 1903, (A. P. Morse), 1 juv. ♀.
Balsam, about 4,000 feet, IX, 15–18, 1908, (Z. P. Metcalf), 1 ♀, [N. C. State Dept. Agr. Cln.].

South Carolina.

Florence, IX, 6, 1911, (R. & H.; in forest foliage), 1 ♀.

Georgia.

Pinnacle Peak, Rabun County, VIII, 20, 1913, (J. C. Bradley), 1 ♀.
Currahee Mountain, VIII, 5, 1913, (H.; beaten from luxuriant vegetation, vines, oak shoots, etc., in blackjack woods), 1 juv. ♂.
Buckhead, VIII, 2, 1913, (R. & H.), 1 juv. ♂.
Isle of Hope, IX, 3, 1911, (R. & H.; heavy undergrowth of gray-bark pine forest), 1 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♀.
De Witt, VII, 25, 1912, 1 ♀, [Ga. State Cln.].
Spring Creek, VII, 16–29, 1912, (J. C. Bradley), 1 ♀.

Hartford, Connecticut, is the most northern location on the Atlantic coast at which we know the species to occur. Past confusion with other species makes distributional studies from the literature, in almost every case, impossible. The species has been taken and recorded by us from as far south as Lakeland, Florida. It has been correctly recorded in the regions under consideration from Bayville, Virginia; Raleigh and Asheville, North Carolina, and Toccoa and Thompson's Mills, Georgia. Like *O. niveus,* the species is both dendrophilous and thamnophilous.

Œcanthus quadripunctatus Beutenmüller.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.; occasional, especially juv., in weeds in open), 1 ♂, 1 ♀.
Cape Henry, VII, 2 and IX, 7, 1903, (A. P. Morse), 2 ♀.
Virginia Beach, VII, 4, 1903, (A. P. Morse), 3 ♂.
Appomattox, IX, 6, 1903, (A. P. Morse), 1 ♀, 3 juv. ♀.
Wytheville, IX, 5, 1903, (A. P. Morse), 3 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 1 ♂.
Tarboro, VII, 7, 1903, (A. P. Morse), 3 ♂, 2 ♀.
Raleigh, VII, 9, 1903, (A. P. Morse), 1 ♂, 5 ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂.
Jefferson, IX, 1912, (F. Sherman), 1 ♀, [N. C. State Dept. Agr.].
Morganton, VII, 12, 1903, (A. P. Morse), 3 ♂, 2 ♀.

Saluda, VIII, 17, 1903, (A. P. Morse), 1 ♀.
Asheville, VII, 21, 1903, (A. P. Morse), 1 juv. ♀.
Balsam, 4,000 feet, IX, 15–18, 1908, (Z. P. Metcalf), 1 ♀, [N. C. State Dept. Agr.].
Wrightsville, IX, 7, 1911, (R. & H.), 6 ♂, 3 ♀.
Winter Park, IX, 7, 1911, (R. & H.), 2 ♂, 3 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 1 ♂, 2 ♀.

Tennessee.

Roan Mountain Station, IX, 3, 1903, (A. P. Morse), 6 ♂, 1 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♀.
Columbia, VII, 28, 1913, (R. & H.), 2 ♂, 4 ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 1 juv. ♂.
Currahee Mountain, VIII, 5, 1913, (H.), 1 ♂.
Augusta, VII, 29, 1913, (R. & H.; waste field), 1 ♂, 1 ♀.
Stone Mountain, VII, 28, 1903, (A. P. Morse), 1 juv. ♂.
Bolton, VII, 29, 1903, (A. P. Morse), 2 ♂.
Jasper, VIII, 5, 1913, (R.), 1 juv. ♂, 1 juv. ♀.
Chickamauga, VII, 10, 1898, (H. L. Viereck), 1 ♂, [A. N. S. P.].
Trenton, VII, 10, 1905, (A. P. Morse), 1 ♂, 1 ♀.
Macon, VII, 30–31, 1913, (R. & H.), 1 ♂, 5 ♀.
West Point, VII, 30, 1903, (A. P. Morse), 1 ♂.
Oglethorpe, VII, 1, 1910, (J. C. Bradley), 1 ♂, 1 ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂.
Tybee Island, VII, 26, 1913, (J. C. Bradley), 1 ♀; VIII, 13, 1903, (A. P. Morse), 1 juv. ♂.
Billy's Island, VI, 1912, (J. C. Bradley), 2 ♀.
Albany, VIII, 1, 1913, (R. & H.; undergrowth in long-leaf pine forest), 2 ♀.
Bainbridge, IX to X, (J. C. Bradley), 1 ♀.

Florida.

Jacksonville, XI, 3, 1911, (W. T. Davis), 1 ♂.
Ortega, IX, 27–28, 1913, (W. T. Davis), 5 ♂, 1 juv. ♂.
Newberry, XI, 18, 1911, (W. T. Davis), 1 ♂.
Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂, 1 ♀.
Tallahassee, VIII, 8, 1903, (A. P. Morse), 1 ♂.

This, the most abundant species of the present genus in the eastern United States, is found almost everywhere over the regions here considered, it has been correctly recorded from as far south in the eastern United States as Fort Myers, Florida. The insect has been frequently recorded in past literature as other species of the genus. The species is more nearly terrestrial than any other of the genus here considered; it is usually found in the open, in weeds and grasses, where it occurs frequently in considerable numbers.

In the above series one specimen, from Live Oak, Florida, has the inner antennal marking greatly reduced, while the outer markings have disappeared. This is very unusual in this species, in which these markings are normally well defined with outline sharp and even.

Œcanthus nigricornis Walker.

Tennessee.

Roan Mountain Station, IX, 3, 1903, (A. P. Morse), 12 ♂, 13 ♀.

North Carolina.

Jefferson, IX, 1912, (F. Sherman; C. L. Metcalf), 2 ♂, 1 ♀, [N. C. State Dept. Agr.].

Blowing Rock, VIII, 1905–1906, (R. S. Wolgum; F. Sherman), 2 ♂, 1 ♀, [N. C. State Dept. Agr.].
Grandfather Mountain, 4,000 feet, IX, 11, 1908, (Z. P. Metcalf), 3 ♀, [N. C. State Dept. Agr.].
Linville, VIII, 28, 1906, (R. S. Wolgum), 1 ♂, [N. C. State Dept. Agr.].
Waynesville, IX, 14, 1909, (Z. P. Metcalf), 2 ♂, [N. C. State Dept. Agr. and Brimley Cln.].
Montreat, 3,000 feet, IX, 21–22, 1908, (Z. P. Metcalf), 1 ♀, [Brimley Cln.].

In addition to the normally very distinctive coloration of this insect, it may be further distinguished from the allied *O. quadripunctatus* by the heavier pronotum, the greatest width of which more closely approximates the length of the same than in that species, while the head between the eyes is weakly but distinctly depressed, a condition not at all or rarely very weakly indicated in *quadripunctatus*.

Only a few specimens in the present series do not exhibit the very strongly defined normal type of coloration, these have the dark markings slightly paler, while in a single female the color pattern is still more decidedly recessive and only in part indicated.

We believe the present species to be confined to the Appalachian portion of the regions at present under consideration. It is widely distributed over the north-central and central-eastern portions of the United States and is the most abundant species of the genus in southern Ontario. Numerous records of *nigricornis* and the synonymous *fasciatus* are, however, erroneous. On the Atlantic coast it is known to occur over but a comparatively limited area north of the territory here studied. The insect is found in weeds and low plants in the open, but particularly in tangles of raspberry vines; it is usually locally distributed, but very abundant.

Œcanthus pini Beutenmüller.

1911. *Œcanthus nigricornis* Rehn and Hebard, (not of Walker, 1869), Proc. Acad. Nat. Sci. Phila., 1910, p. 649. [Raleigh, North Carolina.]

Raleigh, N. C., IX, 7 and 22, 1904, (C. S. Brimley; upland field and alders in pine woods), 2 ♀, [Hebard Cln.].

This species shows nearest relationship to *O. nigricornis*, but is somewhat more robust, with coloration and color pattern distinctive and wholly different, with pronotum normally slightly heavier and more nearly quadrate, and with the head between the eyes even more decidedly depressed. The antennal markings are much as in specimens of that species in which such markings are apparent; in *O. quadripunctatus* these markings are very similar, but with outline more abruptly and evenly defined.

The present species, we believe, is wholly arboreal and only found

in pine trees, except when moving from one to another. Its distribution is as yet very imperfectly known; the species was described from [West Woodstock], Windham County, Connecticut. Other records from Riverton and Anglesea, New Jersey; Chestertown, Maryland, and Brownsville, Texas, do not apply to this species, but several from the pine-barrens region of New Jersey we know to be correct.

Œcanthus latipennis Riley.

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.; weeds in corner of field near deciduous forest), 2 juv. ♂.

Orange, VII, 21, 1913, (R. & H.; very scarce in undergrowth of chestnut woods), 1 juv. ♂.

Petersburg, VII, 22, 1913, (R. & H.; scarce in undergrowth of pine woods), 2 juv. ♂.

Appomattox, IX, 6, 1903, (A. P. Morse), 1 ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.; undergrowth in low pine woods), 2 juv. ♂, 1 juv. ♀.

Goldsboro, VII, 25, 1913, (R. & H.; vegetation in damp places of short-leaf pine woods), 2 juv. ♂, 1 juv. ♀.

Fayetteville, IX, 9, 1911, (R. & H.; beaten from low oaks in short-leaf pine woods), 1 ♂, 1 ♀.

Greensboro, VII, 26, 1913, (R. & H.), 1 juv. ♂.

Saluda, VIII, 17, 1903, (A. P. Morse), 1 juv. ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.; scrub oaks in short-leaf pine forest), 3 ♂, 5 ♀.

Ashley Junction, VIII, 15, 1913, (R.; beaten from undergrowth in long-leaf pine woods), 1 juv. ♂.

Georgia.

Toccoa, VIII, 4, 1913, (H.; beaten from heavy, low scrub oaks), 1 juv. ♂.

Jasper, VIII, 5, 1913, (R.; beaten from scrub), 1 juv. ♀.

Sharp Mountain near Jasper, VIII, 6, 1913, (R.; beaten from blackberry and oak shoots), 1 juv. ♂.

Buckhead, VIII, 2, 1913, (R. & H.; oak shoots in oak woods), 1 juv. ♂, 1 juv. ♀.

Dalton, VIII, 7, 1913, (R.; beaten, on hillside), 1 juv. ♀.

Sand Mountain, VIII, 25, 1903, (A. P. Morse), 1 juv. ♂, 1 juv. ♀.

Warm Springs, VIII, 9–10, 1913, (R.), 2 juv. ♂, 1 juv. ♀.

Augusta, VII, 29, 1913, (H.; oak shoots in sand area, one seen), 1 juv. ♂.

Isle of Hope, IX, 3, 1911, (R. & H.), 1 juv. ♀.

Among the eastern representatives of the genus the present species is distinctive in size, form of pronotum in the males, coloration, color pattern and tegminal proportions; in the male the tegmina are very wide for the genus.

Over the area under consideration the present species has been recorded only from Bayville, Virginia; Raleigh, North Carolina, and Thompson's Mills, Georgia. It is, however, widely distributed, though local, our experience having found it to prefer low oaks and oak shoots in woodlands. Adults of the species are not present until late in the season.

Neoxabea bipunctata (DeGeer).

Chestertown, Maryland, VIII, 25, 1899, (E. G. Vanatta), 1 ♀, [A. N. S. P.].
Rabun County, Georgia., VII, 1910, (W. T. Davis), 2 juv. ♂.
Billy's Island, Ga., VII, 1912, (J. C. Bradley), 1 ♀.

The remarkable proximal antennal joints, pronotum, callosities of the dorsum of the male abdomen, caudal femora with margins unarmed and supplied distad with two and two very small spurs, cerci and subgenital plate in both sexes, constitute only in part the distinctive characters of this extraordinary and, though scarce, widely distributed species.

On the Atlantic coast it is known from as far north as Portland, Connecticut, the above records being the first for the regions at present under consideration. The species is extremely retiring, living only in the densest tangles of heavy forest undergrowth, where solitary examples can be found only after long-continued and vigorous beating.

The Genera of the Group Anaxiphites.

In 1873,[165] Brunner erected the genus *Cyrtoxipha*, but failed to designate by name any species; the following year Saussure used the name and placed in the genus five species,[166] one of which, *gundlachi*, Kirby[167] has selected as genotype. The characters upon which Saussure separated the genera *Cyrtoxipha* and *Anaxipha*[168] have been proven invalid,[169] but we find that two species of the former, *gundlachi* and *columbiana*, possess characters of generic value to separate them from the other species which have been assigned to these genera. We are consequently obliged to restrict the genus *Cyrtoxipha* to these two species and to place all the other American forms, hitherto included in this genus, in the genus *Anaxipha*. This latter genus is as a result found to be very large, the species of which may be divided into several well-marked groups, none of which, however, we feel to be sufficiently differentiated to warrant at present the erection of other genera or subgenera. The type of this genus is *pulicaria* Burmeister as designated by Kirby,[170] who, however, is in error in synonymizing *exigua* and *pulicaria*. The former is a very distinct

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[165] *Mittheil. Schweiz. Ent. Gesellsch.*, IV, p. 168, (1873).
[166] *Miss. Sci. Mex.*, Rech. Zool., VI, p. 373, (1874).
[167] *Syn. Cat. Orth.*, II, p. 80, (1906).
[168] Described by that author in the same study. *Miss. Sci. Mex.*, Rech. Zool., VI, p. 370, (1874).
[169] Rehn and Hebard, *Ent. News*, XXIII, p. 411, (1912).
[170] *Syn. Cat. Orth.*, II, p. 86, (1906).

form and cannot be considered in the fixation of the type of the genus *Anaxipha* as it was not one of the originally included species.

The genus *Falcicula*[171] is monotypic and shows close relationship to *Anaxipha*, but it possesses very distinctive characters in the complete absence of auditory foramina on the cephalic tibiæ and in the structure of the male tegmina. The ovipositor is similar to that of certain species of *Anaxipha* and has the margins minutely serrulate distad. This feature can scarcely be seen with a hand lens and was missed in the original description.

CYRTOXIPHA Saussure.

Genotype: *Cyrtoxipha gundlachi* Saussure.

Head longitudinal, dorsal surface from behind eyes to dorsal apex of inter-antennal protuberance strongly flattened and but little declivent. Eyes longitudinal, much longer than deep, with dorsal margin not raised above plane of flattened portion, more prominent distad than proximad. Last joint of maxillary palpi not as long as penultimate joint, expanding very strongly distad from base with distal truncation transverse, when flattened out nearly forming an equilateral triangle. Cephalic tibiæ with auditory foramen open on both faces. (In the two species known, the color is immaculate and delicate, pale green, but this fades almost invariably in drying to a pale brown, which is the same as the general coloration in a number of species of *Anaxipha*. The spines of the dorsal margins of the caudal tibiæ are in these species extremely delicate and little longer than the spaces intervening between their bases. A wingless condition apparently does not occur, the wing length, however, is never more than one and one-half times the tegminal length.)

ANAXIPHA Saussure.

Genotype: *Anaxipha* [*Gryllus*] *pulicaria* (Burmeister).

Head vertical, dorsal surface not strongly flattened, strongly declivent from occiput to inter-antennal protuberance. Eyes vertical, much deeper than long, evenly protuberant. Last joint of maxillary palpi elongate, longer than penultimate joint, distal truncation transverse or oblique. Cephalic tibiæ with auditory foramen open on both faces in winged individuals, in wingless examples normally present, but rarely open, on outer face only, as in winged material. (Distinctive color patterns are developed

[171] Rehn, *Ent. News*, XIV, p. 258, (1903).

in numerous species. The spines of the caudal femora are shorter than, to much longer than, the spaces intervening between their bases. The majority of the species are winged, with wing length more than twice the tegminal length. Numerous species, however, develop a wingless condition, in several this being the normal state.)

FALCICULA Rehn.

Genotype: *Falcicula hebardi* Rehn.

Agrees with *Anaxipha*, but the cephalic tibiæ possess no auditory foramen and the stridulating area of the male tegmina is minute. (In the one species known the general coloration is uniform pale brown, the size is very small to minute, a winged condition is never developed and the caudal tibiæ are more swollen than in any known species of *Anaxipha*.)

Anaxipha exigua (Say).

Maryland.

Rockville, VIII, 16, (F. Knab), 1 ♀, [U. S. N. M.].

Hyattsville, VIII, 2, 1908, (F. Knab), 1 ♂, [U. S. N. M.].

Plummer's Island, VIII, 16 to IX, 15, 1907 to 1909, (Caudell, Fisher, Knab), 2 ♂, 1 ♀, [U. S. N. M.].

Cabin John Run, VIII, 7, 1902, (T. Pergande), 1 ♀, [U. S. N. M.].

District of Columbia.

Washington, VIII to X, 1878 to 1883, 2 ♂, 10 ♀, [Hebard Cln. and U. S. N. M.].

Virginia.

Glencarlyn, VIII, 12, (A. N. Caudell), 1 ♂, [U. S. N. M.].

Falls Church, IX, 4, 1906, (A. N. Caudell), 1 ♂, 2 ♀, [U. S. N. M.].

Fredericksburg, VII, 20, 1913, (R. & H.), juv. seen.

Petersburg, VII, 22, 1913, (H.), 1 ♂.

North Carolina.

Weldon, VIII, 24, 1913, (R. & H.), 2 juv. ♂.

Raleigh, VIII, 16 to X, 14, 1904 to 1906, (Sherman and Brimley), 5 ♂, 8 ♀, [N. C. State Dept. Agr.].

Fayetteville, IX, 9, 1911, (R. & H.), 3 ♀.

Wilmington, IX, 8, 1911, (H.), 1 ♀.

Lake Waccamaw, IX, 8, 1911, (H.), 1 ♂.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♂, 7 ♀.

Georgia.

Toccoa, VIII, 28, 1909, (J. C. Bradley), 1 ♂.

Lavender, 1 ♂, 1 ♀, [Ga. State Cln.].

Thompson's Mills, X, 1909, (H. A. Allard), 1 ♀, [U. S. N. M.].

Savannah, VIII, 14, 1903, (A. P. Morse), 1 ♂, 3 ♀.

Albany, VII, 31, 1913, (H.), 1 ♀.

Florida.

Jacksonville, (T. J. Priddey), 1 ♂, 1 ♀, [Hebard Cln.].

The larger size, heavy facial markings and narrow but decided dark, longitudinal stripe of the caudal femora readily distinguish this species from any other found in the United States.

Of the present series five females are long winged (Rockville, Washington, Raleigh, Albany and Jacksonville). These and two females with long tegmina and no wings (Virginia near Washington and Thompson's Mills) have the cephalic tibiæ with open auditory foramina on both faces, all of the others have this only on the external

face, though a few show a slight depression on the internal face. Considerable size variation is shown, this having no geographic significance.

The species is usually found in luxuriant grasses or weedy tangles, particularly near water, and is often locally very abundant. It was found immature in great numbers in weeds, both along the river and streams in woods (Fredericksburg), very scarce in short grasses in boggy spot in woods (Petersburg), in undergrowth near stream in forest (Weldon), in rank weedy undergrowth on wet ground on edge of pine forest (Fayetteville, Wilmington, Lake Waccamaw), common on or near the ground in low green vegetation growing on edge of "branch" filled with deciduous trees (Florence) and attracted to light in hotel room (Albany).

This species is known on the Atlantic coast as far north as Westbrook, Connecticut; it has been correctly recorded westward to Brownsville, Texas. Numerous records of *pulicaria* from as far northwest as Cuming County, Nebraska, and the Mississippi River, Minnesota, apply to this species.

Anaxipha pulicaria (Burmeister). Pl. XIV, fig. 20.

North Carolina.

Raleigh, VII, 8, 1903, (A. P. Morse), 1 ♂, 1 ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 1 ♂, 2 ♀.

Georgia.

Tybee Island, IX, 2, 1911, (H.), 8 ♂, 4 ♀.
Thomasville, IV, 9, 1904, (H.), 1 ♂.[172]

Florida.

Gainesville, VIII, 16, 1905, (R. & H.), 1 ♂.[173]
Fort Reed, IV, 23, 1876, 1 ♀, TYPE of *Cyrtoxipha delicatula* Scudder, [M. C. Z.].
Miami, 1887, (E. A. Schwarz), 1 ♀, [U. S. N. M.]; (Mrs. A. T. Slosson), 1 ♂, [M. C. Z.].

Texas.

Doucette, VII, 24, 1912, (H.), 1 ♂, 1 ♀.
Beaumont, VII, 23, 1912, (H.), 10 ♂, 4 ♀.
Dickinson, VII, 20, 1911, (H.), 2 ♂, 2 ♀, 2 juv. ♂, 2 juv. ♀.
Brownsville, VI, 23, 1908, (C. A. Hart; at light), 7 ♂, 7 ♀, [Ill. State Lab. N. H.]; VII, 31 to VIII, 5, 1912, (R. & H.), 2 ♂, 1 ♀; XI, 21 and 23, 1910, (C. A. Hart), 1 ♂, 2 ♀, [Ill. State Lab. N. H.].

This species is smaller, more compact and robust than *A. exigua*, and is immaculate pale brown in coloration. No cephalic markings are found, except in the Brownsville series, where weakly defined darker markings similar to those of *exigua* appear (figured).

In this series, those from Fort Reed and Miami and the specimens taken at Brownsville in June are long winged; these have open

[172] Misidentified as *A. exigua* by Rehn and Hebard, PROC. ACAD. NAT. SCI. PHILA., 1904, p. 801, (1905).

[173] Misidentified as *A. exigua* by Rehn and Hebard, PROC. ACAD. NAT. SCI. PHILA., 1907, p. 318, (1907).

auditory foramina on both faces of the cephalic tibiæ, while all of the other specimens have this organ only present on the external face of these members.

Wingless females of this species are very similar to the largest females before us of *Falcicula hebardi*, but are readily distinguished by the presence of auditory foramina on the external face of the cephalic tibiæ and, though distinctly more compact than *exigua*, are not as compact as *hebardi*. Some variation in the proportions of the caudal tibiæ is found, and though the length appears to vary chiefly with the size of the insect, long-winged individuals indicate that in these this measurement proportionately averages slightly greater. Extremes in length of caudal femora in material before us: wingless, ♂ 4.1 to 5, ♀ 4 to 4.9; winged, ♂ 4.7 to 5, ♀ 5 to 5.2 mm.

This insect does not appear to climb up in high grasses and weeds as much as *exigua* does, but prefers low grasses, particularly in wet locations. It was taken in undergrowth near a "branch" (Florence), in wet undergrowth of pine woods (Yemassee, Gainesville), in moderate numbers in low grass on edge of salt marsh (Tybee Island), in "hammock" near stream (Thomasville), common on swampy ground in tangles of low weeds and some raspberry vines, in woods composed mainly of deciduous trees (Beaumont) and not common in undergrowth of pine woods (Dickinson).

The above records define the known limits[174] of the species' distribution in the United States.[175] Numerous records in the literature, of this species from more northern localities, apply without exception to *exigua*, which name was for a long time incorrectly referred to the genus *Nemobius*.

Anaxipha vittata (Bolivar). Pl. XIV, fig. 21.

Albany, Georgia, VIII, 1, 1913, (H.; forest undergrowth along edge of Flint River), 1 ♀.

Atlantic Beach, Florida, VIII, 24, 1911, (H.; in tangles of raspberry vines in jungle of cabbage palmetto and live oak), 1 ♂.

Punta Gorda, Fla., (Mrs. A. T. Slosson), 1 ♀, [M. C. Z.].

Key West, Fla., III, 15, 1910, (H.; in short, heavy grasses growing in open, on scant soil beside a wet depression in the Key West oölitic limestone), 1 ♀.[176]

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[174] The authors' previous record of a single specimen from Key West, Florida, was based on the specimen here correctly recorded under *A. vittata*.

[175] We have thought best to record here all of the material of the species before us from the United States, in order to correct and define as fully as possible the distribution of the species in this country.

[176] Misidentified as *A. pulicaria* by Rehn and Hebard, Proc. Acad Nat. Sci. Phila., 1912, p. 274, (1912).

This insect agrees with *A. pulicaria* in many respects, but is a smaller, more delicate species. A distinctive color pattern is developed which, when present, readily distinguishes the species.[177] This is strongly marked in the specimens from Atlantic Beach (figured) and Punta Gorda, but very weakly indicated and only by the marking of the occiput and dorsum of the pronotum in the other two specimens.

The specimens here recorded are wingless, numerous long-winged examples are present, however, in the exotic series before us. All of the winged individuals have open auditory foramina on both faces of the cephalic tibiæ; in the wingless examples this organ is missing on the inner face of these members.

This tiny species was not previously known to exist within the United States, a large series now before us shows it to be probably the most abundant and widely distributed species of the genus in Cuba and on the Gulf coast of Mexico.

Falcicula hebardi Rehn.

New Jersey.

Reega, Atlantic County, VII, 31 and VIII, 10, 1914, (H.), 4 ♀.

Maryland.

Near Plummer's Island, VI, 17, 1913, (W. L. McAtee), 1 ♀, [U. S. N. M.].

Virginia.

Near Washington, D. C., V, 30, 1883, 1 ♀, [Hebard Cln.].
Petersburg, VII, 22, 1913, (R. & H.), 4 ♀, 3 ♀.
Cape Henry, VII, 2, 1903, (A. P. Morse), 1 ♀.

North Carolina.

Goldsboro, VII, 25, 1913, (R. & H.), 1 ♂, 4 ♀.
Raleigh, VII, 8, 1903, (A. P. Morse), 2 ♂, 8 ♀.
Greensboro, VII, 26, 1913, (H.), 1 ♂.

South Carolina.

Florence, IX, 6, 1911, (R.), 1 ♀.
Yemassee, IX, 4, 1911, (R. & H.), 1 ♂, 2 ♀.

Georgia.

Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♀.
Hebardville, V, 15, 1915, (H.), 1 ♀, 2 juv. ♀.
Suwannee Creek, VIII, 28, 1911, (H.), 1 ♂.
Cumberland Island, VIII, 31, 1911, (R. & H.), 1 ♂, 1 ♀.

Texas.

Doucette, VII, 24, 1912, (H.), 2 ♂, 2 ♀.
Beaumont, VII, 23, 1912, (H.), 2 ♂.
Dickinson, VII, 20, 1912, (H.), 22 ♂, 21 ♀.

Individuals of this minute species are distinguishable from any others of the Group Anaxiphites, not only by the absence of auditory foramina on the cephalic tibiæ, but also the remarkable reduction

[177] Large exotic series before us show that the species develops an unusual complexity of markings. Certain examples, in the Mexican series, are exceptional in having the caudal femora suffused dorsad and narrowly banded mesad on the outer face with very dark brown, while rare individuals have the dorsal field of the tegmina fuscous. Other specimens have no dark markings whatever and can only with difficulty be separated from small individuals of *A. pulicaria*, which species is, however, appreciably more robust.

of the tegminal stridulating apparatus in the male sex. The general coloration is immaculate pale yellowish brown, with no trace of cephalic markings. The species does not appear ever to develop wings and the tegmina have a more regularly convex contour than in the species of the allied genera.

The species is usually found in greatest numbers in the dry wire-grass and dead needles of the pine woods. It has twice been found in considerable numbers in such situations (Thomasville, Georgia; Dickinson, Texas). The above series was found very rare in heavy grasses of pine forest, *Pinus rigida* (Reega), occasional in grasses in boggy opening in woods (Petersburg), few in number in dry grasses under short-leaf pines, *Pinus echinata* (Goldsboro), in short grass on edge of forest (Greensboro), undergrowth of pine woods (Yemassee), undergrowth of gray-bark pine forest, *Pinus* sp. (Isle of Hope), in dry wire-grass and dead pine needles of long-leaf pine woods, *Pinus palustris* (Cumberland Island) and in heavy undergrowth of same (Hebardville, Suwannee Creek).

The present species has been previously correctly recorded only from the type locality, Thomasville, Georgia, and from Gainesville, Florida.[178]

Cyrtoxipha gundlachi Saussure.

Silver Springs, Florida, XI, 25, 1911, (G. P. Englehardt), 1 ♀, [Hebard Cln.].

This species is only known in the United States from peninsular Florida and has not been previously correctly recorded north of Punta Gorda;[179] it is widely distributed in the West Indies and is known from Central and northern South America.

The present specimen is no larger than the average individuals from Key West, Florida.

Cyrtoxipha columbiana Caudell.

North Carolina.

Stem, end of X, 1908, 1 ♀, [N. C. State Dept. Agr.].

Raleigh, VIII, 24, 1905, X, 3, 1908, (C. S. Brimley), 1 ♂, 1 ♀, [Brimley Cln.].

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂.

Georgia.

Hoschton, VII, 26, 1909, (H. A. Allard), 3 ♂, [U. S. N. M. and Hebard Cln.].

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[178] As the distribution of the species has been found to be so much more extensive than was previously known, we have here recorded all of the material before us in order to define as fully as possible its range. The records of this species (♀), and *Anaxipha exigua* (♂), from Cabañas, Cuba, are incorrect, the material being properly referable to *Anaxipha vittata*. Rehn, *2d Rept. Cent. Exp. Sta. Repub. Cuba*, pp. 223, 224, (1909).

[179] Ashmead's record from Utica, Mississippi, applies properly to *C. columbiana*. *Ins. Life*, VI, p. 25, (1894).

Brunswick, VIII, 30, 1911, (H.), 1 ♀.
De Witt, VII, 24, 1912, (J. C. Bradley), 3 ♂.
Spring Creek, VII, 16 to VIII, 28, 1912 and 1913, (J. C. Bradley), 2 ♂, 2 ♀.

Florida.

Atlantic Beach, VIII, 25, 1911, (R. & H.), 4 ♀.

Mississippi.

Hattiesburg, VII, 17, 1905, (A. P. Morse), 1 ♀.

Texas.

Dallas, (J. Boll), 2 ♀, [M. C. Z. and U. S. N. M.].
Doucette, VII, 24, 1912, (H.), 2 ♂, 2 ♀.

This species is very closely related to *C. gundlachi.* It may be distinguished by its greater size, more specialized and elongate titillatores of the male, which normally extend well beyond the distal margin of the subgenital plate, heavier and longer ovipositor with heavier serrulations (in this character, however, only showing a proportionate size increase in the larger species) and tegmina which usually show a few weak and irregularly placed transverse veinlets. The beautiful and brilliant, though pale, green coloration of both these species in life, almost entirely disappears in dried material.

In the series before us the following extremes in length are found: tegmen, ♂ 5.6 to 6.8, ♀ 6.3 to 7; wing, ♂ 7.3 to 9.2, ♀ 8.8 to 9.4; caudal femur, ♂ 5 to 5.7, ♀ 5.3 to 5.8; ovipositor 3.2 to 3.6 mm.

The species is thamnophilous and dendrophilous and has never been found in the least abundant. Its small size and retiring habits make it a very difficult insect to collect. The present material was taken in a deep forest of gum, sweet gum, etc. (Florence), beaten from bayberry bushes, *Myrica cerifera,* near stream in forest (Brunswick) and from the same on edge of pine woods (Atlantic Beach), and was found scarce in low bushes, particularly in shoots of sweet gum, along stream in forest (Doucette).

The insect was described from Washington, District of Columbia, and Falls Church, Virginia, the northernmost localities from which it is known, and has been previously recorded from Raleigh, North Carolina, and Bainbridge, Georgia. The present records considerably extend the known range of the species westward.[180]

Phylloscyrtus pulchellus (Uhler).

Maryland.

Chestertown, VIII, 17 to 26, 1899, (E. G. Vanatta), 1 ♂, 4 ♀, [A. N. S. P.].

Virginia.

Fredericksburg, VII, 20, 1913, (H.), 1 juv. ♂.
Petersburg, VII, 22, 1913, (R. & H.), 2 juv. ♂, 1 juv. ♀.

North Carolina.

Alamance County, VII, 1905, (F. Sherman, Jr.), 1 juv. ♂, [N. C. State Dept. Agr.].
Weldon, VII, 24, 1913, (R. & H.), 1 juv. ♂.
Goldsboro, VII, 25, 1913, (R. & H.), 3 juv. ♀.
Fayetteville, IX, 9, 1911, (R. & H.), 1 ♂, 1 ♀.

[180] We have thought best to record here all of the material of this little-known species before us. See additional record for species, footnote 179.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 10 ♂, 10 ♀.

Columbia, VII, 28, 1913, (H.), 1 ♂.

Ashley Junction, VIII, 15, 1913, (R.), 1 ♀.

Georgia.

Clayton, VI, 1909, (W. T. Davis), 1 juv. ♀, [Davis Cln.].

Lavender, VIII, 23, 1910, (J. C. Bradley), 1 ♀.

Buckhead, VIII, 2, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.

Macon, VII, 30 and 31, 1913, (R. & H.), 1 ♂.

Columbus, VIII, 9, 1913, (J. C. Bradley), 2 ♂, 2 ♀.

Savannah, VII, 31, 1913, (J. C. Bradley), 1 ♀; VIII, 14, 1903, (A. P. Morse), 8 ♂, 14 ♀.

Sandfly, IX, 3, 1911, (H.), 1 ♂, 1 ♀.

Isle of Hope, IX, 3, 1911, (R. & H.), 1 ♂, 1 ♀.

Billy's Island, VI, 12, 1912, (J. C. Bradley), 1 juv. ♂; IX, 1 to 5, 1913, (J. C. Bradley), 1 ♂.

Albany, VIII, 1, 1913, (R. & H.), 19 ♂, 26 ♀, 3 juv. ♀.

Thomasville, VI, 29, 1903, (for Hebard), 1 juv. ♂, [Hebard Cln.].

Florida.

Jacksonville, (T. J. Priddey), 1 ♂, 1 ♀, [Hebard Cln.].

Sanford, (G. B. Frazer), 1 ♂, [M. C. Z.].

The large series before us shows little size variation. The majority of specimens from the more southern points average darker in coloration, with colors more intense and brilliant. In this species the wings are always present and nearly as long as, but wholly concealed by, the tegmina.

The material here studied was taken: in weeds near Rappahannock River (Fredericksburg), in green undergrowth of heavy forest near stream (Weldon), common in low green undergrowth of "branch" and beaten from heavy green undergrowth in short-leaf pine forest (Columbia), beaten from undergrowth of long-leaf pine woods (Ashley Junction), scarce in tall weeds near stream in oak and short-leaf pine woods (Buckhead), in small clump of sweet gum shoots in gray-bark pine forest (Sandfly), in heavy undergrowth of gray-bark pine forest (Isle of Hope) and common in tangles of small bushes and vines along Flint River (Albany). The species has been recorded as far north on the Atlantic coast as Staten Island, New York; westward its distribution extends far beyond the regions here under consideration.

Hapithus agitator agitator Uhler.

District of Columbia.

Washington, X, 1883, 1 ♂, 2 ♀, [Hebard Cln.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.; common in undergrowth of deciduous forest), 2 juv. ♀.

Orange, VII, 21, 1913, (R. & H.; very scarce in undergrowth of deciduous forest), 1 juv. ♂.

Petersburg, VII, 23, 1913, (H.; in vegetation of boggy spot near woods), 1 juv. ♀.

Norfolk, IX, 8, 1903, (A. P. Morse), 1 ♂, 3 ♀.

We have a large series of adults before us from more northern points on the Atlantic coast, where the species has been recorded as far north as Tottenville, Staten Island, New York.

This geographic race is found to merge with the more southern race, *agitator quadratus*, along the fall line in North Carolina, this being shown by intermediate material before us from Raleigh. These races show little definite differentiation, but typical *agitator* may be said to differ from *agitator quadratus* in the average smaller size; tegmina which normally do not quite reach the distal extremity of the abdomen, in the male with speculum normally lacking a transverse vein and with length of same more nearly approximating its width, in the female with veins normally more irregular and not affording a pattern as generally longitudinal; the caudal femora in length also average proportionately slightly less.

A large series before us from other points in the southeastern United States, particularly those on the Piedmont plateau, are immature, and we are consequently unable to assign the individuals properly. We believe, however, that *agitator agitator* occurs on the Piedmont plateau at least as far south as Atlanta, Georgia. This race is known to occur as far westward as the timbered portions of eastern Nebraska.

Hapithus agitator quadratus Scudder.

North Carolina.

Wrightsville, IX, 7, 1911, (R. & H.), 10 ♂, 15 ♀, 1 juv. ♂.
Wilmington, IX, 8, 1911, (H.), 1 ♂, 1 ♀.
Lake Waccamaw, IX, 8, 1911, (R. & H.), 4 ♂, 4 ♀, 1 juv. ♀.

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 1 ♂, 2 ♀, 1 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 2 ♂, 3 juv. ♂, 5 juv. ♀.

Georgia.

Savannah, VIII, 14, 1903, (A. P. Morse), 6 ♂, 8 ♀, 2 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 9 ♂, 10 ♀, 1 juv. ♂, 2 juv. ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 2 ♂, 5 ♀.
Albany, VIII, 1, 1913, (R. & H.), 1 juv. ♂.

Florida.

Jacksonville, (T. J. Priddey), 4 ♂, 1 ♀, [Hebard Cln.].
Atlantic Beach, VIII, 24 and 25, 1911, (R. & H.), 4 ♂, 5 ♀.
Grant, VII, 1898, 1 ♂, 1 ♀, [Davis Cln.].
Miami, (Mrs. A. T. Slosson), 1 ♂, 1 ♀, [M. C. Z.].

Texas.

Doucette, VII, 24, 1912, (H.), 1 ♀.
Dallas, (J. Boll), 1 ♂, 1 ♀, [M. C. Z.].
Kerrville, VIII, 17, 1912, (H.), 1 ♀.
Flatonia, VIII, 20, 1912, (H.), 2 ♂.
San Antonio, VIII, 16, 1912, (R. & H.), 2 ♂.
Victoria, VII, 27, 1912, (H.), 8 ♂, 1 ♀, 1 juv. ♀.
Brownsville, VII, 31, 1912, (H.), 4 ♂, 3 ♀.
Piper Plantation, near Brownsville, VIII, 3, 1912, (R. & H.), 1 ♂, 6 ♀.

We have recorded above all of the previously unrecorded material of this geographic race from within the United States before us, in order to define more fully its known distribution.

There is considerable variation in the coloration of the form. Occasional specimens have the caudal femora strongly infuscated

medio-longitudinally, the exposed portion of the limb below this being very pale, often cream color; a similar condition is often weakly indicated, while in many series the caudal femora are concolorous with the general coloration. The intermediate channel in the tegmina is also occasionally strongly defined in yellowish white, often this is weakly indicated, while many individuals have this portion concolorous with the rest of the tegmen.

The present material was found common in low vegetation under live oaks on barrier beach (Wrightsville), on low wet ground in undergrowth of pine woods (Wilmington, Yemassee), in green undergrowth of deep forest (Florence), young numerous, but few adults in undergrowth of dry woods (Ashley Junction), common in heavy undergrowth of gray-bark pine forest (Isle of Hope), scarce in tangle of vines and bushes along Flint River (Albany), in heavy undergrowth of jungle "hammock" and in bayberry bushes (Atlantic Beach), in stream bottom choked with deciduous trees (Kerrville, Flatonia), young common, few adults, in scant undergrowth of mixed pine and deciduous forest (Doucette), in rank, high green grasses and nettles along wooded stream (San Antonio), in stream bottom in tangles of vines growing in high weeds (Victoria), by beating tall green weeds in river bottom tangles (Brownsville) and in low heavy jungle tangles (Piper Plantation).

We have found this race abundant in extreme southern Florida and on the Florida Keys.

Hapithus brevipennis Saussure.

Georgia.

Savannah, VII, 31, 1913, (J. C. Bradley), 1 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 2 ♂, 1 ♀.
Sandfly, IX, 3, 1911, (R. & H.), 2 ♂, 3 ♀.
Jesup, IX, 1, 1911, (H.), 1 ♀.
St. Simon's Island, VIII, 30, 1911, (R. & H.), 1 ♂, 2 ♀.
Billy's Island, IX, 1 to 15 and XII, 23, 1913, (J. C. Bradley), 2 ♂, 2 ♀, 1 juv. ♀.

Florida.

Jacksonville, VIII, 1885, (W. H. Ashmead), 1 ♂, 1 ♀; (T. J. Priddey), 1 ♂, [all Hebard Cln.].
Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♂, 1 ♀.
Live Oak, VIII, 26, 1911, (H.), 1 ♂.

Some size variation, irrespective of geographic distribution, is shown by the material before us.

The material taken by us was beaten from luxuriant undergrowth of gray-bark pine forest (Isle of Hope, Sandfly), found scarce under live oaks in area of *Helianthemum coralinianum* (St. Simon's Island), beaten from tangles of grape, raspberry and other vines in jungle "hammock" (Atlantic Beach) and one found on sandy soil among wire-grass (Live Oak).

The type localities, Georgia and Louisiana, our previous records from Thomasville, Georgia, and Pablo Beach, San Pablo and Gainesville, Florida, with those given above, define the known distribution of this beautiful and interesting species.

Orocharis saltator Uhler.

Orocharis gryllodes Saussure (not *Gryllus gryllodes* Pallas, 1772). (In part.)

Maryland.

Point of Rocks, VIII, 19, 1883, 1 ♂, [Hebard Cln.].
Washington, D. C., X, 1883, 2 ♂, 2 ♀, [Hebard Cln.].

Virginia.

Fredericksburg, VII, 20, 1913, (R. & H.), 1 juv. ♂.
Petersburg, VII, 23, 1913, (R. & H.), 1 juv. ♀.

North Carolina.

Weldon, VII, 24, 1913, (R. & H.), 2 juv. ♀.
Goldsboro, VII, 25, 1913, (R. & H.), 1 juv. ♂.
Charlotte, VII, 27, 1913, (R. & H.), 1 juv. ♀.

South Carolina.

Florence, IX, 6, 1911, (R.), 1 ♀.
Columbia, VII, 28, 1913, (R. & H.), 1 juv. ♀.
Isle of Palms, VIII, 15, 1913, (R.), 1 juv. ♀.
Ashley Junction, VIII, 15, 1913, (R.), 3 juv. ♂, 3 juv. ♀.

Georgia.

Rabun County, VII, 1910, (W. T. Davis), 4 juv. ♂, 4 juv. ♀.
Isle of Hope, IX, 3, 1911, (R. & H.), 1 juv. ♀.
Macon, VII, 31, 1913, (R. & H.), 1 juv. ♂, 1 juv. ♀.
St. Simon's Island, VIII, 30, 1911, (R.), 1 ♀.
Billy's Island, VI and VII, 1912, (J. C. Bradley), 3 juv. ♂.

Florida.

Jacksonville, (Priddey; Ashmead), 2 ♀, [Hebard Cln.]; XI, 3, 1911, (W. T. Davis), 1 juv. ♀.
Pablo Beach, XI, 4, 1911, (W. T. Davis), 2 ♂.
Silver Springs, XI, 25, 1911, (G. P. Englehardt), 2 ♂, 1 ♀, [B. I. and Hebard Cln.].

West Indian material before us and study of the literature has shown that *Orocharis saulcyi* (Guérin) is a synonym of *Orocharis gryllodes* (Pallas);[181] that West Indian form is known in the United States only from extreme southern Florida.

The present species was in part correctly recorded by Saussure, but material from the southern States was referred by him to *gryllodes*. We have now sufficient material before us to determine that *saltator* and, in part, *gryllodes* of Saussure[182] (but not of Pallas) are conspecific.

It is true that material of the present species from the southern United States often shows a somewhat heavier development with pronotum proportionately more ample, and in such specimens the mediastine vein of the tegmina frequently bears a greater number of branches. These features are, however, by no means constant;

[181] See Hebard, *Ent. News*, XXVI, p. 468, (1915).

[182] See Saussure, *Mélang. Orth.*, II, p. 755, (1878). That author has evidently also placed West Indian specimens of the group to which *vaginalis* belongs (which group probably merits generic distinction) under this name. The present species never develops a green phase as described by that author.

in specimens from the same locality a remarkable difference in pronotal amplitude in the same sex is often present,[183] while the branching of the mediastine vein is extremely irregular and cannot be relied upon as in any way diagnostic.[184]

The normal coloration of this insect is pale and immaculate reddish brown. Some specimens have the occiput, post-ocular portions of the genæ and dorsal portions of the lateral lobes of the pronotum infuscated; in others these markings are very dark and the dorsum of the pronotum and the tegmina and limbs are mottled and speckled with the same shade. Frequently in such maculate individuals the general coloration is grayish.

The species is known on the Atlantic coast as far north as Matawan, New Jersey; it is found far westward of the regions here considered.

Of the present series we found the young common in undergrowth of deciduous forest (Fredericksburg), young in undergrowth of pine woods (Petersburg), few immature examples in green undergrowth of heavy forest near stream (Weldon), few young in green grasses and weeds in short-leaf pine woods (Goldsboro), on green sprouts in "branch" filled chiefly with gums (Florence), young beaten from bayberry (Isle of Palms), young numerous in undergrowth of dry pine woods (Ashley Junction), young in luxuriant undergrowth of gray-bark pine woods (Isle of Hope) and in bushes apparently killed by a remarkable hymenopterous parasite, *Rhopalosoma poeyi* Cresson (St. Simon's Island).

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[183] In material before us we find the following contrasts in these dimensions: Silver Springs, ♂, 2.3 by 3.4 and 2.7 by 3.9; Thomasville, Georgia, ♀, 2.4 by 3.6 and 2.9 by 3.8 mm.

[184] All or part of the free veins of the lateral field of the tegmina sometimes merge with the mediastine vein at its base, and can then scarcely be distinguished from the normal branches of that vein. The branches of the mediastine vein also bifurcate, though rarely, while distad the vein itself frequently assumes abnormal positions which, in themselves, bring about further differences in the number of branches. The branches of this vein Saussure gives: for *saltator*, ♂ 7 to 8, ♀ 4 to 6; for *gryllodes*, ♂ 10 to 11, ♀ 7 to 10. In our series are males showing 8–9, 9–9 and 8–10 and females showing 5–7 and 6–7 of these branches, such material not being from areas where intergradation would be likely to occur, were geographic races present.

Explanation of Plates XII, XIII, XIV.

Plate XII.—Fig. 1.—*Neotettix proavus* new species. Macon, Georgia. Female (type). Lateral outline. (× 5)

Fig. 2.—Same. Female (type). Cephalic outline of head. (× 5)

Fig. 3.—*Tettigidea armata* Morse. Florence, South Carolina. Male. Outline of cephalic margin of dorsum of pronotum (no cusp). (Greatly enlarged.)

Fig. 4.—*Tettigidea armata* Morse. Florence, South Carolina. Male. Outline of cephalic margin of dorsum of pronotum (moderately cuspidate). (Greatly enlarged.)

Fig. 5.—*Tettigidea armata* Morse. Florence, South Carolina. Male. Outline of cephalic margin of dorsum of pronotum (strongly cuspidate). (Greatly enlarged.)

Fig. 6.—*Orphulella halophila* new species. Key West, Florida. Female (type). Lateral figure. (× 2)

Fig. 7.—Same. Female (type). Dorsal outline of head and pronotum. (× 2)

Fig. 8.—Same. Male (*allotype*). Dorsal outline of head and pronotum. (× 2)

Fig. 9.—*Spharagemon crepitans* (Saussure). St. Simon's Island, Georgia. Male. Dorsal figure. (× 2)

Fig. 10.—Same. St. Simon's Island, Georgia. Male. Lateral figure. (× 2)

Fig. 11.—*Melanoplus nubilus* new species. Fayetteville, North Carolina. Male (type). Lateral outline. (× 2)

Fig. 12.—*Melanoplus stegocereus* new species. Cannoche River at Groveland, Georgia. Male (type). Lateral outline. (× 2)

Fig. 13.—*Melanoplus mirus* new species. Weldon, North Carolina. Male (type). Lateral outline. (× 2)

Fig. 14.—*Melanoplus scapularis* new species. Jesup, Georgia. Male (type). Lateral outline. (× 2)

Plate XIII.—The enlargement of the supra-anal plates is about 10 times, of the cerci about 25 times and of the subgenital plates about 10 times.

Fig. 1.—*Melanoplus decorus* Scudder. Winter Park, North Carolina. Male. Dorsal figure of supra-anal plate and furcula.

Fig. 2.—Same. Winter Park, North Carolina. Male. Lateral outline of cercus.

Fig. 3.—*Melanoplus australis* Morse. Isle of Hope, Georgia. Male. Dorsal figure of supra-anal plate and furcula.

Fig. 4.—Same. Isle of Hope, Georgia. Male. Lateral outline of cercus.

Fig. 5.—*Melanoplus attenuatus* Scudder. Magnolia, South Carolina. Male. Dorsal figure of supra-anal plate and furcula.

Fig. 6.—Same. Magnolia, South Carolina. Male. Lateral outline of cercus.

Fig. 7.—*Melanoplus hebardi* (Rehn). Tyty Plantation, Thomas County, Georgia. Male (type). Dorsal figure of supra-anal plate and furcula.

Fig. 8.—Same. Male (type). Lateral outline of cercus.

Fig. 9.—*Melanoplus nubilus* new species. Fayetteville, North Carolina. Male (type). Dorsal figure of supra-anal plate and furcula.

Fig. 10.—Same. Male (type). Lateral outline of cercus.

Fig. 11.—*Melanoplus stegocereus* new species. Cannoche River at Groveland, Georgia. Male (type). Dorsal figure of supra-anal plate.

Fig. 12.—Same. Male (type). Lateral outline of cercus.

Fig. 13.—Same. Male (type). Lateral outline of subgenital plate.

Fig. 14.—*Melanoplus mirus* new species. Weldon, North Carolina. Male (type). Dorsal figure of supra-anal plate.

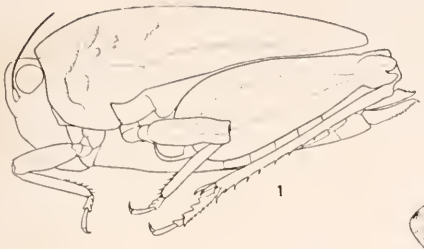
Fig. 15.—Same. Male (type). Lateral outline of cercus.

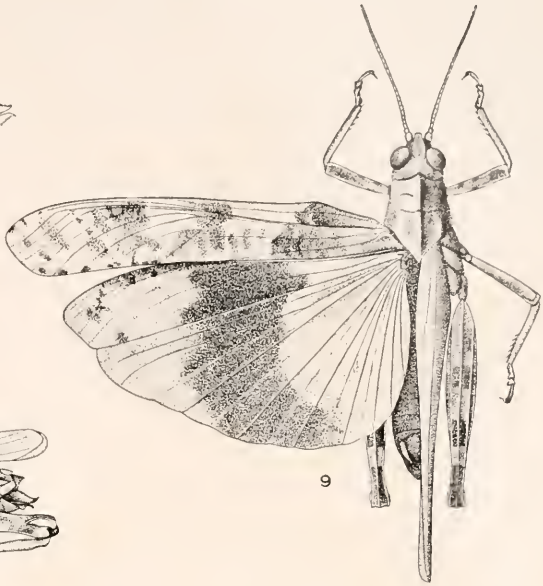
Fig. 16.—Same. Male (type). Lateral outline of subgenital plate.

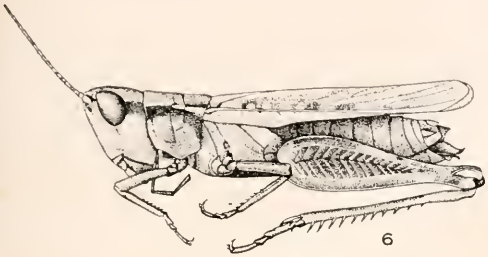
Fig. 17.—*Melanoplus scapularis* new species. Jesup, Georgia. Male (type). Dorsal figure of supra-anal plate.

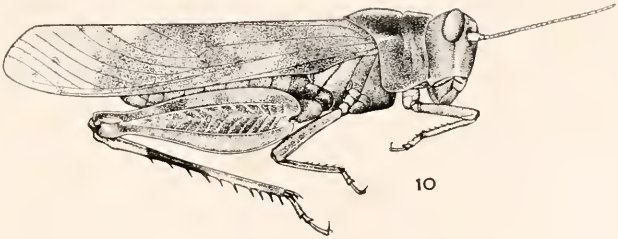
Fig. 18.—Same. Male (TYPE). Lateral outline of cercus.
Fig. 19.—*Melanoplus strumosus* Morse. Currahee Mountain, Georgia. Male. Dorsal figure of supra-anal plate and furcula.
Fig. 20.—Same. Currahee Mountain, Georgia. Male. Lateral outline of cercus.
Fig. 21.—Same. Currahee Mountain, Georgia. Male. Lateral outline of subgenital plate.

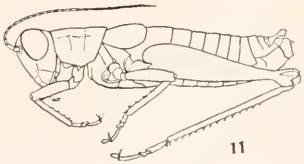
PLATE XIV.—Fig. 1.—*Melanoplus quercus* new species. Thomasville, Georgia. Male (TYPE). Lateral outline of cercus (× 5)
Fig. 2.—Same. Male (TYPE). Lateral outline of cercus and subgenital plate. (× 3½)
Fig. 3.—Same. Male (TYPE). Dorsal figure of supra-anal plate. (× 5)
Fig. 4.—*Scapteriscus vicinus* Scudder. St. Simon's Island, Georgia. Female. Lateral outline (internal) of dactyls of cephalic tibia. (× 4½)
Fig. 5.—Same. St. Simon's Island, Georgia. Female. Dorsal figure of pronotum. (× 2)
Fig. 6.—Same. St. Simon's Island, Georgia. Female. Lateral outline (external) of distal joint of caudal tarsus and claws. (× 4)
Fig. 7.—Same. St. Simon's Island, Georgia. Female. Lateral outline (internal) of spatula. (× 4½)
Fig. 8.—*Scapteriscus acletus* new species. Hebardville, Georgia. Male (TYPE). Lateral outline (internal) of dactyls of cephalic tibia. (× 4½)
Fig. 9.—Same. Male (TYPE). Dorsal figure. (× 2)
Fig. 10.—Same. Male (TYPE). Lateral outline (external) of distal joint of caudal tarsus and claws. (× 4)
Fig. 11.—Same. Male (TYPE). Lateral outline (internal) of spatula. (× 4½)
Fig. 12.—*Scapteriscus mexicanus* (Burmeister). Durango, Mexico. Female. Lateral outline (internal) of dactyls of cephalic tibia. (× 4½)
Fig. 13.—Same. Durango, Mexico. Female. Dorsal figure of pronotum. (× 2)
Fig. 14.—Same. Durango, Mexico. Female. Lateral outline (external) of distal joint of caudal tarsus and claws. (× 4)
Fig. 15.—Same. Durango, Mexico. Female. Lateral outline (internal) of spatula. (× 4½)
Fig. 16.—*Scapteriscus abbreviatus* Scudder. Musa Isle near Miami, Florida. Female. Lateral outline (internal) of dactyls of cephalic tibia. (× 4½)
Fig. 17.—Same. Musa Isle near Miami, Florida. Female. Dorsal figure of pronotum. (× 2)
Fig. 18.—Same. Musa Isle near Miami, Florida. Female. Lateral outline (external) of distal joint of caudal tarsus and claws. (× 4)
Fig. 19.—Same. Musa Isle near Miami, Florida. Female. Lateral outline (internal) of spatula. (× 4½)
Fig. 20.—*Anaxipha pulicaria* (Burmeister). Beaumont, Texas. Male. Cephalic figure of head. (Nearly × 5)
Fig. 21.—*Anaxipha vittata* (Bolivar). Atlantic Beach, Florida. Male. Cephalic figure of head. (Nearly × 5)

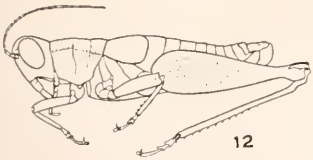




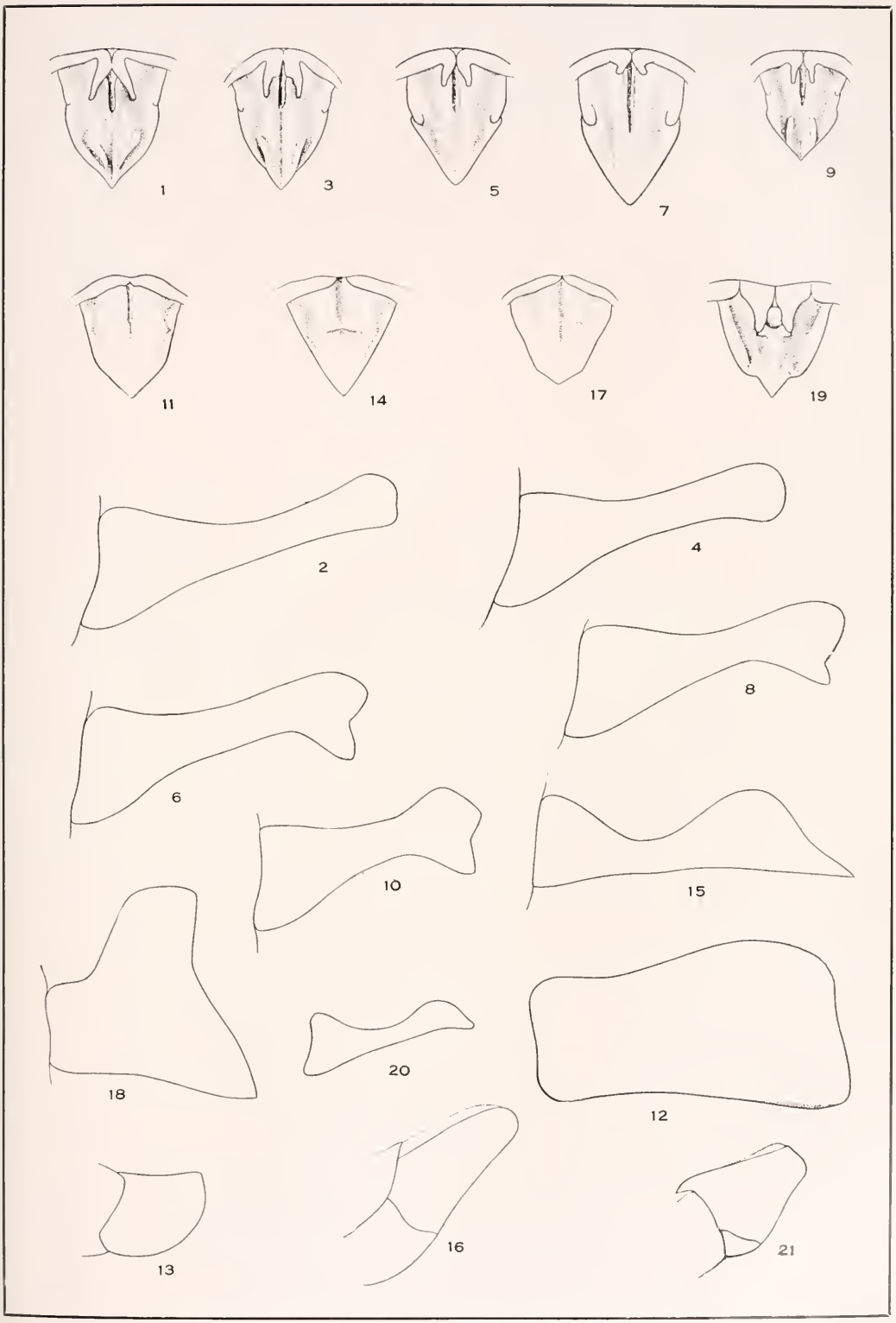




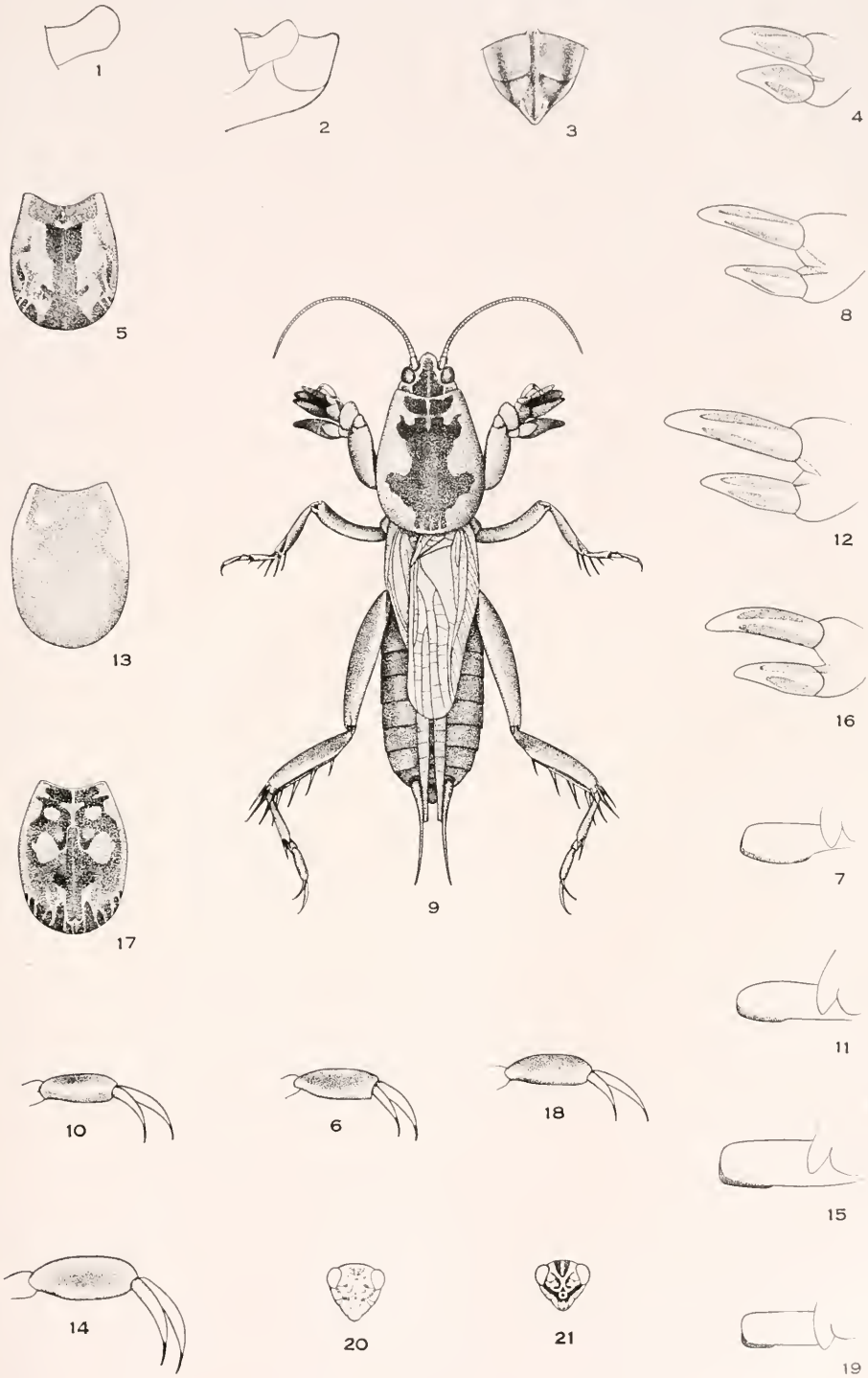




REHN AND HEBARD: STUDIES IN DERMAPTERA AND ORTHOPTERA.



REHN AND HEBARD: STUDIES IN DERMAPTERA AND ORTHOPTERA



REHN AND HEBARD: STUDIES IN DERMAPTERA AND ORTHOPTERA.

HUNTING MOLLUSCA IN UTAH AND IDAHO.

BY JUNIUS HENDERSON AND L. E. DANIELS.

The investigations of Hemphill prior to 1890 in Idaho and northeastern Utah, made that region classic ground in western American conchology. Owing to the existence of many small mountain ranges, in most instances conchologically unexplored, isolated by great expanses of arid territory wholly unfavorable to the larger land snails, in western Utah, Idaho, and Nevada, that area is an attractive field, and some of us have viewed it with longing. It is likely that every range not yet explored will yield one form or more of *Oreohelix* new to science. Indeed, we found a very interesting new form very close to one of Hemphill's localities, and in the same range. Probably Utah is approximately the center of distribution of the genus *Oreohelix*, and a thorough understanding of its forms and their distribution and habits may throw considerable light upon general problems of distribution of plants and animals in the Rocky Mountains and Great Basin, a thing devoutly to be wished. Before beginning serious work upon the unexplored ranges, it seemed to us important to clear up some of the many difficulties arising from a critical study of Hemphill's records and collections, in order to reach a better understanding of his species and varieties. He explored particularly the western edge of the Wasatch mountains and their spurs bordering the Great Salt Lake Basin on the east, thence northward into Idaho and southwestward to the Oquirrh Mountains, which extend southward from the southern end of Salt Lake. His published localities are exceedingly indefinite, as applied to snails of a genus whose colonies are usually of very limited extent and whose varieties are in many instances limited in their known range to the type locality. They were found to be even more indefinite in the field than they looked on paper. In the collections he distributed the labels are still more vague and sometimes misleading. However, we obtained material from somewhere near some of his stations, at least.

Inconsistencies in the descriptions and figures of material collected by Hemphill render the determination of some of the snails of the region difficult. We have been greatly assisted in this work by the loan to the University of Colorado, by Dr. Geo. H. Clapp, of his two

fine series of Hemphill's varieties, which have been critically examined by one of the authors. The other author has some of Hemphill's material in his own collection.

One of Mr. Clapp's collections was formerly owned by Mrs. Geo. Andrews. The shells in this series are mounted on 57 blue cards bearing the printed legend "Genus *Pyramidula*. Group of *Pyramidula alternata*." White printed slips pasted below the specimens use the generic name *Helix* instead of *Pyramidula*, and all of the *Oreohelices* are labelled as varieties of *P. alternata*. All of the printed labels for the Utah material give the localities merely as "near Salt Lake," evidently meaning the lake itself, not the city of that name. Included in that vague locality are shells that undoubtedly came from as widely separated areas as the Oquirrh mountains on the south and Franklin, Idaho, on the north. This collection seems to have been made up during or after 1890, as it includes forms described that year. The other series was purchased by Dr. Clapp directly from Hemphill in 1896, at 25c per lot, 153 trays of two specimens each. The printed labels in this series designate all the *Oreohelices* as varieties of *Helix strigosa*, and the locality stated for all the Utah material is simply "Utah," but in most instances more definite localities, such as "Box Elder Co.," "near Ogden" and "near Salt Lake," have been added with pen and ink.[1]

The soft anatomy of each lot of *Oreohelix* collected alive, with a few exceptions, has been studied by Dr. Pilsbry, whose comments may be found in a separate paper prepared by him. We are also greatly indebted to him for aid in identification of some of our material, and for advice in clearing up difficulties in nomenclature and the literature of the subject.

The authors met, by appointment, at Eureka, Utah, on August 26, 1915, and worked northward into the edge of Idaho, finishing the field work on September 17. Mr. Daniels had visited Stations 1, 1½, 2, 3, 4 and 5 on his way down from Montana to the rendezvous, but we both afterwards visited No. 5, dividing it into three stations, namely 30, 31 and 32, besides visiting others in the same vicinity. The main object of the expedition was to study the *Oreohelices*, and as our time was limited, but little of it was spent in the search for other genera.

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[1] Some of the earlier sets sent out by Hemphill, such as that in the museum of The Academy of Natural Sciences of Philadelphia, have practically the same data on the labels that were given by him in Binney's *Supplement* and *The Nautilus;* most of the labels being printed.

Limestone is common at almost every locality visited, this being a favorable condition for *Oreohelix*. The edges of coarse, angular limestone talus protected from rapid evaporation by overhanging bushes, formed the cover for some of the finest colonies we have seen, the snails occupying crevices among the rocks. At other localities they were abundant under vegetation on limestone slopes totally devoid of talus, and in a few instances they were found in talus where no limestone was observed, though it is almost certain that the soil or rock must have contained a fair percentage of lime in such cases. As some forms were discovered at but one or two stations, we could not determine whether each form chooses definitely a particular kind of cover, but the widely-distributed *depressa* is found indifferently under either rock or vegetative cover. The kind of vegetation did not seem to be important except as affecting its value as a cover to protect the snails from the sun's rays.

In the lots obtained after the first few days of September very few embryos were found. This is unfortunate, as the sculpture and shape of the embryonic whorls are important in classification and they are often much worn in adults. The summer was hot and extremely dry and snails of course were dormant—over ninety days without measurable rain. After the rains commenced on September 2 they became active and filled with water, and large numbers were found in copulation.

A very noticeable feature of the season's catch is the great difference in the color banding of various colonies of what would otherwise be considered the same form. The protean *O. peripherica* (Ancey) is a remarkable example, but scarcely less noteworthy than *O. s. depressa* (Ckll.) and some others. The important fact is that where the banding is weak or wanting on some specimens and strong on others from the same colony, the faintness or absence of bands is most pronounced on the last whorl. This would be interpreted, under the recapitulation theory, to indicate that the color banding is an ancient character of this genus and is in process of disappearing.

The question of recognizing subspecies, varieties and color forms is an ever-recurring one in this genus, many of whose species vary greatly in color, form and sculpture. The practice in American ornithology and mammalogy is to give subspecific rank to geographic races where the great majority of examples in one area differ in the same direction and degree from those of another area. The presence of a smaller number of intergrading forms within the range of either and especially along the common border prohibits specific rank,

the constancy or lack of constancy of characters determining the rank. This method, though requiring a zoological map for the identification of some individuals, seems the most satisfactory way to deal with such cases, where most of the examples from a given area clearly fall into a given subspecies, comparatively few failing to conform; but where mere average characters are used for the separation of such forms, and especially where abnormal specimens are selected and named, it is surely objectionable unless some term is used to indicate a rank lower than subspecies. Professor Cockerell some time ago[2] suggested the use of the term "mutation" to designate sporadic variations from modification of the germ-plasm, "form" for variations resulting from the immediate effect of environment upon the individual, and "variety" for all other variations of lower rank than subspecies. Such use of the terms "mutant" and "form" would imply much greater knowledge of causes of variation than we usually possess. It involves too much guessing as to the cause of a particular variation in a particular case, and in most cases it is impracticable to solve the problem by careful experimentation; indeed, sometimes perhaps impossible. On the other hand, the term "variety" is very confusing because it is so variously used. As is pointed out in the article just refrered to, well-known naturalists use it as an exact synonym of "subspecies" and also as a synonym of "form" and "mutant." This was true of Hemphill and Binney, but we should have progressed since their time. Some forms designated varieties by those gentlemen are so distinct that nowadays no naturalist would hesitate to give them full specific rank. On the other hand, however, Hemphill in several cases selected abnormal specimens from a colony and gave them several varietal names, and was not always even consistent in the use of such names in sorting his material for distribution. Had he made it clear in just what instances his varieties were so selected, and in what cases they were really from quite distinct colonies and fairly represented the colonies, it would be easier for us now. If, for example, his *oquirrhensis* and *gabbiana* were from separate colonies as indicated by his notes and partially confirmed by our material, most of the material from one colony conforming to one type and most of it from the other colony conforming to the other type, we should be justified in considering them two subspecies, notwithstanding intergrading examples in either colony. In some cases we can only determine the

[2] *Nautilus*, XX, 58–60.

question by additional field work, and that is rendered more difficult by the vagueness of his locality data. Sometimes we are aided by a careful reading of all the text of his descriptions. Thus, in reading the descriptions of his *O. subcarinata*, *bicolor* and *lactea*,[3] one without access to his material might well suppose that he was describing really distinct subspecies from separate colonies in the same region, but to his description of *lactea* he added a note to the effect that "the above varieties represent *a* colony of the largest specimens of the *strigosa* group," etc. From an examination of some of Hemphill's material one of the present authors decided that they were not separable before he noticed that note, and Hemphill was certainly not consistent in sorting these "varieties" for distribution. One might be pardoned, then, for suspecting that his *jugalis* and *intersum*, both from the "banks of the Salmon River," represent a similar instance, but an examination of a small amount of material under those names in Clapp's Hemphill collection indicates that they may be distinct and from different colonies.

In dealing with land snails of the semi-arid region, with their limited locomotive powers and prohibitive environmental barriers between colonies, a colony may be the equivalent of a geographic race or subspecies in other classes of animals. The fact that we do not perceive environmental differences in different colonies which would result in geographic races, may merely represent our ignorance of certain factors or of their importance in snail life. Some perfectly good species and subspecies are known from only one locality. It follows, then, from the foregoing remarks, that if nearly all of the members of a colony or group of colonies vary in the same direction and approximately to the same degree from other colonies occupied by the nearest known relatives, but sporadic individuals of the one are found with the other, then one may perhaps be justified in considering them different subspecies. When not fully satisfied that the difference is of a kind or sufficient in degree to be entitled to specific or subspecific rank, the varietal name may be preceded by the word "form," to distinguish it from a subspecies. There are certain characters which are of doubtful value at all times as subspecific characters, unless accompanied by other differences. Such, for example, is size, which may be greatly influenced in one or more colonies or portions of colonies by exceptionally favorable or unfavorable conditions, as where examples from the midst of a dense thicket

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[3] *Nautilus*, III, 133–134.

are larger than those from the edge of the thicket where cover is poor and periods of activity and growth fewer or shorter. A great many, if not all, mere color variations may fall into the same class, though sometimes color differences may be correlated with other undiscovered differences. As for selecting abnormal specimens which completely grade into the typical form in the same colony and giving to them varietal names, as was done by Hemphill and is now being done by various authors, the value to science of such a practice is doubtful.

Colton,[4] in discussing the genus *Lymnæa*, protests against its generic subdivision, but adds: "Species and minor groups on the other hand cannot be too much subdivided. It is an advance to describe every variation that can be distinguished." Probably no one would object to the describing of all distinguishable variations, but there is room for grave difference of opinion as to the advisability of *naming* all such variations, which Colton seems to advocate in quoting with apparent approval the following from Bateson: "They will serve science best by giving names freely and by describing everything to which their successors may possibly want to refer and generally by subdividing their material into as many species as they can induce any responsible society or journal to publish." It is quite possible to carry the naming of species and varieties altogether too far, especially in such a genus as *Oreohelix*. One may easily, by taking averages of color, form and size, make a score of colonies of *O. strigosa depressa* into as many distinct varieties, which, when seen in the mass and compared with each other, could be vaguely distinguished, but when compared with all the colonies from which we have collections would be quite indistinguishable, and not at all distinguishable from each other with only a few specimens in hand. Of such is Hemphill's "var. *carnea*."

A nearly complete suite of the material upon which this report is based has been placed in the cabinet of The Academy of Natural Sciences of Philadelphia.

The Tintic Mountains.

This is a range of irregular outlines covering considerable territory just west of central Utah. It was hitherto conchologically unexplored, and as we spent but one afternoon collecting here and made but one station, it would doubtless well repay further exploration,

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[4] *Nautilus*, XXVIII, 118.

especially the western spurs, which we did not visit, and which are further from territory thus far explored. Tintic folio, U. S. Geol. Surv., covers the Eureka district.

Oreohelix cooperi (W. G. B.)

Sta. 6, on north side of Godiva Mountain, in Eureka, Utah, on a slope of Paleozoic limestone, under shrubs and other vegetation, a few under angular blocks of limestone, no good rock slides exposed. A small form of this species is abundant here. We at first thought it might prove to be new, but it differs from typical *cooperi* of other localities only in its size, and, in average examples, a more nearly pure white ground color. The latter character, however, is quite variable here, but the size is unusually uniform, averaging about 14.5 mm., and varying scarcely a millimeter therefrom, one way or the other.

Oreohelix hemphilli eurekensis new subspecies. Pl. XV, figs. 7, 8.

Shell small, sublenticular; spire slightly elevated; whorls $4\frac{1}{2}$ to $4\frac{3}{4}$, strongly carinated at the periphery, the carina having a tendency to disappear toward the aperture of adults; whorls rounded above, sloping roundly in to the suture so as to form an excavated suture, and on the other hand sloping flatly to the periphery; transverse sculpture well marked, irregular; spiral sculpture consists, in the type, of 6 minute, beaded lines below the periphery, with very indistinct lines in the interspaces and in the edge of the umbilicus; similar sculpture above, but not so well defined nor so plainly of two grades; on the cotypes the lines are not so well defined and not so plainly of two grades below; umbilicus wide, exhibiting all the volutions; apical whorls brown, very dark brown in the type, changing to dirty white on the last whorl; two very obscure dark spiral bands, one above, the other barely below the periphery. Type, in Univ. of Colo. Museum, greater diam. 9.7, lesser 8.8, alt. 5.5. Cotype, in Acad. Nat. Sci. Phila., greater diam. 9.3, lesser 8.5, alt. 6.5.

Type locality, Sta. 6, Eureka, Utah, 7 specimens, all dead shells, associated with *O. cooperi*. The type and cotype are adults, and one specimen in L. E. Daniels' collection probably fully adult but with the peristome partly broken away. These specimens were all submitted to Dr. Pilsbry, who writes as follows: "I at first thought your little species from Eureka was *O. carinifera*, but on further study I am wholly of the opinion that it is a small subspecies of *O. hemphilli*. It differs chiefly by its smaller size and fewer whorls, the sculpture, color and degree of carination being practically identical. *O. hemp-*

hilli has the last embryonic whorl a trifle concave near the periphery, where yours is only flattened, but the difference is not great. *O. carinifera* has the embryonic whorls well rounded throughout, above; it is more depressed and the keel is decidedly pinched out on the last whorl. It may turn out to be another subspecies of *hemphilli*, but with present collections I hardly think so. I do not know what form Binney identified as *hemphilli* from Colorado. My comparisons were with the figured type and a young one of the original lot."

The Oquirrh Mountains.

This range extends southward from the southern end of Great Salt Lake. Hemphill visited the west side of the range,[5] and reported a very interesting series of finds, with *O. utahensis* at the foot of the mountains, *O. oquirrhensis* a short distance up the mountain side, then along the mountain side across a ravine the typical *haydeni* and *gabbiana*, and near the summit a few *haydeni* and two *cooperi*. We searched the canyons around Tooele without finding any of these forms. Then we proceeded to Garfield and worked southward along the west side of the range for many miles and only found one species, at stations 14 and 15. Material labelled *haydeni* in Clapp's Hemphill collection does not appear to belong to that species.

Station 11, cottonwood grove at picnic grounds just within mouth of gulch southeast of Tooele from which gulch the town obtains its water supply.

Paludestrina longinqua (Gould), abundant in water-cress.
Pyramidula cronkhitei anthonyi Pils., 14 specimens.
Euconulus sp., 1 juvenile.
Vitrina alaskana Dall, 2 dead shells.
Zonitoides arborea Say, 3 specimens.
Pupilla blandi Morse, 1 specimen.

Station 12, up the canyon a short distance above Station 11, in rock slide, mostly quartzitic sandstone.

Vitrina alaskana Dall, 3 specimens.
Pyramidula cronkhitei anthonyi Pils., 3 specimens.
Vitrea indentata umbilicata (Ckll.), 12 specimens.
Oreohelix strigosa depressa (Ckll.) common.

Oreohelix strigosa depressa (Ckll.).

Sta. 12 (see above); Sta. 13, about a mile above Sta. 12, on south side, under mountain maple leaves. These two lots are typical in

[5] Binney's 2nd Suppl. to 5th Vol. Terr. Moll. U. S., pp. 29–34.

form, sculpture, color and size, as compared with average examples from Colorado, with two strong color bands, one barely below the periphery, the other well above. Probably all or nearly all of Hemphill's Utah records of *O. strigosa* (Gould) should be referred to this subspecies. This is true of the material labelled *strigosa* in Clapp's Hemphill collection.

Oreohelix strigosa depressa, form **tooelensis** new form.

This form differs from *depressa* chiefly in the color, which is almost invariably a dead, chalky white, in all the material from three colonies northeast of Tooele, Utah, giving the specimens the appearance of dead, weathered shells, in this respect quite unlike the colonies of *depressa* from southeast of Tooele and elsewhere. Shell depressed (in a few examples quite elevated); whorls 5 to $5\frac{1}{2}$, convex; suture well impressed; spiral striæ minute; transverse sculpture slightly less pronounced than in typical *depressa*, especially below; color bands narrow, sometimes strongly marked, but usually rather faint or wanting, one barely below and the other well above the periphery, strong on immature examples; first embryonic whorl smooth, second and third minutely transversely striate, with numerous spiral striæ rippling the transverse sculpture above and below and increasing in strength with the growth of the whorls. Type, in the University of Colorado Museum, greater diam. 19 mm., lesser 16.5 mm., alt. 11.5 mm. Co-type, in Academy of Natural Sciences of Philadelphia, greater diam. 19.6 mm., lesser 17.2 mm., alt. 11.4 mm. Co-type, in L. E. Daniels' collection, greater diam. 23 mm., lesser 20 mm., alt. 13.5 mm. This form also slightly differs from typical *depressa* in anatomy, according to Dr. Pilsbry, but this is a variable feature. The presence sporadically of white examples in *depressa* and other colonies of *Oreohelix* belonging to the *strigosa* group, even though not the dead white which characterizes this form, makes it inadvisable to give this subspecific rank, notwithstanding the fact that the color in these colonies is constant, unless other differences are found which are also constant. Abundant at stations 7, 8, 9 and 10, in the small gulches about six miles northeast of Tooele, north of the smelter, under grass and other vegetation about limestone ledges. Four sinistral specimens were found.

Oreohelix haydeni gabbiana (Hemphill). Pl. XVI, fig. 3.

Patula strigosa var. *gabbiana* Hemphill, per Binney, 2nd Suppl. to 5th Vol. Terr. Moll. U. S., pp. 30, 34, Pl. II, fig. 9, 1886.

Sta. 14, mountain side southwest of Garfield (southeast of Black Rock) west side of Oquirrh Mts., under bushes, on limestone. The

locality had been burned over some years ago, and though the shrubbery had re-established itself, we found no live snails. The "bones" had been long dead. A more thorough search would likely disclose live ones in the neighborhood, as fires usually leave "islands" where such species may be preserved alive. Dead shells were fairly plentiful. A careful conchological survey of this whole range would probably prove profitable. Especially should Hemphill's "*haydeni*," *oquirrhensis* and *utahensis* from this vicinity be investigated.

Sta. 15, south side of a gulch south of Sta. 14, nearly east of Morris, under shrubbery and other vegetation about limestone ledges, not under rocks. This locality had been very recently burned over and the fire was still raging to the southward. We found numerous examples of this species on the burned ground, in a crumbly condition owing to the heat, but in a few small patches of brush untouched by the fire we found about thirty live ones. It is not improbable that the gulch where the fire was burning is the Hemphill locality.

The examples from Sta. 14 are old and much weathered, so that the sculpture is obscure on most of them, but where preserved it is the same as in those from Sta. 15, though the carina is not so pronounced on the average, and they vary more in size and altitude. This is a strongly carinated form, otherwise resembling Hemphill's variety *hydrida*, from Logan. In the best specimens the revolving riblets may be seen with the naked eye, with revolving threads in the interspaces visible under a lens, the intersections of these riblets and threads with the irregular transverse riblets, give to it a knobbed appearance as seen under a lens. This sculpture is characteristic of the *haydeni* group. The primary revolving riblets, six or eight in number, are rather regularly spaced, especially below. Most of our specimens are under 16 mm. in diameter, but the largest one measured is 22 mm., and has two rather strong color bands, one barely below and the other well above the periphery.

The Provo District.

Provo is south of Salt Lake City and at the base of the same range of mountains, hence it is not surprising to find the same species common here. Hemphill reported "typical *strigosa* and *cooperi*, large and small," from this locality. Doubtless his *strigosa* was *depressa*.

Oreohelix strigosa depressa (Ckll.).

Sta. 44, visited by Daniels only, Rock Canyon, due east of Provo, in limestone slides bordered by oak brush. Many examples with the color bands faint or wanting, a few strongly banded. Two sinistral shells were found. Shows same anatomical peculiarity as at Tooele, Sta. 7.

Sta. 45, visited by Daniels only, Slate Canyon, first one south of Sta. 44, limestone slides bordered by scrub oak brush. Banding even less prominent than at Sta. 44.

The Salt Lake City District.

Oreohelix strigosa depressa (Ckll.).

Sta. 46, about a mile up Emigration Canyon, southeast of Salt Lake City, south side of canyon, under mountain maples and other vegetation in fine limestone slide rock. This is a strongly banded form whose anatomy, according to Dr. Pilsbry, agrees with that of *depressa* from Colorado Springs and other localities, as well as from our stations 2 (near McCammon, Idaho) and 28 (near Brigham, Utah). The shells, however, of this lot and those from Sta. 2 differ markedly from those of typical *depressa* from Durango, Morrison, Steamboat Springs and other Colorado localities. Their relative altitude and the altitude of their whorls in proportion to the transverse diameter are much greater, and they scarcely show any of the peripheral subcarination in front of the aperture so common, indeed almost universal, in Colorado shells of this subspecies. On the other hand, however, other lots from elsewhere in Utah, notably near Ogden, appear to grade this lot quite well into typical *depressa*, so that, from any information we now have, we do not dare to make any separation. *Oreohelices* usually differ in relative altitude within any given species or subspecies, and only the uniformity of the increased altitude in this colony makes us hesitate.

Oreohelix strigosa depressa (Ckll.). "var. **carnea**" (Hemph.).

Patula, strigosa var. *carnea* Hemphill, *Nautilus*, IV, 15, 1890. Binney, 4th Suppl. to 5th Vol. Terr. Moll. U. S., p. 174, 1892.

Sta. 43, Dry Canyon, about a mile from the University of Utah, near Salt Lake City, in scrub oak and mountain maple thickets on limestone, visited by Henderson in company with William McArthur. This form was found abundantly here, the color bands faint or wanting on most examples, but quite strong on a few. On an average the specimens have a higher spire than typical *depressa*, but many of them are well depressed. The description of *depressa* appeared

in the same magazine in January, 1890, the reference to Binney's figure seeming to make it a good description, thus antedating *carnea* by five months. *O.* var. *carnea* is not a well-marked variety, and the question of making it a subspecies, or a mere color variety, or rejecting the name altogether, may be purely a matter of opinion, but it is not quite typical *depressa*.

Hemphill records "typical *strigosa* and *cooperi*, both large and small," from near Salt Lake City.

The Ogden District.

Oreohelix strigosa depressa (Ckll.).

Sta. 20, about eight miles up Ogden Canyon, east of Ogden, in rock slide below a limestone ledge at southwest end of a railroad bridge, south side of creek. Large, fine specimens, abundant, strongly banded, some measuring over 26 mm., a few very dark-colored. Professor Cockerell says this is the sort of snail he called "form *major*."[6]

Sta. 21, north side of creek, $\frac{1}{4}$ to $\frac{1}{2}$ mile below Sta. 20, under mountain maples, a few large specimens, up to 26 mm., and up slope in rock slide, the same form abundant, but averaging smaller, about 21 mm.

Sta. 22, south side of creek, half a mile further down, in slide of limestone and a micaceous rock, same subspecies, large, exceedingly abundant. Also half a mile further down under similar conditions. Dr. Pilsbry says of the *Oreohelix* from this station. "This lot is representative of a race of *strigosa* slightly differing from *depressa* in anatomy. The shells seem to me to differ by being less sharply striate, but were it not for the genital difference I would probably not have noticed this." A later letter, however, says that two lots afterwards examined seem intermediate, so that the argument from the anatomy is weakened, and there is no appreciable difference in the shell characters. The same anatomical differences he noted for stations 7, 10 and 13, near Tooele.

Sta. 23, further down creek on south side, opposite thick deposit of consolidated Quaternary gravel, in gneissic slide rock and adjacent bushes, with limestone showing far up slope at top of canyon wall, from which the wash is down over the slide. The same subspecies of *Oreohelix*, abundant, mostly rather high-spired.

At Sta. 22 we found also one of each of the following species:

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[6] See *Nautilus*, III, 102.

Succinea avara Say.

Thysanophora ingersolli (Bland).

Agriolimax campestris (Binney).

It may be well to add that this canyon is the type locality of *Vertigo corpulenta parietalis* (Ancey), and that Hemphill's *Patula striatella* from here is probably *Pyramidula cronkhitei anthonyi* Pils.

Oreohelix strigosa buttoni (Hemph.). ?. Pl. XVI, fig. 2.

Patula strigosa var. *buttonii* Hemphill, in Binney's 3rd Suppl. to 5th Vol. Terr. Moll. U. S., p. 220, 1890, Box Elder Co., Utah. Binney, 4th Suppl. 5th Vol. Terr. Moll. U. S., p. 171, Pl. I, figs. 2 and 10, 1892.

Stations 16, 17, 18 and 19, Taylor Canyon, near Ogden, south of Ogden Canyon, under poison ivy, elderberry, mountain maple and other shrubbery about limestone ledges, the farthest station being about half a mile up the canyon, and 19 being just outside the canyon and to the south, at an old lime kiln. Color light brown to nearly white, color bands from very faint to strong, varying somewhat in width.

Sta. 24, half hour's walk below Gateway, in Weber Canyon, southeast of Ogden, Utah, on south side of canyon in gneiss slide rock, no limestone seen, and another similar slide half a mile farther down.

Sta. 25, about half mile above mouth of Weber Canyon, south side, south of canal, 400 to 500 yards below Utah Light and Railway Co.'s power plant, in a similar slide.

Dr. Pilsbry has examined material from all these stations except 19, and identified it as above. Many examples have strong spiral color bands, and nearly all from 17 have. Otherwise they agree well with those under this name in Clapp's Hemphill collection. The tooth on the columellar margin is very often absent.

At Sta. 17 we also found *Vitrina alaskana* Dall.

Oreohelix peripherica (Ancey). Pl. XV, fig. 1.

Sta. 26, west side of gulch which comes into North Ogden Canyon half a mile or so above its mouth, abundant in scrub oak and other brush on hard sandstone and conglomerate overlaid by limestone, but not found in rock slide. This species and its varieties are more fully discussed under the Cache Junction District. At Sta. 26 the specimens collected average larger and smoother, but present the usual variation in size, as well as in the coarseness of sculpture and elevation of the spire. Many are plain, others with two narrow bands, either faint (especially on the last whorl) or well-marked, but none here with the broad, nearly black bands and white periphery of the *albofasciata* type, though some show a very slight tendency in

that direction, while a few have a faint chestnut tinge suffusing the whole shell, suggesting a tendency to approach the form *castaneus*. Two reversed examples were found.

The Brigham District.

At Sta. 27, at a spring beside a poplar grove just outside the mouth of the first canyon north of Brigham, Utah, in a thin film of water flowing over small rocks, we found a small form of *Physa*, which is tentatively identified as *P. cooperi* Tryon (?) by Mr. Bryant Walker, who adds: "Though slightly larger, these agree very well with some from California named by Hannibal."

Oreohelix strigosa depressa (Ckll.).

Sta. 28, up the steep canyon east of Sta. 27, in sandstone and limestone slides at edge of small mountain maple and oak thickets and other shrubbery. Conditions were not very favorable and specimens were rather scarce and small, not running above 19 mm. in diameter.

The Cache Junction District.

We include in this district the Wheelon, Clarkston and Newton stations, as they are all within a few miles of Cache Junction, Utah, and most of them produced some form of *Oreohelix peripherica* (Ancey), which we wish to discuss somewhat fully. At the stations south and west of the Junction we found the most interesting colonies of *Oreohelix* we have ever visited. Hemphill collected the same forms not very far from our stations, and recorded and distributed them variously as from the "banks of Bear river, North of Brigham," or simply "Box Elder County, Utah." Our stations 29, 30, 31 and 32 are close to the Bear River, in Cache County, just east of the Box Elder County line. Indeed, 29 may be really within Box Elder County. Stations 33 and 34 are just west of the line in Box Elder County, and likewise close to the river.

Hemphill camped on the "banks of the Bear River," north of Brigham, where the valley "was considerably broken by mountain spurs, through one of which the river had cut its way, leaving high, rocky cliffs on either side, with scattered clumps of bushes along the river and on the edges of the bluffs." Wheelon is located just where the river leaves the gorge, our Sta. 33 is not far below Wheelon, 34 within the gorge above Wheelon, 30, 31 and 32 just within the upper part of the gorge, 29 on the bank of the river just above the entrance to the gorge, while Cache Junction itself is in the valley

perhaps a couple of miles up the river from the gorge. A careful consideration of the topography and biological conditions, in connection with Hemphill's notes, convinced us that his camp was just below Wheelon, for in his search for *Oreohelix* he would surely have camped close to the mountains, the valley here being quite unfavorable to land snails. His first find was "on the brow of the bluff and the slope towards the river," evidently near his camp and surely not far from our Sta. 33. There he found his *O. binneyi*, "all plain white." Binney adds, "no revolving bands of color," but his figure seems to indicate one faint, narrow peripheral band. Next he found, apparently near by, "in a clump of bushes among leaves and brush," his variety *albofasciata*, shell "clouded, with the broad, revolving white band at the periphery. None in the bushes were white." (Later, he modified and extended the description, with an added figure.) At the various stations where we found typical *albofasciata* our experience was quite the reverse. We found at some stations the unbanded and narrowly-banded forms without *albofasciata*, but nowhere did we find *albofasciata* without a large proportion of the unbanded and narrowly-banded forms, a peculiarity of distribution reminding one of such instances as the sinistral forms of *Pupilla hebes* and *syngenes*, and the *bigranata* form of *P. muscorum*, which may be found in either pure or mixed colonies. There are reasons for surmising that Hemphill sorted his material in the field and wrote his published notes long afterward from memory, which, if it be the case, may account for the discrepancy in our finds. Then at the rocky cliffs three miles from camp, presumably somewhere near our stations 30, 31, 32 and 34, he found *binneyi* among the bushes, and "the ribbed variety *castaneus*" (Binney's figs. 11 and 14), "on a mossy, grassy slope directly at the foot of a high cliff," a spot which he says was continually shaded from the sun throughout the day. Across a ravine at the foot of another cliff, in wild rye, he found *gouldi* (Binney's figs. 5 and 16), all small, this form having two narrow dark bands, according to the figures. All these forms are transversely ribbed. At every station we found them intermingled, enormously variable in size, shape, color and sculpture, so completely grading together that we were compelled to believe them to belong to one protean species, and the same as Ancey's previously described *peripherica*, a conclusion reached also by Dr. Pilsbry some time ago.[7]

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[7] *Nautilus*, XXVII, 153.

[*Patula strigosa*] var. *newcombi* was named without description by Binney in 1885 (Man. Amer. L. Shells, p. 481), designating U. S. Natl. Mus. Nos. 39,023 and 39,025 to 39,038, from "near Ogden," "Wasatch Mountains" and "Box Elder Canyon." In his Second Suppl. Terr. Moll., 1886, he figured and briefly described it, hence the name is valid only from that date. The description and figures indicate much fewer and more widely spaced ribs than any of our material from that region. *O. wasatchensis* (Hemph.) may connect up with *peripherica* as a subspecies, through *newcombi*, but it is doubtful, and until that problem can be investigated it seems better to consider it a full species.

Oreohelix peripherica (Ancey). Pl. XV, figs. 1, 2, 3, 4

Helix idahoensis Newcomb, var. *peripherica* Ancey, *Le Naturaliste*, IV, 403, 1881.

Patula strigosa, vars. *binneyi*, *multicostata*, *gouldi*, *albofasciata* and *castaneus* Hemphill, in Binney's 2nd Suppl. to 5th Vol. Terr. Moll. U. S., pp. 29–32, Pl. II, figs. 3–6, 8, 11, 13, 14, 16, 1886; 4th Suppl., p. 171, Pl. 4, fig. 9, 1892.

Patula peripherica (1882, *multicostata* 1886) and *castaneus*. Ancey, The Conchologists' Exchange, II, 64, 1887.

Pyramidula strigosa binneyi and forms *multicostata*, *castanea* and *albofasciata* Pilsbry, Naut., XI, 141, 1898; Cat. Amer. Land Shells, p. 32, 1898.

Oreohelix peripherica and local races *binneyi*, *newcombi*, *multicostata*, *gouldi*, *albofasciata* and *castaneus* Pilsbry, Naut., XXVII, 53–54, 1913.

The following is a free translation from the French of Ancey's original description:

"I owe to the kindness of Dr. Newcomb a second variety of this species, with the same shape as the first one, but with a more open umbilicus, ornamented on the periphery with two narrow brown lines, the lower one being more decidedly marked, and provided with ribs, close, irregular and little in relief. It so closely resembles the shape of *Helix* (*Anguispira*) *cooperi* W. G. Binn., that I think it might well be an hybrid displaying the characteristics of the *Helix idahoensis* and *cooperi*. It measures 9 mm. in height and 14 mm. in diameter, and comes from Utah. As to form and color it looks much like the *Helix cooperi* (No. 136) of Binney and Bland's Land and Fresh-water Shells of North America, but it has ribs, while the latter has none. I propose to name this interesting variety *Helix idahoensis* Newcomb var. *peripherica*."

The "first one" referred to above is *O. idahoensis*. We see no reason for making this a subspecies or variety of either *idahoensis*, *strigosa* or *cooperi*. It is interesting to note that Ancey himself pointed out its identity with *multicostata* and the priority of his name, in his paper above cited from *The Conchologists' Exchange*. A careful study of Hemphill's material in the Clapp collection, taken in

connection with a study of our own material, both in the field and in the laboratory, convinces us that the forms mentioned in the foregoing synonymy should not be separated as subspecies. Some of the names may be useful as descriptive terms, provided they are used in such a way as to indicate their rank. The form *albofasciata*, especially, is a good color form, but the same variation is seen in various colonies of *depressa* and *cooperi*, though seldom or never quite so strikingly developed.

Hemphill says of *castaneus* that most of them are "faintly marked with the broad white band of *albofasciata*, but a few are plain chestnut colored." This is exactly the variation that occurs sporadically in many colonies of *depressa* and *cooperi*, and did not warrant the sending out of material from that colony under a distinct name, though it may have been appropriate to have selected the plain chestnut-colored examples and sent them out as mere color forms. Four specimens in Clapp's Hemphill collection are labelled *castaneus*. Two of them, from Box Elder County, Utah, are almost typical *albofasciata*. The other two, from Eastern Oregon, are not at all closely related to the others, and appear to be simply dark, unbanded examples of some undetermined species such as so frequently occur sporadically. The separation of the forms *multicostata* and *gouldi* was based chiefly upon a slight difference in the number and prominence of the ribs. As the ribs are extremely variable at all the stations of the species, and the material separated and labelled by Hemphill shows minute gradation in this respect, as well as in color and form, throughout his whole group of "varieties" from this district, probably no good purpose is served by retaining both of the names, though the average of the ribbing is so much more pronounced at some localities that it may be convenient to retain one of the names without giving it subspecific rank, in which case *multicostata* should be selected.

Sta. 29, steep east bank of Bear River below Cache Junction, just above the entrance to the gorge by which the river breaks through the mountain range to Wheelon, under shrubbery on whitish limestone. *Oreohelix*, connecting the unbanded forms of *peripherica* with the strongly banded *albofasciata* form. In examining 69 live specimens from a space about two rods wide and several rods long, 30 (form *binneyi*) are found to have scarcely a suggestion of color bands; 26 (form *albofasciata*) have a dark band 3 to 4 mm. wide just below the suture, then a white peripheral band of about the same width, a dark band below the periphery varying from 1 to

4 mm., the lower margin of this band irregular, often producing a "clouded" effect, and a broad white band around the umbilicus, such as sometimes occurs around the umbilicus of strongly albofasciated types of *cooperi* and *depressa;* 13 grade almost insensibly from the *albofasciata* form to the *binneyi* form. Frequently a narrow white band occurs just below the suture, and the upper edge of the white peripheral band is exposed well up the spire, of the higher-spired *albofasciata* specimens. Transverse ribs average about two to the millimeter, rather irregular, growth lines showing in the interspaces and microscopic spiral striæ on the ribs and in the interspaces. The color bands are very dark, often forming a striking contrast with the white peripheral and umbilical bands. Diameter 15 to 19 mm. (Pl. XVII, fig. 2.)

Sta. 30, southeast of Sta. 29, directly opposite the power plant dam at the entrance to the gorge, at base of Paleozoic limestone rocks on the lower slope of the mountain, where the vegetative cover is poor and rock slide absent or unexposed. Form *multicostata,* banding weak or absent, ribbing pronounced, diameter 12 to 16 mm., mostly dead specimens, the slope having been very recently burned over. (Pl. XV, fig. 2.)

Sta. 31, farther up the slope, at a heavy, steep limestone ledge, beneath a decumbent species of polygonaceous plant which clings closely to the rock. Form *multicostata,* abundant, much smaller than at Sta. 30, most examples with a narrow and often faint subperipheral color band, and some with a similar band just above the periphery; diameter of adults from 8 to 12 mm., altitude extremely variable (Pl. XV, fig. 3). The snails increase in size again a hundred feet farther up the slope. Stations 30, 31 and 32 form practically a continuous colony, which we separated into stations merely because of the astonishing difference in size within a short distance. Our observations upon this genus lead us to observe that any given species is likely to vary greatly in size with variation in cover. We also found here 97 *Pupilla blandi* (Morse) and 5 *Vallonia cyclophorella* Ancey and *V. sonorana* Pils.

Sta. 32, at the base of a limestone cliff above Sta. 31, where the vegetative cover is better and the cliff affords considerable shade. Forms *albofasciata* and *binneyi,* intergrading as at Sta. 29, except that few are so pronouncedly of the *albofasciata* type as at 29. Diameter from 9 to 16 mm.

Sta. 33, ravine that cuts back into the east bluff of Bear River valley, just below Wheelon, Box Elder County, probably not a great

distance from Hemphill's camp, above irrigation canal, in a dense thicket of birches and mountain maples. Forms *albofasciata* and *binneyi*, showing the same intergradation as at Sta. 29, but a smaller proportion strongly banded. Of 324 live ones examined, only 39 showed very marked bands, most of which were as heavily banded as at 29. Diameter 16 to 18 mm. In the dried-up backwater from the canal at this point we found 80 *Lymnaea parva* Lea (identified by Walker), 1 *Planorbis parvus* Say, 7 *Physa gyrina* Say (?), 2 *Zonitoides arborea* Say and 1 *Vitrina alaskana* Dall.

Sta. 34, above Wheelon, in a ravine on the east side of the gorge, at the south end of the railroad bridge southwest of the tunnel, only a few rods within the eastern border of Box Elder County, under mountain maple, scrub oak and other brush. The same forms of *Oreohelix* as at stations 29 and 33, but the *albofasciata* form proportionately more numerous than at Sta. 33, the banding varying greatly in degree as elsewhere.

It will be noted that wherever the form *albofasciata* was found, it was associated with the *binneyi* form, and that at none of the *albofasciata* stations was the ribbing as pronounced as at stations 30 and 31, at which none of the typical *albofasciata* were found. This suggests that notwithstanding the complete intergradation in all the observed characters of these snails at stations 29 to 34, it may become necessary to recognize two distinct subspecies. In that event the name *peripherica* should be adopted for the *multicostata* form, because it better conforms to Ancey's description and Ancey himself recognized the identity of these two, and did not recognize their identity with any of the other named forms. Then the forms from stations 29, 33, 34 and 37 may be called *O. peripherica binneyi* (Hemph.), with *albofasciata* as a color form. Living specimens from these stations have been retained for breeding experiments.

Sta. 37, about five miles across the valley due west of Sta. 36, a mile or so southwest of Clarkston, in a ravine in the east slope of the same narrow mountain range that the river cuts through at stations 29 to 34, and probably not more than three miles northwest of 29, under low bushes. The *binneyi* and *albofasciata* forms, showing the usual intergradations. From the topographic and biologic conditions observed at a distance, it is not unlikely that this colony extends with a few narrow interruptions, to a point on the river bank just opposite Sta. 29.

Sta. 36, west slope of a small, rounded, barren-looking, isolated,

calcareous mountain northeast of Newton, due east of Sta. 37, under the shrub *Kunzia tridentata* and weeds. We found here, on a very unpromising slope, in considerable abundance, an *Oreohelix* which appears to be identical with the smooth form of *peripherica* from Sta. 26, in North Ogden Canyon, but the specimens average somewhat smaller at Sta. 36 and more in keeping in this respect with the other *peripherica* stations.

Oreohelix rugosa (Hemph.).

Patula strigosa var. *rugosa* Hemphill, Naut., IV, 16–17, 1890. Binney's 4th Suppl. to 5th Vol. Terr. Moll. U. S., p. 174, 1892.

Sta. 3, a little north of west from Clarkston, on the east slope of the same mountain range as Sta. 37 and not more than two or three miles distant, probably about one-third of the way up the mountain, under scrub oak and sage brush. A comparison of this material with *O. rugosa* in Clapp's Hemphill collection shows them to be identical. The shells remind one of *O. hendersoni* Pilsbry, or rather of the subspecies *dakani* Henderson, but Dr. Pilsbry's anatomical examination disproves its relationship to *hendersoni*. It must be remembered, however, that the connection between *hendersoni* and *dakani* is hypothetical, and *rugosa* may prove to be a prior name for the latter. The anatomy indicates a closer relationship to *cooperi* than to *strigosa* or *depressa*, but the shell characters do not appear to grade it into any of those forms, so it is for the present assigned to specific rank. The specimens vary greatly in altitude, as is so frequently the case in this genus.

Pisidium huachucanum Pils. and Ferr.

Found in a spring at Clarkston, Utah, associated with the next species. Both identified by Dr. Sterki.

Paludestrina longinqua (Gould).

In a spring at Clarkston, Utah.

On the bank of Bear River, due west of Cache Junction, we found a single dead shell of *Planorbis trivolvis*. At Sta. 35, a brook northeast of Newton, we found a *Physa* rather plentiful, which was tentatively identified by Mr. Bryant Walker as *P. distinguenda* Tryon (?), but Dr. Pilsbry says it "agrees very exactly with the type of *Physa cooperi*."

The Trenton District.

Trenton, Utah, lies a few miles to the north of Newton and Cache Junction.

Oreohelix peripherica (Ancey).

Sta. 4, "The Cliffs," one mile south of Trenton, on a small, isolated mountain similar to Sta. 36. The smooth form of this species, like that found at stations 26 (North Ogden) and 36 (Newton), was found here. A few show the strong ribbing of the form *binneyi*, but the ribs are not so prominent as in the form *multicostata*. A fire had recently destroyed the brush and leaves, so live specimens were scarce, but dead shells were abundant. Two abnormal specimens are represented on Pl. XV, fig. 4.

Sphærium pilsbryanum Sterki.

A few dead shells found in an irrigating ditch near Trenton, from which the water had been withdrawn for some time. The species was described from Bear Lake as a fossil or subfossil. Dr. Sterki writes that he has one fresh specimen from Utah Lake.

The Logan District.

Binney recorded *Thysanophora ingersolli* (Bland) under the generic name *Microphysa*, from Logan Canyon, collected by Hemphill (2nd Suppl. Terr. Moll., p. 35). It is probably the same form that Ancey, 1887, described from the same canyon as *M. ingersolli convexior* (Conch. Exch., II, 64). We did not visit this canyon.

Oreohelix strigosa depressa (Ckll.).

Sta. 41, first gulch south of Logan Canyon, east of Logan, Utah, in the edges of Paleozoic limestone talus. A small form of this subspecies, running about 18.5 mm. in diameter, mostly strongly banded, a few plain, not abundant, conditions evidently rather unfavorable. A few examples strongly resemble *O.* "var. *albida*" (Hemph.), the type locality of which is "near Logan."

Oreohelix haydeni hybrida (Hemph.). Pl. XV, fig. 4.

Patula strigosa var. *hybrida* Hemphill, Naut., IV, 17, 1890.

Sta. 42, not far within the mouth of the next gulch south of Sta. 41, under mountain maple and other shrubbery, herbs and rocks. The snails were found in fair abundance, a few with color bands, sculpture almost exactly like that of *O. h. gabbiana* from stations 14 and 15, but the keel is much less pronounced and often almost wanting on the last whorl. This is doubtless the form that Hemphill first recorded as "the variety with microscopic ribs, beginning of *haydeni*, among stones at the head of a gulch high on the mountains" (Binney's 2nd Suppl. Terr. Moll., p. 31), possibly the same gulch from which we collected it. Later, in describing and naming the subspecies, he explained that it "is the beginning of the forms of *strigosa* that

finally develop the revolving lines into prominent ribs as seen on the surface of var. *haydeni* Gabb."

The Franklin District.

Franklin is situated in Idaho, a mile or two north of the northern line of Utah, and Sta. 38 is in Idaho, but stations 39 and 40 are a mile and a half or two miles south of the line, in Utah.

Oreohelix strigosa fragilis (Hemphill). Pl. XVI, fig. 1.

Patula strigosa var. *fragilis* Hemphill, Naut., IV, 17–18, 1890. Binney's 4th Suppl. Terr. Moll., pp. 174–175, 1892.

Sta. 38, a small, isolated, barren-looking mountain about a mile west of Franklin, Idaho, in the edges of Paleozoic limestone slides surrounded by sage brush. The specimens from this station are small (few exceeding 17 mm. in diameter), much depressed, not quite so fragile as from the next station, and with a wider umbilicus, as would be expected from the depressed form. The noticeably translucent shell and general appearance, however, connects them with this subspecies, rather than with typical *depressa*. From this station we have also 1 *Vallonia cyclophorella* Ancey, 1 *Pupilla blandi* (Morse) and 2 *Succinea avara* Say.

Sta. 39, Prater Gulch, south of High Creek Canyon, Utah, about six miles southeast of Franklin, Idaho, nearly east of the railroad station of Webster, Utah, in quartzite talus. Rare in several slides visited, very abundant in one. The specimens are typical, but rather larger than most of those in Clapp's Hemphill collection, averaging about 20 mm. in diameter, altitude variable in its proportion to transverse diameter, but nearly all higher than the average from Sta. 38. This subspecies is closely allied to *depressa*, but differs slightly in anatomy, in the translucency and fragility of the shell, and in the narrowing of the umbilicus by the reflected base of the columella. Near Franklin, on red sandstone, is given as the type locality. One might be led to suspect that the fragility of shell is due to lack of lime, from the fact that Hemphill's material came from sandstone and our No. 39 from quartzite, but the snails from Sta. 38, in a limestone habitat, are also fragile, though to a less degree, while *depressa* from quartzite slides are not fragile. The Sta. 39 shells are so fragile that many of them were broken in carrying them in the bags until we found time to clean them, a thing which did not happen with any other *Oreohelices* we collected, and they were not subjected to as hard usage as some. Indeed, it was the fact that they broke so easily that attracted our attention in the

field to the probability that we had Hemphill's *fragilis*, which neither of us had seen before.

At this station *Vitrina alaskana* Dall was noted, but not taken.

Oreohelix haydeni corrugata new subspecies. Pl. XVII, fig. 1.

Shell rather globose; spire elevated, one or two examples tabulate; whorls 5 to $5\frac{1}{2}$, ample, convex, last one scarcely carinated at the periphery on elevated specimens; spiral sculpture strong, closely resembling that of typical *haydeni* and the subspecies *betheli*, consisting of an average of about 13 strong, sharp ridges (in a few examples scarcely stronger than the riblets), the interspaces much broader and occupied by from 3 to 6 spiral riblets or threads; numerous crowded, irregular, transverse riblets and growth lines roughen the shell and give to the spiral ridges and riblets a knobbed appearance under a lens; color pinkish-white to white, first 2 or 3 whorls dark horn-color; altitude of type in Univ. Colo. Museum, 14 mm.; greater diameter, 18 mm.; lesser diameter 15.7 mm.; cotype in collection of L. E. Daniels 13 mm.; greater diameter, 18.5 mm.; lesser diameter, 16 mm.; cotype in Mus. Acad. Nat. Sci. Phila., alt. 14, diam. 19.7 mm.; umbilicus deep and very narrow, almost cylindrical, exhibiting whorls to the apex. The shell is more globose, the whorls of greater caliber and the umbilicus much narrower than in typical *haydeni*, and typical *betheli* is even more depressed and widely umbilicated For purposes of comparison we republish Gabb's figure of *haydeni* (Pl. XVIII, fig. 3), and original figures of *betheli* (Pl. XVIII, fig. 1) and its variety *alta* (Pl. XVIII, fig. 2), neither of which have been hitherto figured. Binney's figures of *haydeni* do not appear to be typical. Type locality, Sta. 40, a small mountain of Paleozoic limestone nearly isolated from the main chain, south of west from Sta. 39, and southeast of Webster, Utah, under the shrub *Kunzia tridentata* and coarse-leafed herbaceous plants, and in one place in a small rock slide. Abundant. This subspecies forms another exception to Hemphill's observation concerning the geographic dividing line between the transversely-ribbed and longitudinally-ribbed forms (Binney's 2nd Suppl. Terr. Moll., p. 31, 1886).

Hemphill recorded *haydeni* from the Oquirrh Mountains and also from near Ogden, but a large series in Clapp's Hemphill collection labelled partly *oquirrhensis*, partly *haydeni* and partly *hemphilli*, all from "near Salt Lake," does not disclose any difference between them, and should probably all be called *oquirrhensis*, except perhaps two much more elevated examples which may be from a different locality.

The McCammon District.

McCammon, Idaho, is about fifty miles northwest of Franklin.

Oreohelix cooperi (W. G. B.).

Sta. 1, one mile north of McCammon, Idaho, on the north side of the railroad. Several additional faint, narrow color bands below periphery.

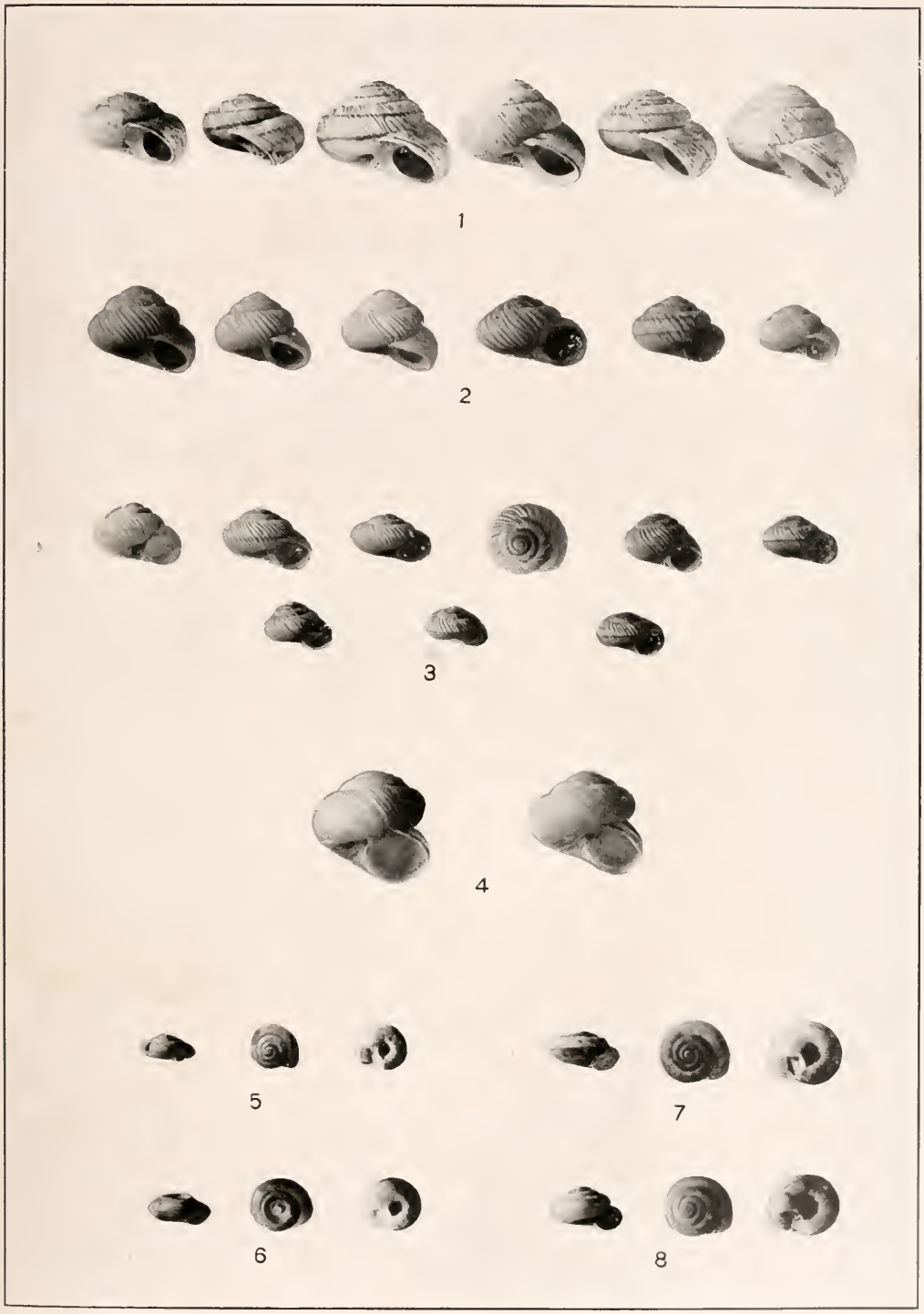
Oreohelix strigosa depressa (Ckll.).

Sta. 2, about six miles up Harkness Canyon, directly east of McCammon, below the first limestone ledge, under leaves and small stones. This form is allied to *depressa* by its anatomy, but is on the average much less depressed, the whorls more convex, and few are strongly banded, though most of them show some traces of color bands, and a number exhibit several faint, narrow bands below, such as are so common in *O. cooperi*, but not so usual in *depressa*.

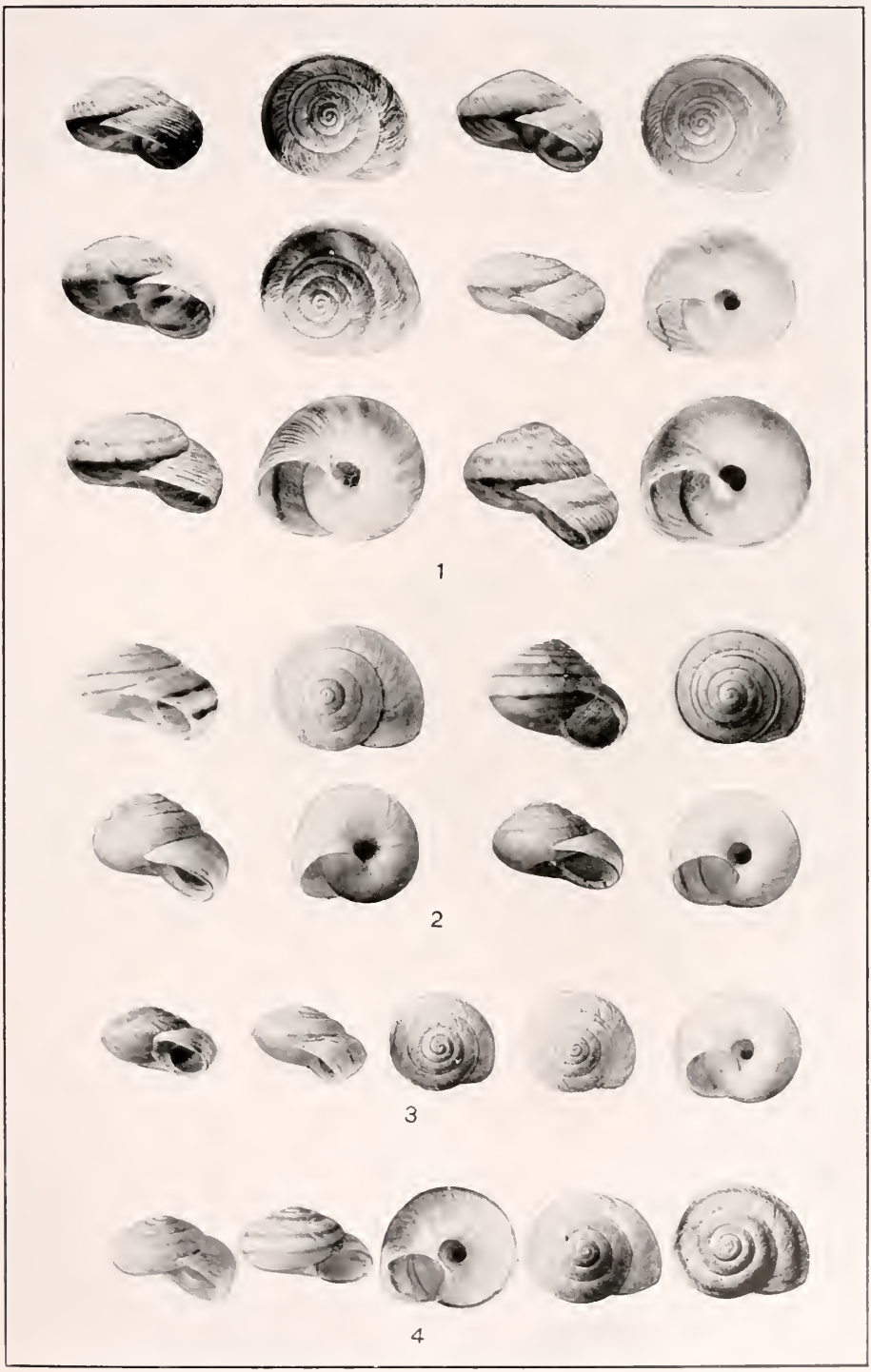
Oreohelix tenuistriata new species. Pl. XV, figs. 5, 6.

Shell small, rather depressed; whorls about $4\frac{1}{2}$, convex, carinated; transverse sculpture consists of numerous, crowded, sharp, wavy lines, presenting a beautiful appearance under a lens, crossed by a number of indistinct, raised, spiral lines; umbilicus open, exhibiting all of the whorls; color of live shell unknown, but probably a dirty white; exact measurements of adult unknown, but diameter about 9 mm., altitude about 5 or 5.5 mm. The paratype in Coll. Acad. Nat. Sci. Phila. measures, alt. 5.1, diam. 8.5 mm. In general appearance and sculpture it closely resembles *O. carinifera* Pils., but the transverse sculpture is sharper than in the two specimens of that species we have been able to examine. Also the second embryonic whorl is sharply striate and convex, while in *carinifera* and *hemphilli* it is smooth and convex and in *yavapai* it is smooth and flatter.

Type locality, Sta. $1\frac{1}{2}$, a canyon between McCammon and Hot Lava Springs, Idaho, about two miles southwest of the latter place. Only three examples were found, all more or less broken. One is in The Academy of Natural Sciences of Philadelphia, one in the University of Colorado, and the type in the collection of Mr. Daniels. These specimens were all submitted to Dr. Pilsbry, who says they represent an undescribed species and belong to the *hemphilli* and *carinifera* group. With more and better material this may prove to be a subspecies of one or the other, but it does not at present seem probable. With it were found, sparingly, *Vallonia gracilicosta* Reinh., *Euconulus fulvus* Müll. and *Vitrina alaskana* Dall.



HENDERSON AND DANIELS: MOLLUSCA OF UTAH AND IDAHO.



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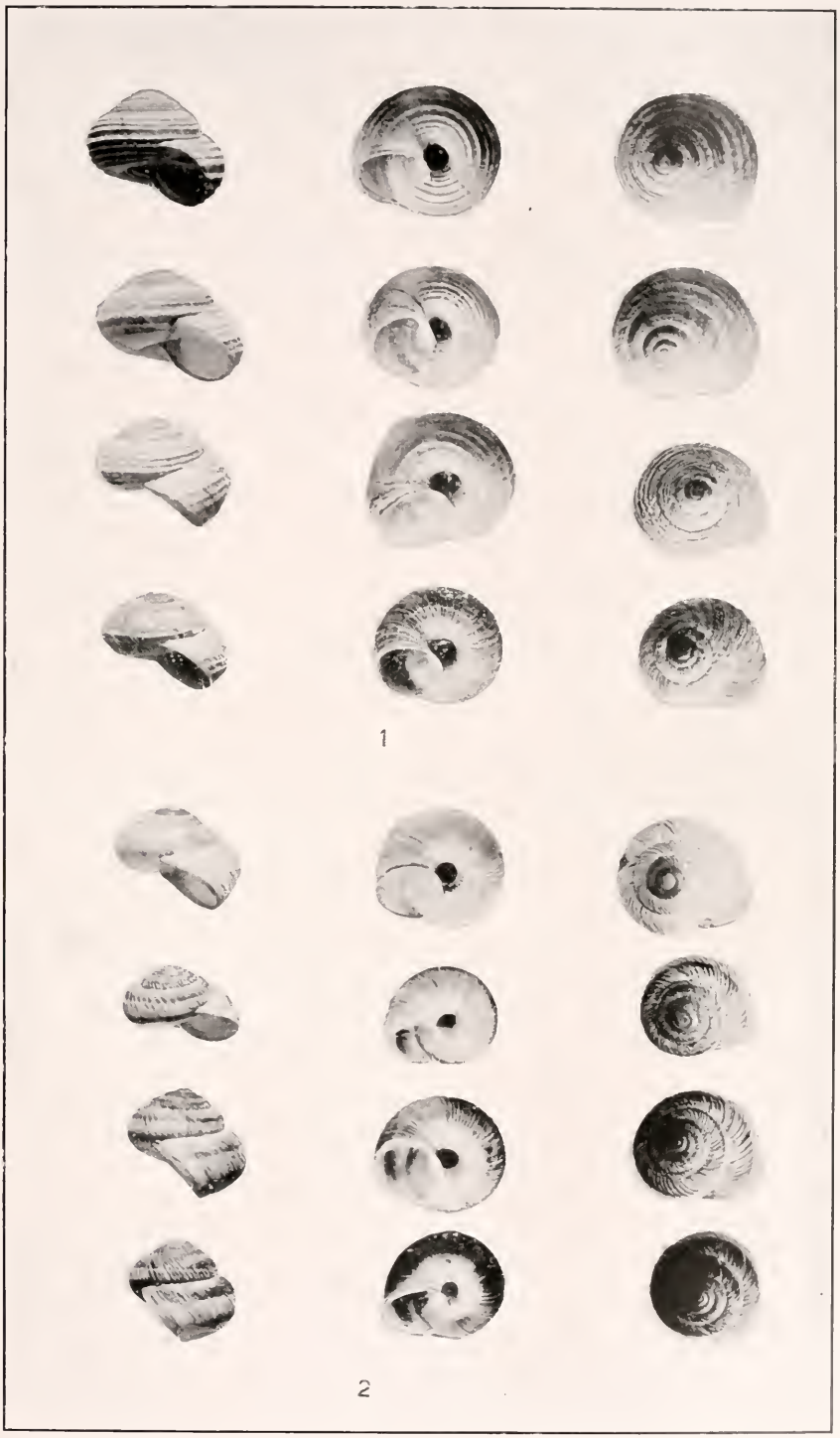
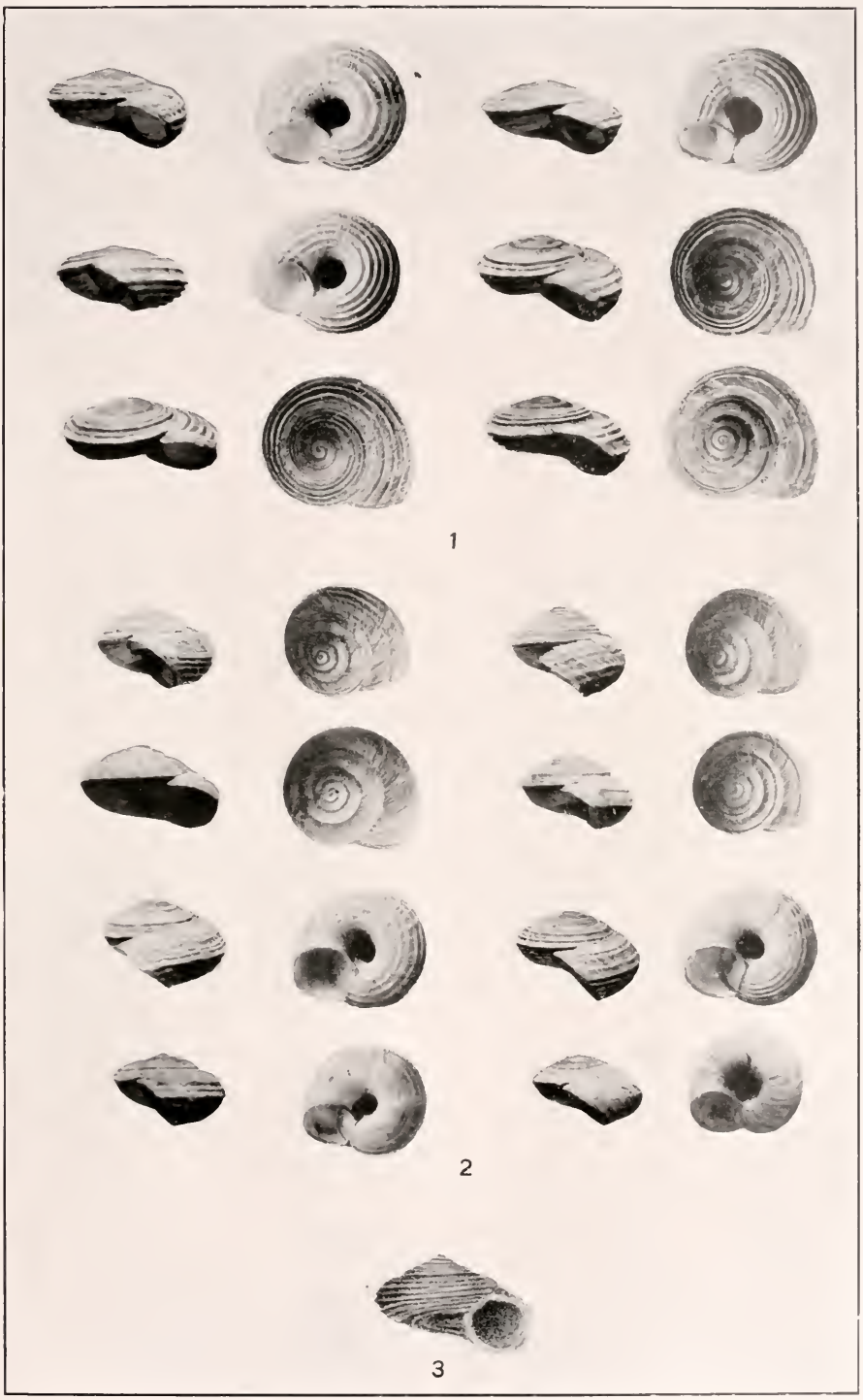


HENDERSON AND DANIELS: MOLLUSCA OF UTAH AND IDAHO.



HENDERSON AND DANIELS: MOLLUSCA OF UTAH AND IDAHO.

Pisidium huachucanum Pils. and Ferr.

In a spring near Port Neuf River, north of McCammon, Idaho. Identified by Dr. Sterki.

Explanation of Plates XV, XVI, XVII, XVIII.

Plate XV.—Fig. 1.—*Oreohelix peripherica*, six examples from Sta. 26, North Ogden Canyon, Utah.

Fig. 2.—*Oreohelix peripherica*, six examples from Sta. 30, near Cache Junction, Utah.

Fig. 3.—*Oreohelix peripherica*, nine examples from Sta. 31, near Cache Junction, Utah.

Fig. 4.—*Oreohelix peripherica*, two abnormal specimens from Sta. 4, near Trenton, Utah.

Fig. 5.—*Oreohelix tenuistriata* n. sp., 3 views of type specimen from near Hot Lava Springs, Idaho. In collection of L. E. Daniels.

Fig. 6.—*Oreohelix tenuistriata* n. sp., 3 views of cotype from near Hot Lava Springs, Idaho. In Univ. Colo. Museum.

Fig. 7.—*Oreohelix hemphilli eurekensis* n. subsp., 3 views of type specimen from Eureka, Utah, in Univ. Colo. Museum.

Fig. 8.—*Oreohelix hemphilli eurekensis* n. subsp., 3 views of co-type from Eureka, Utah. In Acad. Nat. Sci. Phila.

Plate XVI.—Fig. 1.—*Oreohelix strigosa fragilis*, six examples from Sta. 39, east of Webster, Utah.

Fig. 2.—*Oreohelix strigosa buttoni*, four examples from Sta. 16, Taylor Canyon, near Ogden, Utah.

Fig. 3.—*Oreohelix haydeni gabbiana*, five examples from Sta. 15, Oquirrh Mts., Utah.

Fig. 4.—*Oreohelix haydeni hybrida*, five examples from Sta. 42, near Logan, Utah.

Plate XVII.—Fig. 1.—*Oreohelix haydeni corrugata* n. subsp. Three views of four specimens from type lot, Sta. 40, southeast of Webster, Utah.

Fig. 2.—*Oreohelix peripherica* Ancey. Three views of four specimens from Sta. 29, near Cache Junc., Utah.

Plate XVIII.—Fig. 1.—*Oreohelix haydeni betheli*, six examples from type locality, north of river, Glenwood Springs, Colo.

Fig. 2.—*Oreohelix haydeni betheli* var. *alta*, eight examples from type locality, south of river, Glenwood Springs, Colo.

Fig. 3.—*Oreohelix haydeni*, Gabb's original figure from Amer. Journ. Conch.

NOTES ON THE ANATOMY OF OREOHELIX, WITH A CATALOGUE OF THE SPECIES.

BY HENRY A. PILSBRY.

The present study is based chiefly upon material collected by Messrs. Junius Henderson and L. E. Daniels in Utah and southern Idaho.[1] Its object is to determine the characters of the reproductive organs and teeth of the species of this area, both as an aid in the discrimination of the species, and to afford a basis for comparison in further work on the genus. The new catalogue of the species and minor forms of *Oreohelix* appended, embodies the results of study in the museum and field from time to time during the past ten or fifteen years.[2]

The genus *Oreohelix* is one of the most difficult groups of land snails within our boundaries by reason of the multiplicity of forms, and the strange parallelism of shell characters sometimes existing between species or races not directly related. This has led to erroneous identifications, with consequent errors in the data of geographic distribution.

The shell seems to be especially plastic; not only are there many local races of various grades of differentiation, but in any colony of some of the species one finds a wide range of variation in the features usually depended on for specific discrimination, such as absolute size, height of the spire, width of the umbilicus relative to the diameter, and development of the sculpture. Sometimes colored and white individuals exist in the same colony. If the banded pattern is primitive in the *strigosa* and *cooperi* groups, as seems highly probable, then it appears that bandless or white mutations have arisen independently in many colonies, where they sometimes exist with the earlier pattern, apparently in hybrid populations.

Eighty-six names have been proposed for forms of all grades; many of these are quite insufficiently defined, and no doubt part

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[1] For data relating to the localities and shells collected reference must be made to their paper "Hunting Mollusca in Utah and Idaho." A few species collected by Mr. Jas. H. Ferriss and the author are also considered.

[2] The writer has personally collected ten of the twenty-four species known. All of the species and subspecies are contained in the collection of the Academy except the following: *O. bruneri* Ancey, *O. cooperi stantoni* Dall, and *O. strigosa imitaris* Dawson.

of them are superfluous, either because they are synonymous with other names, or because they denote variations not of racial value. In many cases, further collections are requisite, as the small, assorted series of the earlier collectors give no adequate idea of the association of forms in the colonies. Moreover, the location of colonies has often been carelessly recorded, entailing much strenuous field work on the investigator of to-day, work which could have been saved by carefully noting the locations of type localities.

Distribution of Oreohelix.

The genus is almost confined to the western mountain region of the United States, but there is one species in southern Assiniboia and one near the southern boundary of Alberta. Formerly one species extended eastward to eastern Iowa. Southward the genus practically reaches the Mexican boundary, in the Big Hachet mountains of New Mexico and the Huachucas of Arizona; and it will probably be found below the boundary. An outlying species on Catalina Island, California, is widely remote from its kindred, among alien associates.

A northern and a southern area of speciation may be distinguished. The southern group occupies the southern half of New Mexico, Arizona south of the Colorado River, and Catalina Island, California. It comprises all of the recent species of the subgenus *Radiocentrum*, and the species of *Oreohelix* proper which have swollen penes. Species as follows:

O. concentrata.	(Radiocentrum.)
O. metcalfei.	*O. avalonensis.*
O. pilsbryi.	*O. chiricahuana.*
O. yavapai.	*O. clappi.*
O. barbata.	*O. ferrissi.*
O. socorroensis.	*O. hachetana.*
O. cooperi.	

Several of these species have one or more subspecies. *O. cooperi* occurs only at considerable elevations, and in forms differing somewhat from northern specimens. *O. yavapai* has been found also in northwestern Wyoming. It is one of the widely distributed species. The other species are special to the southern area.

In the Florida and Dragoon mountains a few imperfect and very old specimens have been recorded doubtfully as *O. strigosa*; but it seems more likely that they belong to the group with swollen penes, some of which resemble *O. strigosa.*

The northern group occupies Arizona north of the Colorado and

northern New Mexico, north to British America, and in its greatest amplitude from the Mississippi River (pleistocene) to eastern Washington. The most widely spread species is *O. cooperi*, with *O. strigosa depressa* next. *O. haydeni* also is spread over a considerable though much smaller area. Most of the other species and races are relatively local in distribution, and many are known from but one or a few contiguous colonies.

Oreohelix cooperi still occurs from the Black Hills to Montana and Idaho, and from Assiniboia to the southern third of New Mexico and Arizona. Its range was formerly wider, as it is not uncommon in the loess of eastern Iowa. Its presence there indicates a drier and cooler summer climate than that of eastern Iowa to-day. Where I have collected *O. cooperi* in the mountain states it is a shell of the "aspen zone."

Oreohelix is rarely if ever found in abundance except where the country rock is limestone. Some species, in areas largely blanketed by later igneous rock, seem to be wholly restricted to the limestone outcrops. They live on the surface, in dry weather finding refuge under superficial stones, leaves or sticks. Except *O. barbata* in the Chiricahua mountains, I do not remember ever finding *Oreohelix* below the surface layer of stones or rocks.

Reproductive Organs of Oreohelix.

The genitalia have a general resemblance to the same organs in *Ashmunella* and *Sonorella*, but there are some differences. There is never a flagellum, though the epiphallus is well developed. The penis-papilla is obsolete or wanting. The penis consists of a lower segment which is longitudinally ribbed within, and an upper segment with thinner walls which are densely papillose within, and enclose a larger cavity. The internally ribbed part is very short in *Radiocentrum*, but from about a third to over half the total length in *Oreohelix* proper. The distal end is truncate or quite shortly bicornute.

In the figures, the organs are shown in nearly their natural positions, except that in some cases the folds of the penis are slightly opened out, to bring the epiphallus into full view. The specific characters are largely a matter of measurements of the epiphallus and penis and its parts. These measurements are taken with dividers after pulling the organs straight, but without stretching. Thus Pl. 20, fig. 1*a*, and Pl. 22, fig. 7*a* show the penes of two species pinned out for measuring, after drawing figures in the natural positions.

All figures were drawn with an Abbe camera lucida.

In these PROCEEDINGS for 1905, p. 271, a grouping of the species of *Oreohelix* according to the characters of the genitalia was tentatively advanced. The examination of many more species and local races in the main confirms the arrangement then proposed. By the genitalia the species group as follows.

1. Epiphallus about as long as the penis, the retractor muscle inserted upon it; internally plicate part of the penis very short; animal oviparous, etc. Subgenus *Radiocentrum*.
2. Epiphallus much shorter than the penis, the retractor muscle inserted upon both at their junction (except in *O. barbata*); internally plicate part of the penis $\frac{1}{4}$ to over $\frac{1}{2}$ of its length; viviparous species. Subgenus *Oreohelix*.
   a. Penis long, the distal part about equal in diameter to the lower part, though usually collapsing on account of the thinner walls. *O. strigosa, peripherica, hendersoni, elrodi, haydeni* and their varieties. Also *O. cooperi*, which is somewhat intermediate between groups *a* and *b*, being a generalized species in genitalia.
   b. Penis short, the basal part decidedly more swollen than the distal, *O. yavapai, concentrica, metcalfei, pilsbryi, barbata*, and their varieties.

The division of *Oreohelix* into "transversely ribbed," "smooth or striate," and "longitudinally ribbed" groups by Hemphill and Binney is a division of convenience in the identification of specimens, but it has no relation to the affinities of the species.

TEETH OF OREOHELIX.

In *Oreohelix* there are two types of teeth, as W. G. Binney first pointed out. In one group the central and inner lateral teeth have no side-cusps or cutting points. Here belong:

O. strigosa (Gld.). Binney, T. M. vol. V, Pl. IV, fig. H.[3]
O. cooperi (W. G. B.). Binney, T. M. vol. V, Pl. IV, fig. G, and several examined by myself.
O. haydeni (Gabb). Binney, T. M. vol. V, Pl. XVI, fig. B. Also *O. h. betheli* and *O. h. corrugata* examined by myself.
O. peripherica (Anc.). Binney, T. M. vol. V, Pl. XVI, fig. A (var. *newcombi*). Also numerous radulæ of several forms examined by me, from Henderson and Daniel's Stations 29, 30, 33, 36.

[3] Just what race of *strigosa* Binney had remains in doubt. In the same volume he described and figured the genitalia of a Salmon River *strigosa*, which would presumably be *O. s. jugalis*, but perhaps *O. s. subcarinata*. He gives the formula 50-1-50 for a transverse row of teeth. As all the other species of *Oreohelix* examined by Binney and the writer have between 20-1-20 and 33-1-33 teeth, this count is remarkable, and if confirmed would certainly indicate a species distinct from any other of which the dentition is known.

O. strigosa depressa (Ckll.). Pilsbry, Proc. A. N. S. Phila. 1905, Pl. XXII, figs. 1–3 (Pecos, N. M.); also from Colorado Springs, near McCammon, Idaho, and Ogden Canyon, Utah.
O. rugosa (Hemph.). See fig. 1*a*. Formula 19, 13, 1, 13, 19.
O. metcalfei (Ckll.). Formula 17, 11, 1, 11, 17.
O. concentrata (Dall). Pilsbry, Proc. A. N. S. Phila., 1905, p. 276 (Form *huachucana*).
O. yavapai (Pils.). Pilsbry, Proc. A. N. S. Phila., 1905, Pl. XXII, fig. 7.

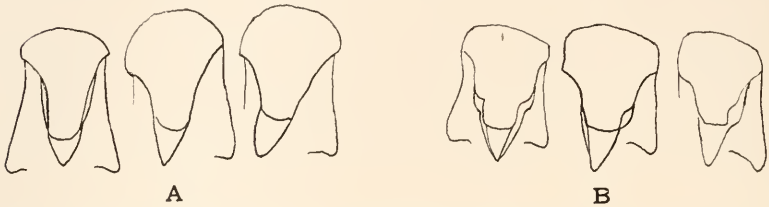


Fig. 1.—Central and two inner lateral teeth of (*a*) *Oreohelix rugosa*, and (*b*) *O. hendersoni*.

In the second group the central and all lateral and marginal teeth have side-cusps. Of this kind are:

O. idahoensis (Newc.). Binney, T. M. vol. V, Pl. IV, fig. I.
O. hemphilli (Newc.).[4] Binney, T. M. vol. V, Pl. IV, fig. J.
O. barbata Pils., Pilsbry, Proc. A. N. S. Phila., 1905, Pl. XXII, fig. 6.
O. chiricahuana Pils., Pilsbry, Proc. A. N. S. Phila., 1905, Pl. XXII, figs. 10, 11.
O. clappi Ferriss, Pilsbry, Proc. A. N. S. Phila., 1905, Pl. XXII, fig. 4.

In *O. clappi* the cusps and cutting points on the central teeth are very small. In *O. hendersoni* (fig. 1*b*) they are small and partly united with the lateral cutting edges of the middle cusp. This species is transitional to the form of teeth found in *O. cooperi*, *O. haydeni* and others. There is therefore no hard and fast line of demarcation between the two groups, although nearly all of the species examined are seen at once to belong to one or the other, and the form of the teeth is therefore a useful specific character.

Nearly all of the radulæ examined have 29 to 33 teeth on each side of the central tooth. A few have not so many, *O. yavapai* having 26, *O. barbata* 23, and *O. hemphilli*, according to Binney, 20.

[4] Binney reported *O. hemphilli* from "Manitou, Williams Canyon, Colorado." The shell from this place needs comparison with the type of *hemphilli*. Whether his figure of the teeth was from the Nevada or the Colorado form is not known. Fig. 157, Man. Amer. Land Shells, p. 168, is not very characteristic, and if *hemphilli*, it is an immature individual. The type of *O. hemphilli* is No. 23,060 A. N. S. P.

The count of teeth is rather small for a Helicid genus. Mr. Binney's count for "*O. strigosa,*" 50–1–50, is so detached from other known species that it needs confirmation.

Oreohelix strigosa (Gld.).

The anatomy of typical *O. strigosa* is unknown, since we have yet to rediscover the typical form. Hemphill's var. *parma* from Spokane Falls is near the original *strigosa*, but it is larger and more solid. Further west, at Blue Lake in the Grand Coulée, there is a small, thin race, closely resembling *jugalis* Hemph. Nothing is known of the soft anatomy of any of the subspecies or races of Washington, central and northern Idaho and Montana.

Oreohelix strigosa depressa (Ckll.). Pl. 19, figs. 1, 2, 3, 4, 6, 7; pl. 120, fig. 8.

(*a*) Specimens from Manitou Canyon, near Colorado Springs, are taken to be typical *depressa* (fig. 1). The penis is long, from over three-fourths to more than the diameter of the shell, the internally costate portion is not swollen, and is *less than half* the entire length—usually about one-third. It has 5 or 6 ribs inside. The distal portion collapses along three lines, so that its section is trefoil shaped. This is due to three bands where the wall is slightly thicker. It lies coiled in the body, usually showing two principal bends. The general appearance in different individuals is shown in pl. 19, figures 1, 2 (also pl. 19, fig. 5, *O. s. fragilis.*) The form *carnea* (pl. 19, fig. 3) is identical with *depressa* anatomically.

(*b*) In another series of specimens dissected the distal part of the penis collapses along two instead of three sides, so that its section becomes flattened instead of triangular. It is also less coiled or twisted than in typical *depressa*. This form of penis is shown in pl. 19, figs. 4 and 7, and pl. 20, fig. 8. The last five measurements in the table on page 346 belong to these. While the trefoil and the flat forms are almost always readily distinguishable, yet in a few specimens of the flat type I have opened, there is some indication of a third ridge in part of the length (Stations 43, 46, figs. 3 and 6 of plate 19).

The flat type is probably more primitive than the trefoil, since it is common to this form of *strigosa, peripherica* and *haydeni*.

O. s. depressa form *tooelensis* H. and D. (pl. 21, fig. 5), from Station 10, about 6 miles from Tooele, Utah, agrees with many specimens of *depressa* in genitalia. The distal part of the penis is flattened.

The radula of *O. s. depressa* from Colorado Springs has 16, 17, 1, 17, 16 teeth, the central and 5 or 6 inner laterals unicuspid.

Oreohelix strigosa fragilis (Hemph.). Pl. 19, fig. 5.

Genitalia as in *O. s. depressa,* the distal portion of the penis collapsing into a trefoil shape in the individual dissected (Station 38).

Length of penis 18 mm.; of internally costate part 5 mm.; epiphallus 4; penial retractor 6 mm.; diameter of the shell about 19 mm.

Oreohelix strigosa buttoni (Hemph.). Pl. 21, fig. 6.

Genitalia as in form *tooelensis, O. s. depressa* from Provo, and others, the penis collapsing flat. The lower part has 5 ribs within. Length of penis 25 mm., of internally costate portion 10, of epiphallus 7 mm., penial retractor 15 mm.; vagina 6.7 mm. The specimens came from Station 16, Taylor Canyon, near Ogden, Utah.

Measurements, in mm., of the genitalia of Oreohelix strigosa depressa.

Locality.	Length of penis.	Length of costate part of penis.	Length of epiphallus.	Length of penial retractor muscle.	Length of vagina.	Length of spermatheca and duct.	Aproximate diameter of shell.	Plate 19.
Colorado Springs, Manitou Canyon	18.5	6.5	7.5	11	8	....	23	Fig. 1
Near Salt Lake City, Sta. 43	24	8	6	11	6	25	. .	Fig. 3
Emigration Canyon, Sta. 46	26.5	11	7	7.5	6.5	.	25	Fig. 6
Near McCammon, Idaho, Sta. 2	23.5 28	7 8.5	6.3 7	10 10.5	5.5	....	27 21.5	Fig. 2 ..
Ogden Canyon, Utah, Sta. 22	27.5	9	7	15	6	...	26	Fig. 7
Near Logan, Utah, Sta. 41	19.5	5.8	5	9	. .	22	19	Fig. 4
Form *tooelensis,* Station 10	17	7	5	7.5	3.6	.	22	Pl. 21 Fig. 5
Oquirrh Mts., Station 13	23	8	7	13.5	6.6	22	25	Pl. 21 Fig. 7
Provo, Utah, Station 44	20.5	8.5	7.5	7	6.5	.	23	Pl. 20 Fig. 8

Oreohelix hendersoni Pils. Pl. 20, fig. 7.

The length of the penis is three-fourths of the diameter of the shell. Its internally costate segment is one-third the total length, and the distal papillose portion is somewhat flattened. Length of the epiphallus is contained $2\frac{2}{3}$ times in that of the penis. The penial retractor muscle is shorter than usual in *P. strigosa depressa.*

The lower third of the spermatheca duct is large, then abruptly contracting. There is a general similarity with the genitalia of *O. s. depressa*. Measurements in mm. follow. Length of penis 12, of its costate lower portion 4; epiphallus 4.5; penial retractor 4; vagina 4; spermatheca and duct 10.5; diam. of shell 16 mm.

The three areas of the radula appear distinct, in a slightly enlarged view, the rows of marginal teeth being oblique. In most Oreohelices the areas are not well marked. The central tooth and laterals have rudimentary side cusps. Formula 16, 12, 1, 12, 16. Text fig. 1*b*. By the forms of the individual teeth and the more distinct differentiation of areas in the radula, this species differs from the *strigosa* series.

Oreohelix haydeni (Gabb). Pl. 21, figs. 1, 2, 4, 8.

O. haydeni does not differ from *O. strigosa depressa* in any important or diagnostic characters of the genitalia or dentition, but the features of the shell seem quite sufficient to give it specific rank.

The typical form, from Weber Canyon in the Wasatch Range, has not been collected alive so far as I know. The forms examined agree pretty closely in soft anatomy. The internally costate part of the penis is about one-third of the total length. The distal portion collapses flat. The penial retractor is decidedly shorter in subsp. *corrugata* and *hybrida* than in subsp. *betheli* and *gabbiana*. This is probably not a character of much importance. The retractor is sometimes continued in the lung floor for some distance, as in pl. 21, figs. 2 and 8. Only the free part is measured in the table. In *hybrida* the penis is more twisted than in the other forms, at least in the individual dissected. In all the forms, the distal part of the penis collapses more or less flat. *O. h. betheli* has four unequal ribs in the lower part.

	Length of penis.	Length of costate part of penis.	Length of epiphallus.	Length of penial retractor muscle.	Length of vagina.	Length of spermatheca and duct.	Approximate diameter of shell.	Plate 21.
O. h. betheli	19	6	18+	7.5	21	.....	5	Fig. 2
O. h. gabbiana	16	6	11	5.5	..	.....	5.5	Fig. 1
O. h. corrugata	16.5	5	7	5	17	.....	5	Fig. 4
O. h. hybrida	16	4	5	4	15	....	5	Fig. 8

In *O. h. betheli* and *O. h. corrugata* the central and inner lateral teeth are unicuspid, but there are narrow, cutting edges overhanging from the central cusps, in place of side cusps.

Oreohelix haydeni mixta n. subsp.

The shell is whitish with the early whorls clay color (the last whorl sometimes having two narrow brown bands, the upper one ascending the spire). Sculpture often equal, rather fine, deeply cut growth-wrinkles, cut by spiral engraved lines, unequally developed, and on the base often grouped so as to leave spiral bands of long granules at intervals. Periphery angular or subangular in front, becoming rounded on the rest of the last whorl. Embryonic shell having irregular radial ripples, and the usual very fine spiral striation; on the last whorl some coarse spirals; peripheral carina strongly pinched out.

Height 18.3, diam. 12 mm.; umbilicus 3.6 mm.

The genitalia (pl. 21, fig. 3) resemble the organs of *O. haydeni* in proportions, the internally ribbed part of the penis being less than half of the total length, but thicker than in *haydeni*, perhaps an individual feature. The distal part has a somewhat trefoil section. It differs from *O. cooperi* by the longer penis relative to the diameter of the shell, its length being about equal to the diameter in this form, but decidedly less in all of the *cooperi* I have measured. The internally costate part is relatively shorter than in *cooperi*.

Glenwood Springs, Colorado, on the bluff above the Hotel Colorado, among oak leaves and debris on a sandstone and shale ledge above station of *O. h. betheli*. Type No. 94,058 A. N. S. P. (from No. 447 of Prof. Ellsworth Bethel, 1907).

Another lot from Mr. Bethel, No. 94,796, consists of individuals like the above lot, with others having two narrow spiral lines in the usual *cooperi* positions. One of this lot (whether banded or plain not known) was dissected, pl. 22, fig. 5. It agrees with the type in proportions of the penis, but the penial retractor and the vagina are shorter. Measurements of the genitalia in mm. follow.

Mus. No.	Length of penis.	Length of internally ribbed part of penis.	Length of epiphallus.	Length of penial retractor.	Length of vagina.	Diameter of shell.
94,058....	18	6.8	6.3	18	9	18.3
94,796....	17.5	7.7	6	8	6	about 18

This is the form which was at one time identified as *O. haydeni gabbiana*. It resembles *O. h. hybrida* very closely, but the embryonic stage differs. The last embryonic whorl is not so convex in *mixta*, and its major spirals are more distinct and the radial ripples are more irregular. The carina is decidedly more prominent, and the whorl as a whole is distinctly more depressed. It is likely that *hybrida* and *mixta* are independent forms of the *haydeni* stock, or perhaps separated relics of a pro-haydeni race.

Some specimens have much the appearance of *cooperi*, but the genitalia show that there is no real connection. There is large individual variation in the height of the spire.

The embryonic shell of *O. h. gabbiana* has stronger spirals both above and below near the end of the last embryonic whorl; its periphery is less pinched out, and it is less depressed. The adult *gabbiana* is usually more strongly angular or keeled.

Oreohelix peripherica (Ancey). Pl. 20, figs. 1 to 6.

In genitalia this species does not differ materially from *O. strigosa depressa* (*b*) and *O. haydeni*. The internally costate part of the penis is less than half of the total length, usually slightly over a third. The internally papillose distal portion usually collapses flat, but one specimen from Station 30 and one from 36 there are weak indications of a third ridge. The cylindric lower part of the penis has 5 or 6 longitudinal ribs within.

Many specimens were opened, from various localities, and including nearly smooth, fine-ribbed and coarse-ribbed, white and banded individuals. Except in size, there is very little variation.

Measurements, in mm., of the genitalia of Oreohelix peripherica.

Locality.	Length of penis.	Length of costate part of penis.	Length of epiphallus.	Length of penial retractor.	Length of vagina.	Length of spermatheca and duct.	Approximate diameter of shell.	Plate 20.
Station 26	18.5	6	4	.....	.....	.....	18–20	Fig. 4
Station 26	16	6	5.5	8.5	.....	.....	.....	.....
Station 29	18.5	7.2	6	.....	5.5	18	18–25	Fig. 3
Station 30	14	6.5	4	5.5	4.5	.....	.....	Fig. 6
Station 33 (White)	18	8	4	11.5	6.6	18	195–20	Fig. 2
Station 33 (Banded)	18	6.5	4.5	10	6	21	20	Fig. 1
Station 36	21	7.5	5	13.5	6.5	23.5	20	Fig. 5

The central and inner lateral teeth have no side cusps. There are about 12 lateral teeth on each side (Station 30). In an individual from Station 36 there are 17, 13, 1, 13, 17 teeth. The transition from lateral to marginal teeth is very gradual in this species, so that the exact number of laterals is somewhat uncertain.

Oreohelix rugosa (Hemphill). Pl. 22, figs. 7, 7*a*.

The penis is about two-thirds the diameter of the shell, therefore shorter than in any form of *O. s. depressa* examined. Its internally costate lower portion is relatively decidedly longer than in *O. s. depressa*, being over half the total length, agreeing with that of *O. cooperi*. Inside the lower part has 5 or 6 fleshy ribs, smooth, as usual, and the upper part has about the same number, but they are lower, and both ribs and intervals are papillose. The duct of the spermatheca is longer than in *O. s. depressa*. Two individuals measure:

Length of penis.	Length of costate part of penis.	Length of epiphallus	Length of penial retractor.	Length of vagina.	Length of spermatheca and duct.	Diameter of shell.
16	11	6	.....	6	29	24.5
16	10	6.2	7.6	. . .	.	.....

There are about 13 lateral teeth on each side, the inner 9 to 11 without side cusps. The transition to marginals is very gradual.

Oreohelix cooperi (W. G. B.). Pl. 22, figs. 1, 2, 3, 4.

Specimens from Wyoming, Utah, Colorado and New Mexico have been dissected. All agree in having the internally costate part of the penis longer than the papillose part, which at once differentiates the species from *O. strigosa* and *O. peripherica*, in which the costate part is much shorter than the papillose part. The penial retractor is short, less than half the length of the penis in the smaller specimens, but about two-thirds the length of penis in the large forms from Yellowstone Park and New Mexico. The median part of the penis is often somewhat swollen, but in other examples this is not noticeable.

The penis has usually four main fleshy ridges in the lower part as in specimens from McCammon, Idaho (fig. 2), and the Black Range of New Mexico, or there may be about 6 unequal ridges (fig. 1, Yellowstone Park, No. 96,973), one of them continuing upwards

further than the others. In the Black Range form the ribbed portion projects upwards into the cavity of the papillose part.

Measurements in mm., of the genitalia of Oreohelix cooperi.

Locality.	Length of penis.	Length of costate part of penis.	Length of epiphallus.	Length of penial retractor.	Length of vagina.	Length of spermatheca and duct.	Approximate diameter of shell.	Plate.
Gleneyre, Colo., 7,000 ft. 82,185	8.6	4.6	4.3	2.4	2	11	16–18	Fig. 3
McCammon, Idaho, Station 1	12	7.5	5.5	5.3	3.7	21	22	Fig. 2
Eureka, Utah, Station 6	12	6.5	5	4	3.7	...	15–16	Fig. 4
O. cooperi maxima. Yellowstone Park, 96,973	14.5	8.7	5	10	5	24	26	Fig. 1
Black Range, N. M. Sta. 26	15.5	9	5	9	5	.....	.....	.....

Oreohelix yavapai extremitatis Pils. & Ferr. Pl. 22, figs. 6, 6*a*.

The specimen figured is from Shell, Wyoming (Pilsbry, Nautilus XXVII, 1913, p. 50). The penis is short, its lower two-thirds swollen, upper third cylindric; internally there are very low, short folds bounded above by a low narrow transverse ridge, in the enlarged part, the upper part having densely papillose walls. Fig. 6*a* represents the penis opened and pinned flat. The papillæ in the upper portion are represented diagrammatically. The epiphallus is not quite half as long as the penis. The base of the spermatheca duct is enlarged, as usual. The uterus contained 8 embryos in the individual figured, the largest of $2\frac{1}{3}$ whorls. Length of penis 7 mm., of its internally costate part 4.5; epiphallus 3.3 mm.; vagina 2 mm.; spermatheca and duct 13 mm.

The central and 5 or 6 inner lateral teeth have no side cusps. The seventh lateral has a well developed ectocone.

The jaw is striate as usual in the genus.

The animal is purplish black above and on the sides, the sole cream colored.

The embryonic shell has $2\frac{1}{3}$ whorls, is convex above with an angular, not acute, periphery. The first $1\frac{1}{2}$ whorls are convex with irregular growth striæ, some microscopic spirals then appearing. The last third of a whorl has about 5 coarse but very low spirals, and the

cuticle, under a high power, is seen to be minutely crinkled, also on the base.

Oreohelix concentrata (Dall). Pl. 22, fig. 9.

The specimen figured is No. 94,343 A. N. S. P., from Miller's Peak, Huachuca Mts., Arizona. The penis is swollen below the middle, length 8 mm., length of internally costate part 4.5 mm.; of epiphallus 4 mm.; of vagina about 3.6 mm. Diameter of the shell 15.5 mm.

This agrees substantially with the large form of the same district, *O. c.* form *huachucana* (Pilsbry, Proc. A. N. S. Phila. 1905, p. 275, pl. 19, fig. 6). Both differ from *O. strigosa* by the swollen penis and relatively larger costate portion, which occupies more than half the total length, as in *O. cooperi*. My former reference of *concentrata* and *huachucana* to *O. strigosa* as subspecies was clearly erroneous, and due to the fact that I had not dissected enough *Oreohelices* to appreciate their specific characters. In the general discussion of the anatomy (Proc. A. N. S. Phila. 1905, p. 271), *O. strigosa* and *huachucana* were put in separate divisions.

Oreohelix metcalfei Ckll. Pl. 22, fig. 10.

Collected in abundance by Mr. Ferriss and the writer, in the Black Range, New Mexico. The penis resembles that of *O. concentrata* and *O. pilsbryi*, the median portion being much swollen, with very thick walls, and broad, longitudinal ribs inside. The much narrower, twisted upper portion has coarse papillæ within, and one longitudinal papillose rib. Length of penis 12 mm., of its internally costate portion 7 mm.; of epiphallus 4 mm.; vagina 4 mm. Diameter of the shell 19.5 mm.

The radula has 12 lateral teeth on each side, like those of *O. s. depressa* except that the cusps are more slender.

Oreohelix pilsbryi Ferriss. Pl. 22, fig. 8.

Genitalia about as in *O. metcalfei*. The swollen part of the penis has about 6 unequal ribs within; these project slightly into the cavity of the papillose portion, which has one longitudinal rib. Length of penis 12, of the ribbed portion 7 mm.; epiphallus 4 mm.; penial retractor 4 mm.; vagina 4 mm.; spermatheca and duct 15 mm. Diameter of the shell 17.6 mm.

Although the shell of *O. pilsbryi* has an astonishing similarity to that of *O. haydeni*, the genitalia show that there is no direct relationship. *O. metcalfei* is closely related to *pilsbryi*, being anatomically indistinguishable.

CATALOGUE OF SPECIES, SUBSPECIES, AND OTHER NAMED FORMS.

Note.—An asterisk (*) following a specific or varietal name indicates that a figure of the genitalia has been published by the writer, and serves to show what species and subspecies require examination. Several other subspecies of the Arizonian species have been dissected but not figured.

O. IDAHOENSIS (Newc.). Coeur d'Alene district, Idaho.
O. COOPERI (W. G. B.).* Black Hills, S. Dakota; (Rocky Mountains).
Forms *trifasciata* Ckll., Mesa Co., Colo.; *confluens* Ckll., Garfield and Mesa Cos., Colo.; *elevata* Ckll., Delta Co., Colo.; *typica* Ckll., Colo.; *minor* Ckll., Rouett Co., Colo.; *iowensis* Pils., Loess of Iowa; *maxima* Pils.,* Yellowstone Park.
O. c. stantoni Dall. Assiniboia.
O. c. globosula Ckll. Summit Co., Colo. (Syn. *globulosa* Pils.).
O. c. berryi Pils. Snowy Mts., Fergus Co., Mont.
O. RUGOSA (Hemph.).* Near Brigham City, Utah.
O. PERIPHERICA (Ancey).* Bear River region, Northern Utah. (Syn., *multicostata*, Hemph.)
Forms *binneyi*, *castanea*, *albofasciata*, *gouldi* Hemph.
O. p. newcombi (Hemph.). Near Ogden, Utah.
O. p. wasatchensis (Hemph.). Near Ogden, Utah.
O. PYGMÆA Pils. Near Shell, Wyoming.
O. STRIGOSA (Gld.). "Interior of Oregon."
O. s. parma (Hemph.). Spokane Falls, Washington.
O. s. jugalis (Hemph.). Salmon River, Idaho.
O. s. intersum (Hemph.). Salmon River, Idaho.
O. s. limitaris (Dawson). Waterton Lake, Montana-Alberta boundary.
O. s. alpina Elrod. Mission Range, Montana. (Syn.: *montana* Elrod.)
O. s. subcarinata (Hemph.). Rathdrum, Idaho.
Forms *lactea*, *bicolor* and *picta* Hemph. Same colony.
O. s. depressa (Ckll.).* Near Durango, Colo.; (Southern Idaho to northern Arizona, Colo., New Mexico).
Form *major* Ckll. Mesa Co., Colo.
" *sinistrorsa* Ckll., Colorado.
" *carnea* Hemph.* Near Salt Lake City, Utah.
" *albida* Hemph. Near Logan, Utah. (? Syn., *Patula strigosa* var. *alba* Ckll., preoc.).
" *tooelensis* Hend. and Dan.* Near Tooele, Utah.
O. s. fragilis (Hemph.).* Near Franklin, Idaho.
O. s. buttoni (Hemph.).* Box Elder Co., Utah; also near Ogden.
O. s. magnicornu Pils. Big Horn Mts., Wyoming.
O. HENDERSONI Pils.* Little Thompson Creek, 10 miles N. W. of Longmont, Colo.
O. h. dakani Hend. New Castle, Colo. (? = *rugosa* Hemph.).

O. HAYDENI (Gabb.). Weber canyon, Utah.
O. h. oquirrhensis (Hemph.). Oquirrh Mountains, Utah.
O. h. gabbiana (Hemph.).* Oquirrh Mountains, Utah.
O. h. utahensis (Hemph.). Oquirrh Mountains, Utah.
O. h. corrugata Hend. and Dan.* Small, nearly isolated mountain, southeast of Webster, Utah.
O. h. hybrida (Hemph.).* Near Logan, Utah.
O. h. betheli Pils. and Ckll.* Glenwood Springs, Colorado.
Form *alta* Pils. and Ckll. Glenwood Springs, Colorado.
O. h. mixta Pils.* Glenwood Springs, Colorado.
O. HEMPHILLI (Newc.). White Pine mining district, Nevada.
O. h. eurekensis Hend. and Dan. Eureka, Utah.
O. TENUISTRIATA Hend. and Dan. Between McCammon and Hot Lava Springs, Idaho.
O. CARINIFERA Pils. Garrison, Montana.
O. BRUNERI (Ancey). Montana. (Not seen by the author, and unknown in American collections.)
O. ELRODI Pils.* MacDonald Lake, Mission Range, Montana.
O. YAVAPAI Pils.* Yavapai Co., Arizona, etc.
O. y. neomexicana Pils.* San Miguel Co., New Mexico.
O. y. compactula Ckll. Pecos canyon, New Mexico.
O. y. extremitatis Pils. and Ferr.* Grand Canyon, Ariz.; also northern Wyoming.
O. y. angelica Pils. and Ferr. Grand Canyon, Arizona.
O. y. profundorum Pils. and Ferr. Grand Canyon, Arizona.
O. y. mariæ Bartsch. Squaw Creek, near mouth Gallatin Canyon, Montana.
O. CONCENTRATA (Dall).* Huachuca Range, Arizona.
Form huachucana Pils.* Huachuca Range, Arizona.
O. METCALFEI Ckll.* Black Range, New Mexico.
O. PILSBRYI Ferriss.* Mineral Creek, Chloride, Sierra Co., New Mexico.
O. BARBATA Pils.* Chiricahua Range, Arizona; also Mogollon Range, N. M.
O. b. minima Pils. and Ferr. Chiricahua Range, Arizona.
O. SOCORROENSIS Pils. Socorro Co., New Mexico.

Subgenus *Radiocentrum* Pils.

O. AVALONENSIS Hemph. Catalina Island, California.
O. CHIRICAHUANA Pils.* Cave Creek Canyon, near the cave, Chiricahua Range, Arizona.
O. c. percarinata Pils. and Ferr. Big Emigrant Canyon, and Paradise Canyon, Chiricahua Range, Arizona.
O. c. obsoleta Pils. and Ferr. White Tail Canyon, Chiricahua Range, Arizona.
O. CLAPPI Ferriss.* Cave Creek, etc., Chiricahua Range, Arizona.
O. c. emigrans Pils. and Ferr. Big Emigrant Canyon, Chiricahuas.
O. c. cataracta Pils. and Ferr. Falls of Cave Creek, Chiricahuas.

O. FERRISSI Pils.* Near mouth of Sheridan Canyon, Big Hachet Mountains, New Mexico.
O. f. morticina Pils. Daniels Peak, Big Hachet Mts., New Mexico.
O. HACHETANA Pils.* Summit of Big Hachet Mt., New Mexico.
O. h. cadaver Pils. Daniels Peak, Big Hachet Mts., N. M.

NOTES ON THE PRECEDING LIST.

In presenting a new catalogue of a genus wherein specific values have been so variously estimated, a brief consideration of the growth and changes of opinion on the subject may be in order. In their work of 1869, Binney and Bland recognized *Helix strigosa, H. cooperi* and *H. idahoensis* as species, no others being then known. In 1878 (Terrestrial Mollusks, Vol. 5) Mr. Binney added *H. haydeni* and *H. hemphilli,* and reduced *cooperi* to a variety of *strigosa.* In his latest general work, Manual of American Land Shells, 1885, Mr. Binney reduced *haydeni* to the rank of a variety of *strigosa.* After this, the remarkable series from Idaho and Utah collected by Henry Hemphill caused Binney to view the entire series of known forms as varieties of *strigosa.* This view was generally accepted, as Mr. Binney was conceded to be the leading authority of his time on American land snails. Mr. Hemphill went further than Binney, ranking the whole group as varieties of the Eastern *H. alternata* Say.

It may be noted here that a relatively small number of species, from only a part of the area of the genus, were known to Binney and Hemphill. The last 15 species of the list given above were unknown at that time. This includes the whole southern group of species having swollen penes and the *Radiocentrum* group (with one exception), besides various lately discovered northern forms of very distinct appearance. In dealing with the species and other forms described prior to 1890 we return to Binney's earlier opinion, and regard *strigosa, cooperi, idahoensis, haydeni* and *hemphilli* as species. *O. peripherica* and *O. hendersoni,* while near *strigosa,* seem to be sufficiently detached to be considered species. *O. rugosa,* though near *cooperi,* is for the time given specific rank. Both of these differ specifically from *strigosa* by the genitalia.

Many of the *subspecies* now recognized were already defined by Binney and Hemphill as varieties of *strigosa.* If the criterion of intergradation with other forms were rigorously applied to them, several would be judged species; yet in actual practice, and as a temporary expedient until the territory is more fully explored, we take the degree of differentiation into the account. In dealing with the forms of single colonies, scattered over a great extent of

unexplored country, our present conclusions must be mere approximations to the facts, which future exploration may be expected to bring out. In treating of forms which are in doubt it seems to me better to attach them as subspecies to a known species, rather than to increase the number of ill-defined species. Oreohelices sometimes have strongly marked conchological features, but when this is not the case, species should not be established in my opinion, without anatomical examination. It seems likely that some forms now considered subspecies of *O. strigosa* will be elevated to specific rank when their areas are well explored, and their soft anatomy worked out.

The "*forms*" of the list above are of unequal value, but all are inserted in order that all names proposed may appear in the list. Some of them are mere synonyms; some are color or size forms, from heterogeneous colonies, in which several mutations are perpetuated in hybrid populations,[5] such as I have described in *Achatinella*.[6] Others are races probably deserving recognition in nomenclature. Much more study must be put on *Oreohelix* before we can confidently assign all the forms to their approximately proper rank.

O. cooperi (W. G. B.). No serious study of the races and forms of this wide-spread species has recently been made. Many years ago Professor Cockerell proposed several varietal names, but in the absence of figures, the application of some of them, as well as their status, has been uncertain. A recent communication from Professor Cockerell quoted below, elucidates them so far as possible in the present condition of the subject.

(1) *typica* = *O. cooperi s. str.*
(2) *confluens.* (3) *trifasciata.* Color (band) variations of *cooperi*, common and well known to us here. Not in any sense special races. Type specimen of *confluens* is in U. S. N. M.
(4) *elevata.* A form of *cooperi* with more elevated spire. Merely an extreme of the ordinary variation of the species; *not* a race.
(5) *minor.* The name was originally given in Nautilus May, 1889, p. 8, and referred to a small form cited by Hemphill. Later I found what I considered to be the same in Colorado, apparently a distinct race. Henderson has used the name for a race in recent years. Now we are both uncertain whether the name should be applied in this sense. It is a fact that in certain localities the shells are small and constitute a "minor" race, but whether all the various colonies of this type have any connection with one another may be questioned. The original *intention* was to follow the European custom, and call all the shells below a certain size *minor*, not regarding the variety as a race or subspecies in any sense. Henderson and I, after consultation, agree that the status of *minor* must be considered subject to revision.
(6) *globosula.* This we have, and can recognize it as a peculiar variation which occurs in the Glenwood Springs district. It occurs in small numbers on the south side of the river, along with the other forms. It may be a hybrid of

[5] See the valuable observations of Daniels, Nautilus XXV, 1911, p. 18.
[6] Manual of Conchology, Vol. XXII.

some sort. It does not seem to be a distinct race or subspecies, but it is not found in other parts of the state so far as we know. The type locality is some distance from the Glenwood Springs locality, but a *wide* range does not appear probable. We can affirm, I think, that this is not a mere variation of the ordinary type, such as *confluens*, etc.; but whether it is a distinct race may well be doubted. Further research is needed.

(7) *depressa*. This you know well.

(8) *major*. Simply a large *depressa;* not a race.

(9) *sinistrorsa*. Sinistral examples. (Brit. Naturalist.)

Thus, only two names are at all doubtful, and here the doubt is essentially one as to the facts of nature rather than of nomenclature. (Theo. D. A. Cockerell.)

O. cooperi form *maxima* is a shell with about the typical shape of *cooperi*, but of large size, the type measuring, alt. 17.6, diam. 26 mm., umbilicus 5 mm., whorls $5\frac{1}{2}$, more rounded than in *O. strigosa depressa*. There is a band at, another above the periphery, and below the suture a wider, paler one interrupted into maculæ. Genitalia, pl. 22, fig. 1, normal for *cooperi*.

The type is from Yellowstone National Park 10 miles southwest of Jardine, Montana, No. 96,973 A. N. S. P., collected by E. M. Kindle. Other specimens are from Grade Canyon near Cokeville, Uinta Co., Wyoming, collected by Mr. J. A. G. Rehn. One of these measures alt. 17.7, diam. 26 mm. In addition to the markings described above, it has a few faint brown circular lines on the base.

Form *iowensis* Pils. is quite small, height 7.7, diam. 11.4, umbilicus 2.6 mm., with $4\frac{3}{4}$ whorls. There is a reddish band just under the periphery, and the initial whorl is very convex and smooth. It is from the loess, type-locality, Iowa City, Iowa. It probably stands close to *stantoni*, which still exists in an environment perhaps not very unlike the loess climate of Iowa.

O. p. wasatchensis is so peculiarly modified that one is strongly inclined to give it specific rank. The elevated spire, the compactly coiled whorls and the peripheral carina all differentiate it from *O. peripherica*. Yet *O. p. newcombii* stands almost intermediate between *wasatchensis* and *peripherica*. It does not differ from the coarsest examples of the latter in form or ribbing, but it has a delicate peripheral keel which continues as far, usually, as the last whorl, whereas *O. peripherica* has no keel in the later neanic and the adult stages. Possibly both *newcombi* and *wasatchensis* may eventually be ranked as species; but until further collections can be made, I leave them associated with *O. peripherica*, with the note that at present we do not have actual evidence of intergradation.

In this connection we may allude to the status of *O. pygmæa*, which may turn out to be a subspecies of *O. peripherica;* yet here again, evidence of intergradation is wanting.

Explanation of Plates XIX, XX, XXI, XXII.

Note.—The "stations" referred to are those of Messrs. Henderson and Daniels Expedition of 1915.

Plate XIX.—Fig. 1.—*Oreohelix strigosa depressa* (Ckll.) Manitou Canyon, Colorado Springs, Colo.

Fig. 2.—*O. s. depressa* (Ckll.) Harkness Canyon, near McCammon, Idaho, Station 2.

Fig. 3.—*O. s. depressa* form *carnea* (Hemph.). Dry Canyon, near Salt Lake City, Utah, Station 43.

Fig. 4.—*O. s. depressa* (Ckll.). First gulch south of Logan Canyon, east of Logan, Utah, Station 41.

Fig. 5.—*O. s. fragilis* (Hemph.). About a mile west of Franklin, Idaho, Station 38. Penis only figured.

Fig. 6.—*O. s. depressa* (Ckll.). About a mile up Emigration Canyon, southeast of Salt Lake City, Utah, Station 46.

Fig. 7.—*O. s. depressa* (Ckll.). Ogden Canyon, Utah, Station 22.

Plate XX.—Fig. 1.—*Oreohelix peripherica* (Ancey). Ravine in east bluff of Bear River, just below Wheelon, Utah, Station 33, banded form. 1*a*, penis of same, pulled straight, with epiphallus.

Fig. 2.—*O. peripherica* (Anc.). Same station, white form.

Fig. 3.—*O. peripherica* (Anc.). East bank of Bear River below Cache Junction, Utah, Station 29. 3*a*, penis of same, opened to show internal structure.

Fig. 4.—*O. peripherica* (Anc.). Gulch opening into North Ogden Canyon, Station 26. A relatively smooth specimen.

Fig. 5.—*O. peripherica* (Anc.). Mountain northeast of Newton, Utah, Station 36. Smooth form of the species.

Fig. 6.—*O. peripherica* (Anc.). East bank of Bear River, below Cache Junction, Utah, Station 30.

Fig. 7.—*Oreohelix hendersoni* Pils., one of the original lot.

Fig. 8.—*Oreohelix strigosa depressa* (Ckll.). Rock Canyon, east of Provo, Utah, Station 44.

Plate XXI.—Fig. 1.—*Oreohelix haydeni gabbiana* (Hemph.). Oquirrh Mts., Station 15.

Fig. 2.—*Oreohelix haydeni betheli* Pils. and Ckll. Glenwood Springs, Colorado. No. 94,059 A. N. S. P.

Fig. 3.—*O. haydeni mixta* Pils. Glenwood Springs, Colorado. No. 94,058 A. N. S. P.

Fig. 4.—*Oreohelix haydeni corrugata* Hend. and Dan. Small mountain southeast of Webster, Utah, Station 40.

Fig. 5.—*Oreohelix s. depressa*, form *tooelensis* Hend. and Dan. About 6 miles northeast of Tooele, Utah, Station 10.

Fig. 6.—*Oreohelix strigosa buttoni* (Hemph.). Taylor Canyon, near Ogden, Utah, Station 16.

Fig. 7.—*Oreohelix strigosa depressa* (Ckll.). Oquirrh Mountains, Utah, Station 13.

Fig. 8.—*Oreohelix haydeni hybrida* (Hemph.). Gulch south of Logan Canyon, Station 42.

Plate XXII.—Fig. 1.—*Oreohelix cooperi* (W. G. B.), form *maxima* Pils. Yellowstone National Park. No. 96,973 A. N. S. P.

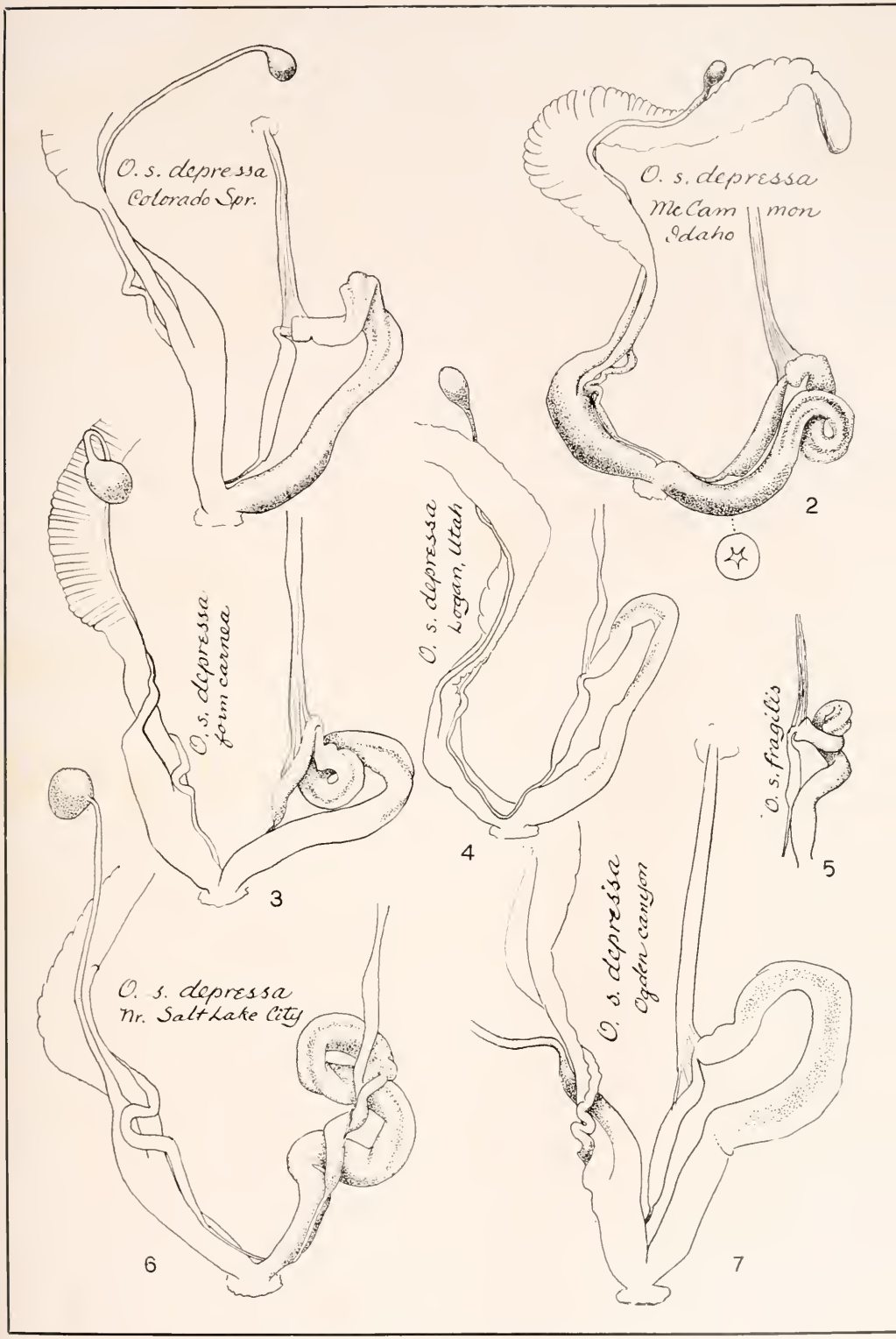
Fig. 2.—*O. cooperi* (W. G. B.). McCammon, Idaho, Station 1.

Fig. 3.—*O. cooperi* (W. G. B.). Gleneyre, Colorado. No. 82,185 A. N. S. P.

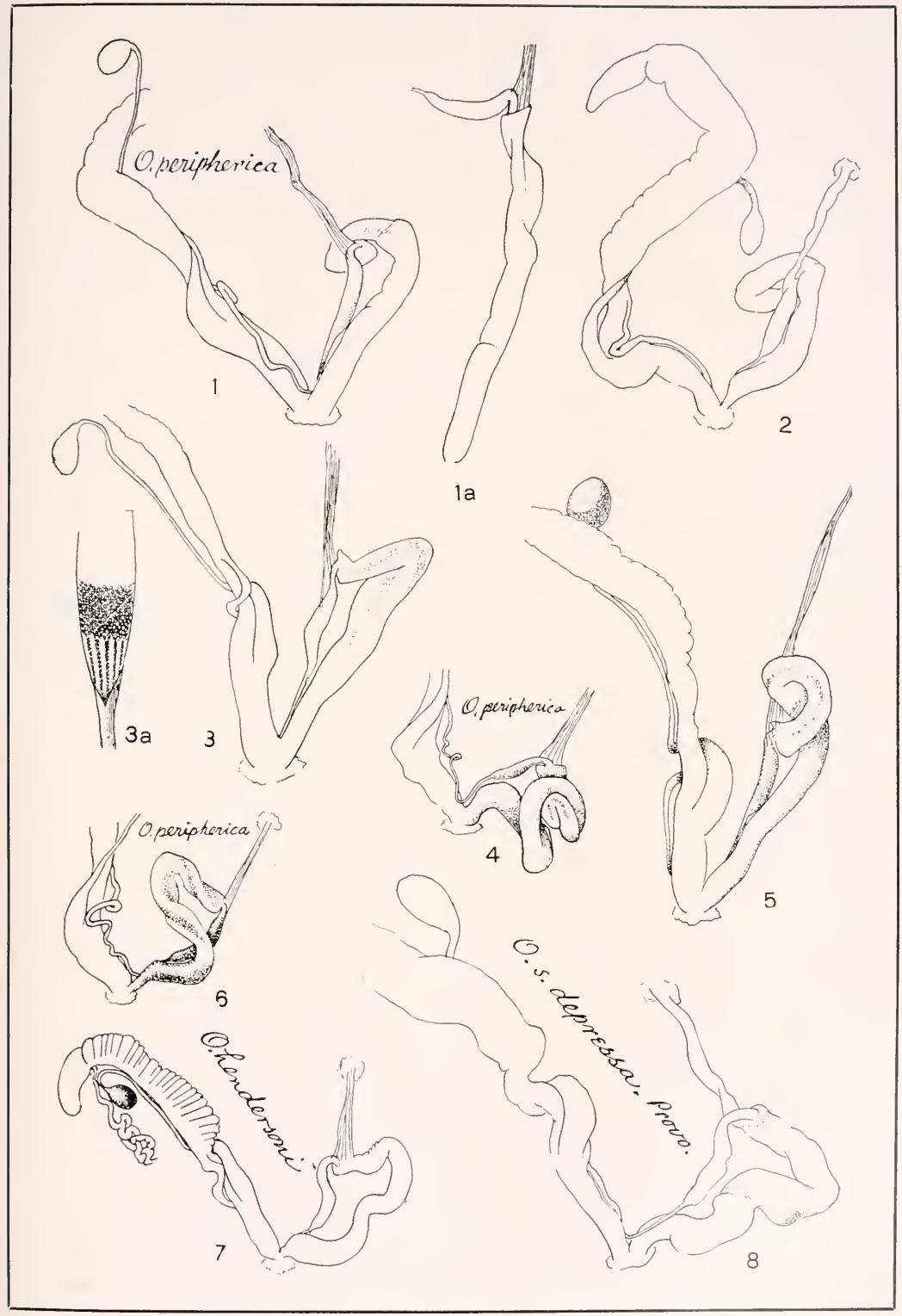
Fig. 4.—*O. cooperi* (W. G. B.). Eureka, Utah, Station 6.

Fig. 5.—*O. haydeni mixta* Pils. Glenwood Springs, Colorado. No. 94,796 A. N. S. P.

Fig. 6.—*Oreohelix yavapai extremitatis* Pils. and Ferr. Shell, Wyoming. 6*a*, penis of same, opened, with the epiphallus.



PILSBRY: ANATOMY OF OREOHELIX.



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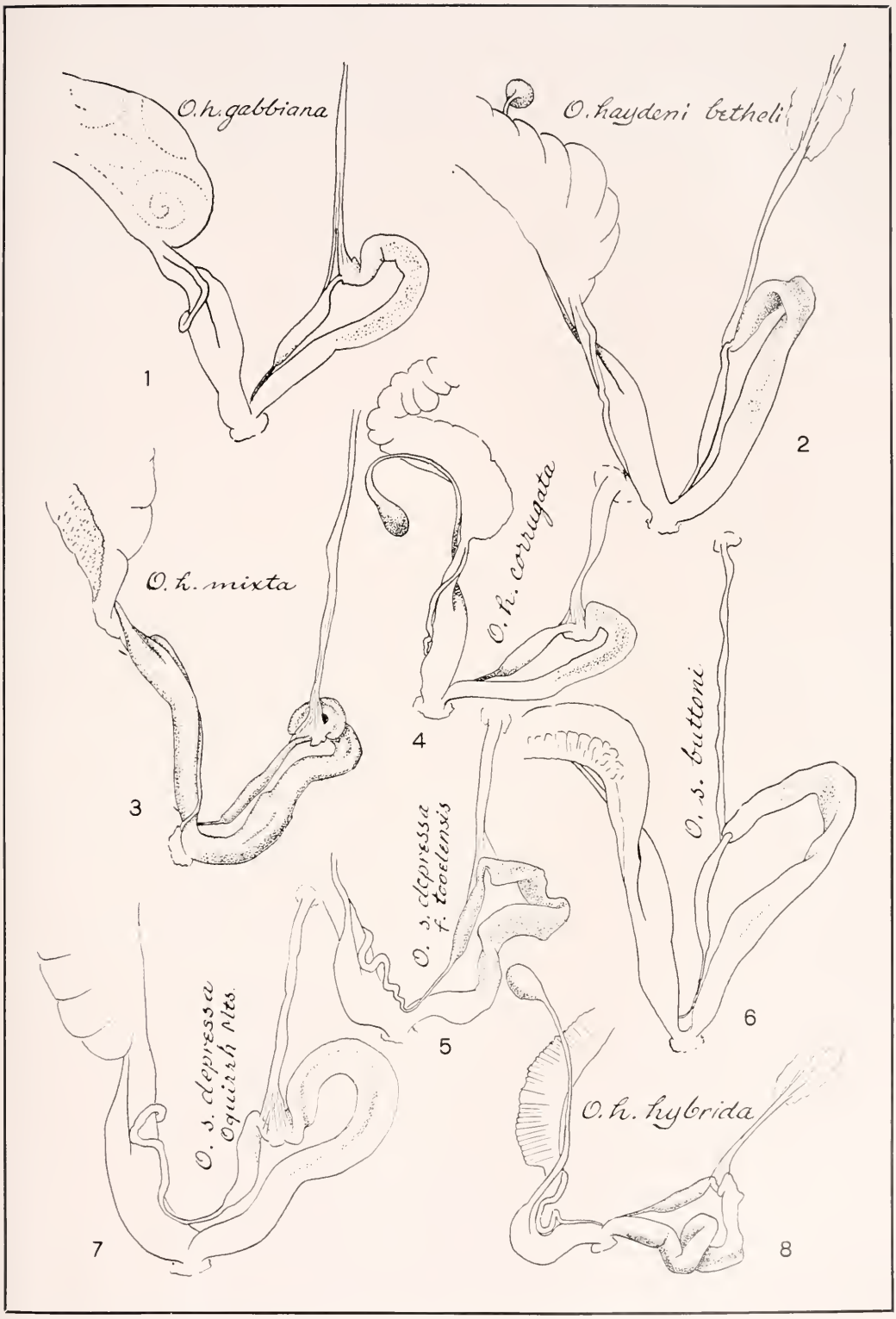

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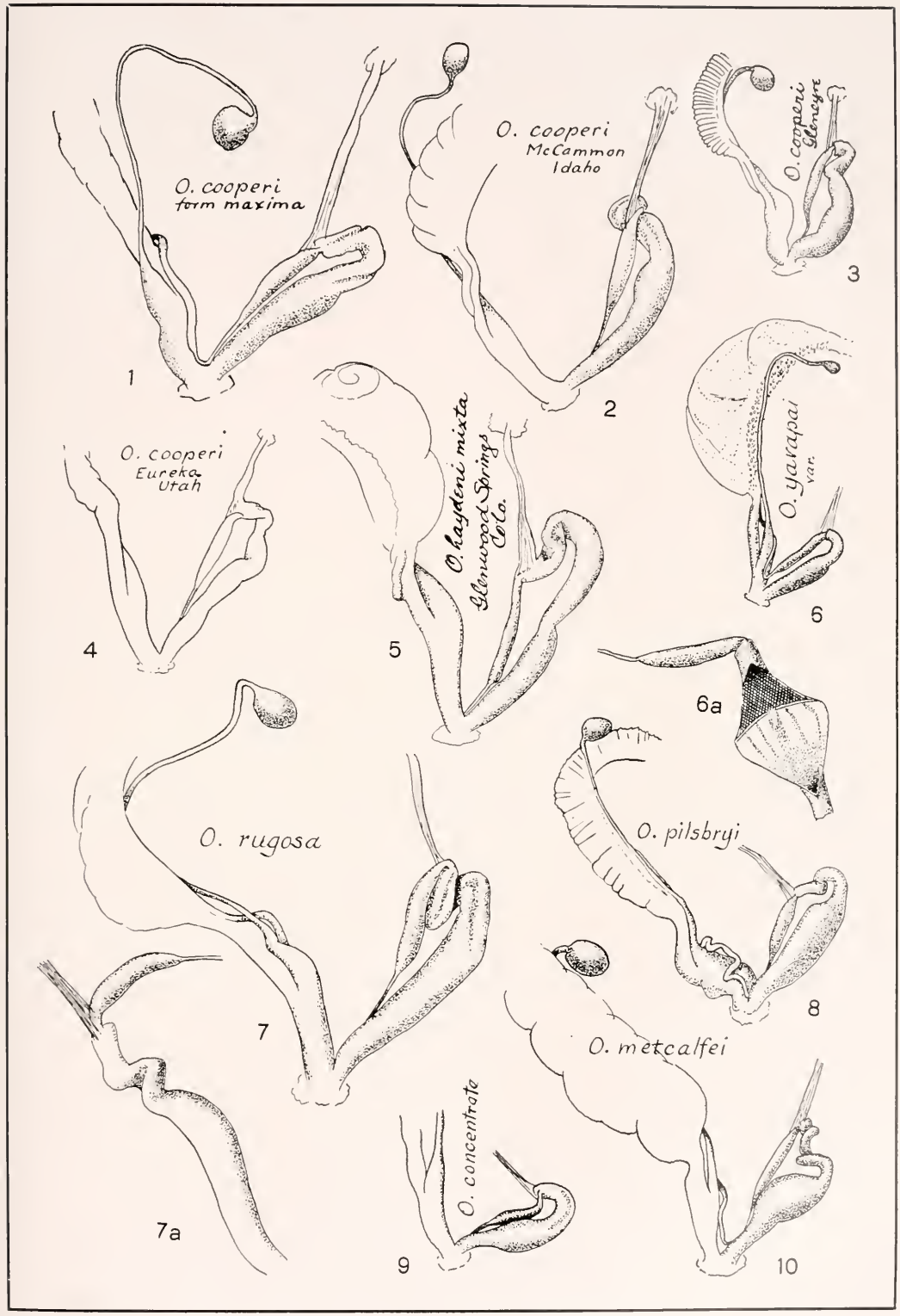

PILSBRY: ANATOMY OF OREOHELIX.

Fig. 7.—*Oreohelix rugosa* (Hemph.). Near Clarkston, Utah, Station 3. 7*a*, penis of same, pulled straight.
Fig. 8.—*Oreohelix pilsbryi* Ferriss. Type-specimen.
Fig. 9.—*Oreohelix concentrata* (Dall). Huachuca Mts., Arizona. No. 94,343 A. N. S. P.
Fig. 10.—*Oreohelix metcalfei* Ckll. Black Range, New Mexico, Pilsbry and Ferriss, Station 15, 1915.

SOME BEES FROM AUSTRALIA, TASMANIA, AND THE NEW HEBRIDES.

BY T. D. A. COCKERELL.

In a paper published in PROC. ACAD. NAT. SCI. PHILA., 1913 (pp. 28–44), I gave a summary of the then known bee-fauna of Australia. During the last two years additional material has come to hand, and the present paper represents the completion of the later work, so far as the material now available permits.

Perhaps the most interesting problem now before us in connection with the new collections is that of the radical difference between the bee-faunæ of Tasmania and New Zealand. It becomes increasingly evident that while Tasmania is very poor in genera as compared with the Australian mainland, it is extremely rich in species in comparison with New Zealand. There can be no doubt that careful collecting in New Zealand will yield a number of additional species, but it is impossible to believe that it will at all approach Tasmania in the extent of its bee-fauna. The Tasmanian bees are very close to those of Australia, and many are even identical, showing clearly the derivation of the fauna. The New Zealand fauna is also wholly of Australian type, but extremely poor in genera and species. Isolation has prevented the accession of species from across the water, but one would expect a much greater development of endemic forms, something more or less parallel with the condition in the Hawaiian Islands. The New Zealand species are all endemic; *Prosopis vicina* Sichel was said to occur in Tasmania and New Zealand, but it was almost certainly based on a mixture, and the name is to be restricted to the New Zealand species. "*Andrena*" *infima* Erichs., from Tasmania, is probably, but not certainly, *Halictus lanarius* Smith. Mr. Meade-Waldo of the British Museum agrees with me that *Paracolletes providus* Sm. is *P. chalybeatus* Erichs. The species which Smith called *chalybeatus* Mr. Meade-Waldo thinks should be united with *P. obscurus* Sm. With these amendments the lists for Tasmania and New Zealand stand as follows. The Tasmanian species also found on the Australian mainland are marked with an asterisk.

TASMANIA. (79 species.)

Prosopis alcyonea Erichs.*
honesta Sm.
hobartiana Ckll.
Prosopis perhumilis Ckll.*
xanthosphæra Ckll. (King I.)
accipitris Ckll.

Pachyprosopis flavicauda Ckll.*
Euryglossa walkeriana Ckll.
nigrocærulea Ckll.*
fasciatella Ckll.*
latissima Ckll.
nubilipennis Ckll.
Callomelitta picta Sm.*
littleri Ckll.
Binghamiella antipodes insularis Ckll.
Paracolletes chalybeatus Erichs.*
obscurus Sm.
viridicinctus Ckll.
obscuripennis Ckll.
hobartensis Ckll.
carinatus Sm.*
melbournensis Ckll.*
leai Ckll.
marginatus Sm.*
launcestonensis Ckll.
subviridis Ckll.
Nomia submærens Ckll.
Halictus orbatus Sm.*
cognatus Sm.
limatus Sm.
globosus Sm.
repræsentans Sm.*
furneauxi Ckll.
blighi Ckll.
bassi Ckll.
baudini Ckll.
boweni Ckll.
demissus Ckll.
imitans Ckll.*
seductus Ckll.*
semipolitus expulsus Ckll.
macrops Ckll.
Halictus confusellus Ckll.
familiaris Erichs.
warburtoni Ckll.
mitchelli Ckll.
burkei Ckll.
lanarius Sm.*
hæmatopus Ckll.
littleri Ckll.
cyclognathus Ckll.*
opacicollis Ckll.*
niveifrons Ckll.
disclusus Ckll.
isthmalis Ckll.
subinclinans Ckll.
pulvitectus Ckll.
tasmaniæ Ckll.
Parasphecodes tilachus Sm.
lithusca Sm.
talchius Sm.
stuchila Sm.
altichus Sm.
taluchis Sm.
recessus Ckll.
perustus Ckll.
rhodopterus Ckll.
rufotegularis Ckll.
cervicalis Ckll.
latissimus Ckll.
excultus Ckll.
wellingtoni Ckll.
turneri Ckll.
Megachile leucopyga Sm.
chrysopyga Sm.*
ordinaria Sm.
tasmanica Ckll.
Exoneura bicolor Sm.*
hamulata Ckll.*

NEW ZEALAND. (18 species.)

Prosopis agilis Sm.
agilis lævigata Sm.
capitosa Sm.
innocens Cam.
maoriana Ckll.
relegata Sm.
cameroni Ckll.
(*sulcifrons* Cam.)
vicina Sich.
Paracolletes boltoni Ckll.
confusus Ckll.
Paracolletes imitatus Sm.
fulvescens Sm.
metallicus Sm.
purpureus Sm.
vestitus Sm.
maorium Ckll.
Halictus huttoni Cam.
smithii D. T.
(*familiaris* Sm.)
sordidus Sm.

Pachyprosopis saturnina Ckll.

Perth, Australia, Feb. 1–7, 1914. (*R. E. Turner;* Brit. Museum). The markings vary; the yellow at anterior corners of mesothorax may be extended, curving round to make two bands on anterior part of disc; there may be a large yellow extension of lateral face-marks mesad of lower end of facial foveæ; the scutellum in the Perth form is practically all yellow.

Euryglossina hypochroma sp. n.

♀. Length about 3.75 mm.; robust, head and thorax shining black; abdomen dark, faintly purplish, above, but clear reddish-yellow below; legs clear yellowish-ferruginous, the anterior femora sometimes mainly black on outer side; mandibles chestnut red, dark at tip; a large yellowish spot on cheeks just above base of mandibles; clypeus and supraclypeal band fulvotestaceous (perhaps yellower in life); a very slender fulvous line running up inner orbits as far as facial foveæ; scape with a light stripe; flagellum thick, clear fulvous beneath; head large, subquadrate, front convex, shining; tubercles clear yellow; mesothorax shining, with extremely minute and sparse punctures, the disc microscopically cancellate; tegulæ testaceous; wings hyaline, nervures and the large stigma sepia; b. n. strongly arched; first r. n. joining first s. m.; second s. m. subquadrate; extreme apex of abdomen ferruginous.

Hab.—Perth, W. Australia, Feb. 1–7, 1914 (*R. E. Turner;* Brit. Museum.) 2 ♀ Allied to *E. perpusilla* (Ckll.), but larger and more robust, with fulvous clypeus, etc. It resembles *Pachyprosopis atromicans* Ckll., but is easily separated by the color of the femora, much smaller second s. m., etc.

Euryglossina flaviventris sp. n.

♀. (Type). Length about 3.75 mm.; head and thorax black; abdomen black with a faint purplish tint above, the venter clear yellow, the extreme lateral margins and the apex rather broadly (the light color more extensive than in *E. hypochroma*) also yellow; legs bright yellow, anterior femora sometimes marked with black, hind tibiæ and tarsi dark brown on outer side; mandibles fulvous; a small fulvous spot on cheeks next to base of mandibles; linear lateral face-marks as in *E. hypochroma;* upper half of clypeus, and a supraclypeal band yellow; antennæ fulvous beneath; front shining; mesothorax microscopically tessellate; tubercles yellow.

♂. Clypeus, supraclypeal area and comparatively broad lateral face-marks yellow, the pattern essentially as in *E. perpusilla;* the lateral face-marks have a small projection opposite antennæ.

Hab.—Mt. Yule, Healesville, Victoria, Feb. 20, 1915, on *Eucalyptus calophylla rosea*, 3 ♀, 1 ♂. (*R. Kelly;* Brit. Museum.) Very close to *E. hypochroma*, from which the female is known by the dark lower part of clypeus and the more broadly light apex of abdomen. Also very close to *E. perpusilla* Ckll., but larger, with more light color on abdomen. It may be better regarded as a subspecies of *E. perpusilla*, but it appears quite distinct.

Euryglossina perpusilla var. **nana** n. v.

♀. Length hardly 3 mm.; abdomen wholly dark above, yellow beneath; clypeus and supraclypeal area wholly black (as in *E. cockerelli* Perkins); linear lateral face-marks poorly developed or absent; stigma dilute sepia.

Hab.—Kalamunda, S. W. Australia, Feb. 9–28, 1914, 2 ♀; also one March 1–11, 1914, 850 ft. (*R. E. Turner;* Brit. Museum). Compared with typical *E. perpusilla*, this looks distinct; but the Queensland *perpusilla* are so variable that it seems impossible to distinguish more than a variety. Some Mackay females lack the supraclypeal band.

Binghamiella antipodes insularis (Ckll.).

Mr. Littler has taken both sexes of *Binghamiella* at George Town, Tasmania, March, 1915. The males agree with my *B. insularis;* the females are what has passed as *B. antipodes* from Tasmania, but have the same essential distinctive characters as the males. There is sufficient reason for regarding the Tasmanian bee as a subspecies, but hardly a species.

Euryglossa depressa sparsa subsp. n.

♀. Differs from *E. depressa* Sm. by the very sparsely though very strongly punctured scutellum, and the anterior middle of mesothorax with scattered irregular punctures, instead of very numerous fine ones; also by having the flagellum ferruginous beneath, though this is variable, and sometimes very obscure. It is readily known from *E. subsericea* Ckll. by the darker, brown-stained wings, facial quadrangle shorter, etc. The mesothorax and scutellum are much more sparsely punctured than in *E. nigrocærulea* Ckll.

Hab.—Mt. Yule, Healesville, Victoria, Feb. 20, 1915, on *Eucalyptus calophylla rosea*—(*R. Kelly;* Brit. Museum). 3 ♀. Smith's description is insufficient to indicate which is the typical race of *E. depressa*, but I have taken as such the form which appears to be common in Victoria.

Prosopis extensa sp. n.

♀. Length about 4 mm.; slender, with long metathorax and subclavate abdomen, looking like some small Pemphredonid wasp; black, the front with an extremely obscure greenish tint; the thorax dull, with the prothorax, pleura and posterior face of metathorax shining; abdomen shining; head not far from round in front view; mandibles, labrum, linear lateral face marks ending about level of antennæ, lower margin and greater part of disc of clypeus yellowish-ferruginous, the pale color on clypeus ending suffusedly above; labial palpi with the second joint remarkably short and stout, almost globose, the third and fourth cylindrical, the third twice as wide as the fourth; maxillary palpi with the basal part stout, the second joint longest, the sixth tapering at end; antennæ rather slender; scape yellow in front, flagellum pale ferruginous beneath; front minutely punctured; vertex elevated, rounded; narrow (ridge-like) upper border of prothorax and the tubercles white; mesothorax densely sculptured with minute punctures and striæ; area of metathorax very large and long, minutely cancellate; legs black, the anterior tibiæ pale ferruginous in front; tegulæ piceous; wings hyaline, nervures and the large stigma piceous; b. n. falling far short of t. m.; first r. n. reaching first s. m. a considerable distance from its apex; second s. m. very small, quadrate; abdomen with microscopic transverse lineolation.

Hab.—Mt. Yule, Healesville, Victoria, on *Eucalyptus calophylla rosea*, Feb. 20, 1915 (*R. Kelly;* Brit. Museum). A very peculiar little insect, with *Euryglossina* venation. It is perhaps most like *P. scintilliformis* Ckll., from which it is known at once by the venation. It is by no means a typical *Prosopis*.

Prosopis aralis sp. n.

♀. Like *P. perhumilis* (which was collected on the same plant at same time and place), but the white face-marks are extended, the broad clypeal band having below (on apical margin of clypeus) a transverse narrow band extending on each side at right angles, while the supraclypeal area has a broadly triangular light mark, the clypeal marking thus resembling an altar with pedestal at base, the offering represented by the supraclypeal mark; hind tibiæ with more than basal third pale; all the basitarsi cream-color. The basal nervure nearly reaches t. m.

Hab.—Mt. Yule, Healesville, Victoria, on *Eucalyptus calophylla rosea*, Feb. 20, 1915 (*R. Kelly;* Brit. Museum) 2 ♀. Possibly a variety of *P. perhumilis*, but apparently distinct. In the coloration of the legs it resembles *P. accipitris* Ckll., from Tasmania.

Prosopis scintilliformis Ckll.

♀. Length about 4.75 mm.; black, similar to *P. perhumilis* and *aralis*, but more slender; mandibles white, rufous at end; narrow creamy-white bands along anterior orbits to level of antennæ; clypeus and supraclypeal area entirely black; first r. n. meeting first t. c.; legs marked as in *aralis*. Scape with a light stripe in front; flagellum pale fulvous beneath; tubercles and transverse marks on prothorax cream-color.

♂. Length about 4 mm.; slender like the ♀; face below antennæ (including transverse supraclypeal mark), and lateral marks with pointed extensions upward at sides, all very pale ochreous (perhaps yellower in life). The face-pattern is like that of the larger and more robust *P. perhumilis*, except that the lateral marks have their inner side longer, extending to beyond the middle of the supraclypeal mark. Both have the fourth antennal joint extremely short.

Hab.—Mt. Yule, Healesville, on *Eucalyptus calophylla rosea*, Feb. 20, 1915 (*R. Kelly;* Brit. Museum). 3 ♀, 1 ♂. The species was described (1913) from a single female collected at Croydon. The male is very distinct from *P. minuscula* Ckll.

Prosopis trimerops sp. n.

♀. Length about or hardly 4 mm.; another species of the type of *P. perhumilis*, but very minute, robust; face-marks rufofulvous (probably yellower in life), consisting of a broad clypeal band, broad lower margin of clypeus (leaving long-cuneiform black areas at sides of clypeus), narrow lateral face-marks which end acutely on orbital margin a little above level of antennæ, and large supraclypeal mark, which is broad below, more narrowed above, and ends in a broad truncation between the antennæ; the supraclypeal area is convex; scape with a light stripe; flagellum fulvous beneath; thorax robust, mesothorax finely lineolate and punctured; upper border of thorax without pale marks, and tubercles with only a very narrow yellow edge; legs marked nearly as in *P. aralis*, but hind basitarsi with only the basal half pale; b. n. almost meeting t. m.; second s. m. broad, receiving first r. n. near its base.

Hab.—Yallingup, S. W. Australia, Nov., 1913, 2 ♀ (*R. E. Turner;* Brit. Museum.)

Prosopis vittatifrons Ckll.

Perth, Australia, Feb. 1–7, 1914 (*R. E. Turner;* Brit. Museum).

Paracolletes halictiformis sp. n.

♀. Length about 8 mm., rather robust, with short wings; black, with mostly white pubescence; head broad; mandibles red, black

at base and apex; clypeus closely and very strongly punctured, but shining between the punctures; sides of face and cheeks with conspicuous pure white hair; front extremely densely punctured, the punctures strong, but much smaller than those on clypeus; area behind ocelli with erect fuscous hair; flagellum short, ferruginous beneath apically; mesothorax and scutellum with very dense distinct punctures; longitudinal median groove of mesothorax distinct; mesothorax and scutellum with evident pale hair around the edges, but otherwise only with thin short brownish hair, not hiding the surface; postscutellum with a tubercle, from which arises a large spreading tuft of hair, partly brownish and partly whitish; area of metathorax rugulose basally, margin finely beaded; posterior face of metathorax with a large deep pit; legs black, the hind tibiæ red, the middle and hind basitarsi very broad; hind tibial scopa large, sordid white, suffused with brown behind; tegulæ rufotestaceous; wings dusky; stigma small, dark reddish, nervures fuscous; b. n. just reaching t. m.; second s. m. receiving first r. n. slightly before middle; third s. m. receiving second r. n. nearly as far from end as first r. n. is from first t. c.; abdomen thick, very finely punctured; hind margins of segments brownish; segments 2–4 with conspicuous white marginal hair-bands, interrupted or very thin in middle of 2; hair at apex dark fuscous.

Hab.—Yallingup, S. W. Australia, Dec. 1 to Jan. 23, 1913–14. (*R. E. Turner;* Brit. Museum.) A peculiar little species, resembling *Halictus.* It may best be compared with *P. sigillatus* Ckll., but it is smaller than that, with much more closely punctured mesothorax. It may also be compared with the much larger *P. perfasciatus* Ckll.

Halictus urbanus Smith.

Kalamunda, S. W. Australia, Mch. 14–Apl. 14, 1914 (*R. E. Turner;* Brit. Museum). 1 ♀. This species, as I have recognized it, varies considerably in size and the color of the legs; it may be composite. The Kalamunda specimen is small, with red tibiæ and tarsi, and agrees with one from Brisbane. This appears to be the true *H. urbanus;* the larger form (♀ slightly over 6 mm. long), with black legs, comes from Stradbroke Island (*H. Hacker*), and certainly would pass for a distinct species, were it not connected by intermediates. This Stradbroke I. form may take the name variety *stradbrokensis*, nov.

Halictus mundulus sp. n.

♀. Length about 5 mm.; black, with the mesothorax and scutellum dark bluish-green; pubescence scanty, dull white, no abdominal

bands or patches; head broad; mandibles ferruginous, dusky apically and black at extreme base; flagellum clear ferruginous beneath; mesothorax moderately shining, scutellum more polished; area of metathorax semilunar, densely irregularly wrinkled, the obtuse margin shining; knees, tibiæ and tarsi ferruginous, the tibia with obscure dusky suffusion; tegulæ amber color; wings hyaline, stigma and nervures pale testaceous; first r. n. meeting second t. c.; outer r. n. and t. c. colorless and very thin; abdomen broad, polished, with very thin pubescence; hind margins of segments obscurely reddish; caudal rima bright ferruginous; hair of venter long, but not curled to form a true scopa. Microscopical characters: clypeus very sparsely punctured; front striate, with punctures between the straiæ; third antennal joint extremely short, fourth a little longer, fifth still longer; mesothorax lineolate, with scattered punctures; abdomen with extremely minute punctures, best developed on first segment; hind spur with one very large obtuse tooth (like the last joint of a finger) and one very low rounded lamella.

Hab.—Kalamunda, S. W. Australia, Mch. 14–Apl. 14, 1914 (*R. E. Turner;* Brit. Museum). Allied to *H. urbanus*, but with the mesothorax quite differently colored. It may also be compared with *H. humilis*, but is quite distinct.

Halictus brazieri sp. n.

♂. Length 11 mm. or slightly over; shining black, with scanty dull white pubescence; hair on inner side of basitarsi and fringe of caudal rima pale golden; outer side of tibiæ with hair partly dark fuscous; head ordinary, only moderately broad; mandibles black, dark red at extreme tip; clypeus shining, with strong not dense punctures, no median groove; front dull in middle, glistening at sides; antennæ pure black; mesothorax shining, with strong rather sparse punctures of practically uniform size; scutellum with very minute punctures, entirely different from those of mesothorax; mesopleura coarsely striate; area of metathorax short, with fine regular cross-striæ, the basal middle with irregular rugæ; sides of area posteriorly bounded by conspicuous elevations; posterior truncation strongly obliquely striate; hind spurs simple (microscopically very briefly serrulate); tegulæ black, a little reddish in middle; wings slightly brownish, stigma dull ferruginous, nervures fuscous, outer r. n. and t. c. much weakened; first r. n. joining end of second s. m.; abdomen shining, with extremely minute punctures; no hair-bands or patches, but third and fourth segments, and base of first, with thin pale glittering hair; hair at apex fuscous; venter with short stiff hair. The wings are unusually short.

Hab.—Yallingup, S. W. Australia, Nov., 1913 (*R. E. Turner;* Brit. Museum). Superficially exactly like *Parasphecodes noachinus* Ckll., but the stigma is more obtuse at end, marginal cell shorter, abdomen much more finely punctured, and basal nervure more strongly arched. The punctureless apical area on first abdominal segment is extremely narrow, less than half as wide as that of *P. noachinus.* These two bees are really congeneric, the genera *Parasphecodes* and *Halictus* practically meeting at this point. This and the next are named after Australian naturalists.

Halictus spenceri sp. n.

♂. Length slightly over 8 mm.; black, rather robust, with thin white hair, faintly ochreous-tinted on head and on thorax above; abdomen without bands or patches, but a little pale hair at bases of second and third segments, and ventral segments with broad dense bands of white hair; face broad, eyes subemarginate; mandibles black; clypeus with a low-triangular creamy white patch, its surface punctured, and with no median groove; antennæ long, black, flagellum moniliform; mesothorax shining (dull in front), with small punctures; scutellum very finely punctured, not bigibbous; area of metathorax semilunar, feebly sculptured, roughened basally with fine rugæ, the apical part microscopically areolate; mesopleura not striate; tegulæ piceous with a rufous spot, the anterior lateral margin pallid; wings dusky, stigma dark fuscous, nervures light fuscous; first r. n. joining second s. m. at end; third s. m. broader than second; abdomen shining, with very fine obscure punctures; apex with a large, broad, rounded, bright ferruginous plate. Front dull. Legs black, with pale hair.

Hab.—Yallingup, S. W. Australia, Sept. 14–Oct. 31, 1913. (*R. E. Turner;* Brit. Museum.) I thought at first that this might be the male of *H. brazieri*, but the structure is too different. It belongs to the group of *H. cambagei* Ckll., where it is easily distinguished by its large size. Some specimens are only about 7 mm. long.

Halictus tannaënsis sp. n.

♀. Length a little over 7 mm., robust; head broad-oval, dark bluish-green, the clypeus and supraclypeal area stained with crimson; face, front and cheeks with thin dull white hair, vertex with fuscous hair; mandibles black, obscurely reddish at apex; clypeus sparsely punctured; front dull, very finely striate; head truncate posteriorly, the occipital margin abrupt; antennæ dark, flagellum with only the faintest red tint toward end; antennal joints 2 to 5 measuring (length) in microns 128, 128, 144 and 176 respectively; mesothorax and

scutellum dullish, yellowish-green, with slight crimson tints, very finely but not extremely densely punctured; dorsum of thorax with thin brownish-tinted hair; area of metathorax semilunar, well-defined, with regular straight plicæ, on the basal half connected by minute cross-ridges; posterior truncation very hairy; legs black, not metallic, last joint of tarsi red; hair of legs black on outer side; hind femora slender, arched beneath, with a long curled pale scopa; inner side of tarsi with light ferruginous hair; hind spur with very long spines; tegulæ fuscous with a ferruginous spot; wings strongly dusky, stigma rufofuscous, nervures fuscous, outer r. n. and t. c. much weakened; second and third s. m. cells about equal, and together not as large as first; first r. n. joining third s. m. near base, third discoidal cell narrowed above; abdomen broad, shining, impunctate, obscurely bluish-green, hair at apex reddish, caudal plate narrow, exposed, venter with a scopa of long white hairs.

Hab.—Tanna Island, New Hebrides, June, 1900 (*J. J. Walker;* Brit. Museum). Allied to *H. perpessicus* Kohl, from Samoa, but easily distinguished by the longer, more oval head. Also allied to *H. saffordi* Ckll., from Guam, but the area of metathorax is quite different.

Halictus epiensis sp. n.

♀. Length a little over 6.5 mm.; superficially and structurally like *H. tannaënsis*, but easily distinguished by the following characters: mesothorax and scutellum narrower, more closely punctured, rich blue-green; area of metathorax larger, more finely sculptured, the very delicate rugæ joined by cross-rugæ, producing a fine reticulation, while apically delicate striæ pass obliquely to each side of a fine median plica; wings very dark (venation as in *H. tannaënsis*). The third antennal joint is very short, broader than long, a little shorter than the second or fourth.

Hab.—Ringdove Bay, Epi Island, New Hebrides, July 21, 1900. (*J. J. Walker;* Brit. Museum.)

Halictus pachycephalus sp. n.

♂. Length about 6 mm., rather robust, with very large broad head (wider than thorax) and short abdomen; black, with dull white hair, the legs ferruginous, the coxæ, trochanters, and basal half or more of femora black, anterior femora black behind except at extreme apex; spurs pale ferruginous. Head about 2.17 mm. wide; mandibles pale yellow with the apex broadly black; labrum pallid; clypeus with a pale yellow apical band, broad in middle; white hair of face

not concealing the shining surface; front dull except at sides, densely punctured, with oblique (mainly transverse) wavy rugæ above the antennæ; a small shining space on each side of middle ocellus anteriorly; antennæ slender, moderately long, the flagellum dull reddish; length of antennal joints in microns, (1. = scape), 560, (2.) 128, (3.) 144, (4.) 240; mesothorax polished and shining, sparsely and finely punctured, median and parapsidal grooves distinct; scutellum shining, the disc impunctate; legs with pale hair; basitarsi cream-colored at base, and a cream-colored spot at base of hind femora; tegulæ rufotestaceous with a pale yellowish mark; wings hyaline, stigma and nervures ferruginous; stigma large; first r. n. meeting second t. c.; third s. m. large, broader above than second; hind wing with four spines on costa much before origin of radial vein, a group of four large hooks (close together) beginning at origin of radial vein, and a group of three hooks a short distance beyond; abdomen shining, very finely punctured, with a thin pruinose pubescence, but no bands or spots; apex with white hair; a broad, rounded, very obtuse red apical plate; venter not very hairy.

Hab.—Yarrawin, New South Wales, 1914. (*W. W. Froggatt*, 250.) Related to *H. spenceri*, but easily separated by the color of the legs. The red stigma and other characters separate it from *H. dolichocerus* and *H. hæmatopus*.

Halictus dolichocerus sp. n.

♂. Length 5 to 6 mm., rather robust, with short broad abdomen; head large, but not conspicuously so as in *H. pachycephalus;* pubescence rather short, dull white; lateral bases of abdominal segments 2 to 4 with cuneiform patches of white tomentum; legs bright ferruginous, blackened at base, anterior femora black except at apex, middle and hind pair with less black; tibiæ with a blackish patch. Eyes rather strongly converging below; clypeus with a broad apical band, which is angularly produced above in middle; face, and whole of front, with rather dense white hair, partly concealing surface of front; front dull; supraclypeal area polished and shining; antennæ extremely long, dark, the fourth joint bright or obscure red beneath; flagellum strongly crenulate beneath; mesothorax polished, finely and not densely punctured; scutellum brilliantly shining, middle of disc impunctate; area of metathorax crescentic, with weak plicæ; margin of area polished; tegulæ rufotestaceous; wings hyaline, nervures and stigma sepia; second s. m. variable; first r. n. joining second t. c. or entering basal corner of third s. m.; third s. m. very large, quadrate, sometimes longer than high; abdomen shining, very

finely punctured, apical half of second segment punctured, not lineolate.

Hab.—Type from Yarrawin, N. S. W., (*Froggatt* 225). Also two from Brewarrina, N. S. W., 1914 (*Froggatt*). The basitarsi may be distinctly yellowish. By the general form and very long antennæ this resembles *H. hæmatopus* Ckll., but it is readily distinguished by the shining mesothorax.

Halictus supralucens sp. n.

♀. Length about 6.5 mm.; of ordinary form, black, with rather scanty white hair; dense bands of pure-white tomentum at extreme bases of second to fourth segments, the central part on second hidden by overlapping first segment; legs very dark brown, with pale hair. Head broad; mandibles black, with a faint red subapical spot; clypeus shining, with irregular strong punctures; front dull except at sides, finely striate; antennæ dark, flagellum with a very obscure reddish tint beneath; mesothorax shining, with irregular large and small punctures, the disc not lineolate or reticulate; parapsidal grooves deeply impressed; scutellum flattened, depressed in middle, strongly polished, almost entirely impunctate; area of metathorax large, poorly defined, appearing rugose from a fine raised reticulation, but the apical part smooth and shining; hind basitarsi with apical brush brilliant orange-ferruginous; tegulæ rather dark chestnut-red; wings dusky, nervures brownish; stigma large, dull amber-color; second s. m. large; first r. n. meeting second t. c. or joining apical corner of second s. m.; abdomen shining at base, duller beyond, with extremely fine punctures; caudal rima fringed with brown hair; venter with white hair, not forming a curled scopa.

Hab.—Kalamunda, S. W. Australia, Feb. 9–28, and at 850 ft., March 1–11, 1914. (*R. E. Turner;* Brit. Museum.) Near *H. mediopolitus* Ckll., but sculpture of mesothorax entirely different. Easily known from *H. orbatus* Sm. by the polished scutellum.

Halictus demissus sp. n.

♀. Length nearly 5.5 mm.; black, with the mesothorax shining green, polished, with sparse punctures of different sizes, the parapsidal grooves very distinct; scutellum also polished, but not green; pubescence scanty, dull white, the abdomen without hair-bands or spots; mandibles chestnut red except basally; clypeus shining, front dull and granular; flagellum entirely dark; area of metathorax large, with delicate but very distinct radiating striæ; legs black; wings hyaline, nervures and the very large stigma sepia; first r. n. joining

second s. m. a little before end; outer r. n. and t. c. very weak; third s. m. very short; abdomen polished, shining, venter with a scopa of long curled hairs. Microscopical characters: front densely covered with elongated punctures running into striæ; surface of mesothorax very delicately reticulated; area of metathorax minutely reticulated between the ridges; hind spur with four obtuse spines.

Hab.—Launceston, Tasmania, Nov. 1, 1914, 2 ♀ (*F. M. Littler*, 2,699). Related to *H. humilis* Sm., but distinguished by the dark legs and striate area of metathorax.

Halictus forticornis sp. n.

♂. Length about 4 mm.; black, with very scanty pale pubescence, no bands or patches on abdomen; head broad, eyes converging below; mandibles pale yellow, ferruginous at apex; lower half of clypeus pale yellow; middle of face shining, front dull; cheeks unarmed; scape black; flagellum very long, thick, submoniliform, light orange-ferruginous beneath; mesothorax and scutellum shining, smooth and polished; area of metathorax roughened basally, but with a broad shining rim; legs black, with knees, apices of tibiæ, and anterior tibiæ in front, ferruginous; tarsi very pale reddish approaching cream-color; tegulæ dark ferruginous; wings hyaline, nervures and the large stigma testaceous; first r. n. joining apical corner of second s. m.; outer r. n. and t. c. extremely weak; abdomen short, shining; sides of venter testaceous. Microscopical characters: front striate; mesothorax with sparse minute punctures, the surface of the disc not lineolate or reticulate; first two abdominal segments distinctly but minutely punctured, the depressed apical part of second transversely lineolate.

Hab.—Kalamunda, S. W. Australia, Feb. 9–28, 1914 (*R. E. Turner;* Brit. Museum). Very close to *H. cyclognathus* Ckll., but head smaller, antennæ longer, and area of metathorax different.

Halictus imitans Ckll.

George Town, Tasmania, Nov. 15, 1914 (*Littler*). New to Tasmania. On Nov. 29 Mr. Littler took *H. lanarius* Sm. at George Town.

Halictus seductus Ckll.

Bridport, Tasmania, Oct. 26–30, 1913 (*Littler*). New to Tasmania.

Halictus semipolitus expulsus subsp. n.

♀. Flagellum black (red at end in typical *semipolitus*): tegulæ piceous or more or less reddish.

Hab.—Georgetown, Tasmania, Nov. 15 and 29, 1914 (*F. M. Littler.*)

Halictus macrops sp. n.

♂. Length 5 mm. or a little over; black, robust, looking like a female, the head very large and broad, the antennæ (which are entirely dark) not very long; hair of head and thorax long, dull white, slightly creamy on thorax above; on abdomen the hair is thin and rather long, rather abundant on apical segments, but not forming bands or patches; apical plate of abdomen very broad, piceous. Mandibles dark red apically; lower margin of clypeus without yellow; hair of face abundant, but not concealing shining surface of clypeus; front dull; mesothorax polished, with fine scattered punctures; scutellum dullish; area of metathorax narrowly crescentic, roughened, with minute short plicæ; legs black, with white hair; tegulæ rufo-fuscous, darkened in front; wings hyaline, stigma and nervures dark reddish, outer r. n. and t. c. evanescent; first r. n. meeting second t. c.; second s. m. very narrow, third large, about twice the size of second; abdomen shining, with very minute punctures, hind margins of segments more or less pallid. Microscopical characters: clypeus distinctly but sparsely punctured, the punctures emitting long plumose hairs; front densely punctured, in the middle also striate, the ridges between the punctures emphasized; mesothorax distinctly but not at all densely punctured, the surface of the disc not reticulate or lineolate; punctures of scutellum smaller than those of mesothorax; first abdominal segment and basal half of second well though minutely punctured, apical half of second transversely lineolate.

Hab.—Launceston, Tasmania. (*F. M. Littler.*) This may be compared with *H. niveifrons* Ckll., from which it is easily known by the broad face.

Halictus lanariellus sp. n.

♀. Length about 8 mm., the abdomen large; black, with dull white hair; bases of abdominal segments 2 to 4 with broad bands of white tomentum, having a faint creamy tint, especially at sides of 2, where it is very dense, the band on 4 so broad as to occupy more than half the segment; legs black, the tarsi ferruginous at apex. Head broad; mandibles obscurely reddish apically; clypeus and supraclypeal area shining and sparsely punctured; front extremely densely punctured, not striate; antennæ dark, flagellum faintly reddish below at apex; mesothorax shining, strongly and rather closely punctured; scutellum shining, depressed and punctured in middle, but

the disc on either side impunctate; area of metathorax crescentic, with fine plicæ which in the middle run into a reticulation, giving a subrugose effect under a lens; hind femora and trochanters with long curled floccus; hind spur simple; tegulæ dark rufous; wings hyaline, stigma and nervures ferruginous; second s. m. very broad, receiving first r. n. at apex; abdomen shining where not covered with tomentum, extremely finely punctured; venter with long white hair, not forming a curled scopa.

Hab.—Yarrawin, N. S. W. (*Froggatt*, 233). Close to *H. lanarius* Sm., but smaller and more shining.

Halictus confusellus sp. n.

♀. Length about 7 mm.; black, with dull white hair; lateral bases of second and third abdominal segments with cuneiform patches of dense white tomentum, the apical part of abdomen also hairy, but not densely; legs black. Mandibles black, faintly reddish subapically; clypeus and supraclypeal area shining, sparsely punctured; front densely punctured; antennæ black; mesothorax and scutellum shining, but very distinctly and quite closely punctured all over; area of metathorax crescentic, with fine radiating plicæ; hind spur peculiar, with a very broad rather short lamina, and a low keel-like one beyond, the latter slightly inclined to be double; tegulæ rufopiceous; wings slightly dusky; nervures fuscous, stigma dull ferruginous; outer r. n. and t. c. evanescent; first r. n. reaching extreme apex of second s. m.; third s. m. much broader above than second; abdomen shining, very finely punctured.

Hab.—Launceston, Tasmania (*F. M. Littler*). Known from *H. imitans* Ckll. by the ferruginous stigma and shorter area of metathorax.

The following key will facilitate the separation of a number of species of *Halictus* discussed above:

Mesothorax green ..... 1.
Mesothorax black; abdomen black ..... 4.
1. Small species, with red (or mainly red) tibiæ ..... 2.
   Larger species, with dark tibiæ ..... 3.
2. Green of thorax very bright ..... *urbanus* Sm.
   Green of thorax obscure ..... *mundulus* Ckll.
3. Mesothorax shining, sparsely punctured ..... *demissus* Ckll.
   Mesothorax dull, much more closely punctured ..... *subinclinans* Ckll.
4. Males ..... 5.
   Females ..... 10.
5. Lower margin of clypeus not yellow ..... *macrops* Ckll.
   Lower margin of clypeus yellow or cream-color ..... 6.

6. Very small, less than 5 mm. long, tarsi yellowish *forticornis* Ckll.
   Larger, at least over 5 mm. long ..... 7.
7. Tarsi black ..... *spenceri* Ckll.
   Tarsi red or yellow ..... 8.
8. Stigma ferruginous; head broad and massive ..... *pachycephalus* Ckll.
   Stigma fuscous ..... 9.
9. Mesothorax shining ..... *dolichocerus* Ckll.
   Mesothorax dull ..... *hæmatopus* Ckll.
10. Small, hardly 5.5 mm. long ..... *semipolitus expulsus* Ckll.
    Larger ..... 11.
11. Disc of mesothorax with scattered punctures of different sizes, *supralucens* Ckll.
    Disc of mesothorax well punctured, the punctures uniform ..... 12.
12. Fourth abdominal segment, except broad apical margin, densely covered with pale felt-like hair ..... *lanariellus* Ckll
    Fourth segment not so ..... 13.
13. Hind margins of abdominal segments reddened; area of metathorax with irregular sculpture ..... *pulvitectus* Ckll.
    Hind margins of abdominal segments black; area of metathorax with fine definite longitudinal plicæ ..... 14.
14. Stigma ferruginous; area of metathorax shorter ..... *confusellus* Ckll.
    Stigma piceous; area of metathorax longer ..... *imitans* Ckll.

A NEW SPECIES OF ONCHIDIOPSIS FROM BERING SEA.

BY WILLIAM H. DALL.

The genus *Onchidiopsis* Bergh (1853) was proposed for certain Arctic mollusks related to *Velutina* and possessing an internal nearly laminar shell. The minor characters of the few species known are in many respects different but their combinations are so intermixed that it is difficult to assign to the differences more than specific value. However the peculiarities of the present species are such that I venture to separate the genus into two sections, as follows:

Genus **ONCHIDIOPSIS** Bergh, 1853.

Section ONCHIDIOPSIS, type *O. grönlandica* Bergh.

Adult animal with an impervious notæum.

Section ATLANTOLIMAX, type *O.* (*A.*) *hannai* Dall.

Adult with a large dorsal foramen in the notæum.

Onchidiopsis (Atlantolimax) hannai n. sp.

Animal, after preservation in spirits, of a yellowish white color except on the sides of the foot and on the osphradium. The foot is muscular, broad, tapering and bluntly pointed behind, extending about one-third of its length behind the hinder margin of the notæum even when contracted; the front edge duplex, auriculate at the anterior lateral angles; proboscis entirely retractile within a transverse slit, below the short stout tentacles; eyes black, distinct, completely imbedded in and a little above the not perceptibly swollen bases of the tentacles, on their outer sides; verge situated behind the right tentacle, large, twisted, at first stout and subcylindrical, then deeply constricted; then compressed and expanded with a conical papilla at the outer corner of the expansion[1] much as in *O. corys* Balch.

The sides of the foot are radially corrugated, the convex folds sometimes more or less granulose; above the corrugated area and in the pedal sulcus below the edge of the mantle the surface is smooth

[1] In Balch's figure of *O. corys* this papilla is shown at the inner corner of the expansion, a difference which is probably due to twisting. Cf. Proc. U. S. Nat. Museum, No. 1,761, pl. 22, fig. 1.

and white, though the corrugations are more or less tinged with slate color. The visceral hump is enormous, subglobular, shorter than the foot, height above the sole 52 mm.; above the sulcus between mantle-edge and foot 40 mm.; longitudinal diameter 42 mm.; transverse diameter 37 mm. The hump is largely covered by a thick, obscurely pustulous, almost coriaceous layer (the notæum) beneath which is a thin, transparent but quite tough mantle which in spirits expands below the basal edge of the notæum above the pedal sulcus especially in front (though not as much as in *O. corys*), like a mass of bubbles, with a hardly perceptible sinus on either side forming an incurrent and an exhalent channel, which however does not affect the margin of the notæum, the latter being entire except for a slight incurvation in the median line in front.

The summit of the notæum (in spirits) exhibits an ovoid foramen about 30 mm. long by 24 mm. wide, through which the shell, covered by the excessively thin transparent mantle, is partially visible.

There is a transverse slit-like opening between the mantle and the pedal sulcus, directly behind the head, in which the osphradium, ctenidium and excretory outlets are situated. The osphradium is of a greenish tint, with darker margins. The gill is translucent white. In the former the filaments are single and elongated on either side of the stalk, not short and double as in *O. corys*. The ctenidium has a single row of long, triangular, not auriculate lamellæ much as in that species.

The jaw much resembles that of *O. corys*, but the radula was so deeply retracted that it was thought best not to break up the unique specimen by cutting to extract it.

The base of the arc of the shell measures 40 mm. long by 32 mm. wide. It has much the shape of the bowl of a deep oval ladle and its depth is about 15 mm. when in normal position. Its structure is concentric, not in circles but in a rounded-quadrate fashion. On the edge of the left side behind is a knot-like nucleus. On the inner surface near this nucleus and extending for a length of about 12 mm. away from it are two elevated straight ridges, which at half their length from the nucleus join to form a single stronger ridge which gradually diminishes and becomes obsolete on the inner surface of the disk. The appearance of these ridges suggests that if the shell was spirally coiled they would form a columella. The outer surface of the shell, to which the mantle adheres tenaciously, is smooth, but undulated by more or less irregularly disposed concentric wrinkles. It is attached to the body only by a small area at the edge near the

nucleus. There is no indication of a periostracum, and the cartilaginous shell is nearly transparent.

The specimen was collected on the beach of St. Paul Island, Bering Sea, after a severe storm, December 5, 1914, by Mr. G. Dallas Hanna of the Bureau of Fisheries, in whose honor it is named. U. S. Nat. Mus. Cat. No. 215,162.

This species differs from *O. corys* by its widely foraminate notæum, its much larger visceral hump, its single instead of double osphradial lamellæ, and the character of its shell. *O. grönlandica*, *glacialis* and *pacifica* have an imperforate notæum. *O. grönlandica* has a low visceral hump and entirely different form of verge. *O. glacialis* has a proportionately much shorter and posteriorly pointed foot, lower hump and different type of verge, and *O. pacifica* shows much the same differences.

The disposition to "lump" together specifically animals of this genus in spite of minor differences, is responsible for much confusion. The differences of more than specific rank run parallel to those in *Velutina*, where some species have the shell entirely covered by the notæum and others have it more or less exposed. It has been suggested that all species have the shell covered in the young, but the specimens of all ages collected by me do not confirm this supposition.

While the edges of the shell and its concave surface, except for the portion near the nucleus, are free from the visceral hump below, it is nevertheless completely covered by an extremely thin layer of tough tissue which can be separated from the shell only with difficulty, usually coming off in small strips. This tissue I assume to be an extension of the mantle as it has none of the characteristics of a periostracum. The entrance of the vagina could not be made out. It required for its demonstration more extensive dissection than was thought advisable for the unique specimen. The animal is presumably hermaphrodite, like the other species of the genus which have been anatomically examined.

THE ZOOLOGICAL POSITION OF THE SARCOSPORIDIA.

BY HOWARD CRAWLEY.

In a paper recently published by the present author (Crawley, 1916), evidence was given to show that the spores of *Sarcocystis muris* are sexually differentiated. This evidence was based upon the findings in the intestinal cells of mice to which the spores had been fed. It is, however, quite possible that a careful study of accurately fixed and stained spores taken directly from the cysts would reveal characters serving to differentiate the males and females. Certain authors, for instance Fantham (1913), in the case of *Sarcocystis colii*, speak of two kinds of spores, but nothing of the sort has as yet been demonstrated in the case of *Sarcocystis muris*.

Nevertheless, as already stated, these spores are males and females and within the intestinal cells of the mouse they quickly develop along their respective lines. This evolution is completed in from 9 to 18 hours, after which fertilization takes place.

My own studies shed no light upon later events. The fertilized female or zygote can be found, sometimes within the epithelial cells, sometimes in the subepithelial tissues, in mice killed one or two days after inoculation. But as yet I have not been able to find the parasite in mice killed at longer intervals than this after feeding.

Erdmann (1914) describes and figures what are apparently the multiplication stages of a parasitic protozoan in the intestinal cells and tissues of mice killed some days after the ingestion of sarcosporidian spores. The precautions taken by Erdmann seem absolutely to preclude infections with any other protozoan. Consequently, as the case now stands, it seems entirely reasonable to look upon these multiplication stages as derived from the zygotes.

According to Nègre (1907) the feces of mice that have been inoculated by feeding the usual cysts contain a stage of the parasite capable of producing the infection if fed to other mice. This is present in the feces from the fifteenth to the sixtieth day after inoculation. It is evidently a resistant encysted stage, since it maintains its vitality for 30 days in the dried feces, and is capable of resisting a considerable degree of heat. When mice are inoculated with this stage, both the time required for the parasites to appear in the

muscles and the percentage of positive cases are the same as when the mice are fed with the stages occurring in the muscles. Nègre, however, was not able to detect this element in the feces and although it seems as if it must be present in the intestinal tissues for a long time after inoculation, it has never been seen. Hence the evidence for its existence, while entirely satisfactory, is wholly indirect.

Nègre's experiments have been repeated at the Zoological Laboratory of the Bureau of Animal Industry, and his results confirmed. The impression is, however, that the infections resulting from inoculation with the fecal stage are heavier than those obtained from feeding infected muscle. Microscopical examination of the spores obtained in this manner show them to be precisely the same as those resulting from the other mode of infection.

As we have seen, Erdmann describes multiplication stages as occurring in the intestine some days after inoculation. The parasite then disappears to reappear at about the forty-fifth day in the muscles. Several authors have endeavored to trace the history of the muscle stages, but of the several accounts the most convincing is that of Negri (1910). This author worked with the white rat, but the parasites of the rat and mouse seem to be identical and there is no reason to suppose that the development of one would be any different from that of the other.

The smallest and hence, doubtless, the youngest stage found by Negri was an elongated body, about 25 μ long. It was found in a rat killed 50 days after feeding. It showed a delicate bounding membrane and was rather indistinctly divided into a number of oval elements, each with a central differentiation. This no doubt represented the nucleus. Negri designates these bodies as sporoblasts.

In somewhat larger cysts the picture is clearer, the oval sporoblasts being completely individualized, and each shows a very distinct nucleus.

From this point on development appears to follow very simple lines. The sporoblasts divide repeatedly by bi-partition, each daughter cell coming to assume the oval form of the mother cell. The parasite itself, the so-called cyst, becomes larger, but this increase in size is due merely to an increase in the number of the sporoblasts, which do not themselves become larger. The entire mass remains separated from the host tissue by the same kind of a delicate membrane.

Matters proceed in this way until the cysts, according to Negri, have attained a length of some 600 μ. From this time on, however,

the two daughter cells arising from the division of a sporoblast do not always take on the oval form of the mother cell, but each retains the form it had at the moment of division and does not again divide. The division of the sporoblast having been longitudinal, the form of the daughter cells is that of a banana and they are, in fact, the spores.

The production of the spores in this way is initiated in the central part of the cyst. At the outset of this new line of development, the cysts will contain many sporoblasts and few spores and there is no doubt that the production of both spores and sporoblasts may take place simultaneously in different or even the same parts of the same cyst. Eventually, however, the divisions of the sporoblasts produce only spores which finally come to be the only elements present within the cysts.

Bertram (1892) describes very early stages of the evolution of *Sarcocystis tenella* in the muscles of the sheep. Several of his original figures have been reproduced in most of the general works on the parasitic Protozoa, and doubtless are familiar to all students of these organisms. Of these, Bertram's figure 22, reproduced by Doflein (1911) as figure 891 C, page 922, represents an element 47 μ long by 6 μ wide. We have here what appears to be a solid body indistinctly marked out into small round or oval elements, each with a nucleus. It is strikingly like the smallest stage of *Sarcocystis muris* as figured and described by Negri.

Bertram also figures somewhat larger stages of the muscle phase of *Sarcocystis tenella*, and in these, reproduced by Doflein (1911) as figures 891 B and D, page 922, the so-called cysts are more or less completely differentiated into rounded or oval nucleated cells, the sporoblasts.

Since the Sarcosporidia are always classified as Neosporidia, it has been tacitly assumed that the earliest stage in the muscles must be an organism in which growth and spore formation take place coincidently. The very smallest stages figured and described by Negri and Bertram are capable of being interpreted in this way, since they appear to consist of bodies of some size, indistinctly divided into rounded or oval nucleated elements. Inasmuch, however, as these bodies occur embedded in the muscular tissues of their hosts, it is by no means easy to get clear-cut pictures of them, and it is wholly possible that the rather indefinite appearances figured by these two authors may be due merely to the difficulty of differentiating the sporoblasts from the surrounding host tissues. In consequence, it is not at all impossible that these earliest stages of Bertram and

Negri may be only groups of sporoblasts, and it is in harmony with this opinion that in both cases these authors figure slightly later stages of the parasite in which the sporoblasts are completely individualized.

More direct evidence, however, is furnished by some material which has recently been examined by the present author. This, from the heart of a sheep, appears to show that at least in the case of *Sarcocystis tenella*, the sarcosporidian cyst originates from a single cell. This conclusion is based upon the discovery of a single partly divided sporoblast, lying in a minute cavity within a cell of the heart. Division had progressed to the point where the two daughter cells were wholly distinct, but still in intimate contact. The next stage found consisted of a group of eight sporoblasts, also lying in a cavity within a heart cell. All of these eight sporoblasts were more or less completely individualized. In addition to these very small stages, larger groups of sporoblasts were found, up to cysts of over 100 μ long. But in all cases the elements composing the groups were obviously the same as the sporoblasts of Negri and Bertram.

Thus the data furnished by Bertram, Negri, and the present author are entirely consistent amongst themselves, and are mutually confirmatory and supplementary. For although the earliest known stage of *S. muris* yet discovered consists of a number of cells, about six or seven, judging from Negri's figure, we can hardly ascribe to it a mode of development different from that of *S. tenella*. Assuming then that these data are accurate, a certain interesting conclusion seems to follow.

This conclusion is in effect that the muscle stage of *Sarcocystis muris* is not an individual, but a congeries or colony of individuals. In other words, the unit is not the cyst or Miescher's tube, but the sporoblast itself.

Assuming that this is true, the life history of *Sarcocystis muris* would be as follows: The ingested spores gain the epithelium of the intestine and develop into the macrogametes and microgametes. The latter fertilize the former and produce the zygotes. By endogenous multiplication the zygotes produce a number of minute elements. There is here a gap in the life history. It is evident that two divergent lines are followed since, as we have seen, some form of the parasite appears in the feces from the fifteenth to the sixtieth day. It is therefore impossible to say whether the multiplication products described by Erdmann are those destined to invade the muscles or to infect the feces. But whatever happens,

it is evident that at the end of several weeks some form of the parasite invades the muscles. This is either the sporoblast itself or its immediate forerunner, which may be the zygote or some element derived from the zygote.

In any event, at a certain point in the evolutionary history, the muscle cells come to harbor individual sporoblasts. These divide many times by bi-partition, but eventually the products of these divisions are no longer sporoblasts, but spores. It may incidentally be noted that unless its development be interfered with, each sporoblast will presumably produce a cyst.

It will be of interest to compare the several stages of the life history of *Sarcocystis muris* with those of an ideal member of the Coccidiomorpha.

The sarcosporidian "spore" develops directly into the sexual stages, the macrogametes and microgametes. These copulate and produce the zygotes. In the coccidiomorphan, the merozoites produced at the end of schizogony follow an identical line of development.

The sarcosporidian zygote divides into a number of small bodies, the further history of which is unknown. The coccidian zygote ultimately produces the sporozoites, although the details whereby this end is gained are subject to great variation.

In the sarcosporidian, some product of the zygote ultimately finds its way into the muscle cells, and produces the colony of sporoblasts. In the Coccidiomorpha, the sporozoites eventually find their way into their appropriate habitats, which are always cells, and grow into trophozoites.

In the sarcosporidian, the sporoblasts divide a number of times by bi-partition, after which spores are produced and division ceases. These spores, in order to develop further, must gain the alimentary canal of another host in which they will evolve into the sexual stages. In the Coccidiomorpha, the trophozoites divide into merozoites. These grow into trophozoites, which again divide into merozoites and so on for an indefinite number of generations. Eventually, however, the merozoites develop, not into trophozoites, but into the sexual forms.

It will next be in order to see what conclusions may be drawn from the data given above. In so doing, it will be convenient to divide the sarcosporidian life history into three portions, namely, the sexual development which takes place in the intestinal epithelium; the stage which follows this; and finally the stage which occurs in the muscles.

In so far as the first of these stages is concerned, that is, the evolution of the microgametes and macrogametes, the parallel between sarcosporidian and coccidiomorphan is exact.

In the second stage, the gaps in our knowledge of the course of events in the Sarcosporidia prevents as precise a comparison. We do not know what happens between the time the parasite leaves the epithelium and the time it invades the muscle, nor has the stage which appears in the feces ever been seen. Nevertheless, the course of events in the two cases must be more or less similar. For in both, the zygote divides into a number of small elements which serve to carry the infection either to other hosts or to other parts of the same host. In the Coccidiomorpha, there is typically a first division into spores, the protoplasm of which secondarily divides into sporozoites. In the sarcosporidian, it is in evidence that the zygote divides into small elements, the further history of which is not known. But in any event, it must be some product of the zygote which on the one hand invades the muscles and on the other develops into the encysted fecal stage. It is conceivable that it is an encysted zygote which infects the feces, but we do not know.

In the third stage, the course of events differs in detail in the two groups of animals, but the end results are the same, since in both there are produced a large number of elements destined to evolve into the sexual stages. In the Coccidiomorpha, there is extensive growth, followed by multiple division, this cycle being repeated an indefinite number of times. In the Sarcosporidia, there is an indefinite number of bi-partitions alternating with only enough growth to restore the element to its original size. In the one case, the Sarcosporidia, multiplicative energy is continuous, while in the other, the Coccidiomorpha, it is periodic, but this difference is not essential.

We may next endeavor to homologize the several stages in the life history of *Sarcocystis muris* with those of the Coccidiomorpha. In the first place, it is entirely evident that the sarcosporidian "spore" is the homologue of the coccidiomorphan merozoite. The sexual stages are alike. The multiplication products of the sarcosporidian zygote are presumably the homologues of either the spores or sporozoites of the Coccidiomorpha. The sporoblast is not so easy to place. It may correspond to either the sporozoite or the trophozoite of the Coccidiomorpha. A knowledge of its derivation is necessary before this point can be determined. Since, however, the sporoblasts are all of much the same size, whether occurring singly or within groups, the distinction here between sporozoite and trophozoite would be largely a matter of terms.

Attention may also be called to the homology of the sarcosporidian muscle stage with the entire schizogonous cycle of the Coccidiomorpha. In the latter, the products of schizogony are set free and are enabled to invade new regions of the host. In the former, a tissue reaction on the part of the host confines them to the region originally invaded.

If the line of reasoning developed above be sound, it seems to follow that the Sarcosporidia are not Neosporidia, but Telosporidia, and moreover Telosporidia which obviously belongs to the Coccidiomorpha. In the discussion given above, the various characters of the Sarcosporidia and Coccidiomorpha were compared, the result showing both resemblances and differences. But as will be pointed out below, the characters of taxonomic value were those wherein the two groups were alike, whereas the differences had to do with characters not used in classification.

Before, however, giving the reasons for regarding the Sarcosporidia to be Telosporidia, it may be advisable to point out the difficulties in the way of regarding them as Neosporidia. This group, which constitutes a subclass of the Sporozoa, is defined by Doflein (1911), p. 701 as composed of Sporozoa which may sporulate during the entire vegetative period.

Thus, a typical neosporidian will consist of a multinucleate organism, in the cytoplasm of which there will be a number of spores in various stages of evolution. It has apparently always been assumed that something of the sort takes place in the Sarcosporidia; that the cyst originates from a multinucleate element which only secondarily becomes multicellular. As we have seen, however, the cyst is composed of separate cells from the very outset. Hence there appears to be no good reason for regarding the Sarcosporidia as Neosporidia.

We are now in position to suggest, at least tentatively, a new classification for the Sporozoa. This class is divided into two subclasses, the Telosporidia and Neosporidia. In the first, division into multiplicative elements takes place only at the end of the vegetative period. In the second, as we have seen, growth and spore formation take place simultaneously.

Following Doflein, the Telosporidia may be divided into two orders, as follows:

1. Coccidiomorpha:
   - Vegetative stage continuously intracellular.
   - Fertilization anisogamous.
   - Sexual generation continuously or transiently intracellular.

2. Gregarinida:
   Vegetative stage, if intracellular at all, only so at first; adults always extracellular.
   Fertilization anisogamous or isogamous.
   Fertilized forms always continuously extracellular.

In the Sarcosporidia, the vegetative stage is intracellular, becoming extracellular only through the destruction of the cells originally occupied. Fertilization is anisogamous and the sexual generation is typically intracellular, becoming extracellular only by accident. Evidently, then, so far as the main characters go, those of the Sarcosporidia are identical with those of the Coccidiomorpha. It therefore seems allowable to place them in this group.

Doflein divides the order Coccidiomorpha into suborders, as follows:

1. Coccidia:
   Sporozoites inclosed in spores.
   Zygotes nonmotile, mostly intracellular.
2. Haemosporidia:
   Sporozoites always free.
   Zygote, as the ookinete, motile, and migrating into new cells.

Judging from Erdmann's contribution, the sarcosporidian zygote does not produce spores, but divides directly into what are possibly sporozoites. This would place the Sarcosporidia closer to the Haemosporidia than to the Coccidia. But the fact that the zygote is apparently nonmotile indicates that the relationship with the Coccidia is the closer. Obviously, however, the Sarcosporidia are neither Coccidia nor Haemosporidia, but our very scanty knowledge regarding this phase of their life history prevents us from defining them in the terms used by Doflein for the two other groups. For the present, it seems best merely to consider them to be one of three suborders making up the Coccidiomorpha.

The Sporozoa may then be reclassified as follows:

Class Sporozoa.
Subclass I, Telosporidia.
Order 1, Coccidiomorpha.
Suborder A, Coccidia.
Suborder B, Haemosporidia.
Suborder C, Sarcosporidia.
Order 2, Gregarinida.

Subclass II, Neosporidia.
Order 1, Cnidosporidia.
Suborder A, Myxosporidia.
Suborder B, Microsporidia.
Suborder C, Actinomyxidia.
Order 2, Haplosporidia.

It is to be observed that the characters used by Doflein to classify the Telosporidia are not those having to do with the nature of the life history. Thus, although the Haemosporidia have two hosts while the Coccidia have but one, these two groups are ranked as closely related suborders. Therefore the fact that we are still in the dark as to whether the Sarcosporidia have two hosts or only one has no bearing upon what is their proper place in the classification of the Sporozoa.

With regard to this question, the probabilities are that there are two hosts. Indeed, such an hypothesis is more or less obligatory when it comes to accounting for the wide-spread occurrence of Sarcosporidia in purely herbivorous animals, such as sheep. As no more than an interesting speculation, it might be suggested that the second host, a carnivor, infects itself by eating the infected flesh of a herbivor. The merozoites, released in the intestine, initiate the sexual cycle and the encysted form is discharged in the feces. This encysted stage, ingested by a herbivor with its food, eventually infects the muscles and the cycle is repeated. Analogy would lead us to suspect that the sexual cycle is, in general, confined to the carnivor; the asexual to the herbivor. This view receives a certain amount of indirect support from the facts that whereas the purely herbivorous sheep and cattle are practically invariably infected, records of the finding of sarcosporidian cysts in the muscles of carnivorous animals are very rare. Finally, the fact that in the mouse both the sexual and asexual cycles occur presents no particular difficulty. Mice are omnivorous and can infect themselves either by eating the flesh of their dead fellows, or, as Nègre first showed, by the contamination of their food with the encysted fecal stage. In conclusion, it may be mentioned that Nègre's discovery is of the utmost significance when it comes to an endeavor to elucidate the life history of the Sarcosporidia. Yet, for whatever may have been the reasons, it has been persistently overlooked or ignored and hence has never been awarded the credit to which it is entitled.

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COLD-BLOODED VERTEBRATES FROM COSTA RICA AND THE CANAL ZONE.

BY HENRY W. FOWLER.

During the summer of 1915 Mr. David E. Harrower gathered the collections listed below, which were later purchased by the Academy. Several of the fishes are new to science, and other records are for rare or unusual forms.

COSTA RICA.

The collections made in Costa Rica were obtained at Guapilis, the Chirripo River Valley and Port Limon, all in the Atlantic drainage.

Guapilis.

A small collection of fresh-water fishes was obtained in the basin of the Rio Guapilis.

Astyanax æneus costaricensis Meek.

Head $3\frac{4}{5}$; depth $2\frac{1}{2}$ to $2\frac{3}{4}$; D. III, 8 to III, 9; A. III, 25, I to III, 27, I; scales 34 to 36 in lateral line to caudal base and 3 more on latter; snout $3\frac{7}{8}$ to 4 in head; eye 3 to $3\frac{1}{8}$; maxillary $2\frac{1}{4}$ to $2\frac{1}{3}$; interorbital $2\frac{7}{8}$ to 3; maxillary teeth 1–2 and 1–1, inner row 4–4. Color when fresh in alcohol olive-brown on back. Broad lateral brassy band, nearly wide as eye, changes behind into leaden-dusky blotch at middle of caudal base, and continues out on median caudal fin-rays to their edges. Hind edges of each caudal lobe narrowly blackish, fin gray, and lower lobe tinged with red. Dorsal warm brown. Adipose fin gray. Anal gray, darker along lower edge and in front with median blood-red tinge or blotch, fading out behind. Pectoral dilute reddish. Ventral bright vermilion. Iris yellowish. Two examples 98 and 100 mm. in length.

Alfaro cultratus (Regan).

Color olivaceous above, when fresh in alcohol. Dusky median streak on back. Iris olivaceous. Lower surface of body and head paler than back. Dusky streak extends down each side of lower jaw and on under side of head till opposite hind pupil edge. Dorsal gamboge-olive. Caudal olive-gray. Other fins pale gamboge. Three examples, 52 to 58 mm.

Priapichthys annectens (Regan).

Head $3\frac{2}{3}$; depth 3; D. I, 9; A. III, 7; scales 28 to caudal base and about 10 more on caudal basally; 9 scales between dorsal and anal origins; 20 scales before dorsal; snout $2\frac{4}{5}$ in head measured from upper jaw tip; eye $3\frac{1}{3}$; maxillary $2\frac{3}{5}$. Gill-rakers about 15 short points. On head above several large cavities or channels lengthwise from near front of snout till over middle of eyes. A transverse channel posteriorly also over eye on each side, and still posteriorly 2 more large pores. Color when fresh in alcohol olivaceous-dusky above and on sides, all scales strongly contrasted by dark or dusky-black borders, forming a prolonged reticulated pattern. Under surface of head and trunk pale to whitish. Jaws dusky. Iris olive. Dorsal olivaceous, marginally grayish and each membrane at base with blackish blotch. Caudal gray, olive-gamboge basally. Pectoral pale olive. Ventral yellowish. Anal bright orange-red in front, edge behind, and basal portion yellowish. One example, a female, 63 mm.

Pœciliopsis isthmensis Regan.

Color of male fresh in alcohol olivaceous above and on sides, lower surface of head and trunk paler. Each scale with dark edge sharply defined and producing greatly contrasted reticulated pattern. Row of underlaid narrow leaden vertical lines or streaks, about 14 in number, along middle of sides. Fins grayish, edges slightly darker. Dorsal mostly tinged olive basally. Edge of intromittent organ dusky. Iris dark. Length 43 mm. for largest, and 22 mm. for smallest, in series of eleven examples. The smaller males show the anal tinged with orange, and dorsal and caudal bases gamboge. Also black dots at edges of scales.

Adult female with scales very dark edged. Dusky spot on each dorsal membrane before dorsal ray basally. Anal gray and ventral whitish. Dusky blotch above vent. Iris olive. One example 50 mm. long.

Pœciliopsis maculifer sp. nov. Fig. 1.

Head $4\frac{1}{3}$; depth $3\frac{2}{3}$; D. I, 8; A. III, 7; P. I, 11; V. I, 5; scales 29 in lateral series to caudal base and 3 more on latter; 9 scales between dorsal and anal origins; 17 scales before dorsal; head width $1\frac{2}{5}$ its length; second branched dorsal ray $1\frac{1}{4}$; first branched anal ray $1\frac{1}{8}$; least depth of caudal peduncle $1\frac{2}{5}$; caudal little longer than head; pectoral $1\frac{1}{8}$; ventral $1\frac{2}{5}$; snout $3\frac{1}{4}$ in head, measured from upper jaw tip; eye $3\frac{1}{4}$; maxillary 3; interorbital $1\frac{4}{5}$.

Body elongate, rather robust forward, deepest at ventral origin, well compressed, predorsal region moderately depressed and abdomen somewhat pot-bellied. Caudal peduncle somewhat large, elongate, least depth but slightly over half its length.

Head small, depressed above, convex below and profiles alike. Snout broad, depressed above, and length (in profile) about half its width. Eye rounded, rather high, and about midway in head length. Eyelids free. Premaxillaries greatly protractile. Maxillary little free, vertical, mostly concealed, and not reaching eye. Mouth small. Lower jaw rather weak, slightly protrudes, and at unison of rami rather weak, shallow. Teeth small, uniform, simple, conic, in a single row and flexibly fastened at bases. Lips rather

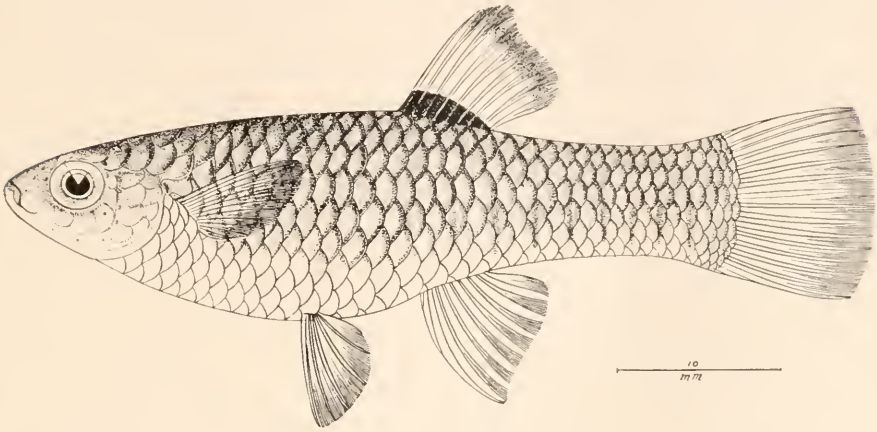

Fig. 1.—*Pœciliopsis maculifer* Fowler.

thin. Tongue small, depressed, free in front. Nostril close above upper front eye edge. Interorbital flattened. Preopercle ridge inclined slightly forward.

Gill-opening extends forward about opposite hind pupil edge. Rakers about 16 short weak points, about $\frac{2}{5}$ of filaments, and latter about half of eye.

Scales large, cycloid, narrowly imbricated, largest on upper surface of head, and become small on caudal peduncle behind. Scales on breast and belly but little smaller than those on sides. Caudal base with several irregular rows of small scales. Several rather large pores or pits on head above, one directly behind upper hind edge of eye. Mucous channel, opening by several pores, along edge of preopercle. Side of snout with several smaller pores.

Dorsal inserted about midway between hind pupil edge and caudal base, second branched ray highest, and depressed fin extending slightly over half way to caudal base. Anal inserted slightly behind dorsal origin, reaches about half way to caudal base when depressed, and first branched ray longest. Both dorsal and anal form distinct point in front at tip of second branched ray, and upper front edge of each also slightly emarginate. Caudal with hind edge convex, each corner forming slight angle. Pectoral rather broad, extends back opposite ventral origin. Ventral inserted about midway between pectoral and anal origins, depressed fin reaching latter, and first branched ray longest. Vent and genital orifice close before anal.

Color when fresh in alcohol olive-yellow generally above, edges of scales darker. Lower surface of head and belly pale to whitish. Dorsal bright orange-yellow, edge gray and base broadly jet-black. Caudal grayish, base yellowish. Pectoral pale olive. Anal and ventral whitish, tinged with yellowish medianly. Broad dark brown median streak down back and brownish line along lower surface of caudal peduncle from anal to caudal base. Iris olive.

Length 55 mm.

Type, No. 45,391, A. N. S. P. (Female.) Rio Guapilis at Guapilis, Costa Rica. July, 1915. D. E. Harrower.

Also Nos. 45,392 to 45,394, same data, paratypes, all females. They show: Head $3\frac{1}{3}$ to 4; depth $3\frac{4}{5}$ to 4; D. I, 8; A. III, 7; scales 30 to 32 in lateral series to caudal base and 3 more on latter; snout 3 to $3\frac{1}{4}$ in head, measured from upper jaw tip; eye $2\frac{2}{5}$ to $2\frac{4}{5}$; interorbital 2; length 25 to 46 mm.

Allied with the preceding species in having the dorsal origin slightly before that of the anal. It differs in the more elongate body. In the small head it resembles *P. pittieri*, though that species is said to have the depth 2.6 to 2.8. The jaws are not so broadly truncate as in *Pœcilopsis* generally, but have a more rounded appearance laterally, as in *Fundulus* and allied genera.

(*Macula*, spot; *fero*, to bear; with reference to the black basal dorsal blotch.)

Mollienisia sphenops tropica (Meek).

Color of adult female generally olivaceous, under surface of head and trunk paler, when fresh in alcohol. Along side of trunk each scale with small obscure orange spot, producing lengthwise streaks. Dorsal olive, base jet-black over good portion. Caudal and pectoral dull olive. Anal orange, hind edge whitish. Ventral whitish. Iris olive. Length 60 mm.

Adult male similar, except black on dorsal broken into numerous small rounded spots, and caudal base slightly mottled. Lower fins whitish. Length 48 mm.

A large female is uniform dark olive above, and paler or whitish below. Fins all paler. Dorsal blotched with black in front at base, and behind basally with some small black dots. Altogether a series of six examples, and all show a black dorsal blotch.

No orange spots on the scales are mentioned for *Platypœcilus tropicus* Meek and *Pœcilia tenuis* Meek. Under *M. sphenops* Regan says,[1] "often a dark spot on each scale of side of body" in female, and in male "spots on sides rarely present."

Cichlasoma spilurus (Günther).

Head $2\frac{7}{8}$; depth $2\frac{1}{5}$ to $2\frac{2}{5}$; D. XVII, 10, 1; A. VIII or IX, 8, 1; snout $2\frac{1}{2}$ to $2\frac{2}{3}$ in head; eye $3\frac{2}{3}$ to 4; maxillary $3\frac{1}{2}$ to 5; interorbital $2\frac{1}{2}$ to $3\frac{1}{8}$. In the small example general color olivaceous, with nine vertical darker bars wider than interspaces along back and sides above, fifth little enlarged medianly as jet-black blotch, and last at caudal base similar. Fins all grayish, ventral brownish along front edge. The larger example is obscure brownish generally, tinged with moss-green on soft dorsal, anal, caudal, pectoral and sides of head. Eight vertical dusky-brown bars, little broader than interspaces, fourth and last black and greatly pronounced. Spinous dorsal, anal and front ventral edge dusky, rest of fin like back. Iris slaty. Lower lip pale. Two examples, 70 and 104 mm. long.

Cichlasoma alfari Meek.

Head $2\frac{2}{5}$ to $2\frac{1}{2}$; depth $2\frac{1}{5}$ to $2\frac{1}{2}$; D. XVII or XVIII, 10 or 11; A. VII, 8 or 9; scales 20 or 21 in upper l.l. (9 tubes in young), and 8 to 12 in lower l.l. (3 tubes in young); snout $2\frac{1}{2}$ to $3\frac{1}{5}$ in head; eye 3 to $3\frac{1}{3}$; maxillary $3\frac{1}{4}$ to 4; interorbital $2\frac{4}{5}$ to $3\frac{1}{3}$. Color in alcohol brownish above, paler to whitish below. Snout with grayish tinge. A number of rather large gray-blue spots on preorbital region, cheek, and opercles. Dusky streak from eye to suprascapula, along side of body to caudal base above, ending in black pale-edged ocellus about size of pupil. Six broad transverse dusky-olive bands cross dark lateral streak, each much wider than interspaces. Behind pectoral dark band broken regularly by pale vertical interspaces, first and penultimate resulting dark blotches especially dark or blackish. Costal region with pale round median spot on each scale, and hind edge of each scale also with dark vertical bar. Vertical

[1] Proc. Z. Soc. London, 1913, p. 1013.

fins grayish on outer portions, brownish basally, with obscurely mottled appearance on spinous dorsal. Last membranes of soft dorsal and anal with few small pale gray spots, also similar spots on middle of caudal. Pectoral gray. Ventral whitish, gray-brown on front outer portion, hind edges white. Iris neutral tint. In the young examples edge of spinous dorsal and front upper edge of soft dorsal maroon-color, fins blotched lengthwise with darker olive. Several pale spots at bases of last dorsal and anal rays. Front ventral edge and lower anal edge broadly gamboge.

Length 33 to 100 mm.

Bufo valliceps Wiegmann.

Four examples, snout to vent 26 to 40 mm.

Hyla bocourti (Mocquard).

Head little longer than wide. Snout rounded, little longer than eye. Canthus rostralis distinct. Loreal region slightly oblique and concave. Tongue ovoid, slightly emarginate behind. Vomerine teeth in two small slightly oblique groups between choanæ. Interorbital little wider than upper eyelid. Tympanum distinct, nearly half diameter of eye. Skin weakly though finely granular above, belly and lower femoral region coarsely granular, Fingers very slightly webbed at bases. Toes two-thirds webbed, and disks half size of tympanum. Distinct fold along inner tarsal edge. Gray-brown above paler or whitish beneath, in alcohol. Dull brownish obscure interorbital bar, and similar band from each upper eyelid down back to vent, with narrow vertebral separation. More contrasted dark brown band from each side of snout tip back to eye, including tympanum and ending in groin, and narrow whitish line along its entire upper edge. Length, from snout to vent, 17 mm.

It resembles *Hyla eximia* Baird in having the dark lateral band from snout to groin. It differs in the obscure dark dorsal band each side of the vertebral line and the toes better webbed.

Eleutherodactylus humeralis sp. nov. Fig. 2.

Body well depressed, elongately ovoid in contour as seen from above, and width slightly greater than length of head. Latter very broad, well depressed. Snout flattened above, and contour as seen from above broadly triangular, tip obtuse. Canthus rostralis distinct. Loreal region level and oblique. Eye moderate, about $\frac{2}{3}$ length of snout, or equal to space between front eye edge and nostril. Mouth large, rictus falling about opposite hind edge of eye. Lips moderate. Maxillary teeth uniserial, conic, mostly uniform.

Vomerine teeth in two large patches, rather closely approximated, oblique, and behind hind edges of choanæ. Tongue broadly ovoid, last third free, and hind edge generally convex, except slight median emargination. Choanæ smaller than vomerine patches of teeth. Interorbital flattened, upper eyelid $\frac{2}{3}$ its width. Tympanum ellipsoid, $\frac{3}{5}$ eye-diameter.

Skin largely smooth, a few granules around vent and post-femoral region. No distinct fold across throat or breast.

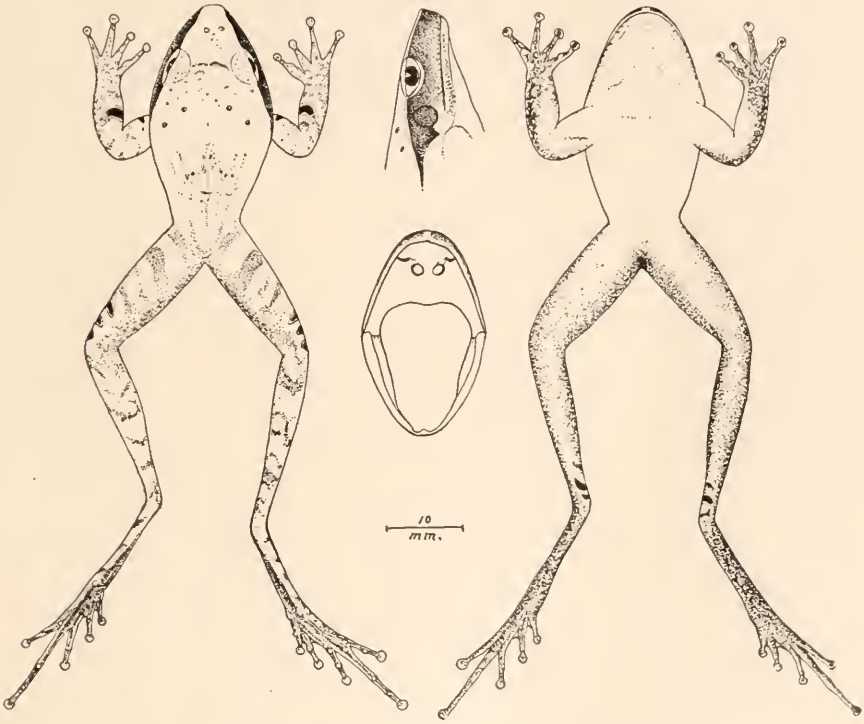

Fig. 2.—*Eleutherodactylus humeralis* Fowler.

Limbs all slender. Fingers free, and only outer toes one-third webbed. First finger little longer than second, and slightly swollen basally. Third finger longest. Tubercles on phalanges apparently well developed. Disks on toes and fingers moderately small, rounded, apparently not quite half size of tympanum. Toes slender, fourth much longest. Apparently no tarsal fold, though hind tubercle distinct.

Color in alcohol pale gray-brown generally above, lower surfaces

largely uniform whitish. On upper surface of snout two small blackish rings, near canthus rostralis and midway in snout length. On each scapular region two similar ones. Narrow dusky streak or line across interorbital from one eyelid to the other. Dusky-black band from each side of snout tip back below eye including tympanum to shoulder. Several obscure dusky small circles form irregular dark triangle on front of pelvis above. Each joint of fore limbs with several obscure brownish transverse bars, one of which, with black blotch, on each ulna and humerus. Hind limbs with three or more similar obscure cross-bars. Outer surface of femur near knee with three more or less connected blackish blotches. Both outer and inner edges of hind limbs, including tibia, tarsus and metatarsus, dusky. Lips mottled with brownish.

Length, from snout tip to vent, 33 mm.

Type, No. 19,593, A. N. S. P. Guapilis, Costa Rica. July, 1915. D. E. Harrower.

This species appears closely related to *E. bocourti* (Brocchi),[2] but differs in several respects. *E. bocourti* has the partly circular tongue entire, the tympanum one-third the eye, first and second fingers of nearly equal length, toes with a rudimentary web, and arms and legs marbled with brown above.

(*Humeralis*, with reference to the dark blotches on the humerus near the knee.)

Dendrobates tinctorum (Keferstein).

One example dull crimson-purple above, variegated with darker markings. A small one beautiful dark crimson, marked with blackish dots on the back and head above. Its lower surface is blotched with blackish. Another larger example buff in general tint, marked or speckled with blackish above, and upper surface of hind limbs, and lower surface of same, blackish. Throat and belly pale buff, with few scattered dusky specks. Altogether four, 13 to 22 mm., measured from snout to vent.

Rana cæruleopunctata Steindachner.

Color in alcohol dark olive on back, with obscure small rounded dull dark bluish spots down middle from between eyes to vent. Blackish band begins on each side of snout near tip, extends back below eye, broadens, includes tympanum and continues to groin, edged very narrowly above its whole extent with whitish line. From

[2] *Hylodes bocourti* Brocchi, Miss. Sc. Mex. Batr., 187 , 50, Pl. 16, fig. 2. Coban, Guatemala.

below eye to shoulder distinct broader white line forms part of lower margin. Dusky band from fore part of shoulder on front of forearm. Front limbs brownish, blotched with darker, and brown streak along entire hind edges. Hind limbs brownish above, each with two or three dusky cross-bars on upper surfaces. Hind surface of each femoral region above with two large golden blotches, lower surface mostly whitish and immaculate. Throat, breast and belly mottled brownish-dusky. Glandular fold scarcely developed. Length, snout tip to vent, 28 mm.

Chirripo River Valley.

A few specimens were obtained in this region during late July.

Phryniscus varius (Keferstein).

Color when fresh brilliant moss-green, marked with bright chrome-yellow spots on back and cross-bars on upper surfaces of limbs. Lower surface of body pale yellowish, marked with slaty blotches and irregular splotches or bands.

Another example also bright green above, finely speckled with blackish, yellow blotches edged with dusky, and sides slaty-gray. Under surface pale yellowish-white with irregular slaty-gray blotches, more sharply defined on lower femoral region.

A third example black above with bright cadmium-orange blotches from behind eye on sides and upper surfaces of limbs. Middle of back with small chrome-yellow specks. Lower surface of head and line above upper lip chrome-yellow, throat with several large black blotches. Under surface of head black, like back marked with chrome-yellow blotches.

Length 31 to 41 mm., from snout tip to vent.

Oxybelis acuminatus (Wied).

One example, 392 mm.

Port Limon.

A more representative collection was gathered during July and August than elsewhere in Costa Rica during this trip. The fishes were all obtained from fishermen or in the markets.

Albula vulpes (Linné).

One, 147 mm. long.

Sardinella humeralis (Valenciennes).

Four examples, 115 to 120 mm.

Opisthonema oglinum (Le Sueur).

One, 190 mm.

Soomberomorus cavalla (Cuvier).

Two, 127 to 195 mm.

Caranx crysos (Mitchill).

One, 125 mm.

Caranx latus Agassiz.

One, 97 mm. Head 3; depth $2\frac{1}{2}$; scutes 35; snout $3\frac{1}{2}$ in head; eye $3\frac{1}{8}$; maxillary $2\frac{1}{10}$; interorbital $3\frac{2}{5}$; curved part of lateral line $1\frac{2}{5}$ in straight portion. Opercular spot obsolete. Narrow naked area medianly on front of breast.

Vomer setapinnis (Mitchill).

Two, 122 and 131 mm.

Chloroscombrus chrysurus (Linné).

Four, 118 to 140 mm.

Trachinotus glaucus (Bloch).

One, 128 mm.

Trachinotus argenteus Valenciennes.

Head $3\frac{1}{8}$; depth 2; D. I, VI–I, 23; A. II–I, 21; snout 4 in head; eye $3\frac{1}{5}$; maxillary $2\frac{1}{2}$; interorbital $2\frac{2}{3}$. Body deep, compressed. Head compressed. Snout broadly convex, length half its width. Eye large, adipose-eyelid rather well developed. Maxillary reaches about opposite first third in eye. Teeth fine, conic, in narrow band above and in broad band below. Mouth rather small, lower jaw much shorter. Nostrils together on middle of front surface of snout. Interorbital high, convex. Rakers about 6+10, lanceolate, about $\frac{2}{7}$ of eye. Scales small. Lateral line complete, slightly wavy in front. Last dorsal spine longest. Soft dorsal with distinct lobe in front, and when depressed reaches $\frac{3}{5}$ in total length of fin. Soft anal also with short front lobe, when depressed $\frac{2}{3}$ total length of fin. Caudal strongly forked, tip of each lobe sharp, and an eye-diameter longer than head. Pectoral $1\frac{1}{3}$ in head. Ventral shorter, $2\frac{1}{8}$ in head. Color in alcohol grayish above, sides and below silvery-white. Front lobe of soft dorsal dusky, also outer edge of upper caudal lobe, fins otherwise whitish. Iris whitish. Length 135 mm.

This little-known fish differs from *T. carolinus* (Linné), when examples of the same size are compared, in the larger eye, more pointed dorsal, anal and caudal lobes, blackish tip of dorsal lobe and dusky edges to caudal lobes.

Pomadasis ramosus (Poey).

Two, 150 and 180 mm.

Eucinostomus harengulus Goode and Bean.

Two, 110 mm.

Gerres olisthostomus Goode and Bean.

Three, 96 to 188 mm.

Larimus breviceps Cuvier.

Two, 128 and 130 mm.

Polydactylus virginicus (Linné).

Two, 190 and 205 mm.

Cichlasoma maculicauda Regan.

Two, 105 and 152 mm.

Hyla punctariola Peters.

Head long as broad. Snout triangular, little longer than eye. Canthus rostralis distinct. Loreal region level, oblique. Tongue ovoid, last third free, hind edge slightly emarginate. Vomerine teeth in two small slightly oblique groups, well separated, and close behind choanæ. Interorbital little wider than upper eyelid. Tympanum obscure, apparently slightly less than half of eye. Skin smooth above, also on throat. Belly and lower femoral region granular. Fingers entirely free. Inner toes slightly webbed basally. Disks about half of eye. Several metatarsal tubercles and one at heel. Light buff-brown on back and upper surfaces of limbs, which latter with obscure cross-blotches or spots. Supraorbital width darker brown than rest of upper surface of head. Upper lip white-edged. Lower surface of body creamy-white, under a lens seen to be marked most everywhere with minute yellowish dots. Disks all whitish. Length, from snout tip to vent, 27 mm.

Eleutherodactylus polyptychus (Cope).

Great variation in color is noticeable in the seven examples from this locality. The largest brownish down middle of back, streaked irregularly on tubercles with dusky. Head brown above, upper lip with short dark streaks. Limbs brownish above, front pair paler, and hind pair each with three or four dusky cross-bars on femur, tibia, tarsus and metatarsus. Lower surface of body and sides whitish, latter formed in contrast as brown streak continues back from eye including tympanum and fades out on front side of belly. Several of the larger examples show a ruddy tinge on the femoral surface closing against the groin and inner surfaces of femur and tibia. Smaller examples all present less striking color-pattern, especially on sides, which only slightly paler. In all dark cross-bars on hind limbs conspicuous. One small example shows narrow pale

vertebral line. Another has blackish streak from eye over shoulder very pronounced. Largest example 23 mm., measured from snout tip to vent, smallest 9.

Dendrobates tinctorum (Keferstein).

Six examples, all uniform dark purplish-black in alcohol. Length 20 to 22 mm., measured from snout tip to vent.

Eublepharis dovii Boulenger.

Two examples, 80 to 127 mm.

Anolis lunifrons Cope.

Dewlap little developed, and sides of neck crimson. Nine examples, 80 to 127 mm.

Anolis insignis Cope.

One, 220 mm.

Anolis capito Peters.

Two, 80 to 202 mm.

Anolis humilis Peters.

Five, 38 to 65 mm.

Ameiva festiva (Lichtenstein).

One, 238 mm.

Ameiva undulata quadrilineata (Hallowell).

Two, 170 and 182 mm. long. These represent *Ameiva gabbiana* Cope, merged in the synonymy of the present species by Dr. Boulenger. They vary slightly. The single enlarged rounded preanal plate is present. Scales in middle of throat but slightly enlarged, and collar with an enlarged plate each side of median line. Humeral scutes in one row. Great variation is also seen in the scutes on top of the head. In one example the frontonasal is not in contact with the posteronasal, as a small scale intervenes. Scales in the supraorbital semicircles and at occiput quite variable. Some blackish dots on throat.

THE CANAL ZONE.

The collections from this section were obtained at Colon, Gatun, Pedro Miguel, Empire and Panama, and are from both Atlantic and Pacific drainages.

Colon.

Only marine fishes were obtained at this locality. A number of smaller species were collected on the reef at Torro Point, in the Caribbean, during July, in which case the locality is given.

Rhinobatos percellens (Walbaum).

One, agreeing with an example from Trinidad.

Tarpon atlanticus (Valenciennes).

Small one, 107 mm. long.

Sardinella humeralis (Valenciennes).

One, 100 mm.

Opisthonema oglinum (Le Sueur).

Three, 80 to 90 mm. long. Also three from Torro Point, 57 to 85 mm. long. All have median caudal rays dusky and row of dark spots on side back from gill-opening.

Anchovia gilberti Evermann and Marsh.

One example, 118 mm.

Hyporhamphus unifasciatus (Ranzani).

Two, 156 and 166 mm. Lower caudal lobe slightly longer than upper.

Sphyræna barracuda (Walbaum).

One, 130 mm. long, from Torro Point.

Sphyræna guachancho Cuvier.

One example, 168 mm.

Mugil curema Valenciennes.

One small example from Torro Point.

Holocentrus adscensionis (Osbeck).

One, 153 mm. long.

Holocentrus siccifer Cope.

One from Torro Point differs from the type, as figured by me, in the black markings on the first two membranes of the spinous dorsal entirely of that color, except the narrowly whitish base. All other membranes of spinous dorsal dusky to blackish, especially basally. Length 52 mm.

Scomberomorus cavalla (Cuvier).

Four, largest 148 mm. in length.

Caranx hippos (Linné).

Two examples, 150 and 165 mm.

Caranx crysos (Mitchill).

One, 132 mm. long.

Vomer setapinnis (Mitchill).

Two, 123 and 183 mm.

Chloroscombrus chrysurus (Linné).

One, 140 mm. long.

Seserinus paru (Linné).

One, 138 mm.

Centropomus undecimalis (Bloch).

One, 254 mm.

Rypticus arenatus Cuvier.

One, 130 mm.

Lutianus apodus (Walbaum).

One, 126 mm. long. Also two from Torro Point, 42 and 43 mm.

Rhomboplites aurorubens (Cuvier).

One, 160 mm.

Hæmulon parra (Desmarest).

One, 145 mm.

Hæmulon plumieri (Lacépède).

Two, 133 and 142 mm.

Hæmulon flavolineatum (Desmarest).

One, 140 mm.

Brachygenys chrysargyreus (Günther).

Two, 143 and 152 mm.

Pomadasis ramosus (Poey).

One, 128 mm.

Orthopristis scapularis Fowler.

One, 170 mm. long.

Archosargus unimaculatus (Bloch).

One, 120 mm.

Isopisthus harroweri sp. nov. Fig. 3.

Head $3\frac{1}{5}$; depth $4\frac{1}{8}$; D. VIII–I, II, 16, I; A. II, I, 18; P. III, 16; V. I, 5; scales 105 in series just above lateral line to caudal base; 16 scales above lateral line to soft dorsal origin; 16 scales below lateral line to anal origin; about 48 scales before spinous dorsal origin; about 60 pores in lateral line to caudal base, and about 40 more pores over caudal fin; head width $2\frac{2}{3}$ in its length; head depth at occiput $1\frac{2}{5}$; third dorsal spine $2\frac{1}{2}$; first branched dorsal ray $2\frac{1}{5}$; first branched anal ray $2\frac{1}{3}$; least depth of caudal peduncle $3\frac{2}{5}$; caudal $1\frac{2}{5}$; pectoral $1\frac{1}{3}$; ventral $1\frac{2}{3}$; snout 4 in head, measured from upper jaw tip; eye $4\frac{2}{5}$; maxillary $2\frac{1}{8}$; interorbital $3\frac{1}{2}$.

Body elongate, slender, well compressed, edges mostly convex

and rather long occipital keel from occipital process slightly trenchant. Caudal peduncle compressed, least depth $1\frac{3}{4}$ its length.

Head well compressed, upper profile concave over eye, otherwise convex, and lower profile steeply inclined convexly. Flattened sides of head approximated below. Snout convex, so that tip of upper jaw level with upper eye edge, length $\frac{7}{8}$ its width. Eye large, rather high, little longer than deep, well anterior. Mouth large, greatly inclined, and lower jaw strongly protruding. Maxillary extends back opposite middle of eye. Teeth large, conic, and depressible in outer series in upper jaw, which also with one enlarged fang-like canine in front, and all along inner edges band of fine teeth. Lower teeth erect, firm, conic, several enlarged along sides of jaws, though between them also single row of small simple teeth. Tongue

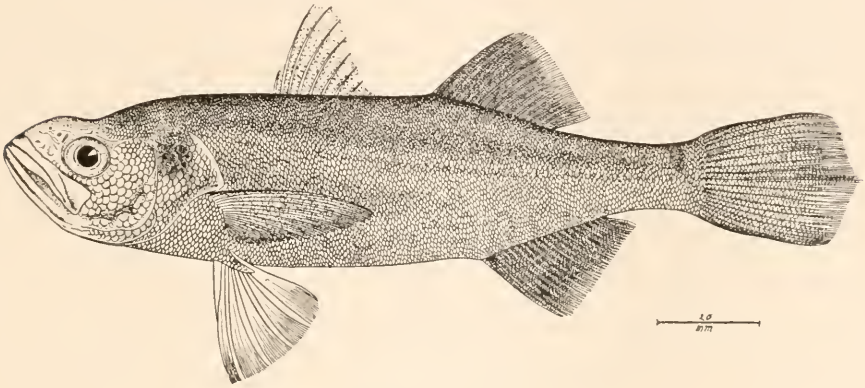

Fig. 3.—*Isopisthus harroweri* Fowler.

long, smooth, free, rounded in front. Mandible convex over surface, capable of great dilation. Nostrils together, close before and slightly above upper edge of eye. Interorbital convex. Suprascapula jagged and hind edge notched. Opercle with large angular membranous flap behind. Hind preopercular edge with membranous edge, notched finely.

Gill-opening extends forward about opposite front nostril. Rakers IV, 1+8, IV, lanceolate, 2 in eye. Filaments about long as rakers. Isthmus narrowly and deeply trenchant.

Scales small, cycloid, more or less irregularly disposed, and very loosely adherent. Head scaly, about 6 rows on cheek. On trunk scales smaller and with more crowded appearance on median dorsal line, about bases of dorsals and caudal. Rather large scales forming

sheath along anal base. Soft dorsal and anal mostly covered with inconspicuous small scales. Lateral line complete, nearly concurrent with dorsal profile. Tubes double on each scale, rather large.

Spinous dorsal inserted little nearer origin of soft dorsal than hind eye edge, third spine longest, second and fourth subequal, and depressed fin extends $\frac{2}{3}$ to soft dorsal. Latter inserted midway between hind preopercle edge and caudal base, first branched ray highest, and fin extends $\frac{3}{5}$ to caudal base. Anal inserted close behind soft dorsal origin, little larger, similar. Caudal double truncate, median rays longest and form point. Pectoral long, pointed upper median rays longest, reach $\frac{2}{3}$ to anal. Ventral inserted little behind pectoral origin, and fin half way to anal origin.

Color in alcohol brownish-olive above, sides and lower surface silvery-white. Head olivaceous above, whitish below. Large dusky nebulous blotch on opercle. Dorsals and caudal dull olive, pectoral paler. Ventrals yellowish, tinged with orange basally. Anal pale yellowish, lower edge narrowly dusky.

Length 174 mm.

Type, No. 45,236, A. N. S. P. Colon, Canal Zone. D. E. Harrower.

Related to *Isopisthus parvipinnis* (Valenciennes), which would differ in having more dorsal rays (21 instead of 16) and fewer anal rays (16 or 17 instead of 18), fewer pores in the lateral line (52 to 54 instead of 60), and in having an indistinct elongate dark blotch from behind the eye to the middle of the opercle.

(Named for Mr. D. E. Harrower, who collected the type.)

Cynoscion jamaicensis (Vaillant and Bocourt).

One, 145 mm.

Larimus breviceps Cuvier.

Two examples, 114 and 158 mm.

Conodon nobilis (Linné).

One, 140 mm.

Umbrina coroides Valenciennes.

Two, 164 and 182 mm.

Eucinostomus harengulus Goode and Bean.

Two, 65 and 117 mm.

Gerres rhombeus Cuvier.

One, 115 mm.

Polydactylus virginicus (Linné)

One, 196 mm.

Abudefduf mauritii (Bloch).

Three from the reef at Torro Point, 34 to 40 mm.

Eupomaoentrus fuscus (Valenciennes).

Ten from the Torro Point reef. Three which are young have a black ocellus at the base of soft dorsal in front, a black saddle-like blotch on the upper surface of the caudal peduncle, and a black axillary pectoral blotch. Length 31 to 95 mm.

Iridio bivittatus (Bloch).

Young example from the reef at Torro Point, 26 mm. in length.

Pomacanthus arcuatus (Linné).

One example, 114 mm. long. The transverse bands are bright lemon-yellow.

Holacanthus tricolor (Bloch).

One, 145 mm. long.

Hepatus cæruleus (Schneider).

One, 100 mm. long.

Hepatus hepatus (Linné).

Two, 112 and 115 mm. long.

Hepatus bahianus (Castelnau).

One, 145 mm. long. Hind caudal edge narrowly whitish.

Spheroides testudineus (Linné).

One, 132 mm. long.

Philypnus dormitor (Lacépède).

One, 125 mm. long from the reef at Torro Point.

Dormitator maculatus (Bloch).

One, 78 mm. long.

Mapo soporator (Valenciennes).

Seven examples from the reef at Torro Point, 36 to 67 mm. long.

Rupiscartes atlanticus (Valenciennes).

One from the Torro Point reef, 70 mm. long.

Ogilbia cayorum Evermann and Kendall.

One from Torro Point reef, 72 mm. long.

Cithariohthys arenaceus Evermann and Marsh.

One, 133 mm. long.

Gatun.

A small collection of fresh-water fishes, amphibians and lizards from this locality.

Brycon striatulus (Kner).

Four examples, 65 to 83 mm.

Astyanax æneus (Günther).

Two, 98 to 103 mm.

Mollienisia sphenops (Valenciennes).

A large series of all ages (33 examples), 29 to 52 mm.

Acara cœruleopunctata Kner and Steindachner.

Fourteen, 47 to 82 mm.

Cichlasoma maculicauda Regan.

Nine examples, all small, about 53 mm. Also large one, 258 mm. long.

Bufo marinus (Linné).

Two, 43 to 52 mm., from snout tip to vent.

Bufo typhonius (Linné).

One, with dark broad vertebral band, 32 mm. from snout tip to vent.

Eleutherodactylus nubilus (Günther).

Two examples, 13 to 28 mm. from snout tip to vent.

Anolis trochilus Cope.

Four examples, 111 to 125 mm. in total length.

Corythophanes cristatus (Merrem).

One, 240 mm.

Enyalioides heterolepis (Bocourt).

One found around rocks near a stream. Length 212 mm.

Ameiva ruthveni Barbour and Noble.

This is represented by one example, 283 mm. long. It differs in several respects from the original account. As there is a group of five anterior supraoculars, with the second largest, the frontal is in contact with the second, third, fourth, and very slightly the fifth, supraoculars. No intercalated pair of scales between outer pair of large occipitals and frontoparietals. The two posterior supraoculars are separated from the superciliaries by narrow wedges of granules, in three or four rows behind. About ten large scales in middle of chin, posteriorly one enlarged twice size of any others. From frontal, down middle of back and tail anteriorly, narrow pale streak. Length 283 mm.

Apparently very closely related to *Ameiva festiva*, of which I have compared examples from Colombia and Nicaragua, which agree with my Port Limon example.

Pedro Miguel.

Rhamdia montaguensis (Günther).

One example, 145 mm.

Piabucina panamensis Gill.

Three, 93 to 105 mm. Active and difficult to secure.

Astyanax mexicanus (Filippi).

Four examples, 67 to 72 mm.

Pœciliopsis retropinna (Regan).

One example, a female, 30 mm. long.

Bufo marinus (Linné).

One, 45 mm. long, measured from snout to vent, with three ticks on its back.

Bufo typhonius (Linné).

Two small examples which agree with Ecuador material. Length 31 and 32 mm. from snout tip to vent.

Leptodactylus caliginosus (Girard).

Vomerine teeth in two closely approximated areas. Eye half length of snout. Nostril near first third in snout length. Tympanum $\frac{4}{5}$ of eye. Skin smooth, except hind femoral region posteriorly, which granular. Slight fold extends from shoulder to groin. Color in alcohol gray-brown generally. Broad blackish triangle between eyes. Black band from each side of snout back, including eye and tympanum, to shoulder, and posteriorly continued as several disconnected black spots. On each side of back, from above tympanum to groin above, black band. Middle of back with lengthwise blackish blotches forming two distinct series on pelvic region. Groin olive-yellow, with few dark cloudings. Fore limbs marbled with dusky, forming a large blotch at and behind elbow. Hind limbs mottled in more contrast with dusky, femoral and tibial regions with several broad dark blotches as cross-bars. Tarsi and metatarsi dusky, outer surfaces mottled or blotched with darker. Under surface whitish, lips mottled with grayish. Length 86 and 91 mm., measured from snout tip to vent. Locality given as Corozal.

Iguana tuberculata Laurenti.

Two young examples, 247 and 251 mm.

Basiliscus basiliscus (Linné).

A female, containing eggs. Length 467 mm.

Ameiva ameiva præsignis (Baird and Girard).

Color in alcohol largely greenish-brown on back. Yellow line each side of back extends from eye, and another similar, though white line from lower edge of eye to groin, interspace jet-black with row of obscure whitish spots. Black band also continued along side of tail at first, fading out behind. Tail brownish above, mottled with dusky. Below lower white lateral line, which most pronounced, gray shade and clouded with dusky or blackish. Under surface of head and trunk gray-white. Upper surface brown, sides whitish. Limbs brownish above reticulated with black, forming two broad black lengthwise lines on hind femoral region and upper continued at first along tail basally short space, gradually fading behind. One example, 255 mm.

Leptodeira polysticta Günther.

One, differing a little from Günther's figure in not having a distinct lengthwise dark bar dividing the neck, but with a lengthwise dark brown saddle-like blotch, pale in the middle. Length 470 mm.

Elaps fulvius (Linné).

Two examples, 502 and 528 mm.

Empire.

Eleutherodactylus rhodopsis Cope.

Two examples, 15 mm., measured from snout tip to vent.

Anolis trochilus Cope.

One example, 83 mm. long.

Anolis lionotus Cope.

Three, 70 to 158 mm.

Norops auratus (Daudin).

Three, 114 to 161 mm.

Panama.

The fishes of Panama Bay have been elaborately treated by Profs. C. H. Gilbert and E. C. Starks in 1905, so that the list here given is only supplementary.

Tachisurus steindachneri Gilbert and Starks.

Head $3\frac{3}{4}$ to $3\frac{7}{8}$; depth $4\frac{3}{4}$ to $5\frac{1}{2}$; D. I, 6 and I, 7; A. VI, 13 and 13; snout $2\frac{3}{4}$ to $2\frac{7}{8}$ in head; eye $5\frac{1}{4}$ to $5\frac{1}{2}$; mouth width $2\frac{2}{3}$ to 3; interorbital $2\frac{2}{5}$; dorsal spine $1\frac{1}{5}$ to $1\frac{1}{3}$. Palatine teeth coarsely granular, without a backward angle extending on inner edge. Granulations or striæ on head extend forward nearly opposite middle of eyes.

Fontanel extends back as narrow groove to occipital plate. Inner surfaces of ventral black, front edge of fin white. Pectoral similarly blackish inside. Upper caudal lobe little longer. Two examples, 200 and 210 mm. long. They differ slightly from the figure given by Gilbert and Starks in the striæ on top of the head extending more distinctly forward.

Muræna clepsydra Gilbert.

One, 595 mm. long.

Pœciliopsis presidionis (Jordan and Culver).

Male and female, 23 and 37 mm.

Tylosurus scapularis Jordan and Gilbert.

Caudal peduncle about wide as deep, and lateral line forms slight though inconspicuous keel along each side. Eye 7 in upper jaw, 3 in postocular part of head. Upper jaw nearly an eye-diameter longer than lower, and not completely closing against lower posteriorly, so that distinct interval is seen between them. D. II, 14; A. II, 15. Upper surface of body greenish in alcohol, especially on head. Sides and below silvery-white. Narrow lateral band of leaden, tapering or narrowed at shoulder and caudal base, and more or less expanded behind. Iris silvery-white. Fins all pale. Length 695 mm.

Holocentrus suborbitalis Gill.

Three examples, 87 to 90 mm.

Mugil curema Valenciennes.

Fourteen small examples, largest 122 mm.

Caranx hippos (Linné).

Two, 111 and 175 mm.

Caranx caballus (Günther).

One, 160 mm. long.

Vomer setapinnis (Mitchill).

Two, 172 and 182 mm.

Centropomus unionensis Bocourt.

One example, 135 mm.

Alphestes multiguttatus (Günther).

Two, 147 and 172 mm. Pectoral with at least five distinct dark vertical cross-bars.

Diplectrum radiale (Quoy and Gaimard).

One, 190 mm. Called "sand mullet."

Rypticus nigripinnis Gill.

Two small examples, 48 and 49 mm.

Xenichthys xanti Gill.

One, 162 mm.

Lythrulon flaviguttatum (Gill).

Two, 140 and 148 mm.

Anisotremus interruptus (Gill).

Four young, 30 to 54 mm.

Anisotremus tæniatus Gill.

One example, 143 mm. long.

Bairdiella ronchus (Valenciennes).

Head $2\frac{7}{8}$; depth $3\frac{2}{5}$; D. X–I, II, 25; A. II, 8; scales 46 in lateral line to caudal base; snout $3\frac{4}{5}$ in head; eye $4\frac{3}{4}$; maxillary $2\frac{1}{5}$; interorbital 4. Snout convexly protruding in upper profile. Lower jaw slightly projects. Lower teeth mostly uniserial, enlarged, conic. Symphyseal knob distinct, surmounted by two canines. Eye little shorter than snout. Preopercle denticles small, larger one below directed forward. Second anal spine $2\frac{2}{5}$ in head. One example, 178 mm. long.

Eucinostomus californiensis (Gill).

One, 83 mm.

Gerres peruvianus Valenciennes.

Three, 75 to 85 mm.

Upeneus grandisquamis Gill.

Four examples, 117 to 164 mm.

Acara cæruleopunctata Kner and Steindachner.

One, 148 mm.

Abudefduf mauritii (Bloch).

Series of all ages which appear to agree with the Atlantic form. Length 38 to 102 mm.

Abudefduf declivifrons (Gill).

One example, 67 mm.

Pseudoscarus perrico (Jordan and Gilbert).

Called "parrot chub." Color in alcohol dusky-brown generally. Blue-green spots radiate around eye. Jaws greenish. Vertical fins livid dull dusky-purple, edges of dorsals and anals narrowly blue-green. Dusky blotch at pectoral base, fin pale. Outer ventral edge pale, rays brownish. Iris yellowish. Length 206 mm.

Hepatus crestonis Jordan and Starks.

Head $3\frac{2}{5}$; depth $1\frac{3}{4}$; D. IX, 25; A. III, 24; snout $1\frac{1}{2}$ in head; eye 4; interorbital $2\frac{4}{5}$; pectoral $1\frac{1}{10}$. In alcohol largely uniform dark chocolate-brown. Dorsals and anals blackish. Caudal slightly paler basally. Pectoral with broad whitish submarginal shade. Length 163 mm.

Chætodon humeralis (Günther).

One example, 124 mm. Jordan and Evermann state "3 dark bands across caudal peduncle at base of fin; caudal fin with a faint band; ventrals dark." My example shows but a single dark transverse bar on caudal peduncle at caudal base and caudal fin with two very sharply contrasted blackish vertical bars slightly expanded medianly, and anterior much wider than any of bars on caudal. The ventrals are whitish with two very indistinct vertical gray bars.

Pomacanthus zonipectus (Gill).

Head $3\frac{1}{4}$; depth $1\frac{2}{5}$; D. XI, 25; A. III, 21; snout 3 in head; eye $3\frac{1}{3}$; interorbital 3. Color faded in alcohol, vertical pale lines whitish. Traces of similarly curved lines, parallel, some irregular in dark areas between whitish lines. Also dark areas with numerous small obscure blackish spots. Length 125 mm.

Chætodipterus zonatus (Girard).

One example, 148 mm.

Balistes vetula Linné.

Two, 100 and 103 mm. long.

Spheroides annulatus (Jenyns).

Two, 49 and 94 mm. long. The dark spots are smaller and more numerous than in Atlantic examples of *S. testudineus* of the same size.

Diodon hystrix Linné.

Two examples, 122 to 125 mm.

Scorpæna mystes Jordan and Starks.

Head $2\frac{2}{5}$; depth $3\frac{1}{3}$; D. XII, 10; A. III, 5; scales 39 to caudal base and 2 more on latter, along lateral line; 7 scales above l.l.; 15 scales in vertical series between l.l. and spinous dorsal origin; snout $3\frac{1}{5}$ in head; eye 5; maxillary $2\frac{1}{5}$; interorbital 5; about 27 pores in lateral line to caudal base. No supraorbital cirrus. Slight pit below front eye edge and suborbital stay. Length 250 mm.

Mapo soporator (Valenciennes).

Twenty-nine examples, 25 to 122 mm.

Garmanina paradoxa (Günther).

Head $3\frac{1}{3}$; depth $4\frac{1}{2}$; D. VII, 1, 11, 1; A. 1, 9, 1; scales 15 in median series on hind part of trunk, begin opposite origin of soft dorsal; 8 scales transversely between last dorsal and anal rays; snout $4\frac{1}{2}$ in head; eye $5\frac{1}{3}$; maxillary $2\frac{1}{2}$; interorbital about 11. Gill-rakers 1+8 short points with broad bases, much shorter than filaments. Color in alcohol pale brownish generally, scarcely paler below. About 13 pairs of deeper brownish transverse bars, from back down along side, and each 2 pairs placed closer to one another, and in places irregularly joined. Each bar seen to be forked as a darker reticulation around a paler spot or centre, also reticulations of various extent. Similar dark transverse bar extends down on cheek, though narrower one immediately behind eye and another on top of head before gill-opening, not extending down on side of head. Iris with pale circle around pupil. Ventrals blackish, edge narrowly whitish. Fins all grayish, clouded or obscurely marked with darker. Length 42 mm.

Microgobius miraflorensis Gilbert and Starks.

One 26 mm. long. Gilbert and Starks give A. 17, though their figure shows 1, 10. My example lacks the cirri about the jaws they represent, and at present the dark spots on the fins are much more contrasted.

Hypsoblennius striatus (Steindachner).

Fourteen examples, 46 to 80 mm.

Batrachoides pacifici (Günther).

Two adults, 178 and 222 mm. long. Young examples differ in the absence of scales.

Gobiesox microspilus sp. nov. Fig. 4.

Head $2\frac{1}{2}$; depth 5; D. 13; A. 9; P. 25; head width $1\frac{1}{3}$ its length; snout $3\frac{1}{2}$; eye 6; mouth width $2\frac{1}{8}$; interorbital $2\frac{4}{5}$; third dorsal ray 3; third anal ray $3\frac{2}{5}$; least depth caudal peduncle $4\frac{1}{3}$; caudal $1\frac{3}{4}$; pectoral $2\frac{1}{5}$.

Body moderately long, depressed forward, compressed behind, convex above, flattened below, and slight median groove before anal. Caudal peduncle compressed, short and little free.

Head large, upper profile convex from snout tip to occiput, lower nearly straight and horizontal. Snout wide, convex over surface, length less than half its width as measured across front of eyes. Eye ellipsoid, high, centre slightly behind first third in head length. Eyelids not distinct, skin of head passing over. Mouth broad,

upper jaw slightly protruding. Lips broad, each fringed with rather long free dermal flaps. Transverse groove of premaxillaries distinct on snout above. Teeth in one row in each jaw, simple, conic, two front ones enlarged or canine-like above. Both jaws with anterior teeth little enlarged, and in front of lower more so, compressed or incisor-like, their tips rather broadly triangular. Inner buccal folds broad. Tongue broad, fleshy, depressed, free around edges. Nostrils rather close together, above level of eye near its front edge, anterior in short fleshy tube and posterior simple pore. Interorbital broad and slightly convex. Opercular spine not extending through integument, concealed.

Gill-opening extends forward about opposite last $\frac{2}{5}$ in head. Gill-rakers about 6 short rudimentary points, much shorter than short gill-filaments.

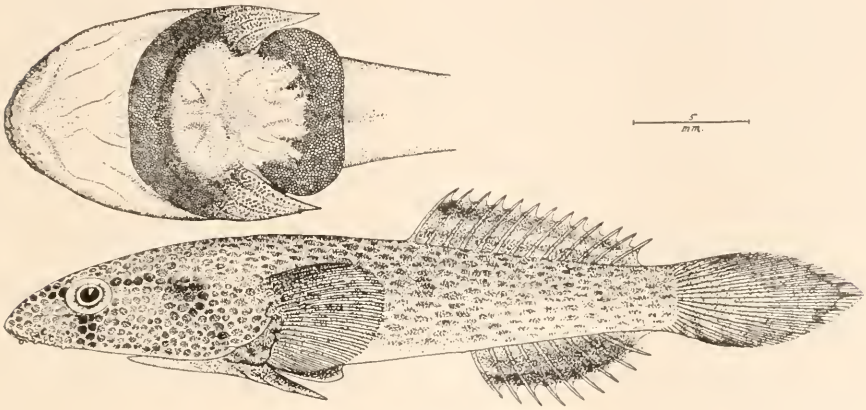

Fig. 4.—*Gobiesox microspilus* Fowler.

Skin smooth. A number of pores along lower side of head, and about fringes of lips.

Dorsal inserted about midway between centre of head and caudal base, tips of rays slightly protrude beyond connecting membranes. Anal inserted slightly behind dorsal origin, fin similar. Caudal rounded behind. Pectoral broad, upper rays longer, hind edge rounded, with free fold in front opposite lower base, and broad flap concealed, behind axilla, extends up from disk. Disk large, circular, its length about $1\frac{1}{4}$ in head. Margins of disk, all for broad extent, finely papillose. Vent before anal, though slightly behind origin of dorsal.

Color in alcohol dark chocolate-brown, except lower surface of

head and disk, which whitish. Entire upper surface marked with closely set dusky spots, mostly of uniform size, and all with a more or less lengthwise disposition. Black blotch on head about an eye-diameter behind eye on its level. From eye dark spots are darkened, to form obscure streak forward, one below and one behind. Vertical fins largely dusky or blackish. Dorsal with sub-basal lengthwise whitish streak, one medianly and protruded tips of rays same color. Anal with median lengthwise paler area, protruded tips of rays whitish. Caudal crossed by three obscure darker bands, tips of rays whitish. Pectorals brownish. Iris slaty, olive-yellowish circle around pupil.

Length 37 mm.

Type, No. 45,213, A. N. S. P. Panama, in a pool. May 30, 1915. D. E. Harrower. Purchased.

Only the above example obtained. This species is very closely allied with *G. papillifer* Gilbert from Lower California. It differs in several respects. *G. papillifer* has the teeth in both jaws biserial. Its color is also said to be uniform dark olivaceous, and the color of the fins is different.

(*Μικρος*, small; *σπίλος*, spot; with reference to the coloration.)

Bufo marinus (Linné).

Two large examples, 96 to 100 mm. long, measured from snout tip to vent.

Bufo valliceps Wiegmann.

Four, 26 to 40 mm.

Bufo typhonius (Linné).

One, 21 mm.

Hyla moquardi Günther.

Two, about 20 mm.

Eleutherodactylus rhodopsis (Cope).

One, 14 mm.

Dendrobates tinctorum (Keferstein).

Four examples, caught in shrubbery. Length 25 to 32 mm.

Pelamis bicolor (Schneider).

One found swimming on the surface. It was hit with an oar and then captured by a boatman.

NOTES ON FISHES OF THE ORDERS HAPLOMI AND MICROCYPRINI.

BY HENRY W. FOWLER.

The present paper is an annotated list of the fishes of the above orders, contained in the collection of The Academy of Natural Sciences of Philadelphia.

HAPLOMI.

ESOCIDÆ.

Esox americanus (Gmelin).

New York (Long Island); New Jersey; Pennsylvania; Delaware; Maryland; North Carolina (Catawba River); South Carolina (Pocataligo River near Manning); Georgia (Thomasville); Florida (Volusia).

Esox vermiculatus Valenciennes.

E. cypho Cope, Proc. Acad. Nat. Sci. Phila., 1854, p. 78. Waterford, Oakland County, Michigan.
E. porosus Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866, p. 408 (on above, *cypho* regarded inept).

No. 7,681, A. N. S. P., type of *E. cypho* Cope. Waterford, Michigan.

Ohio (Hicksville); Indiana (Richmond and Michigan City); Georgia (Etowah River); Texas (Beaumont).

Esox reticulatus Le Sueur.

New Jersey; Pennsylvania; Delaware; Maryland; District of Columbia (Washington); North Carolina (Neuse River); Florida.

Esox lucius Linné.

New York (Lake George); Indiana (Wabash River); Lake Erie; Michigan (Kewenah Point); Iowa (Hornick and Brook River); Sweden; Italy.

Esox masquinongy Mitchill.

Pennsylvania (Lake Conneaut); Michigan (Saginaw Bay); Minnesota (Mankato); Ontario (Sparrow Lake).

UMBRIDÆ.

Umbra limi (Kirtland).

Pennsylvania (Meadeville); Illinois (Northfield); Michigan (Oakland County); Minnesota (Cedar Lake, Minneapolis).

Umbra pygmæa (De Kay).

New Jersey; Pennsylvania; Delaware; Maryland; Virginia (Lower James River).

MICROCYPRINI.

PŒCILIIDÆ.

As pointed out by Regan, this family embraces several well-defined sub-families. To these several others are likely valid, as the *Procatopinæ* (*Procatopus*), with the ventrals placed below the pectorals, and the *Lamprichthyinæ* (*Lamprichthys*), with ctenoid scales and long anal fin (27 to 30 rays), both off-shoots from the *Fundulinæ*. The *Phallostethinæ* (*Phallostethus*) diverge from the *Pœciliinæ*, with the ventrals modified as an intromittent organ.

FUNDULINÆ.

FUNDULUS Lacépède.

GALASACCUS subgen. nov.

Type *Hydrargira similis* Baird and Girard.

Form rather elongate. Snout usually long and conspicuous. Jaws wide, sometimes produced. Sexes usually unlike in coloration, and female often with dark lengthwise lines. Females also without an anal tube on front of anal fin, but in its place basal sheath usually present. No nuptial tubercles or denticles on anal rays of male during spawning season.

Hydrargira Lacépède cannot be used for this group, as its monotype, *H. swampina* Lacépède, is a synonym of *Cobitis heteroclita* Linné and thus a synonym of *Fundulus*.

(*Γάλα*, milk; *σαχχος*, sack; from the vernacular Sac-à-Lait of the typical species.)

Fundulus similis (Baird and Girard).

Hydrargira similis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1853, p. 389. Indianola, Texas.

Nos. 6,987 and 6,988, A. N. S. P. Cotypes of *H. similis* Baird and Girard. Indianola, Texas. From the Smithsonian Institution. Both small examples.

Miami River (Dr. H. A. Pilsbry), Boca Chica Key (Fowler) and Carrabelle (M. Hebard), Florida.

Fundulus majalis (Walbaum).

Besides the large series of local or Middle Atlantic States specimens, already recorded, are others from: Florida (Bayport); South Caro-

lina (Charleston and Hilton Head); Massachusetts (Woods Hole, Nantucket and Salem).

Fundulus punctatus Günther.

Central Guatemala (Cope).

Subgenus FUNDULUS Lacépède.

Type *Fundulus mudfish* Lacépède.

Form short, robust. Snout short or moderate. Jaws not produced. Sexes unlike in coloration, females usually paler or uniform. Female with anal tube on first anal ray. Anal rays of male usually with nuptial denticles during the spawning season.

Fundulus parvipinnis Girard.

Proc. Acad. Nat. Sci. Phila., 1854, p. 154. San Diego, California.

No. 7,255, A. N. S. P. Cotype. From the Smithsonian Institution (No. 938).

Fundulus heteroclitus (Linné).

Fort Macon, North Carolina (Dr. H. C. Yarrow) and Charleston, South Caolina (Dr. J. E. Holbrook).

Fundulus heteroclitus macrolepidotus (Walbaum).

Besides a very large series from various of the Middle Atlantic States, most of which have been listed, are examples from New York (Hudson River at Piermont, Long Beach, South Long Beach, Nassau on Long Beach and New York Harbor); Connecticut (Sachems Head and Scotts Cove near Darien); Rhode Island (Newport); Massachusetts (Woods Hole, Nantucket and Boston).

Fundulus heteroclitus badius Garman.

Prince Edward Island and Magdalen Islands, Canada.[1]

Fundulus grandis Baird and Girard.

Proc. Acad. Nat. Sci. Phila., 1853, p. 389. Indianola, Texas.

No. 7,420, A. N. S. P. Cotype. J. H. Clark. From the Smithsonian Institution (No. 650).

Bayport (Cope) and Carrabelle (M. Hebard), Florida.

Fundulus nisorius Cope.

Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 456. Gaboon, West Africa.

Head 3 to $3\frac{3}{5}$; depth $3\frac{1}{5}$ to 4; D. usually 1, 11, often 1, 10, rarely 1, 12; A. usually 1, 10, often 1, 9, rarely 1, 8 or 1, 11; scales usually 32, often 33, sometimes 31, 34 or 35 in lateral series medianly to caudal base, and usually 4, rarely 3 or 5 more on latter; snout $3\frac{1}{3}$ to 4 in

[1] Proc. Acad. Nat. Sci. Phila., 1915, p. 518.

head, measured from snout tip; eye $2\frac{3}{4}$ to $4\frac{1}{2}$; maxillary $2\frac{3}{4}$ to $3\frac{1}{2}$; interorbital 2 to $2\frac{2}{3}$. Body rather robust, compressed, more so in male. Head short, obtuse. Snout depressed, length $\frac{2}{5}$ to $\frac{1}{2}$ its width. Eye close to upper profile, centre near first third in head. Mouth moderate, lower jaw obtuse, projects. Teeth conic, fine, in bands in jaws, outer row enlarged. Interorbital flat. Gill-rakers 2 or 3+9, lanceolate, about half length of filaments. Scales largest on top of head, smaller on breast, belly and caudal base. Lateral line complete, inconspicuous, as single small pore on middle of exposure of each scale medianly along side. Dorsal origin little nearer caudal base than gill-opening in adult female, much nearer latter in young and adult male. Anal origin about opposite second branched dorsal ray base, fin much higher than dorsal. Female without anal sheath, though with long simple tube, long as first ray. Caudal truncate, rounded convexly behind when spread open. Pectoral not quite reaching ventral, latter not to anal. Paired fins still shorter in adult female. Color in alcohol, of male, brownish generally, little paler below. Sides with about fourteen to seventeen narrow vertical bars, less than half width of exposed scales. Also in course of each bar scattered pearly or whitish rounded spots, smaller and more crowded about caudal base. Vertical fins dusky, with irregular and variable whitish spots, smaller on caudal, and edges of all these fins broadly whitish. Female uniform brownish, paler on under surfaces, and without dusky or dark pectorals and ventrals of male. Male with terminal portions of anal rays covered with little points or denticles, row to each shaft. These absent in female, though in some females a few little points or granules on rays of dorsal fin on their outer portions. Length 33 to 91 mm. Nos. 7,227 to 7,233 and 7,293 to 7,303, A. N. S. P. Cotypes of *F. nisorius* Cope. Gaboon, West Africa. P. B. Duchaillu.

This very interesting species, incompletely described by Cope, is the exact African counterpart of *F. heteroclitus*. It resembles the latter in almost all respects, and differs in but few minor characters, as shorter pectorals, etc.

Fundulus antillarum sp. nov. Fig. 1.

Head $3\frac{1}{3}$; depth $3\frac{4}{5}$; D. 1, 11; A. 1, 9; P. 16; V. 1, 5; scales about 34 in median lateral series to caudal base, and 4 more on latter; 13 scales transversely between dorsal and anal origins; about 23 predorsal scales; head depth at occiput $1\frac{2}{7}$ its length; head width $1\frac{2}{3}$; fifth branched dorsal ray $1\frac{4}{5}$; fifth branched anal ray $1\frac{2}{5}$; least depth of caudal peduncle $1\frac{7}{8}$; caudal $1\frac{1}{10}$; pectoral $1\frac{1}{2}$; ventral $2\frac{1}{4}$;

snout $3\frac{1}{2}$ in head, measured from upper jaw tip; eye $4\frac{1}{3}$; maxillary 3; interorbital $2\frac{1}{6}$.

Body moderately long, also moderately depressed anteriorly, well compressed behind, back scarcely elevated. Caudal peduncle robust, well compressed, about long as deep.

Head moderately short, wide above, upper profile nearly straight from snout tip to occiput and less inclined than lower. Sides of head moderately approximated below. Snout short, depressed, length about $\frac{2}{3}$ its width. Eye rounded, high or close to upper profile and its centre near first $\frac{2}{5}$ in length of head. Mouth rather small, lateral cleft slight, oblique. Premaxillaries well protractile. Maxillary extends down till close before front edge of eye. Lips moderately fleshy. Teeth all simple, conic, in bands in jaws, and

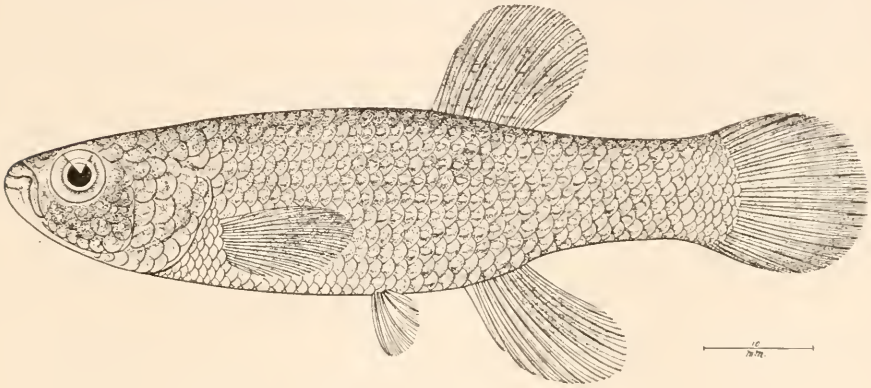

Fig. 1.—*Fundulus antillarum* Fowler.

outer row enlarged and slightly curved. Upper and lower inner buccal folds moderately wide, entire. Tongue fleshy, depressed, elongate, end rounded and free in front. Lower jaw robust, protrudes beyond upper, convex over surface and in profile. Nostrils superior in front of interorbital space and front edge of eye. Interorbital space depressed or flattened, and slight median transverse depression over front of eyes. Hind preopercle edge slightly inclined forward.

Gill-opening extends forward about opposite hind edge of eye. Gill-rakers 2+9, lanceolate, about half length of gill-filaments, which slightly less than horizontal diameter of eye. Isthmus wide. Branchiostegals 4.

Scales moderate with concentric striæ, larger on front predorsal

region and top of head, and smaller on breast, prepectoral region and caudal base. Cheek with 3 rows of scales. Lateral line complete, inconspicuous, developed as single small pore on each exposure of scale.

Dorsal origin slightly nearer gill-opening than caudal base, branched rays about uniformly high, and extend $\frac{2}{3}$ space to caudal base. Anal inserted about opposite base of second or third dorsal ray, and median posterior rays longest, longer than dorsal rays, and reach $\frac{3}{4}$ to caudal base. Caudal apparently truncate behind, rounded as spread open. Pectoral low, rather small, reaches about $\frac{4}{5}$ to ventral. Latter inserted nearly midway between front of eye and caudal base, fin reaching vent, close before anal.

Color in alcohol largely dull brownish with faint olivaceous tinge, especially above. Each scale with a rounded paler basal spot. These spots at intervals of several scales each with pearly tint or whitish, so that traces of about a dozen vertical whitish streaks occur. Fins brownish, dorsal and caudal little darker. Dorsal with several large cream-colored blotches about basal portion of fin, and caudal with three irregular and obscure vertical darker cross-bars. Iris pale yellowish.

Length 78 mm.

Type, No. 7,225, A. N. S. P. St. Martins, Danish West Indies. Dr. R. E. Van Rijgersma.

Also No. 7,226, A. N. S. P. Paratype, same data. Head $3\frac{2}{5}$; depth 4; D. 1, 10; A. 1, 9; scales about 31 to caudal base and 5 more on latter; 13 scales transversely between dorsal and anal origins; about 25 predorsal scales; snout $3\frac{1}{3}$ in head measured from upper jaw tip; eye $3\frac{4}{5}$; maxillary 3; interorbital $2\frac{1}{8}$. Length 76 mm. This example a female, and its coloration largely like the type. Dorsal and caudal fins differ only in being uniform brownish. Anal with a well-developed tube along its front edge but little shorter than first anal ray.

This species is very closely related to *F. heteroclitus*. Compared with examples of equal size, but slight, though apparently constant, points of difference are noted. The males of both species are quite similar, though in *F. heteroclitus* the white spots on the dorsal are much smaller. As the female of *F. heteroclitus* is uniform brownish the female of *F. antillarum* differs in having the base of each scale with a whitish spot. In proportions, measurements, etc., the two species are similar. A large series of *F. heteroclitus* easily covers the structural characters.

I first thought this species was *F. fonticola* Valenciennes.[2] It is described with twelve anal rays, apparently deeper body, and possibly smaller rounded dorsal and caudal. Valenciennes says: "La couleur paraît avoir été un vert uniforme sur tout le corps, et je ne vois aucune tache sur les nageoires." He also gives the following remark, which may in part refer to *F. antillarum:* "Une note, ajoutie à la fin de cet article, fait penser que M. Plée croyait aussi qui ce poisson habite la Martinique, car il dit: 'ce sont les poissons qu'on appelle dormeurs dans nos isles.' Les a-t-il confondus avec de jeunes *Eleotris,* qui sont ainsi dénommés?" This is interesting as showing the possible occurrence of *Fundulus* in the Lesser Antilles, now fully corroborated by the present species. Another species, likely closely related is *F. bermudæ* Günther.[3] It appears to differ in the smaller head, dorsal rays fourteen and anal rays twelve. Later this was redescribed as *F. rhizophoræ* Goode,[4] with its color given as light tawny-brown, with about fifteen regular transverse bands of greenish-brown, each two scales in width and most distinct on trunk posteriorly. No mention is made of the color of the fins. The only remaining West Indian species is *F. cubensis* Eigenmann,[5] which differs entirely in its large scales (24), advanced dorsal and anal and coloration.

(Named for the Lesser Antilles.)

Fundulus hispanicus (Valenciennes).

One from Spain in poor state of preservation. Possibly it differs largely in the more posterior position of the dorsal and anal fins, which are exactly opposite, from the American species. It approaches *Zygonectes* in the large scales (29 to 32) and small dorsal (9 to 11).

Subgenus FONTINUS Jordan and Evermann.

Type *Fundulus seminolis* Girard.

Form long, slender. Snout short or moderate. Jaws not produced. Sexes unlike in coloration during spawning season, otherwise of similar barred appearance. Females with anal sheath, but no anal tube extending beyond. Males brilliant, sometimes with denticles or tubercles on body and fins during the spawning season.

Fundulus diaphanus (Le Sueur).

A very large series from the Middle Atlantic States, already

[2] *Hist. Nat. Poiss.*, XVIII, 1846, p. (198) 148. Porto Rico.
[3] *Ann. Mag. Nat. Hist. London* (4), XIV, 1874, p. 370. Bermudas.
[4] *Amer. Jour. Sc. Art.* (3), XIV, 1877, p. 298. Basden Pond, Bermuda.
[5] *Bull. U. S. F. Com.*, 1902 (1904), p. 222, fig. 1. Rio del Pinar, Cuba.

recorded, besides examples from Massachusetts (Cambridge); Rhode Island (Newport); New York (Sing Sing).

Fundulus diaphanus menona (Jordan and Copeland).

Indiana; Chicago, Illinois; Grosse Isle, Michigan.

Fundulus zebrinus Jordan and Gilbert.

Bull. U. S. Nat. Mus., No. 17, 1882, p. 891 (based on *Hydrargyra zebra* Girard, Proc. Acad. Nat. Sci. Phila., 1859, p. 60. Tributary of the Rio Grande between Fort Defiance and Fort Union, New Mexico. Not of De Kay 1842.)

No. 7,352, A. N. S. P., cotype of *H. zebra* Girard. Coll. Möllhausen. Smithsonian Institution (No. 2,590).

Also a fine series from Indiana (Wabash River); Iowa (Silver Lake); Texas (Red River in Staked Plain from Brazos River to Texas Tuli Canyon, south of Clarendon, between Seymour and Austin, and Comanche Creek at Fort Macon).

Fundulus seminolis Girard.

Lake Kerr, Florida.

Subgenus XENISMA Jordan.

Type *Xenisma stellifera* Jordan.

Form long, very slender. Snout short or moderate. Jaws not produced. Sexes unlike in coloration during spawning season, otherwise of similar finely spotted appearance. Females with anal sheath, but no anal tube extending beyond. Males brilliant, and anal prickly in spawning season.

Fundulus catenatus (Storer).

Virginia (Holston River), Arkansas (Eureka Springs), and Tennessee (Coal Creek in Clinch River basin).

Fundulus stellifer (Jordan).

Xenisma stellifer Jordan, Ann. Lyc. N. Hist. N. Y., 1876, p. 322. Etowah and Oostanaula Rivers, Rome, Georgia.

Nos. 20,718 to 20,720, A. N. S. P., paratypes of *X. stellifer* Jordan. Rome, Georgia. D. S. Jordan. From E. D. Cope.

Subgenus ZYGONECTES Agassiz.

Type *Pœcilia olivacea* Storer.

Form elongate, fusiform. Snout short or moderate. Jaws not produced. Sexes unlike in coloration, at least during spawning season. Females with anal sheath, but no anal tube extending beyond. Males brilliant, and anal sometimes prickly in spawning season. Dorsal and anal fins small, former distinctly inserted behind origin of latter.

Fundulus floripinnis (Cope).

Haplochilus floripinnis Cope, Zool. Wheeler's Surv. Terr., 1875 (1876), p. 695, Pl. 28, figs. 4 a–b. Colorado and Platte Rivers at Denver, Colorado.

Nos. 18,733 to 18,738, A. N. S. P., cotypes of *H. floripinnis* Cope.

Fundulus pulvereus Evermann.

Baldwin Lodge, Mississippi.

Fundulus sciadicus Cope.

Proc. Acad. Nat. Sci. Phila., 1865, p. 78. Platte River, Nebraska.

Nos. 7,183 to 7,201, A. N. S. P. Cotypes. Dr. W. A. Hammond.

Fundulus luciæ (Baird).

A large series of examples from the Middle Atlantic States. All but the examples obtained at Anglesea, New Jersey, on October 3, 1897, by Messrs. W. J. Fox and P. Laurent, have been recorded.

Fundulus chrysotus (Günther).

Tick Island in Spring Garden Creek of the St. John's River basin (Dr. H. A. Pilsbry and C. W. Johnson) and the everglades at Miami River in Dade County (S. N. Rhoads), Florida. Also an example from Beaumont, Texas.

Fundulus balboæ sp. nov. Fig. 2.

Head $3\frac{2}{5}$; depth $4\frac{3}{4}$; D. II, 8; A. I, 12; P. I, 12; V. I, 5; scales 34 in median lateral series to caudal base, and 5 more on latter; 10 scales between dorsal and anal origins; about 30 predorsal scales; head width $1\frac{7}{8}$ its length; head depth at occiput $1\frac{4}{5}$; snout 3; eye $3\frac{1}{3}$; maxillary $4\frac{1}{8}$; interorbital $2\frac{1}{8}$; sixth branched dorsal ray $1\frac{3}{5}$; tenth branched anal ray $1\frac{1}{2}$; least depth of caudal peduncle $2\frac{1}{8}$; caudal $1\frac{1}{10}$; pectoral $1\frac{2}{3}$; ventral $1\frac{4}{5}$.

Body elongate, moderately depressed above in front, compressed behind. Caudal peduncle compressed, least depth little less than its length.

Head depressed above, less so below, and profiles nearly straight, though lower little more inclined. Snout broad, depressed, length $\frac{2}{3}$ its width. Eye large, rounded, slightly before middle in length of head, close to upper profile, and extends more on under surface of head than on upper surface. Mouth terminal, gape not quite half way to eye. Premaxillaries protractile. Maxillary reaches back opposite hind nostril. Jaws robust, protruding, and lower projecting slightly beyond upper. Bands of fine teeth in jaws, and an outer rather wide-set row of slightly enlarged simple conic teeth. Lower jaw rather shallow, rami not elevated inside mouth. Lips rather fleshy. Tongue fleshy, free in front and about edges, well

back in mouth. Upper buccal fold moderately broad, lower narrower. Nostrils lateral on snout above, near front of eye. Interorbital slightly convex. Hind preopercle edge slightly inclined backwards.

Gill-opening extends forward about opposite hind pupil edge. Gill-rakers about 1+7 short robust points, much shorter than gill-filaments, latter about $1\frac{3}{5}$ in eye. Isthmus narrow.

Scales cycloid, with many concentric striæ, little smaller on breast and belly, more so on caudal base. Scales larger on head above and front predorsal region. Lateral line imperfect and incomplete, at row of pores, one to each scale in middle of its exposure, to ventral, behind latter dropping a row of scales and then extending to caudal base.

Dorsal origin about last third in space between centre of eye and caudal base, sixth branched ray highest, and depressed fin extending

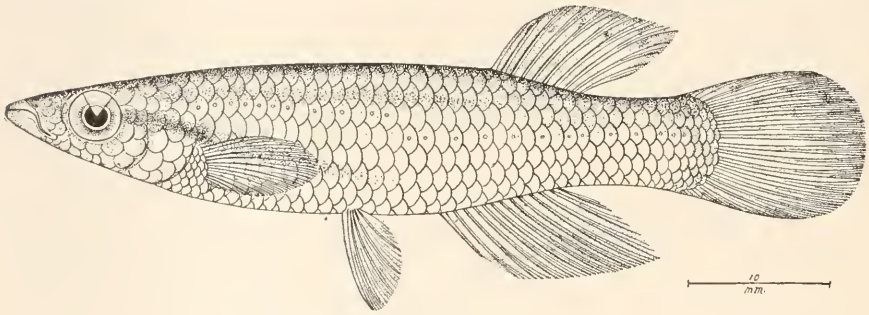

Fig. 2.—*Fundulus balbow* Fowler.

back to caudal base. Front $\frac{2}{5}$ of anal base before dorsal or origin of fin little nearer gill-opening than caudal base, fin like dorsal, only falling slightly shorter of caudal base. Caudal oblong, hind edge apparently slightly convex. Pectoral small, reaches $\frac{4}{5}$ to ventral, latter reaching anal.

Color in alcohol dark olive-brownish generally, with apparently more or less uniform ground-color. A dark or dusky longitudinal band from mouth to eye, behind latter to gill-opening and continued to caudal base. After gill-opening this band extends below median axis of trunk, and its width slightly less than vertical eye-diameter. Iris warm brownish. Fins uniform pale brownish, except dorsal and upper part of caudal, which marked with a few rather wide-set dark brownish spots.

Length 62 mm.

Type, No. 16,728, A. N. S. P. Panama. Lieutenant Fields.

Only the above example known. It is apparently not closely related to any of the known species of the subgenus.

(Named for Balboa, Panama.)

Fundulus nottii Agassiz.

Indiana; North Carolina (Wilmington); Georgia (Thomasville); Florida (Leon County and Walaka).

Fundulus notatus (Rafinesque).

F. aureus Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 78. Detroit River, Grosse Isle, Michigan.

No. 7,142, A. N. S. P., type of *F. aureus* Cope.

Illinois (Illinois River basin at Marley); Missouri; Arkansas; Indian Territory; Texas (Fort Worth).

CHRIOPEOPS subgen. nov.

Type *Lucania goodei* Jordan.

Form fusiform, elongate. Teeth in jaws in two series, simple, conic, outer row enlarged. Jaws short, obtuse. Dorsal fin inserted slightly before anal origin. Female with an anal sheath.

Differs from the other subgenera of *Fundulus* in the dentition, as all have the inner teeth in a fine villiform band, at least in more than one row. It resembles certain species of *Zygonectes* in the black lateral band, but the anterior position of the dorsal at once distinguishes it. Small fishes, little over an inch in length.

(*Chriope,* an old name for *Notropis bifrenatus,* and ὄψ, appearance, to which the type species bears a close superficial resemblance.)

Fundulus goodei (Jordan).

Miami and everglades at Miami River (S. N. Rhoads), and Tick Island in Spring Garden Creek of St. John's River basin (Dr. H. A. Pilsbry), Florida.

OXYZYGONECTES subgen. nov.

Type *Haplochilus dovii* Günther.

Jaws long and spatulate. Gill-rakers rather numerous, 22 to 24, much more so than in many of the subgenera. Dorsal fin inserted entirely behind anal.

This subgenus differs from *Zygonectes* in the long anal with 13 to 16 rays (compared with 8 to 12 in *Zygonectes*). The peculiar physiognomy, with the extremely depressed head, is also a point of difference.

(ὀξύς, pointed; *Zygonectes.*)

Fundulus dovii (Günther).

Central America (Cope).

Aplocheilus panchax (Hamilton-Buchanan).

India.

Aplocheilus macrostigma (Boulenger).

Haplochilus macrostigma Boulenger, Ann. Mag. Nat. Hist., (8) VIII, 1911, p. 268. Lucola River, Luculla River, and Luali River, Portuguese Congo.

Nos. 38,632 to 38,641, A. N. S. P. Paratypes of *H. macrostigma* Boulenger. Luma, Luali River, West Africa. Dr. J. W. Ansorge. Purchased.

Aplocheilus cameronensis (Boulenger).

Gaboon.

Aplocheilus sexfasciatus (Gill).

Epiplatys sexfasciatus Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 136. Gaboon.

Nos. 7,129 to 7,141, A. N. S. P., types of *E. sexfasciatus* Gill. Gaboon, West Africa. P. B. Duchaillu.

Also Luali River at Lundo in Chiloango.

Aplocheilus senegalensis (Steindachner).

Africa.

Aplocheilus spilauchen (A. Dumeril).

Chiloango Town, Portuguese Congo.

Adinia multifasciata Girard.

Proc. Acad. Nat. Sci. Phila., 1859, p. 118. Galveston, St. Joseph Island and Indianola, Texas.

Nos. 7,291 and 7,292, A. N. S. P., cotypes. Indianola, Texas. Smithsonian Institution.

Rivulus micropus (Steindachner).

Ecuador and Pebas, Peru.

Lucania venusta Girard.

Grand Plains Bayou (U. S. F. Com.), Mississippi; Juniper Creek on southwest side of Lake George (Dr. H. A. Pilsbry and C. W. Johnson), Florida.

Lucania parva (Baird).

Besides a large series of local specimens from New Jersey, Delaware and Virginia, are seven from the first-named State at Anglesea (W. J. Fox and P. Laurent on October 3, 1897), not previously listed.

Girardinichthys innominatus Bleeker.

Act. Soc. Ind. Neerl. (Prodr. Ich. Arch. Ind.), 1860, pp. 481, 484 (on Girard's description without a name. Proc. Acad. Nat. Sci. Phila., 1859, p. 118. City of Mexico.)

No. 7,605, A. N. S. P., cotype. City of Mexico. Collection Major W. Rich. Smithsonian Institution.

Also seven examples from Lake Xochimilco in 1885 (E. D. Cope).

ORESTIINÆ.

Orestias cuvieri Valenciennes.

Tinta, Peru, and Lake Titicaca.

Orestias pentlandii Valenciennes.

Lake Titicaca.

Orestias bairdii Cope.

Journ. Acad. Nat. Sci. Phila., 1875, p. 185. Lake Titicaca.

No. 21,554, A. N. S. P., type. Lake Titicaca, Bolivia. Prof. James Orton. 1873. E. D. Cope.

This species has been merged with the preceding by Garman, though it appears to differ in the larger pectoral reaching half way to the vent, besides the much larger predorsal scales.

Orestias agassizii Valenciennes.

O. ortonii Cope, l. c., p. 186. Lake Titicaca.
O. frontosus Cope, l. c. Lake Titicaca.

No. 21,557, A. N. S. P., type of *O. ortonii* Cope.

Nos. 21,555 and 21,556, A. N. S. P., cotypes of *O. frontosus* Cope.

Also several other examples from Peru and Lake Titicaca.

Orestias cypho sp. nov. Fig. 3.

Head $2\frac{3}{4}$; depth $2\frac{2}{3}$; D. 1, 13; A. 1, 13; P. 1, 18; scales 35 in median lateral series to caudal base and 5 more on latter; 14 scales transversely between dorsal and anal origins; about 23? predorsal scales; head width nearly equals its length; head depth at occiput $1\frac{2}{5}$; lower jaw $3\frac{4}{5}$; fifth branched dorsal ray $2\frac{2}{3}$; fifth branched anal ray $2\frac{1}{2}$; least depth of caudal peduncle 2; caudal $1\frac{4}{5}$; pectoral $1\frac{2}{3}$; snout $5\frac{1}{5}$ in head measured from upper jaw tip; eye $5\frac{1}{5}$; maxillary $3\frac{1}{2}$; interorbital $3\frac{1}{8}$.

Body very robust, especially anteriorly, compressed behind, greatest depth about opposite middle of pectoral. Predorsal with elevated rather stout and moderately convex median keel beginning at occiput. Caudal peduncle well compressed, length about $\frac{4}{5}$ its least depth.

Head very wide, robust, large, opercular regions swollen out, so

that depth of head at hind preopercle edge $\frac{2}{5}$ its greatest width. Also prominent ridge on each side of head above opercles. Upper profile slightly convex at first, or to occiput, then concave to predorsal ridge. Lower profile steeply convex. Snout wide, depressed or but slightly convex, length about $\frac{2}{5}$ its width. Eye small, high, front edge near first fourth in head. Mouth vertical, commissure extending slightly below lower eye edge. Upper jaw greatly protractile, or for space slightly greater than eye-diameter. Maxillary vertical, extending back about half way to front of eye. Lips fleshy. Lower jaw vertical, convex in profile, shallow, rami not elevated inside mouth. Teeth small, simple, inconspicuous or concealed more or less in fleshy lips, disposed as narrow short band mostly in front of jaws. Tongue thick, fleshy, depressed, free

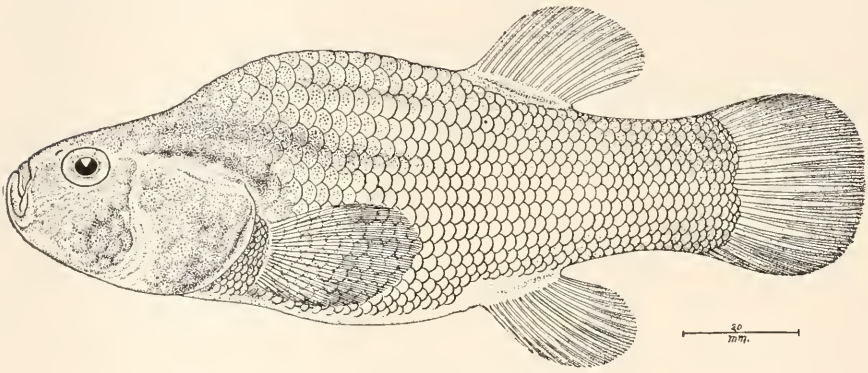

Fig. 3.—*Orestias cypho* Fowler.

around edges. Nostrils 2 little slits, close together, above and opposite front edge of eye. Interorbital wide and slightly convex. Hind ridge of preopercle slightly inclined back. Very slight median concave depression on top of head before predorsal ridge.

Gill-opening extends forward opposite middle of eye. Gill-rakers about 10 short stumps, rudimentary. Gill-filaments slightly longer than eye. Isthmus narrow, gill-membranes forming broad fold across. Branchiostegals 5.

Scales cycloid, largest on predorsal, becoming smaller on hind part of body, caudal base and lower side of trunk. Prepectoral region scaly. Scales on upper surface of head, predorsal and shoulders finely granular, other scales finely roughened with concentric striæ. Cheeks with 4 rows of scales, none below preorbital. Scales down median line of predorsal not especially enlarged. Bases

of dorsal and anal naked, also breast and median line of belly. No lateral line.

Dorsal inserted slightly nearer caudal base than gill-opening, depressed fin not quite reaching caudal base. Anal origin opposite base of first branched dorsal ray, depressed fin reaching $\frac{3}{4}$ to caudal base. Caudal moderately convex behind. Pectoral broad, rounded, $1\frac{2}{5}$ to anal. Vent close before anal.

Color in alcohol largely uniform brownish with olive tinge, under surface paler or whitish. Fins all brownish, uniform. Iris brownish.

Length 153 mm.

Type, No. 21,920, A. N. S. P. Taken from a Permo snake from La Paz, Bolivia. 1876–77. Prof. J. Orton. From E. D. Cope.

Only the above example known. It is closely related, if not identical, with *O. neveni* Pellegrin,[6] but that species differs according to its description in the following respects: Head $2\frac{1}{4}$; depth 3; D. 15; A. 17; P. 21; scales 32; conic teeth somewhat numerous; dorsal inserted midway between gill-opening and caudal base; pectoral $2\frac{1}{2}$ in head. It agrees, however, in having the scales uniform and continuous each side of the median predorsal row, a character by which both species differ from *O. albus* Valenciennes. The latter has a naked lengthwise area each side.

(*Cypho*, hunchback; with reference to the predorsal keel.)

CYPRINODONTINÆ.

Cyprinodon variegatus Lacépède.

C. gibbosus Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1853, p. 390. Indianola, Texas.

No. 7,221, A. N. S. P. Cotype of *C. gibbosus* Baird and Girard. Indianola, Texas. Coll. J. H. Clark. Smithsonian Institution (684).

Besides the numerous local specimens also examined and recorded, the collection contains others as follows: Connecticut (Noank); North Carolina (Fort Macon); Florida (Miami, southwestern region and Carrabelle); Alabama; Mississippi (Baldwin Lodge).

Cyprinodon variegatus riverendi (Poey).

Boca Chica and Marquesas Keys, Florida.

Cyprinodon bovinus Baird and Girard.

C. eximius Girard, Proc. Acad. Nat. Sci. Phila., 1859, p. 158. Chihuahua River, Mexico.

No. 7,223, A. N. S. P. Cotype of *C. eximius* Girard. Chihuahua River, Mexico. Coll. Potts. Smithsonian Institution (No. 3,501).

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[6] *Bull. Soc. Z. France*, 1904, p. 95. Lake Titicaca.

Also several from Lago de Guzman, Chihuahua, Mexico (Dr. P. P. Calvert).

Cyprinodon bovinus rubrofluviatilis subsp. nov. Fig. 4.

Head 3; depth $2\frac{2}{3}$; D. I, 9; A. I, 10; P. I, 15; V. I, 6; scales 27 in median lateral series to caudal base and 4 more on latter; 14 scales transversely between dorsal and anal origins; about 25 predorsal scales; head width $1\frac{1}{2}$ in its length; head depth at occiput $1\frac{1}{8}$, lower jaw $3\frac{1}{8}$; third branched dorsal ray $1\frac{1}{4}$; fourth branched anal ray $1\frac{4}{5}$; least depth of caudal peduncle $1\frac{7}{8}$; caudal $1\frac{1}{8}$; pectoral $1\frac{2}{7}$; ventral $2\frac{1}{2}$; snout $3\frac{1}{8}$ in head measured from upper jaw tip; eye $3\frac{1}{8}$; maxillary 3; interorbital space $2\frac{2}{3}$.

Body well compressed, deepest at dorsal origin, predorsal with

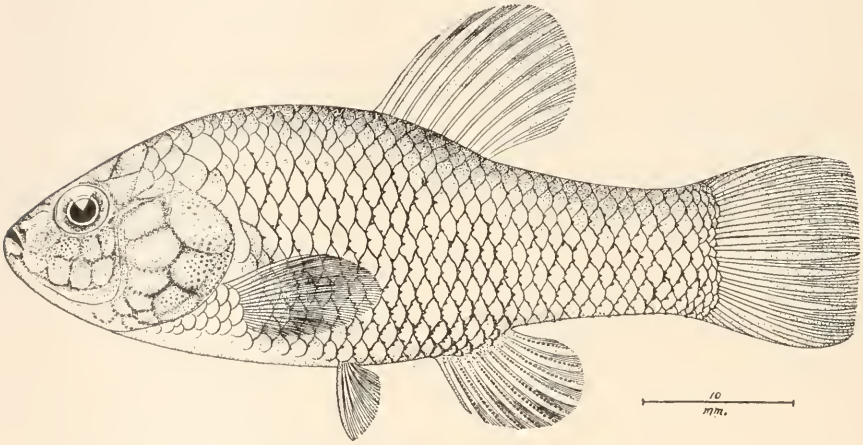

Fig. 4.—*Cyprinodon bovinus rubrofluviatilis* Fowler.

median trenchant keel and well arched before dorsal fin. Caudal peduncle compressed, its least depth $1\frac{1}{5}$ in its length.

Head compressed moderately, upper profile more inclined than lower, and lower sides not especially converging below. Snout short, wide, and length about $\frac{2}{3}$ its width. Eye moderate, high, centre about first $\frac{2}{5}$ in head. Jaws greatly protractile, upper at least distensible space equal to snout length. Maxillary nearly vertical, largely concealed. Lips moderate. Teeth uniserial, compressed, each tricuspid and expanded terminally. Inner upper and lower buccal folds moderately wide. Tongue fleshy, small, depressed, little free around edges. Lower jaw slightly protruding in front, oblique to somewhat vertical, shallow, and rami not elevated inside

mouth. Nostrils close above upper front of eye edge, small, simple. Interorbital slightly convex. Preorbital about $\frac{3}{5}$ area of eye. Hind preopercle edge little free and nearly vertical, entire.

Gill-opening adnate above to gill-opening close above base of first pectoral ray, and extends forward opposite hind pupil edge. Gill-membranes widely connected across rather narrow isthmus. Rakers about 26, short slender points about $\frac{1}{3}$ length of gill-filaments, and latter equal eye. Branchiostegals 4.

Scales rather narrowly imbricated, largest on top of head and opercles, smallest on breast and caudal base. Enlarged humeral scale longer than eye. Scales in 2 rows on cheek. Lateral line obscure and incomplete, formed as short arch of few pores parallel with contour of back far as dorsal origin, a single pore on each scale.

Dorsal inserted midway between centre of eye and caudal base, median rays longest, and depressed fin extends $\frac{3}{5}$ to caudal base. Anal inserted about opposite base of fifth branched dorsal ray, fin extending $\frac{3}{5}$ to caudal base when depressed. Caudal with hind edge slightly convex. Pectoral long, reaches back well beyond ventral origin, latter little before dorsal, and fin reaching vent, which close before anal.

Color of male, in alcohol, uniform brownish on back and upper surface of head. Sides and lower surface whitish. Fins all pale brownish, and except ventrals densely punctate darker as seen under a lens. Iris pale brownish.

Length 53 mm.

Type, No. 20,266, A. N. S. P. Brazos River, between Seymour and Authon, Texas. Collection of W. S. Black. E. D. Cope.

Also large series, Nos. 20,267 to 20,324, A. N. S. P., paratypes, same data. They show: Head 3 to $3\frac{1}{4}$; depth $2\frac{3}{5}$ to 3; D. usually 1, 9, rarely 1, 8; A. 1, 9 or 1, 10; scales 25 to 29 in median lateral series to caudal base and 3 or 4 more on latter; 12 to 14 scales transversely between dorsal and anal origins; snout 3 to 4 in head measured from upper jaw tip; eye $2\frac{4}{5}$ to 3; maxillary $2\frac{3}{4}$ to $3\frac{1}{2}$; interorbital $2\frac{2}{5}$ to $2\frac{3}{4}$; length 33 to 45 mm. Most of this series females, and differing from the male in having six or seven vertical wide cross-bars of dark brownish on trunk. These all more or less variable. Very pale brownish vertical streak at base of caudal. Outer hind portion of caudal with vertical submarginal dusky streak to median rays, though hind edge of fin narrowly pale. Often dorsal and anal rather dark, though former mostly uniform. Young examples colored like females, variable.

This interesting form is closely related to *Cyprinodon bovinus*, apparently differing in the absence of a distinct black pale-edged ocellus on upper hind portion of dorsal.

Also an example from the staked plains between the Brazos River and Tulip, Red River, Texas. 1892. E. D. Cope.

Two from the Red River basin south of Clarenden, Texas. E. D. Cope.

(Named for the Red River, of the most northern inland eastern region at which a member of the genus *Cyprinodon* has been found.)

Cyprinodon macularius Baird and Girard.

Proc. Acad. Nat. Sci. Phila., 1853, p. 389. Rio San Pedro, Arizona.
Cyprinodon californiensis Girard, Proc. Acad. Nat. Sci. Phila., 1859, p. 158. San Diego County, California.

No. 7,219, A. N. S. P., cotype of *C. macularius* Baird and Girard. Rio San Pedro, Arizona. J. H. Clark. Smithsonian Institution (No. 992).

No. 7,220, A. N. S. P., cotype of *C. californiensis* Girard. San Diego County, California. Smithsonian Institution (No. 311).

Also an example from Salt River, in the Gila Basin, at Tempe (Dr. H. A. Pilsbry), Arizona.

Cyprinodon elegans Baird and Girard.

Proc. Acad. Nat. Sci. Phila., 1853, p. 389. Camanche Spring, Texas.

No. 7,222, A. N. S. P., cotype of *C. elegans* Baird and Girard, Camanche Spring, Texas. J. H. Clark. Smithsonian Institution (No. 686).

Cyprinodon mydrus Goode and Bean.

Large series from the Florida Keys, which I collected in 1904.

Lebias fasciatus Valenciennes.

Mediterranean (Bonaparte No. 313). Dr. T. B. Wilson.

GOODEINÆ.

Goodea atripinnis Jordan.

Lake Patscuaro, Mexico (Mexican expedition 1890).

Characodon variatus T. H. Bean.

Rio Verde at Rascon, San Luis Potosi, Mexico.

PŒCILIINÆ.

Gambusia affinis (Baird and Girard).

Heterandria affinis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 390. Rio Medina and Rio Salado, Texas.
G. holbrooki Girard, Proc. Acad. Nat. Sci. Phila., 1859, p. 61. Palatka, Florida.
G. gracilis Girard, l.c., p. 121. Matamoras, Mexico.
Haplochilus melanops Cope, Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 457. Neuse River, North Carolina.
Zygonectes brachypterus Cope, Bull. U. S. Nat. Mus., XX, 1880, p. 34. Trinity River, Fort Worth, Texas.

Nos. 6,974 and 6,975, A. N. S. P., cotypes of *Heterandria affinis* Baird and Girard. J. H. Clark. Smithsonian Institution (No. 66).

Nos. 6,976 and 6,977, A. N. S. P., cotypes of *G. holbrooki* Girard. Palatka, Florida. Smithsonian Institution (No. 77).

No. 6,973, A. N. S. P., cotype of *G. gracilis* Girard. Matamoras, Mexico. Smithsonian Institution (No. 3,506).

Nos. 7,143 to 7,159, A. N. S. P., cotypes of *Haplochilus melanops* Cope. Neuse River, North Carolina. E. D. Cope.

No. 20,446, A. N. S. P., type of *Z. brachypterus* Cope. Trinity River, Fort Worth, Texas. E. D. Cope.

Besides a large series of local material from New Jersey to Virginia are specimens from Big Cypress in Lee County (Baynard), Florida; Devil's River (Pilsbry), Texas; Lake Superior at Pequaming in Brayon County (M. Hebard), Michigan. This species is very abundant in southern New Jersey, Delaware, Maryland and Virginia, coastwise. Although Dr. Regan separates *Heterandria holbrookii* Girard and *H. patruelis* Baird and Girard as distinct species, I feel convinced they are not separable. The amount of variation, even in New Jersey examples, is sufficient to include the limitations he gives, as well as permit still greater latitude. Many aquarium specimens are marked with large black blotches, others are pale and immaculate.

Gambusia punctata Poey.

Mem. Hist. Nat. Cuba, I, 1855, p. 384. Cuba.

No. 6,978, A. N. S. P., probably cotype? Cuba. Prof. F. Poey. Smithsonian Institution (No. 655).

Also examples from Santiago de Cuba and Bahia Honda, Cuba.

Gambusia menieli sp. nov. Fig. 5.

Head $3\frac{1}{6}$; depth 3; D. I, 8; A. II, 8; P. II, 11; V. I, 5; scales about 26 (squamation injured) in median lateral series to caudal base, and 2 more on latter; about 7 scales (squamation injured) between dorsal and anal origins; 20? scales (squamation injured), before dorsal; head width $1\frac{1}{2}$ in its length; head depth at occiput $1\frac{1}{4}$; third branched dorsal ray $1\frac{2}{3}$; third branched anal ray $1\frac{3}{4}$; least depth of caudal peduncle $1\frac{2}{3}$; caudal 1; pectoral $1\frac{1}{4}$; ventral $2\frac{2}{3}$; snout $2\frac{4}{5}$ in head, measured from upper jaw tip; eye $2\frac{3}{4}$; maxillary $3\frac{1}{8}$; interorbital $2\frac{1}{10}$.

Body well compressed, deepest at ventral origin, lower front profile little more convex than upper, and edges all rounded. Caudal peduncle strongly compressed, about long as deep.

Head small, depressed above, constricted sides approximated below, and lower profile little more inclined. Snout wide, depressed, length about $\frac{2}{3}$ its width. Eye large, high, about midway in head length. Mouth broad, commissure about half way to eye, slightly inclined. Jaws produced, upper protractile nearly equal to snout length. Lower jaw with rami firm at symphysis. Teeth in bands of moderate width in jaws, all simple, conic and outer row slightly enlarged and curved. Maxillary greatly inclined, largely slips below front edge of preorbital. Tongue small, depressed, rather narrow, free in front. No teeth on roof of mouth. Lips rather thin. Nostrils close to upper front eye edge. Interorbital broad, flattened. Preorbital large, deeper than long and its length about $\frac{3}{5}$ of eye. Preopercle ridge vertical.

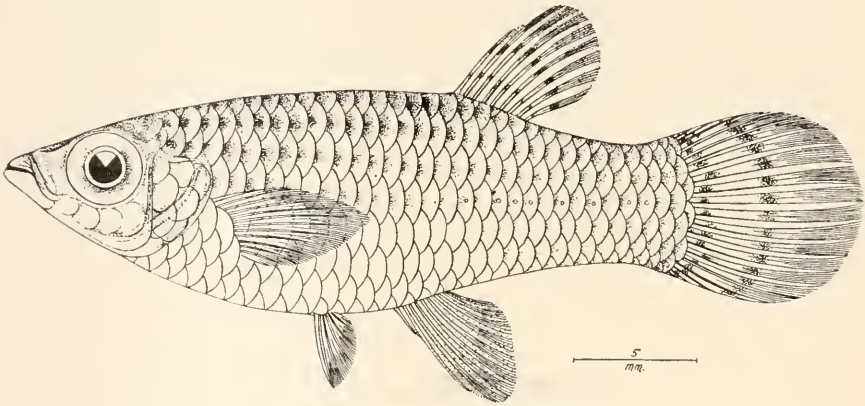

Fig. 5.—*Gambusia mcnieli* Fowler.

Gill-opening forward nearly opposite front rim of pupil. Rakers about 14, very slender, their length about $\frac{1}{3}$ of filaments and latter about $\frac{3}{5}$ of eye. Isthmus narrow and trenchant.

Scales large, narrowly imbricated, smaller on caudal base. Scales large on prepectoral region and a single row on cheek. Opercles and top of head with rather large scales. Obscure lateral line, imperfect, and as simple pore in middle of exposure of scale, course median along side, at least posteriorly (squamation largely damaged anteriorly).

Dorsal origin just behind anal base, or about last third between front edge of eye and caudal base, and depressed fin extending about $\frac{5}{6}$ to caudal base. Anal inserted about midway between middle of eye and caudal base, first branched ray longest and others regularly

graduated down, depressed fin extending about $\frac{3}{5}$ to caudal base. Caudal with hind edge convexly rounded. Pectoral long, with wide base, reaches back nearly opposite anal origin. Ventral small, inserted little nearer anal than pectoral, and not quite reaching former.

Color in alcohol largely brownish, paler below, each scale on back with cluster of dark pigment dots at pockets. Iris slaty with dark pigment dots. Dorsal rays each with median brownish spot and another midway toward base. Median caudal rays with three or four brownish spots, forming irregular transverse bars, especially evident when fin closes. Outer portions of anal rays with few brownish pigment spots. Except as noted, all fins pale or transparent.

Length 35 mm.

Type No. 6,818, A. N. S. P. Panama. J. A. McNiel.

Only the above example, a female, known. It is close to the figure of *G. nicaraguensis* Günther,[7] except the latter shows the dorsal and caudal with more darker spots on the rays, especially terminally. The prepectoral scales smaller, and a dark spot little smaller than the eye above postventral region. Possibly this figure may refer to *Gambusia dovii* Regan,[8] as Günther's *G. nicaraguensis* was based on "several females $1\frac{1}{2}$ or 2 inches long presented by Captain Dow." Now *G. dovii* Regan differs in having the depth $3\frac{3}{4}$ and the head $3\frac{3}{4}$, eye $3\frac{1}{2}$, 32 scales, dorsal rays 7, and interorbital $1\frac{3}{4}$. It is based on a single female 33 mm. long.

G. cascajalensis Meek and Hildebrand[9] differs in the head $3\frac{7}{10}$ to $3\frac{4}{5}$, depth same, D. I, 6, A. II, 7, scales 26, smaller eye ($2\frac{9}{10}$ to $3\frac{1}{10}$), and the coloration.

Three other species, *G. latipunctata* Meek[10] and Hildebrand, *G. cana* Meek and Hildebrand,[11] *G. darienensis* Meek and Hildebrand,[12] all have smaller head, lesser depth, fewer branched rays, more scales, smaller eye, different coloration, etc.

(Named for J. A. McNiel, who collected fishes in Panama many years ago.)

Gambusia nicaraguensis Günther.

Orizaba, Mexico.

[7] *Tr. Z. Soc. London*, VI, 1868, p. 482, Pl. 82, fig. 3. Lake Nicaragua.

[8] *Proc. Z. Soc. London*, 1913, p. 986. Lake Nicaragua.

[9] Field Mus. Pub. 166, Zool. Ser. X, No. 8, 1913, p. 86. Rio Cascajal, Atlantic slope of Panama.

[10] *L.c.*, p. 87. Arrijan, Pacific slope of Panama.

[11] *L.c.* Rio Satiganti, Cana, Pacific slope of Panama.

[12] *L.c.*, p. 88. Rio Capeti, Tuyra River basin, Pacific slope of Panama.

Belonesox belizanus Kner.

Orizaba, Mexico.

Pseudoxiphophorus bimaculatus (Heckel).

Orizaba and Jalapa in Vera Cruz (Dr. P. P. Calvert), Mexico. One example from Orizaba adult, and with exceptionally produced hunch on the predorsal region.

Heterandria formosa (Girard).

Tick Island in Spring Garden Creek, St. John's River basin (Dr. H. A. Pilsbry), Florida.

Pœciliopsis occidentalis (Baird and Girard).

Heterandria occidentalis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1853, p. 390. Rio Santa Cruz, Tucon, Arizona.

No. 6,972, A. N. S. P., cotype of *H. occidentalis* Baird and Girard. Rio Santa Cruz, Tucon, Arizona. Smithsonian Institution (No. 3,511).

Many examples also from the above locality September, 1910, and others from the Salt River in the Gila basin (Dr. H. A. Pilsbry).

This species has recently been placed in *Mollienisia* by Dr. Regan, but the comparison of my series shows it belongs to *Pœciliopsis*.

Pœciliopsis lutzi (Meek).

Head $3\frac{2}{3}$ to $3\frac{7}{8}$; depth $3\frac{2}{5}$ to 4; D. I, 7; A. III, 7; scales 25 to 27 in median lateral series to caudal base, and 2 or 3 more on latter; 8 or 9 scales between dorsal and anal origins; snout $3\frac{1}{8}$ to $4\frac{1}{3}$ in head; eye $2\frac{7}{8}$ to $3\frac{1}{8}$; maxillary $2\frac{3}{4}$ to 4; interorbital 2 to $2\frac{1}{3}$. Body elongate, fusiform, compressed. Head depressed above. Snout truncate as viewed above, length about $\frac{2}{5}$ its width. Eye close to upper profile, centre at first third in head length. Mouth wide, upper jaw greatly protractile. Maxillary nearly vertical. One row of slender bent spoon-like flexible teeth in each jaw. Lower jaw truncate, scarcely projects. Interorbital flat. Rakers about 14 slender weak points, $\frac{1}{4}$ of filaments. Scales mostly uniform, single row on cheek. Dorsal inserted at last third in space between snout tip and caudal base. Anal inserted little nearer pectoral origin than caudal base. Caudal convex behind. Pectoral reaches nearly $\frac{3}{4}$ to anal, ventral $\frac{3}{4}$ to vent. Color in alcohol pale brownish, obscure darker blotch on most scales on back. Sides of head and costal region silvery-white. Row of eight to ten small brownish spots, concurrent with vertebral axis of body along its sides, each spot not greater than diameter of eye. Conspicuous blackish blotch at anal origin, sometimes absent or represented by dark basal line, in smaller examples. Fins pale,

some with several obscure or slightly darker transverse cross-bars. Iris silvery, tinged brownish. Length 40 to 58 mm. Orizaba, Mexico (F. Sumichrast).

This species is closely related to *P. pleurospilus* (Günther), and appears to differ only in the coloration, in which the lateral dark spots are fewer in number. The present species was originally described[13] with "a narrow dark streak on under side of caudal peduncle," a character not indicated on the figure,[14] which is evidently a female. Meek also describes *Heterandria pleurospilus* as identical with Günther's *Girardinus pleurospilus*,[15] but Regan claims, evidently as they are said to have "sides with 8 to 11 black spots . . . . each about as large as eye," that they are not Günther's species,[16] but *H. lutzi* Meek. None of these writers mention the conspicuous black blotch so frequent in adult females at the front basal portion of the anal fin, and well represented in Günther's figure of *G. pleurospilus*.[17]

Leptorhaphis infans (Woolman).

Orizaba, Mexico (F. Sumichrast).

Phalloceros caudimaculatus (Hensel).

Rio Grande do Sul, Brazil. Also several aquarium examples, recently imported to Philadelphia, remarkable for their coloration. Two are females and one a male. They are largely very pale brownish, and below more whitish. Each scale on back with slight or obscure narrow brownish edge. Sides of trunk and head with silvery reflections. Slightly darker brownish streak down middle of back. Fins all whitish, marked irregularly with jet-black blotches. On middle of side, just below middle of depressed dorsal vertical elliptical brownish blotch, obscure, about equal to eye-diameter. Body and head also marked in striking contrast with irregular or variable blackish blotches. Iris grayish. In no two individuals, or even on each side of the same individual, are these color-patterns alike. They are extremely prominent and render the fish very attractive in the aquarium. Though this may be due in large measure to domestication, certain wild examples also show similar modifications, as I have found *Gambusia affinis* and *Mollienisia latipinna*, from Florida, equally as contrasted as in the case of the

[13] Field Mus. Pub. 65, Zool. Ser., 1902, p. 106. Oaxaca, Cuicatlan and Venta Salada, Mexico.
[14] *L.c.*, 93, Zool. Ser., 1904, p. 149, fig. 47.
[15] *Cat. F. Brit. Mus.*, VI, 1866, p. 355. Lago de Dueñas, Guatemala.
[16] *Biol. An. Centr. Pisc.*, 1906–8, p. 99.
[17] *Tr. Z. Soc. London*, VI, 1868, p. 486, Pl. 87, fig. 1.

present species. Possibly these concentrated dark blotches may be of parasitic origin, though a casual examination with the microscope discloses nothing but crowded jet-black chromatophores.

Glaridichthys uninotatus Poey.

Bahia Honda, Cuba.

Girardinus metallicus Poey.

Mem. Hist. Nat. Cuba, I, 1855, pp. 387, 391, Pl. 3, figs. 8–11. Cuba.

No. 6,971, A. N. S. P., cotype. Cuba. Smithsonian Institution (No. 252).

Also another from Cuba without definite locality (W. T. Innes).

Platypœcilus couchianus (Girard).

Monterey, Mexico.

Platypœcilus maculatus Günther.

Orizaba (F. Sumichrast), Mexico (W. T. Innes).

Xiphophorus helleri Heckel.

Orizaba (F. Sumichrast), Jalapa (Dr. P. P. Calvert), Mexico (R. E. Dorsey and F. L. Tappan).

Pœcilia vivipara Schneider.

Surinam (Dr. C. Hering) and Hucares, Porto Rico. I have also examined a large series from Guanica, obtained by Mr. C. F. Silvester in 1915.

Lebistes reticulatus Peters.

Trinidad and Brazil.

Mollienisia latipinna Le Sueur.

South Carolina (Dr. J. E. Holbrook); Boca Chica Key, Hernando County and Bayport (E. D. Cope), Blue Creek in Lake County (Dr. H. A. Pilsbry), and Tick Island (Dr. H. A. Pilsbry), Florida. A small example from the last locality is irregularly blotched over head, trunk and fins with blackish, like some examples of *Gambusia affinis*.

Mollienisia sphenops (Valenciennes).

Venezuela? (Dr. J. F. Bransford), Panama (J. A. McNiel), Wounta Haulover in Nicaragua (Rev. Fluck), Orizaba (F. Sumichrast), and Rio Verde at Rascon, Mexico.

Limia vittata (Guichenot).

L. cubensis Poey, Mem. Hist. Nat. Cuba, I, 1855, p. 388, Pl. 31, figs. 12–13. Cuba.

No. 6,814, A. N. S. P., cotype of *L. cubensis* Poey. Smithsonian Institution (No. 659). Also another Cuban example from Poey.

Guaninar, Cuba.

ANABLEPINÆ.

Anableps anableps (Linné).

Surinam (Dr. C. Hering) and Para, Brazil. Trindad (Dr. B. Sharp).

Anableps microlepis Müller and Troschel.

Pedernales, Venezuela.

Anableps dowei Gill.

Proc. Acad. Nat. Sci. Phila., 1864, p. 4. Lallnia, San Salvador.

No. 6,982, A. N. S. P., type. Lallnia, San Salvador. Capt. Dow.

AMBLYOPSIDÆ.

Amblyopsis spelæus De Kay.

Many from Mammoth Cave, Kentucky.

ON SOME VARIETIES OF THAIS LAPILLUS IN THE MOUNT DESERT REGION, A STUDY OF INDIVIDUAL ECOLOGY.

BY HAROLD S. COLTON.

Introduction.

In this study an attempt is made to correlate some of the many color varieties of *Thais* (*Nucella*, *Purpura*) *lapillus* with the conditions under which the animal lives. The study is based on field work carried out in the neighborhood of Mount Desert Island, Maine, in the summer of 1915. Over 12,000 snails were collected from sixty-seven localities, sorted, and the variations tabulated. These tables were then compared with the environment of the snail.

With respect to *Thais* there is a very general belief that color is correlated with the color of the environment. Cooke (1895) cites a locality in Cornwall where striped forms are found on striped rocks. Blaney (1904) reports yellow forms were found to predominate on the yellow granite rocks of Yellow Island, a small island in Frenchmens Bay on the Maine coast. On account of the great variation of *Thais* and the apparent predominance of one variety in a given locality, a study of the variations might throw light on some of the ecological factors of the sea beach.

Life History of Thais.

Thais (subgenus *Nucella* or *Purpura*) *lapillus* is a carnivorous prosobranch mollusk. It feeds almost exclusively in this region on the mussel, *Mytilus edulis*, and the barnacle, *Balanus balanoides*. The former it attacks by boring a hole in the shell about 1 mm. in diameter, devouring the soft parts by means of its long flexible proboscis. The barnacle is eaten in much the same manner, the hole being drilled through one of the scutes. Not only do they sometimes attack the periwinkle, *Littorina littorea*, but will try to bore through the shell of one of their own kind. Although many shells show scars, there is no evidence, however, that many are destroyed in this way.

The descriptive ecologist has neglected the Atlantic coast north of Cape Cod. King and Russell's classification for the coast of Scotland will not hold for this region. Some day, if some one else

has not undertaken it, the writer hopes to make a descriptive classification of the animal communities of the sea beach in the Mount Desert region. Provisionally he recognizes the following classification of the Littoral Formation:

- Littoral Formation
  - Solid Rock Association
    - Drift Zone.
    - Littorina rudis Zone (Mean High Water).
    - Balanus Zone.
    - (Fucus Zone.)
    - Mytilus Zone.
    - Transition Zone (Mean Low Water).
  - Rock Association.
  - Rock Pool Association.
  - Boulder Association.
  - Shingle or Pebble Association.
  - Sand Beach Association.
  - Mud Flat Association.

The mean rise and fall of the tide is ten vertical feet.

Thais is found in the Solid Rock, Boulder and Rock Pool Associations. In the two former it is confined to the Balanus, Fucus, and Mytilus Zones, and particularly to the Balanus and Mytilus Zones, as there the food is found. There, *Thais* is associated with *Littorina rudis*, *L. palliata*, *L. littorea*, *Balanus balanoides* and *Mytilus edulis*. When the tide is high the cunner (*Tautogolabrus adspersus*) and the pollack (*Pollachius virens*) invade this formation to feed.

Thais is not found in the Shingle, Sand or Mud Flat Associations. Nor is it found alive in any association of the Bottom Formation, unless we should classify the Rock Pool as a detached part of this formation.

It is not found in any stratum other than the upper surface of rocks. It is found therefore neither on the weeds nor under the soil.

Its habitat is very closely associated with its food. (See diagram, fig. 1, illustrating the food relations of *Thais* to its organic environment.)

The eggs are laid in little urn-shaped capsules in sheltered places. They are more abundant in the Mytilus Zone in favored spots, such as in cracks in the rocks or under masses of *Fucus* than in the Balanus Zone. In each capsule about 400 eggs are laid. As cannibalism is practised (Beard 1899, Carpenter 1857, Glaser 1905, Pelseneer 1904, Robert 1902) by the growing snail, a capsule containing snails ready to hatch will hold but 8–14.

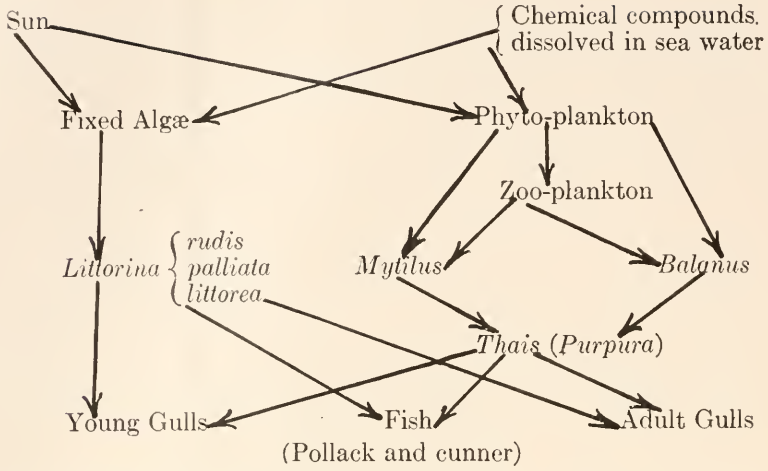

Fig. 1.—Diagram illustrating the principal relations of *Thais* to its organic environment in the Rock Association. To be complete this diagram should show an entire cycle of the material. Each one of the organisms listed above gives off liquids to the sea water that may be again used. They also furnish solids either as waste products or by death, which, when acted on by bacteria, will give more soluble matter as well as a residual solid that will help contribute to the sea bottom in other localities. The dead animals will supply food for amphipods, the amphipods food for fishes like the sculpin, and so relations are established with other associations. This diagram shows that the biota of the Rock Association is dependent alone on the palagic formation. The relationships with other associations are destructive to it rather than constructive.

The young snail has enemies in the shape of fish, so those which fail to take refuge in small cracks in the rocks are destroyed. At this time the food consists of young mussels which grow abundantly in the joints in the rocks. If one does not know where to look for the young snails, none will be seen, so far are they crowded into the cracks.

A few pollack that were caught at high water over a Thais habitat had their stomachs full of young *Littorina palliata* which they had eaten from the same locality in which *Thais* lives. *L. palliata* cannot hide in the rock cracks, as their food is on the Fucus stems. If the fish could find young *Thais*, there is no reason why they should not be eaten as well as *Littorina*.

Although the young snails are hatching throughout the greater part of the summer, most of them hatch out in August and reach between 10–15 mm. in the first winter. This is measured by large ridges on the shell, which indicate periods of rest in the growth of the shell. These rest periods are assumed to indicate the winter, but are not proved to correspond to it.

The curves in fig. 2 show the rate of growth in three different environments. These are but approximations. Further study may show that the first year may be really the second.

The oldest snail found was estimated as being seven years old. The great majority are about two or three years old.

Cooke (1895) estimates that each female snail lays two hundred egg capsules a year. Each capsule contains about four hundred

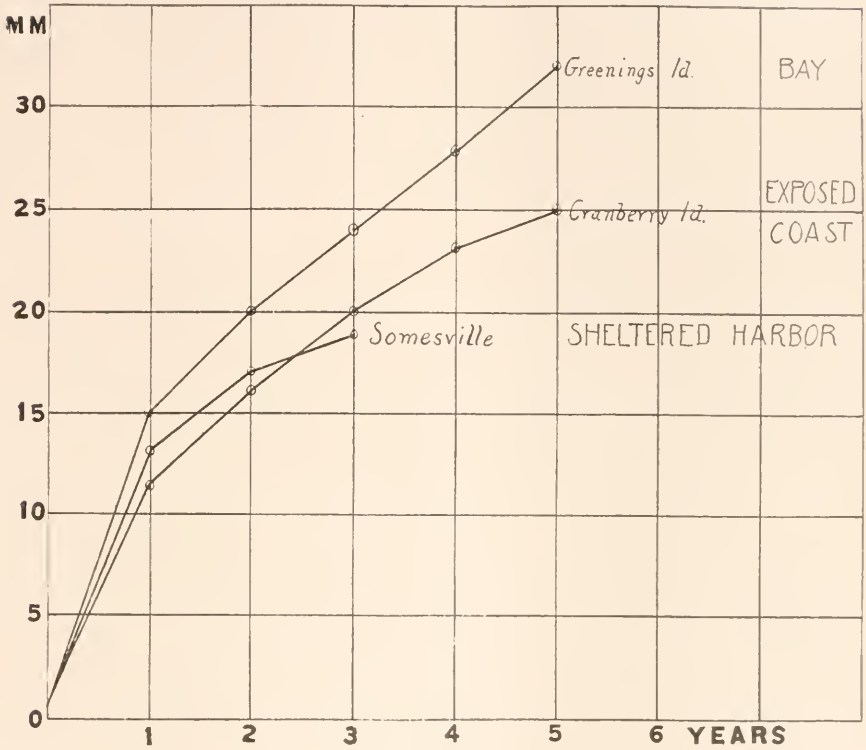

Fig. 2.

eggs. Food seems to be in most places abundant. The snails have been observed to be limited in number by the following factors:

(1) Cannibalism within the egg capsule, only ten to twelve hatching out of 300–400 eggs.

(2) Limit to the number that can take refuge in cracks in rocks and yet get enough to eat.

(3) Fish, such as pollack, will gobble up any stragglers.

(4) Half-grown snails, ones too big for the pollack, are used by herring gulls as food, the empty shells being regurgitated.

(5) Very large specimens are carried by the gulls to a height and dropped on any near-by flat rock in the same way as the gulls treat both sea urchins (*Strongylocentrotus*) and welks (*Buccinum*). Only the largest *Purpura* will break and only the largest are collected for this purpose.

(6) Certain ones seem to be parasitized by a sporocyst, but this was not investigated.

(7) Accidents, such as a surf heavy enough to move the rocks on which the animals live, may destroy others. In such habitats few if any are found. The maximum size of these rocks may in exposed places be boulders two to three feet in diameter, while in very sheltered places *Thais* will be found on pebbles two inches in diameter. The limit is obviously determined by wave action.

(8) Ice probably destroys others, as they are not found in places where shore ice can accumulate.

(a) In Maine they are not abundant in shallow coves that freeze up solid in the winter time.

(b) Their geographical distribution also seems to indicate that sand beaches are a barrier, as *Thais lapillus* is not found west of Montauk Point. On Long Island Sound the barrier has not been determined. Both *Balanus* and *Mytilus* being found west of Stamford, Conn., the most westerly recorded station for *Thais*, and the shore is still rocky. In the north shore ice seemed to form the barrier See map, fig. 3.

Various adaptations are at once manifest on examining this animal: (1) The strong shell, so strong that a drop from a height will not always break it. (2) The strong foot, which makes dislodgment from its substratum difficult. (3) Its habit of seeking shelter under rocks and fucus. (4) The method of egg-laying, with its protection of the young until they are able to care for themselves, although if but two and a quarter per cent. of these laid hatch, those two and a quarter per cent. are almost sure to hatch.

Method.

As each station was visited, from 200 to 500 shells were collected when *Thais* was abundant. In some places they literally covered every inch of the rock. In other places they were so rare that a careful search of a quarter of a mile of beach would often disclose but two or three.

Each collection as made was placed in a bag made of mosquito netting. While still alive the snails were sorted into the dozen or

so groups of the principal varieties. The number in each group was tabulated. For future reference the bag of snails was preserved in a tub of formalin.

A study of the color varieties seems to show that there are a number of colors and patterns that may be combined together in any sort of way. These are as follows:

(1) Pure white shells that show no trace of color.

(2) Purple. The color in this case is diffuse through the shell, but is darker within the aperture.

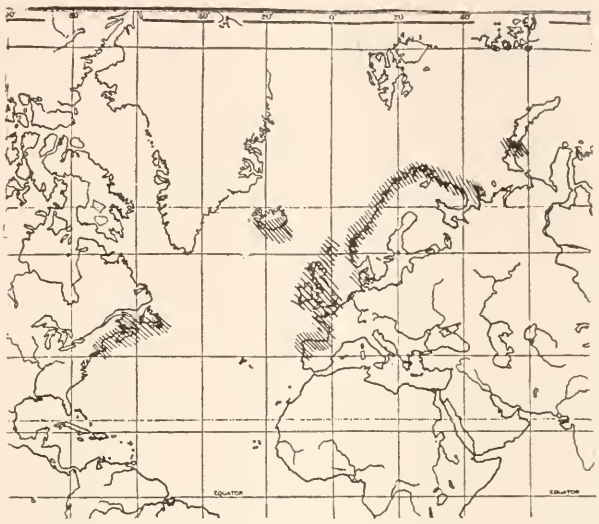

Fig. 3.—Map of the North Atlantic Ocean showing the distribution of *Thais* (*Purpura* or *Nucella*) *lapillus*. (After Cooke, Proc. Mal. Soc. London, vol. II, p. 193.) The cross-hatching shows the occurrence of *T. lapillus*. The southern barrier to *T. lapillus* is not clear, but the northern barrier is obviously the presence of ice on the shore.

(3) Chestnut. This color may be pure quite often, but it is usually combined with purple, forming a chocolate, or with yellow, forming olive.

(4) Yellow is a color which, when uncombined with one of the others, makes the shell very conspicuous on the rocks. Owing to its relative rarity and to its being so conspicuous, it often appears in shell collections in proportions that are misleading. Only by collecting all the snails from a given locality can this be avoided.

(5) *Dilute.* Every one of the colors mentioned above may appear in a dilute in contrast to its intense form.

(6) *White lip* of the apperture is quite common in some localities. In fact, purple is rarely found not associated with a trace of lighter color on the lip. This *white lip* may be combined with all colors and dilutions.

(7) *Narrow stripes.* In many shells about ten narrow white stripes are found on any color background. These are sometimes associated with the ridges which appear on many shells.

(8) *Wide stripes* of white, usually two in number, often appear. The widest stripe equals two or three of the narrow ones and the smaller stripe is double the width of the narrow ones. The widest stripe is always posterior to the narrower stripe.

(9) *Spot of purple* on the columella. This is rare at Mount Desert, but very common at Rye Beach, New Hampshire.

(10) *Imbricata.* A fluting of the ridges of the shell gives rise to the variety called by Lamarck *imbricata.*

Apparently each one of the ten characters recognized may be combined with any other. If this is so there must be 1,103 varieties. Not that many varieties have been found. This is due to the fact that one cannot distinguish certain combinations from one another. As an example, let us consider the case of the colors alone. We have purple, chestnut, yellow, and white. There are eight possible combinations of these: white, purple, chestnut, yellow, purple-chestnut, purple-yellow, chestnut-yellow and purple-chestnut-yellow. These last four are shades of olive and chocolate, and cannot be distinguished easily from one another. If we combine these four color combinations into one group and omit the white lip and purple spot on the columella, we will reduce the possible number of variations to be recognized from 1,103 to 33. Twenty-eight of these thirty-three varieties have been recognized. However, there are five that are so rare that they were not discovered in a collection of six thousand shells when they were particularly sought after. These were narrow stripe dilute yellow, wide stripe narrow stripe yellow, wide stripe narrow stripe dilute yellow, narrow stripe dilute olive, and wide stripe dilute olive. The yellows which contribute to the olive color and the dilute are much rarer than any of the others, so it is no wonder that they are the ones that would be lacking in combinations.

It is obviously impossible to attempt to correlate all the known varieties with environmental factors, so the writer has for the sake of convenience reduced still further the number of groups. The particular groups recognized are as follows:

(1) White; that is, pure white.

(2) Light—pure white, together with intense and dilute chestnut with white lip. The outer layer of the shell of these is white.

(3) Dark—chestnut and purple in all their combinations.

(4) Yellow—pure yellow.

(5) Striped—both narrow and wide stripe in all their combinations and color.

(6) Imbricated—in all the combinations of patterns and colors.

In the tables that follow the number of snails found in each group is stated in per cent. of all the snails in each collection from a given station.

The Relation of the Varieties to the Environment.

The base for this study was Greenings Island, an island located between Northeast and Southwest Harbors in the mouth of Somes Sound. It is triangular in shape, with a perimeter of about two and a quarter miles. The main mass of the island is composed of till, which at one time formed the terminal moraine of the continental glacier before it retired from Somes Sound. This till is protected from rapid wave erosion by outcrops of reddish granite at the east and west end of the island. This granite is cut in several places by broad basalt dykes which run in a general north and south direction. Under wave erosion the till between the outcrops of solid rocks has given material to form a boulder-strewn beach and in favorable places the finer products have given rise to pebble and sandy beaches. On the west or more sheltered side of the island between the granite outcrops are a number of muddy coves.

On this small island we have all the principal Littoral associations present. The distribution of these are found in fig. 4. This figure is a diagram of the shore of Greenings Island, with the vertical scale very much exaggerated. It has been made as though the shore were cut at the northwestern point and folded out so that this northwestern point appears at each end of the diagram. The character of the shore is indicated. The island as a whole is protected from heavy surf by outlying islands, but the eastern end is exposed to the ocean swell from both the south and east, and at times of storms is subject to quite a surf. The northeast shore and south shore are relatively unprotected at the east end, but become more protected toward the west. On the diagram the per cent. of pure white shells are placed in the locality in which the collection was made.

An inspection of this figure will show that the most unprotected portion has the lighest colored snails, while the portion of the island

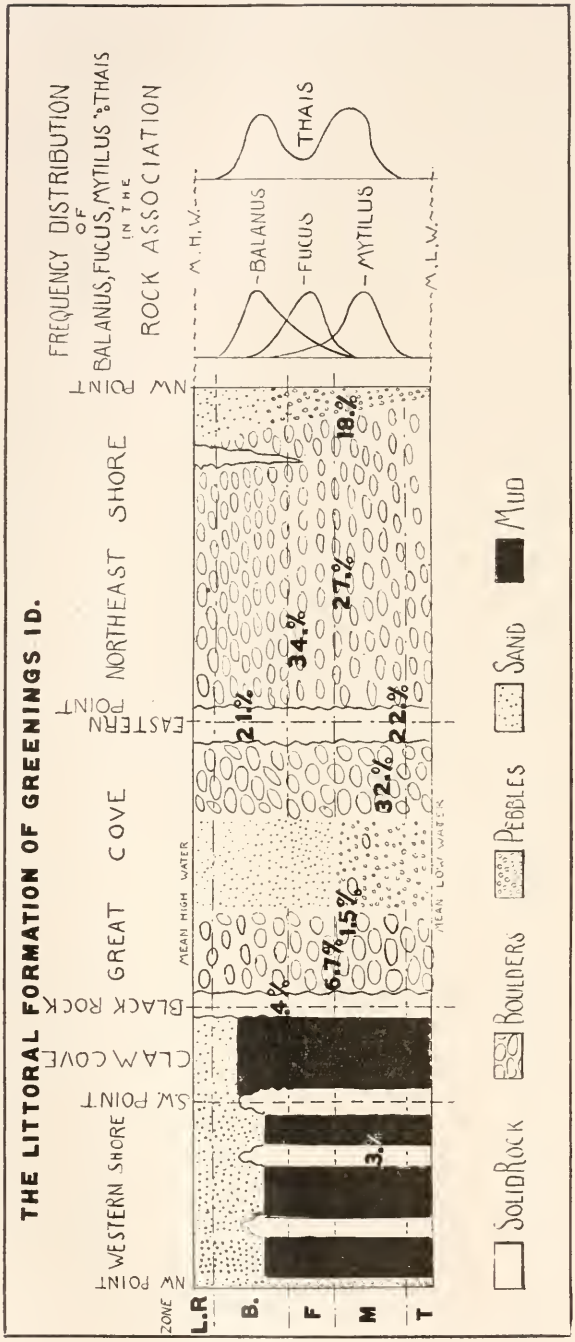

Fig. 4.—Diagram of the beach of Greenings Island, Maine. This is drawn as if the shore of the island were cut at the northwestern point and beach folded out into a straight line. The length of the diagram represents two and a quarter miles. The width represents the space between mean low tide and mean high tide, which is equal at this place to ten vertical feet.

The percentages on the diagram refer to the per cent. of white *Thais* found at each locality. It shows how the number of white are most abundant at the eastern end and fewest at the western.

L. R., Littorina rudis zone; B., Balanus zone; F., Fucus zone; M., Mytilus zone; T., Transition zone.

subject to the smoothest water has the darkest. This difference is very striking and the intermediate stations show intermediate ratios.

This has led the writer to classify the shores according to the waves. These are arbitrary divisions and of course every intergradation is found, but in most cases there is very little hesitation how a given station should be described. If a great uncertainty exists, the station was placed in both classes.

Sea cliff or surf exposed to the open sea. An ordinary row boat can practically never land with safety.

Bay exposed to a moderate surf during high winds. Except at those times a small boat can easily land on the shore without danger of accident.

Harbor so smooth that a row boat can practically always make a landing.

In the tables which follow the stations nearest together are always compared.

TABLE I.

Locality.	Condition.	Station No.	No. of Individuals.	% Lt.	% White.
Bakers Id.	Surf.	23	65	6.1	0
	Bay.	24	167	20.7	6
Seal Harbor	Surf.	54	176	2.8	0
	Bay.	56	34	55.6	44
Cranberry Id.	Surf.	10	319	30	4.3
	Surf.	11	195	59	9.7
	Bay.	13	204	15	5.7

We can conclude that in general the snails on the most exposed situations are darker than those found in the bay.

TABLE II.

Locality.	Condition.	Station No.	No. of Individuals.	% Lt.	% White.
Greenings Id.	Bay.	2	516	44½	21½
	Harbor.	31	333	10	1½
Buckel Id.	Bay.	15	234	63	36
	Harbor.	16	218	13½	5½
Bear Id.	Bay.	43	277	24	12½
	Harbor.	44	67	10½	1½
Orono Id.	Bay.	19	55	11	7
	Harbor.	18	184	50	27
Southwest Harbor	Bay.	37	194	29½	19
	Harbor.	36	196	10½	5½
	Harbor.	35	273	25½	11
	Harbor.	47	172	14½	6½

If we combine the conclusion from Table I with Table II we see that snails in the exposed positions tend to be dark as well as those in the sheltered places, while those in the bay shore tend to be the lighter colored.

The following table includes the results of collections made at stations separated by no barrier, near together, but on a substratum of different colored rocks. The numerous black basalt dykes that everywhere cut the red granite make a number of collections of this sort possible. Only a very few of the possible ones have been studied.

TABLE III.

Locality.	Condition.	No. of Station.	No. of Indiv.	% Lt.	% White.	% Yellow.
Greenings Id., east end.	Red rocks, 1000 ft. to Sta. 2.	25	316	57	34	6.3
	Black rocks, 20 ft. to Sta. 50.	2	516	44	21	0
	Black rocks, 500 ft. to Sta. 21.	50	160	37	22	0
	Red rocks,	21	164	47	32	.6
Greenings Id., southwest end.	Red rocks, 200 ft. to Sta. 28.	31	333	10	1.5	2.1
	Black rocks, 50 ft. to Sta. 30.	28	247	14	6.7	1.2
	Black rocks,	30	289	2.9	.4	3.8
Suttons Id.	Red rocks, 110 ft. to Sta. 8.	9	159	35	2.5	7.5
	Red rocks, 150 ft. to Sta. 7.	8	135	28	2.2	31.8
	Black rocks.	7	123	19	0	18.7

In general, more light-colored snails are found on the red rocks than on the black rocks. The association of yellow forms with the environment is inconclusive. There does not seem to be any correlation from these few cases. Thirty-three collections from red rocks average 4% yellow. Fifteen collections from black rocks average 4.7% yellow.

In this region there are occasional outcrops of a banded rock, a chlorite schist. That there might be a correlation between striped forms and schist is a possibility that may be investigated. The collections from the red granite given in the table are those made nearest to the chlorite schist. This comparison was not in mind when the collections were made, so the stations are often several miles apart.

TABLE IV.

Locality.	Substratum.	Striped Shells.
Blue Hill Bay	Chlorite schist..	1.1%
	Red granite.....	9.8%
Western Way	...Chlorite schist	27 %
	Red granite[1] (average of 18 collections from this region) ..	14.4%
Western Way	Chlorite schist	27 %
Nearest Granite Station	.....Red granite	18.5%

The distance apart of the stations introduces so many other factors that with such meagre data no conclusions can be drawn. The writer expects that the results are really negative.

The relative proportions of the imbricated forms from different localities are as follows:

In the upper bays the water is much warmer than near the ocean. This warmth is indicated at Blue Hill by bathhouses being located along the beaches. None of the resorts farther down the bays have any, the water being too cold for bathing in the bay in those places. The upper bays are relatively shallow and there are muddy spots found on the rocky beaches between the rocks. Five stations in this region had imbricata ranging from 38% to 96%.

In the middle bay region of Blue Hill Bay the water is deep and the rocky shores are clean. No imbricata were found in the three stations in this region.

The western side of lower Blue Hill Bay is shallow, with many islands and ledges. Among these islands there are many mud flats, and the same conditions are found on the upper bay. Five stations had *imbricata* ranging from 9% to 30%.

Near the islands separating the lower bay from the ocean the water is, in general, deep and the rocky shores clean. Five stations, 0–5½% *imbricata*.

On the outer islands the surf, of necessity, keeps the rocks free from sediment. Two stations, 17–57%.

In Somes Sound environmental conditions similar to those in Blue Hill Bay are found. The rocks are muddy in the harbors near mud flats and clean where wave action is possible and the water is deep. If we except two stations at the Southwest Harbor steamboat wharf, where the ratio of *imbricata* was 19% and 19.2%, respectively, the average of thirty-five stations containing 7,119 individuals

[1] Of these eighteen collections, four had over 27% striped, one had 37% striped.

was only .47%. The largest number found was but $3\frac{1}{2}$% at any one station and that was on the rocks of a muddy harbor. The station in Somes Harbor farthest away from the ocean had but .6% *imbricata*.

That there are other geographical factors is shown by the rarity of *imbricata* in the Somes Sound region. Very few are found in exposed situations on the Cranberry Islands and on Seal Harbor Head, situations exposed to the full effort of the surf. Except for a colony at the Southwest Harbor steam-boat wharf, in the whole Somes Sound region they are indeed rare. Out of 2,765 shells collected on Greenings Island but three were imbricated and these three were found at one station on the muddy west side of the island.

However, in general, we can say that the imbricated forms are found in greatest abundance in exposed situations, as Duck Island and Long Island, and also in the most sheltered positions.

Most of the varieties found in the Atlantic are also found in the forms inhabiting the north Pacific Ocean. Dall[2] reports that the lamellated forms of *Thais* in that region are found best developed in sheltered harbors. The Atlantic lamellated forms we have seen may occur in sheltered as well as in exposed situations.

As *Thais* is found in both the Balanus and the Mytilus Zones, is there any difference between collections made close together but in different zones? The answer to this question is summed up in the following table (Table V) compiled from collections made but a few feet apart, but in different zones.

TABLE V.

Locality.	Zone.	Sta.	Lt.	Wt.	Yel.	St.	Imbricata.
Greenings Id., eastern point	*Balanus.*	2	44.5	21.3	0	?	0
	Mytilus.	50	37.5	22.5	0	14.4	0
Steam-boat wharf, S. W. H.	*Balanus.*	37	29.5	19.	17.5	1.5	19.0
	Mytilus.	47	14.5	6.4	4.1	37	19.2
Stanley House wharf, S. W. H.	*Balanus.*	35	25.3	11	2.2	4.0	0
	Mytilus.	34	21.4	4.8	0	5.3	0

(1) There are more light forms in the white Balanus Zone than in the dark Mytilus Zone.

(2) There are fewer yellow forms in the dark Mytilus Zone.

(3) Striped forms not conclusive.

(4) Imbricated forms not affected.

[2] *Proc. U. S. Nat. Mus.*, vol. 49, pp. 557–572.

Natural Selection.

Natural selection, we can assume, is most severe on Little Duck Island. This little island, lying four miles out at sea, is exposed to the surf on every side. The herring gull, one of the chief enemies of adult *Thais*, has a rookery on the island, and every summer thousands of birds roost there at night and have their nests. Everywhere regurgitated Thais shells cover the rocks, which tell a story of a struggle for existence.

In collecting on this island for two hours but four hundred and twenty-nine living snails were found. These were discovered at the lower edge of the Mytilus Zone. All had been picked off the rocks above by the gulls. This collection is chiefly notable in containing a very large proportion of dark individuals, only 1.1 per cent. white were found. Nineteen per cent. were imbricated.

It can be said with justification that where the struggle for existence is greatest on the exposed islands and the muddy harbors selection tends to preserve the dark-colored and the lamellated forms.

Conclusions.

A study of the color varieties leads one to the conclusion that they are hereditary and that we are dealing with things that are probably unit characters. Even the development of lamellæ, as in *imbricata*, are not modifications caused by induction that is caused by the direct action of the environment.

As there are great differences between the ratio of the color varieties present in different localities, we assume that natural selection is acting.

In the bay environment conditions are at an optimum. No mud film covers the Mytilus, and Balanus forms crusts over the rocks an inch to an inch and a half thick. Here *Thais* is most abundant. Five hundred can be gathered in ten minutes or even less. A handful can be gathered at one scoop.

In the surf environment the barnacles do not form such thick crusts. On the harbor shore ice destroys the barnacles in the winter and a mud film covers the mussels. So that the barnacles are usually small and far apart, while the mussels are separated by mud from the rocks. Sand and mud are barriers to *Thais*. Although the surf environment and the harbor environment are the antithesis of one another, yet they have many effects on *Thais* that are similar. These effects are as follows:

(1) The curve of growth, fig. 2, shows that those in the surf environment at a given age are smaller than those from the bay environment.

(2) There is a tendency toward dark individuals.

(3) There is a tendency toward lamellated forms.

These studies show that natural selection has some determining action on the color varieties present. (1) It has been shown that the color of the rocks, whether dark or light, has an effect. (2) It has been shown that the white barnacle-covered rocks contain more light-colored ones than those on the mussel bed but a few feet away. (3) It has been pointed out that those living on rocks near mud flats are darker than on the more exposed points of the same islands.

The present study must leave the question of the relation of the yellow forms and the striped forms to the color of their substratum yet unsettled.

In general, however, there is a relation between the color and the environment. This relation is caused by natural selection and not by the direct action of the environment.

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NEW GENERA AND SPECIES OF GASTROPODA FROM THE UPPER CRETACEOUS.[1]

BY BRUCE WADE.

The extent of the Gastropod fauna discovered in the Upper Cretaceous of Tennessee and the remarkable state of preservation of the hitherto unknown generic types warrant the present preliminary account of some of the more interesting.

The locality is on Coon Creek, in the northeastern part of McNairy County, in west-central Tennessee, and a somewhat detailed account has been published recently in the Johns Hopkins Circular. The horizon is in the lower part of the Ripley formation and hence somewhat older than the classic Owl Creek fauna of the Ripley of Tippah County, Mississippi.[2]

Family CANCELLARIIDÆ.

Genus MATAXA gen. nov.

Etymology: *μάταξα*, cocoon.

Type: *Mataxa elegans* sp. nov.

Shell of medium size and thickness; spire obtuse, its altitude less than half the entire length of the shell; protoconch large and smoothly polished, the earliest volutions for the most part submerged and increasing rapidly in size, thrice-coiled in the type-species; conch solid and slightly glazed, paucispiral, external sculpture subdued, axial sculpture subdued or absent; aperture broadly lenticular and produced anteriorly in a comparatively long recurved canal; outer lip expanded and dentate internally; parietal wall widely and heavily glazed; columella marked by two strong oblique plaits situated far in and behind two or more marginal plaits.

This genus is proposed for a species represented at Coon Creek by perfectly preserved elegant shells and a species *Narona eximia*,

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[1] Published by permission of Dr. A. H. Purdue, State Geologist of Tennessee.

[2] The writer wishes to acknowledge his indebtedness to Prof. E. W. Berry and Dr. J. A. Gardner, of the Johns Hopkins University, under whose guidance this work was done; to Dr. W. H. Dall and Dr. T. W. Stanton, of the U. S. Geological Survey, and especially to Dr. L. W. Stephenson, of the latter organization, who has been engaged for several years in the areal, stratigraphic, and faunal studies of the Cretaceous of the Embayment region.

described and figured by Stoliczka[3] in 1867 from South India and referred to the Cancellariidæ. It differs from *Cancellaria*, in general, by the development of a well-defined canal, by its lack of sharp and conspicuous cancellate sculpture, and further by its less acuminate spire. It differs from *Narona*, a subgenus of *Cancellaria*, in having a longer canal, a spire less acutely elevated, an anterior columellar plait more elevated than the posterior, instead of less so. Probably *Mataxa* is nearer the rare recent subgenus *Massyla*[4] than any other form in the genus *Cancellaria*, but in this comparison, too, there are generic and time differences so great that it seems advisable to assign the Tennessee and South Indian forms to a new genus. *Mataxa* differs from *Massyla* in possessing a thicker, stouter and more solidly built shell; in having a comparatively long recurved canal, and further in nuclear characters. The protoconch of *Massyla* is trochoid, while in the nucleus of *Mataxa* the early volutions are for the most part submerged.

Mataxa elegans sp. nov. Pl. XXIII, figs. 1, 2, 3

Description.—Shell of medium size, ovate in outline; spire less than half the entire length of the shell; whorls of conch three and a half in number; protoconch large, smooth and obtuse, thrice coiled, the first and second volutions for the most part immersed and coiled in a single plane, the final whorl of the protoconch moderately elevated, increasing rapidly in size; surface of conch slightly glazed and inconspicuously sculptured; axials reduced to fine incrementals and one or two exaggerated resting stages; spiral sculpture of low, broad, flattened bands, eight in number upon the penultima of the type, the two posterior the widest and separated from one another by a wide and rather deep sulcus; body spirals very obscure, increasingly so toward the aperture, more than 30 in number, interspaces wider than the spirals and very shallow, excepting directly in front of the suture; suture impressed; aperture more than half the entire length of the shell, lenticular in outline and produced anteriorly into a comparatively long canal; outer lip marked internally by 10 or 12 regularly spaced lirate denticles; columella reinforced with two rather strong oblique folds a little less than half way between the base of the body and the anterior extremity of the aperture and a less prominent marginal fold and occasionally a fourth feeble plication

[3] Stoliczka, F., Cretaceous Fauna of South India, Geol. Surv. India, p. 166, Pl. XII, 1867.

[4] Adams, H. and A., Genera of Recent Mollusca, 1855, vol. I, p. 278.

behind the margin; anterior fasciole rather short, moderately wide, emarginate at the extremity.

Dimensions.—Altitude, 23.4 mm.; maximum diameter, 13 mm.; spiral angle, 57°.

This form is well characterized by its somewhat buccinoid outline and rather low, obtuse spire, subdued spiral sculpture, the slightly flaring outer lip and plicate inner lip. This species is represented in the Coon Creek collection by two perfect specimens which are remarkable for shells as old as the Cretaceous on account of their state of preservation. The individuals possess a certain freshness of appearance and shell-color that remind one of recent gastropods lately recovered from the water.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family VOLUTIDÆ.

Genus TECTAPLICA gen. nov.

Etymology: *tecta*, hidden; *plica*, fold.

Type: *Tectaplica simplica* sp. nov.

Shell of medium size, thick and strong; rudely biconic in outline; spire about one third the entire length of the shell; apex acute; protoconch broken away, scar small; whorls very much appressed; sculpture dominantly axial; aperture lanceolate, produced anteriorly into a slightly bent canal; outer lip simple; inner lip callous; parietal wall glazed; columella marked by three weak but well-defined folds, terminating far within the margin of the aperture.

This genus is well characterized by a thick, strong and simple shell which has a columella marked by feeble folds. It is one of the most primitive of the Volutes and may be considered as ancestrally related to *Volutilithes*. It differs from *Volutilithes* in having a less elongate spire, which is flattish on the sides and not interrupted by pronounced shoulders. *Volutilithes* is typically spinose and has an inner lip usually well excavated and marked by prominent folds, which extend well out on the inner lip.

Tectaplica simplica sp. nov. Pl. XXIII, fig. 4.

Description.—Shell of medium size, biconic in outline; spire acuminate, less than one third the entire length of the shell; whorls very closely appressed, six in number on conch; axial slopes flattish; protoconch broken away, scar small; external sculpture dominantly axial, consisting of ten prominent broadly rounded costæ increasing toward the aperture, crossed by very many faint spiral ridges,

summit of costæ unmarked by liræ; posterior fasciole indicated by the weakening of the axial sculpture; sutures inconspicuous, aperture lanceolate, produced anteriorly into a long canal; outer lip simple; inner lip callous and parietal wall glazed, callus concentrated just below the posterior commissure of the aperture; columella marked by three well-defined but feeble folds terminating within the aperture; posterior fasciole indicated by abrupt constriction of incrementals.

Dimensions.—Altitude, 35 mm.; maximum diameter, 13 mm.; spiral angle, 59° 20′.

This very simple, primitive Volute is represented in the present Coon Creek collection by a single individual. The folds of this form terminate so far within the aperture that it is necessary to section the spire in order to observe the columellar plaits.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Genus **DRILLUTA** gen. nov.

Etymology: A contraction of the generic terms *Drillia* and *Voluta*.

Type: *Drilluta communis* sp. nov.

Shell strong and fusiform; spire elevated; whorls numerous, increasing slowly in diameter; protoconch very small and smooth; sculpture dominantly axial, the costæ interrupted in front of the sutural line by a well-defined but rather narrow fasciole; aperture lenticular, produced anteriorly into a long, gently recurved canal; outer lip broadly arcuate, simple within; inner lip calloused; columella bearing one well-defined oblique fold, frequently with one or two minor folds behind it, all of which evanesce before reaching the aperture.

This genus includes a well-defined and widely distributed group of the Volutidæ, some of which are undescribed and some that have been described have been variously assigned to such genera as *Drillia*, *Voluta*, *Fasciolaria* and *Fusus*. *Drilluta* may be readily separated from *Drillia* by the absence of a posterior siphonal notch and further by the presence of columellar plaits on the Volute. The typical *Voluta* has a lower spire and numerous transverse folds. *Fasciolaria* has a more inflated body whorl and is not characterized by a well-defined posterior fasciole as is the case with *Drilluta*. *Fusus* on account of its smooth columella cannot be confused with *Drilluta*. There are two well-defined groups among the *Drillutæ*, so it seems advisable to separate this group into two sections.

Section A. New section.

Type: *Drilluta communis* sp. nov.

This section is characterized by shells of medium size with well rounded axials and a variable number of columella plaits which terminate within the aperture. The spiral sculpture is very fine on the spiral whorls and young individuals but well-defined on the anterior part of the body of adult individuals, and lacking on the posterior part of the older whorls of such individuals. This section is proposed to include besides the Coon Creek species the form "*Drillia ? distans*" Conrad[5] from Owl Creek, a closely related species from Corsicana, Texas, and a poorly preserved specimen from Brightseat, Maryland. The descriptions and figures of *Voluta lativittata* Griepenkerl[6] and *Voluta canalifera* (Favre) G. Müller[7] indicate generic and sectional relations nearer to Section A of *Drilluta* than to any other forms that have been found in the literature.

Drilluta communis sp. nov. Pl. XXIII, figs. 5 and 6.

Description.—Shell of medium size and fusiform in outline; spire elevated, its altitude approximately one-half the entire length of the shell; apical angle higher on the posterior part of the spire, becoming slightly lower on the younger whorls; protoconch very smooth and trochoid, coiled about three times; whorls of conch closely appressed and eight in number; both axial and spiral sculpture developed, the former dominant, axial costæ rounded and abruptly elevated, 11 to 17 in number to the whorl, 14 on the penultima of the type, costæ flexuous, uniform in strength from the posterior fasciole to the anterior suture and a little less than half way down to the base of the body on the ultima; fasciole narrowed, indistinctly marked on the early whorls, defined in the later whorls by the abrupt disappearance of the axial costæ; spiral sculpture of fine crowded impressed lines on apical whorls, becoming faint and almost disappearing on the medial part of older whorls, but reappearing as coarse, impressed lines on slope of body whorl, becoming faint and disappearing on anterior fasciole; suture impressed; body whorl sloping down smoothly into a broad pillar; aperture lanceolate, produced anteriorly into a very feebly recurved canal; inner lip callous; outer lip simple; columella marked by one well-defined fold and one or two weaker posterior

[5] Conrad, T. A., *Jour. Acad. Nat. Sci.*, Philadelphia, 2d ser., vol. IV, p. 286, pl. 46, fig. 49, 1860.

[6] Griepenkerl, O., 1889, *Palaeontologische Abhandl.*, Band IV, Heft 5, p. 93 (395), Taf. viii, fig. 1, 1889.

[7] Müller, G., 1899, *Abhandl. d. Kön. Preus.-geol. Landesanstalt*, neue Folge, Heft 25, p. 124, Taf. xvi, figs. 13, 14.

folds, all of which evanesce before reaching the aperture, plications invisible in the aperture.

Dimensions.—Altitude, 62 mm.; length of aperture, 31 mm.; maximum diameter, 20 mm.; spiral angle, 40° on posterior whorls, decreasing to 25° on anterior whorls.

This species is one of the most abundant and best preserved univalves at Coon Creek. It shows a considerable range in size and external ornamentation. Some of the young individuals exhibit a fine spiral sculpture over the entire length of the shell. The number of columellar plaits is variable. These terminate far within the body whorl, distant from the margin of the aperture, and in many individuals are almost entirely obscured, although they are readily revealed by sectioning the spire. A comparison of this form with two other members of the section of the genus, one from Owl Creek, the type locality of "*Drillia ? distans*" Conrad and the other from Corsicana, Texas, indicates that the Coon Creek species is intermediate between those cited.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Section B. New section.

Type: *Drilluta major* sp. nov.

This section is characterized by a large, much elevated and elaborately sculptured shell. The whorls are abruptly shouldered. The posterior shoulder is marked by spinous regularly spaced varix-like projections. It is proposed for a well-defined group of *Drillutæ* which include, besides the Coon Creek species, a species from Owl Creek and another from Brightseat, Maryland, which has been questionably referred to *Fasciolaria*[8] on account of the imperfect character of the material. The description and figures of *Voluta magnifica* Griepenkerl[9] and *Voluta* (*Volutilithes*) *subsemiplicata* (d'Orbigny) G. Müller[10] present generic and sectional relations which suggest this section of *Drilluta*.

Drilluta major sp. nov. Pl. XXIII, figs. 7 and 8.

Description.—Shell thick and large, fusoid in outline; whorls closely appressed, seven in number and increasing slowly in size; apex

[8] Gardner, J. A., Md. Geol. Surv., 1916, Cretaceous, Upper, p. 438, pl. xiv, fig. 11.

[9] Griepenkerl, O., 1889, *Palaeontologische Abhandl.*, Berlin, Band IV. Heft 5, p. 94 (396), Taf. viii, fig. 2.

[10] Müller, G., 1899, *Abhandl. d. Kön. Preus. geol. Landesanstalt*, neue Folge, Heft 25, p. 123, Taf. xvi, figs. 10–18–21.

acute, broken away, but protoconch as indicated by the scar probably very small; whorls of spire slightly flattened dorso-ventrally, constricted posteriorly, ultima merging smoothly into a wide pillar; external ornamentation quite coarse and elaborate; axial sculpture of rounded quite strongly elevated costæ waving backward along the shoulder, 11 to 14 to the volution, costæ becoming shorter and less prominent on approaching the aperture, on young whorls costæ reach from posterior fasciole to anterior suture, but become shorter anteriorly and occur only along the shoulder of the whorl; posterior part of whorl constricted and marked by a narrow posterior fasciole set with closely spaced spinose, varix-like processes, most of these processes broken away in type; spiral sculpture absent on first three apical whorls, becoming more prominent anteriorly until conspicuous on body whorl; more than thirty strongly elevated spirals on body whorl, spirals more widely spaced on medial portion of body whorl; spirals along medial portion of body somewhat arcuate on type with most gentle slope anteriorly; body whorl sloping gently into a broad pillar; aperture lenticular and produced anteriorly into a canal; inner lip calloused, parietal wall thinly washed; fold in front of one or two less prominent folds, all of which become obsolete before reaching the opening of the aperture.

Dimensions.—Imperfect specimen: Altitude, 85 mm.; maximum diameter, 32 mm.; spiral angle, 30°.

This magnificent species is represented in the present collection from Coon Creek by two individuals, both of which, while imperfect, yet show the essential characters of the shell. It is well characterized by the elaborate axial and spiral ornamentation, the very acuminate spire and further by the spinose varix-bearing posterior fasciole.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family **FUSIDÆ.**

Genus **FUSUS** Lamarck.

Subgenus ANOMALOFUSUS subgen. nov.

Etymology: ἀνώμαλος, irregular; *fusus*, a gastropod.

Type: *Fusus* (*Anomalofusus*) *substriatus* sp. nov.

Shell of medium size and elongate, fusiform in outline; spire acuminate and of approximately the same length as the aperture; protoconch naticoid and smooth, coiled about three times; axials most prominent ornamentation, costæ irregular in size and spacing; spiral sculpture consisting of many fine elevated liræ of different

sizes which override axials; suture impressed, aperture lenticular and produced anteriorly into a canal; outer lip thickened and dentate within, broadly notched between suture and medial part of outer margin of aperture; inner lip thinly calloused, columella smooth and slightly sinuous.

The nuclear characters, the sharp cancellate sculpture, and intermediately thickened outer lip which is broadly notched in front of the suture seem to assign this form to the rank of a subgenus under *Fusus*. This form bears some resemblance to *Phos* in general outline, but is much more slender. *Phos* is characterized by a columella which is much more sharply twisted. *Anomalofusus* has a longer canal than any of the Buccinidæ and lacks the abruptly excavated columella, plicate in front, which is characteristic of *Phos*. Besides nuclear characters, *Anomalofusus* differs from *Fusus* in its shorter canal, and further by its thickened and notched outer lip.

Fusus (Anomalofusus) substriatus sp. nov. Pl. XXIII, figs. 9, 10, 11.

Description.—Shell of medium size and elongate, fusiform in outline; spire acuminate and of approximately the same length as the aperture; whorls roundly shouldered, three to five in number on conch; protoconch naticoid and smooth, coiled about three times; external sculpture elaborate, axials predominating, costæ well rounded and elevated, irregular in size and spacing, reaching from anterior to posterior suture on spiral whorls, but evanescing on anterior part of body; spiral sculpture consisting of about 14 small primary elevated liræ and in each interspace there are from one to three very fine primary liræ, primary liræ lacking on a narrow band just in front of suture, both primary and secondary liræ override costæ; suture impressed; aperture lenticular and produced anteriorly into a canal; outer lip thickened and dentate within, broadly notched between suture and medial part of outer margin of aperture; inner lip calloused; columella smooth and slightly sinuous.

Dimensions.—Immature individual: Altitude, 17.5 mm.; length of aperture, 9.5 mm.; maximum diameter, 7.5 mm.; spiral angle, 35°.

This elegantly sculptured gastropod is abundant at Coon Creek. There is a wide range in the maturity of individuals, some have only one whorl of the conch, while the older ones have five whorls. The protoconch is preserved and conspicuous on most specimens.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Genus **ORNOPSIS** gen. nov.

Etymology: ὀρνῖς, bird; ὄψις, form.

Type: *Ornopsis glenni* sp. nov.

Shell fairly large and strong; body whorl inflated; spire varying in relative altitude; protoconch very small, smooth, paucispiral, and trochoid; both axial and spiral sculpture well developed; aperture pyriform, abruptly constricted, and sinistrally inclined; outer lip marginally crenate; parietal wall washed by a callus; columella marked by a strong laterally compressed laminar plait situated at the entrance of the anterior canal.

This genus is characterized by a peculiar narrow flexed canal and a sharp laminar plait on the columella directly behind the entrance of the anterior canal. In these respects it differs from the other Fusidæ. In general outline *Ornopsis elevata* greatly resembles the genus *Latirus*, but differs from it in the character of the anterior canal. *Odontofusus* of the Fasciolariidæ has a more elevated spire, a more feeble columella fold and a nearly straight anterior canal. The close, compact spire of *Ornopsis* resembles some of the Buccinidæ, but here again the apertural features are distinctly different.

Ornopsis glenni sp. nov. Pl. XXIV, fig. 1.

Description.—Shell fairly large and strong; elevation of spire less than length of aperture; protoconch very small, smooth, paucispiral and trochoid; volutions of conch six in number, increasing in size from a very small apical whorl to an inflated body whorl; external ornamentation well-defined, axials elevated, well rounded and short, beginning at shoulder and quickly evancescing in front of the periphery of body, becoming less prominent toward aperture and disappearing almost entirely in some individuals, costæ of varying size and spacing, twelve on body of type; spiral lines sharply impressed, more than thirty on body whorl, becoming fine and oblique on pillar; shoulder broad, feebly convex; suture impressed; body whorl abruptly constricted into a slender pillar; aperture pyriform, produced anteriorly into a narrow canal sinistrally inclined; outer lip sharp and marginally crenate; parietal wall washed with a callus thickest at posterior extremity of aperture; columella flattened at the entrance of the canal into a shelf-like fold.

Dimensions.—Altitude, 48 mm.; length of aperture and canal, 33 mm.; maximum diameter, 24 mm.; spiral angle, 60°.

This form is well characterized by its pointed apex, much inflated body and further by the flattened shelf-like fold. It is one of the most abundant gastropods at Coon Creek, being represented in the

collection by many perfect specimens. It is the type of the genus and is named in honor of Dr. L. C. Glenn, Professor of Geology at Vanderbilt University.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Ornopsis elevata sp. nov. Pl. XXIV, figs. 2 and 3.

Description.—Shell of medium size, rugose; spire elevated, its altitude approximately the same as the length of the aperture; protoconch broken away; external sculpture dominantly axial, the costæ elevated and rounded, highest upon the shoulder, becoming faint toward the anterior, evanescent anteriorly and absent altogether upon the posterior fasciole, about twelve on body whorl, irregularly spaced toward aperture; space between shoulder and posterior suture separated by slightly narrower concave intercostals; spiral sculpture of rather low, crowded liræ separated by deeply impressed lines, about twenty on body whorl; liræ equally as well marked on the summit of the axials as in intercostal spaces; suture line impressed; body whorl smoothly constricted anteriorly into a narrow pillar, posterior part of aperture ovate, but broken anteriorly by a rather long narrow anterior canal; inner lip calloused; columella flattened at the entrance of the canal into a flat shelf-like fold.

Dimensions.—Altitude, 34.5 mm.; maximum diameter, 17.2 mm.; spiral angle, 44° 51′.

This species differs from *Ornopsis glenni* in possessing a higher, more acuminate spire and a less inflated body whorl.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family BUCCINIDÆ.

Genus HYDROTRIBULUS gen. nov.

Etymology: ὕδωρ, water; τρίβολος, burr.

Type: *Hydrotribulus nodosus* sp. nov.

Shell moderately large and solid, top shaped in outline; spire less than half the entire length of the shell; protoconch scar small, sculpture vigorous, the axials undulatory, the spirals more sharply defined; aperture pyriform and produced anteriorly into a narrow recurved canal; outer lip expanded and abruptly constricted at the base of the body, dentate within; parietal wall heavily glazed, sometimes bearing a tooth-like process directly in front of the posterior commissure; inner lip excavated and calloused, reflected anteriorly, con-

cealing entirely the umbilicus; edge of pillar flattened at entrance of canal, simulating a fold.

This genus is characterized by a fairly low-spiral angle; vigorous rugose, cancellate sculpture; a much inflated body and further by a much excavated and reflected inner lip, which conceals an umbilicus. Besides the Coon Creek species it is represented by an undescribed species from Owl Creek, Mississippi, and another from Brightseat, Maryland, and further by a species in the Senonian of Aix-la-Chapelle, Germany. The German species was first described by Müller in 1851 and assigned to the genus *Rapa*. Since then it has been variously assigned by other palæontologists to such genera as *Fusus*, *Pyrella*, *Hemifusus*, *Pyropsis* and finally to *Tudicla* by Holzapfel,[11] who discussed the species in 1888. A study of the description and figures of the German form, together with the Coon Creek species and specimens from the Maryland and Mississippi localities, indicates that these species belong to a well-defined group, and it seems advisable to propose for their reception a new genus *Hydrotribulus* of the family Buccinidæ. In general aspect this genus resembles *Pyrifusus*, but differs from it in having a shorter recurved anterior canal and a pillar which is flattened and recurved in a unique manner at the entrance of the canal. *Tudicla* has a much flatter spire, a more globose body and a much more abruptly constricted, longer and straighter canal. It differs from *Strepsidura* in characters of the anterior canal and aperture and further by its characteristic rugose cancellate sculpture.

Hydrotribulus nodosus sp. nov. Pl. XXIV, figs. 4 and 5.

Description.—Shell fairly large and very heavy with a rugosely cancellate sculpture; top-shaped in outline; spire rather low; its altitude less than the length of the aperture, sides converging at an angle of 70 degrees; whorls of conch five in number and rapidly increasing in size to a much inflated body; whorls of conch obliquely shouldered, the peripheral angle of the spire falling in front of the medial horizontal; sculpture vigorous, both axial and spiral, restricted almost entirely to the area in front of the periphery; axials elevated and broadly rounded, sixteen in number on the body whorl of the type, subequal in size and regularly spaced; spiral sculpture of broad, elevated fillets, most prominent on the body; subnodose at the intersections of the axials which they override.

[11] Holzapfel, E., *Palaeontographica*, Band XXXIV, p. 106, Taf. xi, figs. 4–7, 1888.

two in number on the whorls of the spire and four on the medial portion of the ultima, separated by shallow channels of approximately the same width as the fillets; shoulder sloping at an angle of about 45°, very feebly convex; sculpture with retractive undulations corresponding in number and proportion to the axials with an obscure secondary liration and revolving a little behind the periphery; base of body and pillar threaded with flattened spirals which become increasingly narrow anteriorly; suture quite deeply channeled, undulated in harmony with the preceding volution, body whorl constricted rather abruptly into a broad pillar; aperture pyriform. produced anteriorly into a narrow canal; outer lip broadly expanded; crenulated at the margin and feebly cordate within, the cords restricted to the margin and corresponding in position with the interspiral areas; inner lip broadly concave, non-plicate; parietal wall heavily glazed and bearing an obscure tooth directly in front of the posterior commissure; edge of pillar flattened at the entrace of the canal simulating a fold, canal sharply recurved, moderately long and narrow with parallel proximate margins; umbilicus closed by the reflected inner wall of the aperture but indicated by a depression between the callus and the anterior fasciole.

Dimensions.—Altitude, 44 mm.; length of aperture and canal, 28 mm.; maximum diameter, 32.4 mm.; spiral angle, 70°.

This elegant species is represented in the Coon Creek collection by perfectly preserved specimens. The species is characterized by the obliquely shouldered whorls, the prominent subnodose intersections of the banded spirals and the undulatory axials, further by the low spiral angle and outline of cross-section of body.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family **EUOMPHALIDÆ.**

Genus **HIPPOCAMPOIDES** gen. nov.

Etymology: ἱππόκαμπος, sea-horse; εἶδος, shape.

Type: *Hippocampoides serratus* sp. nov.

Shell rather small, flattened or feeble apically; widely and deeply umbilicate; protoconch minute, planarboid, paucispiral; whorls of conch relatively few, increasing rapidly both in diameter and altitude toward the aperture; external surface usually smooth; peripheral margin acutely angulated, often sharply serrate; aperture holostomous, umbilicus funicular, the outer margin acute, conspicuously produced anteriorly.

This flattened form is assigned to the family Euomphalidæ because of its flat spire, its deep wide umbilicus, the outer margin of which is produced conspicuously and further on account of the angular peripheral margin. *Hippocampoides* resembles *Discohelix* somewhat, but differs from it in having a protoconch not inverted and further in not having a whorl with a quadrate cross-section. It may be separated from *Straparollus* by the height of the spire and cross-section of body whorl.

Hippocampoides serratus sp. nov. Pl. XXIV, figs. 11, 12, 13.

Description.—Shell rather small, flattened or very feebly convex, apically concave laterally, the altitude increasing toward the aperture, profoundly umbilicate; protoconch minute, planarboid depressed below the plane of the initial whorl of the conch, the one and one-half component volutions rather loosely coiled and approximately uniform in diameter, line of demarkation between conch and proco-conch indicated by a slight but very abrupt increase in the diameter of the whorl; conch thrice coiled, the whorls increasing regularly and quite rapidly in diameter; external surface smooth and probably polished in the original state; peripheral keel acute, sharply and, on the final half turn, profusely serrate; the indentation nearest the aperture running almost half way to the suture line; the deepest of the serrations coincident with pronounced resting stages so the last half turn seems to be made up of a series of overlapping triangular plates; suture line rather deeply impressed; aperture semi-elliptical in outline, the aperture half again as great as that of the body whorl at its initiation, but less than half that of the body whorl at its close; peristome adnate along the body wall, very feebly emarginate both at the peripheral and at the umbilical keels, approximately straight between the notches, umbilicus very wide, profound, persistent to the apex, funicular, the outer margin acute, probably serrated; area between the peripheral and umbilical keels quite symmetrically concave.

Dimensions.—Altitude, 11 mm.; length of aperture, 5 mm.; maximum diameter, 19.2 mm.

This species is remarkable for the auriculate outline of the apical aspect, the deep serrations of the periphery, the rapid increase of the altitude of the shell toward the aperture, the lateral concavity and the profound umbilicus, approximately half as wide as the entire shell and margined by an acutely angulated keel. The edge of the keel has been macerated, but there is evidence that it was quite strongly serrate.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family **TURBINIDÆ.**

Genus **SCHIZOBASIS** gen. nov.

Etymology: σχίζειν, to split; βάσις, base.

Type: *Schizobasis depressa* sp. nov.

Shell of medium size, thick, porcellaneous, depressed and globose, very low and smoothly rounded; protoconch lost in type species; conch paucispiral, the component whorls increasing regularly and rapidly in diameter; sculpture coarse and dominantly spiral; sutures obscure; aperture circular, interrupted posteriorly by a slight shallow siphonal notch and anteriorly by a slit which marks the entrance of the anterior canal; outer lip not thickened, simple within; inner lip excavated, heavily reinforced; anterior canal rather short with the parallel proximate margins distorted so that it appears as a narrow slit cutting across the base of the shell directly at right angles with the axis; callus almost filling the umbilicus; umbilicus imperforate, the umbilical region spread out in a trigonal area and flattened against base of the columella, from which it is separated by a profound sulcus; depressed umbilical keel marked by growth stages or often poorly defined varices.

This genus is characterized by depressed spire and by a peculiar anterior canal which is short and deep and at right angles to the axis of the shell and resembling a slit in the anterior part of the aperture. It does not seem to be near anything heretofore described, and it has been assigned to the family Turbinidæ only after some hesitation. The Turbinidæ have a much depressed shell and sculptural and nuclear characters much like *Schizobasis*, but none of that family possess the short, well-defined canal which characterized this new genus. The recent *Turbo cornutus*, which is common in the Indo-Pacific, has a very shallow anterior canal. The genus *Sargana* of the Thaisidæ has a much depressed spire, a shallow, posterior notch and a narrow anterior canal inclosed in an umbilical keel which is varicose and altogether possesses points analogous to *Schizobasis*. *Sargana* has an entirely different sculpture and a much produced anterior canal which are family characters, probably great enough to bar *Schizobasis* from the Thaisidæ. *Turbo* differs from *Schizobasis* in being nacreous and in having no well-defined canal. There is an undescribed species of *Schizobasis* that occurs at Eufaula, Alabama.

Schizobasis depressa sp. nov. Pl. XXIV, figs. 8, 9, 10.

Description.—Shell of medium size, thick, porcellanous, depressed and globose, spire very low and smoothly rounded, rising slightly above the body whorl; protoconch broken away in type species; conch paucispiral, the component whorls three and one half in number, increasing regularly and rapidly in diameter, outer wall of one and one-half whorls of the apex broken away from spire of type; sculpture coarse and dominantly spiral, seven low, round spirals on body whorl, evanescing rather suddenly on body near aperture of adult, posterior spiral less rounded and very near posterior suture, obscuring suture line, interspiral spaces much narrower than spirals; a deep spiral sulcus at base of body between anterior spiral and umbilical keel; spiral sculpture consists of irregularly occurring unequal costæ shown on top of spirals and absent in interspiral spaces; costæ receding anteriorly, parallel to outer margin of aperture, aperture circular, interrupted posteriorly by a slight shallow siphonal notch and anteriorly by a slit which marks the entrance of the anterior canal; outer lip simple; inner lip excavated, heavily reinforced; anterior canal rather short with parallel proximate margins distorted so that it appears as a narrow slit cutting across the base of the shell directly at right angles with the axis; callus almost filling the umbilicus; umbilical keel showing two poorly defined varices; umbilical region spread out in a trigonal area and flattened against the base of the columella.

Dimensions.—Elevation, 18.4 mm.; maximum diameter, 23.3 mm.; spiral angle, 125° 40′.

The type of this very interesting genus is represented in the Coon Creek collection by a single perfectly preserved specimen.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

Family **DELPHINULIDÆ**.

Genus **URCEOLABRUM** gen. nov.

Etymology: *urceus*, jug; *labrum*, lip.

Type: *Urceolabrum tuberculatum* sp. nov.

Shell small and porcellanous; trochoid in outline with a conspicuous aperture; apex acute, protoconch broken away in type species, but scar small; sculpture cancellate, often tubercular at the intersection of spirals and axials; suture impressed; aperture circular and much thickened around the rim, umbilicus wide and deep.

This genus is proposed for a well-defined group of forms which are

characterized by a conspicuous circular reinforced aperture, a profound umbilicus, and an elevated cancellate spire. Besides the Coon Creek species two others are known, an undescribed species from Eufaula, Alabama, and a species described by Müller in 1851 from Aachen beds of Vaals, Germany, and referred to the genus *Scalaria*. The same species was referred to *Liotia* by Holzapfel in 1888.[12] This genus differs from typical *Liotiæ* which occur in the Coon Creek strata in having a more elevated spire, a circular reinforced aperture and further by a profound umbilicus. In general outline there is some resemblance to *Delphinula*, but *Delphinula* has a nacreous interior and an aperture which is not reinforced or circular.

Urceolabrum tuberculatum sp. nov. Pl. XXIV, figs. 6 and 7.

Description.—Shell small, solid, porcellanous and ornately sculptured; spire elevated and acute; protoconch scar small; whorls circular in cross-section and four in number; external ornamentation elaborate, axials dominant, costæ 14 in number on penult equally spaced and evanescing on base of the body; spirals forming 5 rows of tubercles at intersection with costæ on body whorl, interspiral space at base of body rather wide, an isolated row of tubercles on anterior margin of the umbilicus; suture impressed and crenate; aperture circular, peristome heavily reinforced and calloused resembling mouth of a jug, rim of aperture half as wide as opening; umbilicus profound and funicular.

Dimensions.—Altitude, 5 mm.; width of aperture, 1 mm.; maximum diameter of body, 3.4 mm.; apical angle, 60°.

This elegant little species is hard and well preserved, being rather common in the Coon Creek sediments. It may be separated from the Eufaula species by the fact that the Eufaula form has fine secondary liræ between the primary spirals and on the band at the base of the body whorl. It differs from the German species of this genus[13] in having sharper axials and tubercles at intersection of costæ and spirals; the German form has radial lines on the reinforced aperture, while aperture of the Tennessee form is smooth.

Occurrence.—Ripley Formation: Dave Weeks Place, on Coon Creek, McNairy County, Tennessee.

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[12] Holzapfel, E., 1888, *Palaeontographica*, Band XXXIV, p. 170, Taf. xviii, figs. 3–7.

[13] Holzapfel, E., 1888, *loc. cit.*


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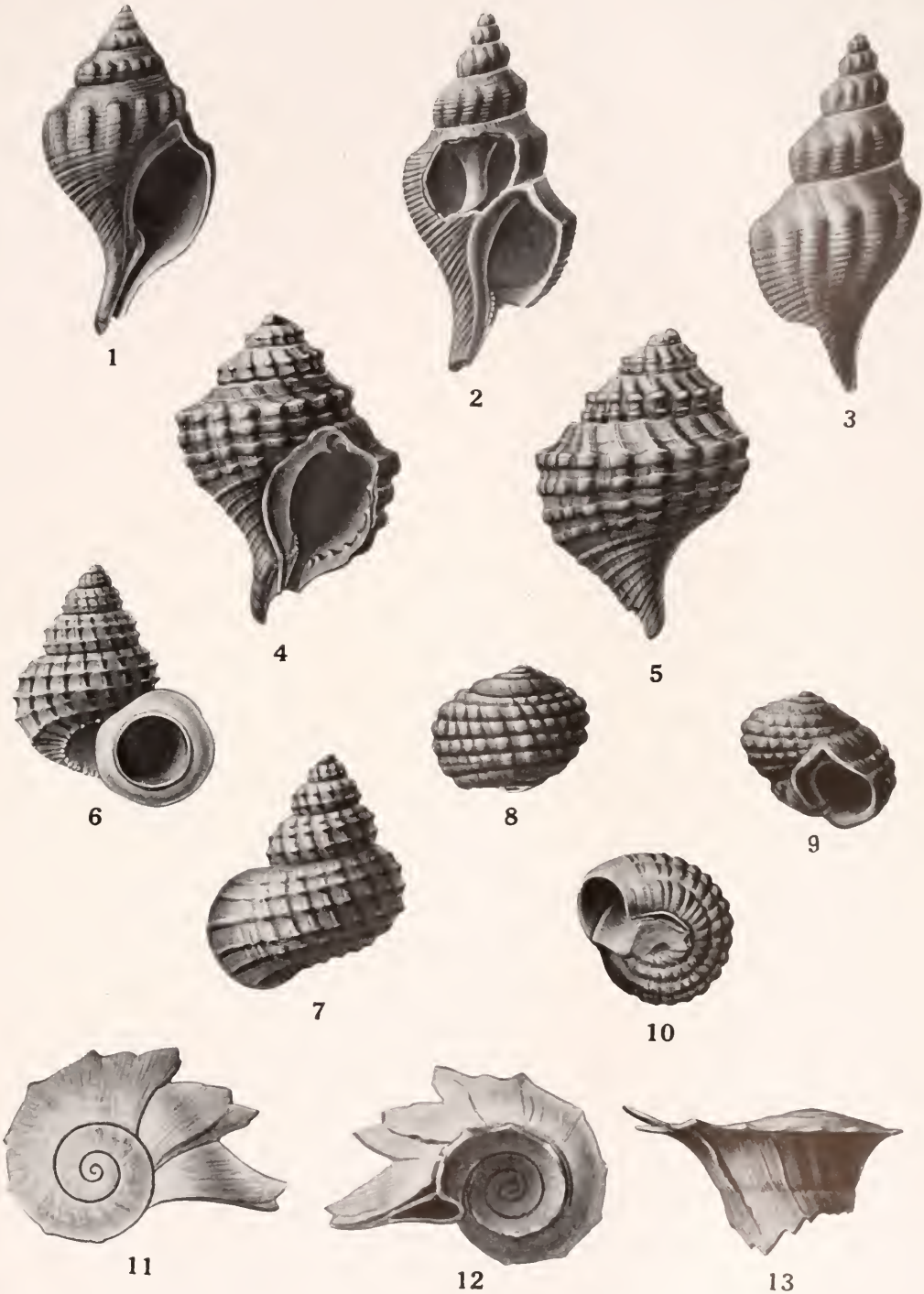
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Explanation of Plates XXIII and XXIV.

Plate XXIII.—Fig. 1.—*Mataxa elegans* gen. et sp. nov. Rear view. × 2.
Fig. 2.—Same. Apertural view. × 2.
Fig. 3.—Same. Apical view. × 10.
Fig. 4.—*Tectaplica simplica* gen. et sp. nov. Apertural view. Nat. size.
Fig. 5.—*Drilluta communis* gen. et sp. nov. Apertural view. Nat. size.
Fig. 6.—Same. Rear view. Nat. size.
Fig. 7.—*Drilluta major* gen. et sp. nov. Rear view. Nat. size.
Fig. 8.—Same. Apertural view. Nat. size.
Fig. 9.—*Fusus substriatus* sp. nov. Apertural view. × 2.
Fig. 10.—Same. Rear view. × 1½.
Fig. 11.—Same. Apical view. × 10.

Plate XXIV.—Fig. 1.—*Ornopsis glenni* gen. et sp. nov. Apertural view. Nat. size.
Fig. 2.—*Ornopsis elevata* gen. et sp. nov. Apertural view. × 1½.
Fig. 3.—Same. Rear view. × 1½.
Fig. 4.—*Hydrotribulus nodosus* gen. et sp. nov. Apertural view. Nat. size.
Fig. 5.—Same. Rear view. Nat. size.
Fig. 6.—*Urceolabrum tuberculatum* gen. et sp. nov. Apertural view. × 6.
Fig. 7.—Same. Rear view. × 6.
Fig. 8.—*Schizobasis depressa* gen. et sp. nov. Rear view. Nat. size.
Fig. 9.—Same. Apertural view. Nat. size.
Fig. 10.—Same. Basal view. Nat. size.
Fig. 11.—*Hippocampoides serratus* gen. et sp. nov. Apical view. × 2.
Fig. 12. Same. Basal view. × 2.
Fig. 13.—Same. Lateral view. × 2.

A POSSIBLE PARTIAL EXPLANATION OF THE VISIBILITY AND BRILLIANCY OF COMETS.

BY DANIEL M. BARRINGER.

WITH AN ADDENDUM BY ELIHU THOMSON.

From a careful study of the so-called "shale-ball" meteorites described in my previous papers on the Meteor Crater of Arizona, I am impelled to make a suggestion that their peculiar and more or less uniform shape may give us a hint of at least a partial cause of the brilliancy of the head of comets and the gradually fading visibility of their tails.

It should not be forgotten that these so-called "shale-ball" meteorites have never before been described, and we would know little of their original shape were it not that the several hundred which have been found by us have been dug out of exceeding finely pulverized silicious dust, so abundantly found with larger rock fragments on the rim of the crater. This finely divided silicious dust is due to the pulverization of a portion of the 1,000-foot white or gray sandstone stratum during the passage through it of the meteoric mass which, by its impact with the earth, as is now proved, made the crater described in my previous papers. The great mass of this exceedingly finely pulverized "silica," so-called, most of which is so fine that it will easily pass a 100-mesh screen, is practically impervious to water, hence these shale-ball meteorites in many cases have retained their original shapes. As previously stated by me, they have no sharp corners, but are, generally speaking, either round, oval or pear shaped, and in fact closely resemble in shape ordinary river gravel. In nearly all cases oxidation has penetrated from the outer surface inward for varying distances, but in most cases not sufficiently far to make it impossible to know what the original shape of the iron mass was when it fell to the earth and was imbedded in the outpouring from the crater, like flour from a barrel, of the finely divided silica dust commingled with rock fragments. In all of the many thousands of iron meteorites found around the crater only one aerolite, or perhaps more accurately siderolite, has been found. This was found by me on June 24, 1905. Inasmuch as by far the greater part of this aerolite was stony in nature, it had

yielded but very slightly to oxidation since it fell upon the earth. It is interesting to note, however, that all of its edges were rounded as if they had been subjected to abrasive action, but it was not as perfectly rounded or oval in shape as the great majority of the iron meteorites. If it fell at the same time as the cluster which made the crater, as I now think is probable, possibly this was due to the fact that it had been gathered up by the iron-headed comet in its passage through space and had not been a member of the cluster for as long a time as its iron companions.

The abrasive action between these masses of meteoric material composing the comet's head, even though it is less than any grinding action that we can conceive of owing to the fact that the mass travels through the ether of space, has, I would suggest, something to do with the visibility of comets. Inconceivably gentle abrasive action may be sufficient to wear off infinitesimal particles of matter, considering the enormous periods of time available. If so, may it not be that the attrition between the masses of meteoric material, for example masses of iron, not only possibly causes a disturbance of the ether where the grinding or milling action takes place, but literally fills the space in and around the head of the comet with exceedingly fine particles of cometary dust? May not these fine particles of matter, possibly electrified, also form the so-called tail as they are swept away from the main body of the comet travelling through space? The explanation of the tail pointing away from the sun is somewhat difficult on this theory, but the difficulty disappears if we can conceive the particles to be so infinitesimally small and so wanting in weight as to be affected by the light waves of the sun and to be driven by them in a direction away from the sun.

There can be no doubt that all the so-called "shale-ball" iron meteorites so far discovered by us in the material forming with the upturned edges of the limestone and sandstone strata the rim of the Arizona crater show evidence of what seems to have been abrasive action. The inference is unavoidable that they have been subjected, during perhaps billions of years, to such action, inconceivably slight, it is true, but nevertheless sufficient to finally reduce them to the shapes in which we find them. It is evident that the abrasion was not produced by their passage through our air. May they not be in fact "celestial cobblestones," and may not the milling action when they rub against each other, even very gently, account, in some way, not perfectly understood, for not only what we term the brilliant head of a comet but for its tail as well?

This is only a theory, but the inference seems to be justified. The rounded shape common to this kind of meteorites is a fact which must be explained, and the only reasonable explanation is that it has been due to mutual abrasion. The largest mass of meteoric iron of this description so far found by us weighed over 100 pounds. I have no doubt, however, that many of them composing the cluster which formed the head of the very small comet, which produced by its impact with the earth what we know as Meteor Crater, were much larger. Evidence that many others fell upon the earth around the crater is to be found in the fact that the plain round about is strewn with what is locally known as "iron-shale," certainly due to the decomposition of these "shale-balls," it being merely oxidized meteoric iron. A great many thousand pieces of this "iron-shale" have been found around the crater, on all sides of it, but most abundantly to the N.N.E., the direction from which the cluster is supposed by those of us who now recognize the true origin of the crater to have approached the earth. This variety of meteoric iron, as I have previously stated, decomposes very much more rapidly than any other meteoric iron ever discovered, owing to the fact that it contains appreciable quantities of chlorine. That thousands of "shale-balls" were strewn about the crater a moment after the impact there can now be no reasonable doubt. It is a remarkable fact, however, that no piece of the so-called "iron-shale" has ever been found which is not slightly curved, similarly to the "iron-shale," found on the outside of the slowly decomposing "shale-ball" meteorites which lie deeply imbedded in the silicious dust forming a great portion of the rim of the crater. Most of the latter have iron centres and the "iron-shale" surrounding them are merely the layers of iron oxide still adhering to the central iron mass. When we compare the two, the pieces of "iron-shale" found on the surrounding plain show conclusively by their shape that the so-called "shale-ball" meteorites from which they were derived were originally more or less globular in shape.

Saturn's rings are now believed to be composed of meteorites, but upon the theory which I have advanced there is possibly no milling or grinding action taking place between them such as may take place for some unknown reason in the head of a comet. I may, however, easily be in error as to this.

If the lunar craters and the Arizona crater have had a common origin, as now seems very probable, there can be no doubt that our knowledge of cosmogony has been greatly advanced by the discovery of the

origin of the Arizona crater and that there is much stronger reason now than ever before to believe in the general correctness of Chamberlin's and Moulton's theory of the building up of planetary systems. It is calculated that some 2,000,000 meteorites reach our atmosphere every twenty-four hours, and it is highly probable that in the early history of the earth it was abundantly bombarded by cometary bodies, that are probably, after all, merely masses of meteoric material which have gotten together and in some way not known to us have assumed orbits of their own. It would seem, however, that most of them, as well as most of the meteoric material originally forming the nebula out of which our solar system has been built up, have long since been gathered into the sun, its planetary bodies or the moons revolving about them. Our moon, having been without an atmosphere for perhaps a great many millions, if not billions, of years, shows evidences of some of the more recent accretions to its mass, outside of the more or less steady rain of cosmic dust. Its numerous craters probably merely represent the gathering in of cometary bodies or clusters of meteorites, for they are apparently exactly similar to our Arizona crater, except that most of them are vastly larger.

If this theory of the building up of solar systems be correct, is it not wonderful to reflect that when one holds in the hand one of these pieces of meteoric material he is probably holding something older than our sun, our own earth, or any of the planetary bodies which with their moons revolve about the sun? That is to say, he is literally holding, practically unchanged through countless eons of time, a part of the nebula out of which our solar system was constructed and which nebula in turn probably represented the wreckage of a previously existing system.

Addendum by Elihu Thomson.

The following comments on the above paper were received by Mr. Barringer from Prof. Elihu Thomson:

I have your letter of June 14, enclosing a communication which you are thinking of sending to The Academy of Natural Sciences of Philadelphia. I think there is little question that the explanation put forward in your paper as to the rounded shape of the shale-ball meteorites is the true one. I have, in fact, often spoken of the inevitable readjustments that may take place in a small cluster revolving around the sun and the attrition between the parts as accounting for the steady production of very finely divided material

driven away from the nucleus by the pressure of light. In fact, I have talked of this very thing with the astronomers, and they have not raised any objections to it. I take it that what happens is about this—at least, this is in accordance with my idea of what happens:

When the comet is far removed from the sun and consists, as it probably almost always does, of a nucleus of fairly heavy pieces surrounded by lighter masses, they are, on account of the cold of space, at a very low temperature, and what little gravitational effect is produced is just sufficient to prevent them being scattered. They are free, at the far distance from the sun, from anything like tidal action. The cluster might even be revolved without being distorted by disturbance of the parts. Should they pass within range of the gravitational effect of Jupiter and have the path slightly disturbed thereby, there would necessarily be (by the slipping of the parts over each other) an attrition or grinding action taking place, and this would continue so long as the body was within the range of the disturbing planet. The same would be true of the cometary clusters passing towards the sun and around it (making a so-called perihelion passage), except that there would be some little difference. In this case, the particles of fine material, the result of the grinding, and held in the cluster, would now be free. The manner of this freeing can easily be understood. The face of the mass of the cluster on the side toward the sun would undergo a warming or heating process. This would result in the evolution into the vacuous space of whatever vapors or gases, however rare they might be (originally occluded in the face of the masses of the cluster), especially from the warmed surfaces. This would amount to a flowing of gas or evolution of gas on the side toward the sun which would lift the dust particles away from the mass, and the very fine particles would thus be free to be driven back by the light pressure to form a tail. It is an old idea that during this process if the sun were highly electrified electrical actions would take place, electrical readjustments to the increasing actions of the sun, but I think it doubtful whether the tail is much, or anything, of an electrical nature, for the reason that the vacuous space in which the tail moves is so high a vacuum that no conduction would be possible.

I am inclined to think that whatever actions of temperature or electrical actions occur would be practically within the nucleus or near it. The spectroscope shows that as the comet approaches the sun gas is actually evolved; and the spectra of cyanogen and carbon monoxide are common in comets, and possibly also hydro-

carbon spectra in some cases. The luminosity of the tail, which, it must be borne in mind is extremely low, according to any way of rating it, is, I think, amply accounted for by the great depth of space in which the fine matter exists and the solar light of high intensity reaching this fine matter: a pure case of diffusion from fine particles. As to cosmic dust not reflecting sunlight as does fine cometary dust, the following explanation, it seems to me, is ample. We see things by contrast. Even if there was a slight luminosity in space, it would simply form a background for the comet's tail, which would be more luminous and more dense in dust. The astronomers have long suspected a very thin veil of dust in the sky, of dust under illumination. The sky is not, in fact, absolutely black. It is black by comparison. Of course, it cannot be expected that ordinary meteorites should ever be seen in the sunlight. They are too small or too far apart. Only when they reach a considerable size do they produce any impression as single spots of light. Witness the asteroids or the little planet Eros, which probably is miles in diameter and yet is difficult to detect.

My idea is that the continual readjustment of the position and relation of the parts within a small cluster, or even within a large cluster forming a large comet, will account for practically all that occurs in the head of the comet and in the tail.

This tail will always point away from the sun. It will curve backwards, for although the particles move in a straight line from the sun, it will curve backwards owing to the progress of the nucleus around the sun. The tail will continue to be formed so long as the disturbing actions occur, and it will fade away as the comet gets so far from the sun as not to be distorted or disturbed. If the comet is not otherwise lost, this action will continue on from the action of the sun with a constant reduction of mass and the final diffusion of the material composing the comet.

Your statement in relation to the aerolite of a stony nature which you found is very interesting to me, as I had not heard that you had found any such stony meteor. It is quite easy, however, it seems to me, to account for it as a survival of perhaps many others present in the cluster. The stony meteorites will naturally be sifted out from the iron meteorites in the flight of a meteor through our atmosphere. They would not only be crushed by air pressure on their relatively greater area per unit of mass, but on account of their lower specific gravity they would not have the ability by momentum to force their way as far. Their relatively

low momentum and greater air resistance in proportion to their mass would make them early losers in the race, while the air pressure encountered would usually smash them into small pieces.

I think it quite probable that the stony matter of the earth is merely an outer layer over an iron centre, and in the smash up of any body due to partial collisions or actual collisions the stony matters must be dissipated, as well as the iron masses, to be gathered up again by the approach near to a large gravitating body like a planet or a sun.

Your expression of "celestial cobblestones" is very expressive and pertinent to the case of the shale-ball masses, and your observation that pieces of apparently broken-up shale-balls are curved indicates a similar origin for all of them. The flight of a cluster of small and large meteoric masses, more or less rounded through our air, would naturally be a sifting-out process, as the smaller bodies would lag behind in the flight.

THE NERVOUS SYSTEM OF CREPIDULA ADUNCA AND ITS DEVELOPMENT.

BY HAROLD HEATH.

The genus *Crepidula* in the vicinity of Monterey Bay, California, is abundantly represented by the members of two species, *C. adunca* and *C. nivea*. In each case the young are retained in capsules within the mantle cavity of the parent, and are liberated when they have attained the form of the adult and are in possession of all the definitive organs with the exception of those belonging to the reproductive system. It is accordingly readily possible to secure extensive series of embryos and to follow the course of development from the ovum to the adult. The embryology of several species of this genus has been studied in great detail by Conklin ('97),[1] and as a result it is clearly established that they all pursue essentially the same developmental path until they reach the veliger stage or a corresponding point where a free-swimming larva is lacking. Beyond this point nothing is known.

In connection with a comparative study of the nervous system of several families of mollusks, I have examined adults of the two above-mentioned species of *Crepidula* with considerable care and have traced its development in *C. adunca*. In view of the fact that *Paludina vivipara* as worked out by Erlanger ('92)[2] is the only other gastropod whose development in this respect is known, the results possess an enhanced degree of interest.

The central nervous system of the adult *C. adunca* is located in the base of the neck, in a spongy mass of connective tissue, placed between the pedal musculature and the overlying mantle cavity. It conforms to the highly centralized type characteristic of the monotocardia generally, with cerebral, pleural and pedal ganglia closely appressed. In several instances, especially in half-grown individuals, the line of demarcation between the cerebral and pleural ganglia is comparatively slight; on the other hand, the pedal ganglia are invariably sharply defined. All are globular bodies of essentially the same size and, as indicated previously, are united by comparatively short commissures and connectives.

[1] The Embryology of Crepidula, *Journ. Morph.*, Vol. 13, 1897.
[2] Zur Entwicklung von *Paludina vivipara*, *Morph. Jahrb.*, Vol. 17, 1892.

Of the more peripheral portions of the nervous system the buccal ganglia are situated in the head region slightly attached to the dorsal face of the radular musculature. From the commissure uniting them two delicate nerves are given off, which course ventrally but rapidly become lost to view among the surrounding muscle bundles. The connectives to the cerebral ganglia arise from the forward borders of each buccal ganglion, extend laterally and anteriorly over the buccal musculature for a short distance, whereupon they pass between some of the bundles of radular muscles to the ventral side of the head. In this position, at each side of the under surface of the radula, they pursue a course posteriorly to the cerebral ganglia. Immediately after reaching the ventral surface of the head they are united by a delicate commissure.

Each cerebral ganglion gives rise anteriorly to one or two nerves, in addition to the buccal connective, which innervate the head. Where one nerve appears it soon divides into an outer and inner branch destined to supply the tentacle and lips, respectively. The relatively strong tentacle nerve gives off a short, stout nerve to the eye and, after dividing, extends far towards the tip of the tentacle. The inner, or lip nerve, passes by a fairly direct path to the dorsal side of the head, and ultimately breaks up in the tissue about the mouth.

The pedal ganglia usually develop four pairs of nerves. The most anterior, springing from the forward border of the ganglion, extends through the pedal musculature to the forward section of the foot, where each branches repeatedly and becomes lost among the muscle fibres. Two other pairs extend ventrally and likewise soon disappear in the compact pedal musculature. In addition to these three pairs, each pedal ganglion gives off from its antero-dorsal surface another nerve destined to supply the base of the neck. On the left side of the body the bundle is comparatively slender and soon becomes lost to view at the junction of the head and mantle. On the right side the corresponding branch has the same size and apparent distribution in lately hatched individuals, but at a later period it becomes greatly enlarged and supplies the penis, which arises relatively late in life. It may be added that the pedal ganglia are united by two commissures, the usual heavy one and another, much more delicate, posterior to it.

The elements of the visceral loop comprise three clearly defined ganglia, the sub-intestinal, the supra-intestinal and the visceral. The first named is a globular body of approximately the same size

as the overlying right pleural ganglion, to which it is attached by a short connective, thus producing a dextral zygoneury, while a somewhat larger connective, passing ventral to the pharynx, unites it with the left pleural ganglion. The supra-intestinal ganglion is a fusiform mass united by a short connective to the right pleural. The visceral ganglion, in contact with the ventral floor of the mantle cavity on the right side of the body, is joined by connectives passing

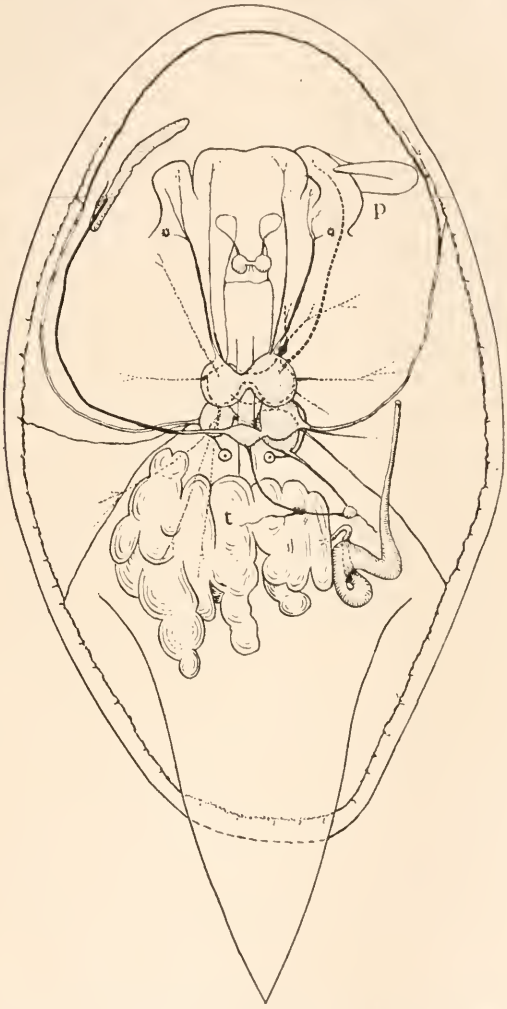

Fig. 1.—Dorsal view of the nervous system of *Crepidula adunca*. The pedal nerves are represented by broken lines; the right posterior pedal nerve is omitted. p., penis; t., testis.

dorsal to the œsophagus and to the right side of the stomach and the adjacent section of the intestine. The visceral connective on the left develops a small nerve, usually associated with a ganglionic enlargement, which has been traced for a short distance beneath the floor of the mantle cavity. The visceral ganglion itself also gives rise to a branch which passes to the wall of the kidney, where it disappears from view.

In this species a well-defined marginal mantle nerve, or *Mantelrandnerv*, is present with many of the essential features of what has been found by Willcox ('98)[3] to exist in *Acmæa fragilis*. In the present instance it is loosely attached to the walls of the marginal mantle sinus, and throughout its course develops numerous delicate branches, which attach to the overlying epithelium or the deeper-seated gland cells. On the right side of the body this marginal nerve is united by two connectives with the pleural ganglion, and, judging from sections, with the sub-intestinal ganglion as well. Of these connectives the anterior is much the heavier, and skirting the floor of the mantle cavity can be followed forward, where it divides into a short, lateral branch uniting with the marginal nerve coming up from the posterior three-fourths of the body, and a slightly more dorsal and relatively larger nerve coursing about the base of the marginal mantle thickening. In other words, the marginal mantle nerve of the posterior part of the body can be traced as far forward as the anterior level of the head in contracted specimens. It actually may continue entirely around the body, but anteriorly it becomes very delicate and finally disappears among the masses of gland cells in the free border of the mantle. However, the heavy connective from the right pleural ganglion attaches to it before its disappearance, and on the other hand extends around the mantle edge in front, where it meets the corresponding nerve from the left pleural ganglion, thus completing the circular mantle nerve, though, as noted before, this anterior section is at a slightly greater distance from the mantle border. The smaller, posterior connective appears to be more largely a product of the sub-intestinal ganglion, and, like the two smaller connectives of the left side, it extends laterally and posteriorly through the pedal musculature to the mantle border. These two smaller connectives of the left side as well as another of much larger caliber arise from the pleural ganglion. The anterior one pursues a course similar to its counterpart on the right and is

[3] Zur Anatomie von Acmæa fragilis, *Jenaische Zeitschr. f. Naturw.*, Bd. 32, 1898.

inserted in practically the same fashion with the marginal mantle nerve.

The osphradial ganglion is a well-defined elongated body situated far forward on the left side of the mantle cavity. The nerve leaving its posterior border pursues a parallel course with the anterior mantle ring connective and enters the supra-intestinal ganglion. Certain species of the genus *Crepidula* are reported.[4] to possess a sinistral zygoneury wherein the supra-intestinal ganglion is united to the pleural of the same side. I have found no evidence of its existence in *C. adunca.*

Turning now to the development of the nervous system, we find that shortly after the first appearance of the foot the ectodermal cells immediately in front of the lateral angles of the mouth opening commence to elongate, and each area rapidly differentiates into a well-defined, probably sensory ridge and the tentacle. Associated with these external developments there is a migration of ectodermal cells from the region of the ridge and tentacle, slight at first, but rapidly increasing, and finally ending, if one can rely on sections, at the time when pigment first makes its appearance in the eye. These migrant cells form the cerebral ganglia, more or less rounded at first, and largely obscured by the heavily staining overlying ectoderm.

Synchronous with the development of the cerebral ganglia the pedal ganglia arise. With the exception of a median, ciliated, slender, wedge-like area, the base facing anteriorly, the cells of the foot likewise become elongated, whereupon cells migrate inwards, forming two large, diffuse masses in contact posteriorly where the commissure subsequently arises. The four ganglionic bodies thus existing at this time appear to be the product solely of migrating elements, since sections give no indication of cell division after the cells have left the ectodermal layer. The same is also true of all the other ganglia now to be considered.

In whole mounts and in sections the cells along the posterior border of each cerebral ganglion can be seen in the late stages of its development to assume an elongated form and to develop fibres which extend posteriorly. In some instances the strands thus produced form two distinct bundles at the outset, one of which passes into the pedal ganglion, while the other at a slightly later stage joins with the pleural. In other instances one bundle first

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[4] Lang's Lehrbuch, p. 213.

appears and subsequently divides to form the cerebro-pedal and cerebro-pleural connectives. During this time the cells of the anterior margin of each cerebral ganglion likewise elongate and rapidly form fibres which extend across the midline and thus form the cerebral commissure.

The buccal are the only ganglia which do not directly arise from cells migrating from the overlying ectoderm; on the other hand,

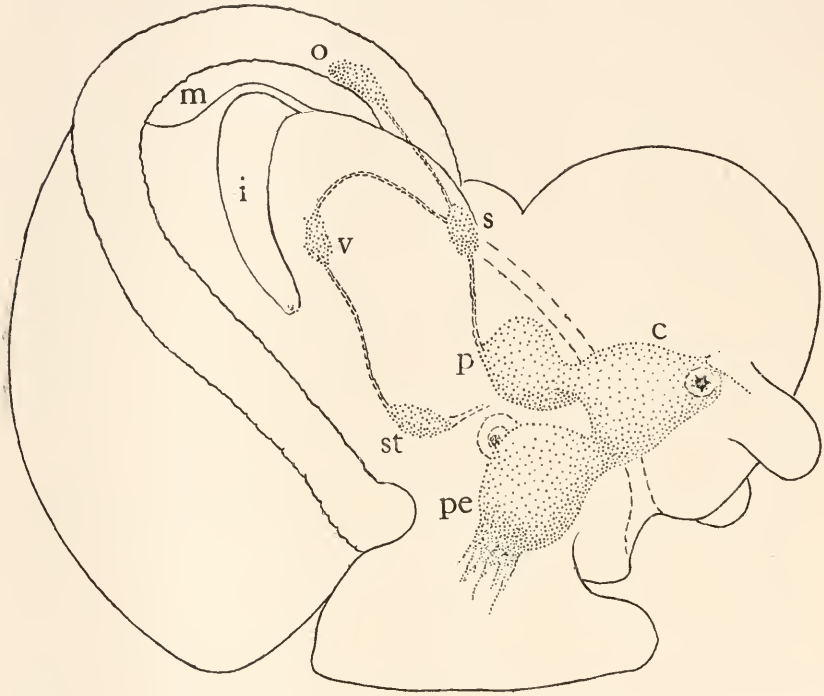

Fig. 2.—Half-developed embryo of *Crepidula adunca*, showing the central nervous system and the visceral loop. c., cerebral ganglion and eye; i., intestine; m., mantle cavity; o., osphradial ganglion; p., pleural ganglion; pe., pedal ganglion and otocyst; s., supra-intestinal ganglion; st., sub-intestinal ganglion; v., visceral ganglion.

they give clear evidence of being products of the cerebral ganglia. At about the same time that the cerebral commissure is forming cells can be seen extending toward the midline from the inner border of each cerebral ganglion. These gradually form an accumulation on each side of the radular invagination, and in some instances completely invest the radular sac. In the stage represented by fig. 2 the ganglia are usually differentiated, though the commissure and

the connectives may continue to contain cells until a relatively late stage in the development of the embryo.

After the cerebral ganglia have developed, yet before they have become fashioned into their final form, the pleural ganglia and the elements of the visceral loop put in their final appearance. Each pleural ganglion is the product of cells migrating from the adjacent ectoderm and arises at the sides of the body immediately posterior and slightly dorsal to the cerebral ganglion. In most instances it is a fairly sharply defined though sheet-like structure, yet it may originate in the form of several distinct masses whose anastomosing fibres form a distinct plexus before they become fused into a single mass.

The ganglia of the visceral loop arise simultaneously. The sub-intestinal occupies a position on the right side of the body at the intersection of the neck and visceral mass; the supra-intestinal lies approximately in the midline at the junction of the neck and visceral mass; while the visceral ganglion is somewhat to the right of the midline and anterior to the terminal section of the intestine. Even while these ganglia are in process of formation delicate fibrils from some of the component, bipolar cells push out between the yolk granules and increasing in number ultimately form the connectives of the visceral loop. The osphradial ganglion rapidly becomes imbedded in the margin of the mantle, and, as in the adult, is united by a connective with the supra-intestinal ganglion. In many instances a delicate connective unites the sub- and supra-intestinal ganglia; no trace of it has been found to exist in adult specimens. The right-sided zygoneurous condition, the union of the pleural and the sub-intestinal ganglion, characteristic of the adult appears to put in an appearance shortly before the embryo escapes from the parent.

At the time of hatching there are traces of a plexus extending about the margin of the mantle, but it is very dim and indistinct. When it becomes clearly defined throughout and capable of being traced it has all of the essential features of the marginal mantle nerve of the adult.

With the increased growth of the mantle and the development of an extensive mantle cavity (beyond the stage represented in text fig. 2) the visceral mass between the mantle margin and the neck becomes completely covered. Furthermore, the absorption of the included yolk creates a more flattened condition of the embryo, which ultimately brings the nervous system into the position characteristic of the adult.

NEW OR LITTLE-KNOWN CRANE-FLIES FROM THE UNITED STATES AND CANADA: TIPULIDÆ, PTYCHOPTERIDÆ, DIPTERA. PART 3.

BY CHARLES P. ALEXANDER.

Introduction.

In this paper, the author has undertaken a review of the Nearctic species of the difficult Eriopterine genus, *Gonomyia*, and has supplied figures of the wings and hypopygia of the various species. The remainder of the paper is in the nature of a continuation of the first two papers under this title.[1] In order to complete the data in some sections of the family, especially the genus *Geranomyia*, it has been deemed advisable to add a few extra-limital species, most of these being Antillean or Middle American forms whose northward range is still not well understood.

Description of New or Little-known Species.

Family **TIPULIDÆ.**

Subfamily LIMNOBINÆ.

Tribe **Limnobini.**

GERANOMYIA Haliday.

Geranomyia Haliday; Entomologists Magazine, vol. 1, p. 154 (1833).

Geranomyia canadensis Westwood. (Plate XXV, fig. 1.)

Limnobiorhynchus canadensis Westwood; Annales Société Entomologique de France, p. 683 (1835).

A wide-ranging species in the central and eastern United States, from New Brunswick and the Hudsons Bay region, south to Georgia and Florida, west to Michigan, Illinois, Kentucky, Tennessee and Texas. Studies by Knab[2] and others show this fly to feed on nectar of Composite flowers (*Eupatorium, Solidago, Aster, Silphium, Rudbeckia, Verbesina, Cacalia,* etc.) in the late afternoon and evening. A male from Brownsville, Texas, in May (C. H. T. Townsend).

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[1] Proceedings of The Academy of Natural Sciences of Philadelphia, October, 1914, pp. 579–606.
Proceedings of The Academy of Natural Sciences of Philadelphia, September, 1915, pp. 458–514.

[2] The Feeding Habits of Geranomyia: *Proceedings of the Entomological Society of Washington*, vol. 12, pp. 61–65 (1910).

Geranomyia guatemalensis sp. n. (Extra-limital.)

Related to *canadensis* Westwood; head gray with a narrow median line; thorax yellowish brown with three indistinct stripes; femora with a brownish subterminal annulus; abdominal tergites ringed brown and yellowish.

Male.—Length, excluding the rostrum, 6.5 mm.; wing, 6.7 mm.; rostrum, 4 mm.

Female.—Length as above, 6.8 mm.; wing, 8 mm.; rostrum, 4.1 mm.

Rostrum elongate, brown, more darkened toward the apex. Antennæ rather short, black, the scape dark brown; flagellar segments rounded-oval. Head gray with a delicate, more or less distinct, median line.

Thoracic dorsum yellowish brown, the præscutum with three broad, though rather indistinct, brown stripes, the middle stripe broad behind, not attaining the suture; scutal lobes brown, median area of the scutum and the scutellum pale yellow; postnotum pale whitish gray, narrowly blackened medially. Pleura dull brownish yellow. Halteres brownish yellow, the knobs darker. Legs with the coxæ brownish yellow; trochanters yellow; femora light brown with a broad, subterminal, brown annulus, the extreme tip paler; tibiæ light brownish, the tips narrowly dark brown; tarsi dark brown. Wings nearly hyaline; stigma distinct, oval, dark brown. Venation: *Sc* long, extending to about two-fifths the length of the sector; *Rs* elongate, almost straight.

Abdominal tergites dark brown, narrowly margined caudally and laterally with dull yellow; basal sternites dull yellowish, more brown on the intermediate segments. Male hypopygium with the penis-guard very long and prominent.

Habitat.—Guatemala.

Holotype, ♂, Aguna, Guatemala; altitude 2,000 feet (Dr. G. Eisen).

Allotype, ♀, topotypic.

Type in the collection of the United States National Museum.

This species differs from the Nearctic *G. canadensis* in the clear gray head, in the subterminal brown femoral ring, not with a black tip as in *canadensis*, the long penis-guard, etc.

Geranomyia knabiana sp. n. (Extra-limital.)

Related to *canadensis* Westwood; rostrum elongate, black; head dark brown; thorax brownish yellow, the præscutum with a broad median stripe; femora with an indistinct brown ring before the tip; wings with subcosta very long.

Female.—Length, excluding the rostrum, about 4.2 mm.; wing, 5 mm.; rostrum, about 2.8 mm.

Rostrum elongate, dark brownish black. Antennæ dark brown, moderately elongated. Head dark brown with a narrow median black line; head constricted behind.

Mesonotal præscutum brownish yellow, brighter in front, with a very broad median stripe that is pale anteriorly, dark brown behind; in the Aguna paratype the præscutum is scarcely marked at all, in the allotype the stripe is distinct for its entire length; lateral stripes not clear; scutum brownish yellow medially, the lobes dark brown; scutellum pale dirty yellow; postnotum brown. Pleura brownish yellow. Halteres short, dark brown, the stem more yellowish. Legs with the coxæ and trochanters dull yellow; femora yellowish brown with a very indistinct brownish subapical annulus; tibiæ dull yellow, darkening into brown at the tip; tarsi dark brown. Wings hyaline, the stigma oval, brown; veins dark brown. Venation: *Sc* very long, extending to two-thirds the length of the sector; Sc_2 at the tip of Sc_1; *Rs* moderately long, a little over two times the basal deflection of R_{4+5}.

Abdominal tergites brown; sternites yellow, the basal segments a little darker.

Habitat.—Central America.

Holotype, ♀, Canal Zone, Panama (A. H. Jennings).

Allotype, ♂, Aguna, Guatemala, altitude 2,000 feet (Dr. G. Eisen).

Paratypes, ♀, with the allotype; ♀, Antigua, Guatemala, September, 1902 (Dr. G. Eisen).

Type in the collection of the United States National Museum.

Similar to *G. canadensis*, but smaller, the femora without a black tip, the præscutal pattern more distinct behind, etc.

This interesting little species is dedicated to Frederick Knab, custodian of the Diptera in the United States National Museum, as an appreciation of his studies on the feeding habits of this genus of crane-flies.

Geranomyia distincta Doane. (Plate XXV, fig. 2.)

Geranomyia distincta Doane; Journal of the New York Entomological Society, vol. 8, p. 186 (1900).

This fly will probably be found to have a wide range throughout the central and eastern United States, it being now known from Connecticut and New Jersey to Texas.

Geranomyia vanduzeei sp. n.

Related to *distincta* Doane; rostrum moderate in length; head pale gray; thorax reddish brown without stripes; wings clear without a

distinct stigmal spot; femora dark brown before the tip, tibiæ black at the tip.

Male.—Length, excluding the rostrum, about 6.5 mm.; wing, 6.6 mm.; rostrum, about 2.5 mm.

Female.—Length as above, about 5 mm.; wing, 6 mm.; rostrum, about 1.8 mm.

Rostrum moderate in length, brownish yellow, darker towards the tip. Antennæ with the first segment brownish yellow, the remainder of the antennæ dark brownish black; flagellar segments short-oval. Head light gray, more yellowish behind.

Thorax reddish brown without distinct stripes or markings of any kind, the scutellum a little more yellow. Pleura pale reddish brown with a very sparse grayish bloom. Halteres short, pale yellow, the knobs a little darker. Legs with the coxæ reddish; trochanters dull yellow; femora dull yellow with a broad brownish annulus immediately before the tip; tibiæ brownish yellow, the extreme tip black; tarsi yellowish brown, the apical segments darker. Wings nearly hyaline; stigma indistinct; veins dark brown, *C*, *Sc* and *Cu* a little more yellowish. Venation: *Sc* long, extending over one-half the length of the radial sector.

Abdominal tergites dull yellow with a narrow, poorly indicated, brown sublateral line; sternites yellowish, on the terminal segments more reddish.

The female is quite similar to the male, but smaller with a still shorter rostrum that is not so noticeably pallid basally; abdominal tergites brown, the last tergite more yellowish.

Habitat.—Southeastern United States.

Holotype, ♂, Braidentown, Manatee County, Florida, March (M. C. Van Duzee).

Allotype, ♀, with the type.

Paratopotypes, 2 ♂ ♀.

The type is in the collection of Mr. Van Duzee, to whom the species is respectfully dedicated.

In its unmarked thorax this species runs closest to *G. distincta* which has a longer rostrum and lacks the dark markings on the femora and the black apices to the tibiæ.

Geranomyia intermedia Walker. (Plate XXV, fig. 3.)

Limnobia intermedia Walker; List Diptera British Museum, vol. 1, p. 47 (1848).

The following specimens are at hand:

A ♀, Kingston, Jamaica, February 10, 1903 (M. Grabham), a ♀,

same locality and collector, April 9, 1903; a ♂, ♀, Havana, Cuba, April, 1900 (J. R. Taylor). The species may be looked for in the Miami section of Florida.

The ground-color of the thorax is yellowish, the stripes usually indistinct, somewhat plumbeous, the middle stripe narrowly divided. The banded abdomen offers an easy recognition character.

Geranomyia diversa Osten Sacken. (Plate XXV, fig. 4).

Geranomyia diversa Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 207 (1859).

Northeastern and central United States, ranging from Maine to Virginia, west to Arkansas.

At "The Rocks" wharf on the James River, Virginia, while a member of the second trip of the "Ecphora," under Prof. Gilbert D. Harris, of Cornell University, in quest of Tertiary fossils, I found this species in large numbers resting on the dripping, water-spattered cliffs of the Yorktown (upper Miocene) formations. On July 2, 1915, they occurred in large numbers, together with *Dicranomyia badia* Walker. Many were found to be heavily infested with a species of *Trombidium*, while others, in large numbers, were found beaten into the mud by being struck by the heavy particles of water dripping from above.

In the north (Ithaca, New York) they occur in mid-summer (August) on rich vegetation along streams. The adult flies feed on various Composite flowers (*Solidago*, *Erigeron*) and also on *Daucus* (Umbelliferæ).

A ♀ specimen, Little Rock, Arkansas, July 11, 1904 (H. S. Barber).

Geranomyia domingensis sp. n. (Extra-limital.)

Related to *cinereinota* Alexander; rostrum short; head black, enclosing a silvery triangle; præscutum brownish gray with a broad blackish median line; wings nearly hyaline, stigma indistinct; vein *Sc* moderate in length.

Female.—Length, excluding the rostrum, about 5.2 mm.; wing, 5.5 mm.; rostrum, about 1.6 mm.

Rostrum very short, black, palpi biarticulate, black. Antennæ with the first segment black; segment two dark brown; flagellum brownish black with a whitish pubescence; first scapal segment elongated; second segment subglobular; flagellar segments oval. Head velvety-black, enclosing a large silvery triangle with its point directed cephalad.

Mesontal præscutum brownish gray with a broad blackish median line; lateral stripes less distinct, broad, brownish; scutum brown,

the lobes scarcely darker than the median area; scutellum pallid; postnotum plumbeous brown with a sparse grayish bloom. Pleura reddish yellow with a light gray bloom. Halteres yellow, the knobs brown. Legs with the coxæ and trochanters dull yellow; femora uniform light brown; tibiæ and tarsi dark brown. Wings nearly hyaline; stigma indistinct; veins dark brown. Venation: *Sc* moderate in length, extending to about one-fourth the length of the sector; *Rs* elongate, somewhat arcuated at its origin; cross-vein *r* at the tip of R_1; basal deflection of R_{4+5} more than two times the length of the *r-m* cross-vein; cell *1st* M_2 elongated, the cell being longer than vein Cu_1 beyond it, though shorter than vein M_{1+2} beyond it; basal deflection of Cu_1 just before the fork of *M*.

Abdominal tergites dark brown, the sternites rather light yellow.

Habitat.—Santo Domingo.

Holotype, ♀, San Francisco Mountains, Santo Domingo, September, 1905 (Aug. Busck).

Type in the collection of the United States National Museum.

This species is closely related to *G. cinereinota* in its short rostrum, conspicuous black thoracic stripe, uniform femora, etc.; it is a smaller fly, with the head black and silvery, without the clear gray coloration of the præscutum, the stigma indistinct and the flagellar segments much shorter and more globular than in the corresponding sex of *cinereinota*.

Geranomyia tibialis Loew. (Plate XXV, fig. 5.)

Aporosa tibialis Loew; Linnæa Entomologica, vol. 5, p. 397 (1851).

A wide-ranging species throughout the Antilles and southward over a large portion of South and Central America. The following unrecorded stations are before me, representing the Loew collections in the Museum of Comparative Zoology, the American Museum and the United States National Museum:

Cuba, part of the Loew collection in the M. C. Z., bearing the label "*rufescens*" in Osten Sacken's writing, but certainly not that species because of the black and enlarged apices of the anterior tibiæ; a ♂, Baracoa, September, 1901 (Aug. Busck).

Santo Domingo, several ♂ ♀, Sanchez, June 7–12, 1915; ♂, San Francisco Mountains, September, 1905 (Aug. Busck).

Porto Rico, ♀, Aguadilla, January, 1899.

Montserrat, a ♀, Plymouth (F. Driver).

Canal Zone, a ♀ (A. H. Jennings).

The species may be looked for in the Miami (Dade County) section of Florida.

Geranomyia lachrymalis Alexander. (Plate XXV, fig. 6.)

Geranomyia lachrymalis Alexander; Transactions of the American Entomological Society, vol. 42, pp. 9, 10 (1916).

The following additional distributional records:

Mexico, Cordoba, April 1, 1908 (Knab).

Guatemala, Escuintla, November 12, 1902 (Eisen).

Costa Rica, Cache, March 3, 1910 (Calvert).

Canal Zone, Tabernilla (Busck).

Geranomyia certhia sp. n. (Extra-limital).

Rostrum elongate; head dark gray; præscutum yellow with three dark brown stripes; legs with the femora and tibiæ tipped with dark brown; wings hyaline with a prominent oval stigma; cord and outer end of cell *1st* M_2 seamed with pale brown; abdomen brown with two black longitudinal dorsal stripes.

Male.—Length, excluding the rostrum, 6 mm.; wing, 7 mm.; rostrum, about 5 mm.

Female.—Length as above, 6.5 mm.; wing, 8.4 mm.; rostrum, about 5 mm.

Rostrum dark brownish black, long and slender, especially toward the tip. Antennæ short, black. Head gray, brighter just behind the antennæ; vertex dark gray with an impressed black line that is narrowed behind; occiput suffused with dull yellow.

Mesonotal præscutum pale buff-yellow with three broad, dark brown stripes, the median one double, ending just before the suture; lateral stripes shorter, crossing the suture and suffusing the scutal lobes; remainder of the scutum buff-yellow; scutellum buff-yellow, a little obscured on either side; postnotum light plumbeous brown with a very delicate impressed median line. Pleura yellow with a sparse pale gray bloom. Halteres yellow, the knobs darker brown. Legs with the coxæ and trochanters dull yellow; femora brownish yellow, the tips broadly dark brown; tibiæ light brown, the tips narrowly dark brownish black; tarsi brown. Wings hyaline, the stigma prominent, oval, dark brown; cord and outer end of cell *1st* M_2 narrowly seamed with pale brown; apex of the wing a little darkened; veins dark brown. Venation: *Sc* long, ending about opposite mid-length of the sector.

Abdominal tergites dark brown, the segments paler, yellowish, laterally, more blackish sublaterally, forming two dorsal black lines down the abdomen; sternites brownish yellow.

Habitat.—Guatemala.

Holotype, ♂, Antigua, Guatemala, September, 1902 (Dr. G. Eisen).

Allotype, ♀, with the type.

Paratopotypes, 3 ♂ ♀.

Type in the collection of the United States National Museum.

This well-marked species suggests *G. enderleini* Alexander (*annulata* Enderlein) in its large size and long rostrum, but differs in the wing-pattern, the darker apices to the femora and tibiæ and the two longitudinal black bands on the abdomen, not annulated as in that species.

Geranomyia virescens Loew.

Aporosa virescens Loew; Linnæa Entomologica, vol. 5, p. 398 (1851).

The following records for this fly admitting it to the United States fauna:

Biscayne Bay, Dade County, Florida (Mrs. Slosson).

Miami, Dade County, Florida (Knab), December 24, 1914, feeding on the blossoms of *Persea* (*Lauraceæ*).

Geranomyia rostrata Say. (Plate XXV, fig. 7.)

Limnobia rostrata Say; Journal Academy Natural Sciences Philadelphia, vol. 3, p. 22 (1823).

This species ranges over the eastern United States and Canada, from Maine and Canada to Florida, west to Illinois and Louisiana. What has been determined as this species ranges over the Antilles and the records for the Greater Antilles, at least, are probably correct. Knab's records show this species to feed on various Composite flowers (*Eupatorium*, *Solidago* and *Helianthus*).

Geranomyia ibis sp. n.

Related to *insignis* Loew; head gray with two black lines; præscutum grayish with three narrow black lines; pleura gray; femora yellowish apically with a subterminal brown annulus; wings nearly hyaline with a sparse darker pattern.

Female.—Length, excluding the rostrum, 7 mm.; wing, 7.3 mm.; rostrum, 2.3 mm.

Rostrum rather short, black. Antennæ black, the flagellar segments short-oval. Head gray with two linear, parallel, black marks extending from the vertex to the occiput.

Pronotum brownish gray, shiny black on the dorso-median line. Mesonotal præscutum pale reddish gray, with three very narrow black stripes, the median stripe only a little broader than the lateral stripes, narrowed caudally and not attaining the suture; lateral stripes long, slightly convergent and more brownish behind, crossing the suture and occupying the proximal edge of the scutal lobes;

scutum, scutellum and postnotum reddish gray. Pleura uniform gray. Halteres short, yellow, the knobs brown. Legs with the coxæ brownish yellow; trochanters yellow; femora brown, the basal and apical quarters yellowish, a rather broad, brown subterminal ring; tibiæ and tarsi dark brown. Wings almost hyaline, the costal area pale yellow; stigma rounded, pale brown; a darker brown spot at the tip of *Sc* and at the origin of *Rs*; a very indistinct seam along the cord. Venation (Plate XXV, fig. 8): *Sc* rather long, ending at about one-third the length of the sector.

Abdominal tergites brown, the sternites more yellowish.

Habitat.—South-central United States.

Holotype, ♀, Hot Springs, Arkansas, June 26, 1904 (H. S. Barber).

Type in the collection of the United States National Museum.

Differs from *G. insignis* Loew (Plate XXV, fig. 9) in the more grayish ground-color of the præscutum with still narrower stripes, the clear gray pleura and the paler wing-pattern; differs from *plumbeipleura* Alexander in the very narrow præscutal stripes, these stripes not as wide as the interspaces, the pale scutal lobes and the pale wing-pattern; from *numenius* Alexander it differs in the much shorter rostrum.

Geranomyia costaricensis sp. n. (Extra-limital.)

Related to *insignis* Loew; mesonotal præscutum with two approximated dorsal brown stripes; pleura yellow with a large brown mark on the mesopleurites; femora with the apex broadly yellow, with a narrow subterminal ring; wings subhyaline with four dark brown subcostal marks and paler seams to the veins.

Female.—Length, excluding the rostrum, 8 mm.; wing, 7.8 mm.; rostrum, about 3.3 mm.

Rostrum moderately elongated, dark brownish black. Antennæ with the first segment black with a sparse grayish bloom; second segment brownish, paler toward the tip; flagellar segments black, elongate-oval. Head brownish gray.

Mesonotal præscutum clear light yellow with two broad reddish brown dorsal stripes, one on either side of the very narrow middle line, these stripes barely attaining the suture; lateral margin of the sclerite brown, widely separated from the median stripes; scutum with the median area broadly yellowish white, the lobes brown; scutellum pale; postnotum yellowish brown. Pleura dull yellow, a large brown blotch on the mesopleurites and a similar one on the lateral portions of the postnotum. Halteres yellow, the knobs brown. Legs with the coxæ and trochanters light yellow; femora

brownish yellow, the apices broadly light yellow with a dark brown subterminal ring, this ring about one-half the extent of the pale tip; tibiæ yellowish brown; tarsi brown. Wings with a pale grayish suffusion, with brown clouds and seams as follows: larger ones at the stigma, at the tip of *Sc* and origin of *Rs*, midlength of the subcostal cell and at the base of this cell; paler brown clouds at the tips of most of the veins, the cross-veins and deflections seamed with this same color. Venation: *Sc* long, extending to about one-third the length of the sector; basal deflection of R_{4+5} very long, the cross-vein *r-m* correspondingly reduced.

Abdominal tergites dark brown, the segments a little brighter at their bases; sternites dull yellow.

Habitat.—Costa Rica.

Holotype, ♀, Cartago, Costa Rica, September 17, 1909 (P. P. Calvert).

Type in the collection of the American Entomological Society.

This species differs from all the members of the *insignis* group (*insignis, lineata, numenius, plumbeipleura, ibis, et al.*) in the peculiar pattern of the præscutum.

Geranomyia subinsignis sp. n. (Extra-limital.)

Related to *insignis* Loew; thorax grayish with three broad dark brown stripes; femora with a broad subterminal brown annulus; wings grayish with extensive brown markings.

Female.—Length, excluding the rostrum, 5.7–6 mm.; wing, 6.4 mm.; rostrum, about 2.2–2.5 mm.

Rostrum moderately elongated, black. Antennæ black. Head black, passing into dark gray on the vertex; a narrow silvery median line extends from the front to the occiput.

Pronotum dull brownish yellow with a dark brown median line. Mesonotal præscutum light gray with three dark brown stripes, nearly subequal in width and much broader than the pale interspaces; middle stripe narrowed behind, barely attaining the suture; lateral stripes narrowed in front, broadened behind, crossing the suture and suffusing the scutal lobes; median area of the scutum and the scutellum pale dirty brown; postnotum brown. Pleura brownish plumbeous. Halteres yellow, the knobs brown. Legs with the coxæ and trochanters pale yellow; femora light brown, passing into light yellow at the tip, this pale area including a broad dark brown subterminal annulus; in the Panaman paratype, the brown annulus is very broad, encroaching upon the yellow tip; the pale area at the tip is about one-half the extent of the brown annulus, which in turn

is a little longer than or subequal to the yellow area proximad to it. Wings with a pale gray tinge, the costal margin with three dark brown blotches, the largest at the origin of *Rs* and the tip of *Sc*; stigma rectangular; a large blotch at the middle of *Sc*; pale brown seams along the cross-veins and deflections of veins; tip of the wing a little darkened; veins dark brown, *R* between the brown markings bright yellow. Venation: *Sc* rather short, extending to about one-quarter the length of the sector; Sc_2 at the tip of Sc_1; basal deflection of R_{4+5} long, restricting the *r-m* cross-vein.

Abdominal tergites dark brown, the ninth segment more yellowish; sternites yellowish brown, the apical segments more yellowish.

Habitat.—Central America.

Holotype, ♀, Aguna, Guatemala, altitude 2,000 feet (Dr. G. Eisen).

Paratopotype, ♀; paratype, ♀, Cucaracha, Canal Zone, November 17, 1908, No. 14 (C. H. Bath).

Type in the collection of the United States National Museum.

Related to *insignis* Loew, but smaller, the thorax grayish with the brown stripes broader, the subterminal brown annulus on the femora much broader, the wings grayish with the brown markings larger and darker; it is a much smaller species than *plumbeipleura* (wing and body, over 8 mm.; rostrum, 3 mm.) with the mesonotal coloration more grayish, the wings with the pattern not so dark, but more extensive, the interspaces of the costal region not so brightened, etc.

Tribe **Antochini.**

This is one of the smaller of the crane-fly tribes, the species of the eastern United States and Canada being as follows:

Antocha saxicola Osten Sacken.

Canadian and Transitional zones of the east, ranging from Ontario and Quebec, south to Georgia, west to Winnipeg, Michigan and Illinois. In New York and New England it flies from May 13 to September 25.

Atarba picticornis Osten Sacken.

Canadian-Transitional and Transitional zones of the eastern United States, ranging from New York and Massachusetts, south to Virginia and North Carolina, west to Indiana and Tennessee. In New York and New England it flies from June 19 to July 13, having an unusually short flight-period. In the south it flies later (October 7, Tennessee) and appears earlier (May 29, Maryland).

Dicranoptycha germana Osten Sacken. (Plate XXV, fig. 10.)

Canadian life-zone of the northeastern United States, ranging from New York, Vermont and New Hampshire, south, in the moun-

tains, to North Carolina. In New York and New England it flies from June 21 to August 8, being quite common in late June and throughout July on vegetation in cool wooded places, usually along streams.

Dicranoptycha nigripes Osten Sacken.

Known only from the type-locality, Dalton, Georgia.

Dicranoptycha sobrina Osten Sacken. (Plate XXV, fig. 11.)

Transitional and Austral life-zones, wide-ranging throughout the northern portions of the United States, from Ontario and New York, south to North Carolina, west to British Columbia, California and New Mexico. In the vicinity of Washington it flies from April 20 to August 31, while in the northeastern part of its range (New York and Ontario) it appears even later, August 30 to September 20.

Dicranoptycha winnemana sp. n. (Plate XXV, fig. 12.)

Transitional life-zone, ranging from Maryland to Georgia.

Elephantomyia westwoodi Osten Sacken.

Canadian and Canadian-Transitional life-zones of northeastern United States and eastern Canada, ranging from Ontario, Quebec, and Nova Scotia, south to North Carolina, west to Wisconsin. In New York and New England it flies from June 5 to August 13, being common throughout late June and July.

Rhamphidia albitarsis Osten Sacken.

Tropical life-zone, ranging from Santo Domingo, through the Antilles to St. Vincent and British Guiana; also in Central America. It may possibly occur in the Miami section of Florida.

Rhamphidia flavipes Macquart. (Plate XXV, fig. 13.)

Wide-ranging throughout the eastern parts of North America, from Ontario, and Quebec south to Georgia and Florida, west to Manitoba, Wisconsin, Missouri and Texas. In New York and New England, it flies from May 29 to August 29; in the southern parts of its range much earlier (Florida, March 14; Texas, March 18).

Rhamphidia mainensis sp. n. (Plate XXV, fig. 14.)

Canadian-Transitional life-zone of the northeastern United States, ranging from Maine to Maryland, west to Illinois.

Teucholabis carolinensis Alexander.

Lower Austral life-zone, known only from the type-locality, Georgetown, South Carolina, August 19, 1915.

Teucholabis complexa Osten Sacken. (Plate XXV, fig. 15.)

Transitional and Austral life-zones of the eastern United States, ranging from New York and Connecticut, south to Georgia, west to Illinois and Kentucky. In the vicinity of Washington it flies from May 7 to July 25.

Teucholabis lucida Alexander. (Plate XXV, fig. 16).

Known only from the type-locality, District of Columbia, August 22, 1915.

Toxorrhina magna Osten Sacken.

Austral life-zones of the southeastern United States, ranging from New Jersey south to Florida; in New Jersey flying from July 19 to August 12, in the south its flight-period being much more extensive (Crescent City, Florida, April 21; Thalman, Georgia, April 28; Bainbridge, Georgia, September, October).

Toxorrhina muliebris Osten Sacken.

Canadian-Transitional life-zones of the northeastern United States, ranging from New York and Maine, south to Maryland, west to Michigan. In New York and New England it flies from June 21 to August 8, being common in places in late June and throughout July.

RHAMPHIDIA Meigen.

Rhamphidia Meigen; Systematische Beschreibung, vol. 6, p. 281 (1830).

Rhamphidia mainensis sp. n.

Rostrum elongated; head light gray with a large brown blotch between the eyes; præscutum light yellowish brown with three dark brown stripes; wings unmarked except the pale stigma; legs dark brown; abdomen dark brown, the basal sternites and the hypopygium yellowish.

Male.—Length, 6–7.5 mm.; wing, 5.8–7.7 mm.

Rostrum elongated, black. Antennæ black, the second segment a little paler apically. Head light gray with a large brown blotch between the eyes.

Mesonotal præscutum light yellowish brown with three dark brown stripes, the middle one broadest, double, becoming indistinct before the suture; lateral stripes shorter, crossing the suture and suffusing the scutal lobes except behind; median area of the scutum and the scutellum pale yellowish gray; postnotum yellowish, darker, more brownish, on the sides. Pleura brownish with a golden-yellow pollen. Halteres light brown, the knobs dark brown. Legs with the coxæ and trochanters yellowish brown; femora dark brown, a little paler basally; tibiæ and tarsi dark brown. Wings sub-

hyaline, the stigma indistinct, brownish; veins dark brown, subcosta more yellowish. Venation (Plate XXV, fig. 14) *Rs* moderate in length, about one and one-half the length of the deflection of R_{4+5}; cell *1st* M_2 small to elongate; basal deflection of Cu_1 variable in position, before, at or beyond the fork of *M*.

Abdominal tergites dark brown, the hypopygium bright reddish yellow; sternites two to five dull brownish yellow basally, the caudal margins dark brown; segments six to seven dark brown; eight and nine dull yellow.

The Maryland paratype is strikingly smaller (the smallest measurements given) than the typical Maine material and has the stigma more distinct, but is undoubtedly the same species.

Habitat.—Northeastern United States.

Holotype, ♂, Orono, Penobscot County, Maine, June 12, 1913 (Alexander).

Paratopotypes, 4 ♂'s; paratype, ♂, Hyattsville, Maryland, September 1, 1912 (Malloch); ♂, Lake Forest, Illinois, July 8, 1906 (Needham).

Type in the collection of the author.

This species differs conspicuously from the only other eastern species of the genus, *R. flavipes* Macquart (Plate XXV, fig. 13), in the elongate rostrum, the uniformly dark legs, the clear wings and the abdominal coloration. It is much more closely related to *R. longirostris* Meigen (western Palæarctic region) which has the antennal flagellar segments more elongated with longer verticils, the thorax differently patterned, the wings broader with a higher cell *1st* M_2, etc.

ATARBA Osten Sacken.

Atarba Osten Sacken; Monographs of the Diptera of North America, pt. 4, p. 127 (1869).

Atarba cincticornis sp. n. (Extra-limital.)

Atarba varicornis Alexander (in part); Transactions of the American Entomological Society, vol. 40, p. 232 (1914).

Antennæ of the male greatly elongated, the flagellar segments bicolored, the basal half of each segment black, the apical half yellow, the segments with long outstretched hairs; cell *1st* M_2 of the wings very small.

Male.—Length, 4.2 mm.; wing, 5 mm.

Rostrum and palpi reddish. Antennæ with the basal segment reddish; second segment dark brown; flagellar segments with the basal half to three-fifths black, the remainder of each segment light yellow; fourth segment largely blackish; flagellar segments with

long outstretched hairs; antennæ very elongated, nearly as long as the body, the individual segments of the flagellum being greatly elongated. Head reddish yellow.

Mesonotum reddish yellow with an impressed median line on the præscutum. Pleura reddish with a very sparse grayish bloom. Halteres yellowish, the knobs darker at their tips. Legs with the coxæ and trochanters dull yellow; femora yellow, narrowly and indistinctly brownish at the tips; tibiæ brownish yellow; tarsi yellowish brown, the tips of the segments brown, the two terminal segments entirely brown. Wings with a grayish yellow tinge, stigma very indistinct, grayish; veins brown. Venation: *Sc* ending about opposite the origin of *Rs*; *Rs* short, a little longer than the basal deflection of R_{4+5}; cell *1st* M_2 small.

Abdominal segments dull yellow, brownish laterally; a brownish black subterminal ring.

Habitat.—British Guiana.

Holotype, ♂, Mallali, Demerara River, British Guiana, March 25, 1913 (H. S. Parish).

Type in the collection of the author.

A. cincticornis is to be separated from the other species of the genus with bicolored antennæ in that it is the basal half of the flagellar segments that is black instead of the apical half (as in *picticornis* Osten Sacken, *varicornis* Alexander).

DICRANOPTYCHA Osten Sacken.

Dicranoptycha Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 217 (1859).

Dicranoptycha winnemana sp. n.

Altogether pale brownish yellow; wings pale yellow, the costal margin fringed with long golden hairs; radial sector about one and one-half the length of cell *1st* M_2.

Male.—Length, 6.8–7.2 mm.; wing, 7–7.6 mm.

Female.—Length, 7.8–8.8 mm.; wing, 8.2–8.8 mm.

Rostrum and palpi brown, the latter darker. Antennæ with the first segment dark brown, grayish pubescent; second segment dark brown; flagellum dull yellow. Head light gray.

Mesonotal præscutum clear light brownish yellow without stripes; scutellum and postnotum a little more yellowish. Pleura pale reddish yellow. Halteres short, yellow. Legs with the coxæ and trochanters pale yellow; femora and tibiæ yellow; tarsi similar with the four terminal segments and the tips of the metatarsi light brown. Wings with the membrane tinged with yellow, the veins light brown;

costal margin and the veins in the costal field with a fringe of long golden hairs. Venation (Plate XXV, fig. 12): *Rs* elongate, about one-half longer than the cell *1st* M_2.

Abdominal segments brownish yellow with a subterminal brownish black ring in the male, lacking in the female.

Habitat.—Eastern United States.

Holotype, ♂, Maryland, near Plummers Island, July 21, 1915 (Alexander).

Allotype, ♀, Plummers Island, Maryland, July 21, 1915 (Alexander).

Paratopotypes, 1 ♂, 10 ♀'s, (McAtee and Alexander); paratype, ♀, Dead Run, Virginia, July 21, 1915 (McAtee); ♂, Lost Mountain, Cobb County, Georgia, July 13, 1913 (Bradley).

Type in the collection of the author.

This is probably the species that Osten Sacken referred to when he said "immature specimens of a paler coloring (than *sobrina*), with uniformly pale feet, and without any trace of a darker tinge near the apex of the wings often occur."[3] These specimens do not represent teneral insects, but fully colored specimens of both sexes, some of them taken in copulation. Besides the pale coloration, the elongate sector will distinguish the species from *sobrina* (Plate XXV, fig. 11).

Tribe **Eriopterini.**

ERIOPTERA Meigen.

Erioptera Meigen; Illigers Magazine, vol. 2, p. 262 (1803).

Erioptera (Erioptera) laticeps sp. n.

Head very broad; coloration dark, the humeral triangles pale; pleura marked with brown and yellow; abdomen banded brown and white; wings nearly hyaline.

Male.—Length, 4.6 mm.; wing, 3.8 mm.

Female.—Length, 5 mm.; wing, 4 mm.

The specimens are described from alcoholic material.

Rostrum and palpi dark brown. Antennæ dark brown, the flagellar segments short-oval, more elongated toward the tip of the organ. Head very broad, especially behind; frontal tubercle distinct. Head dark grayish brown, paler brown on the genæ.

Mesonotal præscutum dark brown, the region before the pseudosutural foveæ light yellow, triangular in outline; remainder of the mesonotum dark brown, the scutellum yellow. Pleura mottled brown and brownish yellow, the sternal region more brownish; a

[3] Monographs of the Diptera of North America, pt. 4, p. 119 (1869).

group of about twenty long pale hairs on the caudal margin of the mesepimeron just cephalad of the halteres. Halteres pale yellow throughout, the knobs large. Legs with the coxæ and trochanters brown; femora dark brown; tibiæ and tarsi, especially the terminal segments of the latter, paler brown. Wings subhyaline, the stigma indistinct; veins brown. Venation (Plate XXVII, fig. 34).

Abdominal tergites one and two dark brown, three to eight dark brown, broadly margined caudally and more narrowly on the sides with pale yellowish white, giving the organ a banded appearance; pleural integument pale; sternites similar to the tergites, but paler brown. Male hypopygium (Plate XXXI, fig. 97) with the pleurites short and stout, the pleural appendages a dorsal cylindrical fleshy lobe and a more ventral acute chitinized point with a smaller chitinized lobe on its ventral face; ninth tergite concave on the caudal margin, underneath with two stout, chitinized lobes that are decussate.

The female has the tergal valves of the ovipositor long, strongly upcurved, chitinized, brown; sternal valves short, pale, acutely pointed.

Habitat.—Western United States.

Holotype, ♂, Blue Lake, Humboldt County, California, June 20–27, 1907 (Bradley).

Allotype, ♀, with the type.

Paratopotypes, 4 ♂'s.

Type in the collection of Cornell University.

Erioptera (Mesocyphona) tantilla sp. n.

Vertex unicolorous; mesonotum brown with three narrow blackish stripes; femora pale with a narrow, indistinct, subterminal band; costal region of the wings dark with tiny spots at the ends of *Sc*, R_1, R_2 and R_3; caudal cells of the wings with gray spots; cell *1st* M_2 closed.

Male.—Length, 4.5 mm.; wing, 3.6 mm.

Rostrum and palpi light brown. Antennæ reddish yellow, the flagellum a little more brownish; flagellar segments very slender with elongate verticils. Head brownish yellow without distinct markings, the vertex with numerous long hairs.

Mesonotal præscutum light brownish gray medially, more yellowish laterally, the central portion delimited on either side by an indistinct narrow brown line; a still darker narrow brown median line, interrupted at the level of the tuberculate pits; scutum with the lobes pale indistinctly marked with brown; an oblique row of about seven

bristles crosses the lobe with a smaller group on the proximal margin of the lobe; scutellum dark reddish brown, distinctly and rather broadly light yellow medially, the sides of the sclerite also passing into yellowish; postnotum brownish gray with an indistinct narrow brown median line. Pleura brownish yellow with a narrow brown pleural stripe; the sternal region a little paler brown. Halteres short, brown. Legs with the coxæ light brown; trochanters dull yellow; femora light brown, the apical quarter more yellowish and enclosing a narrow brown subterminal annulus; tibiæ dull brownish yellow, the tips and the tarsi broken. Wings with the apical costal portion dark brown, the basal costal portion and the caudal portions of the membrane much paler, subhyaline; cells *C* and *Sc* with a few scattered brown spots; a small white spot at the tip of Sc_1, at the tip of R_1, and near the tips of R_2 and R_3; the hyaline areas of the wings with a rather dense but pale pattern of small spots and blotches, brownish in the radial field, passing into grayish on the caudal fields of the wings. Venation (Plate XVII, fig. 35) cell *1st* M_2 closed, the outer deflection of M_3 and cross-vein *m* being present.

Abdominal tergites brownish yellow with abundant long pale hairs; sternites yellowish gray, indistinctly trivittate with brown, the segments with abundant pale brown setigerous punctures.

Habitat.—Southeastern United States.

Holotype, ♂, Jackson, Mississippi, August 8 (H. S. Barber).

Type in the collection of the United States National Museum.

Similar to *E. costalis* Alexander,[4] but the cell *1st* M_2 closed and the wing-pattern much heavier in the costal region.

Erioptera (Empeda) nyctops sp. n.

Pale yellow throughout; wings with *Sc* long; vein R_2 oblique; cross-vein *r* present; cell *1st* M_2 closed with the basal deflection of Cu_1 beneath it.

Male.—Length, 3.8–3.9 mm.; wing, 4.3–4.4 mm.

Female.—Length, 3.8–4 mm.; wing, 4.5–4.7 mm.

Rostrum light yellow, palpi brown. Antennæ with the scapal segments pale yellow, the flagellum light brown. Head bright light yellow. Eyes large, black.

Mesonotal præscutum pale reddish yellow, unmarked, more yellowish laterally; tuberculate pits pale, remote from the anterior margin of the sclerite (as in *Erioptera*); remainder of the mesonotum more shiny. Pleura light yellow. Halteres pale yellowish, the

[4] Proceedings of the United States National Museum, vol. 44, p. 517 (1913).

knobs brown. Legs with the coxæ and trochanters dull yellow; femora brown, a little paler basally; tibiæ and tarsi brown. Wings subhyaline, stigma indistinct, veins pale brownish yellow. Venation (Plate III, fig. 36): *Sc* long, ending beyond the fork of the sector; Sc_1 about four to six times as long as Sc_2; *Rs* long, gently arcuated; cross-vein *r* present, connecting with R_{2+3} at about one-third its length; R_2 oblique (as in *Gonomyia subcinerea*); cell *1st* M_2 closed; basal deflection of Cu_1 at about one-third to one-fourth the length of the cell.

Abdomen brownish yellow, the sternites paler yellow. Male hypopygium (Plate XXXI, fig. 98) with the pleurites moderately slender, broader basally, bearing three appendages, the largest appendage (*a*) very elongate, digitiform, with numerous long scattered hairs on raised tubercles, the apex a little flattened, blunt, this appendage decussate with its fellow of the opposite side; the two smaller appendages are slender, one (*b*) directed proximad, decussate, pale, the tip drawn out into a long point; the third appendage (*c*) slender, directed cephalad, slightly enlarged beyond the middle, the tip subacute. Penis-guard rectangular, on the ventral side running out into a sharp, median chitinized point. In a position of rest the large finger-like appendages lie parallel and are more or less approximated, but not decussate, directed strongly ventrad.

Females have the eyes smaller, the præscutum more yellowish; ovipositor powerful, the valves elongate, upcurved toward the tips.

Habitat.—Northeastern United States.

Holotype, ♂, Mountain Lake, Fulton County, New York, altitude 1,600 feet, June 13, 1916 (Alexander).

Allotype, ♀, Buell Mountain, Fulton County, New York, altitude 1,800 feet, June 18, 1916.

Paratopotypes, 2 ♂'s, 35 ♀'s.

Type in the collection of the author.

The holotype occurred on rich vegetation along a small temporary stream flowing into the lake on June 13. Associated with the species at this time were the following crane-flies: *Dicranomyia pubipennis, Ormosia rubella, Erioptera* (*Empeda*) *stigmatica, Limnophila toxoneura, L. areolata, L. nigripleura, L. brevifurca, L. rufibasis, L. sylvia, Ulomorpha pilosella, Rhaphidolabis* (*Rhaphidolabis*) *tenuipes, R.* (*Rhapidolabina*) *flaveola, R.* (*Plectromyia*) *modesta, Tricyphona vernalis, T. calcar, Dolichopeza americana, Oropeza venosa, Tipula senega, T. iroquois,* and *T. hermannia.*

The allotype and several of the paratypes occurred along a small temporary torrent pouring down the eastern slopes of Buell Mountain

on June 18. Associated with this species were the following crane-flies: *Dicranomyia pubipennis, Limnobia indigena, Limnophila niveitarsis, L. toxoneura, L. areolata, L. adusta, L. brevifurca, L. rufibasis, L. munda, L. montana, L. lenta, L. emmelina, Ula elegans, Rhaphidolabis* (*Rhaphidolabina*) *flaveola, Dolichopeza americana, Tipula senega, T. hermannia, T. macrolabis* and *T. valida.*

This interesting pallid species gave some trouble in assigning it to this genus The general appearance of the fly is altogether that of *Gonomyia*, but the presence of the radial cross-vein, the very elongate subcosta and the position of the tuberculate pits make it more probable that the present reference is the correct one. In its venation it departs widely from that of the genotype, *E. stigmatica* Osten Sacken (Eastern Nearctic), in the oblique, *Gonomyia*-like course of vein R_2, in this respect suggesting certain of the European Empedæ. These insects with the oblique R_2 certainly appear different from *stigmatica*, and if this difference were worthy of a name it is this group that would have to be separated off from *stigmatica*, the genus *Empeda* being erected for the species with the short cell R_2 and the normal, *Erioptera*-like course of vein R_2. This *Gonomyia-Erioptera* group of species gets more complex with the accession of new forms, and it seems probable that the best basis for a division is the position of the tuberculate pits, these being far cephalad in the *Gonomyia*-like forms and retreated far backward and lying at nearly mid-length of the sclerite in the genera and subgenera related to *Erioptera*.

MOLOPHILUS Curtis.

Molophilus Curtis; British Entomology, p. 444 (1833).

Molophilus fultonensis sp. n.

Much larger and darker colored than *M. pubipennis* to which it is most closely related; antennæ of the female much longer than in the corresponding sex of *pubipennis*.

Male.—Length, 3.5–4.4 mm.; wing, 5.6–6.4 mm.

Female.—Length, 4.5–5 mm.; wing, 5.3–6 mm.

Very similar to the smaller *M. pubipennis* Osten Sacken, differing as follows: much larger and darker colored, especially in the male sex, the abdomen being dark brown instead of yellow; thorax without the rich reddish tints of *pubipennis;* pronotum not bright yellow as in *pubipennis*. Hypopygium with two chitinized hooks (Plate XXXI, figs. 95, 96), the curved hook directed abruptly ventrad, ending in a long slender point; the smaller straight one is more dorsad in position, minutely denticulated along the ventral face; proximo-lateral angle

produced into a sharp point. Hypopygium quite as in *pubipennis*, but the ventral hook is more blackened, chitinized, and the point is longer, more slender; dorsal hook more slender, not so blackened, the sharp point on the proximo-lateral angle not so long.

The female has the antennæ much longer than in this sex of *pubipennis*, the flagellar segments dark brown, not yellowish, the terminal segments darkened; flagellar segments elongate-oval instead of merely oval; wings (Plate XXVII, fig. 37) with the anterior margin and apex with a fringe of reddish brown to dark brown hairs, not bright yellow as in *pubipennis*.

Habitat.—Northeastern United States.

Holotype, ♂, Mountain Lake, Fulton County, New York, altitude 1,600 feet, July 7, 1916 (Alexander).

Allotype, ♀, with the type.

Paratopotypes, 15 ♂♀'s; paratypes, 1 ♂, Taylor, Cortland County, New York, altitude 1,200 feet, July 20, 1916, 2 ♂'s, near Cincinnatus, Chenango County, New York, altitude 1,300 feet, July 21, 1916.

Type in the collection of the author.

A large striking species, the largest yet discovered in the eastern States.

The types occurred on rich vegetation along a small temporary stream flowing into the lake. This is the same locality described under *Erioptera nyctops*, but by this date (July 7) the stream had disappeared and the mid-summer crane-fly fauna was quite different from that found less than four weeks before. The principal species recorded now were the following: *Dicranomyia immodesta*, *D. pubipennis*, *D. macateei*, *Elephantomyia westwoodi*, *Erioptera chrysocoma*, *E. chlorophylla*, *E. armillaris*, *E. armata*, *E. caloptera*, *E. stigmatica*, *Molophilus pubipennis*, *M. ursinus*, *Limnophila fuscovaria*, *L. quadrata*, *Bittacomorpha jonesi*, etc.

Molophilus nova-cæsariensis sp. n.

Size small (wing under 3.2 mm.); coloration dark brownish black; wings dusky with the fusion between Cu_1 and M_3 slight; hypopygium of the male with the ventral appendages straight, slender, heavily chitinized.

Male.—Length about 2.7 mm.; wing, 2.8 mm.

Rostrum and palpi blackish. Antennæ rather elongated, dark brown, the flagellar segments cylindrical with an abundant long pale pubescence. Head dark gray.

Mesonotum black with a sparse grayish bloom; pleura dark brown-

ish black, the dorso-pleural membranes a little brighter. Halteres short, dull yellow throughout, the knobs elongate. Legs with the coxæ brown, the trochanters yellowish brown; femora and tibiæ dark brown, the former a little brighter at the base; tarsi light brown, the tips of the segments and all of the terminal two segments darker. Wings with a dusky suffusion, the costal and stigmal regions a little more suffused; veins dark brown. Venation (Plate XXVII, fig. 38): first deflection of R_2 elongate, oblique, not perpendicular as in *ursinus* (Plate XXVII, fig. 39); fusion of M_3 and Cu_1 slight, shorter than the free portion of Cu_1 alone.

Abdomen dark brownish black with a long pale pubescence. Hypopygium narrowed, the ventral appendage very long, slender, acicular and almost straight, heavily chitinized.

Habitat.—Eastern United States.

Holotype, ♂, Ashland, Camden County, New Jersey, May 13, 1905.

Type in the collection of the United States National Museum.

This species occurred in the United States National Museum collection, bearing the label "*M. ursinus ?*" in Coquillett's writing. *M. ursinus* Osten Sacken, probably the smallest crane-fly in the United States (wing of the male, 2.4 mm.), is the only species with which it might be confused; the venation of the two species is quite distinct, that of the new species being much more of the normal *Molophilus* type. *M. ursinus* (Plate XXVII, fig. 39) has the upward deflection of R_2 almost perpendicular and in a line with the radial cross-vein; basal deflection of Cu_1 before the fork of M, the fusion of Cu_1 and M_3 being correspondingly extensive, longer than the free portion of Cu_1 alone; there is a clear, hyaline area running along the anterior face of vein M, this obliterating the base of M_{1+2}; *M. novacæsariensis* (Plate XXVII, fig. 38) has the upward deflection of R_2 elongate, oblique; basal deflection of Cu_1 about at the fork of M, the fusion of Cu_1 and M_3 being very slight, not more than one-half the free portion of Cu_1 alone; there is no hyaline obliterative mark along vein M and the base of M_{1+2} is distinct.

EMPEDOMORPHA gen. n.

Head with the front broad, the eyes widely separated. Rostrum short. Palpi four-segmented, the segments subequal. Antennæ 16-segmented, the second segment not longer and only a little broader than the third; flagellar segments oval with verticils just below mid-length; terminal segments smaller. Legs moderately stout, the

segments with abundant strong hairs; tibiæ without spurs. Wing (of the male) (Plate XXVII, fig. 40) with the stigma enormously enlarged so that the costal and radial veins in that field are bulged outward; stigma extending from the basal portion of cell R_1 to the end of vein R_1; wing (of the female) with the stigma smaller, the cells R_1 not so wide and the cross-vein r consequently shorter and more nearly straight. *Sc* moderately long, ending just before the fork of *Rs*; Sc_2 far retreated, lying just beyond the origin of *Rs*; *Rs* long, straight, in a line with R_{4+5}; cross-vein r long, oblique, somewhat twisted, inserted at the end of *Rs* or just beyond on R_{2+3}; R_{2+3} about as long as R_2 alone; R_2 arcuated at its base; cell *1st* M_2 closed (sometimes open by the atrophy of cross-vein m, which, when present, is usually weak); basal deflection of Cu_1 at or just before the fork of M; fusion of Cu_1 and M_3 moderate, about one-half of Cu_1 alone or a little longer than the deflection of Cu_1.

Genotype.— ? *Trimicra empedoides* Alexander. (Mid-western Nearctic region.)

Empedomorpha empedoides Alexander.

? *Trimicra empedoides* Alexander; Canadian Entomologist, vol. 48, pp. 44, 45 (1916).

This curious fly ranges from South Dakota to Texas and New Mexico, an unrecorded station being Brownsville, Texas, May 3, 1904 (H. S. Barber), a ♀ in the collection of the United States National Museum.

GONOMYIA Meigen.

Gonomyia Meigen; Systematische Beschreibung, vol. 1, p. 146 (1818).

The numerous species of this genus may be divided into three subgenera, *Gonomyia*, *Gonomyella* and *Leiponeura*, and it is the last-named group that has caused so much confusion in the study of crane-flies during the past few years, the species having been described in a wide range of Limnobine and Antochine genera (*Dicranomyia*, *Atarba*, *Elliptera*, *Teucholabis*, *Thaumastoptera*, etc.).

Brunetti, in his exhaustive work on the "Diptera Nematocera of British India," pp. 469, 470, enters into a long discussion as to the homologies of the veins of those species of *Gonomyia* which have but two branches of the sector reaching the wing-margin, *i.e.*, the subgenus *Leiponeura* Skuse. He presents the rather far-fetched idea of the cell R_2 being unusually large, sessile and the vein R_{4+5} lacking so that cross-vein r-m connects M_{1+2} with R_3. A study of a series of the species of the genus show the impossibility of this interpretation, R_{4+5} being one of the most constant veins of the wing in

the Tipulidæ. It is much more reasonable to figure out the disappearance of one of these branches by fusion to the wing-margin, a condition found in many remote crane-fly tribes (Limnophilini, the Neotropical genus *Psaronius* Enderlein; Hexatomini, the genus *Hexatoma* and the reduced form, *Cladolipes*, Palæarctic, etc.). In the genus *Gonomyia* we may start with forms possessing a deep cell R_2 and the radial cross-vein present as in the subgenus *Gonomyella* Alexander (*slossonæ* Alexander) through species with the cell a little less deep [*subcinerea* group (Nearctic), Plate XXVI, fig. 33; *affinis* Brunetti (Oriental) *et al.*]; then to still smaller forked species (*noveboracensis*, Plate XXVI, fig. 30; *aperta* Brunetti) and finally to a group of species that have the cell very tiny (*sulphurella* group, Plate XXVI, fig. 26; *flavonotata* Edwards of the Seychelles Islands *et al.*), a single step further in the fusion of R_{2+3} resulting in the obliteration of the cell and the attainment of the condition found in *Leiponeura* (Plate XXVI, figs. 17–22). With this fusing of the branches of R_{2+3} there occurs a simultaneous tendency for R_{4+5} to bend caudad toward the wing-apex so that in the species of *Leiponeura* these two branches of the radial sector are very widely separated at the wing-margin. It is a very easy matter to pick out the species of this group merely by this one tendency alone, a correlated character, however, being the extremely narrowed, often almost pointed, inner end of cell *1st* M_2 due to the extreme shortening of the basal deflection of M_{1+2}.

Dr. Bergroth has expressed his belief that although *Gonomyia manca* Osten Sacken is a true, though aberrant, member of the genus, the other species that have been described in various Antochine genera, such as *Atarba*, *Elliptera*, *Leiponeura*, etc., are quite distinct from *manca* and really belong to the tribe Antochini. The series of *Leiponeura*, as they occur in the United States alone and without taking into consideration the rest of the world, show a curious and almost complete transition into the *sulphurella* group of *Gonomyia* s.s. I would point out the exceedingly long verticils of the flagellar segments of the male antennæ that are found not only in the species of *Leiponeura* (*manca*, *pleuralis et al.*), but also in *Gonomyia sulphurella*, another proof of the close relationship existing, since this condition of the antennæ elsewhere in the family is rare or lacking.

Occasionally a crane-fly society is found in which the dominant element consists of species of this genus. Such a society was found in the Shaul woods on the east bank of Nowadaga Creek (Castle Creek) south of the village of Indian Castle, Herkimer County, New York, June 13, 1915, and may be described as a *Gonomyia*-association.

The woods are quite open, in places with outcroppings of a transitional character, of Trenton limestones and Utica shales and with a western exposure. The forest cover consists of the dominant arbor-vitæ, *Thuja occidentalis*, with an admixture of *Juglans cinerea, Betula lutea, Ulmus americana, U. fulva, Tilia americana, Fraxinus americana* and a few others. The underbrush was of yew, *Taxus canadensis, Ribes Cynosbati* and *Hamamelis virginiana*. The undergrowth from which the crane-flies were swept consisted of three dominant plants, early meadow-rue, *Thalictrum dioicum*, mandrake, *Podophyllum peltatum*, and ground ivy, *Nepeta hederacea*, with fewer representatives of other species, *Ranunculus abortivus, R. acris, Fragaria vesca*, and an abundance of bladder-fern, *Cystopteris bulbifera*. In places rank growths of *Osmunda cinnamomea, Podophyllum, Solidago, Lysimachia Nummularia*, bound into dense tangles by lianas, *Menispermum canadense* and *Psedera quinque-folia*. Here occurred *Gonomyia mathesoni, Rhabdomastix* (*Sacandaga*) *flava* and *Erioptera venusta*. Along the base of the hill is a broad ditch, now quite dry, but supporting such a flora as *Cystopteris, Lysimachia Nummularia, Tussilago Farfara*, etc. It is very probable that a certain element of the crane-fly fauna emerged from this ditch. The similarity between the crane-fly fauna of this open woods and that of Sport Island in the Sacandaga River, Fulton County, New York, is very close (*Gonomyia alexanderi, G. cognatella, G. mathesoni, Rhabdomastix flava*, etc.).

The crane-fly fauna of this association is as follows:

Dicranomyia liberta, sev.; *Geranomyia canadensis*, rare; *Antocha saxicola*, few; *Erioptera venusta*, comm.; *E. armata*, comm.; *Molophilus pubipennis*, comm.; *Gonomyia alexanderi*, uncomm.; *G. sulphurella*, dom.; *G. mathesoni*, dom.; *G. cognatella* and *G. florens*, loc. abund.; *G. subcinerea*, uncomm.; *Rhabdomastix* (*Sacandaga*) *flava*, uncomm.; *Adelphomyia minuta*, uncomm.; *Limnophila rufibasis*, comm.; *Tipula caloptera*, rare, and *T. macrolabis*, rare.

Sport Island in the Sacandaga River, New York (mentioned above), is rather remarkable in its *Gonomyia* fauna, no less than eight species having been taken here (*G. alexanderi, G. sacandaga, G. manca, G. sulphurella, G. cognatella, G. mathesoni, G. noveboracensis* and *G. subcinerea*), as well as the closely related genus, *Rhabdomastix* (*Sacandaga*) *flava* Alexander. The floral conditions obtaining here have been discussed by the author in an earlier paper.[5]

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[5] *Entomological News*, vol. 23, p. 72 (1912).

A Key to the Nearctic Species of Gonomyia.

1. Two branches of the radial sector attain the wing-margin ..... (Subgenus *Leiponeura* Skuse.) 2
   Three branches of the radial sector attain the wing-margin 7
2. Outer deflection of M_3 absent, the cell *1st* M_2 being open 3
   Outer deflection of M_3 present, the cell *1st* M_2 being closed 4
3. Costa conspicuously china-white; legs banded with white; male hypopygium with the dorsal pleural appendage triangular, the caudal angle a prominent elongate spine; ventral pleural appendage a flattened blade whose inner caudal margin is armed with about five or six acute chitinized appressed teeth, of which the innermost is the largest. (Eastern United States.) ..... *alexanderi* Johnson.
   Costa not conspicuously china-white; legs without white bands; male hypopygium with the dorsal pleural appendage broadly triangular, the caudal angle a short spine; ventral pleural appendage a flattened blade bearing near its dorsal inner side a sharp chitinized point; no serrations along the lobe. (Western United States.) ..... *cinerea* Doane.
4. Pleural stripes conspicuous; stigma distinct 5
   Pleural stripes indistinct or feebly indicated; stigma lacking or very faint 6
5. Legs with the femora tipped with dark brown; costal margin of the wings conspicuously light yellow, the stigma pale brown. (Northeastern United States.) ..... *sacandaga* Alexander.
   Legs with the femora indistinctly darkened at the tip; costal margin of the wings not yellow, the stigma dark brown. (Southeastern United States and southward.) ..... *pleuralis* Williston.
6. Pleura plumbeous with a pale yellow stripe; male hypopygium with the pleural appendage armed with a strongly curved hook. (Southeastern United States and southward.) ..... *puer* Alexander.
   Pleura unstriped, pale; male hypopygium with the pleural appendage very elongate, slender, decussate in a position of rest, the inner face at the apex with a strong bristle. (Eastern United States.) ..... *manca* Osten Sacken.
7. Radial cross-vein present (subgenus *Gonomyella* Alexander) (Southeastern United States and southward.) ..... *slossonæ* Alexander.
   Radial cross-vein lacking (subgenus *Gonomyia* Meigen) 8
8. Basal deflection of Cu_1 far before the fork of M; subcosta long, ending beyond the origin of Rs 9
   Basal deflection of Cu_1 at or beyond the fork of M; subcosta short, ending opposite or far before the origin of Rs 11
9. Wings clear. (Northeastern United States.) ..... *mathesoni* Alexander.
   Wings spotted 10

10. Pleura unstriped; *Sc* rather short, extending to about one-fourth the length of the sector; no dark blotch at the tip of Sc_1; apices of cells R_3 and R_5 largely darkened. (Eastern United States.) ..... *blanda* Osten Sacken.
    Pleura striped with brown; *Sc* long, ending at about half the length of the sector; a dark blotch at the tip of Sc_1; apices of cells R_3 and R_5 only slightly darkened. (Western United States.) ..... *californica* Alexander.
11. Antennæ orange at the base, the flagellum dark 12
    Antennæ black throughout 15
12. Cell *1st* M_2 closed; femora with a dark brown subterminal annulus. (Eastern United States.) ..... *sulphurella* Osten Sacken.
    Cell *1st* M_2 open; femora without a darker subterminal annulus 13
13. *Sc* short ending before the origin of *Rs*, this distance being about equal to the vein R_2. (Western United States.) ..... *flavibasis* Alexander.
    Sc longer, ending opposite, or just before, the origin of *Rs* 14
14. Male hypopygium with the dorsal angle of the pleurite stout, with numerous (about fifteen) slender hairs; ventral appendage simple, stout, tipped by a blunt black spine; second appendage a powerful, curved, subchitinized arm directed proximad. (Northeastern United States.) ..... *florens* Alexander.
    Male hypopygium with the dorsal angle of the pleurite slender, with a few (about ten) stout hairs; ventral appendage bifid, the arm with a long slender black spine; second appendage a slender pale arm that is almost straight, with two hairs at the tip. (Eastern United States.) ..... *cognatella* Osten Sacken.
15. Wings with slender veins, clouded with a milky suffusion; *Rs* very long and straight. (Northwestern North America.) ..... *galactoptera* Bergroth.
    Wings with stouter veins, pale gray to hyaline; *Rs* shorter, more arcuated basally 16
16. Subcosta short, ending before the origin of *Rs*, the distance about equal to the *r-m* cross-vein; vein R_2 oblique, a little longer than the cross-vein *r-m*; male hypopygium with the gonapophyses and penis-guard fused into a large, prominent, cylindrical tube. (Northeastern United States.) ..... *noveboracensis* Alexander.
    Subcosta longer, ending about opposite the origin of *Rs*; vein R_2 longer, the cell R_2 being larger; male hypopygium with the gonapophyses and penis-guard not fused into a cylindrical tube 17
17. Wings long and slender with a strong grayish brown suffusion; halteres elongated; male hypopygium with the ventral pleural appendage very elongate, slender, slightly expanded toward the tip. (Eastern Rocky Mountain region.) ..... *filicauda* Alexander.
    Wings broader, not strongly tinged with grayish; halteres shorter male hypopygium with the ventral pleural appendage not strikingly elongated 18

18. Male hypopygium with the dorsal pleural appendage armed with a chitinized hook 19
    Male hypopygium with the dorsal pleural appendage without a hook, although with two powerful bristles at the tip 20
19. Male hypopygium with the dorsal appendage two lobed, the caudal arm a powerful chitinized spine; ventral arm with a sharp, chitinized, feebly curved spine. (Eastern United States.) ..... *subcinerea* Osten Sacken.
    Male hypopygium with the dorsal appendage irregular, not two lobed, the outer face near the apex with a strong, curved, chitinized hook. (Extra-limital; Guatemala.) ..... *æqualis* Alexander.
20. Male hypopygium with the ventral appendage prominent, directed caudad, narrowed at the base, the apex a slight chitinized tooth directed proximad. (Western United States.) *virgata* Doane.
    Male hypopygium not as described 21
21. Male hypopygium with the ventral appendage a double, dark-colored lobe, the inner arm stout-cylindrical; the outer arm slender, curved, bearing at the tip two divergent hairs; penis-guard subtended by two divergent chitinized arms that are acute at their tips. (Extra-limital; Guatemala.) ..... *unicolor* Alexander.
    Male hypopygium with the ventral appendage pale, not chitinized; penis-guard long and pale, the apex bifid by a deep U-shaped notch; the divergent subtending arms are slender, the ventral margin with a few sharp, appressed teeth. (Extra-limital; Mexico.) ..... *mexicana* Alexander.

Subgenus LEIPONEURA Skuse.

The Cinerea Group.

Gonomyia (Leiponeura) alexanderi Johnson.

Elliptera alexanderi Johnson; Psyche, vol. 19, p. 3, fig. 6 (1912).

This handsome little fly is locally common. Its known distribution over the eastern United States is as follows:

New York, Fulton County, Sport Island, Sacandaga River, June 11, 1914, to August 24, 1910 (Alexander), the type-locality; Herkimer County, Indian Castle, June 13, 1915 (Alexander).

North Carolina, Buncombe County, Black Mountains, June 13, 1912 (Beutenmuller).

A female specimen from Plano, Collin County, Texas, in August (E. S. Tucker), probably belongs here, but may possibly represent *G. helophila* Alexander. This is also the species mentioned by Osten Sacken in the Monographs, part 4, p. 179, without locality.

The wing is shown on Plate XXVI, fig. 17.

The male hypopygium is described below, the characters being largely taken from paratypic material in my collection. Hypopygium (Plate XXIX, figs. 59, 61) with the pleurites rather prominent, cylindrical; ventral pleural appendage (*v*) elongate, the outer angle produced caudad as a rather broad flattened blade that is slightly chitinized at the tip; inner caudal margin of the appendage with about five or six acute chitinized appressed teeth, of which the innermost is the largest; a fleshy lobe on the ventral side of the outer blade; middle pleural appendage lacking (possibly of a caducous nature); dorsal pleural appendage (*d*) lying on the inner caudal angle of the pleurite, triangular in outline, the caudal angle produced caudad as an elongate spine that is heavily chitinized apically, the inner angle a rounded lobe with numerous setigerous tubercles.

The two Nearctic species, *alexanderi* and *cinerea*, have been distinguished by the key given before. There is a third species, *G. helophila* Alexander,[6] that is even closer to *alexanderi*. Its known range is extra-limital (Lesser Antilles and British Guiana to Peru), but it may range into our southern limits. The two species may be separated as follows:

1. Dorsal pleural appendage triangular, the caudal angle a prominent spine that is heavily chitinized apically; middle pleural appendage apparently lacking; ventral pleural appendage with a broad flattened blade, the inner caudal margin with about five or six acute chitinized appressed teeth, of which the innermost is the largest (Plate XXIX, fig. 59). (Nearctic.) *alexanderi* Johnson.

   Dorsal pleural appendage a fleshy lobe bearing many hairs; middle pleural appendage a slender subsinuous spine; ventral pleural appendage with the apex flattened, smooth, chitinized, bilobed; ventral margin of the appendage with two prominent teeth whose margins are minutely denticulate. (Plate XXIX, fig. 60). (Neotropical.) ..... *helophila* Alexander.

Gonomyia (Leiponeura) cinerea Doane

Dicranomyia cinerea Doane; Journal of the New York Entomological Society, vol. 8, pp. 182, 183, Pl. 7, fig. 2 (1910).

The known range of this species is as follows:

Washington, Whitman County, Pullman, August 10, 1898 (Piper); the type-locality.

California, Humboldt County, Blue Lake, June 20–27, 1907 (Bradley).

The wing is shown on Plate XXVI, fig. 18.

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[6] *Entomological News*, vol. 27, pp. 343–346, figs. 1, 3 (1916).

The male has never been described, and this specimen is made the allotype.

Allotype, ♂.—Rostrum and palpi dark brown. Antennæ with the basal segments enlarged, the second segment as large as or larger than the first; flagellar segments small, brown. Head pale with a broad dark brown mark on the vertex sending a small median tongue backward onto the occiput.

Pronotal scutum dark medially. Mesonotal præscutum light brown with three dark brown stripes, the median one split by a narrow vitta of the ground-color; scutum with the lobes dark brown. Pleura pale yellow, striped with brown; a very short brown dorsal stripe extending from the pronotum back to above the fore coxæ; second stripe beginning at the fore coxa extending caudad to the base of the halter; ventral stripe broadest, including the sterna and the bases of the middle and hind coxæ; the pale stripe enclosed broad, extending to the abdomen. Halteres pale. Legs with the coxæ pale; trochanters darker; remainder of the legs broken. Wings hyaline or nearly so, the veins brown; basal deflection of R_{4+5}, *r-m* and the basal deflection of Cu_1 dark brown; a pale brownish gray oval stigma. Venation (Plate XXVI, fig. 18) with *Rs* short, straight, oblique, a little longer than the *r-m* cross-vein; basal deflection of Cu_1 at the fork of *M*.

Male hypopygium (Plate XXIX, fig. 62) with the pleurites rather prominent, cylindrical; ventral pleural appendage (*v*) elongate, flattened, blade-like, the apex chitinized; a rounded lobe on the inner ventral side just before the apex; at the base on the inner dorsal side, a sharp, acute, chitinized point; middle appendage a slender, slightly curved pale hook, directed inward, the apex slightly chitinized; dorsal pleural appendage (*d*) a subtriangular lobe, the caudal angle produced caudad as a short spine, heavily chitinized at the apex, the inner angle prominent, produced slightly cephalad, with numerous setigerous punctures.

Allotype in the collection of Cornell University.

The type is grayish, this color being produced by a pruinosity that is not shown by the alcoholic allotype.

The Pleuralis Group.

Gonomyia (Leiponeura) sacandaga Alexander.

Gonomyia sacandaga Alexander; Proceedings of The Academy of Natural Sciences of Philadelphia, pp. 587, 588, Pl. 27, fig. 25 (wing); Pl. 26, fig. 21 (hypopygium) (1914).

This species is still known only from the type station where it is common.

New York, Fulton County, Sport Island in the Sacandaga River, June 11, 1914, to August 24, 1910; the type-locality.

The wing is shown on Plate XXVI, fig. 19.

The hypopygium having been described and figured in the first part of this series is not repeated here.

Gonomyia (Leiponeura) pleuralis Williston.

Atarba pleuralis Williston; Transactions of the Entomological Society of London, p. 289, Pl. 10, fig. 61 (1896).

This is a tropical species that reaches our southern limit, its range being as follows:

Bermuda, apparently common (Jones).

Georgia, Charlton County, Okefinokee Swamp, June 20, 1912 (Bradley).

Cuba, Baracoa, September, 1901 (Busck).

Porto Rico, Aguadilla, January, 1899 (Busck).

St. Vincent (H. H. Smith); the type-locality.

British Guiana, Bartica, December 9, 1912, to February 26, 1913; Mallali, March 14, 1913 (Parish).

The wing is shown on Plate XXVI, fig. 20.

The male hypopygium has been described and figured by the author in another paper.[7]

The Manca Group.

Gonomyia (Leiponeura) puer Alexander.

Gonomyia puer Alexander; Proceedings of the United States National Museum, vol. 44, p. 506, Pl. 66, fig. 14 (1913).

This is likewise a tropical species that ranges within our limits, its northern distribution being a little more extensive than the last.

South Carolina, Georgetown County, South Island, August 19, 1915 (Alexander); Charleston County, McClellanville, August 8, 1915 (Alexander).

Georgia, Charlton County, Okefinokee Swamp, June 20 to 25, 1912 (Bradley).

Florida, Dade County, Miami, December 19, 1912 (Knab).

Santo Domingo, San Francisco Mountains, August, September, 1905 (Busck); the type-locality.

British Guiana, Bartica, January 3, 1913, to January 10, 1913 (Parish).

The wing is shown on Plate XXVI, fig. 21.

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[7] *Entomological News*, vol. 23, pp. 418–420; figs. 3, 4 (1912).

The male hypopygium (Plate XXIX, fig. 63) with the pleurites very elongated, broader at the base, tapering to the obliquely truncated apex which bears on the inner side a single appendage shaped as a curved hook, bent proximad, dorsad and finally cephalad, the apex acute and strongly chitinized. Anal tube broad, pale, bifid by a deep median notch, the adjacent lobes rounded. Penis-guard (*p.gd.*) very elongate, slender, tapering gradually to the acute apex, at the base on the ventral side with an oval fleshy lobe covered with setigerous punctures on the ventral face.

Gonomyia (Leiponeura) manca Osten Sacken.

Gonomyia manca Osten Sacken; Monographs of the Diptera of North America, part 4, pp. 178, 179 (1869).

A rather wide-ranging species throughout the eastern United States:

New York, Fulton County, Sacandaga Park, August 26, 1916 (Alexander).

New Jersey, Essex County, South Orange, June 30, 1868 (Osten Sacken); the type-locality.

Maryland, Montgomery County, Forest Glen, June 1, 1913 (Knab); Plummers Island, August 18, 1912 (Viereck).

District of Columbia, Washington (Coquillett's types of *Dicranomyia curvivena*).

Virginia, Fairfax County, Great Falls, August 23, 1908 (Knab); Difficult Run, July 25, 1915 (McAtee and Alexander); Glencarlyn, May 28 (Banks).

North Carolina, Jones County, Pollocksville, July 8, 1915 (Alexander); Onslow County, Camp Perry, July 9, 1915 (Alexander); Buncombe County, Black Mountains, June 24, 1912 (Beutenmuller).

South Carolina, Charleston County, McClellanville, August 8, 1915 (Alexander).

Georgia, Decatur County, Bainbridge, September, October, 1910 (Bradley).

The wing is shown on Plate XXVI, fig. 22.

The male hypopygium is of the type of *G. puer* Alexander, *G. inermis* Alexander *et al.* It is shown on Plate XXIX, figs. 64, 65; the pleurites are exceedingly elongated, slender, tapering to the narrow apex, the outer face with many long hairs, on the inner face at the apex with a strong bristle; pleurites in a position of rest, decussate. Penis-guard (*p.gd.*) long and slender, acute, tapering to an acute point, subtended on either side by a flattened blade, ending in a triangular black hook that is bent slightly dorsad at the apex.

Subgenus GONOMYELLA Alexander.

Gonomyia (Gonomyella) slossonæ Alexander.

? *Gonomyia slossonæ* Alexander; Proceedings of The Academy of Natural Sciences of Philadelphia, pp. 588, 589, Pl. 27, fig. 26 (1914).

A tropical species that ranges into the southeastern United States:

South Carolina, Georgetown County, South Island, August 19, 1915 (Alexander).

Florida, Seminole County, Sanford, May 7, 1908 (M. C. VanDuzee); Dade County, Biscayne Bay (A. T. Slosson); the type-locality.

Panama, Paraiso, January 29, 1911 (Busck).

Subgenus GONOMYIA Meigen.

The Blanda Group.

Gonomyia (Gonomyia) mathesoni Alexander.

Gonomyia mathesoni Alexander; Entomological News, vol. 26, pp. 170–172, figs. 1–3 (1915).

A species of the northeastern United States and eastern Canada:

Nova Scotia, Truro, July 7 to 26, 1913 (Matheson).

New York, Fulton County, Sacandaga Park, June 12 to 16, 1914 (Alexander), the type-locality; Herkimer County, Indian Castle, June 13, 1915 (Alexander); Cortland County, Taylor, July 20, 1916 (Alexander); Tompkins County, Ithaca, August 24, 1912 (Alexander).

The wing is shown on Plate XXVI, fig. 23.

The hypopygium of the male has been described and figured in the paper cited above.

Gonomyia (Gonomyia) blanda Osten Sacken.

Gonomyia blanda Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 231 (1859).

This handsome fly ranges over the eastern United States:

New Hampshire, Rockingham County, Hampton, July 15, 1907 (S. A. Shaw).

Vermont, Chittenden County, Burlington, June 23, 1906 (Johnson).

Connecticut, New Haven County, East River, July 16 to 20, 1910 (Ely).

New York, Albany County, Albany, June 26, 1912 (D. B. Young); Herkimer County, Trenton Falls, (Osten Sacken), the type-locality; Cortland County, Taylor, July 20, 1916 (Alexander); Tompkins County, Ithaca, July 19, 1912 (Alexander).

District of Columbia, Washington (Osten Sacken); the type-locality.

Virginia, Fairfax County, Falls Church, June 7, 1914 (Shannon).

South Carolina (in the Berlin Museum).

Georgia, Rabun County, Clayton, altitude 2,000 feet, May 18, 1911 (Bradley).

Michigan, Walnut Lake, June 26 to 28, 1907 (Needham).

Colorado, Clear Creek County, June 27, 1915 (Oslar).

The wing is shown on Plate XXVI, fig. 24.

The male hypopygium (Plate XXIX, figs. 68, 69) with the pleurites stout, the outer angle produced caudad into a long, fleshy, finger-like lobe, blunt at the apex, provided with numerous tubercles; ventral pleural appendage (*v*) large, prominent, being chitinized and bifid, the caudal or outer arm longer, slender, the diameter uniform, the apex subacute; cephalic or inner arm shorter, expanded distally into a broad, truncated apex; dorsal pleural appendage (*d*) a subtriangular fleshy lobe whose inner angle is produced into a prominent chitinized curved horn; the cephalic inner margin with about six hair-bearing tubercles. Ninth tergite with the caudal margin transversely concave, not notched medially. Penis-guard very slender.

Gonomyia (Gonomyia) californica Alexander.

Gonomyia californica Alexander; Canadian Entomologist, vol. 48, pp. 324, 325 (1916).

This is the western representative of the *blanda* group:

British Columbia, Peachland, May 19, 1912.

California, Humboldt County, Blue Lake, June 20 to 27, 1907 (Bradley); the type-locality.

The wing is shown on Plate XXVI, fig. 25.

The male hypopygium (Plate XXIX, figs. 66, 67) with the pleurites stout, outer angle produced caudad into a slender, fleshy lobe, pointed at the apex and sparsely provided with setigerous tubercles; ventral pleural appendage (*v*) a two-armed chitinized rod whose outer ventral arm is stout basally, narrowed toward the apex which is again expanded into a blunt tip; the inner arm bends dorsad, slender, tapering into an acute blackened apex; dorsal pleural appendage (*d*) a triangular fleshy lobe provided with long, coarse hairs. Ninth tergite with a deep, narrow, median notch the lateral angles rounded. Penis-guard (*p.gd.*) prominent, the sides subparallel, the apical half on the dorsal surface with numerous hairs, the apex produced ventro-caudad into a prominent median lobule.

The Sulphurella Group.

Gonomyia (Gonomyia) sulphurella Osten Sacken.

Gonomyia sulphurella Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 230 (1859).

A wide-ranging species throughout eastern North America:

Ontario, Fort Erie, May 30, 1911 (M. C. Van Duzee); Point au Barile, Georgian Bay, July 11, 1914 (R. B. Hughes).

Nova Scotia, Truro, July 7 to August 16, 1913 (Matheson).

Maine, Oxford County, Fryeburg, September 5, 1913 (Alexander).

Vermont, Windsor County, Norwich, July 8, 1908 (Johnson).

Connecticut, Middlesex County, Middletown, June 17, 1909 (Johnson); New Haven County, East River, July 11, 1910 (Ely).

Rhode Island, Washington County, Kingston, September 23, 1907 (Johnson).

New York, Fulton County, Sacandaga Park, June 11, 1914, to August 24, 1910 (Alexander); Herkimer County, Trenton Falls (Osten Sacken), the type-locality; Indian Castle, June 13, 1915 (Alexander); Tompkins County, Ithaca, May 13 to August 24, 1912 (Alexander); Westchester County, Tarrytown, June 9, 1914 (Frost); Nassau County, Sea Cliff, August (Banks).

Pennsylvania, Luzerne County, Hazleton, August 30, 1910 (Dietz).

New Jersey, Cumberland County, Shiloh, June 19, 1915 (Alexander).

Maryland, Prince George County, Hyattsville, August 2, 1908 (Knab).

District of Columbia, Washington (Osten Sacken), the type-locality; May 15, 1909 (Knab).

Virginia, Alexandria County, Rosslyn, May 11, 1913 (Knab); Fairfax County, Dead Run, May 21, 1914 (Shannon); Difficult Run, July 25, 1915 (McAtee and Alexander); Glencarlyn, June 28 (Banks).

North Carolina, Onslow County, Camp Perry, July 9, 1915 (Alexander).

Georgia, Rabun County, Clayton, May 20, 1911 (Bradley).

Louisiana, DeSoto County, Logansport, March 24, 1908 (Tucker).

Texas, Collin County, Plano, May, 1907 (Tucker).

The wing is shown on Plate XXVI, fig. 26.

The male hypopygium (Plate XXIX, fig. 70) with the pleurites elongate, the outer angle produced proximad, dorsad and caudad as a very elongate, slender, irregularly curved and feebly chitinized hook which tapers gradually to an acute point; dorsal pleural appendage (*d*) a cylindrical fleshy lobe, narrowed toward the apex which terminates in a bristle; ventral pleural appendage (*v*) bifid, the dorsal arm short, densely provided with short hairs on the inner face; ventral arm very long, slightly curved, blade-like, the tip subacute, the arm directed proximad, decussate with its mate of the opposite side. Penis-guard stout, fleshy, near the apex on the ventral sur-

face, a chitinized, median appendage directed caudad and slightly ventrad, at the acute apex turned strongly dorsad.

The Cognatella Group.

Gonomyia (Gonomyia) flavibasis Alexander.

Gonomyia flavibasis Alexander; Canadian Entomologist, vol. 48, pp. 317–319 (1916).

A western species that is still known only from the type-locality, Monterey County, California, July 18, 1896.

The wing is shown on Plate XXVI, fig. 27.

The male hypopygium (Plate XXX, figs. 76–78) with the pleurites long and slender, the dorsal angle produced caudad as a flattened, fleshy lobe that bears many hairs on the dorsal face; first pleural appendage very long, flattened, the apex bent, the appendage with many long, prominent hairs; second appendage complex, consisting of a chitinized hook that is slightly bent; underneath the base of this hook is a fleshy lobe with several short bristles on the outer face, including two powerful bristles at the apex; above the base of the hook is a slender, subchitinized rod that is darkened at the tip.

Gonomyia (Gonomyia) florens Alexander.

Gonomyia florens Alexander; Canadian Entomologist, vol. 48, pp. 316, 317 (1916).

A fly of cold Canadian conditions in the northeastern United States:

Maine, Penobscot County, Orono, July 12, 1913 (Alexander).

New York, Fulton County, Sacandaga Park, June 18, 1916 (Alexander); Gloversville, June 22, 1916 (Alexander); Herkimer County, Indian Castle, June 9 to 13, 1915 (Alexander), the type-locality; Tompkins County, McLean, June 5, 1916 (Alexander).

The wing is shown on Plate XXVI, fig. 28.

The male hypopygium (Plate XXIX, fig. 71) with the pleurites very short and stout, the inner dorsal angle produced caudad into a blunt fleshy lobe whose inner margin is fringed with numerous long hairs; a short blunt, fleshy knob (*k*) at the base of this lobe, provided with five long hairs on the margin; first pleural appendage (*i*) slender, originating just below the knob (*k*), directed proximad, the base enlarged with two or three stout hairs, the tip slightly bifid, the caudal arm with two bristles, the cephalic arm with one bristle; a stout bristle just before the tip on the inner or cephalic side; second pleural appendage (*2*) a powerful, chitinized hook, slightly curved, directed proximad, bent strongly cephalad toward the apex; third

appendage (*3*) a slender, fleshy rod, beyond the slightly enlarged base bent strongly dorsad so that it lies above the second appendage, directed caudad at the tip which is capped by a short, blunt, chitinized spine. Ninth tergite short, broad, the caudal margin transverse. Ninth sternite with a prominent median knob on the caudal margin, provided with numerous setigerous tubercles.

Gonomyia (Gonomyia) cognatella Osten Sacken.

Gonomyia cognatella Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 230 (1859).

A more southern species than the last, their ranges overlapping in New York State:

Connecticut, New Haven County, East River, July 6, 1910 (Ely).

New York, Fulton County, Sport Island, Sacandaga River, June 18, 1911, to August 26, 1916 (Alexander); Herkimer County, Indian Castle, June 10 to 13, 1915 (Alexander).

Maryland, Montgomery County, Cabin John Bridge, May 16, 1909 (Knab); Plummers Island, May 24, 1914 (McAtee).

District of Columbia, Washington (Osten Sacken); the type-locality.

Virginia, Fairfax County, Difficult Run, July 25, 1915 (McAtee and Alexander).

North Carolina, Buncombe County, Black Mountains, July 16, 1912 (Beutenmuller).

The wing is shown on Plate XXVI, fig. 29.

The male hypopygium (Plate XXIX, figs. 73–75) with the pleurites very short and stout, the inner dorsal angle produced caudad as a slender, finger-like lobe, fimbriate with eight or nine long stout hairs on the dorsal inner edge; at the base of the lobe a small, slender, cylindrical knob (*k*) with three long hairs at the apex; ventrad of this finger-like angle of the pleurite is an elongate, very slender, pale appendage (*2*) directed caudad and slightly ventrad and proximad, at the apex with two long slender hairs; pleural appendage (*3*) directed ventrad on its basal portion, soon bent directly upon itself, dorsad, the tip caudad; the appendage is pale, chitinized, slender, bifid, the lateral arm with the apex somewhat twisted, the proximal arm a slender, pale stylet directed strongly proximad, at the apex with an elongate, slender, black, chitinized spine. Proximad of the base of the knob (*k*) is a slender appendage with a prominent hair at the apex and two slightly smaller subterminal hairs.

The Galactoptera Group.

Gonomyia (Gonomyia) galactoptera Bergroth.

Gonomyia galactoptera Bergroth; Wiener Entomologische Zeitung, vol. 7, p. 196 (1888).

This fly is still known only from the type-locality, Sitka, Alaska. It is the only New World species of this genus that I have not seen.

The Noveboracensis Group.

Gonomyia (Gonomyia) noveboracensis Alexander.

Gonomyia noveboracensis Alexander; Canadian Entomologist, vol. 48, pp. 319, 320 (1916).

A fly of local distribution in the northeastern United States:

New York, Fulton County, Sport Island, Sacandaga River, June 11, 1914 (Alexander), the type-locality.

The wing is shown on Plate XXVI, fig. 30.

The male hypopygium (Plate XXX, figs. 79, 80) with the pleurites prominent, elongate, with the dorsal inner edge with a prominent tubercle bearing several hairs, ventral inner edge with a row of large setigerous tubercles; pleurites bearing three small appendages, a small inner dorsal cylindrical appendage (*a*) directed cephalad, slightly enlarged basally, at the apex bearing three or four prominent hairs; a dorsal apical appendage (*b*) directed proximad, flattened, enlarged at the apex which bears a row of delicate hairs; a slender, subchitinized ventral apical appendage (*c*) directed proximad, slightly toothed at the tip and on the lower side just before the tip. Gonapophyses and the penis-guard (Plate XXX, fig. 80) fused into a very large, prominent, cylindrical tube armed with chitinized horns and fleshy lobes; dorsal surface of the tube with two subpendulous fleshy lobes, approximated on the median line, densely provided with short, pale hairs; horns of the cylinder directed caudad and slightly ventrad; outermost horns (*a*) very broad at the base, tapering to the acute apex which is curved proximad; the next inner pair (*b*) slender, chitinized, bifid at the apex; innermost pair (*c*) longest, slender, slightly twisted, narrowed toward the apex. Ninth tergite with a broad, rounded median concavity. Ninth sternite with a broad V-shaped median notch, the adjacent angles produced caudo-laterad as fleshy lobes provided with numerous setigerous punctures.

The Subcinerea Group.

Gonomyia (Gonomyia) filicauda Alexander.

Gonomyia filicauda Alexander; Canadian Entomologist, vol. 48, pp. 320, 321 (1916).

Still known only from the type-locality, Webster, near Platte Cañon, Colorado, altitude 9,500 feet, August 24 to 26, 1915 (Oslar),

and the base of Haden Peak, Colorado, altitude 12,000 feet, August 10, 1915 (Oslar).

The wing is shown on Plate XXVI, fig. 31.

The male hypopygium (Plate XXV, figs. 81, 82) with the pleurites moderately elongated, the dorsal angle produced caudad and slightly dorsad as an elongated fleshy lobe that is sparsely hairy, the hairs on the dorsal face strong, those on the inner face weak; ventral pleural appendage (*v*) very long, slender, beyond the base slightly expanded, the apical portion slender, slightly expanded toward the tip, dusky in color and provided with an abundance of long, delicate hairs; dorsal pleural appendage (*d*) a short, fleshy lobe whose caudal margin is produced into a powerful, curved, heavily chitinized hook, directed inward and dorsad; at the tip of the fleshy portion of the lobe are two stout hairs and a group of about eight smaller ones. Penis-guard pale in color, simple, slender, from an enlarged base, the apex split by a deep rounded notch.

Gonomyia (Gonomyia) subcinerea Osten Sacken.

Gonomyia subcinerea Osten Sacken; Proceedings of The Academy of Natural Sciences of Philadelphia, p. 231 (1859).

This is apparently the commonest and most widely distributed species of the genus. It seems to be dimorphic or else there are two very closely allied forms that often occur together, one of which is sulphur-yellow and brown as described for this species, the other much more grayish and more restricted in its distribution than the typical form.

Ontario, Kearney, July 27, 28, 1911 (M. C. Van Duzee); Ottawa, August 13, 1912.

Quebec, Gatineau, July (Beaulieu); Aylmer, June (Beaulne).

Maine, Aroostook County, Fort Kent, August 28, 1913 (Osborn); Piscataquis County, Mt. Katahdin, August 22, 1913 (Alexander); Penobscot County, Orono, June 8 to September 7, 1913 (Alexander); Hancock County, Ellsworth, July 10 to August 16, 1913 (Stanwood).

Vermont, Windham County, Brattleboro, July 15, 1908 (Johnson).

Massachusetts, Middlesex County, Riverside, August 9 (Johnson); Auburndale, August 16 (Johnson).

Connecticut, Middlesex County, Middletown, June 16, 1909 (Johnson); New Haven County, East River, July 3, 1910 (Ely).

New York, Fulton County, Sacandaga Park, June 1, 1914 (Alexander); Gloversville, June 3, 1914 (Alexander); Herkimer County, Trenton Falls (Osten Sacken), the type-locality; Indian Castle, June 9 to 13, 1915 (Alexander); Onondaga County, Green

Lake, June 8, 1915 (Alexander); Tompkins County, Ithaca, May 13 to August 7, 1910; Albany County, Albany, June 26, 1912 (Young); Helderberg Mountains, June 12, 1915 (Alexander); Rockland County, West Nyack, June 15, 1912 (W. Sheffield); Westchester County, Tarrytown, June 9, 1914 (Frost).

New Jersey, Bergen County, Ridgewood, July, 1911 (Leonard); Mercer County, Princeton, June 18, 1915 (Alexander).

Maryland, Montgomery County, Forest Glen, July 6, 1914 (McAtee); Plummers Island, May 26, 1914 (Shannon).

District of Columbia, Washington (Osten Sacken); the type-locality.

Virginia, Alexandria County, Rosslyn, May 11, 1913 (Knab); Fairfax County, Four-mile Run, July 13, 1912 (Knab).

North Carolina, Buncombe County, Black Mountains, June 13, 1912 (Beutenmuller); Jones County, Pollocksville, July 8, 1915 (Alexander).

Michigan, Walnut Lake, June 26–28, 1907 (Needham).

Saskatchewan, Farewell Creek, September (Mrs. V. A. Anthony).

Missouri, St. Louis County, West St. Louis, May 12, 1914 (W. V. Warner).

Kansas, Pottawatomie County, Onaga (Crevecœur).

Montana, Beaver Creek, altitude 6,300 feet; August, 1913 (Hunter).

The wing is shown on Plate XXVI, fig. 33.

The male hypopygium (Plate XXVI, figs. 83–85) with the ninth pleurite elongate, rather slender, the dorso-lateral angle produced caudad in a slender, fleshy lobe that is provided with numerous long hairs; ventral pleural appendage (*v*) a long, slender, pale brown lobe that is almost straight, slightly expanded toward the blunt apex, provided with numerous setigerous punctures; dorsal pleural appendage (*d*) two-lobed, the caudal lobe a powerful, heavily chitinized, curved spine that is directed cephalad at its tip, provided with two or three small, acute denticles before the apex; the ventral arm is again bifid, the caudal portion a sharp, chitinized, feebly curved spine, the cephalic portion a small, subfleshy lobe with several hairs and short spines. Penis-guard very elongate, pale, narrowed at the apex, at the base on either side with a subtending, slender, subchitinized rod that is more or less flexible.

Gonomyia obscura Doane[8] is unrecognizable; the type in the National Museum is a broken female that is close to *subcinerea*, although its

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[8] Journal of the New York Entomological Society, vol. 8, p. 192, Pl. 8, fig. 7 (1900), described as a *Phyllolabis*.

type-location (Pullman, Whitman County, Washington, June 22, 1898) is outside of the range of that species as now known.

Gonomyia (Gonomyia) æqualis Alexander.

Gonomyia æqualis Alexander; Canadian Entomologist, vol. 48, pp. 323, 324 (1916).

An extra-limital species (Guatemala, Central America) whose hypopygium has never been figured.

Male hypopygium (Plate XXX, fig. 86) with the pleurites moderately stout, the dorsal angle produced caudad as a very slender, finger-like lobe that is provided with numerous setigerous tubercles; at the base of this lobe on the inner side is a tiny fleshy protuberance directed proximad; ventral pleural appendage (*v*) a pale fleshy lobe densely covered with short, pale hairs; dorsal pleural appendage (*d*) irregular, fleshy, directed proximad, the caudal or outer face near the apex with a strong, curved, chitinized hook that is directed dorsad and cephalad, the cephalic or inner face with a row of strong bristles, at the tip longer and more approximated. Ninth tergite almost straight across or slightly concave. Penis-guard rather long, compressed, the median appendage pale, slightly curved. Anal tube (*a.t.*) broad, prominent, subtended on either side by a concave wing bearing on the caudal outer angle a fimbriate tuft of yellow bristles.

Gonomyia (Gonomyia) virgata Doane.

Gonomyia virgata Doane; Journal of the New York Entomological Society, vol. 8, p. 189, Pl. 7, fig. 21 (1900).

A western species with the following rather restricted range:

Washington, Pacific County, Tokeland (Doane), the type-locality.

California, Humboldt County, Eureka, June 6, 1903 (H. S. Barber).

The wing is shown on Plate XXVI, fig. 32.

The male hypopygium (Plate XXX, fig. 87) with the ninth pleurites rather elongate, the dorsal inner angle produced caudad as a slender, cylindrical, fleshy lobe that bears numerous long pale hairs; ventral pleural appendage (*v*) prominent, directed caudad, narrowed at the base, the apex a slight chitinized tooth directed proximad; second pleural appendage (*2*) a flattened or concave lobe, heavily chitinized at the apex which is broad, split into two acute teeth, of which the proximal one is the larger; dorsal pleural appendage (*d*) small, fleshy, bent slightly cephalad at the tip which bears two elongate bristles; cephalic or inner face of the appendage bearing numerous setigerous tubercles. Ninth tergite large, the caudal margin feebly convex, bearing a short, pointed tooth just inside the base of the pleurite.

Ninth sternite almost straight across, or slightly narrowed to the truncated apex.

Gonomyia (Gonomyia) unicolor Alexander.

Gonomyia unicolor Alexander; Proceedings of the United States National Museum, vol. 44, p. 507, Pl. 66, fig. 15 (1913).

An extra-limital species (Guatemala, Central America) included here to complete the data.

The male hypopygium (Plate XXX, fig. 89) with the pleurites moderately stout and elongated, the dorsal angle not produced; ventral pleural appendage (*v*) a double lobe, dark colored, subchitinized, the inner arm stout-cylindrical with the tip acute and the inner side with two or three hairs; the outer and more ventral arm slender, curved and bearing near the tip two stout divergent hairs; dorsal pleural appendage (*d*) a subcylindrical fleshy lobe from an enlarged base, at the apex with two powerful bristles; cephalic or inner face with four small hairs that are evenly spaced. Ninth tergite almost straight across or slightly concave. Penis-guard (Plate XXX, fig. 88) seen from beneath, a powerful, quadrangular chitinized base whose caudal angle is a ventrally directed hook, the base subtended on either side by short gonapophyses (*g*) that end in a sharp, conical spine; from above and dorsad of the quadrangular base arise two cylindrical, pointed, chitinized arms that are divergent.

Gonomyia (Gonomyia) mexicana Alexander.

Gonomyia mexicana Alexander; Canadian Entomologist, vol. 48, pp. 321, 322 (1916).

An extra-limital species described from Cordoba, State of Vera Cruz, Mexico, May 8, 1908 (Knab).

The male hypopygium (Plate XXX, fig. 91) with the pleurites elongate, though rather stout; ventral pleural appendage (*v*) a long, pale lobe, subcylindrical, blunt at the apex and bearing sparse, elongate hairs; second pleural appendage strongly chitinized, the tip acute, curved; dorsal pleural appendage (*d*) rather short, cylindrical, fleshy, the cephalic or inner angle of the apex with two powerful bristles; caudal or outer angle of the apex with two smaller hairs. Ninth tergite rather short, the caudal margin straight or nearly so. Penis-guard (Plate XXX, fig. 90) very long and pale, the apex bifid by a deep U-shaped notch, each lobe provided with long hairs; on the ventral face arises a slender, rod-like, median appendage, sparsely short-hairy at the apex and down the ventral face; the divergent subtending arms are slender, somewhat flattened, the apex produced

into a slender cylindrical point, the outer or ventral margin with a few sharp, appressed teeth.

RHABDOMASTIX Skuse.

Rhabdomastix Skuse; Proceedings of the Linnæan Society of New South Wales, series 2, vol. 4, pp. 828, 829 (1889).

Subgenus SACANDAGA Alexander.

Rhabdomastix (Sacandaga) monticola sp. n.

Coloration grayish black; wings whitish hyaline with an indistinct pale brown stigma; cross-vein *r* present but faint; cell R_2 small; cell *1st* M_2 elongate with the basal deflection of Cu_1 inserted at about mid-length.

Male.—Length about 5.5 mm.; wing, 6 mm.

Rostrum and palpi dark brownish black. Antennæ black, the flagellar segments with a long, pale pubescence; flagellar segments narrowed, especially terminally. Head black with a sparse grayish bloom.

Mesonotum black with a sparse grayish yellow pollen; tuberculate pits on the extreme cephalic margin of the sclerite. Pleura clearer gray. Halteres pale, the knobs enlarged, the stem a little darkened basally. Legs with the coxæ black with a sparse gray bloom; trochanters brown; femora dark brown; tibiæ yellowish brown, a little darkened at the base and more narrowly at the tips; tarsal segment one and all except the tip of two yellowish brown; remainder of the tarsi dark brown. Wings subhyaline, the stigma fairly distinct, oval, pale brown; veins dark brown, *Sc* paler. Venation (Plate XXVII, fig. 41) with *Rs* elongate; cell R_2 small, vein R_2 being short, oblique; R_3 arcuated; cross-vein *r* present but very indistinct, bisecting the stigma; cell *1st* M_2 rectangular, somewhat elongated, the veins issuing from it not elongated, divergent; basal deflection of Cu_1 almost mid-length of cell *1st* M_2.

Abdomen dark brownish black.

Habitat.—Western America.

Holotype, ♂, Kokanee Mountain, British Columbia, altitude 8,000 feet, August 11, 1903 (R. P. Currie).

Paratopotypes, 3 ♂'s.

Type in the collection of the United States National Museum.

This species was formerly determined as being *R.* (*S.*) *caudata* Lundbeck[9] in the first part of this series, but additional material

[9] Diptera gröenlandica, Vidensk. Meddel. fra den naturh. Foren., p. 267, Pl. 6, fig. 18 (1898); as a *Goniomyia*, subgenus *Empeda*.

shows that the species is distinct. It serves to connect the generalized *caudata* with the specialized members of the subgenus (*flava*, *parva*). The small cell R_2 and the elongate cell *1st* M_2 with the short, divergent veins issuing from it, and the basal deflection of Cu_1 inserted at nearly midlength of it serve to separate the form from *caudata*. This latter species is described and figured in a publication that is not readily accessible to the student, and its venation is shown on Plate XXVII, fig. 42. With *caudata* this new species agrees in the possession of the radial cross-vein, but this is here very faint and evidently in process of being eliminated. In *R. flava* (Plate XXVII, fig. 43) the cross-vein is lacking.

In regard to the genus *Rhabdomastix* Skuse it will be noted that Kertesz gives the date of Skuse's paper on the Limnobinæ as 1890; the first separates of this article are dated September 25, 1889, and it is this date that has been adopted.

PTEROCHIONEA gen. n.

Palpi short, four-segmented, the segments subequal. Antennæ 11-segmented, the first segment of the scape longer than the second; second segment narrow-subglobular, not strikingly wider than the adjacent segments; first segment of the flagellum elongate, tapering slightly to the tip, formed by the fusion of five segments as determined by the verticils, near the tip with a faint suture that passes about half-way across the segment on the verticillate side; segments four to ten moderately elongated, cylindrical, truncated at both ends (Plate XXXI, fig. 93) with a strong series of verticils; terminal segment formed by the fusion of two segments as determined by the verticils. Wings moderately broad (Plate XXVII, fig. 44); *Sc* moderately elongated ending just beyond the end of *Rs*, Sc_2 at its tip; *Rs* long, strongly arcuated at its origin; cross-vein *r* present; cell *1st* M_2 elongate, the deflection of M_3 over twice the length of the median cross-vein; cell M_1 present; basal deflection of Cu_1 at the fork of *M*; second anal vein short, ending before the origin of the sector. Legs hairy, not incrassated; tibiæ without spurs. Male hypopygium powerful (Plate XXXI, fig. 94), suggesting the *Chionea* type, the pleural pieces stout, cylindrical, with a strong pleural appendage, somewhat curved, nearly as long as the pleurites; ventral lobe small, rounded, hairy.

Genotype.—Pterochionea bradleyi sp. n. (Western Nearctic region.)

This new genus is closest to *Crypteria* Bergroth[10] of the northern Palæarctic region in the curious fusion of the five basal segments of

[10] *Acta Soc. pro Faun. et Flor. Fenn.*, vol. 37, No. 6, pp. 3–7, figs. 1–4 (1913).

the antennæ; however, this fusion-segment is merely elongated and does not show the elongate-conical shape of the segment in *Crypteria* and the even more accentuated condition of *Chionea*. Specimens of *Chionea valga* Harris before me show eight flagellar segments beyond the fusion-segment, the basal ones short, becoming more and more attenuated toward the tip of the organ. Therefore, in the reduction of the antennal segments by the fusion of the basal flagellar segments, *Chionea* also shows a very close relationship to *Crypteria* and *Pterochionea*. I certainly think that Bergroth is right in surmising a relationship between his *Crypteria* and the abnormal, wingless *Chionea*, and *Pterochionea* may now be added to the list of possible *Chionea*-precursors. This interpretation would remove *Chionea* from the neighborhood of *Trimicra* and *Symplecta* and place it at the end of the Eriopterine series along with *Cladura* and the present genus.

The two winged genera of this group may be separated as follows:

1. Antennæ with the second segment enlarged, globular; the two apical segments of the flagellum entirely distinct; cross-vein *r* absent; second anal vein very elongate, extending beyond midlength of the radial sector; hypopygium with the pleural pieces slender with two small, subequal appendages. (Northwestern Palæarctic.).....*Crypteria* Bergroth.

   Antennæ with the second segment not enlarged; the two apical segments of the flagellum fused; cross-vein *r* present; second anal vein short, not reaching to the base of the sector; hypopygium with the pleural pieces stout-cylindrical with a strong, powerful dorsal appendage that is almost as long as the pleurite. (Northwestern Nearctic.).....*Pterochionea* gen. n.

Pterochionea bradleyi sp. n.

Antennæ brown, of eleven segments; wings with cell M_1 present; male hypopygium strong and powerful.

Male.—Length, 5 mm.; wing, 5.6 mm. Fore leg, femur, 3.6 mm.; tibia, 3.8 mm.; hind leg, femur, 4.1 mm.; tibia, 4 mm.

The species is described from alcoholic material.

Rostrum short, light brown; palpi brown. Antennæ dark brown; Head yellowish brown.

Thoracic dorsum dull yellow with indistinct darker stripes on the præscutum. Pleura yellowish. Halteres pale. Legs with the coxæ and trochanters pale yellow; femora light brownish yellow, a little darkened apically, the fore femora darker, being only a little paler at the base; tibiæ and tarsi brown. Wings nearly hyaline, the stigma indistinct; veins dark brown, subcosta pale. Venation (Plate

XXVII, fig. 44): basal deflection of R_{4+5} very short or obliterated, the cross-vein *r-m* being correspondingly longer, arcuated; cell M_1 short, about one-half as long as its petiole.

Abdomen short, the tergites dark brown, the hypopygium even darker. Male hypopygium (Plate XXXI, fig. 94) powerfully enlarged, the pleurites not conspicuously elongated ending in a rounded ventral lobe that is covered with numerous hairs; the single pleural appendage a powerful curved arm that is rather blunt at the tip, with numerous long hairs on the inner face and at the apex where they are exceedingly numerous and spinous, at the extreme apex very tiny.

Habitat.—British Columbia.

Holotype, ♂, Rogers Pass, British Columbia, August 9, 1915 (Bradley).

Allotype, ♀, in copula with the type.

Type, mounted in balsam, in the collection of Cornell University.

This interesting crane-fly is dedicated to the collector, Dr. J. Chester Bradley, of Cornell University, to whom I am indebted for assistance and advice upon many subjects.

Tribe **Limnophilini.**

LIMNOPHILA Macquart.

Limnophila Macquart; Suit a Buffon, vol. 1, Histoire Naturelle Dipteres, p. 94 (1834).

Limnophila irrorata Johnson.

Limnophila irrorata Johnson; Proceedings of the Boston Society of Natural History, vol. 34, No. 5, pp. 127, 128, Pl. 16, fig. 17 (1909).

This interesting species was described from the unique female found floating dead in a water receptacle at Riverton, New Jersey, and had apparently not been found since that time. The fly was rediscovered in 1915 while the author was searching for Venus fly-traps, *Dionæa muscipula* Ell., near Jacksonville, North Carolina. The male sex is here described and the specimen made the allotype:

Male.—Length 7.6–7.8 mm.; wing, 7–7.3 mm. Agrees closely with the female, but the head a little more brownish; petiole of cell R_2 of the wings very short, not as long as the *r-m* cross-vein; basal deflection of Cu_1 inserted beyond mid-length of cell *1st* M_2.

Allotype, ♂, Camp Perry, Onslow County, North Carolina, July 9, 1915 (Alexander).

Allotype in the collection of the author.

The following notes on the natural habitat of the species may be given:

At Camp Perry, Onslow County, North Carolina, July 9, 1915, on a small branch of the New River. The flies occurred in a typical sweet-gum swamp, the dominant forest cover being the *Liquidambar*, *Ilex opaca*, *Quercus michauxi*, *Acer rubrum*, *Fraxinus* sp., with considerable *Liriodendron* and a little *Pinus tæda*, growing in very wet to moist soil, and the undergrowth was very rank and luxuriant, consisting of the all-dominant lizards-tail, *Saururus cernuus*, from which plant the flies were swept; other plants, as *Osmunda regalis*, *Onoclea sensibilis*, *Carpinus caroliniana* and *Callicarpa americana*, being common. The following crane-flies were associated with this species:

Gonomyia sulphurella, rare; *G. manca*, common; *Gnophomyia tristissima*, uncommon; *Epiphragma solatrix*, rare; *Limnophila macrocera*, uncommon; *L. tenuipes* and *luteipennis* abundant; *Penthoptera albitarsis*, common; *Brachypremna dispellens*, abundant, many being heavily infested with a species of *Trombidium*; *Oropeza subalbipes*, rare; *Tipula tricolor*, common; *T. perlongipes*, rare; *Bittacomorpha clavipes* and *Ptychoptera rufocincta*, common.

It should be here noted that there is a *Polymoria irrorata* Philippi[11] that in all probability is a *Limnophila* and prior to the present species. This apparent status of *Polymoria* has been pointed out by the author in another paper.[12]

Limnophila strepens sp. n.

Head light gray with short, brown hairs; thorax yellowish brown with a darker median stripe on the præscutum; legs brownish-yellow, the femora and tibiæ not darkened at their apices.

Male.—Length, about 12 mm.; wing, 11.8 mm.

Rostrum and palpi dark brown. Antennæ short, light brown, the flagellar segments gradually narrowed and lengthened toward the tip of the organ; verticils long, black. Head light gray with numerous, rather short brown hairs, inserted in blackish punctures.

Mesonotum light yellowish brown with a broad darker reddish brown median stripe; lateral stripes indistinct; lobes of the scutum reddish brown, their posterior margin and the scutellum more yellowish; postnotum pale reddish with a sparse gray bloom. Pleura reddish brown with a sparse gray bloom. Halteres pale, the knobs darker at their tips. Legs with the coxæ reddish yellow; trochanters dull yellow; femora and tibiæ brownish yellow throughout; tarsi

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[11] *Verh. zool.-bot. Ges. Wien.* vol. 15, p. 608, Pl. 23, fig. 3 (1865).
[12] *Proc. U. S. National Museum*, vol. 44, pp. 481, 490 and 547 (1913).

brown. Wings subhyaline, costal region more yellowish; apex of the wing broadly but indistinctly darkened; stigma prominent, dark brown; a pale brown seam on the deflection of R_{4+5}. Venation: *Rs* moderate in length, somewhat angulated at its origin; R_{2+3} about equal to or a little shorter than that portion of R_2 before the radial cross-vein; *r* at the tip of R_1; basal deflection of Cu_1 under the middle of cell *1st* M_2.

Abdominal tergites dull yellow, unmarked; sternites a little lighter yellow, the eighth segment and the caudal portions of the seventh a little more brownish.

Habitat.—Western United States.

Holotype, ♂, Marin County, California (Coll. Hy. Edwards, No. 814).

Type in the collection of the American Museum of Natural History.

Related to *flavipila* Doane which has the hairs on the head longer and light yellow in color, the mesonotum darker brown, the pleura light gray, the tips of the femora and tibiæ dark brown, wings with a more yellowish tinge, especially near the costa, R_{2+3} much shorter than that portion of R_2 before the radial cross-vein. In *flavipila* the head and first antennal segment are light gray, not brown as described by Doane.

Limnophila edwardi sp. n.

Antennæ elongated; cell M_1 of the wings absent; thorax with dark stripes on the præscutum.

Male.—Length, 7.2 mm.; wing, 8 mm.; antennæ about 5 mm.

Rostrum dull yellow, the palpi brownish black. Antennæ dark brown, the flagellar segments greatly elongated with outspreading pubescence. Head dark brownish black with a sparse grayish bloom.

Thorax brownish yellow, the præscutum with three broad, dark brown stripes, the middle one broadest, confluent behind with the short lateral stripes; scutum, scutellum and postnotum dark brown. Pleura brownish yellow. Halteres pale, the knobs darker, brown. Legs with the coxæ, trochanters and bases of the femora dull yellow; remainder of the legs dark brown. Wings with a faint brownish tinge; stigma elongate-oval, dark brown; veins dark brown. Venation (Plate XXVII, fig. 45): *Rs* elongate, in a line with R_{2+3}; R_{2+3} longer than the basal deflection of Cu_1; cross-vein *r* at the fork of R_{2+3}; cell M_1 lacking.

Abdomen dark brown, the hypopygium more yellowish.

Habitat.—Northeastern United States.

Holotype, ♂, Simmons Woods, Gloversville, Fulton County, New York, altitude 900 feet, June 22, 1916 (Alexander).

This is the first Eastern species that has the antennæ elongated and cell M_1 of the wings lacking at the same time. It bears a great resemblance to *L. tenuipes* Say, a species with cell M_1 present and the venational details slightly different.

The type was taken in a cold woods with decided Canadian floral tendencies, in association with the following Tipulidæ:

Dicranomyia pubipennis, Ormosia monticola, O. rubella, Erioptera stigmatica, Gonomyia florens, Limnophila toxoneura, L. areolata, L. alleni, L. fuscovaria, L. munda, Adelphomyia minuta, Ula elegans, Rhaphidolabis rubescens, Tricyphona calcar, Tipula oropezoides, T. hermannia and *T. monticola.*

I dedicate this species to Thomas Edward, the eminent Scotch naturalist, the story of whose life and struggles[13] in the interests of natural science has always done much to encourage me in this work.

Limnophila sylvia sp. n.

Antennæ short; cell M_1 of the wings absent; thorax with dark stripes on the præscutum; pleura without stripes.

Male.—Length, 5–5.5 mm.; wing, 6.5–7.6 mm.

Rostrum brownish yellow, the palpi dark brown. Antennæ short, the scapal segments dull yellow, flagellum dark brown; flagellar segments oval. Head brown with a sparse grayish bloom.

Thorax dull light yellow, the præscutum with three dark brown stripes, the lateral stripes confluent with the median stripe; scutum yellow with the lobes largely dark brown; scutellum yellow; postnotum brownish yellow. Pleura yellow. Halteres pale, the knobs brownish. Legs with the coxæ and trochanters dull yellow; femora dull yellow, the tips darker brown; tibiæ yellowish brown, tipped with brownish; metatarsi brownish yellow, the remainder of the tarsi dark brown. Wings with a slight grayish tinge; stigma rather indistinct, brownish; veins dark brown. Venation (Plate XXVII, fig. 46): R_{2+3} rather elongated, about equal to the basal deflection of Cu_1; cross-vein r at the tip of R_1 and situated on R_2; deflection of R_{4+5} arcuated, nearer the wing-root than is the r-m cross-vein; cell M_1 absent; basal deflection of Cu_1 variable in position, at the fork of M, just beyond the fork of M to about one-third the length of the cell *1st* M_2.

Abdominal tergites dark brown; sternites dull brownish yellow,

[13] Life of a Scotch Naturalist: Thomas Edward, associate of the Linnæan Society, by Samuel Smiles (Harper & Bros., 1877).

the caudal margins a little brighter; eighth and ninth sternites dark brown.

Habitat.—Northeastern United States.

Holotype, ♂, Mountain Lake, Fulton County, New York, altitude 1,600 feet, June 13, 1916 (Alexander).

Paratopotypes, 2 ♂'s.

Type in the collection of the author.

This species was associated with *Erioptera nyctops,* and an account of the ecological conditions and associates will be found under the account of that species.

L. sylvia is quite distinct from any of the described species that lack cell M_1 of the wings. From the *quadrata* group it differs in having vein R_2 long, not tending to be oblique, deflection of R_{4+5} nearer the wing-root than is *r-m,* basal deflection of Cu_1 nearer to the base of cell *1st* M_2, etc.; from the *lenta* group it differs in the long sector; from *emmelina,* it differs in the petiolate cell R_2, and from *noveboracensis* it differs in having *Rs* almost in a line with R_{2+3}, the dark brown stripes on the præscutum, etc.

POLYMERA Wiedemann.

Polymera Wiedemann; Diptera exotica, vol. 1, p. 40 (1821).

Polymera georgiæ Alexander.

Polymera georgiæ Alexander; Psyche, vol. 18, pp. 199, 200, Pl. 16, fig. 5 (1911).

This is the only known species of the genus as yet found within our limits and, so far as known, it is confined to the southeastern United States. *P. obscura* Macquart, of northern South America and Middle America, ranges into Cuba and may appear in the Miami section of Florida. *P. geniculata* Alexander of Porto Rico is also regional. The distribution of *Polymera georgiæ* is as follows:

South Carolina, Georgetown County, South Island, August 19, 1915 (Alexander).

Georgia, Decatur County, Spring Creek, July 20, 1912 (Bradley); Glynn County, St. Simons Island, April, May, 1911 (Bradley), the type-locality; Charlton County, Billy's Island, Okefinokee Swamp, June 20, 1912 (Bradley).

Florida, Dade County, Biscayne Bay (Slosson).

The only specimen that I have ever seen alive was taken in a salt-marsh palmetto association on South Island, South Carolina, at the east end of the causeway between South and Cat Islands. The association was a palmetto island surrounded on the west by a perfect sea of the salt rush (*Juncus Roemerianus*). The forest cover con-

sisted of the dominant palmetto (*Sabal Palmetto* (Walt) R. & S.), live oak, *Quercus virginiana*, heavily draped with spanish moss, *Tillandsia*, and the coast white cedar, *Chamæcyparis thuyoides*. The shrubbery consisted of a mixed growth of *Myrica carolinensis*, common; *Ilex vomitoria*, several; *Callicarpa americana*, abundant, and two shrubby Composites, *Iva frutescens* and *Borrichia frutescens*, common. The undergrowth from which the Tipulids were swept consisted of great beds of *Polygonum punctatum*, with a more sparse admixture of spike grass, *Distichlis spicata; Hydrocotyle umbellata;* and the Verbenaceous plants, *Lippia nodiflora* and *Verbena caroliniana*.[14]

The Tipulidæ of the above floral association showed a strong Floridian tendency, the associates of *Polymera* being as follows:

Dicranomyia distans, abundant; *D. floridana*, rare; *Teucholabis carolinensis*, rare; *Gonomyia* (*Leiponeura*) *puer*, rare; *G.* (*Gonomyella*) *slossonæ*, several; *Erioptera* (*Mesocyphona*) *parva*, abundant, and *Brachypremna dispellens*, common.

Tribe Pedicini.

TRICYPHONA Zetterstedt.

1838. *Tricyphona* Zetterstedt; Insecta Lapponica, Dittera, p. 851.

This genus, like the tribe *Pedicini* in general, has a northern distribution throughout the world. There are seven species now known in the eastern United States which may be summarized as follows:

Tricyphona inconstans Osten Sacken. (Plate XXVIII, fig. 47.)

Canadian and Transitional-Canadian zones of the eastern United States and Canada. One of our commonest and best-known crane-flies, ranging from Ontario, Quebec and Newfoundland south (in the mountains) to Georgia and west to Michigan. It is also recorded from Europe, but a very careful comparison with abundant material and a critical study of the male hypopygium must be made before these records can be finally accepted. The fly is abundant in swamps and low swales. In New York and New England it is on the wing from May 12 to September 28, while in the vicinity of Washington it appears even earlier (Great Falls, Virginia, April 20, 1913 (Knab)).

Tricyphona calcar Osten Sacken. (Plate XXVIII, fig. 48.)

Canadian life-zone of northeastern America, ranging from the Hudsons Bay region, Ontario and Quebec south (in the mountains)

[14] I am indebted to Mr. W. L. McAtee, of the United States Biological Survey, for his kindness in determining many of the above-listed plants.

to North Carolina. It is a species of low swampy areas, though usually more wooded than that frequented by *inconstans*. In New York and New England it flies from May 22 to October 1, being abundant in late May and early June, reappearing the latter half of July and being common throughout August and early September. The late summer specimens probably represent a new species, the females having the wings very reduced in size.

Tricyphona auripennis Osten Sacken. (Plate XXVIII, fig. 49.)

Canadian life-zone of the northeastern United States, known only from New Hampshire, Massachusetts (the type-locality) and New York. It flies in June. The only specimens ever seen alive by the author occurred at Indian Castle, Herkimer County, New York, June 10 to 13, 1915; they were found sitting motionless on the perpendicular face of a small cliff, lurking in small crevices of the rock. The cliff is low, of Utica shale, completely saturated by percolating water and well-shaded by large hemlocks, arbor vitæ, yellow birch, mountain maple, *Cornus circinata*, etc., and with a sparse vegetation of *Impatiens biflora*, *Geranium Robertianum*, *Collinsonia canadensis*, *Cystopteris bulbifera* and *Equisetum arvense*.

Tricyphona hyperborea Osten Sacken. (Plate XXVIII, fig. 50.)

A fly of the Hudsonian and possibly the Canadian life-zones of northeastern America and still very rare in collections. It was described from Labrador, and a few specimens have been taken on Mt. Washington, New Hampshire; these specimens are in the collections of the Boston Society of Natural History and the United States National Museum.

Tricyphona katahdin Alexander. (Plate XXVIII, fig. 51.)

Canadian life-zone of the northeastern United States, a late summer species flying during the latter half of August.

Tricyphona vernalis Osten Sacken. (Plate XXVIII, fig. 52.)

Canadian and Canadian-Transitional zones of the northeastern United States. One of our early-flying species, though appearing later, as a rule, than *paludicola*. It ranges from Maine and New Hampshire south (in the mountains) to Georgia, and is found along small streams, temporary and permanent, where the water runs rapidly. The flies may be swept from vegetation or are found in small swarms of eight to ten individuals near the water. In New York and New England it is on the wing in late May, abundant in June and persisting into July. Further south it flies in April or even the last of March, reappearing in late September.

Tricyphona paludicola sp. n. (Plate XXVIII, fig. 53.)

Canadian-Transitional life-zone of the northeastern United States, as yet known only from New York. It flies in early spring (May 7–20), and is found in swampy, stagnant localities.

Tricyphona paludicola sp. n.

Antennæ dark brown throughout; head and thorax grayish brown, the mesonotal præscutum with three dark brown stripes, the middle one split by a broad line of the ground-color; abdomen brown, the tergites uniform in color; wings almost unicolorous, the dark markings reduced to punctiform dots and narrow seams.

Male.—Length, 7.6–8 mm.; wing, 8.6–8.7 mm.

Female.—Length, 10.5–10.9 mm.; wing, 10.5–10.8 mm.

Rostrum and palpi dark brown. Antennæ black, the flagellar segments shortened and gradually narrowed. Head grayish brown.

Mesonotal præscutum pale grayish brown with three dark brown stripes, the middle stripe very broad and more or less bisected by a narrow, median vitta of the ground-color, lateral stripes short, narrow; scutum gray, the lobes with a rounded dark brown spot; scutellum and postnotum light gray. Pleura light gray, the dorsopleural membranes pale brown. Halteres light brown, the knobs dark brown. Legs with the coxæ reddish, gray pruinose; trochanters brownish yellow; femora dark brown, the fore pair with the basal quarter a little brightened, middle pair with the basal third, hind pair with about the basal half brightened; tibiæ and tarsi dark brown. Wings grayish subhyaline, the costal cells more suffused, brownish yellow; tiny dark brown dots at Sc_2, origin of Rs, tip of Sc_1, cross-vein r, above the fork of Rs, cross-vein r-m and a narrow seam along the basal deflection of Cu_1; paler gray clouds underneath the tip of R_{2+3} and near the tip of *2nd A*; veins dark brown, Sc more yellowish. Venation (Plate XXVIII, fig. 53): distance between Sc_2 and the origin of the sector about equal to the sector alone; Rs angulated and often spurred at origin; r at the tip of R_1; distance between the fork of Rs and cross-vein r-m about equal to that cross-vein; petiole of cell R_3 a little longer than r-m; cell *1st* M_2 closed, long and narrow; cell M_1 present, usually longer than its petiole; cross-vein m-cu present or barely obliterated by the fusion of the adjacent veins.

Abdominal tergites dark grayish brown; sternites similar with the basal segments indistinctly ringed with paler; hypopygium concolorous with the rest of the abdomen; valves of the ovipositor brownish yellow.

Habitat.—Northeastern United States.

Holotype, ♂, McLean, Tompkins County, New York, May 13, 1916 (Alexander).

Allotype, ♀, with the type.

Paratopotypes, 24 ♂'s, 1 ♀; 1 ♂, 1 ♀, on May 20, 1916 (P. A. Claassen).

The type is in the collection of the author; Mr. Claassen has deposited his paratypes in the collection of the University of Kansas.

As is very frequent in this genus of flies, abnormalities of the wing-venation often occur; one male specimen has cell *1st* M_2 open by the atrophy of the median cross-vein in both wings; four other males in the series show adventitious cross-veins or spurs in various cells of the wings.

When Osten Sacken described *Tricyphona vernalis*,[15] he had only a male and a female specimen from Washington, D. C., taken in April, these showing the pale antennal bases, cingulated abdomen and heavily patterned wings that are characteristic of *vernalis*. The specimens from the White Mountains, New Hampshire, were added in the Monographs, p. 271. I am greatly indebted to Mr. C. W. Johnson for his kindness in examining the types of *vernalis* and making notes upon them. Abundant material that I have determined as *vernalis* agree in all details with Osten Sacken's descriptions, except that the capillary median ground vitta on the præscutum is less distinct than the description implies.

The gray or brownish gray species of this section of *Tricyphona* may be separated by the following key:

1. Scape of the antennæ yellowish or brownish yellow, the flagellum much darker, dark brown; abdominal tergites brown, the margins of the segments pale producing a cingulated appearance; wings with large rounded clouds at the tips of the longitudinal veins and along the cross-veins..... *vernalis* Osten Sacken.

   Scape of the antennæ dark brown, concolorous with the flagellum; abdominal tergites brown, unbanded; wings with the pattern almost obsolete, reduced to tiny dots and seams..... *paludicola*, sp. n.

The following ecological notes on *Tricyphona paludicola* are taken from my field notes, dated May 13, 1916, 10–11 A.M., at the McLean bogs where we were engaged in making a biological survey of the region under the personal direction of Dr. James G. Needham.

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[15] PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, pp. 291, 292, 1861, as *Amalopis*.

The species occurs in the *Alnus* association a short distance east of Round Pond, in company with *Tipula dejecta* Walker, the only other crane-fly on the wing at this date and hour.

The water is stagnant or nearly so with the little pools filled with an algal growth, kindly determined for me by Dr. J. R. Schramm, of Cornell University, as being near *Microspora* and *Tribonema*, abundant; *Œdegonium* sp. and *Spirogyra* sp., the latter conjugating laterally, and some *Mougeotia*, *Vaucheria*, etc., with many Diatoms; in addition to these there is a dense growth of young seedlings of *Impatiens biflora*. The mud is so soft that it is necessary to wade knee-deep in order to explore this region. There is still ice down underneath the stratum and the *Alnus* is just coming into leaf, allowing the sun to light up the ground underneath. The dominant herbaceous plants at this time were *Carex aquatilis*, *Saxifraga pennsylvanica*, with the plants in bud and the stalks not more than six to nine inches high, and *Caltha palustris* in full flower.

There is no doubt but that the *Tipula* and the present species both emerged from the stagnant pools formed in the marsh adjoining Grassy Creek. Both species of crane-flies were common, but the *Tipula* was more in evidence by its larger size and habit of flying. The *Tricyphona* was usually found resting on the saxifrage or on the inclined side of alder limbs, the males often fluttering about from place to place a short distance above the ground, never very rapidly. The females were found resting on the alder stems, inactive, and the males were presumably searching for them.

In the afternoon when the warmth of the sun made itself felt, none of the *Tricyphona* and only a few of the *Tipula* were in evidence in this haunt, their places having been taken by dense swarms of Chironomidæ and a very few of the crane-fly, *Erioptera septemtrionis* Osten Sacken.

On May 20, Mr. P. A. Claassen found a male and a female in his tent-traps set near this place, proving that the immature stages are spent in the mud beneath.

RHAPHIDOLABIS Osten Sacken.

Rhaphidolabis Osten Sacken; Monographs of the Diptera of North America, pt. 4, p. 284 (1869).

Subgenus RHAPHIDOLABINA subgen. n.

Similar to *Rhaphidolabis* s. s., differing as follows: Antennæ 15-segmented, the first eight segments of the flagellum normal, cylindrical, bearing strong hairs at about midlength, these alternating

in their arrangement, being on the same face on the even segments; the ninth and eleventh segments are smaller and lie between the long, verticillate tenth and twelfth segments; thirteenth segment of the flagellum long, sigmoid, bearing three long hairs at the apex. Wings with the median cross-vein present, connecting M_{1+2} with M_3.

Type of the subgenus, *Rhaphidolabis flaveola* Osten Sacken.

The curious pallid fly that I have deemed best to separate from the other species of the genus is anomalous in many respects and may eventually be placed nearer to *Tricyphona*, where indeed it was provisionally assigned by Needham.[16] It is certainly more distinct from *Rhaphidolabis* than is *Plectromyia* which has herein been considered to have subgeneric value. Under these circumstances it may be better to call the genus *Plectromyia*, that name having page-priority over *Rhaphidolabis*, but for the present the latter name has been retained.

The American species of the genus may be separated by the following key:

1. Antennæ 15-segmented; cross-vein *m* present (subgenus *Rhaphidolabina*). (Northeastern United States.) ..... *flaveola* Osten Sacken.
   Antennæ 13-segmented; cross-vein *m* absent 2
2. Cell M_1 absent (subgenus *Plectromyia*). (Northeastern United States.) ..... *modesta* Osten Sacken.
   Cell M_1 present (subgenus *Rhaphidolabis*) 3
3. Cell R_2 petiolate 4
   Cell R_2 sessile 6
4. Wings whitish hyaline with a dark brown, oval stigma. (Eastern Rocky Mountain region.) ..... *neomexicana* Alexander.
   Wings without a clearly defined, dark brown stigma 5
5. Antennæ of the male elongated; *Rs* long, straight, the distance between Sc_2 and the origin of the sector being less than the length of the sector. (Western United States.) ..... *polymeroides* Alexander.
   Antennæ of the male short; *Rs* short, arcuated, the distance between Sc_2 and the origin of the sector about two times the length of the sector. (Eastern United States.) ..... *tenuipes* Osten Sacken.
6. Coloration grayish brown, the præscutum with three dark brown stripes; abdomen dark brown with paler caudal margins to the segments; wings very pale brown, the radial sector very short, arcuated or angulated. (Northeastern United States.) ..... *cayuga* sp. n.

[16] Twenty-third Report of the New York State Entomologist, Pl. 25, fig. 3, 1907, as *Amalopis*.

Coloration reddish brown, the præscutum with three indistinct stripes; abdomen yellowish brown, the hypopygium bright yellow; wings nearly hyaline, the radial sector somewhat elongated, arcuated. (Northeastern United States.)..... *rubescens* sp. n.

The following general statements may be made regarding these species:

Rhaphidolabis (Rhaphidolabina) flaveola Osten Sacken. (Plate XXVIII, fig. 54.)

Canadian life-zone of the northeastern United States and eastern Canada, Osten Sacken's Maryland type being the most southern record. It is abundant from Ontario and Maine south to Maryland. In New York and New England it flies from May 30 to September 21, being most numerous in June. It may be looked for in cold, damp, shady places, such as along mountain streams and similar situations.

Rhaphidolabis (Plectromyia) modesta Osten Sacken. (Plate XXVIII, fig. 55.)

Canadian life-zone of the northeastern United States, known only from the White Mountains, New Hampshire, the type-locality, and the southern Adirondack Mountains, New York. It is found along small mountain streams, flying in June.

Rhaphidolabis (Rhaphidolabis) neomexicana Alexander.

Rocky Mountain region, known from two stations in Colorado and one in New Mexico.

Rhaphidolabis (Rhaphidolabis) polymeroides Alexander.

Known only from the type-locality, Eureka, Humboldt County, California, May 22, 1903 (H. S. Barber).

Rhaphidolabis (Rhaphidolabis) tenuipes Osten Sacken. (Plate XXVIII, fig. 56.)

Canadian and Canadian-Transitional life-zones of the eastern United States, from Maine to Georgia, flying in April and May in the south, a little later in the north, and reappearing in late summer.

Rhaphidolabis (Rhaphidolabis) cayuga sp. n. (Plate XXVIII, fig. 57.)

Canadian-Transitional zones of the northeastern United States. This is the earliest species of the genus in the north, appearing on the wing in April and early May, reappearing in August. In New York it comes with the very first of the early spring crane-flies, such as *Ormosia nubila*, *O. innocens*, *Limnophila brevifurca*, *Tipula collaris*, *T. dejecta*, etc.

Rhaphidolabis (Rhaphidolabis) rubescens sp. n. (Plate XXVIII, fig. 58.)

Canadian life-zone of the northeastern United States, appearing on the wing a little later than does the last (the first half of June). It is characteristic of cold Canadian woods near running water.

It is probable that, like the last-named species, it reappears in August as described under *R. tenuipes*, such species presumably being double-brooded.

Rhaphidolabis (Rhaphidolabis) cayuga sp. n.

Head brownish gray; thorax grayish brown with three dark brown stripes; abdomen dark brown, the segments narrowly ringed with paler; wings pale brown; cell R_2 sessile, *Rs* very short, arcuated or angulated; cell *1st* M_2 open by the atrophy of the median cross-vein; cell M_1 short.

Male.—Length, 5–5.4 mm.; wing, 6.3–6.6 mm.

Female.—Length, 6.6 mm.; wing, 7.7 mm.

Rostrum and palpi dark brown. Antennæ dark brown, the flagellar segments short-cylindrical. Head brownish gray.

Mesonotum grayish brown, the præscutum with three dark brown stripes, the middle stripe broadest, ending before the suture; lateral stripes narrow and less distinct; scutum light brown, the lobes largely dark brown; scutellum and postnotum dark with a heavy gray bloom. Pleura dark brown with a gray bloom. Halteres light yellow, the knobs dark brown. Legs with the coxæ and trochanters dark brown; femora similar, a little paler at the extreme base; tibiæ and tarsi dark brown. Wings with a light brown tinge, stigma a little darker but poorly defined, veins dark brown. Venation (Plate XXVIII, fig. 57): *Sc* long, Sc_2 far removed from its tip; distance between Sc_2 and the origin of *Rs* about twice the length of the sector; *Rs* very short, arcuated, angulated, or sometimes spurred; cell M_1 short and weak, tending to be evanescent, less than one-half the length of cell M_3.

Abdominal segments dark brown, the caudal margins of the terminal segments narrowly ringed with paler; hypopygium brownish yellow.

Habitat.—Northeastern United States.

Holotype, ♂, McLean, Tompkins County, New York, May 7, 1916 (Alexander).

Allotype, ♀, with the type.

Paratopotypes, 15 ♂ ♀; paratype, 1 ♂, near Johnstown, Fulton County, New York, August 19, 1916 (Alexander).

Type in the collection of the author.

This is the species figured by Needham under the name *tenuipes*,[17] the real *tenuipes* being shown in the same work, Plate 19, fig. 2.

[17] Twenty-third Report of the New York State Entomologist, Pl. 13, fig. 1 (1907).

The types occurred rather abundantly along a small woodland stream and were found commonly resting on the trunks of sugar maples, swarming out into the air at short intervals. The species occurred with the following crane-fly associates:

Ormosia innocens, O. nubila, O. rubella, Erioptera septemtrionis, Limnophila brevifurca, Adelphomyia minuta, Ula elegans, Pedicia conterminata and *Tipula dejecta.*

Rhaphidolabis (Rhaphidolabis) rubescens sp. n.

Head light silvery gray; mesonotum reddish, sparsely gray pruinose, with three indistinct brown stripes; abdomen yellowish brown, the hypopygium bright yellow; wings nearly hyaline; cell R_2 sessile; *Rs* arcuated, rather elongate; cell *1st* M_2 open by the atrophy of *m*; cell M_1 moderate.

Male.—Length, 5.3–5.5 mm.; wing, 6.3–6.6 mm.

Female.—Length 5.5–5.6 mm.; wing, 6.5–7 mm.

Rostrum and palpi dark brown. Antennæ with the basal segments brown, sparsely grayish pruinose; præscutum with three indistinct brown stripes, lateral stripes less evident, median stripe narrowed behind and becoming indistinct at the suture; scutum with the lobes brownish gray, the median area dull reddish yellow; scutellum pale brownish yellow, gray pruinose; postnotum light reddish with a gray bloom. Pleura light reddish with a sparse gray bloom. Halteres pale, the knobs brown. Legs with the coxæ and trochanters light brownish yellow; femora and tibiæ brownish yellow, the latter a little darkened towards their tips; tarsi brown. Wings nearly hyaline, stigma very pale to indistinct, veins dark brown. Venation (Plate XXVIII, fig. 58): *Sc* long, ending at nearly midlength of R_2; distance between Sc_2 and the origin of the sector about twice the length of the latter; *Rs* rather long, strongly arcuated, but not angulated; cell R_2 sessile, sometimes broadly sessile; cross-vein *r* at the tip of R_1; cell *1st* M_2 open by the atrophy of *m*; cell M_1 present, about one-half as deep as cell M_3.

Abdomen pale yellowish brown, the lateral margins more yellowish, the hypopygium bright yellow.

Habitat.—Northeastern United States.

Holotype, ♂, Simmons woods, Gloversville, Fulton County, New York, altitude 900 feet, June 22, 1916 (Alexander).

Allotype, ♀, topotypic, June 12, 1916.

Paratopotypes, 20 ♂ ♀, June 9, 1914; June 12 to 22, 1916.

Type in the collection of the author.

The ecological conditions under which this species lives have been

discussed in the second part of this series of papers[18] under the account of *Tipula cayuga* Alexander. A less detailed notice of the associates taken with the type will be found in the present paper under the account of *Limnophila edwardi*.

Family PTYCHOPTERIDÆ.

BITTACOMORPHA Westwood.

Bittacomorpha Westwood; London and Edinburgh Philosophical Magazine and Journal of Science, vol. 6, p. 281 (1835).

Subgenus BITTACOMORPHELLA subgen. n.

Agrees with *Bittacomorpha* s. s., but the apical cells of the wings with a sparse, strong pubescence, including the tip of cell *Sc*, all of *2nd* R_1, tips of R_3, R_4, R_5 and *2nd* M; in *B. sackeni* Röder, the pubescence is even more extensive, including the end of cell C, first R_1, all of cell R_4, almost the outer half of cells R_3 and R_5, and the ends of *2nd* M and Cu_1; metatarsi of the legs not swollen. A correlated character is the lack of a white ring near the base of the metatarsi.

Type of the subgenus, *Bittacomorpha jonesi* Johnson.

There are four species of this genus now known, two belonging to each subgenus, and their general distribution, seasonal and geographical, may be summarized as follows:

Bittacomorpha (Bittacomorpha) clavipes Fabricius.

The "Phantom Crane-fly" is one of our commonest and best-known species. It is a fly of the Canadian-Transitional to the Austral zones and has a wide range throughout America east of the Rockies, from Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland south to Florida, west to Manitoba and South Dakota. In New York and New England it is on the wing from May 17 to September 23, being common throughout the summer; in the southern part of its range it appears as early as February. The flies are abundant in low, wet swales, swamps, and along lakes and ponds. The curious rust-red lava with an extensile breathing tube is as remarkable as the adult fly.

Bittacomorpha (Bittacomorpha) occidentalis Aldrich.

Western United States, ranging from Washington to California, the latter records being for mid-May.

Bittacomorpha (Bittacomorphella) jonesi Johnson.

A fly of the Canadian life-zone of the northeastern United States,

[18] Proceedings of The Academy of Natural Sciences of Philadelphia, p. 486, September, 1915.

ranging from Maine, New Hampshire and Vermont south (in the mountains) to Mt. Toxoway, North Carolina, the type-locality. In New York and New England it flies from June 11 to August 31, being quite numerous in suitable localities throughout the latter half of June and all of July. It is found in cool, shady spots, usually near running water or springs, being very often found in small dark ravines or along shaded runs. They frequently lurk under dark culverts after the fashion of *Dolichopeza* and *Oropeza*.

Bittacomorpha (Bittacomorphella) sackenii Röder.

Northwestern United States and western Canada, ranging from Queen Charlotte Isle, British Columbia, south to California and east to Colorado. The records indicate that the insect is on the wing in June and early July.

The species of *Bittacomorpha* may be separated by the following key:

1. Wings with the apical cells without a strong pubescence; metatarsi swollen and white basally. (Subgen. *Bittacomorpha*.)..... 2
   Wings with the apical cells with a sparse strong pubescence; metatarsi not swollen, and without white near the base. (Subgen. *Bittacomorphella*.)..... 3
2. Dorsum of thorax deep velvety black with a white median line; cell R_4 of the wings one-third as long as R_5. (Eastern North America.).....*clavipes* Fabricius.[19]
   Dorsum of thorax shiny black without a white median line; cell R_4 of the wings one-half as long as R_5. (Western United States.).....*occidentalis* Aldrich.[20]
3. Tibiæ and metatarsi dark brownish black without white (except the extreme tip of the latter in some specimens), segments two and three of the tarsi pure white. (Western North America.).....*sackenii* Röder.[21]
   Tibiæ black with a broad white band beyond the base; metatarsi with more or less white at the tip, broadest on the fore legs, narrowest on the hind legs; segments two and three of the tarsi pure white. (Northeastern United States.).....*jonesi* Johnson.[22]

Explanation of Plates XXV to XXXI.

Plate XXV.—Fig. 1.—Wing of *Geranomyia canadensis* Westwood.
Fig. 2.—Wing of *G. distincta* Doane.
Fig. 3.—Wing of *G. intermedia* Walker.
Fig. 4.—Wing of *G. diversa* Osten Sacken.
Fig. 5.—Wing of *G. tibialis* Loew.

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[19] *Tipula clavipes* Fabricius; Spec. Insect., vol. 2, p. 404 (1781).
[20] *Bittacomorpha occidentalis* Aldrich; Psyche, vol. 7, p. 201 (1895).
[21] *Bittacomorpha sackenii* Röder; Wien. Entom. Zeit., p. 230 (1890).
[22] *Bittacomorpha jonesi* Johnson; Psyche, vol. 12, pp. 75, 76 (1905).

Fig. 6.—Wing of *G. lachrymalis* Alexander.
Fig. 7.—Wing of *G. rostrata* Say.
Fig. 8.—Wing of *G. ibis* sp. n.
Fig. 9.—Wing of *G. insignis* Loew.
Fig. 10.—Wing of *Dicranoptycha germana* Osten Sacken.
Fig. 11.—Wing of *D. sobrina* Osten Sacken.
Fig. 12.—Wing of *D. winnemana* sp. n.
Fig. 13.—Wing of *Rhamphidia flavipes* Macquart.
Fig. 14.—Wing of *R. mainensis* sp. n.
Fig. 15.—Wing of *Teucholabis complexa* Osten Sacken.
Fig. 16.—Wing of *T. lucida* Alexander.

PLATE XXVI.—Fig. 17.—Wing of *Gonomyia* (*Leiponeura*) *alexanderi* Johnson.
Fig. 18.—Wing of *G.* (*L.*) *cinerea* Doane.
Fig. 19.—Wing of *G.* (*L.*) *sacandaga* Alexander.
Fig. 20.—Wing of *G.* (*L.*) *pleuralis* Williston.
Fig. 21.—Wing of *G.* (*L.*) *puer* Alexander.
Fig. 22.—Wing of *G.* (*L.*) *manca* Osten Sacken.
Fig. 23.—Wing of *G.* (*Gonomyia*) *mathesoni* Alexander.
Fig. 24.—Wing of *G.* (*G.*) *blanda* Osten Sacken.
Fig. 25.—Wing of *G.* (*G.*) *californica* Alexander.
Fig. 26.—Wing of *G.* (*G.*) *sulphurella* Osten Sacken.
Fig. 27.—Wing of *G.* (*G.*) *flavibasis* Alexander.
Fig. 28.—Wing of *G.* (*G.*) *florens* Alexander.
Fig. 29.—Wing of *G.* (*G.*) *cognatella* Osten Sacken.
Fig. 30.—Wing of *G.* (*G.*) *noveboracensis* Alexander.
Fig. 31.—Wing of *G.* (*G.*) *filicauda* Alexander.
Fig. 32.—Wing of *G.* (*G.*) *virgata* Doane.
Fig. 33.—Wing of *G.* (*G.*) *subcincrea* Osten Sacken.

PLATE XXVII.—Fig. 34.—Wing of *Erioptera* (*Erioptera*) *laticeps* sp. n.
Fig. 35.—Wing of *E.* (*Mesocyphona*) *tantilla* sp. n.
Fig. 36.—Wing of *E.* (*Empeda*) *nyctops* sp. n.
Fig. 37.—Wing of *Molophilus fultonensis* sp. n.
Fig. 38.—Wing of *M. nova-cæsariensis* sp. n.
Fig. 39.—Wing of *M. ursinus* Osten Sacken.
Fig. 40.—Wing of *Empedomorpha empedoides* Alexander ♂.
Fig. 41.—Wing of *Rhabdomastix* (*Sacandaga*) *monticola* sp. n.
Fig. 42.—Wing of *R.* (*S.*) *caudata* Lundbeck.
Fig. 43.—Wing of *R.* (*S.*) *flava* Alexander.
Fig. 44.—Wing of *Pterochionea bradleyi* sp. n.
Fig. 45.—Wing of *Limnophila edwardi* sp. n.
Fig. 46.—Wing of *L. sylvia* sp. n.

PLATE XXVIII.—Fig. 47.—Wing of *Tricyphona inconstans* Osten Sacken.
Fig. 48.—Wing of *T. calcar* Osten Sacken.
Fig. 49.—Wing of *T. auripennis* Osten Sacken.
Fig. 50.—Wing of *T. hyperborea* Osten Sacken.
Fig. 51.—Wing of *T. katahdin* Alexander.
Fig. 52.—Wing of *T. vernalis* Osten Sacken.
Fig. 53.—Wing of *T. paludicola* sp. n.
Fig. 54.—Wing of *Rhaphidolabis* (*Rhaphidolabina*) *flaveola* Osten Sacken.
Fig. 55.—Wing of *R.* (*Plectromyia*) *modesta* Osten Sacken.
Fig. 56.—Wing of *R.* (*Rhaphidolabis*) *tenuipes* Osten Sacken.
Fig. 57.—Wing of *R.* (*R.*) *cayuga* sp. n.
Fig. 58.—Wing of *R.* (*R.*) *rubescens* sp. n.

PLATE XXIX.—Fig. 59.—Hypopygium of *Gonomyia* (*Leiponeura*) *alexanderi;* dorsal aspect of the pleural appendages; *d* = dorsal appendage; *v* = ventral appendage.
Fig. 60.—Hypopygium of *G.* (*L.*) *helophila* Alexander; dorsal aspect of the pleural appendages; lettering as in Fig. 59.

Fig. 61.—Hypopygium of *G.* (*L.*) *alexanderi;* ventral aspect of the pleural appendages; lettering as in Fig. 59.

Fig. 62.—Hypopygium of *G.* (*L.*) *cinerea;* ventral aspect of the pleural appendages; lettering as in Fig. 59.

Fig. 63.—Hypopygium of *G.* (*L.*) *puer;* dorsal aspect of right pleurite; *p.gd.* = penis-guard.

Fig. 64.—Hypopygium of *G.* (*L.*) *manca;* dorsal aspect of right pleurite; lettering as in Fig. 63.

Fig. 65.—Hypopygium of *G.* (*L.*) *manca;* lateral aspect; lettering as in Fig. 63.

Fig. 66.—Hypopygium of *G.* (*Gonomyia*) *californica;* dorsal aspect of the right pleurite; lettering as in Figs. 59 and 63.

Fig. 67.—Hypopygium of *G.* (*G.*) *californica;* ventral aspect; lettering as in Figs. 59 and 63.

Fig. 68.—Hypopygium of *G.* (*G.*) *blanda;* dorsal aspect of the right pleurite; lettering as in Fig. 59.

Fig. 69.—Hypopygium of *G.* (*G.*) *blanda;* ventral aspect of the ventral appendage of the pleurite.

Fig. 70.—Hypopygium of *G.* (*G.*) *sulphurella;* dorsal aspect of the right pleurite.

Fig. 71.—Hypopygium of *G.* (*G.*) *florens;* dorsal aspect of the right pleurite; *k* = dorsal fleshy knob; *d* = first or dorsal appendage; *2* = second pleural appendage; *3* = third or ventral pleural appendage.

Fig. 72.—Hypopygium of *G.* (*G.*) *florens;* lateral aspect of the penis-guard.

Fig. 73.—Hypopygium of *G.* (*G.*) *cognatella;* lateral aspect of the penis-guard.

Fig. 74.—Hypopygium of *G.* (*G.*) *cognatella;* dorsal aspect of the right pleurite; lettering as in Fig. 71.

Fig. 75.—Hypopygium of *G.* (*G.*) *cognatella;* lateral aspect of the pleurite; lettering as in Fig. 71.

Plate XXX.—Fig. 76.—Hypopygium of *Gonomyia* (*Gonomyia*) *flavibasis;* dorso-lateral aspect.

Fig. 77.—Hypopygium of *G.* (*G.*) *flavibasis;* ventral aspect of the pleural appendages.

Fig. 78.—Hypopygium of *G.* (*G.*) *flavibasis;* apex of the ventral appendages.

Fig. 79.—Hypopygium of *G.* (*G.*) *noveboracensis;* pleural appendages, ventral aspect.

Fig. 80.—Hypopygium of *G.* (*G.*) *noveboracensis;* ventral aspect of the left side of the penis-guard and the gonapophyses; *a*, *b*, *c* = horns of the fused cylinder.

Fig. 81.—Hypopygium of *G.* (*G.*) *filicauda;* dorsal aspect of the right pleurite; *d* = dorsal pleural appendage; *v* = ventral pleural appendage.

Fig. 82.—Hypopygium of *G.* (*G.*) *filicauda;* lateral aspect of the penis-guard.

Fig. 83.—Hypopygium of *G.* (*G.*) *subcinerea;* dorsal aspect of the right pleurite; lettering as in Fig. 81.

Fig. 84.—Hypopygium of *G.* (*G.*) *subcinerea;* ventral aspect of the left side of the penis-guard.

Fig. 85.—Hypopygium of *G.* (*G.*) *subcinerea;* dorsal pleural appendage.

Fig. 86.—Hypopygium of *G.* (*G.*) *æqualis* Alexander; dorsal aspect of the right pleurite; lettering as in Fig. 81; *a.t.* = anal tube.

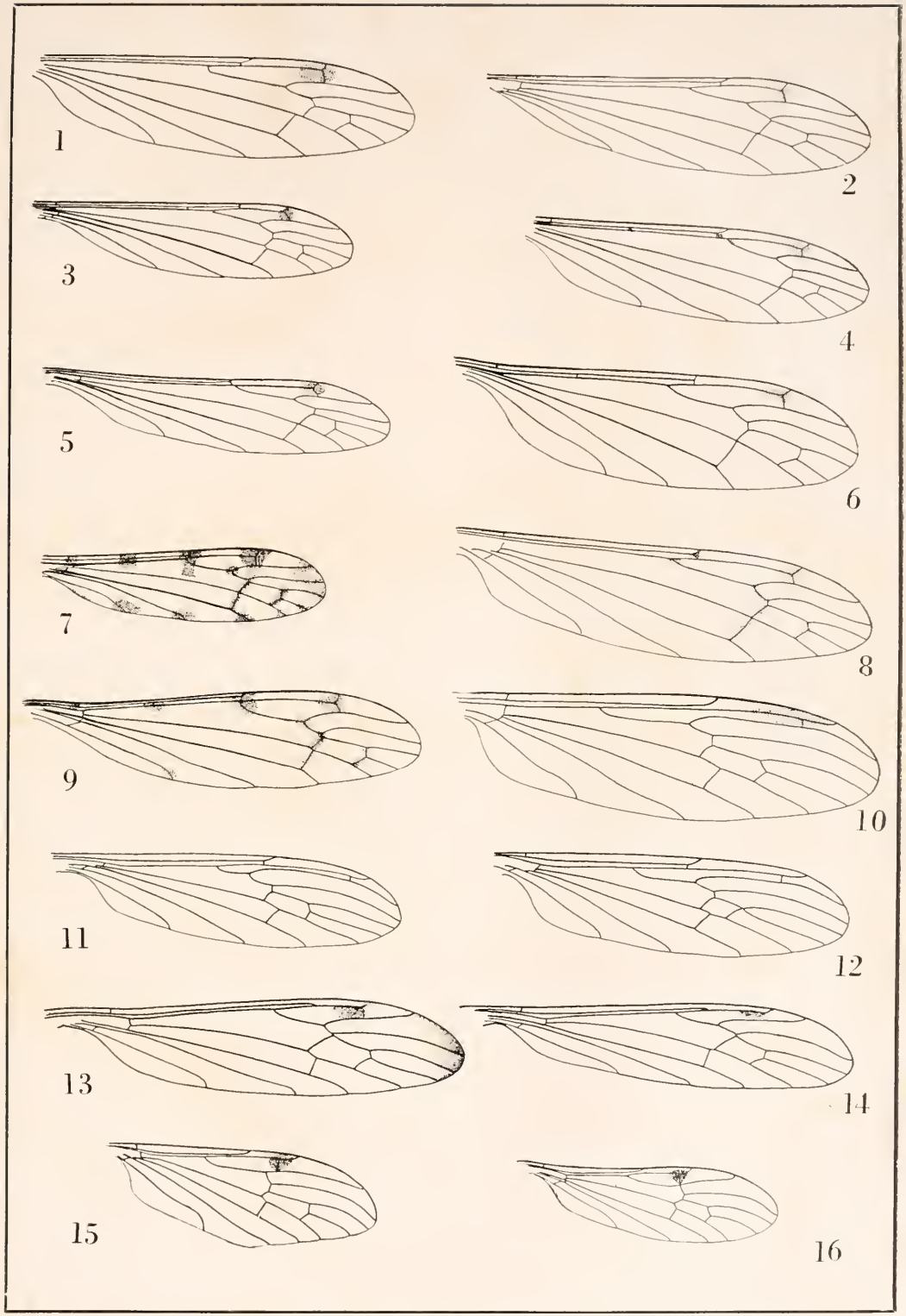
Fig. 87.—Hypopygium of *G.* (*G.*) *virgata;* dorsal aspect of the right pleurite; lettering as in Fig. 81; *2* = second pleural appendage.

Fig. 88.—Hypopygium of *G.* (*G.*) *unicolor* Alexander; ventral aspect of the penis-guard and the gonapophyses; *p.gd.* = penis-guard; *a* = subtending arm; *g* = gonapophyse.

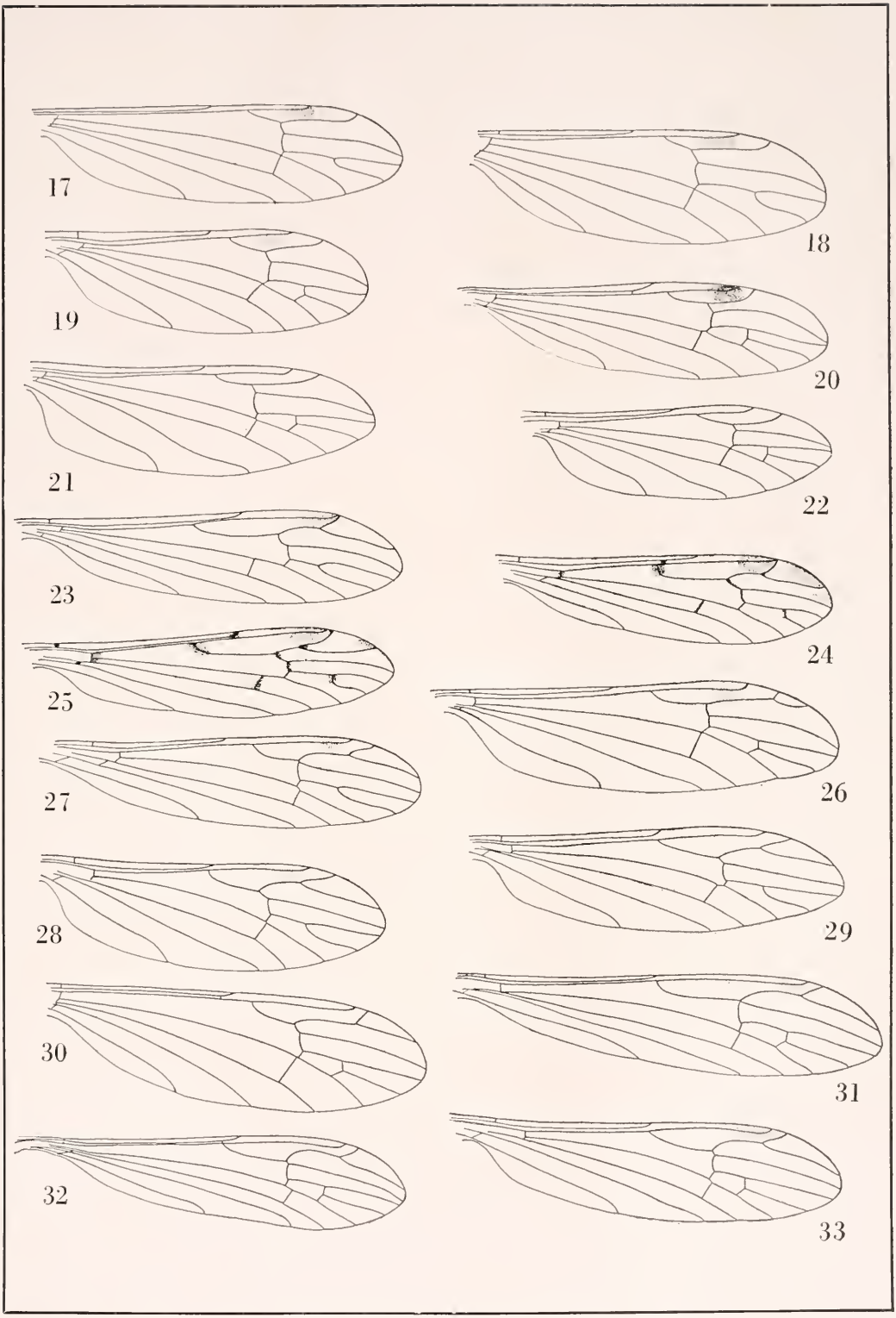
Fig. 89.—Hypopygium of *G.* (*G.*) *unicolor;* dorsal aspect of the right pleurite; lettering as in Fig. 81.

Fig. 90.—Hypopygium of *G.* (*G.*) *mexicana* Alexander; ventral aspect of the penis-guard; lettering as in Fig. 88.

Fig. 91.—Hypopygium of *G.* (*G.*) *mexicana;* dorsal aspect of the right pleurite; lettering as in Figs. 81 and 87.



ALEXANDER: CRANE-FLIES.



ALEXANDER: CRANE-FLIES.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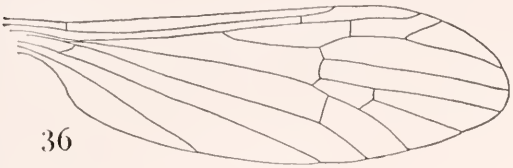
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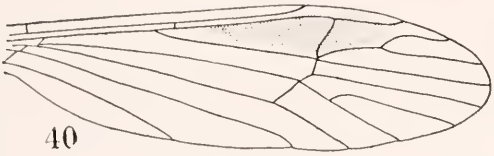
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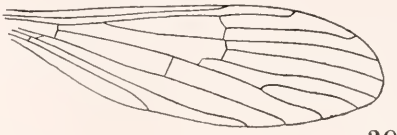
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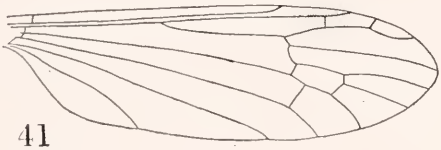
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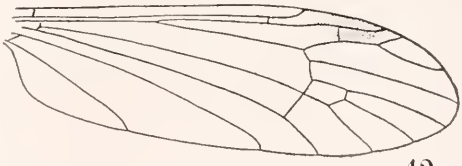
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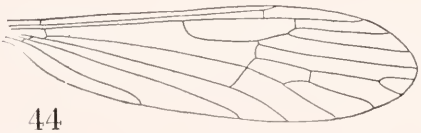
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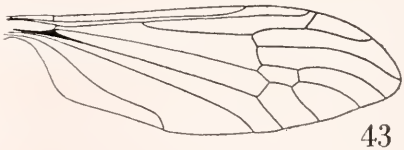
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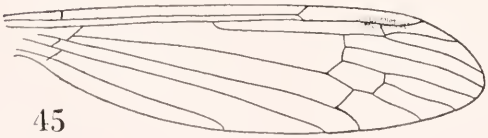
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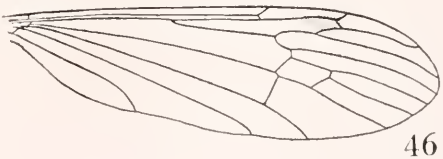
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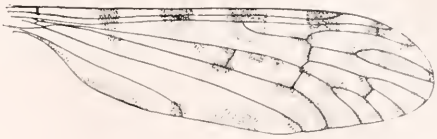
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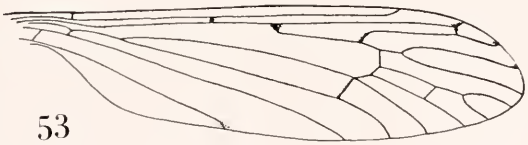
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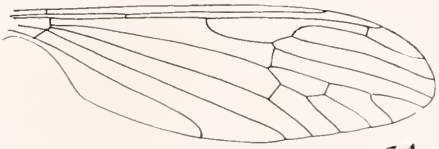
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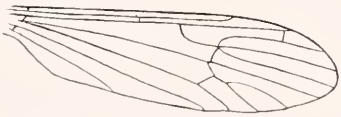
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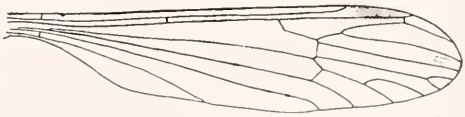
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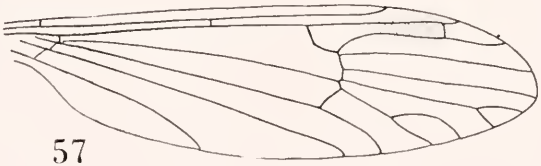
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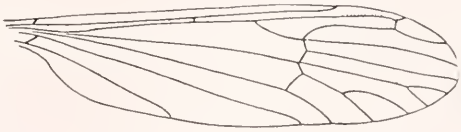
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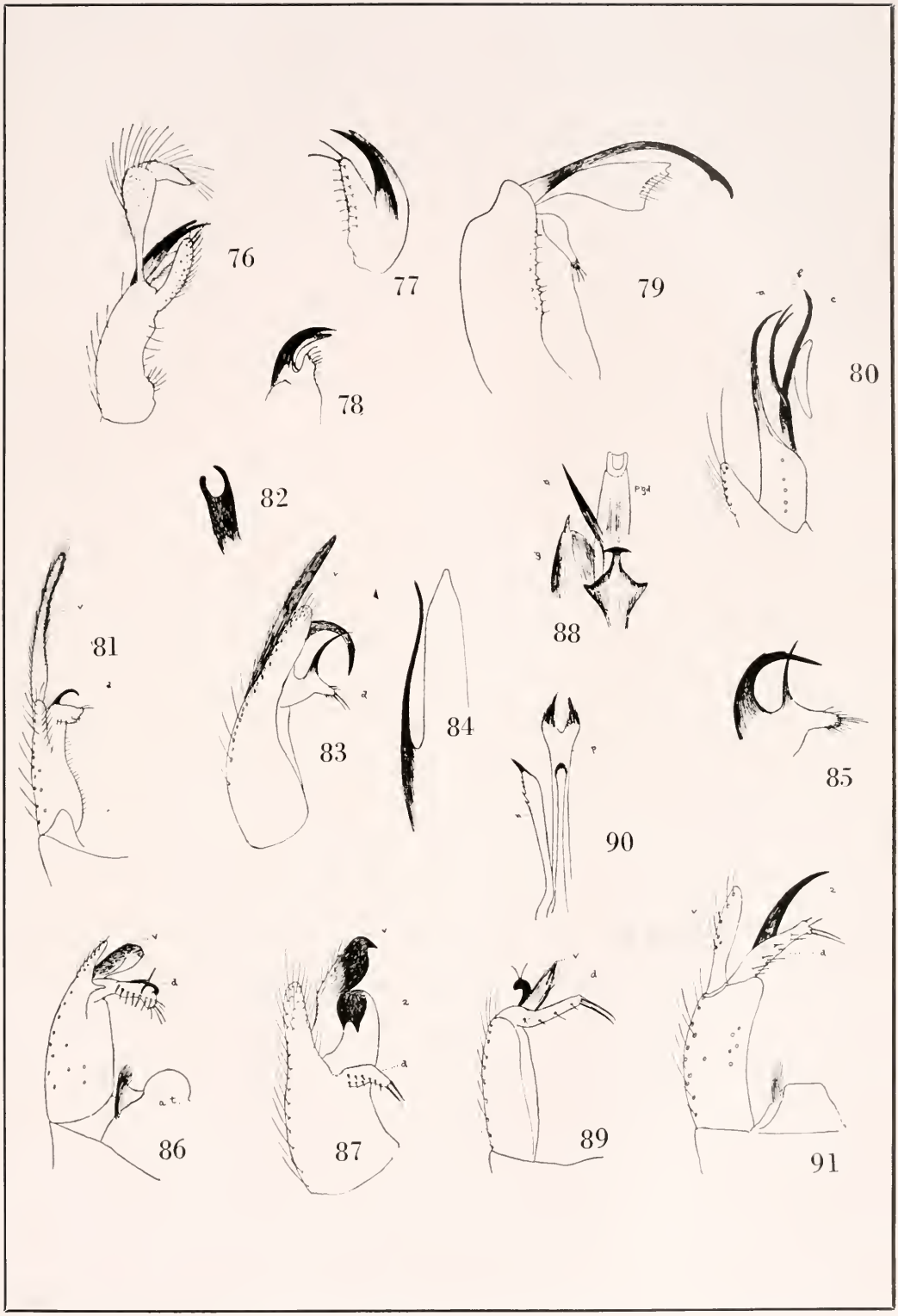
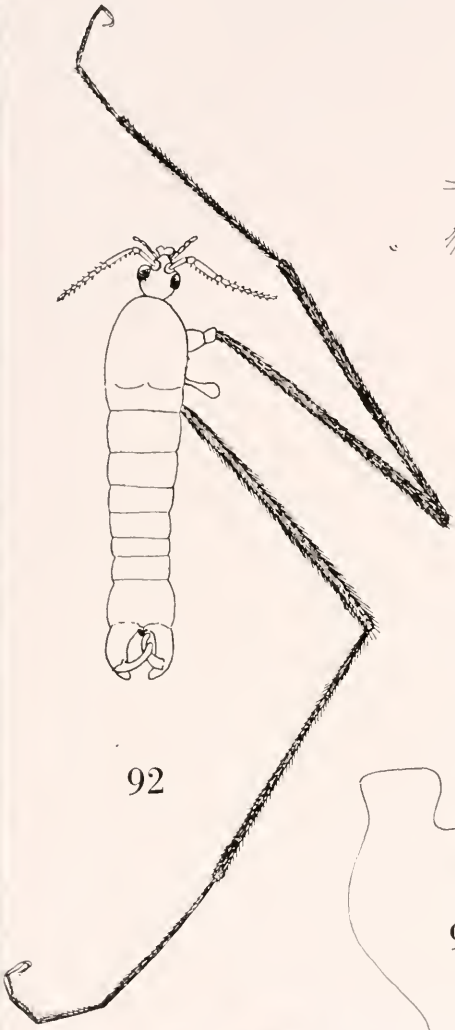


ALEXANDER: CRANE-FLIES.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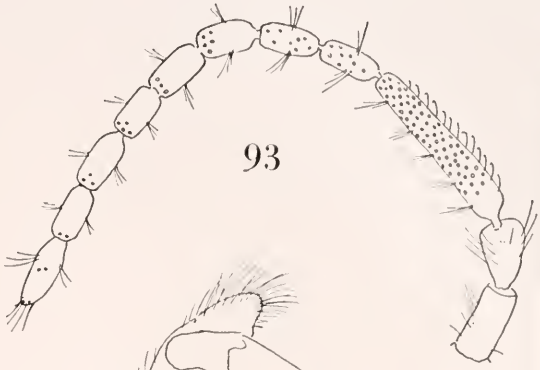
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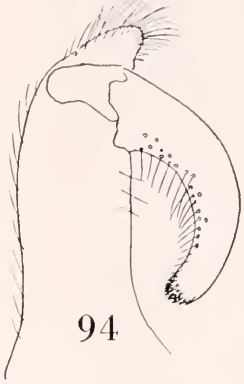
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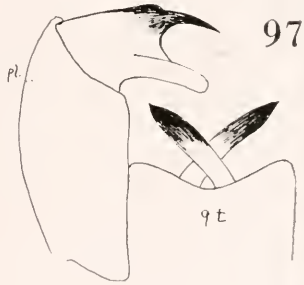
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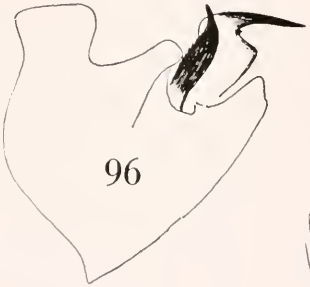
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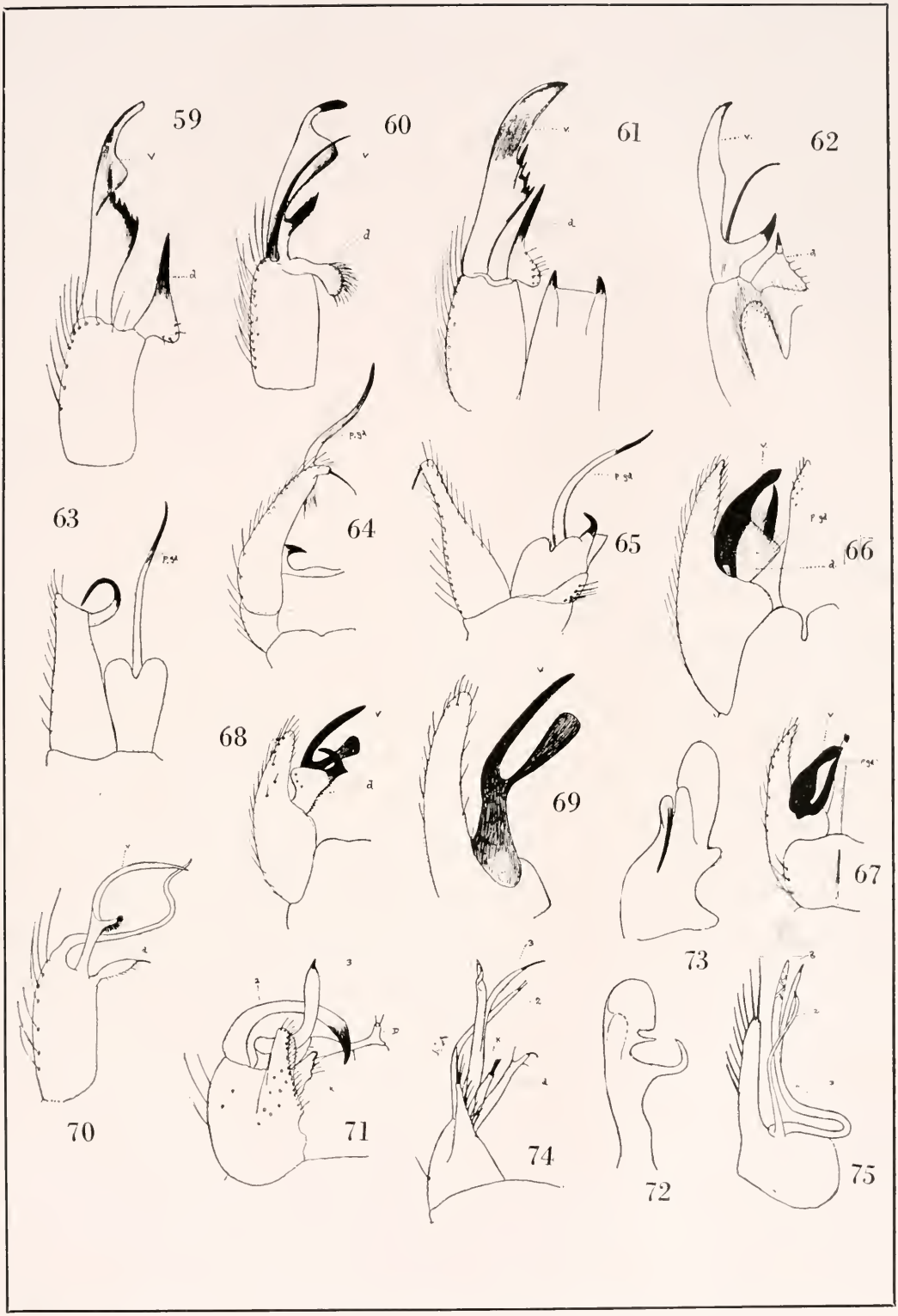

ALEXANDER: CRANE-FLIES.

PLATE XXXI.—Fig. 92.—Habit of *Pterochionea bradleyi*, with the wings and middle leg removed.

Fig. 93.—Antenna of *Pterochionea bradleyi*.

Fig. 94.—Hypopygium of *Pterochionea bradleyi;* dorsal aspect of the right pleurite.

Fig. 95.—Hypopygium of *Molophilus fultonensis;* ventral aspect of the ventral pleural hook.

Fig. 96.—Hypopygium of *M. fultonensis;* lateral aspect.

Fig. 97.—Hypopygium of *Erioptera laticeps;* dorsal aspect; *9t* = ninth tergite; *pl* = ninth pleurite.

Fig. 98.—Hypopygium of *E. nyctops;* dorsal aspect; *a*, *b*, *c* = pleural appendages.

NEW SPECIES OF NORTH AMERICAN BEES OF THE GENUS ANDRENA FROM WEST OF THE 100TH MERIDIAN CONTAINED IN THE COLLECTIONS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

BY HENRY L. VIERECK

The following descriptions are contributions toward a monograph of the Pan-American species of *Andrena*.

The proportions are in terms of divisions of a disc micrometer, with 100 divisions to 1 mm., used in a Spencer Lens Co. binocular with 10 x ocular and 40 mm. objective, each division equals nearly 42μ.

Andrena (Andrena) azygos new species.

Type.—No. 4,010. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Cloudcroft, New Mexico, June 16, 1902 (H. L. Viereck).

Related to *A.* (*A.*) *asmi* Viereck.

Male.—Length 8.5 mm.; *body* black, mostly covered with ochreous hair; *head* with its facial line : transfacial line :: 45 : 64, axial line : temporal line :: 32 : 22, temples produced, almost right angular, the angle apparently opposite middle of eye, malar line : joint 3 of antennæ :: 3 : 7, elevated portion of malar space much shorter than the depressed portion, head covered with ochreous hairs except along the inner eye margin, upper eye margin, and outer eye margin above the middle of temples and on the front where the hairs are black, front indistinctly punctured, dullish, reticulated and finely longitudinally striate, ocellocular line : ocelloccipital line :: 14 : 5, face shining, distinctly punctured, its punctures from one to three puncture widths apart, clypeus nearly planate, clypeus apparently slightly concave near apex, more shining and more distinctly punctured than the face, not elevated directly above the apical margin, clypearea wanting, sculpture of the clypeus not hidden by the moustache, labrarea with a broad rounded emargination, polished, its width at base : length down the middle :: 7 : 3, width at base : greatest length :: 7 : 4, width at apex : length down the middle :: 6 : 3, labrarea at base apparently half as wide as the labrum, the latter with a fringe of ochreous hairs, joint 3 of antennæ : 4 :: 7 : 8, joint 4 and following joints from a little more than one

and one-half times as long as thick to nearly twice as long as thick, dullish, flagel almost straight in outline, antennæ blackish throughout, mandibles nearly typical, rather slender, extending beyond the outer edge of the labrum and nearly to end of the basal third of its fellow, black except for the apical fourth which is dull dark reddish, palpi nearly typical; *thorax* covered with an abundance of dark, dull, ochreous hairs, hairs of dorsulum seemingly shorter than hair of mesopleuræ, dorsulum dullish, finely reticulated and sparsely punctured, the punctures indistinct and from two to five or more puncture widths apart, mostly the latter, notauli represented by a shining line, mesopleuræ dullish with pale ochreous hairs throughout, finely reticulated and mostly covered with shallow pits, that are mostly three or more pit widths apart, scutel hairy and sculptured much like the dorsulum, partly polished, partly sculptured like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark brown, polished, wing base mostly pale stramineous, subcosta blackish, stigma brownish stramineous with a blackish tinge, rest of veins stramineous with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and a little nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown excepting the tarsi and hind tibiæ which are rather dark brown, legs covered with ochreous hairs, hind metatarsi at most hardly wider than mid-metatarsi and nearly half as wide as hind tibiæ at apex of the latter; *propodeum* with its enclosure poorly defined, with irregular rugæ on basal half, finely reticulated on apical half, rounded off at apex, rest of upper face sculptured somewhat like the mesopleuræ but with smaller pits and covered with dark ochreous hair, propodeal pleuræ sculptured apparently like the mesopleuræ, the sculpture not hidden by the uniformly distributed ochreous hairs; *abdomen* with its tergum shining, almost polished, finely reticulated and indistinctly punctured, the punctures mostly three or four puncture widths apart, first tergite, with erect pale ochreous hairs, second and third tergites with appressed ochreous hairs, second tergite with its elevated portion down the middle : depressed portion :: 20 : 6, third and fourth tergites with brownish appressed hairs on the elevated portion, fifth tergite with its basal blackish portion covered with poorly defined punctures that are as many as four puncture widths apart, rest of fifth tergite and exposed portion of sixth and seventh tergites with a

stramineous margin, anal process narrow, almost parallel sided and shallowly emarginate at apex, tergum with rather inconspicuous hairs that are supplemented on the sides of the second, third and fourth tergites by thin ochreous apical hair bands, hair at apex of abdomen of a golden hue.

Andrena (Andrena) caliginosa[1] new species.

Type.—No. 4,039. The Academy of Natural Sciences of Philadelphia.

Type Locality.—San José, California. (Hold.)

Related to *A.* (*A.*) *decussata* Viereck. Probably synonymous with *A.* (*A.*) *nigra* Provancher.

Female.—Length 10.5 mm.; *body* black, covered throughout with black or blackish brown hairs; *head* with its facial line : transfacial line :: 72 : 88, axial line : temporal line :: 37 : 21, malar line : joint 3 of antennæ :: 4 : 15, ocelloccipital line : greatest diameter of lateral ocellus :: 5 : 6, elevated portion of malar space distinctly shorter than depressed portion, front rather distinctly, longitudinally striato-reticulate, not elevated into a welt along the fovea, fovea at most : ocellocular line :: 12 : 16, foveal band virtually wanting, distance between fovea and ocelli : ocellocular line :: 6 : 16, fovea gradually attenuated below its middle and continued to a point apparently above the antennal line, fovea filled with dark seal-brown hairs, face mostly nearly polished, partly indistinctly reticulate, with distinct punctures that are mostly almost adjoining or one puncture width apart, clypeus slightly elevated above the apical margin, convex, not so closely sculptured as the face, the punctures larger and well defined, clypearea present, rather poorly defined throughout, clypeus thinly hairy, its sculpture not at all hidden by hairs, labrarea subemarginate, its width at base : length down the middle :: 8 : 4, width at apex : length down the middle :: 6 : 4, greatest length : width at base :: 5 : 8, labrarea at base nearly one-third as wide as the labrum, the latter with a fringe of dark brownish hairs, labrum with a median longitudinal crista between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 15 : 10, joint 4 a little thicker than long, joint 5 a little longer than thick, succeeding joints a little longer than thick, except joint 12 which is distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending nearly to the outer edge of the labrarea, black except for the apical third which is dark reddish,

[1] This specific name was proposed for this species by Prof. W. M. Davis.

palpi nearly typical; *thorax* covered with an abundance of long slender hairs which are as long on the dorsulum as on the mesopleuræ, dorsulum dullish, finely reticulated, punctured, the punctures mostly from adjoining to three-puncture widths apart, notauli represented by a shining line, mesopleuræ sculptured somewhat like the dorsulum but not so closely or distinctly reticulated, scutel nearly polished but hairy and punctured much like the dorsulum, metanotum hairy and sculptured much like the dorsulum except that the sculpture is mostly denser and less distinct, tegulæ dark brown, polished, wing base partly blackish brown, subcosta blackish brown, stigma dark brown, rest of veins dull brownish stramineous, or blackish brown, first recurrent vein received by the second submarginal cell far beyond the middle and nearly interstitial with the second transverse cubitus, nervulus received by the median cell, nearly interstitial and forming an acute angle with the first abscissa of the discoidal vein, membrane with a uniform blackish brown tinge, legs blackish except for the small joints of the tarsi which are more or less dark brown, legs covered with black or blackish brown hairs, scopa typical, its hairs black or blackish brown throughout, hind metatarsi at most apparently a little wider than mid metatarsi; *propodeum* with its enclosure poorly defined, dullish and finely reticulated, slightly rugose at base, rest of upper face of propodeum sculptured somewhat like the dorsulum but not so distinctly punctured, and covered with similar hair, propodeal pleuræ shining, reticulate, with sparse shallow punctures and almost hidden by the brownish and blackish floccus; *abdomen* with its tergum shining and sculptured much like the propodeal pleuræ but with apparently more distinct and smaller punctures from three to six or more puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergite, first, second, third and fourth tergites with an apical, blackish brown margin, second tergite with its elevated portion down the middle : depressed portion :: 18 : 10, fifth tergite shining, reticulate, its punctures closer together and coarser than on the other tergites, pygidium black, nearly planate, with a shallow furrow on each side, nearly pointed at apex, tergum with thin, inconspicuous, erect hairs that are much longer on the first and second tergites than on the third and fourth, fimbria blackish brown.

Andrena (Andrena) candida tramoserica new race.

Type.—No. 4,011. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California.

Female.—Length 10 mm.; essentially as in *A.* (*A.*) *candida* Smith from which it differs chiefly in the foveæ reaching at most to the antennal line instead of to the clypeal line as in typical *candida.* In this race there is no black hair whatever on the temples. Clypeus down the middle mostly reticulate on the basal half and mostly transversely striate on the apical half.

In a paratopotype the clypeus is almost polished on its apical half.

Andrena (Andrena) complicata[2] new species.

Type.—No. 4,042. The Academy of Natural Sciences of Philadelphia.

Type Locality.—San José, California. (Hold.)

Related to *A.* (*A.*) *trizonata* (Ashmead) and *A.* (*A.*) *candida* Smith, and may prove to be a race of the latter.

Female.—Length 8 mm.; *body* bluish, mostly covered with pale ochreous almost white hairs; *head* with its facial line : transfacial line :: 56 : 67, axial line : temporal line :: 27 : 16, malar line : joint 3 of antennæ :: 2 : 9, ocelloccipital line : greatest diameter of lateral ocellus :: 4 : 4, elevated portion of malar space nearly wanting, head covered with whitish and black hairs, the latter present along the inner eye margin, on most of the front, vertex and upper end of temples, and along the upper two-thirds of the outer eye margin, front rather distinctly, longitudinally striate, not elevated into a welt along the fovea, fovea at most : ocellocular line :: 6 : 13, foveal band wanting, distance between fovea and ocelli : ocellocular line :: 7 : 13, fovea nearly parallel sided, not attenuated below its middle but continued to a point apparently a little below the antennal line, fovea filled with dark seal brown hairs above the middle, with pale hairs below the middle, face mostly nearly polished, indistinctly reticulate, with indistinctly defined punctures that are mostly as many as two puncture widths apart, face with a lateral, coppery margin, clypeus slightly elevated above the apical margin, coppery and blackish with a basal bluish margin, convex, sculptured like the face except that the punctures are larger and well defined and not so close together, clypearea wanting, clypeus with its basal half shining reticulate, its apical half nearly polished, clypeus thinly hairy its sculpture not at all hidden by hairs, labrarea rounded, its width at base : length down the middle :: 10 : 3, labrarea at base a little more than half as wide as the labrum, the latter with a fringe of pale brown hairs, labrum apparently sculptureless and structure-

[2] This specific name was proposed for this species years ago by Prof. W. M. Davis.

less between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 9 : 8, joint 4 thicker than long, the succeeding joints as thick as long or a little longer than thick except joint 12 which is distinctly longer than thick, antennæ blackish throughout, mandibles typical, extending to the outer edge of the labrarea, black except for the apical half which is mostly dark reddish, palpi nearly typical; *thorax* covered with an abundance of pale ochreous almost white hairs which are as long on the dorsulum, where they are thinly mixed with black hairs, as on the mesopleuræ, dorsulum dullish, finely reticulated and punctured much like the face, notauli represented by a shining line, mesopleuræ with almost whitish hairs except along the upper margin where there is an admixture of black hairs, sculptured somewhat like the dorsulum but more closely and less distinctly punctured, scutel hairy and sculptured much like the dorsulum except that most of its hairs are black, and the anterior margin is nearly polished, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and less distinct and the hairs are all whitish, tegular dark brown, partly nearly polished, wing base partly blackish brown, subcosta blackish brown, stigma dark brown, its lower margin blackish, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell in or before the middle and nearly one and one-half times as far from the first transverse cubitus as the first transverse cubitus is from the stigma on the radial vein, nervulus received by the median cell, nearly interstitial and forming an acute angle with the first abscissa of the discoidal vein, membrane with a uniformly brownish tinge, legs blackish except for the small joints of the tarsi which are more or less dark brown, legs covered with whitish and golden hairs, scopa typical, its hairs silvery, the hairs at base above decidedly darkened, hind metatarsi at most apparently a little narrower than mid metatarsi; *propodeum* with its enclosure poorly defined, dullish and finely reticulated, its basal half with a few faint rugæ and a faint median longitudinal raised line, rest of upper face of propodeum sculptured somewhat like the mesopleuræ, and covered with fine pale ochreous hair, propodeal pleuræ reticulated and with sparse shallow punctures that are nearly as close together as the clypeal punctures, and almost hidden by the almost whitish floccus; *abdomen* with its tergum shining, nearly polished, feebly reticulate and finely, sparsely punctured, the punctures mostly from four to six puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, second, third and fourth tergites

with a thin, apical, whitish hair band that is interrupted in the middle of the second and third tergites, apical edge of first, second, third and fourth tergites with a pale stramineous border, second tergite with its elevated portion down the middle : depressed portion :: 16 : 8, fifth tergite shining, reticulate, its punctures coarser than on the other tergites, pygidium nearly planate, almost pointed at apex, tergum with inconspicuous, pale, nearly erect hairs in addition to the hair bands, the hairs of the sides of the first and second tergite much longer than the hairs of the succeeding tergites, fimbria dark brown.

Andrena (Andrena) cristata new species.

Type.—No. 4,012. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Nevada (H. K. Morrison).

Related to *A.* (*A.*) *moesta albihirta* (Ashmead).

Female.—Length 10 mm.; *body* black, mostly covered with pale ochreous almost white hairs; *head* with its facial line : transfacial line :: 56 : 76, axial line : temporal line :: 30 : 18, malar line : joint 3 of antennæ :: 1 : 10, ocelloccipital line : greatest diameter of lateral ocellus :: 5.5 : 5, elevated portion of malar space nearly as long as depressed portion, head covered with white hairs, front rather indistinctly, longitudinally striate, not elevated into a welt along the fovea, fovea at most : ocellocular line :: 10 : 14, foveal band present and at upper end of the inner eye margin : ocellocular line :: 1 : 14, distance between fovea and ocelli : ocellocular line :: 3 : 14, fovea attenuated below its middle where it is apparently only one-half or a little more than half as wide as the greatest width of the fovea, the latter continued to a point apparently a little below the antennal line, fovea filled with dark seal-brown hairs, fovarea wanting, vertex and temples along the upper edge of the eye with black hairs, face mostly polished, partly indistinctly reticulate, with indistinct punctures that are as many as five or more puncture widths apart, clypeus slightly elevated above the apical margin, convex, sculptured like the face except that the punctures are larger and well defined, clypearea present but poorly defined, clypeus thinly hairy its sculpture not at all hidden by hairs, labrarea subemarginate its width at base : length down the middle :: 8 : 3, width at apex : length down the middle :: 7 : 3, labrarea at base nearly half as wide as the labrum, the latter with a fringe of golden hairs, labrum with a median longitudinal crista between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 9 : 8, joints 4 and 5 thicker

than long, the succeeding joints as thick as long or little longer than thick except joints 11 and 12 which are distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrarea, black except for the apical fourth and inner edge which are clear dark reddish, palpi nearly typical; *thorax* covered with an abundance of pale ochreous almost white hairs which are as long on the dorsulum where they are darker than the almost whitish hairs on the mesopleuræ, dorsulum dullish, finely reticulated and punctured like the face but more distinctly so, notauli represented by a shining line, mesopleuræ with almost whitish hairs, sculptured somewhat like the dorsulum but not so closely or distinctly punctured, scutel hairy and sculptured much like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and less distinct, tegulæ dark brown, polished, wing base partly blackish brown, subcosta blackish brown, stigma pale brownish stramineous, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and nearly as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish except for the tarsi and hind tibiæ which are more or less dark brown, legs covered with brownish golden and ochreous hairs, scopa typical, its hairs of the lower half pale ochreous, almost white, of its upper half with a brownish hue, hairs at base above decidedly darkened, hind metatarsi at most apparently a little narrower than mid metatarsi; *propodeum* with its enclosure poorly defined, dullish and finely reticulated, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but with smaller punctures, and covered with finer pale ochreous hair, propodeal pleuræ with sparse shallow punctures and almost hidden by the almost white floccus; *abdomen* with its tergum shining and sculptured much like the face, the punctures from two to six or more puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, second, third and fourth tergites with an apical, whitish hair band that is interrupted in the middle, apical edge of first, second, third and fourth tergites with a stramineous border, second tergite with its elevated portion down the middle : depressed portion :: 16 : 9, fifth tergite shining, reticulate, its punctures closer together than on the other tergites, pygidium nearly planate, with a shallow furrow on each side, nearly pointed at apex, tergum with inconspicuous, pale, nearly erect hairs in addition to the hair bands, fimbria dark seal-brown.

Andrena (Andrena) friesei new species.

Type.—No. 4,035. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*A.*) *fulvihirta* Viereck and Cockerell.

Female.—Length 11 mm.; *body* black, mostly covered with bright tawny or ochreous hairs; *head* with its facial line : transfacial line :: 62 : 77, axial line : temporal line :: 31 : 19, malar line : joint 3 of antennæ :: 15 : 9, ocelloccipital line : greatest diameter of lateral ocellus :: 7 : 5, elevated portion of malar space nearly wanting, head covered with tawny and black hairs, front longitudinally striate, not elevated into a welt along the fovea, fovea at most : ocellocular line :: 10 : 15, foveal band present and at upper end of the inner eye margin : ocellocular line :: 1.5 : 15, distance between fovea and ocelli : ocellocular line :: 6 : 15, fovea attenuated below its middle, cuneiform and continued to a point well below the antennal line, fovea filled with pale hairs along the inner eye margin and lower half, and with very dark seal-brown hairs on the upper half, in addition with some blackish hairs, fovarea wanting, vertex and temples along the upper edge of the eye with black hairs, face dullish, finely indistinctly reticulate, with indistinct punctures that are mostly as many as four puncture widths apart, clypeus distinctly elevated above the apical margin, slightly convex, nearly planate, sculptured like the face except that the punctures are closer together, clypearea barely represented by a median longitudinal shining streak, clypeus thinly hairy its sculpture nearly hidden laterally by hairs, labrarea truncate its width at base : length down the middle :: 9 : 5, width at apex : length down the middle :: 5 : 5, labrarea at base nearly half as wide as the labrum, the latter with a fringe of brownish hairs, labrum apparently sculptureless and without a definite structure between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 9 : 8, joint 4 and 5 thicker than long, the succeeding joints as thick as long or a little longer than thick except joints 11 and 12 which are distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending a little beyond the outer edge of the labrarea, black except for the apical third which is dark reddish, palpi nearly typical; *thorax* covered with an abundance of tawny hairs which are as long on the dorsulum where they are darker than the almost ochreous hairs on the mesopleuræ, dorsulum dullish, covered with reddish hairs, finely reticulated and punctured like the face but not so distinctly, more closely, notauli represented by a

shining line, mesopleuræ with almost ochreous hairs, sculptured somewhat like the dorsulum, scutel hairy and sculptured like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and less distinct, tegulæ blackish brown, shining, reticulated, wing base partly blackish brown, subcosta blackish brown, stigma pale brownish stramineous bounded by dark brown veins, rest of veins dull stramineous with a blackish tinge, first recurrent vein received by the second submarginal cell in or a little beyond the middle and nearly one and one-half times as far from the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus nearly interstitial and forming an acute angle with the first abscissa of the discoidal vein, membrane uniformly tinged with brown, legs blackish, covered with brownish hairs excepting most of hind trochanters, coxæ and femora on which the hairs are rather ochreous, scopa atypical, its hairs mostly much shorter than half the greatest width of hind tibiæ and nearly erect, appearing brownish except along the edges where the hairs are pale, nearly ochreous, hairs at base above decidedly darkened, hind metatarsi presumably at most apparently a little narrower than mid metatarsi; *propodeum* with its enclosure poorly defined, dullish and finely reticulated, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but less shining, and covered with finer pale tawny hair, propodeal pleuræ with a few shallow punctures, finely reticulated, and almost hidden by the ochreous floccus; *abdomen* with its tergum dullish, appearing almost impunctate, the punctures mostly from two to four puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, second, third and fourth tergites with an apical, whitish hair band that is interrupted in the middle of the second and third, apical edge of first, second, third and fourth tergites with a whitish stramineous edge, second tergite with its elevated portion down the middle : depressed portion :: 18 : 9, fifth tergite more shining, reticulate, its punctures distinct compared with the punctures on the other tergites, pygidium nearly planate, nearly pointed at apex, tergum with inconspicuous dark appressed hairs, in addition to the hair bands, except laterally on the first and second tergite where there are some whitish nearly erect hairs, fimbria dark seal-brown.

Andrena (Andrena) inclinata[3] new species.

Type.—No. 4,033. The Academy of Natural Sciences of Philadelphia.

[3] This specific name was applied to this species by Prof. W. M. Davis in the seventies of the preceding century.

Type Locality.—California. (No further data.)

Related to *A.* (*A.*) *fulvihirta* Viereck and Cockerell.

Female.—Length 12 mm.; *body* black, abdomen with a faint greenish tinge, mostly covered with pale ochreous or whitish hairs; *head* with its facial line : transfacial line :: 70 : 89, axial line : temporal line :: 35 : 21, malar line : joint 3 of antennæ :: 2 : 11, ocelloccipital line : greatest diameter of lateral ocellus :: 6 : 5, elevated portion of malar space in part nearly as long as depressed portion, head covered with whitish hairs, front rather distinctly, longitudinally striate and finely reticulate, not elevated into a welt along the fovea, fovea at most : ocellocular line :: 9 : 18, foveal band present and at upper end of the inner eye margin : ocellocular line :: 2 : 18, distance between fovea and ocelli : ocellocular line :: 8 : 18, fovea slightly attenuated below its middle where it is nearly as wide as the greatest width of the fovea, the latter continued apparently to the antennal line, fovea filled with whitish hairs, vertex and temples along the upper edge of the eye with whitish hairs, face mostly shining, partly indistinctly reticulate, with indistinct punctures that are from one to three puncture widths apart, clypeus distinctly elevated above the apical margin, convex, sculptured like the face except that the punctures are sparser on the apical half, seemingly transversely reticulated, clypearea wanting, clypeus quite hairy its sculpture nearly hidden by hairs, labrarea slightly subemarginate, its width at base : length down the middle :: 10 : 3.5, width at apex : length down the middle :: 7 : 3.5, labrarea at base nearly half as wide as the labrum, the latter with a fringe of pale ochreous hairs, labrum punctured between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 11 : 9, joints 4 and 5 and following joints except end joint thicker than long, the end joint distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending nearly to the outer edge of the labrarea, black except for the apical half which is clear reddish, mandibles at base with a dome-shaped polished bursa, palpi nearly typical; *thorax* covered with an abundance of pale ochreous almost white hairs which are decidedly shorter and thicker on the dorsulum than the almost whitish hairs on the mesopleuræ, dorsulum dullish, finely reticulated and indistinctly punctured, the punctures not forming sharp contrast to the reticulation, notauli represented by a shining line, mesopleuræ with almost whitish hairs, sculptured somewhat like the dorsulum, its lower and anterior aspect, however, more shining and more distinctly punctured, scutel hairy and sculptured much like the shining part

of the mesopleuræ, metanotum hairy and sculptured like the scutel except that the sculpture is denser and less distinct and dullish, tegulæ dark brown, polished, wing base partly blackish brown, subcosta blackish brown, stigma and rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle but not as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus virtually interstitial and forming an acute angle with the first abscissa of the discoidal vein, membrane uniformly tinged with yellowish stramineous except the apical border which has a brownish tinge, legs blackish brown except for the onychii and hind tibiæ and rest of hind tarsi which are more or less pale brownish, legs covered with whitish hairs, scopa typical, its hairs almost white except at base above where they are decidedly darkened, hind metatarsi at most apparently a little narrower than mid metatarsi; *propodeum* with its enclosure poorly defined, dullish and finely reticulated, rest of upper face of propodeum sculptured somewhat like the dorsulum, and covered with finer, much longer whitish hair, propodeal pleuræ nearly polished, finely reticulate, with a few shallow punctures and almost hidden by the nearly white floccus; *abdomen* with its tergum shining, very finely reticulated and finely, sparsely, indistinctly punctured, the punctures from two to six or more puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, second, third and fourth tergites with an apical, whitish hair band that is interrupted in the middle of the second, apical edge of first, second, third and fourth tergites with a stramineous border, second tergite with its elevated portion down the middle : depressed portion :: 20 : 9, fifth tergite shining, reticulate, its punctures closer together than on the other tergites, pygidium nearly planate, with a shallow furrow on each side, rounded at apex, tergum with inconspicuous, pale, nearly erect hairs, in addition to the hair bands, fimbria dark seal-brown.

Andrena (Andrena) jennei new species.

Type.—No. 4,013. The Academy of Natural Sciences of Philadelphia.

Type Locality.—North Yakima, Washington, May 20, 1903 (Eldred Jenne, No. 60).

Presumably related to *A.* (*A.*) *runcinatæ* Cockerell.

Male.—Length 8 mm.; *body* black, mostly covered with pale ochreous or whitish hair; *head* with its facial line : transfacial line :: 48 : 67, axial line : temporal line :: 34 : 23, temples produced

into a near carina-like welt and with a rounded nearly right angle below the middle of the eye, and an obtuse rounded angle above the middle of the eye, malar line : joint 3 of antennæ :: 1 : 8, elevated portion of malar space nearly wanting, head covered with whitish hairs throughout, front dullish shining, rather coarsely, sparsely striate, ocellocular line : ocelloccipital line :: 16 : 5, face shining nearly polished, faintly reticulated and distinctly punctured, the punctures mostly from one to two puncture widths apart, clypeus planate, not elevated directly above the apical margin, sculptured much like the face but more nearly polished, clypearea wanting, sculpture of the clypeus not hidden by the moustache, labrarea subemarginate, width at base : length down the middle :: 8 : 3, width at apex : length down the middle :: 4 : 3, labrarea at base apparently a little more than half as wide as the labrum, the latter with a fringe of golden hairs, joint 3 of antennæ : 4 :: 8 : 4, joint 4 a little thicker than long, joint 5 and following joints distinctly longer than thick, antennæ dullish, flagel, straight in outline, antennæ blackish throughout, mandibles typical, slender, extending beyond the outer edge of the labrum, black except for the apical fourth which is dark reddish, palpi nearly typical; *thorax* covered with an abundance of pale ochreous or whitish hairs, hairs of dorsulum nearly as long as hair of mesopleuræ, dorsulum dullish, sculptured much like the face but not so distinctly or closely, notauli represented by a shining line, mesopleuræ with pale ochreous hairs throughout, finely reticulated and mostly covered with shallow pits, much like the dorsulum, scutel hairy and polished and with a few punctures that are smaller than on the dorsulum, metanotum hairy and sculptured much like the dorsulum except that the sculpture is denser, tegulæ dark brownish stramineous, polished, wing base mostly dark brown, subcosta dull light brownish stramineous, stigma bounded by yellowish stramineous veins, its membrane concolorous with the subcosta, rest of veins concolorous with the veins bounding the stigma, membrane pale with a faint brownish tinge, recurrent vein received by the second submarginal cell beyond the middle and a little nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus nearly interstitial, received by the median cell, forming an acute angle with the first abscissa of the median vein, legs blackish brown excepting the tarsi and hind tibiæ which are rather pale brownish stramineous, legs covered with pale ochreous hairs, hind metatarsi at most hardly wider than mid metatarsi and nearly half as wide as hind tibiæ at apex of the latter;

propodeum with its enclosure poorly defined, irregularly coarsely rugose, rounded at apex, rest of upper face indefinitely punctured and coarsely irregularly sculptured between the punctures, covered with pale ochreous hair, propodeal pleuræ shining, finely reticulated along the lower and anterior margin, elsewhere with a loose network of fine rugæ in the interstices of which the integument is indistinctly reticulate and punctured, partly nearly hidden by pale ochreous hairs; *abdomen* with its tergum nearly polished and finely punctured, the punctures sparsest on the depressed portion of the first tergite, second, third and fourth tergites uniformly sculptured, partly finely, indistinctly reticulate, with their punctures two to six or seven puncture widths apart, second tergite with its elevated portion down the middle : depressed portion :: 16 : 7, fifth tergite with its basal blackish portion covered with poorly defined punctures that are as many as six puncture widths apart, depressed portion of tergites brownish with an apical whitish edge, anal process entire, truncate, dark brownish at apex, tergum with rather conspicuous pale ochreous hairs that are supplemented on the sides of the second, third and fourth tergites by thin pale ochreous apical hair bands, hair at apex of abdomen pale ochreous. In manipulating the head with a pair of forceps in order to get a better view of the labrarea the clypeus was almost symmetrically impressed.

Andrena (Andrena) littlefieldi new species.

Type.—No. 4,014. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Colorado Springs, Colorado, April 22, Worthington Littlefield collector (T. D. A. Cockerell).

Related to *A.* (*A.*) *polygoni* Viereck and Cockerell and closely resembles *A.* (*A.*) *placida* Smith.

Male.—Length, 6.5 mm.; *body* black, covered with whitish hairs; *head* with its facial line : transfacial line :: 40 : 52, axial line : temporal line at most :: 13 : 14, black, its pubescence whitish throughout except along the lower edge of the labrum where it is golden, clypeal punctures shallow, not sharply defined, at most two puncture widths apart, mostly adjoining or nearly so, the interstices polished, clypearea wanting clypeus convex, mandibles black with reddish castaneous tips, palpi typical, joint 3 of antennæ : 4 and 5 :: 6 : 9, 3 : 4 :: 3 : 2 and 3 : 5 :: 6 : 5, antennæ blackish brown, labrarea widely, arcuately emarginate, greatest length of labrarea nearly twice the shortest length and apparently a little more than one-fourth the width of the labrarea at its base, cheeks rounded or subtrapezoidal, widest a

little above middle of eye; *thorax* black and with whitish pubescence, dorsulum dullish, partly shining, finely reticulate, with scattered punctures that are inconspicuous, shallow and as much as five puncture widths or more apart near the centre of the dorsulum; scutel sculptured like the centre of the dorsulum but not distinctly reticulated, metanotum densely sculptured, dull, legs pubescent like the thorax except the tarsi which have the hairs on the under surface rather golden, tarsi dark brown or blackish except onychii which are dark stramineous, claws brownish stramineous, tegulæ and scale over wing base blackish, subcosta blackish brown, rest of veins and stigma pale yellowish stramineous, basal vein and media darker, brownish, membrane with a yellowish stramineous tinge, nervulus interstitial and forming almost a right angle with the first abscissa of the discoidal vein, first recurrent vein received a little before the middle of the second submarginal cell; *propodeum* rugulose except at apex of the ill-defined enclosure where it appears to be granular; *abdomen* black with a greenish tinge, its second, third and fourth tergites with a brownish to brownish-stramineous depressed apical margin, tergites imperfectly reticulate and shining, with shallow punctures about as sparsely distributed as on the scutel although not so distinctly defined, pubescence whitish throughout, second, third and fourth tergites poorly fasciate laterally, anal plate brownish stramineous and emarginate like a bird's tail.

Andrena (Andrena) lummiorum new species.

Type.—No. 4,034. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Vancouver, British Columbia, April 10, 1904 (R. V. Harvey, No. 602).

Related to *A.* (*A.*) *asmi* Viereck.

Female.—Length 10.5 mm.; *body* black, mostly covered with pale ochreous hair; *head* with its facial line : transfacial line :: 67 : 82, axial line : temporal line :: 34 : 20, malar line : joint 3 of antennæ :: 4 : 13, elevated portion of malar space as long as the depressed portion, head covered with whitish and black hairs, front longitudinally striato-punctate, not elevated along the inner foveal edge, covered with black hairs, vertex with pale ochreous and black hairs fovea at most : ocellocular line :: 11 : 13, foveal band wanting, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 2 : 13, fovea hardly constricted near its middle where it is apparently nearly as wide as the greatest width of the fovea, the latter continued below

as a shallow furrow down to a point apparently nearly on the clypeal line, fovea blackish brown, lower margin of front, supraclypeal areas, clypeus and inner margin of face with whitish hairs mixed with black hairs, face shiny, punctured and finely reticulated, the punctures mostly from nearly adjoining to two puncture widths apart, clypeus elevated above the apical margin, convex, with a poorly developed median longitudinal welt, more coarsely and more sparsely punctured than the face, clypearea poorly defined, clypeus with its basal half dullish reticulate, its apical half nearly polished, labrarea subemarginate, its width at base : length down the middle :: 14 : 4, width at apex : length down the middle :: 6 : 4, labrarea at base nearly two-thirds as wide as the labrum, the latter with a fringe of dark hairs, joint 3 of antennæ : 4 + 5 :: 13 : 12, joints 4 and 5 as thick as long, the succeeding joints apparently a little longer than thick, the end joint distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to a little beyond the outer edge of the labrum, black except for the apical half which is mostly dark reddish, palpi nearly typical; *thorax* covered with an abundance of pale and black hairs which are tawny on the dorsulum where they are somewhat shorter than the black and whitish hairs on the mesopleuræ, dorsulum dullish, indistinctly punctured and finely, densely reticulated, the sculpture nearly hidden by the dense covering of pale hair with a tawny tinge, notauli represented by a shining line, mesopleuræ with black hairs except for a streak of white hair along the convexity between the anterior face and the lateral face and along the upper margin where the hairs are whitish, sculptured like the dorsulum though not so finely and more conspicuously reticulated and punctured, scutel hairy and sculptured much like the dorsulum except for being less densely sculptured, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark brownish, polished, wing base partly blackish brown, subcosta blackish brown, stigma brownish stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus received by the median cell, nearly interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown except for the claws which are brownish stramineous, legs covered with blackish or brownish hairs except the mid and hind femora, hind coxæ and trochanters, and lower third of scopa where the hairs are whitish or silvery, scopa

nearly typical but loose, hind metatarsi at most nearly as wide as mid metatarsi; *propodeum* with its enclosure poorly defined, medially with a shallow impression, finely reticulated throughout and with short weak radiating, crooked plicæ along the base, rest of upper face of propodeum sculptured somewhat like the dorsulum but more distinctly and covered with nearly white hair, propodeal pleuræ shining, distinctly reticulated and with a few scattered indistinct punctures, and almost hidden by the whitish floccus; *abdomen* with its tergum shining, finely reticulated and finely indistinctly sparsely punctured, its first and second tergite with long, nearly erect pale ochreous hairs, the succeeding tergites with distinctly shorter pale ochreous hairs that on the fourth and fifth tergites are mixed with a few black hairs, second tergite with its elevated portion down the middle : depressed portion :: 10 : 22, fifth tergite with its sculpture more distinct than that on the preceding tergite, pygidium truncate, black at apex, second and third tergites with a thin apical hair band, fimbria blackish with pale hairs laterally.

Andrena (Andrena) monogonoparia new species.

Type.—No. 4,015. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Nevada (H. K. Morrison).

Related to *A.* (*A.*) *frigida cockerelli Graenicher.*

Male.—Length 8.5 mm.; *body* black, mostly covered with whitish hair; *head* with its facial line : transfacial line :: 54 : 70, axial line : temporal line :: 36 : 25, temples produced into a right angle, the angle opposite the middle of the eye, malar line : joint 3 of antennæ :: 2 : 8, elevated portion of malar space shorter than the depressed portion, head covered with whitish and black hairs throughout, the white hairs present only on the clypeus, supraclypeal area and to some extent on the vertex, occiput and temples, front rather roughly reticulated and partly indistinctly striate, ocellocular line : ocelloccipital line :: 18 : 6, face shining, distinctly punctured, its punctures mostly from one to two puncture widths apart, the interstices finely reticulated, clypeus apparently slightly convex, elevated directly above the apical margin, nearly polished and punctured much like the face, clypearea wanting, sculpture of the clypeus not hidden by the moustache, labrarea with two faces, emarginate beneath at the apex of the lower face, width at base : length down the middle :: 8 : 3, width at apex : length down the middle :: 25 : 3, labrarea at base apparently half as wide as the labrum, the latter with a fringe of golden hairs, joint 3 of antennæ :

4 :: 8 : 7, joint 4 and following joints nearly twice as long as thick the terminal joint excepted, which is apparently at least twice as long as thick, dullish, flagel undulate in outline, antennæ blackish throughout, right mandible nearly typical, rather slender, extending nearly to the end of the basal fourth of its fellow, black except for the apical third which is mostly dark reddish, palpi slender, nearly typical; *thorax* covered with an abundance of whitish hairs, that are sparsely mixed with black on the dorsulum and scutel, hairs of dorsulum seemingly as long as hair of mesopleuræ, dorsulum dullish, finely reticulated and sparsely punctured, the punctures rather indistinct and mostly four or five puncture widths apart, notauli represented by a shining line, mesopleuræ with whitish hairs throughout, finely reticulated and mostly covered with shallow pits that are mostly two or three puncture widths apart, scutel hairy and sculptured much like the dorsulum except that it is partly nearly polished, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ brownish stramineous, polished, wing base mostly pale stramineous, subcosta blackish, stigma brownish stramineous with a blackish tinge, rest of veins dull stramineous with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and little nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial, forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown excepting the tarsi and hind tibiæ which are rather dark brown, legs covered with whitish hairs, hind metatarsi at most hardly wider than mid metatarsi and nearly half as wide as hind tibiæ at apex of the latter; *propodeum* with its enclosure well defined, finely reticulate, rounded at apex, rest of upper face sculptured somewhat like the mesopleuræ but with smaller pits and covered with whitish hair, propodeal pleuræ sculptured apparently like the mesopleuræ the sculpture not hidden by the uniformly distributed whitish hairs; *abdomen* with its tergum shining, finely reticulated and indistinctly punctured, the punctures many puncture widths apart, first and second tergites with erect whitish hairs, third and following tergites with dark or blackish hairs excepting the fifth beyond its base which like the apex of the abdomen is covered with pale brownish hairs, second tergite with its elevated portion down the middle : depressed portion :: 23 : 5, fifth tergite with its basal blackish portion covered with poorly defined punctures that are many puncture widths apart, rest of fifth tergite and depressed portion of sixth tergite brownish

stramineous, anal process spatulate and stramineous at apex, not emarginate, tergum with its hairs not supplemented on the sides of the second, third and fourth tergites by apical hair bands.

Andrena (Andrena) obscuripostica new species.

Type.—No. 4,016. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Nevada (H. K. Morrison).

Related, presumably, to *A.* (*A.*) *apacheorum* Cockerell.

Female.—Length 9 mm.; *body* black, covered with pale ochreous pubescence; *head* with its facial line : transfacial line :: 53 : 74, axial line : temporal line :: 29 : 17, black, its pubescence ochreous except along the lower edge of the labrum where it is reddish brown, along the lower edge of the mandibles where it is brownish and in the foveæ where it is seal-brown, except for the long blackish hairs and on the occiput and temples where it is whitish, fovea apparently at most two-thirds as wide along the ocellocular line than the latter is long, hardly separated from the eye margin where the ocellocular line joins the latter, fovea shallow, fovarea wanting, fovea extending distinctly below the antennal line but apparently falling short of the clypeal line, clypearea wanting, clypeal punctures distinct, most of the punctures from one to two puncture widths apart, the interstices partly polished partly reticulated on the disc, elsewhere reticulated throughout, clypeus convex, deeply, transversely impressed just before the apical edge, mandibles black except for the apical two-thirds of the inner margin and all of the apical third which are reddish castaneous, palpi typical, joint 3 of antennæ : 4 + 5 :: 9 : 8, antennæ blackish brown, labrarea broad and short, subemarginate, nearly as wide at apex as at base, four times as wide at base as long down the middle, malar space virtually crowded out by the eye; *thorax* black with thin ochreous pubescence above and whitish pubescence on the pleuræ, dorsulum mostly dull and finely reticulated, with indistinct punctures that are as many as four to five puncture widths apart, scutel sculptured like the dorsulum, metanotum densely sculptured, legs pubescent like the pleuræ except that the hairs of the tibiæ and tarsi are brownish golden, scopa golden, its hairs not dense enough to obscure the tegument, their arrangement and character typical, tarsi and hind tibiæ dark brown, rest of legs darker, tegulæ and wing base dark brownish stramineous to blackish, stigma pale brownish stramineous, subcosta blackish brown, border of stigma and remaining veins brownish stramineous, darker than the stigma, first recurrent vein received by the second submarginal cell a little

beyond the middle, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein; *propodeum* with a poorly defined funnel-shaped enclosure, sides of the propodeum similarly sculptured with the enclosure though more rugulose and in addition indefinitely punctured; *abdomen* dullish black, finely reticulated and indistinctly punctured, the tergum from the base of the depressed margin of the second tergite to the end of the fourth tergite more shining than elsewhere but nevertheless finely reticulated, depressed portion of the second tergite down the middle : elevated portion :: 7 : 16, second, third and fourth tergites with most of their depressed portion covered with a whitish fascia, erect pubescence of tergum also whitish, that of the first and second tergite rather conspicuous, fifth tergite punctured, no definite sculpture between the punctures, fimbria dark brown, pygidium, planate, rounded at apex, conical in outline, dark reddish brown to blackish, and with a slightly submarginally impressed line on each side.

Andrena (Andrena) pulverea new species.

Type.—No. 4,043. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California (no further data).

Related to *A.* (*A.*) *papagorum* Viereck and Cockerell.

Female.—Length 9 mm.; *body* black, mostly covered with pale ochreous or whitish hairs; *head* with its facial line : transfacial line :: 52 : 65, axial line : temporal line :: 28 : 17, malar line : joint 3 of antennæ :: 2 : 9, ocelloccipital line : greatest diameter of lateral ocellus :: 3 : 4, elevated portion of malar space nearly wanting, head covered with whitish hairs, front rather indistinctly, longitudinally striate, not elevated into a welt along the fovea, its crista poorly developed, fovea at most : ocellocular line :: 10 : 13, foveal band wanting, distance between fovea and ocelli : ocellocular line :: 4 : 13, fovea slightly attenuated below its middle where it is apparently only a little narrower than the greatest width of the fovea, the latter continued to a point well below the antennal line, upper half of fovea filled with pale seal-brown hairs, lower half with still paler hairs vertex and temples along the upper edge of the eye with dark hairs, face shining, finely reticulate, with distinct punctures that are as many as one to three puncture widths apart, clypeus distinctly elevated above the apical margin, slightly convex, dullish, sculptured like the face except that the punctures are seemingly smaller and the reticulation denser, clypearea present but poorly defined and represented by a narrow impunctate area, clypeus

thinly hairy, its sculpture not at all hidden by hairs, labrarea triangular, its width at base : length down the middle :: 12 : 5, labrarea at base nearly two-thirds as wide as the labrum, the latter with a fringe of brownish hairs, labrum apparently structureless and sculptureless between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 9 : 6, joints 4 to 9 thicker than long, the succeeding joints as thick as long or a little longer than thick except joint 12 which is distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending a little beyond the outer edge of the labrarea, black except for the apical half which is dark reddish, palpi nearly typical; *thorax* covered with an abundance of whitish hairs which are distinctly shorter on the dorsulum where they are darker than the almost white hairs on the mesopleuræ, dorsulum dullish, finely reticulated, indistinctly punctured, the punctures mostly many puncture widths apart, notauli represented by a shining line, mesopleuræ with almost white hairs, sculptured somewhat like the dorsulum but more shining and more distinctly punctured, scutel hairy and sculptured much like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and less distinct, tegulæ blackish brown, polished, wing base partly blackish brown, subcosta blackish brown, stigma pale brownish stramineous, rest of veins dull stramineous, with a blackish tinge excepting the cubiti which are yellowish, received by the second submarginal cell beyond the middle and nearly as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, membrane uniformly tinged with yellowish brown, legs dark brown, covered with brownish golden and pale ochreous or whitish hairs, scopa typical, its hairs of the lower half pale ochreous almost white, of its upper half with a golden hue, hairs at base above decidedly darkened, hind metatarsi at most apparently a little narrower than mid metatarsi; *propodeum* with its enclosure poorly defined, shining and finely reticulated, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but with smaller punctures, and covered with finer pale ochreous hair, propodeal pleuræ fine reticulated, shining and with sparse shallow punctures and almost hidden by the nearly white floccus; *abdomen* with its tergum shining, satiny, finely reticulate and indistinctly punctured, the punctures from two to six or more puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, second, third and fourth tergites with an apical,

whitish hair band that is interrupted in the middle of the second and third tergites, apical edge of first, second, third and fourth tergites with a whitish stramineous border, second tergite with its elevated portion down the middle : depressed portion :: 18 : 9, fifth tergite dullish, reticulate, its punctures larger than on the other tergites, pygidium nearly planate, sculptured, punctate and rugulose, nearly truncate at apex, tergum with inconspicuous whitish hairs in addition to the hair bands and the nearly erect whitish hairs laterally on the first and second tergites, fimbria pale brown.

Andrena (Andrena) sancta new species.

Type.—No. 4,017. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California (no additional data except a written n. on the locality label).

Related to *A.* (*A.*) *parnassiæ* Cockerell.

Female.—Length 10 mm.; *body* black, mostly covered with whitish hairs; *head* with its facial line : transfacial line :: 53 : 71, axial line : temporal line :: 29 : 16, malar line : joint 3 of antennæ :: 1.5 : 9, elevated portion of malar space nearly wanting, head covered with whitish hairs, front shiny, finely longitudinally striate, with a poorly defined crista and not elevated along the inner margin of the fovea, fovea at most : ocellocular line :: 8 : 13, foveal band nearly wanting, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 6 : 13, fovea somewhat constricted near its upper end, nearly parallel sided throughout and continued below the constriction as a shallow furrow down to a point apparently a little below the clypeal line, fovea pale seal-brown above its middle, pale ochreous or whitish below, fovarea wanting, face dullish, finely reticulated and indefinitely punctured, clypeus distinctly elevated above the apical margin, slightly convex, with its basal half sculptured much like the face but distinctly punctured, the apical half mostly almost polished and coarsely punctured, the punctures from nearly adjoining to two puncture widths apart on each side of the impunctate, median longitudinal, feeble, welt-like clypearea, clypeus thinly hairy, its surface not hidden, labrarea truncate, width at base : length down the middle :: 11 : 5, width at apex : length down the middle :: 3 : 5, labrarea at base nearly two-thirds as wide as the labrum, the latter with a fringe of pale stramineous hairs, joint 3 of antennæ : 4 + 5 :: 9 : 9, joint 4 as thick as long, the succeeding joints a little longer than thick except the fifth which is as long as thick and the end

joint which is much longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrum, black except for the apical half which is dark reddish, palpi nearly typical; *thorax* covered with an abundance of whitish hairs which are shorter on the dorsulum where they are pale ochreous than the whitish hairs on the mesopleuræ, dorsulum dullish, punctured, finely reticulated except for the middle third of the posterior half which is polished and punctured, the punctures of the reticulated area from nearly adjoining to nearly four puncture widths apart, the punctures of the polished area much sparser, notauli represented by an impressed line, mesopleuræ with whitish hairs throughout, finely reticulate and sparsely punctured, scutel hairy and sculptured much like the polished part of the dorsulum except for being more finely punctured, metanotum hairy and sculptured like the dullish portion of the dorsulum except that the sculpture is denser, tegulæ dark brownish stramineous, polished, wing base partly blackish brown, subcosta blackish brown, stigma dark brownish stramineous, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and apparently as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown except for the tarsi which are more or less dark brownish stramineous, legs covered with whitish hairs, scopa typical, its hairs of a whitish hue, and concolorous throughout except for the hairs on the basal half of the upper edge where the hairs are blackish brown, hind metatarsi at most apparently as wide as mid metatarsi; *propodeum* with its enclosure poorly defined, triangular, finely reticulated, not at all rugose, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but seemingly with smaller pits and covered with whitish hair, propodeal pleuræ distinctly reticulated and with a few ill-defined punctures, and almost hidden by the whitish floccus; *abdomen* with its tergum shiny, punctured and delicately reticulated, the punctures fine and from two to eight or more puncture widths apart on the first tergite except on its depressed portion where the punctures are closer together, the punctures on the elevated portion of the second, third and fourth tergites similar to those on the first tergite and sparser than on the depressed portions of the second, third and fourth tergites, where the punctures are much as on the depressed portion of the first tergite, second tergite with its elevated portion down the middle : depressed

portion :: 18 : 8, fifth tergite with its sculpture coarser, its punctures not so well defined as on the preceding tergite, pygidium black, planate, truncate at apex, tergum with inconspicuous pale hairs, second, third and fourth tergites with an apical, interrupted, white, hair band, fimbria brownish.

Andrena (Andrena) scutellinitens new species.

Type.—No. 20,679, U. S. National Museum.

Type Locality.—California (C. F. Baker, No. 2,378).

Related to *A.* (*A.*) *nubecula* Smith.

Female.—Length 8 mm.; *body* black, mostly covered with pale ochreous or yellowish hairs; *head* with its facial line : transfacial line :: 59 : 63, axial line : temporal line :: 28 : 16, malar line : joint 3 of antennæ :: 2 : 9, ocelloccipital line : greatest diameter of lateral ocellus :: 7 : 5, elevated portion of malar space nearly wanting, head covered with hairs that are concolorous with the body hairs, front rather distinctly, longitudinally striate, frontal crista vestigeal, front not elevated into a welt along the fovea, fovea at most : ocellocular line :: 7.5 : 11, foveal band represented by a shiny line at upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 4 : 11, fovea somewhat attenuated below its middle where it is apparently only a little narrower than the greatest width of the fovea, the latter continued to a point apparently a little above the clypeal line, fovea filled with hairs that are concolorous with the body hairs, vertex and temples along the upper edge of the eye with the hairs concolorous with the body hairs, face polished with distinct punctures that are from adjoining to as many as three puncture widths apart, clypeus slightly elevated above the apical margin, convex, sculptured like the face except that the punctures are larger and mostly not so close together, clypearea present but poorly defined, clypeus thinly hairy its sculpture not at all hidden by hairs, labrarea emarginate, its width at base : length down the middle :: 12 : 4, width at apex : length down the middle : 3.5 : 4, labrarea at base nearly two-thirds as wide as the greatest length of labrum, the latter with a fringe of pale hairs, labrum without a median longitudinal crista between the labrarea and apical edge of labrum, joint 3 of antennæ : 4 + 5 :: 9 : 9, joint 4 thicker than long, the succeeding joints as thick as long or a little longer than thick except joint 12 which is distinctly longer than thick, antennæ blackish brown throughout, mandibles typical, robust, extending to the outer edge of the labrarea, black except for the apical half which is mostly clear dark reddish, palpi nearly typical; *thorax* covered with an abundance

of yellowish hairs which are much shorter on the dorsulum where they are darker than the almost whitish hairs on the mesopleuræ, dorsulum shining, partly polished, partly finely reticulated, punctured like the clypeus but not so sparsely, notauli represented by a shiny line, mesopleuræ with almost whitish hairs, sculptured somewhat like the dorsulum but more densely reticulated, scutel hairy and mostly polished, otherwise sculptured much like the dorsulum, metanotum hairy and densely sculptured, the sculpture nearly hidden by the hairs, tegulæ blackish brown, polished, wing base partly blackish brown, subcosta blackish brown, stigma pale yellowish stramineous, rest of veins dull brownish stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus nearly interstitial, received by the median cell and forming an acute angle with the second abscissa of the median vein, membrane uniformly tinged with brown, apical margin darkest, legs blackish except for the small joints of the tarsi which are more or less pale brown, legs covered with brownish golden and nearly whitish hairs, scopa typical, its hairs golden except at base above where they are decidedly darkened, hind metatarsi at most : mid metatarsi :: 11 : 12; *propodeum* with its enclosure rather well defined, shiny, finely reticulated and roughened by oblique lateral rugæ, rest of upper face of propodeum rugulose, punctured and reticulated, covered with fine nearly whitish hair, propodeal pleuræ reticulated, with sparse shallow punctures and almost hidden by the almost white floccus; *abdomen* with its tergum shining and finely reticulated as well as punctured, the punctures from one to three or more puncture widths apart on the first tergite, the punctures hardly closer on the succeeding tergites, first, second, third and fourth tergites with the depressed margin covered with a broad nearly whitish hair band that is not interrupted in the middle, apical edge of first, second, third and fourth tergites with a stramineous border that is nearly hidden by the hair bands, second tergite with its elevated portion down the middle : depressed portion :: 16 : 12, fifth tergite shining, reticulate, its punctures coarser than on the other tergites, and nearly hidden by the fimbria, pygidium convex, without a shallow furrow on each side, nearly pointed at apex, tergum with inconspicuous blackish hairs in addition to the hair bands and the nearly erect yellowish hairs at base of first tergite, fimbria dark cacao-brown.

Allotype.—No. 4,041. The Academy of Natural Sciences of Philadelphia.

Allotype Locality.—Nevada (H. K. Morrison).

Length 6.5 mm.; *body* black, mostly covered with ochreous or yellowish hair; *head* with its facial line : transfacial line :: 53 : 62, axial line : temporal line :: 27 : 17, temples rounded, subtrapezoidal, malar line : joint 3 of antennæ :: 1 : 7, elevated portion of malar space as in the female, front distinctly striated, shining, ocellocular line : ocelloccipital line :: 12 : 5, face polished, distinctly punctured, its punctures mostly adjoining or one puncture width apart, clypeus convex, sculptured much like the face, somewhat elevated directly above the apical margin, clypearea represented near the apical margin, sculpture of the clypeus nearly hidden by the moustache, labrarea with a broad emargination, polished, its width at base : greatest length :: 8 : 4.5, width at apex : length down the middle :: 5 : 3, labrarea at base nearly half as wide as the labrum, the latter with a fringe of pale golden hairs, joint 3 of antennæ : 4 :: 7 : 5, joint 4 and following joints from as long as thick to a little longer than thick excepting the end joint which is distinctly nearly twice as long as thick, flagel, almost straight in outline, antennæ dullish and blackish throughout, mandibles atypical, robust, extending a little beyond the outer edge of the labrum and to the middle of its fellow, black except for the apical half which is dull dark reddish, palpi nearly typical; *thorax* as in the female except that the dorsulum is mostly polished, legs blackish brown excepting the tarsi and hind tibiæ which are paler, hind metatarsi at most hardly wider than mid metatarsi and nearly half as wide as hind tibiæ at apex of the latter; *propodeum* with its enclosure much as in the female, more regulose and with an ill-defined median longitudinal carina, rest of upper face as in the female, propodeal pleuræ sculptured apparently as in the female; *abdomen* as in the female except as follows: fifth tergite with a hair band like the preceding tergites, apical edge of all tergites with a pale stramineous border, hair band of second tergite interrupted in the middle, second tergite with its elevated portion down the middle : depressed portion :: 14 : 8, tergum with pale appressed hairs on the second segment, anal process narrow, truncate, pale stramineous at apex, its sides diverging, hair at apex of abdomen of a golden hue.

Andrena (Andrena) semifulva new species.

Type.—No. 4,048. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California (E. Norton).

Related to *A.* (*A.*) *saccata* Viereck.

Female.—Length 13 mm.; *body* black, mostly covered with black hairs; *head* with its facial line : transfacial line :: 73 : 98, axial line : temporal line :: 39 : 26, malar line : joint 3 of antennæ :: 4 : 14, elevated portion of malar space nearly as long as depressed portion, head covered with black or blackish hairs except for some pale hairs on the vertex, front more reticulate than striate, not elevated along the inner foveal edge, fovea at most : ocellocular line :: 18 : 24, foveal band wanting, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 5 : 24, fovea hardly constricted near its middle where it is apparently nearly as wide as the greatest width of the fovea, the latter continued below the middle as a narrowing shallow impression down to a point distinctly below the clypeal line, fovea very dark seal-brown, face shining, finely reticulated and rather indistinctly punctured, the punctures one to three puncture widths apart, clypeus slightly elevated above the apical margin, convex, sculptured much like the face but more shining and more distinctly punctured, clypearea wanting, clypeus densely hairy laterally where its surface is nearly hidden by hairs, labrarea rounded, its width at base : length down the middle :: 20 : 5, convex at apex, labrarea at base at least two-thirds as wide as the labrum, the latter with a fringe of brownish hairs, joint 3 of antennæ : 4 + 5 :: 14 : 11, joint 4 nearly as thick as long, the succeeding joints as long or a little longer than thick, the end joint distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrum, black except for the apical half which is partly dark reddish, palpi nearly typical; *thorax* covered with an abundance of slender hairs which are ochreous on the dorsulum where they are a little shorter than the blackish hairs on the mesopleuræ, dorsulum dullish, finely reticulated and closely punctured with rather indefinite punctures, notauli represented by a shining line, mesopleuræ with blackish hairs, except along the upper margin where the hairs are concolorous with the hairs of the dorsulum, scutel hairy and sculptured much like the dorsulum except for being less finely sculptured, metanotum hairy and sculptured like the dorsulum except that the sculpture is coarser, tegulæ dark brownish stramineous, reticulated and shiny, wing base partly blackish brown, subcosta blackish brown, stigma pale stramineous with a blackish tinge, rest of veins dull brownish stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell a little before, in or a little beyond the middle and as near or nearer to the first transverse cubitus

as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown except for the tarsi which are more or less brownish stramineous, legs covered with blackish or dark brown hairs, scopa typical, its hairs of a blackish brown hue and concolorous throughout, hind metatarsi at most apparently as wide as mid metatarsi; *propodeum* with its enclosure poorly defined, finely reticulated, not at all rugose, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but covered with ochreous hair, propodeal pleuræ finely reticulate and with sparse indefinite punctures, not hidden by the poorly developed blackish floccus; *abdomen* with its tergum shining, finely reticulated and finely punctured, the punctures poorly defined and from two to six or more puncture widths apart on the first tergite, second, third and fourth tergites sculptured much like the first tergite, second tergite with its elevated portion down the middle : depressed portion :: 29 : 10, fifth tergite with its sculpture of the same kind as the preceding tergite, pygidium black, almost planate and nearly pointed at apex, dullish, without an enclosure, tergum with rather conspicuous blackish hairs, second, third and fourth tergites without a hair band, fimbria blackish brown. A paratopotype has the hair of the dorsulum and scutel reddish and the labrarea truncate, the truncature as wide as the length of the labrarea down the middle.

Andrena (Andrena) sola new species.

Type.—No. 4,047. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*A.*) *subtilis* Smith, and probably a small variety of that species.

Female.—Length 11 mm.; *body* black, mostly covered with pale hairs; *head* with its facial line : transfacial line :: 63 : 84, axial line : temporal line :: 33 : 21, malar line : joint 3 of antennæ :: 1.5 : 10, elevated portion of malar space virtually wanting, head covered with pale ochreous hairs, front finely longitudinally striate on each side of a well-developed median longitudinal crista, not elevated along the inner foveal edge, fovea at most : ocellocular line :: 12 : 17, foveal band well developed, polished and sparsely punctured, fovea nearly contiguous to the upper end of the inner eye margin, distance between fovea and ocelli at the latter point : ocellocular line :: 1 : 17, fovea constricted near its middle where it is apparently only two-thirds as wide as the greatest width

of the fovea, the latter continued below the constriction as a shallow depression down to a point apparently on the clypeal line, fovea with a little more than its upper half seal-brown, the rest pale ochreous, fovarea widest a little below the middle of the fovea, not angulated, its widest part : ocellocular line :: 2.5 : 17, face shiny, delicately reticulated and sparsely punctured, its punctures not well defined and from two to four puncture widths apart, clypeus distinctly elevated above the apical margin, convex, polished and dullish reticulate, punctured as sparsely as the face but the punctures larger and more distinct, clypearea wanting, clypeus thinly hairy, its sculpture not obscured by the pubescence, labrarea truncate, width at base : length down the middle :: 13 : 5, width at apex : length down the middle :: 5 : 5, labrarea at base nearly half as wide as the labrum, the latter with a fringe of dark hairs, joint 3 of antennæ : 4 + 5 :: 10 : 10, joint 4 thicker than long, the succeeding joints from as long as to distinctly a little longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrarea, black except for the apical half which is blackish except for a reddish tinge, palpi nearly typical; *thorax* covered with an abundance of pale hairs which are tawny on the dorsulum where they are shorter than the whitish hairs on the mesopleuræ, dorsulum dullish, reticulated and punctured, the punctures apparently better defined and closer together than the punctures of the face, notauli represented by a shiny line, mesopleuræ distinctly reticulated and punctured somewhat like the face but the punctures larger, with whitish hairs, except along the upper margin where the hairs are tawny as on the dorsulum, scutel hairy and sculptured much like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark brownish stramineous, with a blackish tinge, membrane uniformly tinged with brown, first recurrent vein received by the second submarginal cell before the middle and nearly as near to the first transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown except for the claws which are more or less brownish stramineous, legs covered with whitish and brownish hairs, scopa typical, its hairs of a whitish hue, and concolorous throughout except that the hairs on the upper margin are brownish to almost blackish at base of upper margin, hind metatarsi at most apparently as wide as mid metatarsi; *propodeum* with its enclosure sharply defined, finely reticulated, not at all rugose, rest of upper

face of propodeum sculptured somewhat like the mesopleuræ and covered with whitish hair, propodeal pleuræ with delicate reticulations, more shiny than the mesopleuræ and more sparsely punctured and almost hidden by the whitish floccus; *abdomen* black with a bluish tinge, with its tergum shining, finely reticulated and punctured, first tergite more distinctly and more closely punctured than the face, punctures on the elevated portion of the second and third tergites nearly as close together as on the disc of the first tergite and a little larger than on the depressed portions, second tergite with its elevated portion down the middle : depressed portion :: 18 : 11, fifth tergite dullish and with rather indistinctly defined punctures that are from three to four puncture widths apart, pygidium black, planate, pointed at apex, dullish without an enclosure, tergum with inconspicuous pale hairs, second, third and fourth tergites without a hair band, fimbria pale seal-brown.

Other Locality.—Half way up Mt. Hamilton Road near San José, California, on wild cherry (H. Morrison, 1,477).

Andrena (Andrena) stictigastra new species.

Type.—No. 4,036. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Presumably related to *A.* (*A.*) *fulvinigra* Viereck and Cockerell.

Female.—Length 9.5 mm.; *body* black, covered throughout with black or blackish brown hairs; *head* with its facial line : transfacial line :: 57 : *80, axial line : temporal line :: 30 : 17,* malar line : joint 3 of antennæ :: 2 : 7.5, elevated portion of malar space barely represented, head covered with black or blackish brown hairs, front coarsely striated, fovea at most : *ocellocular line :: 10 : 16, foveal band poorly developed, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 5 : 16, fovea constricted near its middle where it is apparently half as wide as the greatest width of the fovea, the latter continued below the constriction as a shallow depression down to a point apparently on the clypeal line, fovea with dark hair,* fovarea wanting, face polished, not so densely punctured as the clypeus, clypeus slightly elevated above the apical margin, convex, shining, covered with distinct adjoining or nearly adjoining punctures, clypearea exceedingly narrow but extending nearly from base to apex, clypeus thinly hairy with dark hairs, labrarea rounded truncate, its width at base : length down the middle :: 10 : 5, width at apex : length down the middle :: 3 : 5, labrarea at base nearly half as wide as the labrum, the

latter with a fringe of dark hairs, joint 3 of antennæ : 4 + 5 :: 8 : 6.5, joint 4 thicker than long, *the succeeding joints at most a little longer than thick, antennæ blackish throughout,* mandibles typical, robust, not extending to the outer edge of the labrum, but slightly overlapping below the middle of the labrum, black except for the apical third which is dark reddish, palpi nearly typical; *thorax* covered with blackish hairs which are darkest on the dorsulum where they are shorter than the dark brownish hairs on the mesopleuræ, dorsulum dullish, finely reticulated, coarsely punctured, the punctures from nearly adjoining to six puncture widths apart, the punctures mostly sparsely distributed, notauli represented by an impressed shining line, mesopleuræ sculptured much like the scutel but more coarsely so, with dark brownish hairs, except along the upper margin where the hairs are blackish, scutel hairy and exceedingly densely punctured, its punctures as close together as possible, metanotum hairy and sculptured like the scutel except that the sculpture is apparently not so coarse, tegulæ blackish stramineous, with blackish margins, polished, wing base partly blackish brown, membrane with a uniform blackish brown tinge, subcosta blackish brown, stigma bright brownish, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus not interstitial but nearly so, received by the median cell and forming an acute angle with the second abscissa of the median vein and with the first abscissa of the discoidal vein, legs blackish brown except for the claws which are more or less brownish stramineous, legs covered with blackish hairs, scopa typical, its hairs of a blackish brown hue, and concolorous throughout, hind metatarsi at most apparently as wide as mid metatarsi; *propodeum* with its enclosure well defined, coarsely sculptured in addition to having at least five well-defined longitudinal carinæ on each side of a median longitudinal carina, rest of upper face of propodeum sculptured somewhat like the metanotum but not so finely and covered with blackish brown hair, propodeal pleuræ shining, delicately reticulated and with sparse shallow punctures, not nearly hidden by the blackish brown floccus; *abdomen* with its tergum polished, punctured, the punctures clear cut but small and from one to four puncture widths apart on the first tergite, from one to three puncture widths apart on the elevated portion of the second and third tergites where the punctures are seemingly larger than on the depressed portions

and from one to three puncture widths apart on the depressed portions of the second and third tergites, second tergite with its elevated portion down the middle : depressed portion :: 13 : 6, fourth tergite more sparsely punctured than second and third, fifth tergite with its punctures sparse, ill defined and surrounded by fine reticulations, pygidium dullish, slightly convex, rounded broadly truncate at apex, tergum with inconspicuous blackish hairs, second, third and fourth tergites without a hair band, fimbria blackish brown or dark seal-brown. The parts described in italics have been destroyed by museum pests, so the italicised points are what will probably be found in a perfect specimen.

Andrena (Andrena) subnigripes new species.

Type.—No. 4,018. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*A.*) *nigripes* Provancher.

Female.—Length 10 mm.; *body* black, mostly covered with pale hairs; *head* with its facial line : transfacial line :: 55 : 77, axial line : temporal line :: 30 : 17, malar line : joint 3 of antennæ :: 1 : 11, elevated portion of malar space nearly as long as depressed portion, head covered with ochreous hairs, except for some scattered blackish hairs or brownish hairs along the inner eye margin, on the clypeus and mandibles, front longitudinally striate, dullish, with a well-defined median longitudinal crista, fovea at most : ocellocular line :: 10 : 16, foveal band poorly developed, dullish, with a few large punctures, fovea nearly contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 5 : 16, fovea constricted near its middle where it is apparently half as wide as the greatest width of the fovea, the latter continued below the constriction as a narrowing depression down to a point apparently midway between the clypeal line and the antennal line, fovea with pale seal-brown hairs above the middle, pale ochreous nearly white hairs below the middle, face partly shining, partly dullish, reticulated and with a few large scattered punctures, clypeus decidedly elevated above the apical margin, feebly convex, with a median longitudinal shining welt at the anterior edge, mostly finely reticulated, dullish and indistinctly punctured, clypearea represented by the welt described above, otherwise wanting, clypeus with its elevated edge shining, labrarea rounded at apex, nearly triangular, width at base : length down the middle :: 14 : 4, labrarea at base nearly two-thirds as wide as the labrum, the latter with a fringe of dark

hairs that have pale tips, joint 3 of antennæ : 4 + 5 :: 11 : 7.5, joint 4 thicker than long, like the fifth, the succeeding joints as long as or a little longer than thick except the end joint which is distinctly longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to a little beyond the middle of the labrum, black except for the apical half which is dark reddish, palpi nearly typical; *thorax* covered with an abundance of tawny hairs dorsally and over the tubercles, the hairs as thin and long on the dorsulum as on the mesopleuræ where the hairs are pale ochreous, dorsulum dull, finely reticulated, and closely punctured, the punctures from one to three puncture widths apart on the anterior third, less distinct and more widely separated on the posterior half where the dorsulum is in addition finely longitudinally striated, notauli represented by a shining line, mesopleuræ with pale ochreous hairs, except along the upper margin where the hairs are tawny like on the dorsulum, sculptured somewhat like the anterior third of the dorsulum except that the punctures are represented by pits, scutel hairy and sculptured much like the dorsulum except for being less distinctly sculptured and not striate, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and nearly hidden by the hairs, tegulæ dark brown, polished, wing base partly dark brown, subcosta blackish brown, stigma brownish stramineous with a blackish tinge, rest of veins dull brownish stramineous, membrane with a brownish tinge, first recurrent vein received by the second submarginal cell before the middle and not as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus nearly interstitial and forming an acute angle with the median vein and the first abscissa of the discoidal vein, legs blackish except for the tarsi which are more or less blackish brown, and the claws which are reddish stramineous, legs covered with blackish hairs, excepting the femoral hairs and the flocci which are pale ochreous, scopa typical, its hairs of a blackish hue, and concolorous throughout, hind metatarsi at most apparently as wide as mid metatarsi, the latter with pale hairs along the upper edge; *propodeum* with its enclosure poorly defined, finely reticulated, with short feeble rugæ along the basal edge, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but not so coarsely and covered with pale ochreous hair, propodeal pleuræ nearly hidden by the pale ochreous floccus, reticulated and with a few scattered shallow pits; *abdomen* with its tergum shining, rather indistinctly punctured, the punctures from two to five puncture widths apart, first tergite with its punctures not so close together as the

punctures on the elevated portion of the second and third tergites where the punctures are from two to five puncture widths apart, depressed portions of the second, third and fourth tergites almost impunctate, second tergite with its elevated portion down the middle : depressed portion :: 17 : 11, fifth tergite with its punctures coarse and as many as five or six puncture widths apart, pygidium not planate but convex, nearly pointed at apex, tergum with inconspicuous dark brown or blackish hairs, first tergite with some pale hairs, tergum not fasciate, blackish to dark seal-brown.

Andrena (Andrena) tæniata new species.

Type.—No. 4,049. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*A.*) *peckhami* Cockerell.

Female.—Length 11 mm.; *body* black, mostly covered with whitish hairs; *head* with its facial line : transfacial line :: 63 : 79, axial line : temporal line :: 35 : 22, malar line : joint 3 of antennæ :: 2 : 10, elevated portion of malar space nearly wanting, head covered with whitish hairs, front dullish, finely longitudinally striate, with a well-developed crista, and not elevated along the inner margin of the fovea, fovea at most : ocellocular line :: 11 : 16, foveal band nearly wanting, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 5 : 16, fovea not constricted near its middle, nearly parallel sided throughout and continued below as a shallow furrow down to a point apparently on the clypeal line, fovea whitish or pale ochreous, fovarea wanting, face shining, almost polished, punctured, the punctures close together and rather poorly defined, clypeus distinctly elevated above the apical margin, slightly convex, with a basal and lateral reticulate punctured margin and a nearly polished punctured disc, the punctures from nearly adjoining to five puncture widths apart, clypearea poorly developed, clypeus thinly hairy, its surface not hidden, labrarea emarginate beneath what appears to be the apical truncature, width at base : length down the middle :: 14 : 4, width at apex : length down the middle :: 7 : 4, greatest length of labrarea : width at base :: 5 : 14, labrarea at base two-thirds as wide as the labrum, the latter with a fringe of pale stramineous hairs, joint 3 of antennæ : 4 + 5 :: 10 : 9, joint 4 a little thicker than long, joint 5 as long as thick, the succeeding joints apparently a little longer than thick, antennæ blackish throughout, end joint distinctly longer than thick, mandibles typical, robust, extending to a little

beyond the middle of the labrum, black except for the apical half which is mostly dark reddish, palpi nearly typical; *thorax* covered with an abundance of whitish hairs which are shorter on the dorsulum where they are pale ochreous than the whitish hair on the mesopleuræ, dorsulum dullish, punctured and finely reticulated throughout, its punctures mostly from one to two puncture widths apart, notauli represented by a shiny line, mesopleuræ with whitish hairs throughout, punctured and finely reticulated, the punctures much sparser than on the dorsulum, scutel hairy and sculptured much like the dorsulum except for being more distinctly punctured, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark brownish, stramineous, polished, wing base partly blackish brown, subcosta blackish brown, stigma pale brownish stramineous, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, the second abscissa of the radius shorter than the first, nervulus forming an acute angle with the second abscissa of the discoidal vein and received by the first discoidal cell, legs blackish brown except for the claws which are more or less brownish stramineous, legs covered with whitish hairs, the hairs on the tarsi and fore tibiæ dark, scopa typical, its hairs of a pale ochreous or whitish hue throughout, with the hairs at base above slightly darkened, hind metatarsi at most apparently as wide as mid metatarsi; *propodeum* with its enclosure poorly defined, triangular, finely reticulated, not at all rugose, rest of upper face of propodeum sculptured somewhat like the mesopleuræ but more closely punctured and covered with whitish hair, propodeal pleuræ delicately reticulated and punctured, the punctures rather coarse and from two to eight or more puncture widths apart, not hidden by the whitish floccus; *abdomen* with its tergum shiny, punctured and delicately reticulated, first tergite with its punctures finer and closer together than on the propodeal pleuræ, the punctures of the depressed portion closer together than on the rest of the tergite, on the elevated portion of the second, third and fourth tergites the sculpture is denser than on the elevated portion of the first tergite, on the depressed portions of the second, third and fourth tergites the sculpture is mostly hidden, second tergite with its elevated portion down the middle : depressed portion :: 19 : 9, fifth tergite with its sculpture coarser, its punctures not so well defined as on the preceding tergites, pygidium brownish

with a blackish apical half, slightly convex at apex where it is finger shaped in outline, tergum with inconspicuous blackish and whitish hairs, second, third and fourth tergites with a well-defined apical whitish hair band, fimbria pale brownish stramineous.

Andrena (Andrena) yumorum new species.

Type.—No. 4,019. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California (E. Norton).

Presumably related to *A.* (*A.*) *micranthophila* Cockerell.

Male.—Length 13.5 mm.; *body* black, mostly covered with black hair; *head* with its facial line : transfacial line :: 77 : 94, axial line : temporal line :: 42 : 21, temples rounded, subtrapezoidal, malar line : joint 3 of antennæ :: 2 : 12, elevated portion of malar space much shorter than the depressed portion, head covered with long slender hairs throughout, clypeal hairs and a tuft adjoining mandibles whitish, supraclypeal area and area around base of antennæ with a mixture of whitish and blackish hairs, mandibles and labrum with pale hairs, rest of head with black hairs, front partly sparsely pitted, mostly coarsely striate, ocellocular line : ocelloccipital line :: 20 : 9, face shining, covered with distinct, adjoining or nearly adjoining punctures, clypeus apparently slightly elevated directly above the apical margin, almost polished, convex except on the apical half down the middle where it is apparently slightly concave, and punctured like the face, sculpture of the clypeus nearly hidden by the moustache, labrarea nearly triangularly emarginate on its inferior aspect, its anterior aspect truncate, width at base : length down the middle :: 14 : 7, width at apex : length down the middle :: 6 : 7, length down the middle : greatest length :: 7 : 8, labrarea at base apparently at least twice as wide as the labrum, the latter with a fringe of golden hairs, joint 3 of antennæ : joint 4 :: 12 : 7, joint 4 as long as thick, following joints a little longer than thick by measure although appearing distinctly longer than thick, dullish, flagel nearly straight in outline, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrum, black except for the apical half which is mostly dark reddish, palpi nearly typical; *thorax* covered with an abundance of pale and black hairs, hairs of dorsulum shorter than hair of mesopleuræ, dorsulum distinctly punctured, dullish compared with the face, its punctures smaller and closer together than on the face, in addition covered with black hairs except along the edges where there are pale ochreous hairs, notauli represented by a shining line, mesopleuræ with whitish

hairs except along the hind edge where the hair is black, not reticulated but covered with adjoining punctures that are larger than on the dorsulum, scutel with black hairs and sculptured much like the dorsulum except for a border of pale hairs like on the mesopleuræ, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser and nearly all the hairs are pale ochreous, tegulæ blackish brown, polished, bordered with black hairs except on the anterior third where the hairs are mostly pale ochreous, wing base mostly dark brownish stramineous, subcosta blackish, stigma dark brown with a blackish tinge, rest of veins dull brownish stramineous with a blackish tinge, first recurrent vein received by the second submarginal cell before the middle and at least half again as near to the second transverse cubitus as the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial forming an acute angle with the first abscissa of the discoidal vein, membrane in median and submedian cells nearly colorless, rest of membrane with a distinct brownish tinge, the broad apical margin darkest, legs blackish excepting the tarsi and hind tibiæ which are rather dark blackish brown, legs covered with blackish and brownish hairs except femora and coxæ which have more or less pale hair, hind metatarsi at most hardly wider than midmetatarsi and nearly half as wide as hind tibiæ at apex of the latter; *propodeum* with its enclosure poorly defined, coarsely rugose on its superior aspect, as many as 21 longitudinal carinæ present, truncate at apex, its posterior face finely reticulate, rest of upper face sculptured somewhat like the mesopleuræ but with adjoining pits rather than punctures and covered with long black hair, propodeal pleuræ sculptured apparently like the upper face, the sculpture nearly hidden by the uniformly distributed black hairs; *abdomen* with its tergum polished, blackish, with dark brownish depressed margins, distinctly punctured, the punctures from nearly adjoining to four puncture widths apart on the first tergite, second, third and fourth tergites punctured much like the first, second tergite with its elevated portion down the middle : depressed portion :: 38 : 9, fifth tergite with its basal blackish portion covered with well-defined punctures that are as many as three puncture widths apart, rest of fifth tergite and exposed portion of sixth and seventh tergites dark brown or blackish, anal process broadly truncate at apex, shallowly emarginate, tergum with rather conspicuous black nearly erect hairs that are not supplemented on the sides of the second, third and fourth tergites by apical hair bands, hair at apex of abdomen blackish brown.

Andrena (Parandrena) austrocalifornica new species.

Type.—No. 4,020. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*P.*) *cyanosoma* Cockerell, var.

Female.—Length 8.5 mm.; *body* dark greenish, almost completely covered with short whitish hairs; *head* covered with short hair that is mostly whitish, the only dark or blackish hairs are sparsely scattered along the inner and lower edge of the foveæ, front longitudinally striate throughout except laterally on the lower half where it is reticulate and rather indefinitely punctured, fovea whitish except for a few erect dark hairs, at most almost exactly two-thirds as wide as the ocellocular line is long, attenuated below and reaching distinctly below the antennal line but not to the clypeal line, facial line : transfacial line :: 50 : 61, axial line : temporal line :: 26 : 16, joint 3 of antennæ : joints 4 + 5 :: 7 : 6, joints 4–8 inclusive apparently thicker than long, the remaining joints not much longer than thick, antennæ blackish except that beyond the fourth joint they are brownish beneath, antennæ dullish, end joint typical, clypeus convex, with adjoining and nearly adjoining punctures, clypeus appearing black, covered with sparse whitish hairs, clypearea wanting, labrarea nearly twice as wide at base as at apex and nearly as wide at apex as long down the middle, emargination triangular and shallow, not extending more than one-fifth the length of the labrarea from apex toward base, labrarea at base apparently somewhat more than one-third as wide as the labrum which latter has a fringe of golden hairs, base of mandibles and eye nearly adjoining, the malar space accordingly represented by not much more than a shining line, mandibles black with the apical half mostly reddish castaneous except for a blackish stain near the middle of the apical half, typical in shape, palpi slender, nearly typical; *thorax* covered with whitish hairs that are short and close together on the dorsum and long and more separated on the pleuræ and sternum, dorsulum covered with adjoining or nearly adjoining and not well-defined punctures, dullish, scutel sculptured much like the dorsulum, but more shining, metanotum seemingly reticulated, more coarsely sculptured than the dorsulum, tegulæ, costa, subcosta and stigma mostly blackish brown, rest of veins brownish stramineous, membrane with a distinct brownish tinge, second submarginal cell apparently longer than the first, second abscissa of cubitus apparently as long as the first transverse cubitus, nearly half as long as the third

and a little longer than the fourth abscissa of the cubitus, nervulus received by the median cell, nearly interstitial and forming an acute angle with the second abscissa of the median vein, legs dark brown, covered with whitish or pale ochreous hairs except on the scopa where the hairs of the upper half are brownish like the hairs at the base of hind tibiæ, inner side of hind metatarsus covered with golden brown hairs, scopa loosely arranged, almost typical, onychii dark brown, claws brownish stramineous the latter with brownish tips; *propodeum* with its enclosure funnel shaped, not well defined, rather coarsely reticulated except on its posterior face where it is finely reticulated, rest of propodeum more finely sculptured than the upper aspect of the enclosure, propodeal pleuræ fine reticulated and with a few indistinctly defined punctures, posterior face of propodeum with a narrow median, longitudinal sulcus; *abdomen* not fasciate, not sculptured like the dorsulum, much more finely sculptured, reticulate, in addition to the reticulation there are widely separated, rather indefinite punctures, second tergite depressed distinctly less than one-half but more than one-third, abdomen covered with fine whitish hair that is erect on the basal tergite and appressed elsewhere, depressed portions of second, third and fourth tergites more or less brownish toward the apex which latter is brownish stramineous, ventral aspect of third tergite somewhat brownish, fimbria dark brown, pygidium black, planate, indefinitely sculptured and with an indistinctly defined central area.

Andrena (Parandrena) mendosa new species.

Type.—No. 4,021. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California, no further data; on the locality label is a written j.

Has characters in common with *A.* (*P.*) *andrenoides* (Cresson).

Female.—Length 8 mm.; *body* black, covered with whitish hairs; *head* covered with whitish hairs, with its facial line : transfacial line :: 43 : 72, axial line : temporal line :: 22 : 13, front longitudinally finely striate, foveal hairs whitish, fovea at most half as wide as the ocellocular line is long, fovea attenuated below, extending to or a little below the clypeal line, separated from the eye margin near its upper end by a sloping nearly bare space that is nearly one-sixth as wide as the ocellocular line is long, joint 3 of antennæ : 4 + 5 :: 8 : 6, joints 4–10 inclusive wider or apparently wider than long, terminal joint longer than wide and typical, antennæ black or blackish except beneath on the apical half where they are coffee-brown, face

seemingly sculptureless except for distinct punctures that are apparently at most not more than two puncture widths apart, clypeus convex, almost gabled down the middle, with a broad highly polished clypearea somewhat like in *A.* (*A.*) *miserabilis* Cresson, on each side of the clypearea and above the latter the clypeus is mostly finely reticulated and punctured, the punctures mostly two to three puncture widths apart, clypeus almost bare, labrarea triangular, pointed at apex, at most between one-third and one-fourth as long down the middle as wide at base, labrarea apparently not more than one-third as wide as the labrum, the latter with a fringe of golden hairs, length of malar line : length of joint 3 of antennæ :: 2 : 8, the elevated portion of the malar space apparently no longer than the depressed portion, mandibles typical, robust, not extending to the outer edge of the labrum, with their basal half black, the apical half mostly reddish castaneous, palpi slender, nearly typical; *thorax* covered with whitish hairs throughout, dorsulum finely reticulated, its punctures shallow and from two to six or more puncture widths apart, notauli represented by impressed lines, scutel with its anterior half mostly polished and sparsely punctured, its posterior half finely sculptured, metanotum indefinitely sculptured, tegulæ pale brownish stramineous, wing base darker, subcosta blackish brown, costa dark brown, stigma pale yellowish brown, rest of veins dark brownish stramineous, membrane with a strong brownish tinge, second submarginal cell distinctly shorter than the first, second abscissa of cubitus apparently hardly longer than half of the length of the first transverse cubitus and about one-fifth the length of the third abscissa and exactly as long as the fourth abscissa of the cubitus, nervulus received by the median cell and forming an acute angle with the second abscissa of the median vein, legs black covered with whitish hairs, hair of tibiæ and tarsi rather ochreous, scopa compact, mostly whitish, brownish at base, most of its hairs branched, tarsi and claws dark brownish stramineous; *propodeum* with its enclosure poorly defined, funnel shaped, finely reticulated, upper aspect of propodeum outside of the enclosure finely and coarsely reticulated, pleuræ of the propodeum finely reticulated and with a few punctures; *abdomen* shining, almost polished, delicately reticulated, more finely and sparsely punctured than the dorsulum, second tergite depressed between one-third and one-fourth, abdomen inconspicuously covered with fine whitish hair, second, third and fourth tergites with a distinct apical fringe of white hair that is interrupted in the middle of the second and third tergites, apical margin of fourth tergite brownish,

other depressed margins black, fimbria whitish with an ochreous tinge, pygidium black.

Other Locality.—Nevada (H. K. Morrison).

Andrena (Parandrena) olivacea new species.

Type.—No. 4,022. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*P.*) *perchalybea* Viereck.

Female.—Length 9.5 mm.; *body* greenish and almost completely covered with whitish pubescence, compared with the original description of *A.* (*P.*) *perchalybea* Viereck this species differs as follows: *head* covered with long hair that is whitish throughout, front longitudinally striate except above the antennal scrobes where it is indefinitely reticulate and sparsely punctured, fovea whitish, at most hardly more if more than half as wide as the ocellocular line is long, fovea hardly attenuated below and extending only a little below the antennal line, facial line : transfacial line :: 57 : 72, axial line : temporal line :: 31 : 20, joint 3 of antennæ : joints 4 + 5 :: 9 : 7, black apical third of clypeus separated from the greenish basal portion by a coppery zone, brownish part of antennæ pale yellowish brown; *thorax* covered throughout with whitish hairs, dorsulum with deep punctures, bounding veins of stigma, stigma and costa yellowish stramineous, rest of veins pale brownish stramineous, membrane almost colorless, with a yellowish brown tinge, hair of the black legs more or less whitish with an ochreous tinge, inner side of metatarsi with brownish hairs, plumose hairs of scopa darker than the simple hairs, rather ochreous except at the base of the tibiæ where they are brownish, claws brownish stramineous throughout except that the hind claws are castaneous at their tips; *propodeum* with its enclosure finely sculptured on the posterior aspect, the upper aspect longitudinally rugose on each side of a median longitudinal carina, rest of upper aspect of propodeum coarsely reticulated, rest of propodeum finely reticulated and with widely separated shallow punctures; *abdomen* with its pygidium planate otherwise apparently as in the original description with which this species is compared.

Allotopotype.—The Academy of Natural Sciences of Philadelphia. Length 6.5 mm.; *body* as in the female as described above; *head* with its facial line : transfacial line :: 46 : 53, axial line : temporal line :: 26 : 15, temples neither carinate nor angulate but subtrapezoidal, front striatopunctate, clypeus convex, its punctures adjoining or almost adjoining, clypeus blackish along the

anterior edge, hairs of clypeus forming a moustache that nearly obscures the sculpture, clypearea wanting, malar space virtually wanting, represented by not much more than a shining line, joint 3 of antennæ : joint 4 :: 7 : 3 and : joints 4 + 5 :: 7 : 8, joint 6 and succeeding joints distinctly longer than wide, joint 4 distinctly wider than long, antennæ blackish brown throughout, dullish, end joint typical, clypearea semicircular emarginate to the base, appearing as a nearly triangular tubercle on each side of the emargination, at most the labrarea is hardly half as long as wide at base, otherwise the labrum is much the same as in the female, mandibles robust not so greatly attenuated as in typical *Andrena*, simple, black, apical half mostly reddish castaneous, palpi apparently as in the female; *thorax* as in the female except that the dorsulum is mostly coppery and not so distinctly or closely punctured, nervulus more nearly interstitial but still received by the median cell, stigma and costa dark brownish, the stigma a brighter brown than the costa, otherwise the wings are similar to the wings in the female, legs black, with whitish hairs even on the inner side of metatarsi and all over hind tibiæ, the latter at most distinctly less than twice as wide as greatest width of hind metatarsi, otherwise the legs are much the same as in the female; propodeum as in the female except that the upper aspect both outside and inside the enclosure is rather finely reticulated and that the rather coarse rugæ on each side of the median longitudinal carina in the female are here represented by poorly developed rugæ on each side of the median longitudinal carina; abdomen very similar to the female abdomen, hair at apex whitish with an ochreous tinge, anal process truncate with a pale stramineous margin.

Andrena (Parandrena) perchalybia new species.

Type.—No. 4,023. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Washington State (H. K. Morrison).

Related to *A.* (*P.*) *cyanosoma* Cockerell var.

Female.—Length 9.5 mm.; *body* dark greenish, almost completely covered with dark brown or blackish hair; *head* covered with long hair that is mostly brownish but largely blackish on the face, front longitudinally striate down the middle, punctured and indefinitely reticulate on the sides, fovea seal-brown, at most less than one-half as wide as the ocellocular line is long, but more than one-third as wide as the latter line is long, fovea attenuated below and reaching to or a little below the antennal line, facial line : transfacial line ::

57 : 71, axial line : temporal line :: 33 : 20, joint 3 of antennæ : joints 4 + 5 :: 11 : 9, joints 4–8 inclusive apparently thicker than long, the remaining joints not much longer than thick, antennæ blackish except that beyond the fourth joint they are brownish beneath, antennæ dullish, end joint typical, clypeus convex, with almost adjoining and adjoining punctures, clypeus appearing blackish, almost hidden by the dark brown pubescence, clypearea wanting, labrarea at most apparently a little more than half as long as wide at base and shaped somewhat thus, ᗺ, *i.e.*, like a capital b lying on its straight side, labrarea at base apparently somewhat more than one-third as wide as the labrum which latter has a fringe of golden brown hairs, base of mandibles and eye nearly adjoining, the malar space accordingly represented by not much more than a shining line, mandibles black with the apical half mostly blackish castaneous, typical in shape, palpi slender, nearly typical; *thorax* covered with black or dark brown hairs except around the tubercles where there is some pale, apparently ochreous hair, dorsulum finely reticulated, also with shallow punctures that are as many as four puncture widths apart, scutel and metanotum sculptured much like the dorsulum, the metanotum, however, not so definitely sculptured as the scutel; tegulæ and subcosta blackish-brown, bounding veins of the stigma almost concolorous with the subcosta, stigma yellowish brown, rest of veins brownish stramineous, membrane with a distinct brownish tinge, second submarginal cell apparently longer than the first, second abscissa of cubitus apparently as long as the first transverse cubitus, nearly half as long as the third and a little longer than the fourth abscissa of the cubitus, nervulus received by the median cell and forming an acute angle with second abscissa of the median vein, pubescence of the blackish legs pale brown except that the hair of the fore femora is fuscous like the hair at the base of hind tibiæ; scopa as in *A.* (*P.*) *subchalybea* Viereck except that the simple hairs are ochreous rather than whitish, hair on inner side of hind metatarsus golden brown, onychii and claws brownish stramineous, the latter with castaneous tips; *propodeum* with its enclosure funnel shaped, well defined, finely sculptured and with an irregular net work of rugæ in addition to the underlying sculpture, rest of propodeum except its pleuræ sculptured much like the enclosure but more coarsely so, propodeal pleuræ finely reticulated and with a few crater-like punctures, posterior face of propodeum with a narrow median, longitudinal sulcus; abdomen not fasciate, sculptured like the dorsulum but with distinctly smaller punctures that are apparently,

in part, more widely separated, second tergite depressed distinctly less than one-half but more than one-third, abdomen covered with fine almost whitish hair that is erect on the basal tergite and appressed elsewhere, depressed portions of second, third and fourth tergites more or less brownish stramineous, ventral aspect of third tergite somewhat brownish, fimbria fuscous brown, pygidium convex, black, without an impressed line or other definite sculpture.

Andrena (Parandrena) subchalybea new species.

Type.—No. 4,024. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Has characters in common with *A.* (*P.*) *manifesta* (Fox).

Female.—Length 8.5 mm.; *body* greenish, covered with whitish and black pubescence; *head* with its facial line : transfacial line :: 56 : 64, axial line : temporal line :: 28 : 9, covered with blackish brown pubescence except on the vertex where it is whitish tinged with brown, front longitudinally striate and reticulate, foveal hairs seal-brown, fovea at most less than half but more than one-third as wide as the ocellocular line is long, separated from the eye margin near its upper end by a sloping, nearly bare space that is nearly one-sixth as wide as the ocellocular line is long, fovea attenuated below and almost reaching the antennal line, joint 3 of antennæ distinctly longer than 4 + 5, but distinctly shorter than 4 + 5 + 6, joints 4–10 inclusive wider or apparently wider than long, terminal joint longer than wide and typical, antennæ blackish except the flagel which beyond the third joint is brownish beneath, face with shallow nearly adjoining punctures, clypeus indistinctly punctured, appearing rippled, anterior half of clypeus dark and bronzy almost hidden by the pubescence, clypearea wanting, clypeus convex, labrarea at most not more than half as long as wide at base, triangularly emarginate, labrarea apparently somewhat less than one-third as wide as the labrum which latter has a fringe of shining brownish stramineous hairs, base of mandibles and eye nearly adjoining, the malar space accordingly represented by not much more than a shining line, mandibles robust, blackish, mostly castaneous beyond the basal half, typical in shape, palpi slender nearly typical; thorax covered with whitish pubescence, tinged with brown on the pleura, thoracic pubescence mixed with black or blackish hairs that are easily overlooked on the dorsulum, all hairs black on anterior and posterior margin of mesopleuræ, dorsulum finely reticulated, also with shallow punctures that are as many as five puncture widths

apart, scutel and metanotum sculptured much like the dorsulum, the metanotum with the sculpture indefinite on its posterior edge, tegulæ and wing base dark brown, subcosta and stigma almost concolorous, dark brown, rest of veins and the membrane brownish stramineous, second submarginal cell apparently longer than the first, second abscissa of cubitus apparently as long as the first transverse cubitus, nearly half as long as the third and nearly one and one-half times as long as the fourth abscissa of the cubitus, nervulus received by the median cell and forming an acute angle with the second abscissa of the median vein, pubescence of the brownish to black legs whitish with a brownish tinge excepting the fore legs, the pubescence of which is mostly fuscous, like the hairs at the base of the scopa, scopa loose and nearly typical in character on the lower half where its hairs are simple and whitish, atypical on the upper half where the hairs are mostly branched and brownish, hairs of the inner side of hind metatarsus silvery and pale golden, onychii and claws pale stramineous, the latter with dark tips; *propodeum* with its enclosure funnel shaped, well defined, finely sculptured and with an irregular net work of rugæ in addition to the underlying sculpture, rest of propodeum except its pleuræ sculptured much like the enclosure but more coarsely so, propodeal pleuræ finely reticulated and with a few crater-like punctures, posterior face of propodeum with a narrow, median, longitudinal sulcus; *abdomen* sculptured like the dorsulum but with distinctly smaller punctures that are apparently, in part, more widely separated, second tergite depressed distinctly less than one-half but more than one-third, abdomen covered with fine whitish hair that is erect on the basal tergite and appressed elsewhere, depressed portions of second, third and fourth tergites more or less brownish stramineous, ventral aspect of third tergite brownish, fimbria pale brown, pygidium distinctly longer than wide at base, planate, rounded at apex, with a finely sculptured enclosure, the sculpture of which resembles stippling, base of pygidium pale brown followed by dark brown, most of pygidium black.

Andrena (Parandrena) submoesta new species.

Type.—No. 4,025. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California; no further data; on the locality label is a written "u."

Related to *A.* (*P.*) *subchalybea* Viereck.

Female.—Length 7 mm.; *body* greenish and clothed with whitish

hairs, compared with the original description of *A.* (*P.*) *subchalybea* Viereck this species differs as follows: *head* with its facial line : transfacial line :: 40 : 57, axial line : temporal line :: 23 : 13, covered throughout with whitish hairs, front finely longitudinally striate, frontal crista well developed, foveal hairs ochreous, fovea extending nearly to the antennal line, joint 3 of antennæ : 4 + 5 :: 7 : 6, flagel beyond the sixth joint rather pale brownish beneath, face with indistinct punctures that are as many as five or more puncture widths apart and indistinctly reticulated, clypeus sculptured much like the face, clypeus mostly faintly bronzy, its tegument easily seen through the rather thin pubescence, labrarea subtruncate, almost pointed at apex, labral fringe golden; *thorax* including pleuræ with whitish hairs except on the tergum where the hairs have an ochreous tinge, subcosta blackish, stigma and rest of veins almost concolorous, dark brownish stramineous, stigma, costa and radial vein darkest, second abscissa distinctly shorter than the first transverse cubitus, less than half as long as the third and hardly longer than the fourth abscissa of the cubitus, nervulus interstitial and forming an acute angle with the first abscissa of the median vein, legs brownish, covered with whitish or pale ochreous hairs, hairs of femora and tibiæ rather ochreous, scopa almost typical in character, mostly with long, simple, ochreous hairs, hairs along the upper edge shorter, darker and branched, hair at base of scopa brownish, hair on under side of metatarsi golden, onychii and claws as well as the small tarsal joints yellowish stramineous, the claws with dark tips; *propodeum* with its enclosure poorly defined, finely, rather indistinctly reticulate except for some feeble rugæ down the middle and along the basal margin, rest of the upper aspect or the propodeum more distinctly reticulated; *abdomen* with the second tergite depressed hardly more than one-fourth, tergites satiny, ventral aspect of first and second tergites also brownish, second, third and fourth tergites with a distinct apical band of appressed whitish hairs that is interrupted medially on the second and third tergites, fimbria pale golden brown, pygidium mostly hidden by the fimbria, its apex nearly pointed and blackish.

Andrena (Ptilandrena) francisca new species.

Type.—No. 4,026. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California. (No further data.)

Related to *A.* (*P.*) *cærulea territa* Cockerell.

Female.—Length 9.5 mm.; *body* bluish, covered mostly with

blackish hairs; compared with the original description of *A.* (*P.*) *pediculihirta* Viereck this species differs as follows: *head* with its facial line : transfacial line :: 60 : 67, axial line : temporal line :: 27 : 15, covered with blackish hairs except in the foveæ, the latter with seal-brown appressed hairs and long blackish hairs, fovea at most hardly one-half as wide as the ocellocular line is long, extending only a little below the antennal line, separated from the eye margin by a nearly bare band that is nearly one-sixth as wide as the greatest foveal width, front not elevated along the inner edge of the fovea, joint 3 and succeeding joints of antennæ lost but probably the antennæ are as in the species with which this is compared, clypearea wanting, clypeus finely reticulated, sparsely, indistinctly punctured, more sparsely and more indistinctly punctured than the face, blackish except basal half which is greenish and coppery, labrarea subemarginate, at most nearly three times as wide at base as long, the emargination extending nearly one-fourth the distance from apex to base, labrarea about half as wide at apex as at base, malar line short, its proportion probably the same as in the species with which this is compared, mandibles extending to the outer edge of the labrum, black, apical half partly blackish castaneous; *thorax* covered with blackish hairs except on the dorsulum where the hairs are mostly ochreous interspersed with black hairs and on the scutel and the metanotum where the hairs are all ochreous, dorsulum dullish, finely reticulated, somewhat more closely punctured than in the species with which this is compared, notauli represented by almost elevated lines, scutel sculptured much like the dorsulum, metanotum indefinitely sculptured, wing base blackish brown, stigma throughout and all veins except subcosta and membrane dull brownish stramineous, nervulus interstitial, forming an acute angle with the second abscissa of the median vein, legs blackish brown, covered with blackish hairs except on the inner surface of the hind metatarsi where it is pale seal-brown, scopa with blackish, feathery hairs throughout; *propodeum* with its enclosure separable from the surrounding area only by reason of being impunctate, without a median, longitudinal raised line, rest of upper aspect of propodeum greenish blue, sparsely punctured and reticulated, the reticulation nearly the same as in the enclosure, most hairs of upper aspect of propodeum ochreous, rest of propodeum with blackish hairs, propodeal pleuræ greenish blue; *abdomen* with its tergum bluish, not fasciate but covered throughout with blackish hairs except on the first and second segments where there are some ochreous

hairs, fimbria blackish brown, pygidium blackish, slightly convex near apex and nearly pointed.

Andrena (Ptilandrena) nubilifascia new species.

Type.—No. 4,027. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Related to *A.* (*P.*) *pallidifovea* Viereck.

Female.—Length 11.5 mm.; *body* black, mostly covered with whitish hairs, compared with the original description of *A.* (*P.*) *pedieulihirta* Viereck, this species differs as follows: *head* with its facial line : transfacial line :: 35 : 23, covered with whitish hairs except on the labrum and mandibles where the hairs are brownish, foveæ with whitish hairs throughout, separated from the eye margin near its upper end by a nearly bare band that is nearly one-fourth as wide as the greatest foveal width, front not elevated along the inner edge of fovea, joint 3 of antennæ : 4 + 5 :: 10 : 9, joints 4 and 5 apparently thicker than long, the succeeding joints longer than thick, face nearly as closely and nearly as distinctly punctured as the clypeus, the punctures seemingly at most two puncture widths apart, clypeus indistinctly reticulated, and covered with distinct adjoining or almost adjoining punctures, clypeus hardly elevated above the apical margin, labrarea a little more than three times as wide at base as long down the middle and a little more than half as wide at apex as at base, malar line : joint 3 of antennæ nearly :: 1 : 10; *thorax* covered with thin whitish hairs, dorsulum dullish, sculptured much like the clypeus but with its reticulation more distinct, notauli represented by a shining line, scutel mostly more densely sculptured than the dorsulum, its anterior edge shining, metanotum sculptured much like the posterior half of the scutel, nervulus received by the first discoidal cell, nearly interstitial, forming an acute angle with the first abscissa of the discoidal vein, legs covered with dark brown to blackish hairs except on the femora where most of the hair is pale ochreous and on fore tarsi where it is pale golden brown, scopa with blackish brown branched hairs throughout, greatest width of mid metatarsi : greatest width of hind metatarsi :: 11 : 12; *propodeum* with its upper aspect outside the enclosure sculptured almost like the dorsulum but not so distinctly punctured; *abdomen* almost polished and distinctly punctured, with three thin white fasciæ outside of which the tergites are covered with blackish brown hair excepting the first and second and extreme sides of the third and fourth tergites where there is more

or less pale hair, punctures of first tergite spaced nearly as on the dorsulum, second tergite with smaller, closer punctures than the first tergite, indistinctly reticulate, length from base of punctured portion to apex of second tergite : length of depressed margin down the middle :: 28 : 8, third tergite sculptured much like the second, fourth tergite less distinctly punctured but more distinctly reticulated than the preceding tergite, fifth tergite dullish, reticulated and with punctures that are nearly as large and as sparsely or more sparsely distributed than on the first tergite, fimbria dark seal-brown, pygidium slightly convex, nearly truncate at apex, blackish, without an enclosure, indefinitely sculptured, base of pygidium pale brown.

Andrena (Ptilandrena) pediculihirta new species.

Type.—No. 4,028. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Southern California (H. K. Morrison).

Female.—Length 9.5 mm.; *body* black, covered with pale ochreous hairs; *head* with its facial line : transfacial line :: 59 : 73, axial line : temporal line :: 28 : 15, covered with pale ochreous almost whitish hair except in the upper half of the foveæ and on the labrum, front rather coarsely longitudinally striate, foveæ with whitish hairs on the lower half, the upper half with its hairs mostly pale seal-brown, foveæ at most a little more than half as wide as the ocellocular line is long, attenuated below and extending to or close to the clypeal line, hardly separated from the eye margin near its upper end, front welted along the inner edge of fovea, joint 3 of antennæ : 4 + 5 :: 9 : 8, joints 4–10 inclusive apparently thicker than long, the succeeding joints longer than thick, terminal joint typical, antennæ blackish throughout, face shining, indistinctly reticulated, rather indistinctly punctured, the punctures as many as three puncture widths apart, clypeus convex with a narrow, dullish reticulated clypearea down the middle, but not extending to the apex, clypeus on each side of and below the clypearea reticulated and punctured, more closely and distinctly punctured than the face, clypeus decidedly elevated above the apical margin, the elevated edge with a shining border that is nearly sculptureless, clypeus thinly hairy its surface not at all hidden by the hairs, labrarea truncate, nearly four times as wide at base as long down the middle and apparently exactly as long down the middle as wide at apex, labrarea at base nearly half as wide as the labrum, the latter with a fringe of golden brown hairs, malar line : joint 3 of antennæ :: 15 : 8, the elevated portion nearly as long as the depressed portion, mandi-

bles typical, robust, not quite extending to the outer edge of the labrum, with their basal half black, apical half mostly dark reddish, palpi slender, nearly typical; *thorax* covered with pale ochreous, almost whitish hairs, dorsulum shining, partly indistinctly reticulated, partly polished, punctured, the punctures from two to five puncture widths apart, notauli represented by an impressed line, scutel with its anterior half mostly shining almost polished and punctured somewhat like the dorsulum, its posterior half mostly dullish and finely reticulated in addition to being punctured like the anterior half, metanotum sculptured somewhat like the posterior half of the scutel, tegulæ blackish, wing base partly blackish, subcosta and lower edge of stigma blackish, stigma dark reddish brown, stramineous, rest of veins and membrane dull brownish stramineous, first recurrent vein received by the second submarginal cell before the middle and not as near to the first transverse cubitus as the latter is to the stigma on the radius, nervulus received by the median cell, nearly interstitial and forming an acute angle with the second abscissa of the median vein, legs black, tarsi and claws mostly brownish, legs covered with pale ochreous hairs, mid metatarsi distinctly wider than hind metatarsi, scopa rather compact, nearly obscuring the tibia, lower edge with nearly whitish hairs, base of scopa with pale brownish hairs; *propodeum* with its enclosure finely reticulate and with a median, longitudinal raised line, rest of superior aspect of propodeum with a coarse network in addition to indistinct fine reticulation, propodeal pleuræ with very fine reticulations, almost polished, and partly with sparse punctures; *abdomen* shining, indistinctly punctured and reticulated, second tergite depressed more than one-third but less than one-half, tergum with dark brownish appressed hairs, and three white hair bands the first of which is interrupted in the middle, fimbria whitish at base pale seal-brown beyond the middle, pygidium convex, black, finely but indefinitely sculptured, nearly pointed at apex without apparent impressed lateral lines.

Andrena (Scrapter) alamonis new species.

Type.—No. 4,029. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Alamogordo, New Mexico, April 16, 1902 (H. L. Viereck). Related to *A.* (*S.*) *imitatrix* Cresson.

Female.—Length 10 mm.; *body* black, covered with whitish hairs; *head* with its facial line : transfacial line :: 60 : 74, axial line : temporal line :: 32 : 19, black, its pubescence whitish except along

the lower edge of the labrum where it is brownish, fovea with whitish pubescence, fovea nearly three-fourths as wide along the ocellocular line as the latter is long, hardly separated from the eye margin where the ocellocular line joins the latter, fovarea not trenchant, impunctate but represented by a shining space that is widest and almost angulate at a point nearly half way between the anterior ocellus and the antennal line, fovea apparently extending a little below the clypeal line and distinctly extending far below the antennal line, clypearea present, the punctures on each side of it as many as five or more puncture widths apart, elsewhere on the clypeus the punctures are from adjoining to one and two puncture widths apart, clypeus convex, polished, indistinctly or not at all reticulate, mandibles almost entirely blackish or entirely blackish, palpi typical, joint 3 of antennæ slightly though distinctly shorter than joints 4 + 5 or joint 3 : 4 + 5 :: 7 : 8, antennæ blackish brown, labrarea truncate, subemarginate, apparently half again as long down the middle as wide at apex and at least three times as wide at base as at apex; *thorax* black, with whitish pubescence that has an ochreous tinge on the dorsal surface, dorsulum shining, reticulate and distinctly punctured, the punctures from nearly adjoining to five or more puncture widths apart, scutel sculptured like the dorsulum, metanotum more densely sculptured than the scutel, legs pubescent like the thorax except that the hairs are mostly darker with a golden to brownish golden tinge, scopa pale golden, its hairs not so dense as to obscure the tegument, the arrangement and character typical, tarsi rather pale brown except the metatarsi which are very dark brown, hind femora with golden brown hairs at apex, tegulæ brownish stramineous, wing base blackish, stigma dark brown, subcosta blackish, veins brownish stramineous, membrane with a brownish stramineous tinge, first recurrent vein received by the second submarginal cell nearer the second transverse cubitus than the first transverse cubitus is to the stigma, nervulus received by the median cell, nearly interstitial and forming an acute angle with the second abscissa of the median vein; *propodeum* regulose except for the enclosure which is plicate, somewhat as in *A.* (*Scrapter*) *cratægi* Robertson, enclosure defined by the difference in sculpture and with a median longitudinal low crista; *abdomen* polished, black, without a metallic tinge, depressed portion of tergites brownish, the tergites covered with setigerous punctures that are seemingly sparser and distinctly smaller than on the dorsulum; *abdomen* appearing bare without fasciæ, its pubescence whitish

except that the fimbria is pale golden, fifth tergite punctured and dullish, reticulate, pygidium blackish, slightly convex, with a lateral impressed line on each side near the base, smooth and apparently finely sculptured.

Recalls *A.* (*A.*) *cressonii* Robertson and allies, but is no doubt properly placed in species group *imitatrix*.

Andrena (Trachandrena) marioides new species.

Type.—No. 4,030. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Nevada (Morrison).

Related to *A.* (*T.*) *cleodora* Viereck.

Female.—Length 9 mm.; *head* black, its pubescence ochreous except along the lower edge of the labrum where it is brownish, fovea with pale ochreous pubescence, a little more than two-thirds as wide along the ocellocular line as the latter is long, narrowly separated from the eye margin where the ocellocular line joins the latter, fovea deep its boundary along the front almost vertical, fovarea rather well developed, punctured, angulate at a point nearly half way between the anterior ocellus and the antennal line, fovea extending distinctly below the antennal line but apparently falling short of the clypeal line, clypearea wanting, clypeal punctures distinct, adjoining or almost adjoining all over, clypeus convex, polished, apparently not at all reticulate, mandibles black, reddish castaneous near the middle and at apex, palpi typical, joint 3 of antennæ : 4 + 5 :: 4 : 5, antennæ blackish brown, labrarea truncate, apparently as wide at apex as long down the middle and at least two and one-half times as wide at base as at apex; *thorax* black, and with ochreous pubescence that has a reddish tinge on the dorsal surface, dorsulum shining, reticulate and distinctly punctured, its punctures from one to five or more puncture widths apart, scutel sculptured like the dorsulum, metanotum densely sculptured, legs pubescent like the thorax except that the hairs of the tibiæ and tarsi are more golden than ochreous, scopa pale golden its hairs almost dense enough to obscure the tegument, their arrangement and character typical, tarsi and hind tibiæ rather stramineous, rest of legs blackish brown, tegulæ and wing base brownish stramineous, stigma pale brownish stramineous, subcosta blackish brown, border of stigma and remaining veins brownish stramineous, darker than the stigma, first recurrent vein received by the second submarginal cell nearer the second transverse cubitus than the first transverse cubitus is to the stigma, nervulus interstitial and forming an acute

angle with the first abscissa of the discoidal vein; *propodeum* with a well-defined enclosure that is finely reticulate and traversed by rather longitudinal crooked and delicate rugæ, rest of propodeum more coarsely rugose than the enclosure which latter ends in a sharp edge at apex; *abdomen* polished, reddish with blackish stains down the middle of the tergum, without a metallic tinge, depressed portion of second tergite down the middle : elevated portion :: 17 : 7, second, third and fourth tergites with a distinct lateral fascia as in *A.* (*T.*) *salicifloris* Cockerell, abdomen sparsely inconspicuously punctured, the punctures of the elevated portion more distinct than those of the depressed portion, abdominal pubescence whitish with an ochreous tinge, fimbria yellowish golden, fifth tergite dullish, punctured, no definite sculpture between the punctures, planate with a triangular dark reddish brown area that is indistinctly punctured separated from a blackish margin by an impressed line on each side of the pygidium.

In a paratopotype the nervulus is received by the median cell and the first recurrent vein is received by the second cubital cell almost in the middle.

Other Locality.—A paratype from Ogden, Utah, May 16, 1915 (A. Wetmore) [U. S. Biological Survey], has the abdomen reddish throughout and may represent a pale race of this species.

Andrena (Trachandrena) nortoni new species.

Type.—No. 4,031. The Academy of Natural Sciences of Philadelphia.

Type Locality.—California, No. 10 (E. Norton).

Related to *A.* (*T.*) *swenki* Viereck and Cockerell.

Female.—Length 9 mm.; *body* black, mostly covered with bright ochreous hairs; *head* covered with bright ochreous hairs, with its facial line : transfacial line :: 62 : 73, axial line : temporal line :: 30 : 17, malar line : joint 3 of antennæ :: a little more than 1 : 8, elevated portion of malar space nearly as long as depressed portion, front polished and punctured, the punctures as many as three puncture widths apart, not elevated along inner foveal edge, fovea at most : ocellocular line :: 12 : 14, foveal band wanting, fovea virtually contiguous to the upper end of the inner eye margin, distance between fovea and ocelli : ocellocular line :: 1.5 : 14, fovea decidedly constricted near its middle where it is apparently only one-fourth as wide as the greatest width of the fovea, the latter continued below the constriction as a narrowing furrow down to a point apparently on the clypeal line, fovea pale

ochreous throughout, fovarea widest a little below the middle of the fovea, angulated at its widest point where it is as wide as the fovea is wide opposite the angulation of the fovarea, the latter polished and with a few large punctures, face polished, with large adjoining and nearly adjoining punctures, clypeus slightly elevated above the apical margin, convex, polished and punctured much like the face, clypearea present on the apical two-thirds of the clypeus, the latter thinly hairy, its surface not at all hidden by hairs, labrarea truncate, width at base : length down the middle and width at apex :: 10 : 4, labrarea at base half as wide as the labrum, the latter with a fringe of pale golden hairs, joint 3 of antennæ : 4 + 5 :: 8 : 10, joint 4 thicker than long, the succeeding joints longer than thick, antennæ blackish throughout, mandibles typical, robust, extending to the outer edge of the labrum, black except for the apical half which is clear, dark reddish, palpi nearly typical; *thorax* covered with an abundance of slender hairs which are reddish on the dorsulum where they are shorter than the ochreous hairs on the mesopleuræ, dorsulum dullish, finely reticulated, coarsely punctured, the punctures ranging from adjoining to one puncture width apart, notauli represented by an impressed dullish line, mesopleuræ with pale ochreous hairs, except along the upper margin where the hairs are reddish, finely reticulated and mostly covered with shallow, adjoining pits, scutel hairy and sculptured much like the dorsulum except for being less reticulate and distinctly shining, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark brownish stramineous, polished, wing base partly blackish brown, subcosta blackish brown, stigma brownish stramineous with a reddish tinge, rest of veins dull stramineous, with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and a little nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown except for the tarsi and hind tibiæ which are more or less brownish stramineous, legs covered with pale ochreous or golden hairs, scopa typical, its hairs of a golden hue, and concolorous throughout except the hairs at base above which are slightly darkened, hind metatarsi at most apparently as wide as midmetatarsi; *propodeum* with its enclosure feebly defined except at apex where its truncature is bounded by a carina, finely reticulated and in addition with a loose network of sharp rugæ on each side of a median longitudinal carina,

rest of upper face of propodeum sculptured somewhat like the mesopleuræ but with smaller pits, and covered with pale ochreous hair, propodeal pleuræ with sparse shallow excavations that are finely reticulated and almost hidden by the pale ochreous propodeal floccus; *abdomen* with its tergum polished, punctured, the puncture clear cut but small, from two to many puncture widths apart on the first tergite, from adjoining to one puncture width apart on the elevated portion of the second, third and fourth tergites where the punctures are larger than on the depressed portions and from one to four puncture widths apart on the depressed portions of the second, third and fourth tergites, second tergite with its elevated portion down the middle : depressed portion :: 6 : 16, fifth tergite shining reticulate, with its punctures from adjoining to four puncture widths apart, pygidium, black, planate and rounded at apex, tergum with inconspicuous pale hairs, second, third and fourth tergites with a broadly interrupted golden ochreous hair band, fimbria golden ochreous.

Allotopotype.—The Academy of Natural Sciences of Philadelphia.

Length 7 mm.; *body* black, mostly covered with bright ochreous hair; *head* covered with pale ochreous hairs throughout, with its facial line : transfacial line :: 49 : 61, axial line : temporal line :: 26 : 10, temples rounded, subtrapezoidal, malar line : joint 3 of antennæ :: 1.5 : 6, elevated portion of malar space shorter than the depressed portion, front dullish with adjoining, shallow pits that are reticulate, laterally striate-pitted, and striate, ocellocular line : ocell-occipital line :: 13 : 5, face dullish, indistinctly reticulate and with large rather coarse nearly adjoining or adjoining punctures, clypeus apparently not elevated directly above the apical margin, convex, polished and punctured much like the face, clypearea present but not well developed and confined to the anterior half, sculpture of the clypeus nearly hidden by the moustache, labrarea truncate, width at base : length down the middle :: 9 : 2.5, width at apex : length down the middle :: 4 : 2.5, labrarea at base apparently a little more than half as wide as the labrum, the latter with a fringe of pale golden hairs, joint 3 of antennæ : 4 :: 6 : 10, joint 4 and following joints from a little more than twice as long as thick to nearly twice as long as thick, dullish, flagel somewhat undulate in outline, antennæ blackish throughout, mandibles atypical, robust, extending to the outer edge of the labrum, black except for the apical half which is clear dark reddish, palpi nearly typical; *thorax* covered with an abundance of slender pale ochreous hairs, hairs of dorsulum seem-

ingly as long as hair of mesopleuræ, dorsulum dullish, finely reticulated, coarsely punctured, the punctures ranging from adjoining to three puncture widths apart, notauli represented by an impressed dullish line, mesopleuræ with pale ochreous hairs throughout, finely reticulated and mostly covered with shallow, adjoining pits, scutel hairy and sculptured much like the dorsulum, metanotum hairy and sculptured like the dorsulum except that the sculpture is denser, tegulæ dark blackish brown and brownish stramineous, polished, wing base mostly pale stramineous, subcosta brownish stramineous with a blackish tinge, stigma brownish stramineous with a reddish tinge, rest of veins dull stramineous with a blackish tinge, first recurrent vein received by the second submarginal cell beyond the middle and a little nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus interstitial and forming an acute angle with the first abscissa of the discoidal vein, legs blackish brown excepting the tarsi and hind tibiæ which are rather dark brownish stramineous, legs covered with pale ochreous hairs, hind metatarsi at most hardly wider than mid metatarsi and nearly half as wide as hind tibiæ at apex of the latter; *propodeum* with its enclosure feebly defined, not sharply truncate but truncate at apex, finely reticulated and in addition with about six crooked, longitudinal carinæ on each side of a nearly straight median longitudinal carina, rest of upper face sculptured somewhat like the mesopleuræ but with smaller pits and covered with pale ochreous hair, propodeal pleuræ sculptured apparently like the mesopleuræ the sculpture nearly hidden by the uniformly distributed pale ochreous hairs; *abdomen* with its tergum polished excepting the elevated portions of tergites which are partly reticulate but yet nearly polished, punctured, the punctures small and not clear cut, from two to many puncture widths apart on the first tergite, from one to three puncture widths apart on the elevated portion of the second, third and fourth tergites where the punctures are larger than on the depressed portions where the punctures are farther apart, second tergite with its elevated portion down the middle : depressed portion :: 10 : 8, fifth tergite with its basal blackish portion covered with poorly defined punctures that are as many as four puncture widths apart, rest of fifth tergite and exposed portion of sixth and seventh tergites stramineous, anal process dark brownish, emarginate, the emargination forming an obtuse angle, tergum with rather conspicuous pale ochreous hairs that are supplemented on the sides of the second, third and fourth

tergites by ochreous apical hair bands, hair at apex of abdomen pale ochreous.

Other Locality.—San José, California (Hold). One female paratype in the collection of The Academy of Natural Sciences of Philadelphia, Pennsylvania.

Andrena (Trachandrena) quintiliformis new species.

Type.—No. 4,032. The Academy of Natural Sciences of Philadelphia.

Type Locality.—Yosemite, California, June 24, 1902 (B. Chapman).

Related to *A.* (*T.*) *quintilis* Robertson.

Female.—Length 9.5 mm.; *body* black covered with pale and blackish hairs; *head* with its facial line : transfacial line :: 60 : 74, axial line : temporal line :: 30 : 17, covered with pale ochreous hairs excepting most of the broad part of fovea and occiput where the hairs are brownish and on the labrum where the hairs are golden, front elevated along inner foveal edge, coarsely punctured the punctures from one to two puncture widths apart, fovea at most nearly three-fourths as wide as the ocellocular line is long, separated from the eye margin near the upper end by a sloping, nearly bare, punctured band that is in width : ocellocular line :: 1 : 13, fovea decidedly constricted near its middle where it is apparently less than half as wide as the greatest width of the fovea, the latter continued below the constriction as a narrowing furrow down to a point apparently a little below the clypeal line, upper half of fovea brownish, lower half pale ochreous, fovarea widest a little below the middle of the fovea and at its widest point angulated and nearly as wide as the upper end of the narrowest part of the fovea, fovarea polished and with a few large punctures, face polished and with large adjoining and nearly adjoining punctures, clypeus decidedly elevated above the apical margin, convex, polished and punctured much like the face except that laterally some of the punctures are confluent, clypearea present on the apical two-thirds of the clypeus, the latter thinly hairy, its surface not at all hidden by hairs, labrarea truncate, apparently exactly three times as wide at base as long down the middle and nearly half as wide at apex as at base, labrarea at base nearly two-thirds as wide as the labrum, the latter with a fringe of golden brown hairs, malar line : joint 3 of antennæ :: 1.5 : 7, the elevated portion nearly as long as the depressed portion, joint 3 of antennæ : 4 + 5 :: 7 : 9, joints 4 and 5 nearly as long as thick, the succeeding joints longer than thick, antennæ blackish throughout, mandibles typical, robust, not quite extending to

the outer edge of the labrum, black except for part of the apical half which is dark reddish, palpi slender, nearly typical; *thorax* with a velvety covering of coarse pale ochreous hairs except on the dorsulum where the posterior half inside the notauli is mostly covered with coarse blackish hairs, dorsulum polished, partly indistinctly reticulated, coarsely punctured, the punctures ranging from confluent to one puncture width apart, notauli represented by an impressed shining line, mesopleuræ with pale ochreous hairs, coarsely sculptured somewhat like the metanotum but with larger, more distinct punctures, scutel hairy and sculptured like the anterior third of the dorsulum, metanotum with hairs like on the scutel, but more densely hairy, dullish and with its punctures less distinct and closer together, tegulæ blackish except for a polished, brownish stramineous portion, wing base blackish, subcosta blackish, costa blackish stramineous, stigma dark reddish brown with a blackish tinge, rest of veins blackish stramineous but not so dark as the costa, first recurrent vein received by the second submarginal cell beyond the middle and nearer to the second transverse cubitus than the first transverse cubitus is to the stigma on the radial vein, nervulus received by the median cell, nearly interstitial and forming an acute angle with the second abscissa of the median vein, legs black and blackish brown, claws mostly pale brown, legs covered with pale ochreous hairs except on the tibiæ and tarsi where it is darker, rather pale brownish, scopa typical, its hairs pale ochreous except at base above where they are dark brown, mid metatarsi at most apparently as wide as hind metatarsi; *propodeum* with its enclosure sharply defined especially posteriorly where its truncature is bounded by a carina, finely reticulate and in addition traversed by at least seventeen longitudinal crooked carinæ, rest of upper aspect of propodeum appearing to be coarsely reticulate and covered with pale ochreous hairs, pleuræ of propodeum with sparse shallow excavations that are finely reticulated and almost hidden by the pale ochreous propodeal floccus; *abdomen* with its tergum polished, punctured, the punctures clear cut, adjoining on the elevated basal portions of the second, third and fourth tergites, usually one puncture width or a little more apart on the first tergite and on the depressed portion of the second, third and fourth tergites, second tergite with its elevated portion down the middle : depressed portion :: 10 : 15, fifth tergite with adjoining or nearly adjoining punctures and reticulate, pygidium blackish, slightly convex, nearly pointed, with an elevated enclosure, tergum with inconspicuous

blackish hairs except at base and laterally where there are some pale hairs, second, third and fourth tergites with a medially interrupted white hair band, fimbria blackish brown.

Other Localities.—California, one paratype with a written n on the locality label, nothing more [Acad. Nat. Sci. Phila.]; one paratype, Fallen Leaf Lake, California, June 21, 1915 (A. K. Fisher) [U. S. Biological Survey].

November 21.

Mr. Charles Morris in the Chair.

Seventy-one persons present.

The Publication Committee reported the reception of papers under the following titles:

"Some aboriginal sites on Green River, Kentucky," by Clarence B. Moore (April 2). (For publication in the Journal.)

"The zoological position of Sarcosporidia," by Howard Crawley (April 26).

"The flounders of the genus Hippoglossoides," by Carl L. Hubbs (May 3).

"Cold-blooded vertebrates from Costa Rica and the Canal Zone," by Henry W. Fowler (May 18).

"Notes on fishes of the orders Haplomi and Microcyprini," by Henry W. Fowler (May 18).

"On some varieties of Thais lapillus in the Mount Desert Region," by Harold L. Colton (June 12).

"New genera and species of Gastropoda," by Bruce Wade (June 22).

"A possible partial explanation of the visibility and brilliancy of comets," by Daniel M. Barringer (July 1).

"The nervous system of Crepidula adunca and its development," by Harold Heath (September 18).

"New or little-known crane-flies from the United States and Canada, Part III," by Charles P. Alexander (October 16).

"New species of North American bees of the genus Andrena from west of the 100th meridian," by Henry L. Viereck (October 21).

"On Moschites verrucosa (Verrill) and its allies," by S. Stillman Berry (October 24).

The deaths of the following members were announced:

Alexander W. Biddle, M.D.
Eckley Brinton Coxe, Jr.
Alexander Uhle, M.D.
Alexander Brown.
Theodore N. Ely.

The deaths of the following correspondents were also announced:

Elias Metschnikoff.
Edgar A. Smith.

R. J. L. Guppy.
Thomas Lauder-Brunton.
Edgar A. Mearns, U. S. Army.

Dr. Henry Skinner made a communication, illustrated by lantern slides, on a collecting tour in eastern Cuba. (No abstract.)

The following were elected members:

C. W. Weidenbacker.
Arthur H. Thomas.

A paper by Henry L. Viereck on Andrena was ordered to be published. See page 550.

December 19.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Twenty-four persons present.

The deaths of Edwin A. Barber and Edward P. Borden, members, were announced.

The Publication Committee reported the reception of the following papers:

"Third synonymic study of the mollusks of the Department of Alpes-Maritimes mentioned by Antoine Risso, with notes on their classification," by Commandent E. Caziot. Translated by William H. Dall. (Transferred to *The Nautilus*.)

"Notes on Salamanders," by Henry W. Fowler and Emmett Reid Dunn.

The following annual reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

The six meetings now provided for by the By-Laws were held December 21, 1915, January 18, February 15, March 21, April 18 and November 21, 1916. Communications were made by William P. Magie and Daniel M. Barringer, Witmer Stone, Edwin G. Conklin, Merkel H. Jacobs, and Henry Skinner.

Twenty-three papers have been presented for publication, as follows: Henry W. Fowler, 2; William H. Dall, 2; Nathan Banks, 1; J. A. G. Rehn and Morgan Hebard, 1; R. W. Shufeldt, 1; J. Henderson and L. E. Daniels, 1; H. A. Pilsbry, 1; George W. Tannreuther, 1; T. D. A. Cockerell, 1; Walter Sonneberg, 1; Joseph C. Thompson, 1; Clarence B. Moore, 1; Howard Crawley, 1; Carl L. Hubbs, 1; Harold S. Colton, 1; Bruce Wade, 1; D. M. Barringer and Elihu Thomson, 1; Harold Heath, 1; Charles P. Alexander, 1; Henry L. Viereck, 1; S. Stillman Berry, 1.

Sixteen of these communications have been published in the Proceedings, one in the Journal, five have been returned to the authors, and one awaits the action of the Publication Committee.

Six hundred and twenty-two pages of the Proceedings with thirty-two plates have been issued. We are indebted to Mr. Clarence B. Moore for the third part of the sixteenth volume of the Journal, consisting of eighty pages and four beautiful plates in color.

Mr. Morgan Hebard contributed $301.79 toward the expense of publishing the second number of the Proceedings for 1916.

The American Entomological Society (Entomological Section of the Academy) has published four hundred and thirty-four pages, with twenty plates of the Transactions, and four hundred and eighty pages and twenty-five plates of the Entomological News. A new series, entitled Memoirs, has been begun, of which one hundred and forty-one pages have been issued.

The Manual of Conchology has been increased by one hundred and sixty-eight pages and twenty-eight plates, completing the twenty-third volume and the first part of the twenty-fourth.

The Academy's contributions to science, therefore, during the past year totals 1,925 pages and 109 plates.

The interruption in the exchange service due to the war, reference to which is made in the report of the Librarian, still continues.

Well-bound copies of the centenary volume of the JOURNAL and of the INDEX TO PUBLICATIONS were expressed to Mr. Peter H. Goldsmith, Director of the Pan-American Division of the American Association for International Conciliation, as a contribution to a library of American books to be placed in Buenos Ayres in furtherance of the admirable object of the society. The binding was paid for by the President of the Academy.

Eight members have been elected. Fifteen deaths have been announced. Resignations of membership have been received from Charles D. Hart, Silas L. Schumo, and John M. Reynolds. Three have been dropped from the roll.

The special appointments by the Council: the Standing Committees, the Councillor, the Curator of the William S. Vaux Collections, and the Custodian of the Lea Collections, remain without change.

Under the provisions of the endowment of the Hayden Memorial Geological Award, a gold medal is to be again conferred next year upon a geologist or paleontologist whose work deserves the recognition. A committee consisting of R. A. F. Penrose, Jr., Amos P. Brown, Edgar T. Wherry, Charles D. Walcott, and Henry F. Osborn, has been appointed by the Academy on the nomination of the Council, to select a worthy recipient. Dr. Penrose has complied with a request to act as Chairman of the Committee.

Revision of the Articles of Agreement with the American Entomological Society, made December 17, 1875, and modified November 27, 1894, was, on the recommendation of the Council, adopted by the Academy, December 21, 1915. By the revised articles the Society agrees to deposit its collections in the Academy in perpetuity, the Academy to take care of such collections to the best of its ability. In case of dissolution of the union, the library of the Society remains in its possession. None but members of the Academy can be elected members of the Society, the meetings of which for scientific or business purposes must be held on the Academy's premises.

By the will of the late John T. Morris, the Academy's relation to the Botanical Garden, Museum, and Library provided for therein is defined. The income of $25,000 is bequeathed to the Academy on the death of the testator's sister.

A successful meeting of the American Ornithologists' Union was held in the library, lecture hall, and museum from November 13 to 16.

Six courses of lectures were delivered on Mondays from January

10 to May 1. Three were by Dr. Witmer Stone on wild bird life, one by Dr. B. F. Royer on oral hygiene, four by Dr. H. A. Pilsbry on shells and shell fish, three by Dr. Henry Skinner on insects, three by Dr. Spencer Trotter on the wanderings of animals, and three by Dr. Stone on the wild flowers of Pennsylvania and New Jersey.

In addition, seven afternoon lectures were delivered to students of the Girls' High School by Drs. Skinner, Pilsbry, Moore, and Stone.

The withdrawal of Mr. Delos Culver as a Jessup Fund Beneficiary was reported.

EDWARD J. NOLAN, *Recording Secretary.*

REPORT OF THE CORRESPONDING SECRETARY.

The further decrease in foreign correspondence, due to the almost complete cessation of receipts from central Europe, has resulted in a smaller total of communications for 1916 than for many years.

No new correspondents were elected, but the following named died: Orville A. Derby, Elias Metschnikoff, Edgar A. Smith, José M. Rovirosa, R. J. Lechmere Guppy, Sir Thomas Lauder Brunton and Edgar A. Mearns. The decease of several other correspondents, as one of the unfortunate results of the European War, has been reported, but it has been impossible to secure satisfactory verification.

There have been no international scientific congresses and few events of scientific importance in this country in which this Academy was invited to participate. Invitations were received from the Kitasato Institute in Tokyo, the City Club of Philadelphia, the Philadelphia Electric Company, the American Branch of the League to Enforce Peace, the California Academy of Sciences, the College of Engineering of the University of Illinois and the committee in charge of the fiftieth anniversary of the scientific activity of Alexander Karpinsky. A letter of congratulation sent to Professor Karpinsky elicited an appreciative response.

Thanks were received also from the Ohio Academy of Sciences for the appointment of a delegate and the sending of a congratulatory message and from the American Ornithologists' Union for courtesies received during the recent meeting in the Academy's building.

Miscellaneous correspondence was conducted as usual.

Statistics of the correspondence transacted follow:

Communications received:

Acknowledging the receipt of the Academy's publications	145
Transmitting publications to the Academy	26
Requesting exchanges or the supply of deficiencies	5
Invitations to learned gatherings, celebrations, etc	5
Notices of deaths of scientific men	5
Circulars concerning the administration of scientific and educational institutions, etc	12
Photographs and biographies of correspondents	4
Letters from correspondents	24
Miscellaneous letters	48
Total received	272

Communications forwarded:

Acknowledging gifts to the library	1,001
Requesting the supply of deficiencies	151
Acknowledging gifts to the museum	106
Acknowledging photographs and biographies	4
Letters of sympathy and congratulation, addresses, etc	6
Diplomas and notices of election of correspondents and delegates' credentials	19
Miscellaneous letters	119
Annual reports and circulars sent to correspondents	181
Total forwarded	1,587

Respectfully submitted,

J. Percy Moore, *Corresponding Secretary.*

REPORT OF THE LIBRARIAN.

The library of the Academy during the past year has been increased by 6,086 additions. Of these 578 were volumes, 5,344 were pamphlets and parts of periodicals. There were 160 maps, photographs, and one sheet.

They were received from the following sources:

Exchanges	2,843	United States Bureau of Education	32
Isaiah V. Williamson Fund	1,062	Department of Marine and Fisheries, Ottawa	32
United States Department of Agriculture	698	Imperial Department of Agriculture, British West Indies	27
General Appropriation for purchase of books	299	Henry A. Pilsbry	27
James Aitken Meigs Fund	98	California State Commission of Agriculture	27
Authors	98	Pennsylvania Department of Agriculture	26
Editors	76	New York Agricultural Experiment Station	24
Board of Agriculture, London	76	Commission of Telegraph, Mato Grosso, Brazil	23
American Entomological Society (Entomological Section of the Academy)	73	Trustees of British Museum	22
North Carolina Geologic and Economic Survey	52		
Colorado Agricultural College	34		

Miss H. N. Wardle	22
Library of Congress	20
Thomas B. Wilson Fund	19
Argentine Government	19
U. S. Department of the Interior	18
William J. Fox	15
Pan-American Union	14
Pennsylvania Department of Health	13
New York State College of Forestry	13
U. S. Department of Commerce and Labor	12
Secretary of Works, Mexico	12
California Fish and Game Commission	11
American Iron & Steel Institute	10
Henry Skinner	10
Department of Mines, Queensland	10
University of Michigan	10
National Academy of Sciences	9
Museum of the American Indian Heye Foundation	9
Publication Committee of the Academy	7
Edward J. Nolan	7
Lowell Observatory	7
University Geological Survey of Kansas	7
Vermont Agricultural Experiment Station	7
Tennessee State Geological Survey	6
Ohio Biological Survey	6
Statens Skogsförsöksanstalt, Stockholm	6
Department of the Naval Service, Ottawa	6
Thornwell Museum	6
Samuel G. Dixon, M.D.	6
University of Wyoming	5
Seismologic Station of Cartuja	5
Estate of Albert Lucas	5
United States War Department	4
Direccion de Estudios Biologicos, Mexico	4
New Mexico College of Agriculture and Mechanic Arts	4
East Indian Government	4
Commission of Conservation, Canada	4
Wallace G. Levison	4
Department of Agriculture, Costa Rica	4
James A. G. Rehn	3
University of Tennessee	3
Mississippi State Geological Survey	3
Michigan Geological and Biological Survey	3
Indiana University	3
Louisiana State Museum	3
Geological Commission of Finland	2
Colorado Museum of Natural History	2
Seismological Society of America	2
Delaware County Institute of Science	2
Office National des Universités et Écoles françaises	2
Geological Survey of Alabama	2
Commissioners on Fisheries and Game, Massachusetts	2
Illinois State Geological Survey	2
Maryland Geological Survey	2
Department of Trade and Customs, Australia	2
Dr. Ida A. Keller	2
State Entomologist, Illinois	2
Peabody Museum	1
State Board of Charities, New York	1
Boston City Hospital	1
Harvard University	1
Wisconsin Geological and Natural History Survey	1
Geological Survey of Ohio	1
Department of Fisheries, Bengal, Bihar and Orissa	1
Observatory of Madrid	1
United States Brewers' Association	1
Danish Government	1
Government of Formosa	1
Missouri Bureau of Geology and Mines	1
Warren Academy of Sciences	1
George H. Clapp	1
Massachusetts State Board of Agriculture	1
Yale University	1
Miss Emily H. Thomas	1
Zoological Society of Philadelphia	1
West Virginia Geological Survey	1
Second Pan-American Scientific Congress	1
Cuerpo de Ingenieros de Minas del Peru	1
Bentham Trustees, Kew Gardens	1
George L. Harrison, Jr.	1
New Jersey Department of Conservation and Development	1
New South Wales State Fisheries	1
Albert de Monaco	1
Geological Survey of Georgia	1
Tiflis Seismological Station	1
Philadelphia Museums	1

Dr. W. K. Shea	1	Clarence B. Moore	1
Cornell University Agricultural Experiment Station	1	Florida State Geological Survey	1
Rockefeller Foundation	1	Jardim Botanico do Rio de Janeiro	1

These additions have been distributed to the several departments of the library as follows:

Journals	3,788	Medicine	23
Agriculture	948	Mineralogy	21
Geology	448	Bibliography	19
Geography	153	Mammalogy	18
Botany	127	Physical Sciences	11
General Natural History	102	Helminthology	7
Entomology	86	Chemistry	3
Anthropology	79	Philology	3
Ornithology	40	Herpetology	1
Ichthyology	30	Dictionaries	1
Conchology	29	Encyclopedias	1
Anatomy and Physiology	26	Miscellaneous	36
Voyages and Travels	26		

Among the more important works received are

Herrich-Schaffer. Neue Schmetterlinge aus Europa, etc. 3 parts. 1856–61.
Meerburg. Plantæ rariores coloribus depictæ (Afbeeldingen van zeldzaame Gewassen). 1789.
Hanley. An illustrated and descriptive catalogue of recent bivalve shells. 1842–56. An extra-illustrated copy from Hanley's own library. Presented by Mr. George H. Clapp.
Nees von Esenbeck, Hornschuh und Sturm. Bryologia Germanica. 2 parts in 3 volumes. 1823–31.
Junghaus. Icones Plantarum rariorum. Centuria I. Folio. 1792.
Beddome. Icones Plantarum Indiæ Occidentalis. Vol. I. 1868–74.

The following journals are new to the collection:

Addisonia. New York.
American Entomological Society, Memoirs.
Anthropological Institute, London. Occasional Papers.
Arbeiten zur Entwicklungspsychologie. Leipzig.
Board of Agriculture, London. Journal.
California Fish and Game Commission. Teachers' Bulletin.
Colombo Museum. Memoirs.
Congreso de Naturalistas Espanoles. Actas y Memorias.
Departmento de Agricoltura, Costa Rica. Publicaciones.
Department of Marine and Fisheries, Ottawa. Annual Report.
Eugenics Review. London.
Geographical Review. New York.
Geologe (Der). Leipzig.
Jardim Botanico de Rio de Janeiro. Archivos.
Journal of Bacteriology. New Haven.
Journal of Ecology. London.
Journal of Micrology. Reading, England.
Junta de Ciencies Naturals, Barcelona. Anuari.
Iowa Naturalist. Iowa City.
Lorquinia. Los Angeles.
Mines Handbook. New York.
Massachusetts State Board of Agriculture. Economic Biology-Bulletin.
Museum of the American Indian Heye Foundation. New York. Contributions.

New Jersey Department of Conservation and Development. Trenton. Annual Report.
New York Mineralogical Club. Brooklyn. Bulletin.
New York State College of Forestry. Syracuse. Bulletin.
Notes on Rhode Island Ornithology. Bristol.
Ohio (The) Journal of Science. Columbus.
Physiological Abstracts. London.
Service Géologique de l'Indochine. Hanoi-Haiphong. Bulletin.
Thornwell Museum. Clinton, South Carolina. Annual Report.
Vermont Agricultural Experiment Station. Bulletin.

Four hundred and four volumes have been bound.

The special catalogue of books subject to loan has been completed and is now in use. Certain works not included in the list may, by order of the Council, be borrowed with the consent of the Librarian.

Under the revised By-law, 61 works in 66 volumes have been loaned. Seven of these are still outstanding. 1,226 works in 1,476 volumes have been used in the study rooms by students of the Academy.

The requirement that these books be registered before removal from the library has resulted in desirable convenience of access and recovery when wanted by other readers.

We are under obligation to Mrs. William H. Bennett for the repair and regilding of the frame containing the portrait of her father, George W. Carpenter, Treasurer of the Academy from December, 1826, until his death, June 7, 1860.

Six volumes and four duplicate pamphlets have been sold.

184 volumes were given by the Academy and 29 by the President to Geneva College, Beaver Falls, Pennsylvania, as a help in replacing the library of that institution, which has been destroyed by fire.

With the rest of the scientific and literary world we are still suffering from the effects of the English embargo on books from Germany and other belligerent nations. The hoped-for relief referred to in my last report, where the subject is treated of at some length, has not been accorded, and notwithstanding strenuous efforts on the part of American importers to secure concessions from the British censors, what has been called "the intellectual famine" continues. The Foreign Trade Adviser of our own Department of State is not apparently able to modify the situation, although, with the Librarian of Congress, he has shown every disposition to do so as far as possible. Shipments sent by way of Rotterdam have been detained on the most trivial pretexts, yet it is only under the protection of the official permits that a supply of current issues and deficiencies can safely be secured. Foreign publishers rarely prepare large editions of the works issued by them and especially is this the case in the present

deplorable condition of affairs, so that if transmissions be lost, the deficiencies in sets can probably never be supplied.

The British Trade Adviser has recently required all institutions to make their own applications. If this rule be insisted upon it will enormously increase the labor and uncertainties of importation. Our own importers make application for ninety-two institutions. The British official will, it is to be hoped, acknowledge the disadvantage of increasing the required documents in that instance alone from one to ninety-two, so that the representations of the Librarian of Congress may secure a modification of this order, but in the meantime we must cultivate such patience as we can until the world is providentially restored to its normal condition.

I am glad to again acknowledge, officially and personally, the zeal and efficiency of my assistants, William J. Fox and Furman Sheppard Wilde.

EDWARD J. NOLAN, *Librarian.*

REPORT OF THE CURATORS.

The year just completed finds the Academy's collections and buildings in better condition than ever before. The members of the museum staff have devoted their time to the care and study of the material in the several departments. Large numbers of specimens have been labelled, catalogued and rearranged, while many groups have been critically studied and specimens redetermined. The accessions to the museum have been numerous and of great value, as shown by the accompanying list of additions.

Much has been done to render the exhibits more accessible and more attractive. Through the appropriation of $10,000, made at the last session of the State Legislature, it was possible to secure 52 plate-glass and mahogany or oak exhibition cases, while four others were purchased from the E. D. Cope Fund and ten from the William S. Vaux Fund.

With these it is possible to complete the furnishing of the Archæological and Mammal floors and the first floor of the north wing, and to transfer to new cases the William S. Vaux Collection of minerals and a large part of the exhibition series of mollusks. Part of the transfer to the new cases has already been accomplished, and the work will be finished during the coming year.

For the study collections 105 metal-covered cases, 420 glass-covered boxes and 1,300 trays were secured for the accommodation

of insects, plants, mollusks, birds, and mammals. The study collections, it should be remembered, constitute the scientific basis of a museum. Specimens in the exhibition cases have, for the most part, a comparatively limited life and in course of time have to be replaced. The study specimens, however, when properly housed and protected from light, dust, and insect pests can be preserved indefinitely.

It is therefore a matter for congratulation that the immense study collections of the Academy containing the types and historic specimens of a century of scientific research are being rapidly placed beyond danger and their preservation assured.

In no one year has such progress in housing these collections been made as in that just closed.

Early in the year the exhibit of the Pennsylvania Department of Health, which was awarded the grand prize at the Panama-Pacific Exposition, was received at the Academy and installed in the gallery of the Mineralogical Hall, which was temporarily allotted to the State for this purpose, the installation, lighting, and guarding of the exhibit all being assumed by the State.

The exhibit has proven very attractive and instructive and has attracted large numbers of visitors.

The attendance in the museum throughout the year has been large and is constantly increasing, especially the numbers of classes from public and private schools which come under the guidance of their teachers.

Local field work was carried on extensively by several members of the staff, resulting in valuable additions to the collections of fishes, crustaceans, reptiles, batrachians, etc.

Mr. Clarence B. Moore has continued his exploration of the Indian mounds of the Southern States and has provided an additional case for the display of the valuable material secured during the year.

Mr. J. A. G. Rehn was sent to Tucson, Arizona, where, through the courtesy of the American Museum of Natural History, he joined an entomological expedition to the adjoining desert regions. In consideration of his services the Academy will receive a valuable share of the material collected.

Details of the work in the various departments and a list of the accessions are appended.

Mammals.

An air-tight sheet-iron room was fitted up on the fourth floor, close to the mammalian study collections, in which have been hung

all of the tanned skins of large mammals which were formerly stored in the basement. This ensures their safe preservation and provides ready access to them. New tag labels were placed upon them by Mr. Rehn and they were arranged in systematic order.

A number of additional storage cases were made available for the medium-sized mammal skins by the substitution of new storage cases in the bird department and two plate-glass and mahogany exhibition cases were provided from the State appropriation, completing the furnishing of the mammal hall.

Twenty-four mammals have been received from the Zoological Society of Philadelphia, which have been variously prepared by the taxidermist as skins or osteological specimens.

Much use has been made of the study collection during the year and specimens have been loaned to N. Hollister, H. W. Henshaw, and L. A. Fuertes.

Birds.

The relaxing of the old unmounted skins in the study series of Passeres was completed by Mr. D. E. Culver, who was a student on the Jessup Fund during the first half of the year, while the remainder of the trays and the cases have been labelled by Dr. Stone. He has also transferred the skins of the larger birds to the twenty new metal-covered cases provided by the State appropriation. The collection of eggs has also been arranged in new cases and the old wooden cabinets removed.

A number of birds have been identified for the Zoological Society during the year.

During the summer and autumn Dr. Stone, with the assistance of the taxidermist, Mr. McCadden, rearranged the greater part of the Delaware Valley Ornithological Club Collection, incorporating a great deal of new material presented by the Club and relabelling a large part of the exhibit. By removing the shelves and supporting the groups from the back of the case a very much more attractive display has been obtained. The entire series of shore-birds were remounted on natural bases.

With Mr. Rehn's help, the Guatemala and Santa Marta collections received last year have been catalogued.

Two valuable collections were also received during the present year—the L. L. Jewel collection of Panama birds, purchased by subscription by members of the Academy, and an additional lot of specimens from Santa Marta, Colombia, purchased from M. A. Carriker. These comprise some 700 skins.

Many ornithologists have studied the collections at the Academy and specimens have been loaned to J. P. Chapin, W. E. C. Todd, and Albert Laessle.

Reptiles and Batrachians.

Mr. Henry W. Fowler has during the year catalogued 350 specimens and given a careful supervision to the collection, replenishing alcohol when necessary.

He has also conducted extensive field work in Pennsylvania, New Jersey, Maryland, and Virginia, which resulted in securing forty local collections of reptiles, batrachians and fishes. Two papers were published during the year on cold-blooded vertebrates in the Academy collection and two others are now in preparation.

Fishes.

This department has also been under Mr. Fowler's care and much of the work of collecting and publication just described covers the fishes also. Twelve large local collections of Pennsylvania fishes, presented by Mrs. E. S. and W. I. Mattern, deserve special mention, as well as a number of mounted game fishes, the gift of Mr. A. B. Loeb.

Mollusks.

Dr. Henry A. Pilsbry, Special Curator, reports specimens received from 56 persons and institutions. Among the more interesting accessions are a series of the mollusks collected this year in Utah and Idaho by Messrs. Junius Henderson and L. E. Daniels; several hundred lots from Maine, taken by Mr. Bayard Long; a large series of Californian shells from Mrs. Oldroyd, and collections from Guatemala and Panama from Messrs. S. N. Rhoads and D. E. Harrower, respectively.

Studies on the Pupillidæ for a monograph of the family have occupied most of the time of the Special Curator. Considerable additions to our collection of these shells have been obtained from various correspondents.

Mr. E. G. Vanatta has been occupied chiefly with the determination of specimens for correspondents and with labelling and arranging accessions to the museum. Miss Caroline Ziegler has continued the work of cataloguing the collection.

The collection has been consulted by various visiting naturalists, and specimens have been loaned for study to Bryant Walker, Paul Bartsch, and S. S. Berry.

Insects.

Thirty metal cases and 420 boxes were secured with the State appropriation for the accommodation of the collection of insects, and Dr. Henry Skinner, head of this department, and Mr. E. T. Cresson, Jr., have spent the greater part of the year rearranging the collections and mounting recent accessions.

In the Diptera the families Stratiomyiidæ, Tabanidæ (in part), and Leptidæ have been rearranged. Studies have been made of the Ephydridæ by Mr. Cresson. Thirty-two new species were described.

In the order Coleoptera the Horn types have been numbered and the families Dytiscidæ, Hydrophilidæ and part of the Silphidæ rearranged, while many specimens have been identified and added to the collection.

The local collection has also been rearranged.

In the Lepidoptera the American moths have been arranged in the new cases as well as all of the exotic moths, except the Noctuidæ and Geometridæ.

In Orthoptera Mr. J. A. G. Rehn has arranged the exotic Tettigoniidæ and portions of the Blattidæ, Mantidæ, and Acrididæ in the new cases.

He has also continued his studies of the Brazilian Orthoptera in the Academy's collection and material loaned by the U. S. National Museum and Stanford University, while some time has been devoted to the determining of South African collections submitted by the Transvaal Museum, for which work the Academy receives a duplicate series.

Mr. Rehn spent the months of July and August in the field on an entomological expedition to southern Arizona, undertaken jointly with the American Museum of Natural History. Valuable collections were obtained, in which the Academy will share when they are worked up.

Mr. Morgan Hebard has, as in the past, given generously of his time and material toward the development of the Orthoptera collections. He also generously provided a preparator during part of the year, who completed the mounting and labelling of the material obtained in 1915 on the Hebard-Academy expedition in the West.

Many specialists have made use of the collections during the year and a loan was made to E. B. Williamson.

Other Invertebrates.

Mr. Henry W. Fowler has labelled and arranged about 200 small

jars of Crustacea as well as various lots of local Arachnida, Myriapoda, etc., received during the year.

Dr. Witmer Stone collected a large series of Crustacea at Cape May, New Jersey, from which groups were prepared and mounted for exhibition. Bases were constructed representing sand beaches, mud flats, etc., with accessories collected and prepared for the purpose. Some groups of the larger mollusks were also prepared, making eighteen in all, which form an instructive exhibition of the more striking invertebrates of our seacoast.

Vertebrate Fossils.

Mr. William Palmer, of the U. S. National Museum, has studied the collection of fossil cetaceans from the Miocene of Maryland and determined many unnamed specimens. He has also borrowed portions of the series for further study.

Invertebrate Fossils.

Mr. W. P. Woodring, of Johns Hopkins University, has borrowed the series of unnamed fossils from Bowden, Jamaica, in the Academy's collection and is engaged in studying and identifying them.

Mr. Joseph Willcox has presented the Academy with a series of specially selected specimens of Miocene and Pliocene mollusks, comprising the most perfect examples obtained by him in his many years' work in the Tertiary beds of the Southern States, from Virginia to Florida. These make a noteworthy exhibit in the museum and a fitting memorial of Mr. Willcox's palæontological researches.

Herbarium.

The continued illness of Mr. Stewardson Brown has left the herbarium largely dependent upon the voluntary service of Messrs. Bayard Long and S. S. Van Pelt, who have been in attendance a large part of the year and have given personal attention to such matters as have arisen in connection with the department.

Mr. Long has cared for the local herbarium as heretofore, has made critical studies of various groups and accomplished a considerable amount of local field work. Mr. Van Pelt has devoted himself mainly to the mounting of specimens for the local herbarium, amounting to over 3,000 sheets.

Miss Ada Allen has been employed in mounting plants for the general herbarium and has prepared 2,000 sheets.

Mr. Berwynd Kauffman has been employed during part of the

year in cataloguing and distributing the mounted plants that have accumulated during the period of Mr. Brown's illness and has disposed of the greater part of them.

Dr. Witmer Stone and Mr. Van Pelt have resorted the packages of plants in the Porter collection and arranged them temporarily in the 40 new metal cases provided by the State appropriation, placing them in systematic order, so that they may be easily consulted. Messrs. Long and Van Pelt have gone critically over several of the orders, separating the local material and duplicates.

A number of botanists have consulted the herbarium during the year and specimens were loaned to J. M. Greenman, M. L. Fernald, K. K. McKenzie, Agnes Chase, Harold St. John, and E. S. Steele.

Minerals and Rocks.

From the State appropriation six new oak and plate-glass table cases were secured for the William S. Vaux collection of minerals and ten others were purchased from the William S. Vaux Fund. These have been substituted for the old cases, and Mr. Samuel G. Gordon, a student on the Jessup Fund, has cleansed the entire collection, after which he assisted Mr. F. J. Keeley, curator of the department, in selecting a series for exhibition. These were arranged according to the sixth edition of Dana's System. The relabelling of the collection will be undertaken at once.

The duplicates have been arranged on trays in closets immediately under the exhibition series, while the Academy's collection of minerals is arranged in the lower part of the closets, following the same systematic arrangement. Thus for the first time all the general collections of minerals are brought together.

The meteorites, representing about 60 falls, are arranged in glass cases in the entrance hall, while the local collection of minerals has been removed to the first floor of the museum just beyond, where it is arranged by Mr. Gordon in some of the old Vaux cases. Numerous small collections received from time to time have been gone over critically and specimens of value picked out, while the duplicates have been made up into sets for schools and other institutions.

Mr. Gordon made a field trip through Franklin and Adams Counties, Pennsylvania, during the summer and secured a valuable series of volcanic rocks.

Archæology.

From the State appropriation two horizontal and five upright exhibition cases have been provided and one mummy case. This

has made it possible to display specimens belonging to the Spear collection of Polynesian material and other specimens withheld from exhibition because of lack of space. A further display of California and Nevada basketry from the Gottschall collection has also been possible, while the archæological collections from Egypt and Europe and ethnological material from India and the Philippines have been rearranged.

The department has as heretofore been under the care of Miss H. N. Wardle, who, beside the rearrangement above described, has prepared numerous labels.

Mr. Clarence B. Moore has placed on exhibition the valuable objects found on his Green River expedition and has provided a new horizontal exhibition case for their display.

WITMER STONE, *Chairman*,
SAMUEL G. DIXON,
HENRY A. PILSBRY,
HENRY TUCKER.

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTION.

The past year has been rendered epochal in the history of the William S. Vaux collection by the installation of new cases, in which the entire collection has been rearranged. On completion of relabelling, which is under way, the collection will be in creditable condition.

Accessions during the year include ten specimens of calcite and geyserite from Yellowstone National Park, presented by Mrs. Walcott, and eighteen specimens purchased. Most important among the latter were hopeite and parahopeite from Rhodesia and several meteorites.

I again take pleasure in acknowledging the active and efficient assistance of Mr. Samuel G. Gordon, on whom devolved most of the actual work of transferring the collection.

Respectfully submitted,

F. J. KEELEY, *Curator Wm. S. Vaux Collection.*

REPORTS OF THE SECTIONS.

BIOLOGICAL AND MICROSCOPICAL SECTION.—The Section has held six stated meetings during the year.

The Conservator reports the presentation to the Section, by

Mrs. Edward S. Sayres, of Prof. Henry Carvill Lewis' microscope, a Beck National, together with a case of miscellaneous slides.

Communications on various subjects were made by the following members: Hugo Bilgram, F. J. Keeley, T. Chalkley Palmer, Dr. Thomas S. Stewart, W. H. Van Sickel, S. L. Schumo, Dr. D. W. Horn and C. S. Boyer.

The following officers were chosen for the year 1917:

Director	Dr. J. Cheston Morris.
Vice-Director	T. Chalkley Palmer.
Recorder	Charles S. Boyer.
Treasurer	Dr. Thomas S. Stewart.
Conservator	F. J. Keeley.

CHARLES S. BOYER, *Recorder.*

ENTOMOLOGICAL SECTION.—The Section has held six stated meetings during the year, with an average attendance of ten. Three members and an associate were elected.

Communications on subjects of interest were made at each meeting. Among those contributing were Henry Skinner, Philip P. Calvert, James A. G. Rehn, Philip Laurent, Morgan Hebard, and J. C. Bradley.

The following officers were elected for the year 1917:

Director	Philip Laurent.
Vice-Director	R. C. Williams, Jr.
Secretary	J. A. G. Rehn.
Treasurer	E. T. Cresson.
Conservator	Henry Skinner.
Recorder	E. T. Cresson, Jr.
Publication Committee	E. T. Cresson, P. P. Calvert, E. T. Cresson, Jr.

E. T. CRESSON, JR., *Recorder.*

BOTANICAL SECTION.—At the annual meeting, held December 19, 1916, the following officers were elected for the ensuing year:

Director	Ida A. Keller, Ph.D.
Vice-Director	Joseph Crawford.
Recorder	John W. Eckfeldt, M.D.
Conservator and Treasurer	Stewardson Brown.

BENJ. H. SMITH, *Director.*

Mineralogical and Geological Section for 1916.—The Section held four meetings, with increased average attendance. Communications were made by Prof. Thomas C. Brown, on Paleozoic Reef Deposits and on Petroleum and Natural Gas in Butler County, Pennsylvania; by Mr. F. Lynwood Garrison, on the World's Supply of Minerals, and by Prof. Florence Bascom, on some of the National Parks. Other subjects of geological or mineralogical interest were discussed.

There were four field excursions, with an average attendance of 20. The places visited were: (1) portions of the New Red Gwynedd shales and Norristown shales, also Hudson River shales, all in Bucks County; (2) certain exposures of crystalline rocks between Philadelphia and West Chester; (3) crystalline rocks and their minerals near the southern edge of Delaware County; (4) crystalline rocks and their minerals between Media and Newtown Square, Delaware County.

The following officers of the Section have been elected for the year 1917:

Director	Benjamin Smith Lyman.
Vice-Director	F. J. Keeley.
Recorder and Secretary	W. B. Davis.
Treasurer and Conservator	George Vaux, Jr.

Respectfully submitted by order of the Section,

Benj. Smith Lyman, *Director.*

Ornithological Section.—The Section has been active during the year in encouraging ornithological work at the Academy. The Pennsylvania Audubon Society and the Delaware Valley Ornithological Club have held their meetings in the building, with the result that a broader interest has been taken in the ornithological department and many valuable accessions have been received.

November 13–16 the American Ornithologists' Union held its annual meeting at the Academy, bringing to our museum leading ornithologists from all parts of the United States and Canada. The meeting was the largest and most successful ever held by the Union and drew to the Academy large numbers of visitors.

At the annual meeting of the Section the following officers were elected for the ensuing year:

Director	Spencer Trotter.
Vice-Director	George Spencer Morris.

Recorder ..... Stewardson Brown.
Secretary ..... William A. Shryock.
Treasurer and Conservator ..... Witmer Stone.

WITMER STONE, *Conservator.*

The annual election of Officers, Councillors and members of the Committee on Accounts was held December 19, 1916, with the following result:

PRESIDENT	Samuel G. Dixon, M.D., LL.D.
VICE-PRESIDENTS	Edwin G. Conklin, Ph.D.,Sc.D., John Cadwalader, A.M.
RECORDING SECRETARY	Edward J. Nolan, M.D., Sc.D.
CORRESPONDING SECRETARY	J. Percy Moore, Ph.D.
TREASURER	George Vaux, Jr.
LIBRARIAN	Edward J. Nolan, M.D., Sc.D.
CURATORS	Samuel G. Dixon, M.D.,LL.D., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D.
COUNCILLORS TO SERVE THREE YEARS	Edwin S. Dixon, Henry Skinner, M.D., Sc.D., Robert G. Le Conte, M.D., George Spencer Morris.
COMMITTEE ON ACCOUNTS	Charles Morris, Samuel N. Rhoads, John G. Rothermel, Thomas S. Stewart, M.D., Walter Horstmann.

COUNCIL FOR 1917.

Ex-Officio.—Samuel G. Dixon, M.D., LL.D., Edwin G. Conklin, Ph.D., John Cadwalader, A.M., Edward J. Nolan, M.D., Sc.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D.

To serve three years.—Edwin S. Dixon, Henry Skinner, M.D., Sc.D., Robert G. LeConte, M.D., George Spencer Morris.

To serve two years.—Philip P. Calvert, Ph.D., Frank J. Keeley, Walter Horstmann, William Pepper, M.D.

To serve one year.—Charles B. Penrose, M.D., LL.D., Ph.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.

COUNCILLOR	George Vaux, Jr.
CURATOR OF MOLLUSCA	Henry A. Pilsbry, Sc.D.
CURATOR OF WILLIAM S. VAUX COLLECTIONS	Frank J. Keeley.
CUSTODIAN OF ISAAC LEA COLLECTION	Joseph Willcox.
ASSISTANT LIBRARIAN	William J. Fox.
ASSISTANTS TO CURATORS	Henry Skinner, M.D., Sc.D., Stewardson Brown, Edward G. Vanatta, Henry W. Fowler, James A. G. Rehn, Ezra T. Cresson, Jr.
ASSISTANT IN LIBRARY	Furman Sheppard Wilde.
AID IN ARCHÆOLOGY	Harriet Newell Wardle.
AID IN HERBARIUM	Ada Allen.
Taxidermist	David M. McCadden.
Janitors	Charles Clappier, Daniel Heckler, James Tague, Jacob Aebley, Adam E. Heckler.

STANDING COMMITTEES, 1917.

FINANCE.—Effingham B. Morris, John Cadwalader, A.M., Edwin S. Dixon, Walter Horstmann, and the Treasurer.

PUBLICATIONS.—Henry Skinner, M.D., Sc.D., Witmer Stone, A.M., Sc.D., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D., Sc.D.

LIBRARY.—Henry Tucker, M.D., George Vaux, Jr., Frank J. Keeley, Witmer Stone, A.M., Sc.D., Spencer Trotter, M.D.

INSTRUCTION AND LECTURES.—Henry Skinner, M.D., Sc.D., Henry A. Pilsbry, Sc.D., Charles Morris, James A. G. Rehn, George S. Morris.

ELECTIONS IN 1916.

January 18.—Walter Sonneberg, Samuel T. Bodine, David Wilbur Horn, William S. Huntington.

March 21.—A. A. Jackson, Edward Martin, M.D.

November 21.—C. W. Weidenbacker, Arthur H. Thomas.

ADDITIONS TO THE MUSEUM.

1916.

Mammals.

Captain Frank S. Besson, through Mr. Nathan Griffith. Mounted Armadillo (*Tatu novemcinctum*), Brownsville, Texas.

Estate of Dr. Thomas Biddle. Skin and skull of Barbary Ape (*Simia innuus*), Tangier, Morocco.

Dr. Samuel G. Dixon. Skull of Atlantic Walrus (*Odobænus rosmarus*). Horns of Hartebeest (*Bubalis* sp.), Gemsbok (*Oryx gazella*), Indian Buffalo (*Buffelus bubalis*), Greater Koodoo (*Strepsiceros strepsiceros*), and Domestic Ram (*Ovis aries*). Mounted head of Pacific Walrus (*Odobænus obesus*).

W. J. Fox. Skull of Dolphin (*Delphinus delphis*), Sea Isle City, New Jersey.

William D. Griscom. Skins of five Muskrats (*Ondatra zibethica*) [one albino] and of three Brown Rats (*Mus norvegicus*), Salem, New Jersey.

Dr. Joseph Kalbfus. Skin of Least Weasel (*Putorius allegheniensis*), Mercer County, Pennsylvania.

Keystone-Hindley Gear Company. Tibia of horse (*Equus caballus*). From under City Hall, Philadelphia.

Miss Maggie Macaw. Skin of Monkey (*Lasiopyga* sp.) and Spotted Cat (*Felis* sp.), Africa.

Samuel N. Rhoads. Jumping Mouse (*Zapus hudsonicus*), Haddonfield, New Jersey; Muskrat (*Ondatra zibethica*), Haddonfield, New Jersey.

Dr. Henry R. Wharton. Brown Rat (*Mus norvegicus*), Salem, New Jersey.

A. P. Willets. Jumping Mouse (*Zapus hudsonicus*), Haddonfield, New Jersey.

Zoological Society of Philadelphia. Specimens prepared as follows: Mounted: Sloth Bear (*Melursus ursinus*). Skin and skull: Bonnet Macaque (*Macacus pileatus*), Fishing Cat (*Felis viverrina*), Crab-eating Dog (*Canis cancrivorus*), Spotted Skunk (*Spilogale* sp.), Two-spotted Paradoxure (*Nandinia binotata*), Polar Bear (*Thalarctos maritimus*), Thibetan Blue Bear (*Ursus pruinosus*), Sewellel (*Aplodontia rufa*), Larger Egyptian Gerbille (*Gerbillus pyramidum*), Hairy-rumped Agouti (*Dasyprocta prymnolopha*), Agouti (*Dasyprocta* sp.), Harnessed Antelope (*Tragelaphus gratus*), Himalayan Tahr (*Hemitragus jemlaicus*), Northern Warthog (*Phacochœrus æthiopicus*). Prepared as skin: Sewellel (*Aplodontia rufa*), young Coypu Rat (*Myopotamus coypu*). Prepared as skeleton: Meerkat (*Suricata tetradactyla*). Prepared as skull: Vulpine Phalanger (*Phalangista vulpina*).

Birds.

George B. Benners. Nest of Yellow-throated Warbler (*Dendroica dominica*).

Miers Busch. Collection of bird skins.

Frank M. Crawford. Eggs of Emu (*Dromæus novæ-hollandiæ*) and Whooping Crane (*Grus americana*). Collection of eggs of various species of birds.

Delaware Valley Ornithological Club. Seven nests and ten sets of eggs of Pennsylvania birds.

Dr. Samuel G. Dixon. Female Golden Pheasant (*Chrysolophus pictus*), skin.

A. B. Loeb, through Mrs. Sol. Selig. Collection of mounted birds.

Edward Norris. Head and wing of Blue Goose (*Chen cærulescens*), Chesapeake Bay.

H. Ormsby Phillips. Skin of Screech Owl (*Megascops asio*), West Chester, Pennsylvania.

Samuel N. Rhoads. Skin of Red-winged Blackbird (*Agelaius phœniceus*), Haddonfield, New Jersey.

Witmer Stone. Sets of eggs of the Black Skimmer and Common Tern, Virginia.

George H. Stuart, 3d. Skin of Loon (*Gavia immer*) and Old Squaw Duck (*Harelda hyemalis*), North Carolina.

Dr. Henry R. Wharton. Three skins of Hooded Merganser (*Lophodytes cucullatus*), and two skins of Red-tailed Hawk (*Buteo borealis*), Salem, New Jersey.

A. P. Willets. Red-winged Blackbird (*Agelaius phœniceus*), Tuckerton Bay, New Jersey.

Zoological Society of Philadelphia. Prepared as skins: Indian Gray Shrike (*Lanius laktora*), Yellow Oriole (*Icterus xanthornus*), Gray Struthidea (*Struthidea cinerea*), Fish-hawk (*Pandion haliætus carolinensis*), European Flamingo (*Phœnicopterus roseus*), and *Amazona viridigenalis*. Prepared as skin and sternum: Great-billed Black Cockatoo (*Calyptorhynchus macrorhynchus*). Prepared as skull: Greater Titmouse (*Parus major*). Twelve eggs of birds laid in the Zoological Society's Gardens.

Purchased by subscription of members. Collection of 500 bird skins from Panama, made by the late L. L. Jewel.

Purchased. One hundred and twenty-five skins from Santa Marta, Colombia; seventeen from South Georgia Island.

Reptiles and Amphibians.

Dr. Fred Baker. Three turtles, Angkor Ruins, Cambodia.

P. P. Calvert. Small collection of reptiles and amphibians, Costa Rica.

Morgan Hebard. Collection of reptiles and amphibians, Miami, Florida.

Philip Laurent. Scarlet snake (*Cemophora coccinea*), Gulf Hammock, Florida; two toads (*Bufo fowleri*), New Jersey.

Bayard Long. Five vials of amphibians, Maine.

Dr. H. A. Pilsbry. Horned Toad (*Phrynosoma*), New Mexico.

Dr. Witmer Stone. One box tortoise (*Terrapene carolina*), Cold Spring, New Jersey.

Dr. S. D. Swope. Skin of Green Rattlesnake (*Crotalus lepidus*), Animas, New Mexico.

Zoological Society of Philadelphia. White's Cyclodus (*Tiliqua scincoides*).

Fishes.

R. M. Abbott. Cling-fish (*Gobiesox strumosus*), Maryland; jar of fishes, Maryland.

R. M. Abbott and Henry W. Fowler. Collection of fishes, Anne Arundel County, Maryland.

Argentine Commission, Panama-Pacific Exposition. Collection of thirty dried fishes.

P. P. Calvert. Small collection of fishes, Costa Rica.

C. Dager. Goldfish (*Carassius auratus*).

James Donaldson. Burr Fish (*Chilomycteris schoepfi*).

E. R. Dunn. Jar of fishes, James River, Virginia.

H. W. Fowler. Three jars of fishes, Cecil County, Maryland.

H. W. Fowler, E. S. Mattern, H. E. Thompson, H. H. Burton and Dr. F. Pennell. Sixteen bottles of fresh-water fishes, Virginia, Pennsylvania, and New Jersey.

W. J. Fox. Hog Fish (*Orthopristis chrysopterus*), Sea Isle City, New Jersey.

Morgan Hebard. Jar of fishes, Boca Grande, Florida.

W. T. Innes. Several *Mollienisia latipinna*, Louisiana.

A. B. Loeb, through Mrs. Sol. Selig. Collection of mounted fishes.

D. McCadden. Lizard fish (*Synodus fœtens*), Ocean City, New Jersey.

E. S. and W. I. Mattern. Several hundred fishes, Eastern Pennsylvania; ten jars of fishes, Lehigh County, Pennsylvania.

Philadelphia Aquarium. Several groupers (*Epinephelus*), Key West, Florida.

R. C. Williams, Jr. Spotted File-fish (*Alutera punctata*), Corson's Inlet, New Jersey.

Edward Wilson. Burr Fish (*Chilomycteris schoepfi*), Cape May, New Jersey.

Recent Mollusca.

Jacob Aebly. Four land shells from Westmont, New Jersey.

Benjamin Albertson. *Helix hortensis* Müll. from Nantucket, Massachusetts.

J. L. Baily, Jr. *Nuttallina fluxa* Cpr. from La Jolla, California.

F. C. Baker. Thirty trays of shells from New York and Korea.

Dr. Fred Baker. *Dentalium vallicolens* Ray. from off San Diego, California.

Dr. Paul Bartsch. Three species of shells from North Carolina, Utah, and Montana.

M. J. Becker. Five trays of fresh-water shells from California.

S. S. Berry. Thirty trays of land and fresh-water shells from Montana and California.

E. Bethel. *Oreohelix haydeni* Gabb from Glenwood Springs, Colorado.

Dr. A. P. Brown. Eight species of shells from Pennsylvania and Antigua.

O. Bryant. Five species of land shells from Bermuda.

H. F. Carpenter. Four species of shells from Rhode Island and Florida.

Charles W. Cash. *Pecten magellanicus* Gm. from off Nantucket, Massachusetts.

Dr. Robert Clarke. Five species of land shells from Beaver Falls, Pennsylvania.

George H. Clapp. Twenty-eight trays of shells, United States, Canada, and Bahamas.

W. F. Clapp. Seven species of Hawaiian marine shells.

C. M. Cooke. Thirteen trays of Hawaiian land shells.

E. B. Cope. *Polygyra hopetonensis* Shutt. from Imri, Florida.

C. A. Copeland. Two species of marine shells.

L. E. Daniels. Three trays of fresh-water shells from Montana.

J. H. Ferriss. Thirteen trays of land shells.

H. W. Fowler. Forty-eight trays of shells from the eastern United States.

L. S. Frierson. *Unio tamaulipanus* Conr. from Menardville, Texas.

S. G. Gordon. Four species of land shells from Adams County, Pennsylvania.

D. E. Harrower. Twenty trays of shells from Panama and Costa Rica (purchased).

Morgan Hebard. Forty-two trays of land shells from Virginia, Florida, and Texas.

J. B. Henderson. Eighteen trays of shells from New York and West Indies.

Junius Henderson. Forty-two trays of land shells from Utah, Colorado, and Idaho.

Heye Collection. *Bifidaria* from Big Wall, Cuba.

A. A. Hinkley. Seventeen trays of land and fresh-water shells from Arkansas, Missouri, and Illinois.

Dr. A. P. Hitchens. *Helix hortensis* Müll. from Percé, Canada.

Tom Iredale. *Elasmias ovata* Ant. from Sunday Island, Kermadec Islands.

P. Laurent. *Euglandina rosea* Fer. from Gulf Hammock, Levy County, Florida.

Dr. S. L. Lewis. Seventy-eight trays of marine shells.

Bayard Long. Three hundred and forty-three trays of shells from Maine and New Jersey.

H. Loomis. *Nuttalina* from Japan.

A. L. Lovett. *Prophysaon fasciatum* Ckll. from Corvallis, Oregon.

H. N. Lowe. Thirty-four trays of shells from California and West Africa.

J. G. Malone. Thirty-one marine shells from Oregon and Alaska.

H. L. Mather and H. W. Fowler. *Goniobasis virginica* Gm. from Leslie and Charlestown, Maryland.

E. S. Mattern. Two fresh-water shells from Pennsylvania.

David McCadden. *Donax fossor* Say from Ocean City, New Jersey.

E. A. McIlhenny. Two marine shells from Alaska.

L. H. McNeill. *Polita cryptomphala* Cl. from Irvington, Alabama.

Dr. H. E. Meyer. Twenty-four species of mollusca.

Clarence B. Moore. *Io spinosa* Lea from a mound near Widows Creek, Jackson County, Alabama.

Miss S. Newlin. *Spondylus varians* Sby.

Mrs. I. S. Oldroyd. Two hundred and seventy-eight trays of western American shells.

W. H. Over. Twenty trays of land and fresh-water shells from South Dakota.

Miss R. M. Pierce. Two marine shells from Wildwood, New Jersey.

H. A. Pilsbry, Sc.D. Three hundred and six trays of shells.

Purchased. Two hundred and thirty-six trays of shells.

C. T. Ramsden. Three species of Cuban land shells.

W. J. Raymond. Four trays of fresh-water shells from California and Oregon.

J. A. G. Rehn. Two land shells from South Dakota and Wyoming.

J. A. G. Rehn and M. Hebard. Five species of fresh-water shells from LakeWaccamaw, North Carolina.

Sidney Reily. Two marine shells from Virginia.

S. N. Rhoads. Three land shells from the West Indies.

S. Raymond Roberts. Forty-four species of shells from Jamaica and New South Wales.

H. H. Roney. Four species of shells.

A. D. Rusnak. Three marine shells from Galveston, Texas.

A. F. Satterthwait. Thirty-six species of land and fresh-water shells from West Lafayette, Indiana.

Mrs. Charles Schäffer. Three marine shells.

S. L. Schumo. *Opeas micra* Orb. from Moneague, Jamaica.

Burnett Smith. Sixty-one trays of shells from New York.

H. H. Smith. *Polygyra albolabris major* Binn. from near Elamville, Alabama.

Witmer Stone, Sc.D. Five trays of shells from California, New Jersey, and Wisconsin.

D. Thaanum. Three Hawaiian land shells.

H. W. Trudell. Two species of shells from Bermuda.

E. G. Vanatta. Seven species of shells from New Jersey, Pennsylvania, and Maryland.

T. Van Hyning. Three species of land mollusca from Iowa and Florida.

Bryant Walker. Five shells from Alabama, Michigan, and Illinois.

J. B. Walter. Six species of land shells from Monroe County, Pennsylvania.

J. Walter and B. Long. Twelve species of land and fresh-water shells from Delanco, New Jersey.

Robert Walton. *Opeas mauritianum* Pfr. from a greenhouse in Philadelphia, Pennsylvania.

Miss H. N. Wardle. Seven species of land shells from Spruce Cabin Falls, Monroe County, Pennsylvania.

W. Webb. *Elasmias wakefieldiæ* Cox from New South Wales.

H. E. Wheeler. Nineteen species of fresh-water shells from Arkadelphia, Arkansas.

J. Willcox. *Polygyra albolabris* Say from Wilmington, North Carolina.

F. M. Woodruff. Three species of *Epiphragmophora* from Oregon, etc.

Miss Lilian Zech. *Epiphragmophora zechæ* Pils. from San Gabriel Mountains, California.

Insects.

Anastasio Alfaro. One hundred and thirty-one Orthoptera, Costa Rica.

American Museum of Natural History. *Stilpnochlora laurifolia*, Jamaica.

F. W. Armstrong. Eight Lepidoptera, Colombia.

Nathan Banks. One *Myrmosa banksi* (paratype), four *Mutilla scrupea*, two *Mutilla geryon*, United States.

Ignacio Bolivar. One *Gesonia punctata*, Java.

Brooklyn Institute of Arts and Sciences. Three Blattidæ, Arizona, Texas.

H. G. Bryant. Eleven Lepidoptera, Brazil.

P. P. Calvert. Eighteen Aphids, Chestnut Hill; one Lepidopteron, Scotland.

E. R. Casey. Twenty-five Hemiptera, Pennsylvania; fourteen Orthoptera, Pennsylvania.

D. M. Castle. One *Cicada*, Florida; one *Megathymus yuccæ*, Florida.

T. D. A. Cockerell. Twelve Hymenoptera, United States.

J. W. Cockle. Seven Lepidoptera, British Columbia.

J. W. Coxey. Seven Lepidoptera, Western States; six, Japan.

Erich Daecke. One *Atlanticus davisi*, Pennsylvania.

W. T. Davis. Three Lepidoptera, New Jersey.

Henry Fox. Eleven Orthoptera, Virginia.

G. M. Greene. Sixty-one Coleoptera, United States; seven, New Jersey; four, District of Columbia; two Diptera, Pennsylvania.

F. Haimbach. One hundred and nineteen Lepidoptera, United States.

D. E. Harrower. One Lepidopteron, Costa Rica.

J. R. Haskin. Fourteen Lepidoptera, California.

Morgan Hebard. Eight Stenopelmatinæ, western United States; one thousand three hundred moths, Hot Springs, Virginia; thirty-eight Lepidoptera, Georgia and Florida; two *Lycæna lygdamas*, Hot Springs, Virginia; seventeen *Stenopelmatus*, western United States; thirty-one Blattidæ, Lower California and western United States; four Blattidæ, United States; three hundred and sixty-one Blattidæ, North America, West Indies, Central and South America; one hundred and nineteen insects, Southern States.

F. M. Jones. Six Lepidoptera, Pennsylvania.

University of Kansas. One Blattid, Arizona.

C. H. Lankester. Ten Orthoptera, Costa Rica.

Philip Laurent. Three *Epizeuxis laurenti*, North Carolina; ten Orthoptera, Florida.

R. A. Leussler. Four *Satyrodes canthus fumosus*, Nebraska; six Lepidoptera, Nebraska.

Carlos Lizer. Twenty-seven Orthoptera, Argentina.

W. M. Mann. Two *Myrmecoblatta rehni* (paratypes), Hidalgo, Mexico.

J. W. McGowan. Two Coleoptera, Costa Rica.

L. W. Mengel. *Perisamia inconspicua* (type), South America; *Catagramma horstii* (type), South America.

H. Morrison. One Hymenopteron, Indiana.

H. M. Paishley. Two *Gerris argenticollis* (cotypes), Massachusetts.

Pennsylvania State Department of Zoology. Five North American Blattidæ.

H. A. Pilsbry. Two Coleoptera, Hawaii.

A. F. Porter. Thirty Lepidoptera, West Indies.

C. T. Ramsden. Two *Isognathus rimosa woodi* (types), Cuba; eight Lepidoptera, Cuba; *Catopsilia avellaneda*, Cuba.

J. A. G. Rehn. Ten North American Blattidæ; four Lepidoptera, Texas.

W. D. Robinson. One Coleopteron, Pennsylvania.

Henry Skinner. Eleven Lepidoptera, California; one, Peru.

Stanford University. Two hundred and thirty-one Orthoptera (thirteen types), Brazil.

Witmer Stone. One Coleopteron, Wisconsin.

University of Pennsylvania. Eleven Lepidoptera and one Coleopteron, Florida; two Mallophaga, Africa.

W. C. Thompson. Thirteen Coleoptera, New Jersey.

United States National Museum. Two Blattidæ, Texas and San Domingo.

E. G. Vanatta. Ten insects, United States.

Mrs. B. L. Weathersbee. One specimen of *Dynastes tityus*, South Carolina.

H. B. Weiss. Eight Blattidæ, New Jersey.

R. C. Williams, Jr. Twenty Lepidoptera, Alaska; eighty-five Lepidoptera, Guatemala.

E. Woolman. Six Coleoptera, Pennsylvania.

Invertebrates.

(Other than Insects or Mollusks.)

R. M. Abbott. Collection of crabs, Maryland.

R. M. Abbott and Henry W. Fowler. Collection of crustaceans, myriopods, and arachnids, Maryland.

Benjamin Albertson. *Lepas hillii* Leach from Muskeget Island, Massachusetts.

F. C. Baker. Two anemones and a crab from Korea.

M. J. Becker. Bryozoa from Monterey Beach, California.

P. P. Calvert. Five crabs, Costa Rica.

C. A. Copeland. One gorgonian and eleven sponges.

Henry W. Fowler. Collection of crustaceans and arachnids, Maryland.

Morgan Hebard. Collection of crustacea, Florida.

V. T. Innes. One crustacean from San Diego, California.

Agnes F. Kenyon. One crustacean, Australia.

Dr. S. L. Lewis. Eleven corals and echinoderms.

Bayard Long. Two *Helicopsyche* from Maine. Two vials of crustaceans from Maine.

J. G. Malone. Eight starfishes, etc., from Alaska and Washington.

E. A. McIlhenny. One shrimp from Admiralty Bay.

W. E. Meehan. *Chelonibia testudinaria* L. from Fortesque, New Jersey.

Mrs. I. S. Oldroyd. Seven trays of brachiopods from California.

H. A. Pilsbry, Sc.D. Thirty-one specimens of corals, crabs, etc.

S. Raymond Roberts. Three invertebrates from Massachusetts and New South Wales.

C. Henry Roney. Two invertebrates from the Pacific Ocean.

Witmer Stone, Ph.D. Eighteen groups of crustaceans and mollusks, Cape May, New Jersey; *Balanus eburneus* Gld. from Cobbs Island, Virginia.

Emily H. Thomas. Eleven corals and echinoderms.

H. W. Trudell. One invertebrate from Bermuda.

United States National Museum. Five barnacles, California and Cuba.

H. L. Viereck. *Planes minutus* L. from Cape May, New Jersey.

C. M. Wheatley. Three crustaceans, California.

Wheatley Collection (deposited). Two trays of crustaceans.

Homer Wheeler. *Balanus hesperius lævidomus* Pils. from Puget Sound.

A. P. Willets. Mud crab (*Eurypaopeus depressus*), New Jersey.

Invertebrate Fossils.

Miss Ida H. Boyer. One tray of *Pyrula* from Fullerton, California.

M. J. Becker. *Macoma congesta* Conr. from Monterey, California.

Mrs. M. K. Langsdorf. One hundred and sixty-five trays of Devonian fossils, New York.

Bayard Long. Six trays of Cretaceous fossils from New Jersey.

Miss Ethel A. Merkel. *Ammonites* and two other fossils.

D. E. Harrower. Fourteen trays of fossils from the Canal Zone (purchased).

Joseph Willcox. Two hundred and seven Pliocene and Miocene fossils.

Fossil Plants.

Miss Esther A. Merkel. Coal plant.

Misses Newlins. Specimens of coal slate with fern impressions.

MINERALS.

MIERS BUSCH. Collection of minerals.

FOOTE MINERAL COMPANY. Sixteen casts of meteorites.

MISSES NEWLIN. Collection of minerals.

MISS EMILY H. THOMAS. Collection of minerals.

MISS GRACE G. TOWN. Stalagmite.

WM. S. VAUX COLLECTION. Eighteen specimens (purchased).

PLANTS.

G. W. BASSETT. Three local plants.

MR. BRENDLE. *Salvia vertisillata.*

O. H. BROWN. Ninety-eight specimens of plants, Cape May, New Jersey.

WALTER DEANE. One hundred and thirty-eight specimens chiefly from New Hampshire.

DR. SAMUEL G. DIXON. *Viburnum opulus,* Berks County, Pennsylvania.

DR. J. W. ECKFELDT. *Evanthis hyemalis,* Painter's Arboretum.

WILLIAM FINDLAY. *Salix purpurea,* near Philadelphia.

WM. J. FOX. *Achillea millefolium,* Sea Isle City, New Jersey.

GRAY HERBARIUM. *Sabatia campanulata* and *Elatine triandra,* New England.

E. B. HARGER. Five hundred and sixty plants chiefly from Connecticut.

CLARENCE KNOWLTON. Three hundred and seventy plants, Maine and Massachusetts.

HENRY HOLLINSHED. One hundred and forty-nine plants, Delair, New Jersey.

FRANK J. KEELY. Hybrid Oak, Chester County, Pennsylvania.

BAYARD LONG. Nineteen local plants.

BAYARD LONG and F. W. PENNELL. Sixty-three New Jersey plants.

BAYARD LONG and HAROLD ST. JOHN. Thirty-eight plants, New Jersey and Maryland.

W. H. LEIBELSPERGER. Three hundred and ninety-six specimens of plants, Berks County, Pennsylvania.

MISSOURI BOTANIC GARDEN. Forty-six sheets of miscellaneous plants.

J. H. MUMBAUER. *Pyrola chlorantha.*

K. K. MCKENZIE. *Carex straminea,* Cape May, New Jersey.

NEW YORK BOTANIC GARDEN. *Agalinus acuta,* Long Island.

J. P. OTIS. Eighteen plants, Eastern Shore of Maryland.

H. W. PRETZ. Five hundred and seventy-one plants, Northampton and Lehigh Counties, Pennsylvania.

F. W. PENNELL. Two local plants.

H. A. PILSBRY. Collection of plants from New Mexico.

WITMER STONE. *Habenaria integra,* Cape May County, New Jersey.

W. A. STOWELL. Nine specimens of oaks, Clifford, New Jersey.

UNITED STATES NATIONAL MUSEUM. *Polygonum dumetorum,* Washington, District of Columbia.

E. G. VANATTA. Five plants from the neighborhood of Philadelphia.

PROF. W. KLINE. *Cynosurus cristatum,* Ursinus College Campus, Penna.

NETHERLANDS COMMISSIONERS, PANAMA-PACIFIC EXPOSITION. Collection of sandalwoods, seeds and nuts.

OTTO BEHR. Seven sections of Pennsylvania forest trees.

C. H. JENNINGS. Ten sections of Maryland forest trees.

MICROSCOPES, ETC.

MRS. EDWARD S. SAYRES. Microscope and slides formerly belonging to Prof. Henry Carvill Lewis.

ARCHÆOLOGY, ETC.

C. F. DERBY. Model of native boat, Ceará, Brazil.

GEORGE G. HEYE. Three hundred and thirty-five specimens of celts, pottery fragments, etc., Trinidad and West Indies.

CLARENCE B. MOORE. Important additions to the Clarence B. Moore Collection, from burial mounds along the lower Mississippi.

MISSES NEWLIN. Indian arrows.

EDWIN H. STULB. Head of Maori chief, made in Kauri gum.

MRS. WILLIAM ALBERT SULLIVAN. Elephant carved in plumago, Ceylon.

PURCHASED. Several articles of pottery.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1916.

Species described as new are indicated by heavy-faced, synonyms by italic numerals.

GENERAL INDEX.

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