

AN ECOLOGICAL SURVEY OF THE FRESH WATER INSECTS OF PUERTO RICO *

1. THE ODONATA: WITH NEW LIFE-HISTORIES

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Very little intensive work has been done in the fresh water fauna of the Island. The Fish Commission Expedition to Puerto Rico in 1900 said: "... An examination of the literature pertaining to the Natural History of the West Indies showed that comparatively little was known concerning the fishes, and scarcely anything of the other aquatic animals or of its aquatic flora." Although the conditions at present are not so critical in the entomological field because of the work of Howard, Dyar and Knab (1912), Dyar (1928), Curran (1928) (1931), Leng and Mutchler (1914) (1917), Barber (1923) and Needham and Fisher (1936), who included in their publications the aquatic insects belonging to the groups discussed; as well as the articles published by other authors like Tower (1912) (1921), Hoffman (1925), Root (1929), Earle (1930), Wells (1930), Bradt (1932) and others, the aquatic insects of the Island are far from well known. Two other workers, Klots (1932) and Alexander (1933) have contributed greatly to the knowledge of the insect aquatic fauna. Alexander states in his paper that the reduced number of species must be due to lack of collecting rather than to the scarcity of species. His contention has been corroborated by the material he most kindly determined and shown in appendix A. A glance through this, which shows the determinations made up to the present time by the specialists to whom material has been submitted, supports also the statement made before.

In spite of the small size of the Island its fresh waters harbor species of all the phyla which in similar environments occur over the world. Protozoans, coelenterates, platyhelminthes, nemathelminthes, annelids, molluscs, arthropods and vertebrates, all of them, in their adult or developmental stages have representatives in the different fresh water habitats of the Island. Among the aquatic insects there are members of all orders having them, with the only possible excep-

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tion of the Plecoptera. Very striking is the apparent absence of these, which must be attributed to their impossibility, being poor flyers, to reach the Island. This seems to be the only factor because places where they could live are plenty all over.

The habitats for all these species vary greatly, from the rapid, turbulent flow of the rivers in the higher levels of the Island, through the slow moving courses of the same along the coastal plains to the few small standing lakes, lagoons, pools and marshes.

Puerto Rico has been called the land of the rivers, possibly rightly so, if one considers that on its 3,500 square miles there are about 1,500 streams although not all of them are really rivers. The majority are tributaries to about 80 or 100 larger ones. The high altitude of the mountains, attaining heights of over 4,000 feet, when taken in consideration to the width of the Island which is only about 35 miles, make these rivers exceedingly rapid when cutting their way through the gorges of the central mountains range. The placing of the chain of mountains (Fig. 2), which has been secondarily determined by erosion as shown by Meyerhoff (1933), about two thirds away from the northern coast, has a decisive influence upon the nature of the rivers. Rainfall, due to the placing of the mountains in relation to the prevailing winds during the year, is most common on the north side where it may attain a maximum of 140 inches on Mt. El Yunque. Corresponding areas on the southern slope may get only 100 inches and sometimes go through periods of drouth. Thus the rivers which flow into the north and west have longer courses and are less rapid than those on the southern and eastern side. The longest river of the first group may attain a length of 40 miles while the corresponding one of the southern side would be less than half that length. The northern rivers usually have a permanent flow of water while those on the opposite side may dry up completely during sometime in the year. The beds of these rivers vary greatly. There are some rocky ones with practically no loose stones in them high up in the mountains; others are gravelly with small and medium sized boulders along their middle courses and lastly that portion close to their mouths where sandy and silty bottoms are found. The beds of those on the southern slopes, although similar to the ones last mentioned, are more rocky and the boulders are more common in them.

To the mechanical and climatological factors determining the nature of the rivers has to be added the influence brought about by the altering of natural conditions through human activity. The Island being heavily populated has been completely deprived of most

of its natural forests. So a few hours of rainfall may cause the rivers to swell and small streams of water soon become imposing torrents. But with the same rapidness with which they swell do they return to their normal volumes. This rapid run-off washes into the rivers considerable amounts of silt and mud. Because of this, although at the higher levels the water soon becomes clear and transparent, in the lower places it may remain muddy for days of even weeks, depending on the duration of the rain. This mud has settled and filled the bottoms of some rivers which are no longer navigable to small boats as they used to be. This sudden variation in volume of the rivers is nicely shown in their beds which usually are dual in nature. The one where the river normally and continually runs and a wider one marked by the effects of the rushing waters during the floods. Sometimes during this period water is left along the edges of the rivers in the lower lands and holes close to them, and pools and marshes, some temporary others permanent, are formed. Upon reaching the sea the tide tends to keep them back and part of their course, for some distance up, is rendered more or less brackish.

The plant life occurring in the rivers and along their edges and serving as food for the vegetable feeders varies at different levels. High up in the mountains are found very few plants: only the algae, desmids and diatoms which are capable of clinging to the rocks in the swift running waters; in the slower running ones on wet stones and along the edges, are found the mosses and liverworts together with some ferns and higher aquatic plants. Lower down in the less rapid waters the most common and easily seen aquatic plant is *Potamogeton* besides the algae and lower forms, and along the edges are most commonly found "Malojillo", *Panicum* sp., *Polygonum* sp., and sedges and rushes; close to their mouths, where there is a very sluggish flow, the "flor de agua" *Castalia ampla* Salisb. makes its way farthest toward the center of the river, while farther back along the edges and marshy places the cat-tails *Typha angustifolia* L. and taller sedges like *Mariscus jamaicensis* (Crants) Britton and other smaller ones are seen together with other aquatic and semi-aquatic plants.

There are no true lakes on the Island. The only one which approaches this type of body of water is the one near Manatí called Tortuguero Lake. It occupies an area of 4 by 1½ kilometers, has no permanent inflow of water and fills up only during the rainy season from the waters of the nearby small hills called "mogotes". It is subject to great variations in its level, although it has never been known to dry up completely. I have seen its west end entirely

dry in August and walked along places where it would have been impossible to do it in March when Doctor Needham and I collected at the extreme west end. The shore line on its southern side had receded no less than 25 feet from the original one where collecting had been done during February and March. Notwithstanding its variations, aquatic insect life is always abundant along the shore. The lake has no natural connection with the sea and although very close to it, its waters are fresh. There is the possible exception of those of its northern shore where collecting of insects forms was remarkably poor compared with the southern shore. Possibly the wind and a certain degree of brackishness were responsible for this. There are two pipes leading from the lake to the sea by means of which it is drained when the water level gets too high. The aquatic plants which occur in it and along its shores and serve as food and shelter to aquatic insects have been discussed by Cook (1928). A sphagnum, *S. cuspidatum* var. *serrulatum* Schlisph, kindly determined by Dr. LeRoy Andrews, was found by Doctor Needham along the southern shore of the lake.

The next larger body of water approaching a lake is Cartagena Lagoon. It is much smaller in size than Tortuguero and as indicated by Danforth (1926) subject to wide variations in its water level. Cook (1928) also mentions this fact and states that in 1926 in a period of about two months the shore line had gone back about ten meters. There are records of it having dried up completely. Like Tortuguero it has not permanent inlet of water, neither an outlet. In cases when heavy rainfall fills it most completely Danforth (1926) says it overflows and the excess reaches the sea through the Boquerón river and its tributaries. The plant life found here is similar to the one of Tortuguero Lake and has been also discussed by Danforth and Cook. A remarkable difference in a species of the open water was that of *Nais* sp. which Danforth states in one instance nearly choked the lagoon. When Doctor Needham and I were there *Nais* was not so common but its place was occupied by *Ceratophyllum* sp. which was very thick. Cartagena Lagoon like Tortuguero Lake, harbors a numerous fauna of aquatic insects as well as other fresh water forms.

There are a few, other smaller lagoons along the northern coast. Also those like that of Guánica and two smaller ones near Cabo Rojo. Some collecting was done in them but they do not seem to compare in any way to the larger two.

Swamps are most common along the northern shore. The largest one is Caño Tiburones between Arecibo and Barceloneta. Through

its natural outlet by way of Arecibo River; through the canal which has been opened at its east end and leads into the Manatí River, and through the many ditches and canals made trying to drain it as indicated by Cook (1926), a large area has been rendered salty. The waters are not fitted for all fresh aquatic insects and only the hardier ones seem to be found there. Very little or practically no collecting has been done here.

A peculiar and highly specialized fresh water habitat on the Island is represented by the sink holes near Isabelá. A dry region, generally speaking, these sink holes which retain the water of the few showers, offer the only place for aquatic animals. Some of them, in August, were nearly dry, others completely choked with the "flor de agua" and "lechuguilla de agua" (*Pistia atratiotes* L.) while others had some water in them. All at the time mentioned, were very muddy and did not look very promising for collecting. Yet, they yielded heavily both in number of species and in individuals. Because of the nature of the surrounding country the water of these sink holes has a high alkalinity and possibly this may have some effect upon their inhabitants.

An additional habitat for the fresh water forms is the one offered by the irrigation systems developed in some parts of the Island. What is the nature of the forms living here I do not know since not much collecting has been done in them. I have collected mayflies, Baetinae, in a small, temporary system near Fajardo. If in such a small one as this mayflies were collected, there is no doubt that the more permanent ones of Isabelá and Juana Díaz would certainly yield much more. Their importance in upsetting natural conditions through the agency of fresh water forms living in them has been pointed out by Earle (1925) (1930) who warned of the dangers of the extension of malaria on the Island due to the breeding of mosquitoes in the temporary pools formed in the irrigation ditches. Hoffman also believes they will be means for the distribution and spreading of Schistosomiasis as it may have happened already in Guayama and adjacent places, by offering breeding and living places for *Planorbis* sp., the snail which is the intermediate host of the latter disease.

With such a variety of environment in which to live, fresh water forms and thereby aquatic insects must be numerous. How has it been possible to miss, up to this time, some of them, is more than an usual happening which can be accounted for only by the absence of an intensive collecting. Mayflies, although not so common on the lowlands, are certainly numerous along the creeks in the higher areas

and no citation, but with only one exception, is found in current literature about the group. This is in strong contrast with the findings of Dr. J. R. Traver as shown in Appendix A.

The two hundred vials which contained the material collected by Dr. James G. Needham and myself during the months of February and March, together with those accumulated by me during periods of irregular collecting, when finally sorted turned into two thousand. From their contents have come out a number of additional records as well as additional new genera and species which I hope may be a stimulus to further the interest on the Island's fresh water fauna.

Interesting and important as is the determination of the existing species there still remains a no less during and satisfying phase of the work. Set in a peculiar environment, due to special physiological and biological conditions together with the fight among themselves for food, shelter and ability to perpetuate their kind by means of reproduction, with the ensuing struggle for existence, each one of these groups has developed special means of meeting conditions for the aforesaid purpose. To study their occurrence, distribution, relationship and some of their adjustments and how they have developed is a most fascinating enterprise. The pages to follow are a most humble start in one of the groups. The discussion is based on part of the material collected by Dr. James G. Needham and myself. He not only determined the species but placed at my disposal the notes and records which he made during his stay on the Island and upon which I have drawn. For his wise counsel and many kindnesses during our long association, I will be always greatly obliged. A similar obligation and appreciation is herein expressed for all the specialists who have determined the material included under their names in Appendix A as well as to those others to whom some material has been submitted and is under way of determination. My thanks also to all others who in any direct or indirect way have helped me during my work. The drawings on plates IV, V and VI were done by Dr. Velma Knox, and the wings on plate VII were photographed by Mr. Archie Hess. To both of them my sincere thanks.

ODONATA

The dragonflies are among the insects most commonly seen in Puerto Rico. How Ledru (1810) failed completely to report in his list these insects is not understood. In any open space, along the many rivers on the Island, along the shores of the lakes, lagoons, or temporary pools fly these conspicuous forms of insect life. There are

some that are not so easily spotted due to their habits of keeping in shady places or else among the plants close to the bodies of water, which are easily missed unless specifically looked for.

The number of species, forty-three, herein discussed is considered small if compared with those of Cuba. Doctor Klots (1931) in her excellent paper on the Odonata of Porto Rico and the Virgin Islands attributes this reduced number to the scarcity of breeding places but "the fact of Cuba's longer association with the continental land mass and of Porto Rico's earlier isolation" should receive further consideration. This earlier isolation preventing the arrival of some forms, together with the subsidences and upliftings of Puerto Rico which brought changes in climate and habitats, these latter ones especially along the coast, may have been factors determining the odonate fauna. Extinction also through the action of the stronger odonates feeding upon the weaker, as well as destruction brought about by other animals, may have been deciding factors. Schmidt (1930) in discussing the amphibians and reptiles mentions some of the preceding factors, and although there is a great difference between these forms of animal life and insects, still there is a possibility of considering them. Taking in consideration the number and nature of the rivers on the Island, as well as lagoons and other swampy places, I think there are enough breeding places for supporting a larger number of species than those at present in existence. Puerto Rico, at least on its northern side, is amply supplied with rivers which do not dry up during the entire year and also there are a few lakes which could be used as breeding places. It is true that lakes are scarce and only one, Tortuguero Lake, has never been known to dry up, but the rivers with their rapid running waters high up in the mountains and their sluggish courses along the coastal plain could afford places to lotic and static species wherein to breed. Wilson (1911) while discussing the Odonata of Jamaica points out the influence of the nature of the rivers of the Island in keeping the majority of the species "confined to the immediate vicinity of the isolated ponds and quiet streams".

There is the possibility of the extinction of some of the species originally occurring on the Island. The case of *Protoneura capillaris* and *Leptobasis vacillans* failing to be collected together with all the other forms reported from the Island tends to show something along this line. This consideration is highly questionable since there is always the possibility of not having hit the places where these forms breed. A specimen of the former was collected in a house, flying to lights, in Hato Rey, near Río Piedras, by the author about

six years ago, but unluckily he failed to state definitely the date when caught and it was impossible to do it years afterward when the specimen was determined. No other specimens have been ever collected. This is also the case with *Leptobasis*.

Taking as a basis all available records, those published as well as those based on the collecting done by Doctor Needham and the author, a seasonal distribution of the Odonata of Puerto Rico has been considered. Fig. I shows this distribution. Taken as a whole there seems to be no seasonal distribution of the Odonata. There are extreme cases which tend to show the contrary, but a more intensive collecting and detailed observations in the biology and ecology of those forms may modify such views. Very little has been done along the ecology of these insects on the Island, most of the information available being only along strictly taxonomic lines. In the impossibility of formulating any reliable general statements the individual species will be discussed later, always conditioned by the need of further observation and more widely spread collecting. The maps, Fig. 3 and 4, showing the collecting places give the impression that the Island as a whole has been fairly covered. But in a majority of those places no intensive collecting has been carried out and when this is done changes and modifications of present conditions are certain to crop out.

An altitudinal distribution of the forms was also tried as shown in Table II. As in the previous cases and for the same reason it is impossible to make general statements. The different species of *Anisoptera* upon which data are available may be grouped into four main divisions: (1) above 2,000 feet: *Macrothemis celeno* and *Scapania frontalis*. Nymphs of *Dythemis rufinervis* have been collected also above this level. If a nymph collected in Buena Vista Camp in Maricao Forest Reserve is an *Aeschna*, as it is being assumed, there would have to be added to this group *Aeschna cornigera* which is the species reported from the Island. Adults of the latter have been collected in the next division. (2) Above 1,000 and up to 2,000 feet: *Aeschna cornigera*, *Anax junius*, *Dythemis rufinervis*, *Erythrodiplax connata justiniana*, *Erythrodiplax umbrata*, *Leptthemis vesiculosa*, *Orthemis ferruginea*, *Tramea abdominalis*, and *Pantala flavescens*. (3) Above 500 and up to 1,000 feet: *Erythemis plebeja* and *Tramea binotata*. (4) From sea level up to 500 feet: *Brachymesia herbida*, *Cannaeria furcata*, *Coryphaeschna adnexa*, *Erythrodiplax minuscula*, *Idiataphe cubensis*, *Miathyria marcella*, *Micrathyria aequalis*, *Micrathyria dissocians*, *Perithemis domitia* and *Tramea onusta*. Here should also be added *Anax amazili* known only from

the Island by its nymph and *Acanthagyna nervosa* of which there are no available records as to adult distribution,¹ but Doctor Klots' (1932) supposition of a nymph would place it in this group. If from group 3 and 4 are removed the two *Trameas* and placed in group 2 where the other occurring on the Island has been found and also *Coryphaeschna adnexa* which because of being a strong flier could easily go to higher levels, there would be a possibility of reducing all forms to two main divisions: those capable of trespassing the 1,000 feet level and the other below this altitude and possibly restricted to the coastal areas or lower levels of the Island.

In the Zygoptera, Table II, three main groups have been found: (1) Above 2,000 feet, *Telebasis vulnerata* is found. (2) From 1,000 to 2,000 feet with *Telebasis dominicanum* and *Enallagma civile* as adults plus *Enallagma coecum* and *Lestes forficula* as nymphs included. (3) From sea level up to 500 feet comprising *Anomalagrion hastatum*, *Argiallagma minutum*, *Ceratura capreola*, *Enallagma cultellatum*, *Ischnura ramburii*, *Lestes forficula*, *Lestes scalaris*, *Lestes spumarius*, and *Protoneura capillaris*. If from group three, as in Anisoptera, are removed the *Lestes* included, and *Enallagma cultellatum* placed arbitrarily with the other *Enallagmas*, there could be also two main divisions: those not trespassing the 500 feet and the ones going higher than the 1,000 feet level; the geographical regions corresponding to those indicated under Anisoptera.

Because dragonflies are strong fliers the altitudinal distribution of adults has not a great meaning unless it is correlated with the same distribution of their nymphal stages. The incomplete knowledge of distribution on the island of such stages makes impossible, except in individual cases later indicated, such correlation and the preceding discussion will be, no doubt, greatly modified as more data are accumulated.

Little could be said about the horizontal distribution of Odonata, especially along the lower levels, due to the ability of the adults to fly for very long distances. But there seems to be some forms which are strongly localized as shown by the collecting done up to the present time. Here would belong *Ceratura capreola* and *Argiallagma minutum* among the Zygoptera and *Idiataphe cubensis* among the Anisoptera. A decided case of localization was observed in the Guajataca River near Lares about 1,000 feet above sea level. Here were collected nymphs of *Dythemis rufinervis* and *Scapanea frontalis* in large numbers. A distance of two feet determined the species to be obtained. In a small pool, with its bottom covered with fine sand and

¹ See note at end. (page 85.)

silt, were to be collected the nymphs of the first. So numerous were they that they could be seen through the clear water, running in front of the net. Two feet below in the small riffles and clinging to the loose stones and pebbles of the gravelly bottom one could obtain only the nymphs of *Scapanea*.

It is a very striking fact the absence of the larger forms of Anisoptera like *Anax*, *Coryphaeschna* and others when compared with the smaller forms of the same suborder normally flying as adults all over the Island. Among the Zygoptera it is also noticed the relative absence of the *Lestes* spp., the largest Zygoptera on the Island, when compared with the rest of the members of this suborder. Wilson (1911) noticed also this fact while collecting in Jamaica. The factor determining this condition is not clearly understood, more so in the case of *Anax junius*. This species has been found in the nymphal stage in pools and in Tortuguero Lake where due to its large size it could have easily lived in competition with smaller forms. Yet the number of adults when compared with the rest of the forms in the mentioned lake was exceedingly low. A similar situation exists with *Coryphaeschna*: lots of nymphs were collected by Doctor Needham and the author in Tortuguero Lake, but not a single adult was seen. It could be thought that the season for transforming had not been reached, but in no case of the many occasions the author has been on the mentioned lake, has he seen the large anisopterans showing up. Possibly the large size of the nymphs make them easy pray to other more aggressive enemies or to some parasites, or either the adults have secluded habits and keep among the plants and trees close to the breeding places.

The geographical distribution of the odonate fauna of the West Indies, and thereby of Puerto Rico, has been discussed by de Selys (1856) who in placing the odonata fauna of Cuba at that time considered it closest to that of Florida and South America. He pointed out the scarcity of the Gomphinae, only represented by *Aphylla caraiba*, as well as the Calopteryginae represented only by another single species *Hetaerina luteola* Rambur (*Hetaerina cruentata* Selys) and the complete absence of the Cordulinae. Kolbe (1888) and Wilson (1911) considered affinities mainly with South American forms and Klots (1932) states “. . . that our characteristic Antillean fauna is most nearly allied to that of Central America, and that it arrived probably at the time of the late Tertiary connection with Central America, when all our present families of Odonata were in existence. . .” In accounting for a few forms found in Jamaica and Haiti and not present on the other islands she admits the

possibility of a “. . . secondary land bridge via the east-west mountain chain from Haiti through Jamaica to Honduras, in addition to the Yucatan-Cuba connection”. She further indicates the importance of the flight habits of the dragonflies as well as the presence or absence of bodies of water and the latter in determining the distribution of this form of insect life.

In playing their part in the economy of nature odonates follow all other forms of animal life. Among the most common enemies of odonates are the birds which attack both nymphs and adults. Gundlach (1878) mentions 31 species feeding on insects, but in no case makes specific reference to particular insects and so no mention of the odonates is made. Bowditch (1902) (1903) mentions 30 species attacking insects, but only two of them *Mimus polyglottos orpheus* (Linnaeus), Jamaican Mocking bird, and *Melanerpes portoricensis* (Daudin), Porto Rican Woodpecker, are reported as having eaten adult dragonflies. Wetmore (1916) of 69 species feeding on insects mentions 12, or 17.4 per cent of them preying on odonates whether in adult or nymphal stage, (Table III), *Butorides virescens cubanus* (Oberholser), Cuban Green Heron, and *Marila affinia* (Eyton), Lesser scaup duck, heading the list in percentages. Eighty-four per cent of the stomach food contents of three herons was made up of the “. . . abdomen of adult dragonfly, nymphs and several damsel flies”. and 69 per cent of the ducks food was made up of dragonfly nymphs. Danforth (1926) who discusses the stomach food contents of 53 species, (Table III), found 15 of these, or 28.3 per cent had eaten odonates. *Totanus melanoleucus* (Gmelin), Greater yellow legs, and *Falco columbarius columbarius* (Linnaeus), Pigeon Hawk, represent the two worst enemies of dragon and damsel fly nymphs respectively with corresponding percentages of 65.33 and 12 of their food. The Pigeon Hawk, again and *Egretta candidissima candidissima* (Gmelin), Snowy Egret, are the ones with heaviest toll among the adult dragon and damsel flies in the order mentioned with 73 per cent and 15 per cent respectively. Most of the adult odonates, may have been taken while transforming and not able to fly very much, but there is no doubt that some of them are caught while on the wing as has been observed by Danforth in the cases of *Hydrochelidon nigra surinamensis* (Gmelin), Blacktern, and *Tyrannus dominicensis dominicensis* (Gmelin), Gray kingbird, the latter seen catching *Leptemis vesiculosa* (Fabricius) which is a rather swift dragonfly. Dr. James G. Needham has seen also this last bird catch on the wing *Tramea abdominalis* Rambur which in its flight is still faster than the former dragonfly.

In the nymphal stage dragonflies are picked upon more often than damselflies, a thing which is natural due to the small size of the damsel fly nymphs and also to their habit of clinging to small stems under water. Danforth's work shows that 53.3 per cent of the species of birds feeding on odonates attacked the nymphs of the dragonflies while only 13.3 per cent of them had eaten damselfly nymphs. In the adults the conditions are reversed, 40 per cent of the birds feeding on damselflies while 20 per cent feed on dragonflies. This is a good correlation, the latter being better fliers and standing usually in open spaces where they can see their enemies while the former are poor fliers, if compared with their relatives, and keep more often among the grasses close to the water on which they rest for longer periods and can be caught thus more easily.

Lizards have been reported to prey also on odonates, but Wolcott (1924) found only one case in 50 individuals of *Anolis pulchellus* Dumeril and Bibron, where a damsel fly, *Enallagma* sp., had been eaten. Dexter (1932) found that the nymphs of odonates constituted 0.8 per cent by bulk of the food of 301 specimens of *Bufo marinus* L. I have seen the latter sitting on the leaves of water plants from which I have collected transforming damselflies in Cartagena lagoon and certainly some of these have been eaten. Fishes are by far the worst enemies of the nymphs and in a few cases of adults. I have not found any data regarding Puerto Rican fishes.

But to all this fight with other species has to be added the struggle among the nymphs and adults of the odonates themselves. I have seen the big *Anax* feed upon the rapid *Lepthemis* and this in turn on *Erythrodiplox umbrata*, and Doctor Needham observed repeatedly cases of cannibalism among *Ischnura ramburii*. The fight easily seen in the air is no less intense and fierce in the water where the young nymphs fall easy prey to the larger ones.

The odonates in their adult stage are beneficial because of their predatory habits and destruction of many harmful insects like the mosquitoes. Nymphs may be counted also in the same category, but this is lessened by the fact that the nymphs may destroy young fishes. The adults feed upon mostly any kind of insect that they can get hold of. In Tortuguero Lagoon the numerous *Lepthemis* flitting in the air at the time of observation, February and March, were attacking the small white swamp moths *Nymphula fluctuosalis* Zeller which were then very abundant. These moths flew very low over the water surface, among the emergent aquatics, and so were in part protected from *Lepthemis*, but did not have such protection when attacked by *Lestes* sp. and other damselflies, which were feeding upon

them eagerly, because these latter ones fly also close to the surface of the water. In the Yúnez River in the gorge above the bridge on Km. 19.6, I have seen the big *Anax* together with some swallows, early in the morning, flying up and down the river and feeding on the adult mayflies dancing in the air about 30 to 40 feet above.

After the general remarks before made the following discussion will include observations applying to the individual cases and which could not be included before. The species will be placed for convenience in alphabetical order.

AESCHNIDAE

This family is represented by the subfamily Aeschninae only. The six species reported from the Island are by no means common either in the adult or nymphal stage. The most common one seen in flight is *Anax junius* and only a few recent records of *Aeschna cornigera* (A.M.N.H.) and *Coryphaeschna adnexa* (Needham and García-Díaz) are to be found. I saw once, at dusk, flying above the level of the electric light post about 30 feet high in Stop 38½ Hato Rey, near Río Piedras, an adult *Gynacantha*.¹ I have the impression of having collected also a teneral specimen of the latter under the wireless towers at Cayey, but the misplacing of the specimen makes it impossible to state it as a fact. The nymphs of *Anax* are by far the commonest and they are easily told from those of *Coryphaeschna*, when alive, because the latter have whitish eyes while the former do not.

Acanthagyna nervosa Rambur

No adults have been collected.¹ Gundlach (1888), collected them in Cuba on December 15 near Cárdenas and in the Zapata swamp; Kohl (1916) records them from the Isle of Pines, September 11, 1912. The nymph, if Klots' (1932) supposition is right, was caught July 31st, 1926, on the university campus in a ditch with temporary water where the sewage overflow of a building was discharged. The water was ill-smelling due to a dead cat in the water a short distance from where the nymph was collected. No other odonate nymphs were found here and only some tadpoles with it. From this it appears that the nymph does not require clear running or clean water. The tadpoles probably served as food.

Aeschna cornigera (Brauer)

The adult upon which this record rests was caught in Adjuntas, June 8-13 (A.M.N.H.). No other adults have been seen or collected.

¹ See note at end. (page 85.)

A nymph collected by Doctor Needham, March 23, 1936, in a creekic front of Camp Buena Vista in the Maricao Forests, over 2,350 feet above sea level, seems to be an *Aeschna*, but is too young to make an accurate determination.

Anax amazili (Burmeister)

(Pl. VI, Fig. 8)

No adults have been collected in Puerto Rico. The record rests on two nymphs collected by me in Hato Rey, Stop 30, near Río Piedras, September 15, 1926, and determined as such by Byers (1927). The nymphs were full grown. The place where they were collected was a rather shallow temporary pool, not over three feet deep at its most, whose water remained usually very clear during the rainy season. Many other odonates as nymphs and adults were collected and seen in this pool, but only *Anax junius* belonging to the Aeschninae was caught here on different occasions on the wing. The pool dried up completely during the year so the life cycle must take place in a year or less. This is possible if we take into consideration Calvert's (1934) paper, who although he thinks that in the greater part of North America two successive generations of *A. junius* do not occur, admits "that under continued high temperature of both water and air two generations per year may be possible". The last two mentioned climatic conditions are easily met on the Island. No more nymphs have been collected. The place of original collection is no longer in existence since the hollow was filled up.

Hagen (1867), calls this species from Cuba "scarce". Calvert (1899) has a record of a female from Tepic, October 1894, 1036 meters altitude, and from Cuba Gundlach (1888) gives records November 15, 1888 and adds "un ejemplar fué cogido en Octubre 1871 en la Habana". This shows the species occurs at widely different altitudes and its indicated infrequent occurrence in Cuba possibly accounts for absence of adults in Puerto Rican collections.

Anax junius (Drury)

Although not very often seen, the records show it is to be found throughout the entire year and from sea level 2,000 feet up. Most easily caught when copulating because when doing so the pair usually rests along the shore of the pond. Needham (1901) has discussed the habits of the nymphs which are "notoriously cannibalistic" a fact possibly accounting for the very few reaching adult stage. La Muda, Feb. 21; Almirante Road Km. 6.7, March 9; Lares, March 22;

Cabo Rojo, Feb. 23; Needham and García-Díaz. Nymphs; Lake Tortuguero, Feb. 19; March 20; Almirante Road, Km. 6.7 March 18, Needham and García-Díaz; Cartagena Lagoon, Oct. 31; Isabela, May 12, García-Díaz.

Coryphaeschna adnexa (Hagen)

(Pl. V, Fig. 4; Pl. VI, Fig. 7)

In only two places were adults of this species seen. I have records from Cuba in May, June and November which tends to show that adults occur throughout the whole year if these records are added to the ones indicated here.

Large numbers of the nymphs of this genus were collected on the west end of Lake Tortuguero among *Polygonum* plants in standing water about 2½ feet deep. The nymphs of *Anax* were equally numerous. The white eyes of *Coryphaeschna* distinguish them at once.

Florida Road, Km. 4.6, Feb. 28; La Muda, Feb. 21; Needham and García-Díaz. Nymphs: Tortuguero Lake, March 20; Needham and García-Díaz; Isabela, May 12; Cartagena Lagoon; Oct. 31; García-Díaz.

Gynacantha trifida (Rambur)

Not a single record has been added to those of Stahl, Kolbe and Gundlach.¹ A nymph considered by Klots as *Acanthagyna* has been reported from the Island. I think I have seen and collected this species as stated before. Their habit of flying at dusk is possibly responsible for their absence in collections and Gundlach's mention of their occurrence in the woods is another possibility. It has been caught in Cuba during August and September, occurring in large flocks along the coast and seen migrating from north to south in December.

LIBELLULIDAE

These are the dragonflies most often seen and collected all over the Island. Some of the species are remarkable for their absence in collections. Among these are *Micrathyría didyma didyma* and *Micrathyría hageni*, specimens of which have not been collected after Gundlach's and Kolbe's records. Two more genera have recently been added to the Puerto Rican list, *Idiataphe* (= *Ephidatia*) *cubensis* and *Brachymesia furcata*. *Tramea onusta* and *Micrathyría*

¹ See note at end. (page 85.)

aequalis are also new records for the Island. Only where field notes are at hand or additional records to those of Klots (1932) will be discussed below.

Bachymesia furcata (Hagen)

(Pl. VI, Figs. 1, 3, 5)

One of the new records. A single adult male caught in flight in Coamo Springs near the reservoir April 5, 1930, Needham and García-Díaz. No more adult specimens have been collected on the Island, but no collecting has been done in the place of collection since the data before mentioned.

Cannacria herbida (Gundlach)

(Pl. VI, Figs 2, 4, 6; Pl. VI, Fig. 1)

This species seems to be restricted to the costal plain where adults are quite common throughout the year. The adults fly close to the water and to the edge of the river, pond or lake. Usually they select a stick over the surface of the water where they perch persistently and to which they return after repeated disturbance. A female was seen ovipositing in the Bayamón River close to the sea where the water becomes more or less brackish when the nearby sea sweeps in. While ovipositing, unattended by male, she descended swiftly, at long intervals, to the water surface dipping the tip of her abdomen. This procedure certainly made eggs less liable to the fish havoc. No nymphs were discovered at this time. On August 10th the nymphs assumed to be this species by comparison with those of *Cannacria gravida* as discussed by Needham and Fisher (1936) and with Doctor Geijskes' description (1934) were exceedingly common along the Cartagena Lagoon shore.

Tortuguero, Feb. 10, Needham and García-Díaz; Tortuguero, Feb. 15; Río Piedras, Feb. 12; Palo Seco, Mar. 21, Needham and García-Díaz; Río Piedras, Flying to lights at home, one female, May 19; Lago Las Torres, June 21; Cartagena Lagoon, August 10, October 31; Yauco, November 11; Fajardo. Las Cabezas, December 19, García-Díaz. Nymphs: Cartagena Lagoon, August 10, García-Díaz.

Dythemis rufinervis (Burmeister)

This is a species which could be placed with the lotic ones, but is capable of living under completely static environment since it is found high up in the mountain rivers, 2,000 feet, and also in Tortuguero Lake at sea level. The adults are twig perchers. Once

they select a place to stand they come back to it repeatedly when disturbed and even after being hit by the net. The males fly close to the water edge over the stream. They are alert, fast flyers and difficult to get when in flight. The nymphs were collected in large numbers in the Guajataca River, in running water, but in a shallow pool with sandy bottom upon which the nymphs rested. They were not easily seen when at rest, matching with the surroundings, but once moving one could easily see them as they moved on the sand or swam through the water in front of the sieve net. They are capable of standing dryness since some placed in a pail in the late afternoon got out of it and were found next morning in the car or crawling over the sidewalk close to which the car had been left.

Tortuguero Lake, Feb. 10, Needham; La Muda, Feb. 21; Cartagena Lagoon, Feb. 23; Tortuguero Lake, Feb. 15; Florida Road Km. 19.3; Yúnez River, Feb. 28; Río Blanco, Power plant, March 8; Almirante Road, Km. 6.7, March 3; Arecibo, Tanamá River, March 13; Lares, Guajataca River, March 23; Cabo Rojo, Feb. 24, Needham and García-Díaz; Ponce, Río Bucaná, June 21, Coamo, Río Puyón, June 20, García-Díaz. Nymphs: Lares, Guajataca River, March 23; Caguas, March 4; Florida, Yúnez River, Feb. 28; Río Piedras, March 18, Needham and García-Díaz; Florida, Yúnez River, Aug. 14, García-Díaz.

Erythemis plebeja (Burmeister)

One of the most difficult dragonflies to obtain because of its alertness and swift flight and also because it usually chooses open spaces for perching where it is difficult to catch. Cabo Rojo, Feb. 23; Florida, Yúnez River, Feb. 28; Lake Tortuguero, March 20, Needham and García-Díaz; Lago Las Torres, June 21; Cartagena Lagoon, October 31, García-Díaz.

Erythrodiplax connata justiniana Selys

I have found them most abundant in swampy places usually with a lot of vegetation but they occur also along the rivers. They are fast fliers and their direction in flight is erratic. They fly low and seldom stand on the higher plants, preferring the lower ones, usually selecting new perching places every time. Once having located a place where they occur, one is sure to get a good series since they keep close to the place even if many times disturbed. On March 13, 1935, on Almirante Road and in a swamp about one hundred yards west from the road sign Km. 6.7, I collected a good series of this

species many of which had recently emerged. I failed to obtain nymphs since I did not search for them. Two years before, June 27, 1933, I got also a very good series on this locality by the road side. Doctor Needham has a nymph caught in Florida Road Km. 4.6, which he thinks is this species. The adults, though sometimes localized, have been found widely spread over the Island reaching altitudes of 2,000 feet. They like *E. umbrata* do not prefer the open spaces, but the grasses and bushes back of the open waters.

Yúnez River, on the Florida Road Km. 19.3, Feb. 28; Almirante Road Km. 6.7, March 9, 13; Lake Tortuguero March 19-20, Needham and García-Díaz; Almirante Road, Km. 6.7, June 27; Coamo, Río Puyón, June 20, Lago Las Torres, June 21, García-Díaz.

Erythrodiplax minuscula (Rambur)

Judging from collecting done at different times on different places over the Island, this species, like *E. berenice naeva*, is not common. Cartagena Lagoon, October 31, García-Díaz.

Erythrodiplax umbrata (Linnaeus)

Usually the most comon species of dragonfly on the Island. It prefers, as said before, places back of the open water among the weeds or bushes. Not very hard to catch. When flying over the water they keep close to the surface. Copulate most of the time without coming to rest in a very short time and the female begins ovipositing at once, dipping the tip of the abdomen at different places in a small area and then moving to some other place. A striking fact is that although adults are common, the nymphs are not so commonly and easily collected. Possibly the nymphs have habits similar to those of *Idiataphe*.

Idiataphe (= *Ephidatia*) *cubensis* (Hagen)

(Pl. VII, Fig. 3)

Cowley, (1934) finding *Ephidatia* preoccupied has proposed *Idiataphe* for this genus. Dr. James G. Needham found this species for the first time February 10, in Tortuguero Lake where he reared it and has published the description of the nymph. Needham and Fisher (1936). Puerto Rico is the second place in the West Indies where this species has been found. A curious happening is that in Tortuguero Lake, on two different instances—March and August,—the cast skins were numerous, clinging to the stems of sedges and

grasses as well as on the leaves of the same, but the adults were exceedingly scarce to the extent that only two or three were obtained. Do adults keep in secluded places or are they destroyed by some enemies? If the adults are peculiar about their habits no less are the nymphs. For nearly a whole forenoon were nymphs searched for with the sieve and apron nets along the shore of the lake among weeds and water plants with no success. Doctor Needham's suggestion of the possibility of hiding among the roots made possible collecting a few living ones. Upon pulling some sedges growing in the water or close to the water edge, they were found living there. Among the roots of some stumps of *Chrysobalanus Icaco* L. in the water along the shore, they were found also. Finding them is a real job and only five nymphs were obtained. Although this species seems to be strongly localized as shown by the record of having been found only in Tortuguero Lake, not too much stress can be placed upon this fact when the habits of nymphs and adults are taken into consideration.

Lake Tortuguero, Feb. 10, Needham; Lake Tortuguero, March 20, Needham and García-Díaz. Nymphs: Lake Tortuguero, Feb. 10, Needham; Lake Tortuguero, Feb. 14, Needham and García-Díaz.

Lepthemis vesiculosa (Fabricius)

One of the most common, if not the commonest, species on the Island. Adults fly tirelessly along the open waters, keeping most of the time close to the shore. They may be exceedingly common and yet few cast skins may be found. When copulating they come to rest, those that I have seen, and are then easily caught as in *Anax*. Though I have seen large numbers of them, I have not noticed many of them copulating. The female when ovipositing keeps close to the water and dips her abdomen in the water in limited areas and then moves on. When the tip of the abdomen of an ovipositing female is placed in a vial, the eggs are seen to come out singly, but rapidly, in a stringlike fashion. They stick easily to the bottom or sides of the vial, are whitish-yellow in color, but on standing turn brown. The nymphs live in pools and standing waters, but also in running water since in 1930 Doctor Needham collected numerous nymphs among algae mats growing in the shallow Coamo River back of Coamo Spring hotel. The highest altitude record is 1,800 feet. On Fig. 1 there are some months in which *Lepthemis* is not recorded. This is because there are no actual records, but there is no doubt that this species occurs throughout the entire year.

Macrothemis celeno (Selys)

A widely spread species over the Island. Primarily a lotic one, ranging from sea level to above 2,000 feet. The adults fly along the rivers and usually come to rest on the gravel or stones along the edges. They are very difficult to catch because of their swift flight. When standing on the stones or gravel one has to strike from above, since they have the habit of shooting straight up from their resting place if disturbed. A female seen ovipositing unattended by the male, flew eight to twelve inches above a sandy riffle and made lightning-quick dashes to the water's surface and back again to the same level, hitting the water lightly with the tip of the abdomen each time, this descent and return made so quickly that the eyes could hardly follow. Although present in lower levels, it is most common and easily seen along the water courses in the high levels. The nymphs in the rivers are found among the overhanging roots and stems of plants growing close to the edges.

La Muda, Feb. 21; Florida, Yúnez River, Feb. 28; Río Blanco, on Hicaco River dam above the power plant, March 8; Lares, Guajataca River, March 22; Arecibo, March 13, Needham and García-Díaz, La Catalina, Luquillo Mts., July 2; Ponce, Río Bucaná, June 21; Coamo, Río Puyón, June 21; Cartagena Lagoon, October 31; García-Díaz. Nymphs: La Muda, Feb. 9, Florida, Yúnez River, February 28, Needham and García-Díaz.

Miathyria marcella (Selys)

Apparently restricted to the costal plain where it has been only collected up to the present time.

Cartagena Lagoon, Feb. 23, Needham and García-Díaz; Cartagena Lagoon, October 31, García-Díaz. Nymph: Río Piedras, Forestry Department pool, Feb. 7, Needham.

Micrathyria aequalis Hagen

Collected only north of Cabo Rojo along an irrigation ditch. Not reported before from the Island. Very similar to *M. dissocians* but easily distinguished because of its smaller size and the smaller white spots on segment 7. Cabo Rojo, Feb. 24, Needham and García-Díaz.

Micrathyria dissocians Calvert

The most common species of the genus occurring on the Island in sharp contrast with the marked absence of *M. didyma didyma* and

M. hageni which rest yet upon Gundlach's and Kolbe's records. Apparently confined to the costal plain.

Isabela, March 25, Needham; Cabo Rojo, Feb. 24; Florida, Yúnez River, Feb. 28; Almirante Road Km. 6.7, near Vega Baja, March 9, Arecibo, March 13, Needham and García-Díaz; Almirante Road, Km. 6.7 near Vega Baja, June 27, García-Díaz.

Orthemis ferruginea (Fabricius)

The collecting records thus far are from eastern two-thirds of the Island, but it is certainly present all over. It has been caught from sea level up to the 2,000 feet line. There is no doubt that it will be found above this since this species is capable of wide vertical distribution. A species rather difficult to catch because of its swift flight and perching on twigs in open spaces. Some adults are remarkably red. I have seen a female ovipositing on the tiles of the vestibule of a building in the University and when disturbed insisted upon coming back and doing it again. An adult was caught also April 12, flying to the lights at my home. The nymphs of two reared adults when compared with Klots' (1932) supposition for *Brachymesia gravida* confirmed Doctor Needham's (1936) belief that such supposed nymph is but an *Orthemis*.

Florida, Yúnez River, Feb. 28; Río Blanco, by power house, March 8; Almirante Road Km. 6.7 March 9; Lake Tortuguero, March 20, 21; Arecibo River, March 13, Needham and García-Díaz. Río Piedras, an adult flying to home lights, April 12; La Catalina, Luquillo Mts., July 22; Ceiba, Ensenada Honda, July 24; Río Piedras, June 22; Fajardo, Las Cabezas, December 19; Yauco, November 1; Ponce, Río Bucaná, June 21, García-Díaz. Nymphs: Isabela, March 25, Needham.

Pantala flavescens (Fabricius)

Not so common as the other species. Prefers sunny open spaces where it flies tirelessly keeping usually almost the same level, and about five feet from the ground, while getting its food. Usually there are a few together when doing so.

Lake Tortuguero, Feb. 10, Needham; Almirante Road, near Vega Baja, Km. 6.7, March 9, Needham and García-Díaz; Fajardo, Quebrada Vuelta, July 24; Yauco, Dec. 1, García-Díaz.

Perithemis domitia (Drury)

The adults are not commonly seen, recorded only from three places on the Island, probably due to their sensitiveness, as mentioned by

Needham and Haywood (1929) to bright shiny or cloudy damp days. I collected a good series of nymphs in a sink hole pool near Isabela, Road No. 2 Km. 103 on May 12. The pool was extremely muddy, heavily loaded with organic matter made up mainly of leaves which had fallen from the trees which surrounded and partially covered the pool. The water fleas and small ostracods were so common that they formed brown patches on the surface and around any stumps above the surface of the water. The nymphs were found along the edges of the pool. Some of them were taken to the laboratory and reared, yielding seven females and three males. The former agree with Dr. Ris (1930) remarks about specimens from Cuba as quoted by Klots (1932). Five of the females show also a brown spot on the anterior wing occupying the first cell of the bridge and part of the cells under this as well as the first cell between M_1 and M_2 sometimes extending to the other cells above and below this latter ones. On the posterior wing a similar spot past and close to the oblique vein filling part of the area of the cell as well as some of the cells above and below. In two females the spots did not show clearly, but the faintly colored areas could be partially made out. Perhaps the specimens were killed before coloring up completely. The large number of females to males in the lot reared, though it may have no meaning at all, is in strong contrast with their absence in collected specimens. A female seen ovipositing, unattended, in the above-mentioned pool flew close to a piece of wood emerging above the surface of the water and while in flight rapidly and repeatedly touched the wood close to the surface of the water; she did this for a number of times, quit, and began doing it again, repeating the process on different occasions.

Cabo Rojo, February 24, Needham and García-Díaz; Isabela, May 12, García-Díaz, Nymph: Isabela, May 12, García-Díaz.

Scapanea frontalis (Burmeister)

This is mainly a lotic species on the Island and restricted principally to the higher levels, although there are records from Mayagüez and Wilson (1911) found it also in Jamaica "along the dead water at sea level". But the nymphs in Puerto Rico have been collected, up to the present, only above the 500 feet level, becoming commoner higher up. The living adult males make themselves conspicuous while in flight by the white spot near the tip of the abdomen segments 7, 8, and 9, and which does not show in many preserved specimens. The females do not show this spot. Both are strong

fliers fitting close to the water up and down the course of the stream, loitering over pools. They are stremely shy, though approachable, but of one is missed by the net usually all go away. Most of them are caught on the wing. They copulate without coming to rest. Their nymphs are capable of standing dryness to a large degree since they crawled out of a bucket of water during the night, and like those of *Dythemis* mentioned before, were found the following day on the floor of the car and on the sidewalk. They prefer rapid running water, clinging to the stones—some of them to the under surface.

Luquillo Mountains, February 18; Río Blanco, above Hicaco River dam, March 8; Lares, March 22, Needham and García-Díaz. Nymphs: Florida, Yúnez River, Feb. 28; Arecibo River, near Utuado, March 13; Lares, March 13; Needham and García-Díaz.

Tramea abdominalis (Rambur)

The most common of the *Trameas* on the Island. Besides flying alone I have seen them flocking together in large numbers while feeding on the Chironomids which keep in cluster from 12 to 15 or 20 feet above the ground. The female may oviposit unattended or with the male. When the latter happens the male releases the female from one to two inches above the surface of the water, when she descends to oviposit hovering meanwhile above and on her coming up the male seizes her again; both fly for a short time and repeat the action described. If the female is missed by the male she continues to oviposit unattended, sometimes the male trying to get hold of her repeatedly. The eggs, yellowish in color, descend slowly in a cluster of 7-10 eggs to the bottom. The keeping of the eggs together in such a fashion without scattering, renders them no doubt subject to the attacks of fishes and other enemies and here is a possible explanation of the comparative scarcity of nymphs of this genus when compared with the number collected of nymphs of other genera.

Río Piedras, Feb. 7, 9; Tortuguero Lake, Feb. 10; Isabela, March 25; Needham; Tortuguero Lake, Feb. 15; Cartagena Lagoon, Feb. 23; Cabo Rojo, Feb. 24; Florida, Yúnez River, Feb. 28; Río Blanco, near power house, March 8; Almirante Road Km. 6.7; March 9; Arecibo, March 13, Tortuguero Lake, March 20, 21, Needham and García-Díaz; Almirante Road, Km. 6.7, June 27; Cartagena Lagoon, Oct. 31; Lares, Oct. 30; Peñuelas, March 24; Lago Las Torres, June 21, García-Díaz. Nymphs: Cartagena Lagoon, Feb. 23, (reared). Neeham and García-Díaz.

Tramea binotata (Rambur)

The least common species of *Tramea* found on the Island if compared with the other two. The nymph is unknown. Florida, Yúnez River, Feb. 28; Almirante Road, Km. 6.7 near Vega Baja, March 9; Arecibo, March 13; Tortuguero Lake, March 19, 20, Needham and García-Díaz.

Tramea onusta (Hagen)

A species not reported from the Island although from the West Indies. I have collected them flying together and among the flocks of *T. abdominalis*. Not captured at higher levels but undoubtedly there.

Cartagena Lagoon, Feb. 23; Arecibo River, March 13; Tortuguero Lake, March 20, 21, Needham and García-Díaz; Ceiba, July 24; Fajardo, Las Cabezas, December 19; Yauco, Nov. 1, García-Díaz.

ZYGOPTERA

An additional genus, *Argiallagma* has to be added to those already listed from the Island and also a species, *Enallagma cultellatum*. Small as are some of them and with peculiar habits of life, as will be indicated presently under each species, a few of these odonates are liable to be overlooked. The status of their nymphal stages remains practically the same as stated by Klots (1932) with the only exceptions of *Enallagma coecum* and *E. cultellatum*, both of which have been reared. To these two should be added a supposition believed to be the nymph of *Argiallagma*. These three nymphs with others of the Anisoptera are discussed further on. It is a striking fact that the nymphs of these odonates, with the exception of those of *Ischnura* and *Enallagma coecum*, are very uncommon although the adults occur in the place where collecting is done. A single family *Coenagrionidae* with two subfamilies *Lestinae* and *Coenagrioninae* have been thus far reported.

Anomalagrion hastatum (Say)

The most inconspicuous of all the zygopterans on the Island and easily overlooked because, although the male has a yellow color, this blends with the dry leaves of the plants in the nearly dry places back of the open waters where they occur. They keep among the plant and weeds and the females, mostly dull colored, are also not easily seen. It seems to be restricted to the lower levels reaching the 500 feet line where it has been collected, though future collecting may alter this view.

Río Piedras, Forestry Department pool, Feb. 8, 9; Tortuguero Lake, Feb. 10, 15, Needham; Guánica Lagoon, Feb. 24; Río Piedras River back of Experimental Station, Feb. 12; Florida, Yúñez River, Feb. 28; Almirante Road, Km. 6.7; near Vega Baja, March 9; Tortuguero Lake, March 19, 20, Needham and García-Díaz; Almirante Road, Km. 6.7, June 27, García-Díaz.

Argiallagma minutum (Selys)

(Pl. IV; Pl. V, Figs. 1, 3; Pl. VII, Fig. 2)

Doctor Needham collected this species for the first time on the Island in Tortuguero Lake, Feb. 10, and later at Almirante Road, Km. 6.7, March 9. Regarding the collecting at this last place he says: “. . . the *Argiallagmas* were captured among the weeds, none over the pond, but in plashy places where they could flit through the small intervening openings from stem to stem. I broke paths through the weeds so as to get about more easily, and then traversed these, scanning the bordering stems for the delicate little damselflies. They did not seem to be common but by diligence got a good lot. Only rarely was any other species found near them; *Anomalagrion hastatum* betimes and very rarely an *Ischnura ramburii*; this latter lives more openly.”

So far this species has been collected from only two places and no comment can be made as to its distribution considering the above notes, but it seems to be a localized form. In August I went to Almirante Road, where Doctor Needham had collected adults, to obtain some nymphs, but was unable to find them. Although I searched most carefully, I saw but one adult specimen which I missed when I tried to capture it. I collected though some in Tortuguero Lake.

Tortuguero Lake, Feb. 15, Needham; Almirante Road, Km. 6.7; near Vega Baja, March 9 in copula; Tortuguero Lake, March 20, (in copula), Needham and García-Díaz; Tortuguero Lake, August 16, (in copula), García-Díaz. Nymph: (Supposition) Almirante Road, Km. 6.7, March 9, Needham and García-Díaz.

Ceratura capreola (Hagen)

(Pl. V, Figs. 2, 5)

Another species which tends to be a localized one, keeps among the plants and weeds not flying in the open. Nothing is known about its habits and the nymph is unknown, although Klots (1932) published a supposition and another is also discussed in this paper.

Tortuguero Lake, Feb. 15, Needham; Tortuguero Lake, March 20, Needham and García-Díaz; Florida, in swampy hollow close to River, Aug. 15, García-Díaz.

Enallagma civile (Hagen)

These dainty blue damselflies are found most often in pools and standing water; they may be found also along running water. In flight they keep close to the surface of the pool and do not fly for very long periods, pausing repeatedly on anything above the water or among the plants along the edge. They have been collected from sea level to 2,000 feet. Although adults are common the nymphs are apparently scarce for reasons given in the discussion of the nymphs farther on.

Río Piedras, Forestry Department pool, Feb. 8; Río Piedras, River back of the Experimental Station, Feb. 12; Isabela, March 25, Needham; Cartagena Lagoon, Feb. 23; Florida Road, Km. 4.7, Feb. 28; Almirante Road, Km. 6.7, March 9; Tortuguero Lake, March 20, Needham and García-Díaz; San Germán, April 28; Almirante Road, June 27; Cartagena Lagoon, August 9, 10, November 31, García-Díaz.

Enallagma coecum (Hagen)

This species is primarily lotic, preferring running water but it may be found also along standing waters. Widely distributed over the Island. Its nymph has been collected above 1,000 feet level and the adults above the 2,000 feet line. The former have the habit of hiding among the roots of sedges growing close to the water near the edges and are found also among overhanging roots of other plants. In a random collecting in the creek at Florida Road, Km. 4.7, the nymphs of this species outnumbered those of *Ischnura* in a ratio of ten to one. No other species of Zygoptera were found with them.

La Muda, Feb. 9; Río Piedras, River back of the Experimental Station, Feb. 12; Florida, Yúnez River, Feb. 28; Florida Road, Km. 4.7, Feb. 28; Caguas, Cagüitas River, March 4, Río Blanco, above Río Hicaco dam, March 8; Almirante Road Km. 6.7, March 9; Tortuguero Lake, March 20; Adjuntas, March 23; Arecibo, Tanamá River, March 13; Needham and García-Díaz; Cayey Wireless Station, May 6; Florida, Yúnez River, August 15; La Catalina, Luquillo Mountains, July 22; San Germán, River near the town, April 28; Ponce, Río Bucaná, June 21; Coamo, River Puyón, June 21, García-Díaz. Nymphs: Florida, Yúnez River, Feb. 28; Florida Road, Km. 4.7, Feb. 28; Caguas, Cagüitas River, March 4; Río

Blanco, above Hicaco River dam, March 7; Almirante Road, Km. 6.7, March 9; Arecibo-Utuado Road, Kms. 56 and 60 near Utuado, March 13; Río Piedras, March 18; Lares, Guajataca River, March 22; Adjuntas, March 23, Needham and García-Díaz; Florida, Yúnez River, June 21; in marshy-swampy hollow close to River, August 15, García-Díaz.

Enallagma cultellatum (Hagen)

(Pl. V, Fig. 6, 7)

Found only in Tortuguero Lake by Doctor Needham, February 10, thus adding another species record for the Island to the genus. On February 15 there were many in copula and some of them ovipositing. A female while carrying this latter process stood on a leaf of *Nymphoides humboldtianum* bending its abdomen around the margin and under the leaf on whose lower epidermis made crescent shaped slits and stuck the eggs with their micropylar end pointing towards the openings of the slits. These were placed in a semicircular arrangement. The eggs had a black conic apex surrounded by some substance which was impossible to ascertain whether it was a secretion or part of the epidermis of the leaf. While the female was ovipositing, the male kept hold on her, standing out in the air. Some nymphs were transforming and specimens were collected on the stems of plants about a foot above the water. These can be easily told from the other species by the rather stout, highly chitinized, terminal spine at the end of the serrated edges of the gill plates. Some of the adults were seen standing along the sandy shore of the lake and were common. This was in contrast with conditions in August when I saw very few, being able to collect but an adult and an additional teneral one. Possibly another localized species, the male is easily distinguished by its bright yellow frons, clypeus and labrum. A young nymph from Caño Tiburones places it among the hardiest ones for reasons given under the next species.

Tortuguero Lake, Feb. 10, Needham; Feb. 15, Needham and García-Díaz; August 16, García-Díaz. Nymphs: Tortuguero Lake, Feb. 10, (cast skins) Needham; Feb. 15; Caño Tiburones, March 12, Needham and García-Díaz.

Ischnura ramburii (Selys)

The most common damselfly on the Island through the entire year, but apparently restricted to the lower levels. There are no records above the 300 feet line. They become so numerous at times that failing to find food enough for all, they resort to cannibalism.

The pairs in copula fly for long periods together, resting among plants and flying about, but not necessarily ovipositing. This is another of the hardest Zygopterans on the Island, since I collected nymphs in the waters of Caño Tiburones which are decidedly brackish because of their connection with the sea by way of the Arcibo River.

Río Piedras, pool in Forestry Department, Feb. 7, 8, 9; Tortuguero Lake, Feb. 10; Maunabo, Feb. 11; Isabela, March 25, Needham; Río Piedras, River back of Experimental Station, Feb. 12; Tortuguero Lake, Feb. 15; Cartagena Lagoon, Feb. 23; Guánica Lagoon, Feb. 24; Florida Road, Km. 4.7, Feb. 28; Caguas, March 4; Almirante Road, Km. 6.7, March 9; Arcibo, March 13; Lake Tortuguero, March 19, 20; Palo Seco, March 21, Needham and García-Díaz; Cartagena Lagoon, August 10, García-Díaz. Nymphs: Tortuguero Lake, Feb. 15; Río Piedras, River back of the Experimental Station, Feb. 18; Cartagena Lagoon, Feb. 23; Guánica Lagoon, Feb. 25; Caño Tiburones, March 12; Tortuguero Lake, March 20, Needham and García-Díaz; Isabela, May 12; Cartagena Lagoon, August 10, October 31, García-Díaz.

Lestes forficula (Rambur)

The most common species of the Lestinae, occurring mainly along the coast but nymphs of it have been collected at Las Cruces on Road number one in a place 1461 feet high. The females may oviposit attended or not by the male. In the first case the male clings to the support while the female thrusts her ovipositor into the tissues of the weed or water plant. A female was seen ovipositing in the leaves of a sedge from 8 to 10 inches above the surface of the water. Other times they oviposit closer to the surface and gradually go down the support below the surface inserting their eggs, until nearly the whole abdomen is in the water.

Río Piedras, pool in Forestry Department, Feb. 8; Tortuguero Lake, Feb. 10; Isabela, March 25, Needham; Río Piedras, River back of the Experimental Station, Feb. 12; Tortuguero Lake, Feb. 15; Cartagena Lagoon, Feb. 23; Florida, Feb. 28; Almirante Road, Km. 6.7, March 9; Arcibo, March 13; Tortuguero Lake, March 19-20, Needham and García-Díaz. Tortuguero Lake, August 17, García-Díaz. Nymphs: Río Piedras, pool in Forestry Department, (reared), Feb. 8, Needham; Tortuguero Lake, (reared), Feb. 15; Cartagena Lagoon, (cast skins only), Feb. 23, Needham and García-Díaz.

Lestes scalaris (Gundlach)

Not common, if compared with the preceding one, on the Island. Florida, Yúnez River, Feb. 28; Almirante Road, Km. 6.7, March 9, Needham and García-Díaz.

Lestes spumarius (Selys)

The least common species of *Lestes* on the Island, judging from the records which are only those of Selys and an additional one of the American Museum of Natural History. No specimens were obtained even when looked for in the place last mentioned.

Protoneura capillaris (Rambur)

A single specimen of this species caught on the Island after Selys (1886) record; unluckily the date was not indicated, about 1928. Flying to lights.

Río Piedras, Hato Rey Stop 38½, García-Díaz.

Telebasis dominicanum (Selys)

This species, and the following one prefer to the open spaces the margin of the bodies of water where they are found or else among the weeds some distance from them. Adults have been collected from sea level to the 2,000 level.

Río Piedras, River back of the Experiment Station, Feb. 12; Guánica Lake, Feb. 24; Florida, Yúnez River, Feb. 28; Florida Road Km. 4.7; Caguas, Caguaitas River, March 4; Almirante Road, Km. 6.7, March 9; Arecibo, Tanamá River, March 13, Needham and García-Díaz; San Germán, River near town, April 28; Florida, swamp in hollow close to the river, August 15; Almiente Road, Km. 6.7, June 27, García-Díaz.

Telebasis vulnerata (Hagen)

(Pl. V, Figs. 8, 9)

The adults of these species have been collected in more places than the preceding one. Well distributed all over the Island with habits as indicated already. I have collected specimens above 2,000 feet level in the Luquillo Mountains in and above La Mina Recreational Area, flying in the shade along the courses of the small creeks.

No nymphs of these species have been described so far. A female specimen reared by Doctor Needham from Buena Vista Camp in Maricao is described farther on. Klots' nymph (1932) is that of *Enallagma coecum*.

La Muda, Feb. 9; Tortuguero Lake, Feb. 15; Florida, Yúnez River, Feb. 15; Río Blanco, near the power house, March 8; Arecibo, Tanamá River, March 13, Needham and Gacía-Díaz. Nymph: Maricao Forests, Camp Buena Vista, March 24, Needham and García-Díaz.

THE NYMPHS

The immature stages or nymphs of Odonata of the West Indies were for the first time thoroughly and systematically considered by Klots (1932). The majority of her suppositions were later corroborated by the collecting and rearing done by Dr. James G. Needham. In a later paper, Needham and Fisher (1936) the senior author added the description of *Idiataphe (Ephidatia) cubensis*. The descriptions which are to follow will increase the number known and modify some of the previous accounts. Yet there still remain a good number of nymphs to be reared and a great deal to learn about their habits, some of which have been indicated on the preceding pages. Following the plan of previous discussions the descriptions are placed, for convenience, in alphabetical order.

ANISOPTERA

Brachymesia furcata Hagen (Supposition)

(Pl. VI, Figs. 1, 3, 5)

Length 20.9–22.8 mm.; abdomen 14.0–14.9 mm.; hind femur 6.67–7.20 mm.; width of head 5.57–5.7 mm.; of abdomen 8.0–8.5 mm.

Head two times as wide as long; greatest width across the eyes; the latter ones bulging conspicuously, the anterior two thirds of their margins in a smooth curve which becomes rapidly straightened on the posterior third; hind angles with minute rather thickly set black spines; occiput smoothly emarginate. The meeting of the extremities of the occiput and the hind angles marked by two broad ridges which diminish in size anteriorly. Ratio of antennal segments 1:8:1.8:1.1:1.2:1.6:1. Last antennal segment slightly constricted near its end, the following portion forming a minute bulb. Labium thin, its hinge behind the first pair of legs but not reaching the middle of the second pair; length 3.3 mm., width 3.97–4.05 mm. Margins of medial lobe and inner edge of lateral lobes smooth and beset with strong setae. These are more or less regularly spaced along the entire length of the margin of the medial lobe which shows a cluster of them at its middle point. They are nearly absent along the basal half of the margin of the lateral lobe but become very numerous towards the apex where it meets the distal margin. Labial teeth strong, serrated and with spinules varying in number from 0 on that closest to the terminal hook to 5 on some of the middle ones and decreasing in the following ones. Lateral setae 7–8, mentals 10–13.

Legs slender, the femora with no definite pattern on them but the first and second darker than the third with their distal portions lighter than the rest. The tibia of the first leg with a well marked dark brown spot midway its length, the distal end also tinged with brown. Posterior wing pad 6.76-7.2 mm. long.

Abdomen wider than the head, smooth. Dorsal hooks on segments 3-10; those on segments 6-9 strongly developed, with highly chitinized tips and broad bases. The one on segment 9 as long as segment 10 whose hook is minute if compared with the others. No definite color pattern but lighter blotches midway between the dorsal hooks and the margins. Lateral spines on segments 8 and 9, short, strongly chitinized, somewhat incurved and with short, stout setae back of them along the edge of the segments. Length of spines 0.45 mm. and 0.6-0.75 mm. respectively. Appendages short, sharp pointed; superior and inferiors equal, laterals about one half as long, measuring 1.8-1.95 mm., 0.93-1.05 mm. and 1.87-1.95 mm. respectively.

Isabela, bare lime sink hole, March 25, Dr. James G. Needham.

REMARKS

Among the material there were these six cast skins collected by Doctor Needham in a bare lime sink hole near Isabela. They were different from all other nymphs of the genera of dragonflies known to occur on the Island. The only possibility left of nymphs not collected was *Brachymesia furcata*. As indicated before there is a good series of cast skins which are believed to be *Cannacria herbida* which agree with Doctor Geijskes' description of this supposed *Brachymesia furcata*. This was pointed out by Needham and Fisher (1936). There are some differences between Doctor Geijskes' measurements and the averages of those of the six nymphs considered in this paper and shown on Table I. They could be due to the preservation or to the possibility of Doctor Geijskes' nymphs not representing the ultimate instar as he believes.

If the nymph described has been correctly placed, it will show that Doctor Needham's contention (1930) that *Brachymesia* and *Cannacria* should be kept as two different genera is the correct one. The main differences distinguishing *Brachymesia furcata* from *Cannacria herbida* are the size of the abdominal appendages and the nature of the dorsal hooks. The former are shorter and the latter broader and stronger in *furcata* than in *herbida*. These major differences are corroborated by others like the difference in the last antennal segment, the shape of the eyes, the size of the lateral spines on segments 8 and 9, the width of the abdomen, the smaller hook of *herbida* on segment 10 and other differences indicated on Table I.

TABLE I
MEASUREMENTS OF CAST SKINS OF *B. furcata* and *C. herbida*

	<i>Brachymesia furcata</i>						<i>Cannacia herbida</i>						Averages		Geijskes' measure.
	I (a)	II	III	IV	V	VI	I (a)	II	III	IV	V	VI	<i>furcata</i>	<i>herbida</i>	
Length of body.....(b)	21.2	22.0	20.9	22.6	.....	21.9	20.5	23.0	24.5	23.5	22.0	21.67	22.56	18.5-19.
Length of abdomen.....	14.0(c)	14.5	14.2	13.6	14.9	14.2	15.4	14.2	14.7	16.0	15.7	14.23	15.16	.....(f)
Length of post-wing pad.....	6.75	6.75	6.75	6.75/7.05	7.2	6.75	6.75	6.45	6.6	6.6	6.67	6.6	6.82	6.61	
Width of head.....	5.55	5.70	5.7	5.7	5.7	.....	5.25	5.17	5.85	6.0	5.7	5.7	5.66	5.61
Width of abdomen.....	8.0	8.5	8.50	8.5	8.0	8.2	7.35	7.2	7.35	7.48	7.7	7.35	8.28	7.4	
Labium:															
Length.....	3.3	3.30	3.3	3.3	.....	3.82	3.75	4.2	4.27	4.27	4.12	3.3	4.07	.....
Width.....	4.05	3.97	4.05	4.05	4.05	4.27	4.12	4.57	4.68	4.72	4.50	4.03	4.47	4.5-5.0	
Lateral setae.....	8	8	7	7	8/7	8	8	9/10	10	10	10	7-8	8-10	10	
Mental setae.....	10	10/13(e)	10/11	12/10	10/11	8/10	8	13	14/13	13	13	10-13	8-14	12-13	
Setae on labial teeth.....	2.4	1-5	1-5	1-5	0-4	1-3	1-3	1-3	1-2	1-3	1-3	0.5	1-3	2-5	
Abdominal appendages:															
Superior.....	1.95	1.87	1.8	1.83	1.87	1.9	3.0	3.0	2.85	2.85	2.85	1.87	2.9	.92	
Lateral.....	.937	1.05	.97	.937	1.05	.975	1.05	.975	1.05	1.05	1.05	.986	1.02	.80	
Inferior.....	1.95	1.87	1.87	1.87	1.95	1.95	3.0	3.0	2.85	2.85	2.85	1.91	2.9	.96	
Dorsal hooks of abdomen (d)	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	
Spine on 8th segment.....	.45	.45	.45	.45	.45	.45	.63	.75	.45	.73	.63	.45	.636	.28	
Spine on 9th segment.....	.75	.63	.67	.60	.60	.60	1.12	1.2	.70	.90	.90	.64	.94	.80	
Length of 10th segment.....	.45	.45	.45	.45	.52	.45	.52	.525	.45	.52	.48	.45	.46	.....
Length of femora:															
I.....	3.52	3.75	3.60	3.67	3.75	3.75	3.30	3.15	3.3	3.48	3.3	3.37	3.67	3.31	
II.....	4.80	4.95	5.02	5.1	5.10	5.10	4.23	4.20	4.27	4.40	4.2	4.2	5.01	4.25	
III.....	6.67	6.75	7.05	7.05	7.05	6.75	6.37	6.22	6.07	6.30	6.22	6.15	6.91	6.22	

(a) The Roman numbers stand for the individual cast skins considered. All those of *B. furcata* came from a bare lime sink hole in Isabela, March 25. Under *Cannacia* I was obtained on the same date and place before mentioned. II, V and VI from Cartagena Lagoon, February 24 and August 20; III and IV from Cabo Rojo, February 24.

(b) Head missing or so broken that it could not be accurately measured.

(c) All measurements in millimeters.

(d) The tenth segment bears an additional very small hook in both species.

(e) The corresponding left and right having different numbers or unequal in length.

(f) Not given.

Coryphaeschna adnexa (Hagen)

(Pl. V, Fig. 4; Pl. VI, Fig. 7)

Length 41.5 mm.; abdomen 28.25 mm.

Large head, greatest width across the eyes 8 mm.; the latter large and rounded, their most proximal slightly sinuated margin 1.6 mm. from the occipital margin, measured from the greatest depth of the sinuation. Occiput emarginate, its proximal mid-point to a corresponding one on the vertex margin 1.4 mm., its width 5.25 mm. across. Maximum length across the head, back of the proximal margin of the eyes 6.25 mm. Ratio of the antennal segments: 1:1.5:2:1:1.5:1.5:1. The labium measures 7 mm. in length and 5 mm. wide; sides from hinge out more or less parallel for about 4 mm. where they broaden out to attain the maximum width of 5 mm. Very small setae along the finely serrated edges starting a little below the place where the broadening begins where there is besides the ridge of spinules a few of the latter on the inner surface of the labium; somewhat flattened along the margins where breadth is largest. Distal margin of medial lobe rather convex rising .5 mm. above horizontal line between bases of lateral lobes. A cleft .2 mm. deep and .15 mm. wide in the middle with two chitinized rounded teeth about .1 mm. from the edge of the cleft rising about .03 mm. above the margin. Hairs along the margin rising as high as the two teeth close to cleft. Lateral lobes with their inner lower margin denticulated beyond the curved proximal end, the small teeth increasing in size until they reach the large chitinized tooth at the distal end of the inner margin on the lower end of the nearly squarely truncate distal margin of the lateral lobe. This outer distal margin is also denticulated, but the teeth are small and compare only with those at the proximal end of the ventral margin of the lateral lobes; the large ventral tooth is about $\frac{1}{3}$ the length of the truncate distal margin. Very small setae along the middorsal line of the movable hooks.

The legs with a few hairs on them; possibly some of the latter even lost during dryness, but by no means are they hairy. Measurements of femur, tibia, and tarsus as follows: I 3.6:4.25:2; II 5.1:4.75:2; III 6:6:2.5. Posterior wing pads 8.75 mm.

Abdomen elongate, widest at the sixth segment measuring 7.3 mm. Spines on segments 6, 7, 8, 9 having a length of .25; .6; .75; and .5 respectively. Lateral margin of spine bearing segments serrate with fine setae in the notches. Gonapophyses on 8th segment 2.75 mm. long, reaching the hind border of segment nine; those on this latter segment 2 mm. long reaching beyond the hind margin. Lateral appendages 3.75 mm. long, more or less rounded and ending in a strongly chitinized sharp point; as long as the superior which is rounded at the tip. Inferior appendages the same length of lateral reaching a fraction of a millimeter beyond the superior, triquetral in shape, incurved tips chitinized but not as heavily as laterals.

Almirante Road, near Vega Baja, Km. 6.7, March 9, Dr. James G. Needham.

REMARKS

The preceding description is based on a cast skin supposed to represent the last larval instar because it was dry and on a bulrush. A very thin mud film covered the surface hiding all possible color patterns.

A number of similar nymphs were obtained in Tortuguero Lake together with those of *Anax*. They are easily told from these latter ones, when alive, because they have white eyes, as well as by their abdominal appendages.

None of the living nymphs collected had attained the size of the described cast skin, but undoubtedly are the same species. The younger nymphs have a tendency to be darker in color than the older ones. Antennal segments 3 and 4 are brown in color as well as the distal end of the terminal one. The labia of the younger ones may show smaller additional teeth between the cleft and the two larger teeth mentioned in the description. The color pattern on the legs is variable also from completely patternless ones, through some of their femora marked with three rings and a brown or black spot about $\frac{2}{3}$ distant from the proximal end of the femora. These dots are the ones to hold most consistently throughout. The abdomen has no definite color pattern, but in the middle size nymphs there may appear on the sides two diagonally placed brown spots, most easily seen and occurring more frequently, on segments 5-8 although the anterior ones may show them also. A black dot on the ventral surface of the inferior appendages, close to the chitinized tip and separated from this by a less chitinized and equal to or slightly larger than the black spot itself.

Klots (1932) suggests the possibility of another species besides *C. adnexa*; since, as stated by her, this is not certain I have assumed this nymph to be the latter.¹

ZYGOPTERA

Argiallagma minutum (Selys)

(Pl. IV; Pl. V, Figs. 1, 3; Pl. VI, Fig. 2)

Length 9 mm. + 4 mm. gills, abdomen 5.75 mm.

Head flattened, hind angles rounded with easily seen, sparsely placed spines. Antennal segments 1 and 2 with dark brown spots on their inner margins, close to the joint, also on distal outer margin of second segment. Proximal fourth of the third brown, the rest of the antenna with no markings. Ratio of antennal segments 1:1.1:2.5:1.8:1.1:9:7. Widest distance across the eyes 2.7

¹ See note at end. (page 85.)

mm. Labium with four mental and seven lateral setae. Distal margin of mentum more or less even, but beset with very minute teeth-like spines which give it the appearance of being finely denticulated. Inner margin of lateral lobe finely serrated; distal inner fixed tooth small and sharply incurved, notch between this and central distal lobe rather shallow and only half as wide as deep. Central terminal lobe squarely truncate with external third showing minute spines on border. Inner extreme close to fixed tooth, pointed.

Femur of first leg with two diffuse brown rings and proximal end tinged with the same color; the second with similar markings but deeper in color; on the third the pigment is not so heavy, but the rings may be easily seen. Tibiae with no definite rings, but brownish in color. Femur, tibiae and tarsi as follows: I 1.5 mm.; 1.5 mm.; 0.75 mm.; II 1.9 mm.; 2.0 mm.; 0.75 mm.; III 2.4 mm.; 2.5 mm.; 1.00 mm. Posterior wing pad 2.9 mm.

Dorsal surface of abdominal segments brown, mottled with numerous, small dots lighter in color. Middorsal area of segments with no dots on it and lighter in color than the rest, increasing in width from proximal margin of fifth segment and reaching its maximum on segment 10. About the middle of the segments 7, 8 and 9 and on the sides of the light middorsal areas, dark brown dots. Similar but fainter dots about $\frac{2}{3}$ of the segment on 5 and 6. Lateral keels with spines. Female gonapophyses on 8 and 9, reaching beyond the distal margin of segment 10. The one on the 8th is the longest and that of the 9th with tips highly chitinized. Gills, lateral ones lanceolate, tapering to a point; more or less pigmented throughout with scattered larger brown dots. Heavier and larger pigmented areas on outer margins of distal half tending to form irregular bands. Tracheal branches pinnately arranged, being more numerous in upper half above central main trunk, than in lower area, pigmented and scarcely branched. Marginal spines about one-half the length of the gill.

Almirante Road, near Vega Baja, Km. 6.7, March 9, Needham and García-Díaz.

REMARKS

The description is based on a single specimen obtained in the same place where a series of adults were collected at the same time. One of the legs was cleared and showed the characteristic long spines of the genus.

Ceratura capreola (Hagen) (Supposition)

(Pl. V, Figs. 2, 5)

Length 9.5 mm. + 3.8-4.3 mm. gills; abdomen 6.1 mm.

Hind margins of head standing out more than usual with many spines easily seen. Greatest width across the eyes 3.3 mm. Segments one and two of the antenna brown in color, the rest with a very faintly tinge on their proximal ends. Ratio of the antennal segments 1:1.5:2:1.7:1.2:9:5. Labium

strong and large with one mental and six lateral setae. Distal margin slightly crenated with minute spines in crenulations close to base of lateral lobes, which becomes teeth-like as they approach to the center. Lateral lobes with straight smooth inner margin; the distal central margin between the fixed tooth and the movable hook slanting rapidly from the former to the base of the latter, slightly crenulated and having a few minute spinules on its central length.

Femora with dark colored proximal ends and two dark brown rings showing better on the first two than on the hind one. Tibiae with very fine hairs on their outer surfaces, more numerous than usual. The femur, tibia and tarsus measuring: I 1.6 mm.; 2.0 mm.; 0.8 mm.; II 2.25 mm.; 2.4 mm.; 1.1 mm.; III 2.75 mm.; 3.0 mm.; 1.2 mm.

Abdomen cylindrical; a light middorsal area on each segment, largest on 9 and 10. The rest of the segments dark brown in color with numerous setae, but no strong spines. Lateral keels conspicuous on segments 2-7, without spines, the distal ends of those on 2-5 white in color. Distal margins of segments 5-9 with dull white marks. Male ganophyses reaching the middle of segment 10. Gills with practically no branches in the proximal third, those beyond, not greatly branched, pigmented and running more or less parallel to the margins, but rearward. Sides of gill gradually widening out for about half the distance, when they widen suddenly becoming abruptly to a point at the tip. Main trachea pigmented and a little pigment throughout the entire gill, with rounded, irregularly scattered, patches along the margins. Marginal spines of middle gill about one half the length of the gill with fine setae between the spines.

Río Piedras River, south of the Agricultural Experimental Station, March 18 Needham and García-Díaz.

REMARKS

Four nymphs with the setal formula given were collected. One of them is too young and the other three are too old to show the venation.

Klots (1932) has described a nymph collected by Doctor Needham at Wismar, British Guiana, April 13, 1930. These nymphs differ in many details from the one described by Doctor Klots, but is only a supposition which is justified mainly on the basis of the size. The nymphs which I take for fully mature, because of the stage of development of the wing pads, are too small for any of the other species on the Island with the exception of *Argialagma minutum* from which are easily distinguished by the setal formula. The measurements given are based on one of the nymphs since of the other three one is too young and the other two had their abdomen elongated due to poor preservation.

Enallagma civile (Hagen)

REMARKS

The nymph of this species was described by Doctor Needham and Cockerell (1903). Its absence in the collection struck me, more so when adults were collected and seen in many places where nymphs apparently were absent. Upon examining the venation of the wing pads of some nymphs believed to be *Ischnura ramburii* I found that M_1-M_2 arose in many of them between the 4th and 5th post-nodals instead of between the 3rd and 4th. This suggested the possibility of some of these nymphs being those of *Enallagma civile*. This supposition was backed to a certain extent by some of those nymphs having three mental setae, other with three mentals and sometimes a rudimentary fourth one, while a few others would have four mental and lastly a rudimentary fifth one. These facts made it impossible to certainly distinguish *Enallagma civile* from *Ischnura ramburii*, since all other characters, including the gills, seem to intergrade and be similar in the two species. The lengths of the second and third antennal segment are somewhat reliable in distinguishing them. In *Enallagma* the third segment is fully one and a half times longer than the second while in *Ischnura* it is slightly longer, but never as in the first case. The Puerto Rican species, as it often happens with corresponding northern and southern ones, seems to be smaller in size than that described by Needham and Cockerell. Were it not for this, it could be easily told apart because none of Puerto Rican species attain the size of the original description. A reared series of both species will be the only possible final criteria.

Enallagma coecum (Hagen)

Length 12-12.5 mm. + 4.3 mm.-4.5 mm. gills; abdomen 8-8.3 mm.

Dorsal surface of head back of posterior margin of eyes dotted with brown spots which are the bases of small spines; hind angles smooth and but with a few spines on margin. Widest distance across the eyes 3.1 mm. First and second antennal segments brown, proximal and distal ends of third segment tinged with brown with a lighter middle area; segments 4, 5 and 6 with proximal ends tinged with brown also. Ratio of antennal segments 1:1:1.5:9:5:3:2. Labium with one mental and three lateral setae. Distal margin of mentum irregularly serrated for about one-fourth its distance from the base of lateral lobe, from there on to the center more regularly serrated with minute spinules set in the notches. Inner margin of lateral lobe uneven: deep notch between terminal hook and central distal portion between the latter and movable hook. Distal margin of this central lobe broken into 3-5 irregular teeth.

Femora of all legs with an apical brown ring, rest of the legs without markings. Inner proximal end of tibiae with a chitinized spine-like outer mar-

gin. Distal end of tarsus darker in color than the rest. Femora, tibia and tarsus: I 1.55 mm.; 1.9 mm.; .9 mm.; II 2.1 mm.; 2.2 mm.; 1 mm.; III 2.7 mm.; 2.75 mm.; 1.15 mm.; Posterior wing pads 3.9 mm.

Abdomen covered with numerous spines. A middorsal thin line which broadens posteriorly on segment 8, 9 and 10, where the clear area covers most of the dorsal surface. An area, darker than the rest of the segment, on the sides of the clear line, widest in segments 6 and 7 and hardly noticeable on the sides of clear area on segment 10. On the distal middorsal margins of segments 4-9 two brown spots separated by the clear central line. On the same margins and half way between dorsal dots and lateral keel a small dark dot on segments 4, 5, and 6. Lateral keels well developed on segments 2-8 with easily seen spines on the entire keel. Gonapophyses of female on 8 and 9, reaching distal end of segment 10, those of male as far as the middle of segment 10. Gills jointed, marginal spines extending to the joint, the rest of the margin with very fine setae. A main central trachea with few rather simple lateral branches most numerous beyond the joint, on proximal half some pigmented tracheal branches. Pigment on proximal half close to central trachea; on distal half covering a broader area in irregular patches, sometimes tending to form 2 or 3 cross bands. The tips of unbroken gills end in a point but in the majority this tip breaks and the gill ends in an acute angle.

Adjuntas, March 28, Needham and García-Díaz.

REMARKS

Klots (1932) in discussing the species *E. coecum* and *E. cardenium* after a most careful and exact consideration of the male appendages as well as indicating other differences in the adults did not feel like making them two different species, but the second a subspecies of the first. The rearing of a male and female specimen by Doctor Needham and myself and a comparison of these nymphs with the description of the one by Byers (1930), tend to make a valid species for *Enallagma cardenium*. The differences between the described nymphs as well as those of the adults indicated by Klots, it is believed, substantiate this view.

The nymphs upon which Klots based her description as *Telebasis dominicanum* were, I think, not fully developed which may account for discrepancies in both descriptions.

Enallagma cultellatum (Hagen)

(Pl. V, Figs. 6, 7)

Length 11.5 mm. + 5 mm. gills; abdomen 7.5-8 mm.

Head much wider than long; eyes standing out laterally from hind margins with the emargination where the former and the latter meet deeper than usual; hind margins slightly spinulose and not smoothly rounded, but tending to form a wide angle at their extreme outer points as they curve into proximal

margin of eyes. First segment of the antenna and two-thirds of the second brown in color; the rest with no markings. Ratio of antennal segments: 1:0.8:1.6:1.0:0.6:0.4:0.3. Labium with 3 + 1 mental and 5 lateral setae. Central distal portion of mental lobe smoothly rounded with its edge crenulated, with small denticles set in the crenulations, most easily seen in central half of the entire margin. Inner margin of lateral lobe minutely crenulated. A deep broad, slightly deeper than broad, notch between the terminal fixed tooth and the distal central portion of the lateral lobe; this latter one broken into three well defined teeth followed by an irregular broken surface and a straight outermost side; the first tooth about twice the size of the following one.

Legs slender, the femora with distal or apical brown rings, their proximal ends also brown; tibiae with a proximal incomplete brown ring showing best on the ventral surface, the rest of the legs with no color pattern. Measurements of femur, tibia and tarsus: I 1.5 mm.; 1.8 mm.; 0.8 mm.; II 2.0 mm.; 2.1 mm.; 0.9 mm.; III 2.6 mm.; 2.7 mm.; 1.00 mm.

Abdomen with lateral keels strongly developed on segments 2-8, spiny, ending at their distal end in two strong chitinized spines in segments 2-7; segment 8 with only one distal lateral spine; segment 9 without a well marked lateral keel, but showing a single strong terminal spine in place corresponding to preceding ones. On middorsal line of segments 4-9, on distal margin, two spines larger and more strongly chitinized than the rest, on middorsal surface of segment 2 near its proximal margin a close tuft of setae; a smaller and similar tuft on segment one. Gonapophyses of female on 8 and 9 not reaching but close to distal margin of segment 10. Gills jointed about half-way their length, with pigmented branched tracheae. Marginal spines to the joint terminating in one thicker than the other with a strongly chitinized base.

Tortuguero Lake, February 14, 15, Needham and García-Díaz.

REMARKS

A reared male and a few cast skins served as a basis for the description. No other nymphs were collected. The measurements are mainly from the cast skins. The color pattern of the gills of the living nymphs may vary from the one given herein.

A very young nymph from Caño Tiburones shows on its gills the characteristic spine of the marginal ones. The gills have many transparent areas alternating with incomplete, irregular transverse, light brown areas. Lateral branches few, branched and pigmented.

Telebasis vulnerata (Hagen)

(Pl. V, Figs. 8, 9)

Length 12.5 mm. + 4.5 mm. gills; abdomen 7.5 mm.

Head with large conspicuous eyes, posterior margins smoothly rounded and slightly spinulose. Ratio of antennal segments 1:1.5:2.6:1.8:1.1:8:5 The second segment with a small distal outwardly placed dark spot. The rest with no markings. Extremely fine setae on papillae on the middle of segment three

as well as on its distal end where they are more numerous. Similar papillae and setae on distal ends of segments 4-7. Labium reaching the middle coxae; three mental setae with many minute ones scattered about; six easily seen lateral ones with an additional weaker and smaller one close to the base of lateral lobe. Distal margin of mentum smooth with teeth-like spinules separated by a distance at least equal to the size of the spinules. Central distal margin of lateral lobe somewhat truncate with a slight notch close to fixed tooth and on its outer two thirds bearing spinules similar to those of distal margin of mentum.

Femora with two brown rings separated by three nearly equal light areas. The first brown ring on the first femora not so clearly marked at the others. Extreme proximal end of the tibiae tinged with brown as well as distal end of femora. Distal end of tibiae light in color followed by a brown ring, rest of tibia clear. Femora, tibiae and tarsi as follows: I 2.0 mm.; 2.4 mm.; tarsi missing; II 2.6 mm.; 2.7 mm.; 1.1 mm.; III 3.3 mm.; 3.4 mm.; 1.4 mm.; Posterior wing pads 4 mm.

Abdomen with well developed spines on the lateral keels of segments 4, 5, 6, 7 and 8 though less numerous on the first and last of those mentioned. The distal margins of these segments decidedly brown with light clear areas. Two brown broken lines close to the lateral keels. Dorsal surface of some segments sparsely covered with short spines most numerous in segments 6, 7, and 8. The tenth segment decidedly circular, the distal margin fringed with short, strong chitinized spines. Female gonapophyses on 8th and 9th segments nearly reaching distal margin of segment 10. Gills about three and a half times as long as wide; dorsal marginal spines of middle gill, one half its length, on the spaces between the spines very fine setae varying in number, but most numerous on distal ones; the main trachea pigmented with light and dark places, lateral branches not very numerous, but strong and more branched towards the basal portion of the gill, pigmented. Basal half of gill with little pigment when compared with distal one where it is irregularly scattered in darker blotches with lighter areas between.

Maricao Forest Reserve, Camp Buena Vista, March 24, Needham.

REMARKS

A single reared female specimen, on the cast skin of which is based the description. No more nymphs collected. As indicated before I think the nymph described under this name by Klots (1932) is *E. coecum*.

TABLE II. THE ALTITUDINAL DISTRIBUTION OF ODONATA:
NYMPHS AND ADULTS

Species	Nymphs			Adults		
	No. of Sta.	Min. Alt.	Max. Alt.	No. of Sta.	Min. Alt.	Max. Alt.
ANISOPTERA						
1. Acanthagyna nervosa.....	*1	80	.....	.....	.....	.....
2. Aeschna cornigera.....	*1	2350+	.....	1	1968	.....
3. Anax amazili.....	1	80	.....	.....	.....	.....
4. Anax junius.....	5	**0	1968	9	0**	1896
5. Cannacia herbida.....	*1	20	.....	11	0	300
6. Brachymesia furcata.....	*1	164	.....	1	300	.....
7. Coryphaeschna adnexa.....	3	0	164	3	0	300
8. Dythemis rufinervis.....	5	80	2000+	18	0	1896+
9. Erythemis plebeja.....	.....	.....	.....	6	0	500
10. Erythrodiplax berenice naeva.....	.....	.....	.....	1	.....	60
11. Erythrodiplax c. justiniana.....	*1	.....	164	12	0	1896
12. Erythrodiplax minuscula.....	.....	.....	.....	2	20	80
13. Erythrodiplax umbrata.....	2	0	80	17	0	1050
14. Gynacantha trifida.....	.....	.....	.....	.....	.....	.....
15. Idiataphe cubensis.....	1	.....	0	1	0	.....
16. Lepthemis vesiculosa.....	3	0	300	18	0	1050
17. Macrothemis celeno.....	4	100	1300	18	0	2000+
18. Miathyria marcella.....	1	.....	300	4	0	86
19. Micrathyria aequalis.....	.....	.....	.....	1	20	.....
20. Micrathyria didyma didyma.....	.....	.....	.....	.....	.....	.....
21. Micrathyria dissocians.....	*1	.....	300	8	20	233
22. Micrathyria hageni.....	.....	.....	.....	.....	.....	.....
23. Orhemis ferruginea.....	4	80	1300	18	0	1980
24. Pantala flavescens.....	.....	.....	.....	8	0	1500
25. Perithemis domitia.....	2	80	164	3	20	164
26. Scapanea frontalis.....	3	500	1968	10	16	2000+
27. Tramea abdominalis.....	1	.....	20	17	0	1896
28. Tramea binotata.....	.....	.....	.....	4	0	500
29. Tramea onusta.....	.....	.....	.....	8	0	104
ZYGOPTERA						
30. Anomalagrion hastatum.....	2	80	.....	11	0	500
31. Argiallagma minutum.....	*1	.....	.....	2	.....	.....
32. Ceratura capreola.....	0	.....	.....	3	.....	500
33. Enallagma civile.....	0	.....	.....	11	0	1896
34. Enallagma coecum.....	10	80	1050	23	0	2000+
35. Enallagma cultellatum.....	1	0	.....	1	0	.....
36. Ischnura ramburii.....	3	0	300	18	0	300
37. Leptobasis vacillans.....	.....	.....	.....	.....	.....	.....
38. Lestes forficula.....	8	0	1461	10	0	500
39. Lestes scarlaris.....	.....	.....	.....	2	0	500
40. Lestes spumarius.....	.....	.....	.....	1	.....	17
41. Protoneura capillaris.....	.....	.....	.....	1	.....	80
42. Telebasis dominicanum.....	.....	.....	.....	9	17	1968
43. Telebasis vulnerata.....	1	.....	2350	15	16	2000

* Nymphs designated by supposition.

** Sea level.

TABLE III. BIRDS FEEDING ON ODONATA AS SHOWN BY STOMACH CONTENTS

	Bowdish, 1902				Danforth, 1926				Wetmore, 1915; 1927			
	Anisoptera		Zygoptera		Anisoptera		Zygoptera		Anisoptera		Zygoptera	
	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults
1. <i>Butorides virescens cubanus</i> (Oberholser)..... (Cuban Green Heron, Martinete)									some	1		several
2. <i>Butorides virescens maculatus</i> (Boddaert)..... (West Indian Green Heron, Martinete)					32 %			10 %				
3. <i>Comsothlypis americana usneae</i> (Brewster)..... (Northern Parula Warbler, Reinita)					2.6%							
4. <i>Crotophaga ani</i> (Linnaeus)..... (Ani, Judío)					2.6%			1.4%		.5%		
5. <i>Dendroica petechia bartholemica</i> Sundeval..... (Porto Rican Yellow Warbler, Reinita)										1.3%		
6. <i>Egretta candidissima candidissima</i> (Gmelin)..... (Snowy Egret, Garza blanca)								4 %	15 %	2		
7. <i>Eristmatura alleni</i> (Danforth)..... (Allen's Ruddy Duck, Chorizo)					4.5%							
8. <i>Falco columbarius columbarius</i> (Linnaeus)..... (Pigeon Hawk, Gavilán, Lechuza)						73 %	12 %					
9. <i>Florida coerula coerulescens</i> (Latham)..... (Little Blue Heron, Garza Azul)										2		
10. <i>Gelochelidon nilotica</i> (Gmelin)..... (Gull-billed Tern, Gaviota)					4%					50%		
11. <i>Helodromas solitarius solitarius</i> (Wilson)..... (Solitary Sandpiper, Putilla)											3	
12. <i>Herodias Egretta</i> (Gmelin)..... (Egret, Garzón blanco)												
13. <i>Hirundo rustica erythrogaster</i> (Boddaert)..... (Barn Swallow, Golondrina)									5.3%			
14. <i>Hydranassa tricolor ruficelis</i> (Goose)..... (Louisiana Heron, Garza de vientre blanco)					5%							
15. <i>Hydrochelidon nigra surinamensis</i> (Gmelin)..... (Black Tern, Gaviota prieta)						3.8%		2%				
16. <i>Holoquiscalus niger brachypterus</i> (Cassin)..... (Porto Rican Crackle, Chango)						1.3%						
17. <i>Marila affinis</i> (Eyton)..... (Lesser Scaup Duck, Pato silvestre)									69%			
18. <i>Melanerpes portoricensis</i> (Daudin)..... (Porto Rican Woodpecker, Carpintero)		1										
19. <i>Mimus polyglottos orpheus</i> (Linnaeus)..... (Jamaican Mockingbird, Ruiseñor)		1										
20. <i>Oxyechus vociferus rubidus</i> Riley..... (Antillean Killdeer, Playero)											3.9%	
21. <i>Podilymbus podiceps antillarum</i> (Bangs)..... (Antillean Piedbilled, Zaramago)					8%				2	1.3%		
22. <i>Progne dominicensis</i> (Gmelin)..... (Caribbean Martin, Golondrina de Iglesias)											8%	
23. <i>Seirus novaboracensis novaboracensis</i> (Gmelin)..... (Northern Water Thrush, Pipzita)									10			
24. <i>Seirus motacilla</i> (Vieillot)..... (Louisiana Water Thrush, Pipzita chica)											1	
25. <i>Totanus melanoleucus</i> (Gmelin)..... (Greater Yellow Legs, Playante)					65.3%							
26. <i>Tyrannus dominicensis dominicensis</i> (Gmelin)..... (Gray Kingbird, Pittiro)												

SUMMARY OF TABLE III.

	Bowdish, 1902	Danforth, 1926	Wetmore, 1916; 1927
Total number of species of birds reported feeding on insects...	30	53	69
Species feeding on odonates.....	2	15	12
Percentages of species preying on odonates.....	6.6	28.3	17.4

NOTE

While the preceding pages were in press specimens were collected which alter some records and points of view taken at the time the work was done.

Acanthagyna nervosa Rambur

Specimens were collected in Tortuguero Lake, west end Oct. 31. The end of the lake was completely dry. While collecting, late in the afternoon, it became quite dark when a specimen was seen. Presently other specimen appeared and seven were collected. They fly close to the ground, from 12 to 18 inches, among the clumps of grasses. Once seen it is most probable to capture them, even if missed once or twice, because they keep flying slowly around.

The collecting of these specimens in this place questions the supposition of the numph described under *Coryphaeschna adnexa*. The adults were collected exactly on the same place where the nymphs believed to be the same as that dscribed were collected. Could these nymphs be those of *Acanthagyna nervosa* and not those of *Coryphaeschna adnexa*?

Gynacantha trifida (Rambur)

Specimens of this species were captured for the first time in Ameryjul, a small farm on the Trujillo Alto road Km. 1.2, Oct. 9, at dusk, close to a small creek east of the main road. Another specimen was caught in the same place Dec. 8 at 5:00 P. M. Two other specimens were obtained about four kilometer from the place: one at home, Stop 38½ Hato Rey, Nov. 18, which flew into the bath room and another found in a room of the Stahl building in the University by Mr. R. Córdova Marqués, Dec. 20.

The adults appear late in this afternoon. They are very rapid flyers making it nearly impossible to capture them. They do not fly usually in the open but keep "nosing" into the higher plants and bushes. Their somber colors make it some times impossible to distinguish them and only their flight makes them visible. I have never seen one standing still. Now and then they dart up into the open space above, reaching an altitude of 30 feet or more.

The collection of the specimen at Stop 38½, Hato Rey, verifies the statement made on page 55. The presence of adults in the mentioned area questions, in view of the statements made under *Acanthagyna* in this note, Klots' (1932) assumption about the nymph believed by her to be that of *Acanthagyna*.

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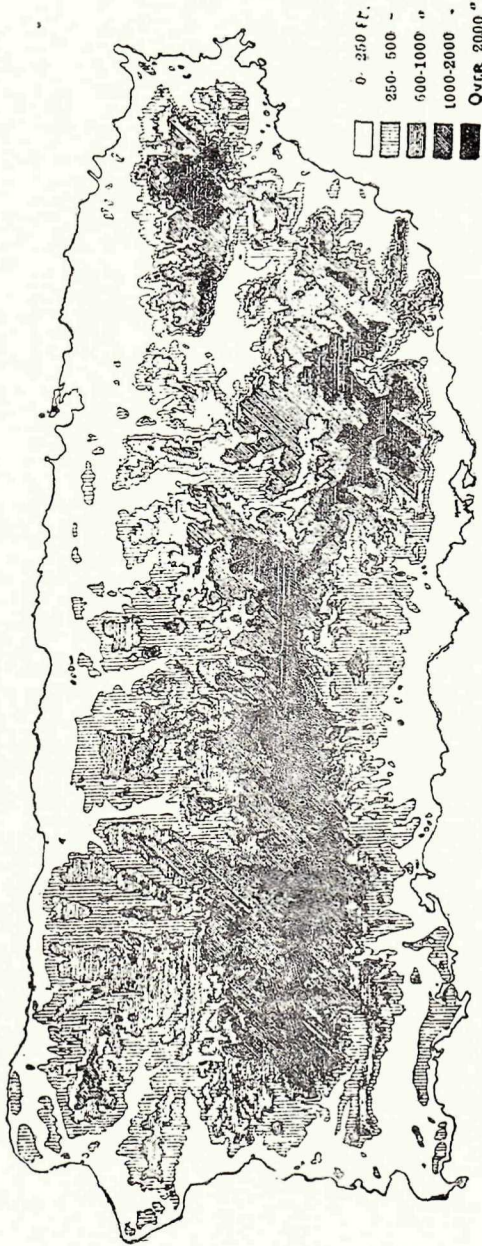
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SEASONAL DISTRIBUTION OF ODONATA

SPECIES	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
ANISOPTERA												
ACANTHAGYNA NERVOSA												
AESCHNA CORNIGERA												
ANAX AMAZILI												
ANAX JUINIUS												
CANNACRIA IHERBIDA												
BRACHYMESIA FURCATA												
CORYPHAESCHNA ADNEXA												
DYTHEMIS RUFINERVIS												
FRYTHEMIS PLEBEJA												
FRYTHRODIPLAX BERENICE N.												
FRYTHRODIPLAX CONNATA J.												
FRYTHRODIPLAX MINUSCULA												
FRYTHRODIPLAX UMBRATA												
GYNACANTHA TRIFIDA												
IDIATAPHE CUBENSIS												
LEPTHEMIS VESICULOSA												
MACROTHEMIS CELENO												
MICRATHYRIA MARCELLA												
MICRATHYRIA AQUALIS												
MICRATHYRIA DIDYMA DIDYMA												
MICRATHYRIA DISSOCIANS												
MICRATHYRIA HAGENI												
ORTHEMIS FERRUGINEA												
PANTALA FLAVESCENS												
PERITHEMIS DOMITIA												
SCAPANEA FRONTALIS												
TRAMEA ABDOMINALIS												
TRAMEA BINOTATA												
TRAMEA ONUSTA												
ZYGOPTERA												
ANOMALAGRION HASTATUM												
ARGIALLAGMA MINUTUM												
CERATURA CAPREOLA												
ENALLAGMA CIVILE												
ENALLAGMA COECUM												
ENALLAGMA CULTELLATUM												
ISCHNURA RAMBURII												
LEPTOBASIS VACILLANS												
LESTES FORFICULA												
LESTES SCALARIS												
LESTES SPUMARIUS												
PROTONEURA CAPILLARIS												
TELEBASIS DOMINICANUM												
TELEBASIS VULNERATA												

LEGEND: NYMPHS TRANSFORMING ADULTS COPULATING OVIPOSITING

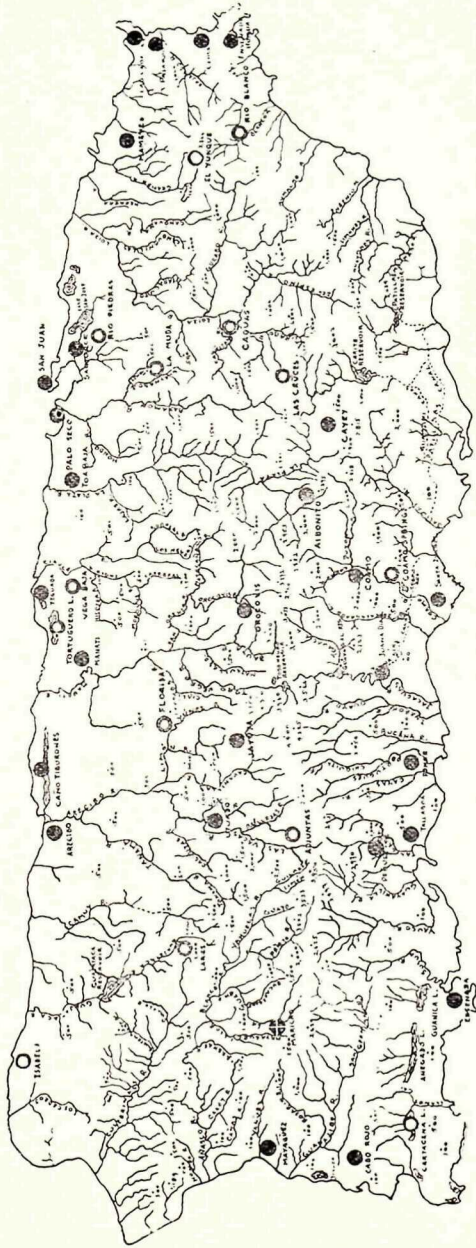
FIG. 1



PHYSIOGRAPHIC MAP OF PUERTO RICO

FIG. 2

LOCALITIES IN PUERTO RICO WHERE ANISOPTERA HAVE BEEN COLLECTED



● Nymphs

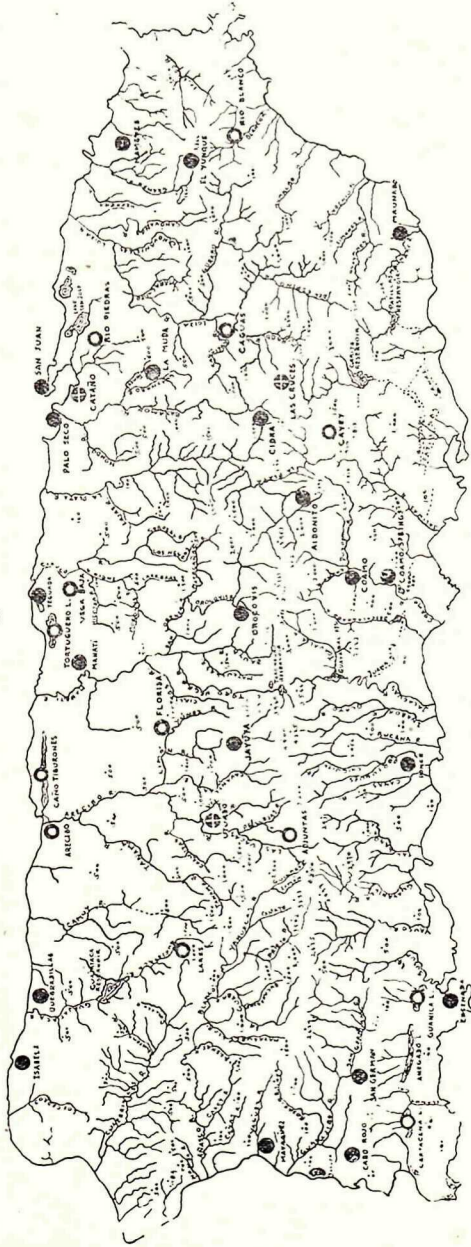
○ Nymphs and Adults

● Adults

LEGEND:

FIG. 3

LOCALITIES IN PUERTO RICO WHERE ZYGOPTERA HAVE BEEN COLLECTED



⊕ NYMPHS

○ NYMPHS AND ADULTS

● ADULTS

LEGEND

FIG. 4

APPENDIX A

The following is a record of the material collected in Puerto Rico together with the one discussed on the preceding pages. As stated before, I feel a deep and great obligation for the specialists who most kindly have made the determinations. Dr. C. P. Alexander determined the Tipulidae; Dr. C. Betten the Trichoptera—this order has been worked only to genera due to lack of time on my part to take advantage of Doctor Betten's help; Dr. W. T. M. Forbes the Lepidoptera; Dr. R. Matheson the Culicidae; Dr. P. N. Musgrave the Dryopidae; Dr. A. J. Mutchler the Dytiscidae, Gyridae and Hydrophilidae; Dr. J. G. Needham the Odonata; and Dr. J. R. Traver the Ephemeroptera. Dr. O. A. Johannsen is working the rest of the Nemocera, and Dr. H. B. Hungerford the aquatic Hemiptera. I have still some material which will be submitted, in the near future, to other specialists.

COLEOPTERA

Dryopidae: det. Dr. P. N. Musgrave.

1. *Cylloepus danforthi* Musgrave.
2. *Neoelmis gracilis* Musgrave.
3. *Phanocerus* hubbardi** Schaeffer.

Dytiscidae: det. Dr. A. J. Mutchler.

4. *Bidesus** sp.
5. *Copelatus posticatus* F.
6. *Hydrocanthus iricolor* Say.
7. *Laccophilus bifasciatus* Chevrolat.
8. *Laccophilus proximus* Say.
9. *Pachydrus brevis* Sharp.
10. *Pachydrus globosus* Aube.
11. *Rhantus* calidus** F.
12. *Thermonectes basillaris* Harris.
13. *Thermonectes circumscriptus* Latreille.
14. *Thermonectes margineguttatus* Aube.

Gyrinidae: det. Dr. A. J. Mutchler.

15. *Dineutes metallicus* Aube.
16. *Dineutes longimanus portoricensis* Ochs.
17. *Gyrinus rugifer* Regimbart.

Hydrophilidae: det. Dr. A. J. Mutchler.

18. *Berosus guadaloupensis* Fleut. and Salle.
19. *Berosus tessellatus* Chevrolat.
20. *Derallus* rudis** Sharp.
21. *Enochrus nebulosus* Say.
22. *Enochrus ochraceus* Melsh.
23. *Hydrophilus insularis* Chevrolat.

* New record of genus and species based on material collected.

24. *Hydrophilus ater intermedius* Jacq. Duval.
25. *Nechydrophilus* phallicus** Orohymont.
26. *Ochthebus* sp.
27. *Paracymus* subcupreus?** Say
28. *Pelosoma** sp.
29. *Phaenotypus* palmarum** Schwarz.
30. *Tropisternus collaris* F.
31. *Tropisternus lateralis* F.

DIPTERA

Culicidae: det. Dr. R. Matheson.

32. *Chaoborus* festivus** D. & S.
33. *Culex antillum-magnorum* Dyar.

Tipulidae: det. Dr. C. P. Alexander.

34. *Dolichocheza (Megistomastix) acutiloba*** Alex.
35. *Dolichocheza (Megistomastix) obtusiloba*** Alex.
36. *Erioptera (Mesocyphona) caloptera* Say.
37. *Erioptera (Mesocyphona) portoricensis* Alex.
38. *Gonomyia (Lipophleps) bicornuta* Alex.
39. *Gonomyia (Lipophleps) monacantha*** Alex.
40. *Gonomyia (Lipophleps) orthomera*** Alex.
41. *Gonomyia (Lipophleps) pleuralis* (Will.)
42. *Gonomyia (Lipophleps) subterminalis* Alex.
43. *Gnophomyice diazi*** Alex.
44. *Helius (Helius) albitarsis* O. S.
45. *Hexaloma (Eriocera) trifasciata* (Boder).
46. *Limonia (Geranomyia) antillarum* Alex.
47. *Limonia (Dicranomyia) brevivana torrida* Alex.
48. *Limonia (Neolimnobia) diva* Schiner).
49. *Limonia (Dicranomyia) distans* O. S.
50. *Limonia (Rhipidia) domestica* O. S.
51. *Limonia (Rhipidia) tetraleuca*** Alex.
52. *Limonia (Geranomyia) subrecisa* Alex.
53. *Polymera (Polymera) geniculata* Alex.
54. *Shannonomyia leonardi* Alex.
55. *Shannonomyia triangularis* (Alex.)
56. *Toxorhina (Toxorhina) fragilis* Lw.
57. *Trentepholia (Paramongoma) niveitarsis* Alex.

EPHEMEROPTERA: det. Dr. J. R. Traver.

Baetidae.

58. *Baetis* garcianus*** Traver.
59. *Baetis* spp.
60. *Borinquena** carmencita*** Traver.
61. *Borinquena contradicens*** Traver.
62. *Caenis** sp.
63. *Callibaetis completa* Banks.
64. *Cloeodes** maculipes*** Traver.

* New record of genus or species based on material collected.

** New genera and species based on material collected.

- 65. *Cloeodes portoricense*** Traver.
- 66. *Cloeodes consignatum*** Traver.
- 67. *Cloeodes* sp.
- 68. *Neohagenulus*** *julio*** Traver.
- 69. *Neohagenulus tinctus*** Traver.
- 70. *Neohagenulus* sp.

LEPIDOPTERA: det. Dr. W. T. M. Forbes.

*Arctiidae****

Progona pallida Moschler.

*Cosmopterigidae****

Eriphia? sp.

*Phaloniidae****

Phalonia sp.

Pyralidae.

71. *Argyractis sumptuosalis* Moschler.

72. *Nymphula rugosalis* Moschler.

*Tineidae****

Achanodes sp.

Homostinea? tischeriella? Walsingham.

Mea incudella Forbes.

Protodarcia sp.

*Tortricidae****

Balbis excitana? Moschler.

Epiblema sp.

TRICHOPTERA: det. Dr. C. Betten.

Helicopsychinae.

73. *Helicopsyche* sp.

Hydropsychidae.

74. *Smicridea** sp.

Hydroptilidae.*

75. *Hydroptila* sp.

76. *Neotrichia** sp.

77. New genera.**

78. *Oxyethira** sp.

Leptoceridae.

79. *Setodes**sp.

Philopotamidae.

80. *Chimarra albomaculata* Kolbe.

81. *Chimarra* sp.*

*Polycentropidae**.

82. New genus.**

Psychomyiidae.*

83. *Lype** sp.

Rhyacophilidae.*

84. *Atopsyche** sp.

* New record of genus or species based on material collected.

*** Not aquatic.

EXPLANATION OF PLATES

PLATE IV

Argiallagma minutum (Selys)

PLATE V

1. *Argiallagma minutum*, labium.
2. *Ceratura capreola*, labium.
3. *Argiallagma minutum*, gill.
4. *Coryphaeschna adnexa*, labium.
5. *Ceratura capreola*, gill.
6. *Enallagma cultellatum*, gill.
7. *Enallagma cultellatum*, labium.
8. *Telebasis vulnerata*, labium.
9. *Telebasis vulnerata*, gill.

PLATE VI

1. *Brachymesia furcata*, part of abdomen with dorsal hooks and caudal appendages.
2. *Cannacria herbida*, part of abdomen, lateral, with dorsal hooks and caudal appendages.
3. *Brachymesia furcata*, part of the abdomen, lateral, with dorsal hooks and caudal appendages.
4. *Cannacria herbida*, antenna.
5. *Brachymesia furcata*, antenna.
6. *Cannacria herbida*, part of abdomen, with dorsal hooks and caudal appendages.
7. *Coryphaeschna adnexa*, caudal appendages.
8. *Anax amazili*, caudal appendages.

PLATE VII

Wings of:

1. *Cannacria herbida*.
2. *Argiallagma minutum*.
3. *Idiataphe cubensis*.

PLATE IV

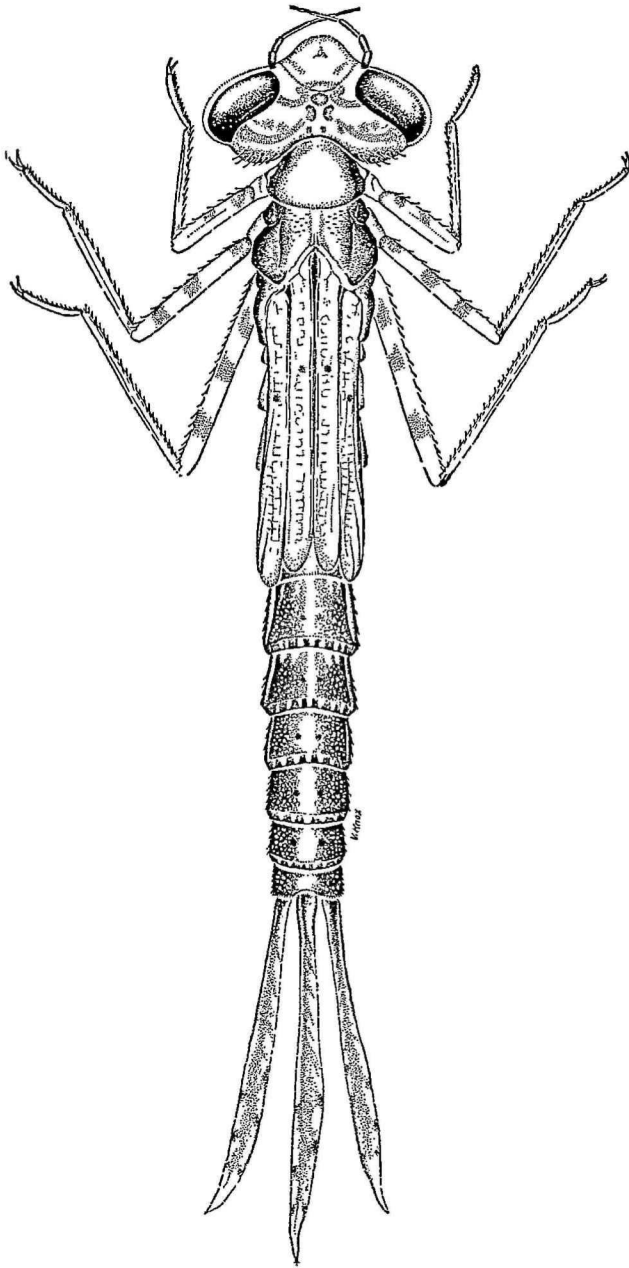


PLATE V

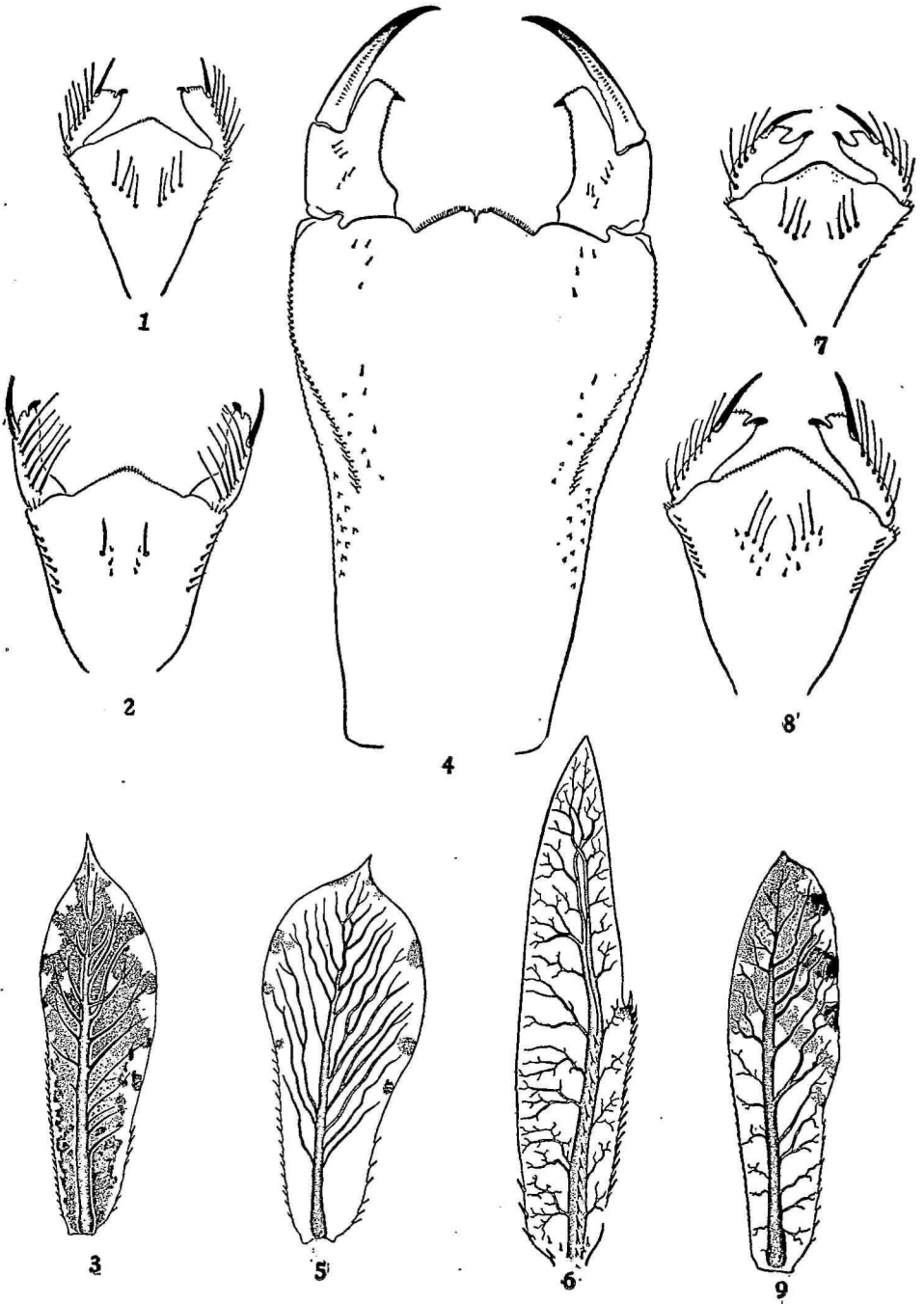


PLATE VI

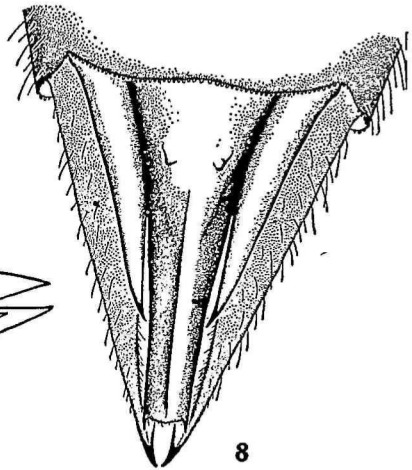
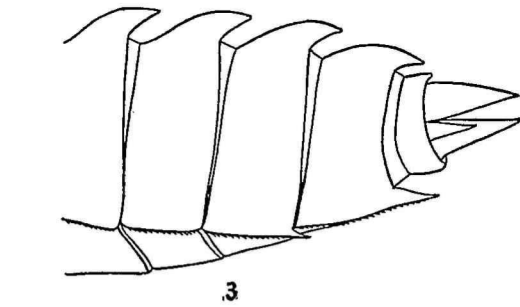
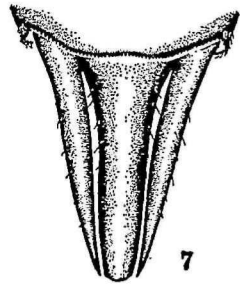
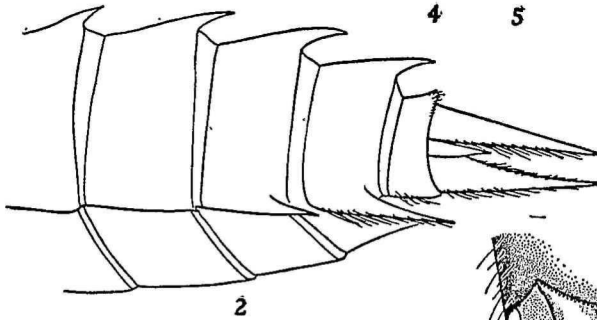
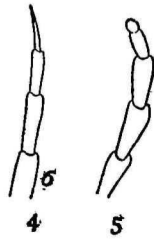
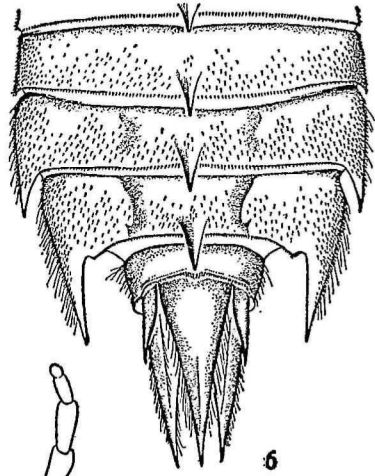
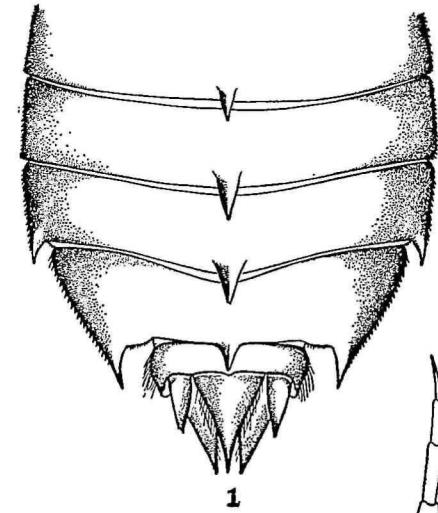


PLATE VII

