A Generic Revision of the Aquatic Moths of North America: (Lepidoptera: Pyralidae, Nymphulinae)

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I. INTRODUCTION

Although the Lepidoptera are primarily terrestrial they include several families capable of a true aquatic existence during their developmental stages. This adaptation is particularly advanced in the pyralid subfamily Nymphulinae where not only the early stages, but even some of the adult females are suited to an aquatic life.

Generic assignment of the California species was precluded by a study of generic types, and it soon became evident that there was a greater morphological divergence than could be adequately handled by the existing nomenclature. Because of their multiple generic affinities and origins in other faunal zones it was necessary to examine all of the concerned generic type species regardless of their distribution. For North America this resulted in the resurrection of four available names to their original status, the change of one to a new status, and the addition of eleven new names. With the existing names, this makes a total of eighteen genera in North America, fifteen of which occur in continental United States. The present paper is an attempt to characterize all of the genera essential to the proper interpretation of generic taxa in the group and to summarize their biological adaptations.

HISTORICAL

It is believed that the present paper is but an introduction to a rather large, natural group of moths which have been greatly neglected to date from treatment by modern systematic methods. Although Klima (1937) included about 96 genera and over 1,300
species in the subfamily Nymphulinae it seems that as high as 50 per cent of the genera should be relegated to other groups. Whether the Nymphulinae are monophyletic or polyphyletic in origin will depend upon future studies from a world-wide point of view.

As early as 1844 Duponchel placed these moths in his subtribe Nymphulites. The earlier works of Hübner (1796, 1802, 1816) and Guenée (1854) are apt to be confusing, but in actuality are the basis of our classification. The paper of Lederer (1863), although disregarded temporarily by certain American authors, was an attempt to place the classification of the Pyralidae on a more sound basis. He did not separate out the Nymphulinae, but placed them with related groups in the Pyralidae. Meyrick's contributions (1885, 1887, 1890, 1895) were useful, but his lack of the use of genitalic features and of illustrations means that each species will have to be examined for generic placement. Hampson's contributions are useful (1896, 1897) as he brought together all of the known species under Hydrocampinae and in his 1897 revision devised phylogenetic schemata which may be subject to change with future work. His use of external features in the Nymphulinae does not always reflect the true relationships of the moths in question. The works of Shibuya (1928, 1929) on the Japanese and Formosan Nymphulinae are useful, but here again genitalia were not used and he followed Hampson in general features. The paper of Sylvén (1947) is excellent, but he is limited by the restricted number of species of Nymphulinae in the Swedish fauna, which he readily acknowledges. More recent workers include Marion (1952, 1953) and Munroe (1951) who employ the use of genitalia along with other features in their excellent work on the Pyralidae.

There are many European faunal works which include the aquatic pyralids in Nymphulinae, Hydrocampinae, or Pyraustinae. These include works of Spuler (1910), Wahlgren (1915), Handlirsch (1925), Eckstein (1933), and Beirne (1952). The systematic advances in these compilations are limited.

The work of Pierce and Metcalf (1938) on the genitalia of British pyrales led them to place this group of moths in the family Hydrocampidae. They include Acentropus, which is generally placed by most workers in the Schoenobiinae.

American contributions to the systematics of the Nymphulinae
AQUATIC MOTHS OF NORTH AMERICA—LANGE

are limited, and most authors have placed our species in *Catocalysta* (*Elophila*) or *Nymphula*, or have included genera which should be placed elsewhere. Grote (1880, 1881, 1883) named several of our species. The 1906 revision of Dyar is the most useful paper on the North American species. Keys to the eastern United States larvae and adults are given in the paper of Forbes (1923). A reflection of the large number of tropical species is shown in Schaus's publications (1924, 1940) where he named many species. His use of external features in the Nymphulinae makes it necessary to examine each of the species for generic placement. Pennak (1953) placed all of our United States species in either *Elophila* or *Nymphula*.

**ECONOMIC IMPORTANCE**

The Nymphulinae for the most part are of little economic importance, but a few species damage rice and water lilies. The rice caseworm, *Nymphula depunctalis* (Guen.), damages rice in the Philippines according to Sison (1938), and South (1926) reported damage to rice in Malaya. The damage to rice and other grasses caused by *Nymphula fluctuosalis* Zeller (now considered to be in the genus *Parapoynx*), a species widely distributed in the tropical and subtropical world, is reported by Williams (1944). Berg (1950) lists *Nymphula nymphaeata* (Linne) as damaging rice in Italy and water lilies in England, and *N. vitalis* (Bremer) as injuring rice in Japan. Damage to water lilies in aquaria by *N. oblitalis* (Walker) (*Synclita*) was reported by Williams (1944).

A California species, *Synclita occidentalis* Lange, is of some importance in rice fields as it feeds upon many weeds that may interfere with rice growth. The larvae of *Parargyractis* have been taken from the stomachs of fish in California, and according to Welch (1914) certain other aquatic caterpillars, such as *Bellura melanopyga* Grote, are a favorite food of fish.

**COLLECTING METHODS**

Adults of the Nymphulinae can be collected at light, and often some distance from water. Adults often rest upon the cement or wooden supports of bridges over the streams they frequent and can be collected during the day in such locations. They can also
be taken from bushes or trees growing along the edges of streams. It is not unusual to find them concentrating in certain trees back from the water's edge. They also frequent the shady and protected sides of large boulders along the edges of streams, and can be collected with an insect net. They often occur with adult Trichoptera and frequent similar locations. The wings of many groups are held characteristically—the hind wings, particularly in the males, are tilted roof-like at an angle downwards from the body. Adults of the plant-frequenting nymphulines can often be collected during the daytime resting on aquatic plants. Toward evening they become more active and can be collected as they fly from plant to plant.

Larvae of the rock-dwelling forms are collected in the more oxygenated niches in streams, lakes, or springs where they occur under silken sheets, or sometimes in old cocoons. The cocoons are made of a tough, felty-like material, and can be easily detached from the rocks by means of a pair of forceps. It is difficult to rear the adults from detached cocoons, but those about to emerge will do so in moist battery jars. Larvae of the plant feeding forms are usually taken in cases, either floating on the surface of the water or attached to the floating leaves or stems of aquatic plants. They will often complete their life history out of water and adults will emerge from pupae in cocoons if they are placed in moist rearing chambers.

Larvae are best preserved by killing first in hot water and transferring to 70 per cent alcohol. The cocoons are also diagnostic and can be preserved with the larvae. Adults can be spread when first collected or relaxed and spread at a later date.

Acknowledgments

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me notes and a fine selection of adults, including many tropical representatives. I am greatly indebted to the British Museum authorities who through W. H. T. Tams, E. C. Zimmerman, and Edward L. Martin sent several needed shipments of Palearctic representatives.

Milton W. Sanderson made it possible for me to examine larvae and adults in the collection of the Illinois State Natural History Survey. I am greatly indebted to Charles P. Kimball of Sarasota, Florida, who allowed me to examine his large collection of nymphauline moths. Edward L. Martin compared Synclita gurgitalis Lederer, with Nymphula obliteralis Walker, and confirmed my opinion that they are congeneric; and also examined the type female of Argyractis argentilinealis Hampson, and sent a specimen identical with the type. Henry Dietrich sent the type (abdomen of the male) of Argyractis dodalis Schaus.

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Explanation of Figures

In order to denote the actual specimen illustrated, each figure presents information concerning the locality, slide number, and location of the slide. The abbreviations used in signifying disposition of the slides are as follows:

B.M. = British Museum of Natural History.
C.A. = California Academy of Sciences, San Francisco.
C.U. = Cornell University.
I.N.H.S. = Illinois Natural History Survey Collection, Urbana.
L.A. = Los Angeles Museum.

In connection with certain figures, corresponding parts of the male genitalia, unless otherwise specified, are indicated as follows: A = aedeagus; B = processes of eighth sternite.

II. PHYLOGENY AND GEOGRAPHIC DISTRIBUTION

It may be premature to present a phylogeny of the North American Nymphulinae at this time, but it is felt that an attempt may add impetus to other workers to collect additional material of both adults and immature stages. In this way the existing gaps in our present knowledge will be narrowed considerably. Hundreds of species names are available in the group, but generic assignment is difficult without examining each one critically. This is particularly true in a group where color patterns may be very similar. The phylogenetic scheme in plate 1 is considered preliminary and is based upon material examined by me personally during a two-year study of the group.

I assume that Nymphulinae, as limited in this paper, is a group of monophyletic origin possibly derived from Scoparia-like pyraustid ancestors that fed on mosses or lichens in tropical rain forests and gradually became adapted to feed upon higher plants in aquatic situations. The genus Neurophyseta which is now represented in the tropics, seems to be a primitive nymphuline which could be an ancestral type, although the immature stages are not known. The lateral lobes from the valva of the male genitalia suggest Scoparia, but in the males of Neurophyseta, the presence of greatly enlarged and angulate labial palpi is a unique feature.

At some point in the phylogeny of the group there appears to have been a division into two main stems, as shown in plate 1, which divide the Nymphulinae into two natural groups, a plant feeding group, the Nymphulini, and a rock-dwelling group which feed upon algae, the Argyractini. The larvae of the Nymphulini have mandibles adapted to cut off portions of leaves, whereas the mandibles of the Argyractini are enlarged and flattened and modified to scrape off algae growing on rocks. The larvae of
Nymphulini are with or without gills, and are adapted to make cases of plant parts, which are sometimes air-tight. The larvae of the other more highly evolved group, the Argyractini, live under silken nets on rocks and the larvae usually have a full set of blood gills.

On the basis of these studies, and absence of biological evidence, it is difficult to place in a tribal classification certain

Plate 1. A phylogeny of the North American Nymphulinae with an indication of other generic relationships.
primitive forms which have a full quota of wing veins and primitive genitalia. The genera centering around Ambia, for example, are primitive in wing venation, wing shape, and genitalic features, and could be considered either plant-feeding types or rock-dwellers. Another group of primitive, Oriental, rock-dwellers which do not fit into the North American classification of Nymphulini and Argyraetini are the group of genera close to Aulacodes, which include Theilia, Eooephyla, Parthenodes, and perhaps others. They have vein M<sub>2</sub> present in the hind wings, or at least in the ones I have examined, and have a primitive wing shape, and a few show features reminiscent of Argyractis. These forms make silken nets and cocoons on the rocks very similar to Parargyractis. This habit could be an adaptation to the environment in the Oriental and other tropical areas where they occur, and for this reason I have not indicated a direct relationship between the Aulacodes group of genera and the Argyractis group. It is also difficult to assign the genera of the Oligostigma group to a definite tribe, although the similarity in male genitalia and wing shape would indicate that they are also rock-dwellers.

Referring back to the stem of the Nymphulini we see that Cataclysta and Neocataclysta are considered primitive types and this is indicated by the fact that the larvae feed on Lemna, a rather primitive group of plants. The group of genera with gills, culminating in the well-known genus Parapoynx can be considered a side-branch. The Australian genera Hygraula and Hydreuretis have genitalia similar to Parapoynx and could have a common origin. The larvae of Hydreuretis are known to be gilled. The Palearctic genus Kasania shows certain indications of relationship with the gilled forms, but on the other hand certain genitalic features are rather similar to Nymphula and Synclita. The genus Chrysendeton, a genus of wide tropical distribution, is distinct, and possibly allied to the Australian genus Anydraula.

PLATE 2

Wing venation of: fig. 1. Nymphula ekthlispsis (Grote), Center Harbor, New Hampshire, slide U-114A (U.S.N.M.); fig. 2. Argyractis argentinaalis Hampson, Estado de Bahia, Cachimbo, Pujo, Brazil, 1890, type series, U-85A (B.M.); fig. 3. Munroessa gyralis (Hulst), Fernald No. 10512, 1886, U-82 (I.N.H.S.); fig. 4. Parapoynx maculalis (Clemens), Bilby, Alberta, Canada, U-56 (C.A.); fig. 5. Parapoynx allionealis
The most highly evolved forms of the Nymphulini appear to be *Nymphula*, then *Munroessa*, and culminate in *Synclita, Contiger*, and *Nymphulieilla*. The Argyractini seem to divide into three main stems. One, the *Argyractis* branch, leads to *Argyractoides, Neargyractis*, and *Usingeriessa*. *Argyractis* seems to be Amazonian, *Argyractoides* to be Neotropical, and *Neargyractis* and *Usingeriessa* extend into the Nearctic subregion. The second and probably most successful group in the Argyractini from the standpoint of numbers of species is the genus *Parargyractis*. It seems to be evolved from an ancestral *Argyractis*, and has been able to adapt itself to a greater range of ecological situations. These include swiftly flowing streams, lakes, and springs. *Eoparargyractis* evolved from a *Parargyractis* type of ancestor and apparently is adapted to living in lakes. The third branch of the Nymphulini ends in the genus *Oxyelophila*, a group showing features of *Argyractis*, but highly evolved in wing venation, and unique in genitalic features. Nothing is known of the life history.

It is difficult to give an accurate account of the distribution of the Nymphulinae because generic assignment of species is impossible unless the species have been examined critically. In addition, many forms are included in the group which have relationships to other subfamilies. However, a few comments may be of value.

The United States is represented by 39 species in 15 genera of which 9 genera include a single species. Of these 9, only 3 are endemic, indicating the influence of other regions. Of the remaining 6 genera, 5 are Neotropical in their immediate origin, and one, Holartetic. Of the 15 genera in the United States, 9 show immediate Neotropical origin and 6 are Holartetic. The genus *Parapoynx* is not only Holartetic, but also shows relationships with the Australian *Hygraula* and *Hyduretis*. *Chrysendeton* shows relationships with the Australian *Anydraula*. *Neocataclysta* is the Neartetic counterpart of the Paleartetic *Cataclysta*.

An accurate account of the North American species is difficult.
AQUATIC MOTHS OF NORTH AMERICA—LANGE

(C.A.); fig. 13 *Chrysendeton imitabilis* (Dyar), Paradise Beach, Florida, U-141A (C.A.); fig. 14 *Chrysendeton claudialis* (Walker), New Brighton, Pennsylvania, U-112 (U.S.N.M.); fig. 15 *Undulambia striatalis* (Dyar), St. Petersburg, Florida, male, U-116A (U.S.N.M.); fig. 16 *Synclita obliteralis* (Walker), Brownsville, Texas, U-62 (W.H.L.).
It is estimated that in addition to 10 of the 15 genera found in the United States, an additional 15 or more genera should occur in Mexico, and Central America, and an additional 100 species. For example, the genus *Argyracris* is shown by Klima (1927) to contain 103 Neotropical species of which about half occur in Panama and Mexico. An additional 39 species are assigned to *Catalydsta*, many of which occur in Central America and Mexico. These species will probably be found to belong to several genera, but still the number of species is an index of the abundance of the group. It is estimated that we could have as many as 30 genera and 160 species in North America.

From a world point of view it is even more difficult to determine the distribution of genera. In compiling species listed in Klima (1937) the Regions have the following relationships of species to genera: Neotropical, 378 to 29; Oriental, 377 to 39; Australian, 319 to 42; Ethiopian, 75 to 15; Palearctic, 63 to 15; and Nearctic, 44 to 9. The results of these tabulations are minimized when it is realized that 5 of the Nearctic genera are not in the Nymphulinae.

In the Oriental Region it is interesting to note that there is a good representation of both plant-feeding and rock-dwelling types as indicated by the 39 species of *Nymphula* and 32 species of *Aulacodes*, 6 of *Eoophyla*, and 23 of *Parthenodes*. In addition, there are 31 species of *Ambia* and 39 species of *Oligostigma*.

The Australian Region has a great many monotypic genera, but it is interesting to note that a total of 43 species of *Aulacodes*, probably rock-dwelling types, are cited by Klima.

As mentioned above, the largest group of Neotropical species (103) is in the *Argyracris* group, which are now split up into several genera. This indicates again that the rock-dwellers are

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**PLATE 4**

Wing venation of: fig. 17. *Parargyractis truccealis* (Dyar), Clear Lake, California (W.H.L.); fig. 18. *Oxyelophila callista* Forbes, New Braunfels, Texas, paratype, U-68 (W.H.L.); fig. 19. *Usingerissa brunniidalis* (Dyar), Bear River, Placer Co., California, U-150 (W.H.L.); fig. 20. *Neargyractis moniligeralis* (Lederer), Jamaica, U-113 (U.S.N.M.); fig. 21. *Parargyractis kearjottalis* (Dyar), Aranipa Canyon, Arizona, U-124 (C.U.); fig. 22. *Parargyractis jaliscalis* (Schaus), Patagonia, Ari-
zona, U-62 (W.H.L.); fig. 23. Parargyactis bifascialis (Robinson), Victoria, Texas, U-133 (C.U.); fig. 24. Parargyactis opulentalis (Lederer), Algonquin, Illinois, U-97A (I.N.H.S.); fig. 25. Parargyactis schaefferalis (Dyar), Baldwin Hills, Los Angeles Co., California, U-64 (L.A.).
quite successful. *Ambia* types are also abundant, with a total of 42 species.

The paucity of records in the Ethiopian Region may be due to the lack of collecting, but the known species seem to divide about evenly between plant-feeding and rock-dwelling types.

Only a few representatives of the different genera have become adapted to conditions actually prevailing in the Holarctic Region. I believe that the aquatic moths had a tropical origin, and moved north during favorable climatic conditions, but that only a few could adapt themselves to cooler or other changing conditions. It would appear that the warm water of the tropics provides the most optimum conditions for these aquatic insects, and the resultant increase in the number of generations has been of signal importance in deriving the many different groups.

III. TAXONOMY

When considered from a world point of view there may not be a sharp line of distinction between the Nymphulinae and the Pyraustinae, but because of several common genitalie characteristics, other morphological features, and similar biological adaptations, I am considering the Nymphulinae a distinct subfamily. In this respect, I am following recent workers in the Pyralidae including Sylven (1946) and Marion (1952). Beirne (1952), on the other hand, considers the subfamily Pyraustinae to contain all groups commonly included in the Nymphulinae, Scopariinae, and Pyraustinae.

A subfamily classification based upon wing venation alone is of limited value. In the system used by Forbes (1923), for example, in which the Nymphulinae are separated on the basis of whether $R_2$ in the forewing is stalked with $R_3$ and $R_4$ or separated from $R_3$ and $R_4$, the system breaks down at a specific level in the genera *Parapogynx* and *Munroessa*. It is interesting to note that in cer-
(W.H.L.); fig. 31. *Chrysendeton autobella* (Dyar), Rio Trinidad, Panama, U-239 (U.S.N.M.); fig. 32. *Usingeria onyxalis* (Hampson), Orlízaba, Mexico, U-122A (U.S.N.M.); fig. 33. *Acentropus niveus* (Olivier), Tyringham, Massachusetts (W.H.L.); fig. 34. *Aulacodes aechmialis* Guenée, Guatemala, U-205A (B.M.); fig. 35. *Argyractoides leucogonialis* (Hampson), Rio Inumbari, Peru, U-241A (U.S.N.M.).
tain nymphulines wing venation may be of specific identity. A classification based upon whether \( R_3 \) of the forewing is on the same stalk with \( R_3 \) and \( R_4 \), or whether it arises from the cell, such as proposed by Beirne (1952), is of value, but again breaks down at the specific level in the genus *Parapoyx*. Such a classification would exclude certain species from his all-inclusive Pyraustinae.

The male and female genitalic features indicate a number of similarities. In the males the valva are often blade-like. The gnathos, in most cases, arises on the posterior end of the tegumen, is well developed, and often possesses dorsal teeth. The uncus is usually simple, not lobed or divided. In the females the base of the ductus bursae is often well sclerotized, the ductus bursae often has a collar or valve-like section, and the bursa often has bands of spicules, internal spines, or other ornamentations. The female genitalia are often of specific value in cases where the males have similar genitalia, but both male and female structures possess good features for the differentiation of species.

Certain species placed in the Nymphulinae by other workers were examined and found to go into other subfamilies. For this reason they are not included in the keys or given detailed descriptions. These include the following: *Hydropionea fenestralis* (Barnes and McDunnough); *Eurhrhynx urticata* (Linne); *Piletocera bufalis* (Guenée); *Parambria gnomosynalis* Dyar; *Nymphula nomophilalis* Dyar; *Stenioodes gelliasalis* (Walker); *Geshna cannalis* (Quaintance); *Geshna primordialis* Dyar; and *Diathestrausta reconditalis* (Walker). *Nymphula australis* (Hulst) is probably a synonym of *Blepharomastix stenialis* (Guenée), and not a nymphuline.

Approximately 700 genitalic and wing slides were made during the preparation of this paper, and when available, numerous mounts of each species were prepared in order to adequately study the extent of variation. An attempt was made to at least partially figure all of the material examined by me and in the case of type species to give drawings of the male and female genitalia and the wing venation. A similar diagnosis is given for each genus beginning with a description of the superficial features, followed by a description of the male and female genitalia, a listing of the type species, a discussion of the taxonomic position of the genus in relation to other related genera, and finally, biological notes.
Family **PYRALIDAE**

Subfamily **Nymphulinae**


Proboscis well developed. In forewings R₂ usually, but not always, stalked with R₃+₄; R₅ free, or basically stalked with R₂+₃+₄. Maxillary palpi well developed. Labial palpi long, ascending; in many forms, but not all, the third segment is longer than half the median segment. Male genitalia with well-developed uncus; gnathos well-developed, usually arising at posterior extremity of tegumen, often, but not always, toothed on dorsal surface. Female genitalia with base of ductus bursae often sclerotized; bursa with or without signum. Larvae of known species aquatic, either feeding on aquatic plants, or rock dwellers feeding on algae or diatoms.

The aquatic moth, *Acentropus niveus* (Olivier), although it is included in the keys, and discussed under "biology," is considered to belong to the subfamily Schoenobiinae and for this reason is not treated systematically in this paper.

On the basis of their biology and morphology the North American Nymphulini seem to separate into two groups, the Nymphulini, or plant-feeding types, and the Argyraetini, or rock-dwellers, feeding on algae and diatoms, often in fast-flowing streams. With the examination of additional tropical forms our present concepts of the tribes may have to be modified.
Tribe Nymphulini

Nymphulites Duponchel, 1844, Cat. methodique des Lepid. d'Europe, p. 201 (emen.).
Nymphulini Handlirsch, 1925, in Schröder's Handbuch der Entomologie, p. 902.

Forewings with vein 1A absent. Hindwings with vein $M_2$ present; vein 1A present, entire. Middle and hind legs of females lacking tibial swimming hairs. Female genitalia with signum absent, or if present, usually arranged as compact groups of spines. The larvae of this group are plant feeders, with or without gills, often making tubes or cases of leaves in which they live. The mandibles of the larvae are small and the teeth are arranged in a semicircular fashion for feeding on leaves.

**Type Genus:** *Nymphula* Schrank, 1802 (emendation of *Nymphulites* by designation of Duponchel 1844).

Tribe Argyractini Lange, new tribe.

Forewings with vein 1A present. Hindwings with vein $M_2$ absent; vein 1A vestigial, occasionally entire. Middle and hind legs of females with a well-developed row of tibial, swimming hairs. Female genitalia with signum absent, or with scattered or spirally arranged thorn-like spines, or with small spines arranged in extensive bands. The larvae of this group are suited to an aquatic habitat, feeding on algae and diatoms on the surface of rocks under silken webs, often in fast-flowing streams, or in lakes, or springs. The mandibles of the known species are large, flattened, and the teeth arranged in a flat plane. The known larvae have blood gills. The adult females of the known species are capable of entering water and depositing their eggs on rocks, sometimes several feet under water.

**Type Genus:** *Argyractis* Hampson, 1897, by present designation.

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**PLATE 6**

Male genitalia of: fig. 36. *Munroessa icciusalis* † (Walker), no data, U-257 (I.N.H.S.); fig. 37. *Chrysosodeton claudialis* (Walker), New Brighton, Pennsylvania, U-112A (U.S.N.M.); fig. 37B. *Chrysosodeton imitabilis* (Dyar), Archbold Biological Station, Lake Placid, Florida, aedeagus, U-66A (W.H.L.); fig. 38. *Parargyractis truccealis* (Dyar), Clear Lake, California, U-2 (W.H.L.); fig. 39. *Ambia ptolescusalis* Walker, Cairns,
Queensland, U-306 (E.G.M.); fig. 40. *Aulacodes aechmialis* Guenée, Guatemala, U-205 (B.M.); fig. 41. *Argytractis argentina elegalis* Hampson, type series, Brazil, U-311 (B.M.); fig. 42. *Anhydra praecelsalis* (Walker) S.E. Australia, U-199 (B.M.); fig. 43. *Undulambia striatalis* (Dyar), U-116 (U.S.N.M.).

Scale as fig. 43.
KEY TO GENERA OF NORTH AMERICAN NYMPHULINAE BASED UPON SUPERFICIAL CHARACTERS OF THE ADULTS

1. Labial palpi pendent; 2A of fore wings extending only to center of inner margin (fig. 33).......................... Acentropus Curtis, 1834
   Labial palpi ascending; 2A of fore wings reaching anal angle

2. M2 present in hind wings (fig. 7)........................................ 3
   M2 absent in hind wings (fig. 32)........................................ 13

3. Hind wings strongly incised below apex........................................ 4
   Hind wings not incised or with slight indication.............................. 5

4. Male with costal glandular swelling on forewing (fig. 15); median tibial spurs of metathoracic legs very long, attaining apex................................................ Undulambia Lange, 1956
   Males lacking costal glandular swellings; median tibial spurs short, not attaining apex................................................ Contiger Lange, 1956

5. Males with basal costal fold (fig. 9); M3 in hind wing stalked with M2 near outer margin; Florida........... Oligostigma Gueneé, 1854
   Males lacking basal costal fold; M2 not stalked with M3 in hind wing

6. Outer margin of hind wings with series of black and metallic spots

   Outer margin of hind wings lacking spots................................................ 7

7. Black and metallic spots limited to small area on emarginate subapical part of termen of hind wing.... Oligostigmoides Lange, 1956
   Black and metallic spots extending the entire length of the termen of the hind wing

8. Black spots distinctly separate with pupillate, bluish centers; vein 1A in secondaries complete............... Neocataclysta Lange, 1956
   Black spots not distinctly separate; bluish or other metallic spots not pupillate; vein 1A in secondaries vestigial

   .................................................................................. Chrysendeton Grote, 1881

9. Color of wings fuscos to reddish-brown; small, wing expanse of males usually not exceeding 16 mm........................... 10
   Light-colored species with wings variously banded, immaculate white, streaked with dark lines, or with ocellate spots; wing expanse of males usually exceeds 16 mm........................... 11

10. Apex of forewing pointed (fig. 101); dark fuscos species; second segment of labial palpi triangularly tufted apically........................ Nymphulietta Lange, 1956
    Apex of forewing rounded (fig. 97); fuscos, with reddish or brownish markings; second segment of palpi lacking triangular tuftings........................................... Syntita Lederer, 1863

11. Antennae, especially in males and on terminal segments, ringed distally with tufts of scales, giving enlarged appearance to segments; labial palpi long, ascending to center or apex of frons and with scales projecting downwards from segments 1 and 2......................................... Parapoyx Hübner, 1826
   Antennae simple, ciliate, some segments with appressed scales
on one side; labial palpi lack downwardly projecting scales from segments 1 and 2.

12. Forewings with prominent subterminal white band and three large ocellate spots margined with black...Nymphula Schrank, 1802
Forewings lacking subterminal white band and three ocellate spots
Munroessa Lange, 1956

13. Forewings falcate apically (fig. 18)......Ozyelophila Forbes, 1922
Forewings not falcate apically

14. Cell in hind wings open (fig. 29)......Eoparargyractis Lange, 1956
Cell in hind wings closed

15. Cell in hind wings extending beyond center of hind wing;
tornus of forewing in most species rounded (fig. 22); outer margin of hind wings not emarginate below apex
Parargyractis Lange, 1956
Cell in hind wings extending to about center or just beyond center of wing (fig. 19); outer margin of hind wings emarginate below apex

16. Veins Sc and Rs branching at about one-half distance to apex
of hind wing (fig. 35)
Veins Sc and Rs branching just before apex of hind wing (fig. 20)

17. Tegulae long, particularly in male; black spots on secondaries small, confined chiefly to veins (fig. 35); usually light-colored species of contrasting colors...Argyactoides Lange, 1956
Tegulae in male short; black spots on secondaries usually large, not confined to veins, and inwardly edged with a linear, black line; dark colored species...Usingeriessa Lange, 1956

18. Forewing broad, apex broadly rounded (fig. 20)
Forewing slender, apex distinctly pointed (fig. 2)

Key to Genera of North American Nymphulinae
Based Upon Male Genitalia

1. Costa of valva with four, long, sickle-shaped processes...Nymphula Schrank, 1802
Costa of valva without sickle-shaped processes (figs. 52, 83)...

2. Eighth sternite with a central posteriorly projecting process (fig. 109B)
Eighth sternite lacking a posteriorly projecting process

3. Central process of eighth sternite wide, triangulate; aedeagus very long, angulate...Contiger Lange, 1956
Central process of eighth sternite narrowed terminally (fig. 106B); aedeagus shorter, not angulate

4. Uncus long, slender, finger-like; cupped process near base of tegumen on each side near base, absent...Synclita Lederer, 1863
Uncus short, wide at base, constricted at middle, spatulate at tip; cupped process near base of tegumen presented.

5. Aedeagus with one to several large, internal spines or cornuti

6. Saccus of vinculum wider than basal junction of gnathos (fig. 118); cornutus of several large spines; male with sexual tufts on eighth sternite.

7. Gnathos arising near articulation of valva (figs. 116, 119)

8. Uncus penciliform, long, slender, greatly surpassing gnathos (fig. 37); sexual tufts on 8th sternite absent; cornutus distinct, but not greatly enlarged.

9. Gnathos wide apically and with separate nipple-like process (fig. 120); aedeagus longer than valva; base of valva distinctly wider than apical portion.

10. Valva distinctly narrowed apically; aedeagus clavate, with bulbous base (fig. 43A); juxta lobes surround aedeagus.

11. Sacculus of left valva with thumb-like processes or small papilla-like processes with projecting setae.

12. Sacculus of valva with thumb-like process set with setae (fig. 51); distal end of sacculus with projecting tuft of hairs; apex of valva broadly falcate.

13. Tuft of setae arising from verruca-like area at basal margin, or near basal margin of valva.

1. *P. maculalis* (Clemens) 1860, lacks processes.
14. Tuft of setae located above saccus near basal margin of valva; aedeagus one-half length of valva; valva greatly elongated with strong costal area and long, apical spines. .......................................................... *Neocataclysta* Lange, 1956

Tuft of setae from base of valva; aedeagus more than one-half length of valva; valva enlarged, truncate, or emarginate apically, apical spines short ........................................... *Munroessa* Lange, 1956

15. Valva with apical thumb-like process or harpe near costal margin; outer margin of valva truncate. *Oligostigmoides* Lange, 1956

Thumb-like process on valva absent. ................................................... 16

16. Valva simple, evenly rounded apically; sexual tufts on 1st and 8th sternites absent in male (figs. 79–82) .......................................................... *Parargyractis* Lange, 1956

Valva peaked, or with median, apical, thumb-like process; often with apical recurved spines; sexual tufts often present. ............................. 17

17. Valva blade-like with median, apical, thumb-like process and apical recurved spines (fig. 141) ................................. *Neargyractis* Lange, 1956

Valva peaked apically .......................................................... 18

18. Juxta with two converging lateral arms (fig. 142); spines of gnathos greatly produced ........................................... *Usingeriessa* Lange, 1956

Juxta lacking converging arms (fig. 41); spines of gnathos reduced. ................................................................................................. *Argyractis* Hampson, 1897

**Key to Genera of North American Nymphulinae Based Upon Female Genitalia**

1. Ostium small; base of ductus bursae sclerotized only at ostium. .......................................................................................... *Acentropus* Curtis, 1834

Ostium large, opening into a sclerotized portion of ductus bursae. ......................................................................................... 2

2. Ductus bursae with spines .................................................................................................................. 3

Ductus bursae lacking spines ................................................................................................................... 4

3. Ductus with rows of thorn-like spines; bursa copulatrix ovate ........................................................................... *Argyractis* Hampson, 1897

Ductus with a valve-like group of large spines some of which project into bursa copulatrix (fig. 126); bursa elongate ........................................................................... *Neargyractis* Lange, 1956

4. Bursa copulatrix with spines or sclerotized plates or bands..... 5

Bursa copulatrix lacking ornamentations ........................................................................................................ 11

5. Bursa copulatrix with separate, thorn-like spines, few to many in number; spines in some species arranged spirally (fig. 123) ......................................................................................... *Parargyractis* Lange, 1956, in part

Bursa copulatrix with sclerotized plates, groups of small, dentate or spinulate spines ........................................................................................................................................... 6

6. Bursa copulatrix with scattered, dentate or spinulate spines ........................................................................... *Usingeriessa* Lange, 1956

Bursa copulatrix with sclerotized plates or spines arranged in a definite pattern. .................................................................................................................. 7
7. Bursa with sclerotized bands or plates, spines vestigial

8. Bursa with distinct spines arranged in a definite pattern

8. Bursa with band in bursa extensive, curved, with ends approximate; collar of ductus bursae long (fig. 61)

Oligostigma Guenée, 1854

Bursa of one or two small bands of closely set spines

9. Bursa with two groups of closely arranged spines (fig. 64)

Neocataclysta Lange, 1956

Bursa with restricted, linear bands composed of very small spines

10. Bursa with one linear band made up of small spicules (fig. 58)

Oxyelophila Forbes, 1922

Bursa composed of two linear bands

Parapoynx Hübner, 1826, in part

11. Ductus bursae slender, long, may extend to first or second abdominal segment in some species; lightly sclerotized and little differentiation of basal part (fig. 53)

Parapoynx Hübner, 1826, in part

Ductus bursae shorter, never attaining base of abdomen; base of ductus sclerotized, usually differentiated from distal part

12. Bursa copulatrix opaque, surface roughened, reticulated, or with raised elevations or spines

Parapoynx Hübner, 1826, in part

Bursa copulatrix transparent, surface markings absent

13. Bursa copulatrix constricted anteriorly with a bowed sclerotization (fig. 54)

Argyractoides Lange, 1956

Bursa lacking sclerotized structure

14. Surface of bursa finely reticulated; collar section of ductus bursae between base and bursa enlarged, greatly attenuated distally; bursa weakly developed

Syncitia Lederer, 1863

Surface of bursa roughened, or with raised elevations or spines; collar section of ductus bursae not attenuated distally; bursa sac-like, developed

15. Bursa with sparsely scattered spines over surface (fig. 145)

Nymphuliella Lange, 1956

Surface covered with densely distributed spicules or raised elevations

16. Base of ductus bursae wide, joined distally to valve-like spined structure; ovipositor short; anterior apophyses not joined at base

Munroessa Lange, 1956

Base of ductus bursae elongated; sclerotized collar of bursa in place of spined structure (fig. 59); ovipositor very long; anterior apophyses greatly developed, joined at base

Chrysendscon Grote, 1881

17. Ductus bursae with longitudinal striations; little differentiation between basal and terminal portions of ductus bursae (fig. 60)

Undutambia Lange, 1956

Ductus bursae lacking longitudinal striations; usually a basal
sclerotized portion of ductus bursae clearly separated from terminal portion.

18. Ductus bursae very wide (fig. 71); bursa a spheroidal, membranous sac. \textit{Oligostigmoides} Lange, 1956

Ductus bursae narrow; bursa elongate, or if spheroidal, clearly differentiated from ductus bursae.

19. Base of ductus bursae well developed, attenuated terminally; surface scobinate or spiculate.

Base of ductus bursae more restricted; scobinations or spicules absent.

20. Surface of ductus bursae scobinate; a distinct valve-like sclerotization between base and terminal portion of ductus bursae (fig. 74).

Surface of ductus bursae spined; valve-like sclerotized plate absent (fig. 136).

21. Base of seminal duct enlarged and sclerotized (figs. 127, 138); basal portion of ductus bursae not distinctly separate from terminal portion.

Genus \textit{Undulambia} Lange, new genus.

(Figures 15, 43, 60, 94.)

Frons rounded. Ocelli absent. Labial palpi very long, slender, attaining or greatly surpassing apex; a few projecting scales, but mostly smooth. Maxillary palpi short, with few projecting scales. Forewing broad, arcuate apically; apex pointed; outer margin undulate between veins, or smooth; outwardly curved at basal half; glandular, costal swelling present or absent; R₁ short, fused with Sc; R₂, ₃, ₄ stalked; R₅ separate, approximate or separated from M₁ at base; M₂, ₃ and Cu₁ approximate at base; 1, 2, 3A present. Hindwing with apex peaked; deeply incised below apex; outer margin undulate; Sc and Rs stalked from below or just beyond cell; M₂ well separated or approximate with M₃ and Cu₁; 1, 2, 3A present. Median tibial spurs of metathoracic legs long, subequal, reaching end of tibiae; apical spurs long, subequal.

Male Genitalia: Valva simple, blade-like; costa weak; sacculus strong, inflated basally. Uncus peneillate, curved ventrally. Gnathos wide as base, attenuate apically; with small denticles on dorsal surface; Sacculus enlarged. Juxta plate-like. Aedeagus clavate, with bulbous base, attenuated below; cornuti absent.

Type Species: \textit{Ambia striatalis} Dyar, 1906, by present designation.
An examination of the type species of *Ambia, A. ptolycusalis* Walker from Borneo, Celebes, and Australia, loaned for study by W. H. T. Tams and E. G. Munroe indicated that *A. striatalis* was not congeneric. It undoubtedly shows relationships to *Ambia* as is indicated by the wing shape, venation, and general features of the genitalia.

I have examined only three species which I assign to *Undulambia*, although this is a large tropical group in which much remains to be investigated. These included species are *U. striatalis* (Dyar), *U. arnoulalis* (Schaus), and an unidentified species collected by Sehlinger and Ross from Tingo Maria, Peru. These three species agree in male genitalia; the clubbed aedeagus, pen-cillate uncus, and broadly based gnathos with minute dorsal spicules. They also agree in wing venation in most features. The Peru species lacks the costal glandular swelling in the male. The long spines on the metathoracic legs are characteristic of *Undulambia*. *Ambia ptolycusalis* has ocelli, unlike *Undulambia*, and in addition it has three groups of scale tufts in cilia of forewing at veins M₃, Cu₁ and Cu₂, a feature lacking in *Undulambia*.

*Undulambia* seems to be tropical in origin and is considered to be rather primitive, judging from its wing venation, wing shape and male genitalia. The male genitalia are reminiscent of *Aulacodes*.

**Biology:** Nothing is known concerning the habits of *Undulambia* or of true *Ambia*. Until more is known it is difficult at this time to definitely place it as a plant-feeding type or to consider it more closely allied to some of the primitive rock-feeding types with vein M₂ present.

**Genus Oligostigma** Guenée.

(Figures 9, 51, 61.)


Tongue long. Frons elevated. Labial palpi upright, not attaining center of frons; segments 1 and 2 with knife-like edge below; third segment short. Maxillary palpi short, slender, not quite reaching end of labial palpi. Antennae long; minutely ciliate, with tuft-like rings of scales. Ocelli present. Primaries long; apex pointed; outer margin angulate, outwardly produced near
PLATE 7

Male genitalia of: fig. 44. *Cataclysta lemnata* (Linné), Ille et Vilaine, Rennes, France, U-135 (B.M.); fig. 45. *Neocataclysta magnifica* (Hübner), Woods Hole, Massachusetts, U-65A (C.A.); fig. 46. *Synclita obliteralis* (Walker), No. 13375, U-87 (I.N.H.S.); fig. 47. *Synclita occidentalis* Lange, n. sp., Biggs, California, U-208 (W.H.L.); fig. 48. *Argyroctoides leucogonialis* (Hampson), Rio Inumbari, Peru, U-241 (U.S.N.M.); fig. 49. *Oligostigmoides cryptae* (Druce), Orizaba, Mexico, U-121 (U.S. N.M.); fig. 50. *Parapoxynx stratitota* (Linné), Europe, U-201 (B.M.); fig. 51. *Oligostigma junceae* (Guenée), Venezuela, U-147 (C.U.); fig. 52. *Nymphula nymphaeata* (Linné), Europe, U-196 (B.M.).

Scale as fig. 52.
center; male with costal fold, and fovea at base of Sc on undersurfaces; R₁ free; R₂, 3, 4 stalked, arising from origin of R₁; R₅ free; M₂, 3 and Cu₁ closely approximate at base. Secondaries broadly triangular; costal margin outwardly inflated; disel cell reduced; Sc and Rs arising from one-third length of wing; M₁ and M₂ fused for most of length, forked near outer margin; R₉, M₁, and M₂ with black scales at outer margin; 1, 2, 3A present.

Legs long; tibiae of all legs in male with specialized tufts of hairs; metathoracic legs with long, medial, subequal, tibial spurs and apical spurs; tarsi greatly lengthened.

**Male Genitalia:** Valva subrectangular, truncate apically, costa developed, sacculus well-developed and with apical group of hairs; bases of valva with papilla-like processes with apical spines; uncus short, finger-like, with long spines; gnathos wide basally, attenuate apically, slightly bent dorsally at tip, apical spines absent.

**Female Genitalia:** Ductus bursae long, base elongated and covered with small spicules; a collar-like, sclerotized portion of ductus bursae between basal area and distal, coiled, membranous portion leading to bursa; bursa large, covered with spicules, with band-like signum composed of numerous small spines.

**Type Species:** *Oligostigma juncealis* Guenée 1854 (by subsequent designation of Hampson, 1897, as *Oligostigma junceale* Guenée).

It seems apparent that the genus *Oligostigma* Guenée has been used to include a number of related, but probably not congeneric species. *Oligostigma, sensu strictu,* appears to include only a single known species, *O. junceale* (Guenée) from South America. It appears to be related to *Oligostigmoides* from Mexico, and has possible affinities with *Aulacodes, Theila,* and *Eoöphylla.*

**Biology:** The biology of *Oligostigma junceale* is not known. Judging from its morphological relationships it is thought that the larvae are aquatic, living on rocks upon algae and making cocoons similar to *Theila* and *Eoöphylla.*

**Genus Oligostigmoides** Lange, new genus.

(Figures 10, 49, 71, 78.)

Tongue long. Labial palpi long, slender; ascending; attaining apex; first and second segment with projecting scales below; third segment long, acicular. Maxillary palpi slender, roughly sealed.
Antennae minutely ciliate; tufted with rings of scales. Ocelli present. Primaries elongate; apex rounded; outer margin evenly rounded; \( R_1 \) free; \( R_2, 3, 4 \) stalked; \( R_5 \) free; \( M_2, 3 \) and \( Cu_1 \) approximate at base. Secondaries broadly angulate; outer margin below apex distinctly incised and with group of about 7 black spots; Se anastomosing for considerable distance with \( R \); \( M_1 \) free; \( M_2, 3 \) and \( Cu_1 \) approximate at base; 1, 2, 3A present. Legs moderately long; prothoracic legs with slight apical tuft of tibial hairs in male; metathoracic legs with long, subequal, medial, and apical spurs.

**Male Genitalia:** Valva broad; truncate apically; with apical, corona-like group of crotchet-like spines; thumb-like spined process apically near costa with a group of spines beyond. Uncus prominent; enlarged apically. Gnathos strong, elbowed toward uncus; with several large, dorsal teeth. Aedeagus large; inflated terminally; group of spine-like cornuti, and terminal spicules. Eighth sternite with 2 lateral, rod-like supporting arms.

**Female Genitalia:** Ductus bursae short, wide. Base of ductus bursae very wide, scobinate. A short, sclerotized portion of ductus bursae between base and membranous portion leading to bursa. Bursa a mebranous sac; signa lacking.

**Type Species:** *Oligostigmoides cuernavacale* Lange 1956, by present designation.

This genus is close to *Oligostigma* and includes two known species, *Oligostigmoides cuernavacale* Lange, and *O. cryptale* (Druce), both known from Mexico. The male and female genitalia are diagnostic. It also differs from *Oligostigma, sensu stricto*, in the broader primaries with evenly rounded outer margin, in the wing venation and in the much longer labial palpi with long, acuminate third joint.

**Biology:** The biology of *Oligostigmoides* does not seem to be recorded, but should be similar to *Oligostigma*.

### *Oligostigmoides cuernavacale* Lange, new species.

*(Figures 10, 71, 78.)*

Closely related to *O. cryptale* Druce, but more tawny and with more extensive white markings.

**Male:** Expanse 26 mm. Labial palpi ascending, not quite attaining apex; light brown outside, white inside; third segment long, smooth. Maxillary palpi short, ascending. Antennae mi-
nutely ciliate; banded with dark brown scales; tufted apically. Forewings tawny with some fuscous scales and white transverse bands; a median, transverse band of white, brown, and tawny scales, edged basally with outwardly curved white line, and white line terminally; a postmedian band, edged with white, not reaching inner margin; a subapical area of tawny scales; a white, thin, submarginal line, inflated near apex; a marginal, tawny band; bases of cilia alternately light and dark banded on termen. Hindwings with indication of dark-brown basal patch; a subbasal dark band; a median white area outlined with brown lines, angulate outwardly and edged with white; an apical tawny area with dark edging; a submarginal white line, outlined in brown, not reaching margins; a marginal tawny band, edged with dark scales; apex with a group of seven black dots on margin between veins M₁ and Cu₁. Body and legs tawny. Metathoracic legs with subequal, median, tibial spurs.

**Male Genitalia:** Valva broad, enlarged and truncate apically; costa strong; a thumb-like, apical process directed toward costa, set with spines, followed by a more apically placed group of spines; apex with group of recurved, crotchety-like group of spines, margin of sacculus with a thumb-like process. Uncus strong, narrowed medially and inflated at apex. Gnathos well developed, angulate, with terminal portion directed dorsally toward tip of uncus, with several large apical, dorsally set spines. Aedeagus long, narrowed basally; inflated apically; with group of moderately large spines and surface spicules. Eighth sternite with a U-shaped sclerotized arm.

**Female:** Similar to male, but larger. Expanse 28 mm. Discal spot on primaries tends to be more distinct.

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**PLATE 8**

Female genitalia of: fig. 53. *Parapoynx stratitata* (Linné), Europe, U-202 (B.M.); fig. 54. *Argyractoides leucogonialis* (Hampson), Rio Inumbari, Peru, U-253 (U.S.N.M.); fig. 55. *Ambia ptolcusalis* Walker, Celebes, U-204 (B.M.); fig. 56. *Anydraula glycerialis* (Walker), Australia, U-198 (B.M.); fig. 57. *Cataclysta lemmata* (Linné), Europe, U-138 (B.M.); fig. 58. *Oxyelophila callista* Forbes, New Braunfels, Texas, U-68 (W.H.L.); fig. 59. *Chrysendeton claudialis* (Walker), Pittsburgh, Pennsylvania, U-119 (U.S.N.M.); fig. 60. *Undulambia striatalis* (Dyar), St.
Petersburg, Florida, U-120 (U.S.N.M.); fig. 61. Oligostigma junceale (Guenée), St. Laurent du Moroni, U-137 (U.S.N.M.); fig. 62. Nympheula nympheacata (Linné), Europe, U-197 (B.M.); fig. 63. Argyractis argenteilinealis (Hampson), type series, compared with female type, No. 2530 (B.M.); fig. 64. Neocataclysta magnificaalis (Hübner), Lutz, Florida, U-140 (W.H.L.); fig. 65. Parargyractis truckealis (Dyar), Sierra County, California, U-19 (W.H.L.); fig. 66. Synclita occidentalis Lange, n. sp., paratype, U-215 (W.H.L.).

Scale as in fig. 59, unless indicated.
FEMALE GENITALIA: Base of ductus bursae very wide, densely scobinate. Ductus bursae short, of uniform width, with sclerotized valve-like structure near base. Bursa a spheroidal, membranous sac.

HOLOTYPE: Male, Cuernavaca, Morelos, Mexico, October, 1902; A. Koebele.

ALLOTYPE: Female, same data as holotype.

PARATYPE: Female, same data as holotype. Expanse 32 mm.

This species is related to *O. cryptale* Druce of which Mr. Capps sent two specimens from the National collection determined by Schaus from Jalapa and Orizaba, Mexico. The male genitalia are distinct from *O. cryptale*. In *O. cryptale* the aedeagus is half the size; the process on the sacculus is missing; and the thumb-like process on the apical part of the valva is smaller. The female genitalia are similar although in *O. cryptale* the ductus bursae is smaller and the bursa copulatrix larger. In superficial features of the primaries *O. cryptale* is darker in general coloration; the marginal band is smaller; the disel mark is more distinct; and the white markings are more evident. In the secondaries the transverse, medial white band is more reduced in *O. cryptale*.

Genus *Neocataclysta* Lange, new genus,

(Figures 12, 45, 64.)

Labial palpi long, slender; attaining apex. Maxillary palpi short; rough-sealed. Antennae filiform; ciliate; tufted apically. Forewing moderately broad; tornus evenly rounded; R₁ free; R₂ stalked with R₃₄; R₅ free; M₂₃ and Cu₁ approximate at base; frenulum, in female, of three bristles. Hindwing with outer margin evenly rounded; Sc anastomosing with R for short distance; M₁ free; M₂₃ and Cu₁ approximate, but definitely separated at base; 1, 2, 3A present; black spots on outer margin with pupillate, metallic-bluish scales. Legs long; metathoracic medial, tibial spurs with inner spine twice as long as outer. Male genitalia with valva long, slender, sacculus strong, with group of basal spines, apex with long spines; uncus short, finger-like; gnathos with inconspicuous group of dorsal spicules; aedeagus with compact group of cornuti. Female genitalia with base of ductus bursae wide, with scattered spicules, leading to a heavily sclerotized col-
lar; bursa large, elongate, signa of two conspicuous groups of closely set spines.

**Type of Genus:** *Pyralis magnificalis* Hübner 1796, by present designation.

This genus is erected for a single species, *Neocataclysta magnifica* (Hübner), the only species examined from North America to date which shows definite relationships with the European *Cataclysta lemnata* L. It is apparent from this study that *Cataclysta* has been used in the past to include an unrelated group of moths having black and metallic spots on the outer margin of the hind wings. The western species formerly placed in this group actually are more closely related to the Neotropical genus *Argyractis*, and its relatives.

The characters separating *Neocataclysta* from *Cataclysta* are presented in the tabulation below:

<table>
<thead>
<tr>
<th><em>Cataclysta</em></th>
<th><em>Neocataclysta</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Valva in male wide.</td>
<td>Valva in male long and slender.</td>
</tr>
<tr>
<td>Female bursa lacking signa.</td>
<td>Female bursa with signa of two groups of spines.</td>
</tr>
<tr>
<td>Frenulum in female of one bristle.</td>
<td>Frenulum, in female, of three bristles.</td>
</tr>
<tr>
<td>Tornus in forewing angulate.</td>
<td>Tornus in forewing rounded.</td>
</tr>
<tr>
<td>Labial palpi not reaching apex.</td>
<td>Labial palpi reaching apex.</td>
</tr>
<tr>
<td>Metathoracic, tibial, medial spurs subequal.</td>
<td>Spurs with outer spine half length of inner.</td>
</tr>
</tbody>
</table>

The known distribution of this species is from Quebec, west to Illinois, and south to Georgia and Florida.

**Biology:** As is the case with the European *Cataclysta lemnata* L., the larvae of this species apparently make cases of *Lemna* leaves. The caterpillars, pupae, and the case were apparently described by Forbes (1911, 1922) as an *Elophila* species. Forbes describes the larvae as gill-less, making spheroidal cases of *Lemna* leaves. I have examined cases and larvae from the Illinois Natural History Survey Collection (rearing 13941) which seem to be this species. The cases are tubular, about 10 mm. long, and are composed of from 6 to 10 or more *Lemna* plants molded and held together with silk. The gill-less larvae are about 9 mm. long, robust, smooth, and have spiracles A3 and A4 conspicuous (as mentioned by Forbes). Details in the life history do not seem available.
Genus *Parapoynx* Hübner.

(Figures 4, 5, 6, 8, 50, 53, 69, 72, 84, 85, 86, 87, 88, 108, 125, 128, 129, 137.)


Frons flattened. Antennae ciliate, with apical segments, especially in male, ringed apically with tufts of scales. Labial palpi long, ascending to center or apex of frons; a few scales projecting downwardly from segments 1 and 2. Maxillary palpi short. Ocelli present. Legs long, slender, with long, subequal tibial spurs. Forewing long, slender; R₁ free; R₂ free or stalked with R₃-₄; R₅ free. Hind wings elongate; outer margin straight or slightly inwardly curved below apex; Sc anastomosing with R for considerable distance; M₁ free; M₂-₃ and Cu₁ arising approximate from lower angle of cell; 1, 2, 3A present.

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**PLATE 9**

Female genitalia of: fig. 67. *Munroessa gyralis* (Hulst), No. 10253, U-103 (I.N.H.S.); fig. 68 *Munroessa icclusalis* ? (Walker), Champaign, Illinois, 1887, U-106 (I.N.H.S.); fig. 69. *Parapoynx allionealis* Walker, No. 4470, 1886, U-84 (I.N.H.S.); fig. 70. *Pararygymctis longipennis* (Hampson), Todds Lodge, Oak Creek Canyon, Arizona, U-339 (W.H.L.); fig. 71. *Oligostigmoides cuernavaca* Lange, n. sp., allotype, U-130 (C.A.); fig. 72. *Parapoynx badiulalis* (Walker), Antioch, Illinois, U-184 (I.N.H.S.); fig. 73. *Pararygymctis cronialis* (Druce), Orizaba, Mexico, U-76 (U.S.N.M.); fig. 74. *Nymphula ekthiopsis* (Grote), Center Harbor, New Hampshire, U-114 (U.S.N.M.); fig. 75. *Pararygymctis drumalis* (Dyar), Stemper, Florida, U-142 (U.S.N.M.); fig. 76. *Eopararygymctis irrortalis* (Dyar), Tallahassee, Florida, U-484 (W.H.L.); fig. 77. *Pararygymctis cappsi* Lange, n. sp., paratype, U-171 (W.H.L.). Male genitalia of: fig. 78. aedeagus, *Oligostigmoides cuernavaca* Lange, n. sp., holotype, U-88A (C.A.); fig. 78A, left valva; fig. 78B, gnathos.

Scale as fig. 68 unless specified.
MALE GENITALIA: Valva simple, blade-like; base of valva in most species with a setigerous papilla-like process, or processes, contiguous with or adjacent to the saeculus; uncus and gnathos stout; gnathos with dorsal spines absent or with small teeth; aedeagus small, lacking cornuti.

FEMALE GENITALIA: With characteristic, elongated ductus bursae (fig. 53), in some species extending almost entire length of abdomen; base of ductus bursae a sclerotized cup, followed by a collar in some species; ductus bursa nonsclerotized for the most part, extending into an elongate bursa copulatrix; bursa lacking signa, or with two longitudinal bands of small denticles (figs. 128, 129).

TYPE SPECIES: Phalaena Geometra stratiotata Linné, 1758 (by subsequent designation of Guenée 1854 as Paraponyx stratiotalis Linné).

The genus Paraponyx is restricted to include those species formerly placed in Nymphula which have the male and female genitalia structures designated and which have gilled larvae feeding on aquatic plants. The blade-like, simple male genitalia are characteristic and show probable relationships with the Australian genera Hydretetis Meyrick, and Hygraula Meyrick.

Munroe (1951) called attention to the fact that Paraponyx curviferalis (Walker) is distinct from P. badiusalis (Walker) and listed several Canadian localities. An examination of specimens sent by Dr. Sanderson in the Illinois collection shows that two males of P. curviferalis (Walker) were included with P. badiusalis; one from Cedar Lake, Illinois, June 19, 1892, Shiga and Hart; and one from Fox Lake, Illinois, June 22, 1892, Shiga and Hart. These specimens were compared with examples sent by Dr. E. G. Munroe. These records are the first from the continental United States. The female bursa of P. curviferalis has the two longitudinal bands of denticles less pronounced than in P. badiusalis, P. obscuralis, and P. seminalis (figs. 87, 108, 128, 129).

BIOLOGY: The habits of Paraponyx stratiotata L. were early recognized, but are reviewed in the book by Beirne (1952). The larva has eight groups of up to six tapering gills and lives on water plants, submerged, where it spins the leaves and stems to form an open web in which it lives. Host plants include Potamogeton spp., Elodea canadensis and Ceratophyllum demersum. To
assist in respiration the larva undulates its body rapidly for about 20 seconds at 1–3 minute intervals. Pupation occurs in a large oval cocoon attached to the stem of the food plant.

The life history of our North American species has received attention from numerous authors. Hart (1895) reported the gilled larvae of *Parapocyx obscuralis* Grote feeding among the leaves of *Vallisneria spiralis*, first feeding exposed, and later webbing several leaves together.

Additional observations on *P. obscuralis* were made by Berg (1950) who listed four *Potamogeton* spp. as host plants. He reports that eggs were laid on the lower surface of the leaves near the margin.

Life histories and habits of other *Parapocyx* species, including *P. maculalis* (Clemens), *P. badiusalis* (Walker), and *P. allioanealis* Walker can be obtained by referring to the papers by Berg (1949, 1950), Forbes (1910, 1923), Hart (1895), McGaha (1952, 1954), Welch (1916, 1922, 1924) and Welch and Sehon (1928).

The article by McGaha (1954) reviews our knowledge of the biology of *Parapocyx* spp. and adds additional observations.

Genus *Chrysendeton* Grote.

(Figures 13, 14, 37, 59, 144.)


Frons rounded; apex produced; ocelli present. Labial palpi long, slender; first and second segments rough-scaled below; attaining approximate center of front. Maxillary palpi short; pointed apically; rough-scaled basally. Antennae short; thickened basally; ciliate; rows of longitudinally placed scales basally, becoming tufted apically. Forewings narrow; R₁ free; R₂ stalked with R₃-₄; R₅ free; M₁ free; M₂-₃ and Cu₁ approximate at base; a group of posteriorly projecting scales on underside arising at base of wing. Hind wing narrow; pointed apically; Se and R forked from approximate center of wing; cell partly open; M₂-₃ and Cu₁ approximate at base; 1A vestigial; 2–3A present. Legs long; metathoracic legs with single, long, median tibial spur in male, outer spine half length of inner in female, and with subequal apical spurs.
MALE GENITALIA: Valva long, blade-like, pointed apically; uncus very long, slender, pencillate; gnathos wide basally, gradually attenuate apically, set with inconspicuous dorsal teeth; aedeagus long, with a single, stout, thorn-like cornutus.

FEMALE GENITALIA: Ovipositor long, needle-like; anterior and posterior apophyses greatly lengthened, joined anteriorly; base of ductus bursae elongate, sclerotized; ductus bursae long, with enlarged, sclerotized portion, or collar-like area at union with ductus seminalis, followed by an elongate portion, which may be sparsely set with spineules, or greatly sclerotized and folded (C. imitabilis); bursa a distinct sac or enlarged continuation of ductus bursae, with surface ornamented with densely distributed spineules.

TYPE SPECIES: Cataclysta medicinalis Grote 1881 (syn. of Cataclysta claudialis Walker 1859 ?) by designation of Klima 1937.

Grote (1881) included two species as group A of Hübner's genus Cataclysta in Chrysendeton, namely C. medicinalis Grote, and C. helopalis Clemens. The latter species is generally recognized as a synonym of Neocataclysta magnificalis (Hübner). Grote (1882) and Smith (1891) included the originally included species under Chrysendeton, although Hampson (1897), and Dyar (1906) placed medicinalis Grote (or claudialis Walker) in Cataclysta and Elophila respectively. Klima (1937) synonymized Chrysendeton under Cataclysta. I am using Chrysendeton to include three known North American species which are distinct from Cataclysta in wing venation, external features, and in genitalia. Its relationships seem to lie with Anydmula, an Australian genus. An examination of A. glycerialis Walker indicates similarities in the wing venation (fig. 27) and in the male genitalia (fig. 42).

An indication of the southern origin of the genus is shown in "Chrysendeton" autobella Dyar, from Panama, a species showing distinct relationships with the northern species, although differing in certain details of wing venation (fig. 31) and in genitalia features. Dr. Forbes sent specimens of "Cataclysta" azadalis Schaus from Surinam, and "C." nigstriata Hampson from the Solomon Islands. These two species also show relationships in structural details with our species.

BIOLOGY: I am not aware of any biological studies of this group. The extreme strengthening of the female ovipositor and its slen-
der shape would possibly indicate that the eggs are inserted into plant tissues. In no other group of the Nymphulinae examined by the present author are the female structures modified to this extent.

**Chrysendeton kimballi** Lange, new species.

(Figure 144.)

**Male:** Expanse 10.5 mm. Frons with pale, reddish-brown scales. Labial palpi long, slender, attaining approximate center of frons; externally with reddish-brown scales, internally lighter. Antennae dark reddish-brown, ciliate, with longitudinally placed scales, tufted apically. Forewing with basal, dark reddish-brown area, with central, orange-red dash; an oblique, basally directed, white, postbasal streak; a wide, median, basally directed, reddish band, with subcostal dash of orange-red, followed by a postmedian, irregularly outlined white spot; a postmedian white mark on inner margin; a subapical, outwardly directed, white streak, converging upon but not reaching, a submarginal white streak; an orange-red marginal band; inner angle with a triangular patch of silvery scales; cilia gray. Hindwing with few dark basal scales; a wide, postbasal white streak in line with white streak on forewing; a wide, median, basally angulated, reddish-brown area, with a few darker scales and a light orange-red spot toward costal margin; a postmedian white area, followed by an ochraceous field with scattered dark brown scales; a marginal group of five contiguous, velvety-black marginal spots, with interspersed silvery scales, and a group of four reddish-orange spots on outside, and a reddish-orange dash at apex; cilia gray. Patagiae of long, white scales. Body reddish-brown. Legs light brown; median spur of metathoracic leg long, almost attaining end of tibia.

**Male Genitalia:** Valva blade-like, with weak costa, terminal recurved spines, sacculus enlarged basally and set with spines; uncus wide basally, attenuated terminally, set with two small inconspicuous spicules; saecus well-developed; aedeagus long, with single spine and group of terminal spicules, angulate.

**Female:** Expanse 12 mm.; as male except more extensive white areas.

**Female Genitalia:** Apophyses greatly lengthened; base of ductus bursae elongated, selerotized, leading to a collar-like, narrow area; ductus bursae at junction of ductus seminalis enlarged,
sclerotized, and with group of spicules, then extending to elongated bursa; entire surface of ductus bursae set with small spicules.

**Holotype**: Male, Oneco, Manatee County, Florida, May, 1954; collected by Paula Dillman.

**Allotype**: Female, Sarasota County, Florida, May 5, 1946; collected by C. P. Kimball.

**Paratypes**: Data as holotypes; one female, May 28, 1953; three males, June 15, 1954; one male, July 25, 1953; one male, September 27, 1954; one male, September 30, 1954. Data as allotype: one male, May 4, 1946; one male, May 13, 1946; one female, May 16, 1946; one male, May 21, 1946.

This species is named for Mr. C. P. Kimball who collected part of the type series, and who has contributed a great deal to our knowledge of Florida Lepidoptera. The holotype and allotype will be deposited in the California Academy of Science.

I associate with this species two males from Camden, Arkansas, collected by J. C. Bradley on June 2, 1918, and a single male from the Black Mountains, North Carolina, May, 1912, all from the Cornell collection.

In superficial coloration this species appears closer to *Chryses-deton imitabilis* Dyar, but in genitalic features it is related to *C. claudialis* Walker. The small size, bright markings of white and orange-red, and the wide, less angulate medial band of the hind wings will distinguish it from *C. claudialis*; *C. imitabilis* is larger and lacks the subapical white streak of the primaries. The male genitalia in this group are close and show some variation. In this species the single large spine in the aedeagus is similar to *C. claudialis*; *C. imitabilis* has a greatly enlarged cornutus. The gnathos is wider at the base, shorter valva, and less rounded saccus than *C. claudialis*. In the female genitalia *C. imitabilis* is

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**PLATE 10**

Male genitalia of: fig. 79. *Parargyractis avernalis* (Grote), Greer, White Mts., Arizona, U-155 (W.H.L.); fig. 80. *Parargyractis cronialis* (Druce), Orizaba, Mexico, U-75 (U.S.N.M.); fig. 81. *Parargyractis capsii* Lange, n. sp., holotype, U-42 (U.S.N.M.); fig. 82. *Parargyractis longipennis* (Hampson), White Mts., Arizona, U-274 (W.H.L.); fig. 83. *Nm. phula ekthilipsis* (Grote), Center Harbor, New Hampshire, U-110 (U.S. N.M.). Left valva of: fig. 84. *Parapoynx seminealis* (Walker), St. Peters-
burg, Florida, U-111 (U.S.N.M.); fig. 85. \textit{Parapoynx obscuralis} (Grote), Algonquin, Illinois, U-60 (U.S.N.M.); fig. 86. \textit{Parapoynx allionealis} Walker, Sanford, Florida, U-83 (W.H.L.); fig. 87. \textit{Parapoynx badiusalis} (Walker), Antloch, Illinois, U-88 (I.N.H.S.); fig. 88. \textit{Parapoynx maculalis} (Clemens), Montclair, New Jersey, U-58 (U.S.N.M.).

Scale as in fig. 83.
quite distinct, having a ductus bursae greatly sclerotized and with the wall folded. The female structures differ from *C. claudialis* in being much shorter, with less differentiated bursa, and in the uniformly spiculate ductus bursae.

Our present information would indicate that *Chrysendeton kimballi* is the southern counterpart of *C. claudialis*. I am following certain other authors in regarding *C. medicinalis* Grote, described from Carbondale, Illinois, as *C. claudialis* Walker, even though Barnes and McDunnough (1914) mention the fact that they are separated in the British Museum collection.

**Genus Munroessa** Lange, new genus.

(Figures 3, 11, 36, 68, 112, 113, 131, 134, 146, 150.)

Frons slightly elevated. Antennae ciliate, tufted apically. Labial palpi slender; segments 1 and 2 with downwardly projecting scales; attaining center or apex of frons. Maxillary palpi short, rough-scaled apically; attaining apex of labial palpus segment 1. Legs long; tibial spurs subequal, slender to stout. Forewings broad with outer margin uniformly curved, or expanded in the middle; R₁ free; R₂ free or stalked with R₃-₄; R₅ free; M₂-₃ and Cu₁ approximate at base. Hind wings broad; outer margin slightly inwardly curved below apex; outer margin evenly curved, or slightly crenulate between veins; Sc anastomosing with R for short distance; M₁ free; M₂-₃ and Cu₁ approximate at base; 1, 2, 3A present.

**MALE GENITALIA:** Valva blade-like with terminal spines; uncus long, simple, tongue-shaped or spatulate; gnathos well-developed, set with dorsal apical teeth; base of valva with pad-like area set with long spines; aedeagus stout, with numerous small spines, or several large cornuti.

**FEMALE GENITALIA:** Ostium wide; base of ductus bursae with extensive sclerotization, followed by valve-like area often set with spines; bursa an extended longitudinal sac with a single spined signa (*M. gyralis*) or surface denticles.

**Type Species:** *Nymphula serralinealis* Barnes and Benjamin, 1924, by present designation.

*Munroessa* is named for E. G. Munroe in recognition of his systematic work on Pyralidae and his assistance in the many problems of delimiting genera in this group.
The genus *Munroessa* is erected to include a rather homogeneous group of moths formerly placed under *Nymphula*. The blade-like valva with basal spine tufts, well-developed uncus, and slender, spined gnathos will separate *Munroessa* from *Nymphula*, and *Cataclysta* to which it seems related. The gnathos is reminiscent of *Synclita*. The female genitalia are quite characteristic, with wide ostium, well sclerotized base of the ductus bursae, and sac-like bursa with external ornamentations. The markings of the adults in many of the species show a similar basic pattern.

The best known species in North America is *Munroessa icciusalis* (Walker). An examination of specimens of this species collected in different parts of the United States indicates, however, that several species may be involved in what has been called "icciusalis." Three specimens in the Illinois collection and one from Ontario, Canada, in the California Academy collection, have entirely different male and female genitalia, and in addition have markings suggesting *M. faulalis* (Walker), which has been listed as a synonym of *M. icciusalis* (Walker).

Differences in genitalie structures observed in other specimens may well be within the limits of variation of *Munroessa icciusalis* (Walker). Variations in the male and female genitalia in what is called *M. icciusalis* are shown in figs. 36, 36A, 146, 150, and 150A.

The types of *Leucochroma icciusalis* Walker and *L. faulalis* Walker should be examined critically. Due to the uncertainty involved I am making *Nymphula serralinealis* Barnes and Benjamin type of the genus *Munroessa*, as two paratypes are available for study.

The known species indicate a wide range in distribution across the United States, south to Florida and north to Canada.

**Biology:** Observations on the biology of *Munroessa serralinealis* (Barnes and Benjamin) was recently described by McGaha (1954) who pointed out that the immature stages may have been included in the past under *M. gyralis* (Hulst). The gill-less larvae feed on *Nymphaea odorata* and *N. tuberosa* where they feed on leaves when small, and later bore into the tops of the petioles. Pupal chambers usually occur in the petioles.

A review of the biology of *Munroessa icciusalis* (Walker) is given by Berg (1950). The larvae of this species make cases of various aquatic plants including *Potamogeton* spp., sedges,
**Lemna, Menyanthes, and Vallisneria**, making an oblong, biconvex case. The larvae lack gills and do not exhibit periodic undulating movements of the body which is a habit shown by the gilled forms (Welch and Sehon, 1928). Water is excluded from the gas-filled case.

**Genus Nymphula** Schrank.

(Figures 1, 52, 62, 74, 83.)


Frons evenly rounded. Antennae ciliate, with few appressed scales, apically tufted. Labial palpi ascending, rough-scaled beneath. Maxillary palpi short. Ocelli present. Legs long, slender, with stout tibial spurs at about 3/4 from base and apically. Forewing broad, outer margin outwardly curved below apex; R₁ free; R₂ free or stalked with R₃–₄; R₅ free; M₂–₃ approximate at base. Hind wing broad, incurred below apex; Sc anastomosing short distance with R; M₂–₃ and Cu₁ arising approximate at lower angle of cell; 1, 2, 3A present.

**Male Genitalia**: Uneus stout, thumb-like; gnathos scapula-like, laterally compressed, dorsally denticulate; valva elongate, slender, usually with sickle-shaped hairs from costal edge; base of valva with verruca-like spined area; eighth sternite with sclerotized W-shaped supporting arm; aedeagus well-developed, with several thorn-like cornuti.
Female Genitalia: Base of ductus bursae wide, followed by a distinct sclerotized, valve-like collar; bursa an extended, elongate sac; signa absent, although base (N. ekthlipsis) may be denticulate.

Type Species: *Phalaena Geometra nymphaeata* Linné, 1758 (monotype by designation of Hübner [1816] 1826 as *Nymphula potamogalis* = *N. potamogata* Linné).

According to Pierce and Metcalf (1938) the type of *Nymphula* is *nymphaeata* Linné by monotype, but Schrank's original description contains two species, *Nymphula potamogalis* (= *stagnata* Donovan) and *Nymphula nymphaealis*, with no designation of a type.

The present author has examined only *Nymphula nymphaeata* (Linné) and the single North American species referable to this restricted use of the generic name, *Nymphula ekthlipsis* (Grote). Sylven (1949) also includes *N. stagnata* Donovan) and *N. rivularis* Duponchel. Pierce and Metcalf’s (1938, plate 19) figure of the male genitalia of *stagnata* lacks the typical sickle-shaped processes found in the other species and could be in the genus *Munroessa*.

*Nymphula sensu strictu* includes the so-called “china marks moths” and seems related to *Munroessa*, *Synclita*, *Contiger*, and *Nymphulicella* in biology and in the presence of a knife-like, laterally compressed and dorsally toothed gnathos. In addition, these forms have sclerotized processes or other structures on the eighth sternite.

Biology: The life history of *Nymphula nymphaeata* was apparently reported as early as 1736 by Reaumur, and mentioned by numerous European authors. Beirne (1952) points out that this species is associated with stagnant ponds and the relatively undisturbed parts of rivers. The eggs are laid on the undersides of the leaves of several aquatic plants, including *Potamogeton* spp., *Hydrocharis morsus-ranae*, and *Sparganium* spp. The aquatic, gill-less larvae live in flat, oval cases made up of pieces of the leaf of the host plant. The cases float free in the water or are attached to the host plant. To obtain oxygen the larva undergoes periodic vibratory movements of the body.

The larvae of *Nymphula stagnata* according to Beirne (1952) feed underneath the water on the aquatic plants, *Sparganium* spp., and *Nuphar luteum*, boring into the stems when young, and
later spinning two pieces of leaves together to form a chamber in which it lives.

The life history of our North American species, *Nymphula ekthlipsis* is imperfectly known. Forbes (1923) states that the larva makes an oblong case on sedge.

**Genus Synclita Lederer.**

(Figures 16, 46, 47, 66, 97, 106, 132.)

*Synclita* Lederer 1863, Wiener Entomologische Monatschrift, 7(12): 448-449, 483, pl. 17 (fig. 17), pl. 19 (fig. 1).

Frons slightly elevated; flattened. Antennae thickened basally; ciliate, with few scattered, appressed scales; tufts of apical scales, particularly in males. Labial palpi upturned, attaining middle or apex of frons; segments 1 and 2 with sparse, downwardly projecting scales; segment 3 short, ending in truncate group of scales. Maxillary palpi short. Legs stout; tibial spurs of meso- and metathoracic legs subequal, stout. Forewings moderately broad, with evenly rounded outer margin; R₁ and R₂ free; R₃₋₄ stalked; R₅ free; M₂, M₃, and Cu₁ approximate at base; 1, 2, 3A present. Hind wings subrectangular in general outline; Sc anastomosing with R for short distance; M₁ free; M₂₋₃ and Cu₁ approximate at base; 1, 2, 3A present.

**Male Genitalia:** Valva, short, blade-like, firmly attached basally; gnathos laterally compressed, knife-like, with well-developed dorsal teeth; uncus finger-like; eighth sternite with a median process; aedeagus stout, with large cornutus and numerous smaller spines.

**Female Genitalia:** Reduced in length; ostium wide; base of ductus bursae leading to a valve-like structure, followed by a heavily sclerotized, attenuated ductus bursae; bursa reduced to a small, membranous, inconspicuous sac.

**Type Species:** *Synclita gurgitalis* Lederer 1863 (= *S. modestalis* Lederer) by monotype.

Moths in the genus *Synclita* can be recognized by the small size, gray brown, or fuscous coloration, the thick antennae, and the characteristic male and female genitalia. The laterally compressed gnathos is also found in *Nymphula, sensu strictu*, and *Contiger vittatalis*, and the central process of the eighth sternite is similar to *Nymphuliella daeckealis*.

Through the courtesy of E. Martin and E. G. Munroe, I have
PLATE 11

Wing venation of: fig. 89. *Hydropionea fenestralis* (B. and McD.), Chiricahua Mts., Arizona, U-350A (C.A.); fig. 90. *Eurhyncha urtica* (Linné), New York, U-351A (W.H.L.); fig. 91. *Piletocera bufalis* (Guenée), Florida, U-344A (U.S.N.M.); fig. 92. *Paramia gnomosynalis* Dyar, Panama, U-434 (U.S.N.M.); fig. 93. "Nymphula" *nomophilalis* Dyar, Everglades, Florida, U-444A (U.S.N.M.); fig. 94. *Undulambia arnoula* (Schaus), male, Colima, Mexico, U-435A (U.S.N.M.); fig. 95. *Steniodes gelliasalis* (Walker), Castro, Parana, Brazil, U-343 (U.S.N.M.).
been able to examine a series of *Synclita gurgitalis* Lederer from several South American localities. It is obvious that our North American species of the "obliteralis" group are congeneric with *Synclita*. In *S. gurgitalis* the median process of the eighth sternite is more produced than in our species. The shape and nature of this process seems helpful in the separation of species in this group.

The more southern distribution of *Synclita*, and abundance in the southern fringe of continental United States suggests a tropical origin for the genus. Until all of the species previously placed under *Nymphula* are examined, the phylogeny of the group remains in question.

Our common species in North America, which has been previously placed in *Nymphula*, is *Synclita obliteralis* (Walker). The present study indicated a division into two species, true *S. obliteralis* extending from Texas to Florida, eastern localities, and the Hawaiian Islands, and a western species, *S. occidentalis*, in California and Arizona. There seem to be other variations in the "obliteralis" group which should be investigated.

**Biology:** The biology of the western *Synclita occidentalis* Lange, has been investigated by the writer and pertinent information is presented under this species. The life history of *S. obliteralis* (Walker) has been investigated by several workers. The larvae of *Synclita* are gill-less, living when young submerged in water, under the protection of a small piece of an aquatic plant. As the larvae grow they cut two pieces of leaf and construct a case in which they live, and in which they seem to be exposed to air and not water.

Hart (1896) found *Synclita obliteralis* (Walker) (as *Hydrocampa obliteralis* Walker) associated with the floating leaves of *Potamogeton natans*. Williams (1944) reported its introduction into Hawaii in 1942 and its immature stages and damage to water lilies (*Nymphaea* spp.) He reported the eggs glued to the underside of water lily leaves and the larvae cutting pieces of leaves and becoming case bearers.

**Synclita occidentalis** Lange, new species.

(Figures 47, 66.)

A fuscous species with reddish and white markings, closely related to *S. obliteralis* (Walker).
MALE: Expanse 15.5 mm. Frons with light brown scales. Labial palpi on exposed sides with fuscous scales, mottled with lighter brown; light brown scales on inner surfaces; first and second segment roughcaled below; third segment terminating bluntly. Maxillary palpi fuscous, attaining middle of third segment of labial palpi. Antennae ciliate, with some scale tufts. Forewings fuscous, with reddish and white markings; basal fuscous band followed by a postbasal fascia; a submedian reddish area; a fuscous median band with a white dash on costa; a postmedian area with white scales on costa and white discal spot, with indistinct, white, postmedian line attaining inner margin; a submarginal reddish-brown area with fuscous scales and white dash near costa; a marginal band of fuscous, with linear, scattered white scales; cilia with bases alternately dark and light. Hind wings fuscous, with a basal, reddish dash and an indistinct reddish mark near angle; cilia dark-based. Body with fuscous and brown scales; abdomen with lighter transverse bands on posterior edges of segments. Legs heavy-set; tibial spurs subequal, stout; tarsal segments dark-banded posteriorly.

MALE GENITALIA: Valva simple, blade-like; uncus elongate, finger-like; gnathos laterally compressed, set with dorsal teeth; aedeagus stout, with group of small cornuti; eighth sternite with central arm bearing two lateral, short, thorn-like projections.

FEMALE: Expanse 20.5 mm. As male except with lighter reddish cast to both wings and with reddish mark on hind wings near angle not clearly defined.

FEMALE GENITALIA: Base of ductus bursae wide, surface minutely and evenly speicate; collar of ductus bursae well sclerotized, attenuate; bursa copulatrix reduced to an elongate sac.

HOLOTYPE: Male, collected as larva on Echinodorus cordifolius on August 5, 1954, at Elkhorn Ferry, Yolo County, California, with adult emerging August 16, 1954, W. H. Lange.

ALLOTYPE: Female, with same data, emerging August 18, 1954.

PARATYPES: California (collected by W. H. Lange unless specified). As holotype and allotype, emerging on following dates: 1 female August 9, 1954 (from pupa); 1 female August 16; 2 males, 1 female, August 17; 2 females, August 19. Biggs, Butte County, as follows; 1 male, 1 female, July 9, 1954, as pupae on Echinodorus cordifolius, adults emerging July 12: female, July 13, 2 females, July 17; 1 female flying in rice field, July 17, 1954; 11
males flying in rice field, August 5, 1954; 5 males, 1 female, flying in rice field, August 12, 1954; 1 female as pupa on *Bacopa rotundifolia*, on August 5, 1954, emerged August 14; 1 female flying in permanent pond, August 15, 1954. Maxwell, *Colusa County*, as follows: collected as larvae and pupae on *Potamogeton gramineus* on August 12, 1954, emerged as follows; 1 male, August 16; 1 female, August 18; 1 male and 1 female, August 19; 1 male, August 22; 1 male and 1 female, August 23; flying in rice field, 1 male and 2 females, August 12, 1954. *Riverside County*: 1 female, Rancho la Sierra, near Arlington, September 19, 1946, F. H. Rindge (E. G. Munroe). *San Diego County*: 1 male, San Diego, October 3, 1919; 1 female, August 3, 1920, Karl R. Coolidge (Los Angeles Museum); 1 male, 1 female, San Diego, August, 1919; 2 females, San Diego, September, 1919; 2 males, September, 1920, E. Piazza (British Museum). *Stanislaus County*: 1 female, Los Banos, April 23, 1926, E. C. Van Dyke (California Academy).

The holotype and allotype will be deposited in the California Academy of Science.

**Distribution outside California**: The California Academy has one female from Patagonia, Arizona, collected August 1, 1924, by E. P. Van Duzee, but it is not included as a paratype due to its poor condition.

This species is closely allied to and is probably the western counterpart of *Synclita obliteralis* (Walker). It is larger in size, more brightly marked, and has more reddish coloration on the upper and lower surfaces than *S. obliteralis*. In addition, the valvae are larger, gnathos longer, and the 2-pronged blunt process of the median process of the eighth sternite will separate it readily from the pointed structure of *S. obliteralis* (fig. 46). All of the specimens examined from Texas to eastern localities and south to Florida have a pointed condition of the process on the eighth sternite. Specimens from Hawaii are also true *S. obliteralis*.

The depth of the ground color in specimens from different localities shows a good deal of variation, particularly in the females, some specimens being light reddish-brown and others a uniform dark fuscous. The white markings and discal spot also varies among individuals reared from the same lot.

**Biology**: The life history of this species is similar to that recorded by Hart (1896) and Williams (1944) for *Synclita*
obliteralis (Walker). The eggs are disc-like and are laid singly or slightly overlapping in groups of from 10 to 57 on the under-sides of hydrophytes, usually near the edges of the leaves. The young larvae are purely aquatic, lack gills, and cut out small pieces of leaves which they attach to the lower surfaces of floating leaves, and cause a characteristic shot-hole appearance to the leaves. As the larvae become larger they cut out two pieces of leaves and make oblong cases in which they live as case bearers and never acquire gills. The cases apparently contain air and the larvae are exposed to air and not water. Cases often are found floating on the surface, or may be found underneath leaves or attached to the petioles of leaves several inches under water. Pupation occurs in the silken cases. At least two generations were observed in the Sacramento Valley. Adults were commonly found in rice fields and in permanent ponds. Hosts include Bacopa rotundifolia, Potamogeton gramineus, Sagittaria sp., Echinodorus cordifolius, Jussiaea californica, and Typha californica. A preferred host plant was Echinodorus.

Genus Contiger Lange, new genus. (Figures 98, 109, 136.)

Labial palpi slightly ascending; slender; rough-scaled. Maxillary palpi attaining center of labial palpi. Frons slightly elevated. Occiput prominent, with two laterally placed ocelli. Antennae thickened basally; densely ciliate; with scale tufts apically. Forewing with subfalcate apex; indented below apex, outwardly curved to rounded anal angle; R1 free; R2 stalked basally with R3-4; M2-3 and Cu1 approximate at base. Hind wing subrectangular; outer margin indented below rounded apex; Sc and R anastomosing for short distance; M1 free; M2-3 and Cu1 approximate at base; 1, 2, 3A present. Metathoracic legs with subequal median, tibial spurs, and stout, apical spurs; tarsi long.

MALE GENITALIA: Valva simple, blade-like, with basal group of spines; uncus long, finger-shaped; gnathos very long, flattened, with apiecal, ventral peak, and dorsal teeth; juxta set with group of projecting spines; aedeagus extremely long, with single projecting spine-like cornutus, and group of smaller cornuti; eighth sternite with projecting, pyramid-like process.

FEMALE GENITALIA: Base of ductus bursae wide, separated from bursa by valva-like, sclerotized collar; with uniformly dis-
persed, broad-based spines; bursa copulatrix an elongate, membranous sac, devoid of ornamentations; anterior apophyses well developed and fused at ends.

**Type Species:** *Oligostigma vittatalis* Dyar 1906, by present designation.

The name *Contiger* is derived from a Latin noun (m.) a spear bearer, referring to the armed aedeagus.

This genus is erected to receive a single known species, *Contiger vittatalis* (Dyar) described from Florida. It seems most closely related to *Nymphuliella*, and shows some characteristics of *Synclita* and *Munroessa*. In external features it is characterized by the unique shape of the wings, particularly the subfalcate nature of the forewings, and the undulate appearance of the outer margins of the wings. It is *Ambia*-like in general appearance, but with quite distinct genitalia. The slightly ascending labial palpi are more like *Nymphuliella*. The long aedeagus with apical spine is unique (fig. 109B). The process of the eighth sternite is a feature found in *Nymphuliella* and *Synclita*. The female genitalia show relationships with *Nymphuliella*.

I have had the opportunity of examining a cotype, Hastings, Florida, collection of W. D. Kearfott sent from the U. S. National Collection by Mr. H. W. Capps, and a specimen from Opelousas, Louisiana, sent for study by Dr. E. G. Munroe.

The relationships of this genus would indicate a southern origin.

**Biology:** No biological data on *Contiger vittatalis* seems available.

Genus *Nymphuliella* Lange, new genus.

(Figures 101, 121, 145.)

Labial palpi slightly ascending. Maxillary palpi, ascending, attaining middle of frons. Frons slightly elevated. Occiput of head enlarged, with two laterally placed, conspicuous ocelli. Antennae thickened basally; ciliate; with apical tufting. Forewing wide; outer margin slightly indented below apex, and expanded toward anal angle; R\(_1\) free; R\(_2\) approximate at base with R\(_{3-4}\); R\(_5\) free; M\(_{2-3}\) joined at base; Cu\(_1\) approximate to M\(_{2-3}\) basally; a pencil-like posteriorly projecting group of scales at base on underside. Hindwing large; slightly incised below apex; Se and R anastomosing for short distance; M\(_{2-3}\) and Cu\(_1\) approximate at base; 1,
2, 3A present. Metathoracic legs with long, submedian tibial spurs and acicural apical spurs; tarsi long.

**Male Genitalia**: Valva blade-like, short; uncus stout; gnathos well-developed, with dorsal teeth; tegumen with cupped, ventrolateral processes near base; aedeagus stout, with large cornutus and several smaller cornuti; eighth sternite with central, posteriorly projecting arm.

**Female Genitalia**: Base of ductus bursae large, covered with spicules; broad, collar-like attachment of base to bursa; bursa elongate sac with sparsely scattered spicules.

**Type Species**: *Diathrausta daeckealis* Haimbach 1915, by present designation (*= Nymphula broweri* Heinrich, 1940, *a new synonymy*).

This genus is erected for a single known species, *Nymphuliella daeckealis* (Haimbach), which seems to be associated only with sphagnum bogs. This species appears *Diathrausta*-like, or like small male specimens of *Synclita oblateralis* (Walker). The wing venation, genitalia, and habits of the larvae, are distinctly nymphuline. It shows relationships to *Synclita* in the general appearance of the male genitalia, and the pencil-like tufts of scales at the base of the forewings is reminiscent of *Neurophyseta* and *Ambia*. The palpi ascend only slightly, a feature not noted in other nymphulines. All known facts would indicate a tropical origin for the genus.

**Biology**: Biological notes are given by Heinrich (1944) under the name, *Nymphula broweri* Heinrich. The gill-less larvae are aquatic and feed on *Cephalozia fluitans*, a plant associated with sphagnum bogs.

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Genus *Oxyelophila* Forbes, new status.

*(Figures 18, 58, 118.)*


Labial palpi slender, attaining center or apex of frons; first segment with a few projecting scales. Maxillary palpi short, pointed apically. Ocelli absent. Antennae minutely ciliate; in male stouter, with a few appressed scales; female, filiform, apically tufted. Forewing slender, falcate apically; R1 free; R5 stalked with R3+4; R5 free; M2, M3, and Cu1 approximate at base; 1A vestigial. Hind wing slender, pointed apically; slightly indented below apex; Sc + R1 and Rs forked near margin; M1 free; M2
absent; $M_3$ and $Cu_1$ stalked free of cell; 1A vestigial. Meso- and metathoracic legs in female with tibial swimming hairs; spurs of metathoracic legs well developed, with median and apical spurs with inner spurs twice as long as outer.

**Male Genitalia**: Valva blade-like, greatly narrowed at tegumen; costa well developed; long spines from base of sacculus. Uncus tongue-like; enlarged basally. Gnathos with wide base, pencillate apically; few inconspicuous dorsal teeth. Saccus very wide at base. Aedeagus stout, with a group of several large and smaller teeth. Eighth sternite with a pair of laterally located sexual tufts. Seventh sternite in some species with a central, arm-like process.

**Female Genitalia**: Base of ductus bursae enlarged; collar region narrowed, sclerotized. Ductus bursae beyond collar area enlarged, extending directly into a large, membranous, elongated bursa copulatrix. Bursa with a ribbon-like signum composed of small spicules, and a group of spicules located at the neck region.

**Type Species**: *Argytractis (Oxyelophila) callista* Forbes, 1922, by original designation.

This genus is quite distinct in wing markings and venation, and in male and female genitalia, and apparently constitutes a group of tropical origin included in the *Argytractis* complex. Dr. Forbes sent a female paratype for examination. The male of this species is apparently unknown. *Oxyelophila* seems quite highly evolved judging from the wing shape, absence of one radial vein in the forewings, and in the specialized sexual features. One species examined, *Oxyelophila melanograpta* (Hampson), from Surinam, has a peculiar arm-like structure on the abdomen basad of the paired sexual tufts, a structure absent in *O. harpalis* (Snellen).

**Biology**: The biology of this genus is unknown. The larvae should be algal feeders on rocks similar to *Parargytractis*. The tibial swimming hairs in the females indicate that they enter the water to deposit their eggs.

Genus **Argytractis** Hampson.

(Figures 2, 41, 63.)


Labial palpi long, ascending; attaining center of frons; first segment tufted below; second segment with a few projecting
scales; third segment smooth. Maxillary palpi short, reaching about end of second segment of labial palpi. Antennae in male ciliate, with an appressed row of scales; in female more filiform, tufted apically. Ocelli greatly reduced or absent. Vertex of head elevated. Forewing subfalcate; termen slightly indented below apex; anal angle evenly rounded; R₁ free; R₂, 3, 4 stalked; R₅ free; M₂, ₃ and Cu₁ approximate at base; 1A vestigial. Hindwings elongate; costal margin slightly inflated; apex arcuate; slightly indented below apex; outer margin evenly rounded; Se and Rs forked near apex; M₁ free; M₂ absent; M₃ and Cu₁ approximate at base; 1A vestigial; 2, 3A present. Legs short; metathoracic legs with long median, tibial spurs and shorter apical spurs, with outer spur about 1/2 length of inner; tibiae of meso- and metathoracic legs in female with swimming hairs. Base of abdomen in male with a pair of sexual tufts.

**Male Genitalia:** Valva peaked, with long recurved spines; sacculus enlarged basally. Uncus well developed, blade-like. Gnathos wide basally and narrowed terminally; with dorsal spines reduced to microscopic spicules. Sacculus well developed, rounded. Aedeagus long, with group of closely set spines. Eighth sternite with two groups of sexual tufts in male and two rod-like lateral arms.

**Female Genitalia:** Base of ductus bursae elongate, sclerotized. Sclerotized collar-like area present. Ductus bursae long, often with small seobinations and spines, and neck section near bursa with large thorn-like spines. Bursa spheroidal, and with numerous closely set spines, often with star-like bases.

**Type Species:** Argyractis argentilinealis Hampson, 1897, by original designation.

Specimens of *A. argentilinealis* Hampson were sent for study by W. H. T. Tams and E. G. Munroe. The original lot from the British Museum apparently contained two species, and so E. L. Martin kindly made a mount of a female from the type series and compared it with the type which he then sent for my examination (fig. 63).

I have personally only examined the type species and one other sent by Dr. Forbes from Tumatumari, British Guiana, that I consider to belong to the genus *Argyractis, sensu stricto*. There are undoubtedly many other species. The male and female genital features and the long, narrow wings with linear metallic markings and reduced black spotting in the hind wings, seems to be
characteristic. It is one of a group of tropical genera, some of which seem to be undescribed. It is related to \textit{Usingeriessa}, \textit{Argyroactoides}, \textit{Neargyractis}, and \textit{Parargyractis}, and may be more characteristic of the Amazonian basin. It is included here because it forms an important link to our study of North American Argyractini.

\textbf{Biology:} No biology seems to be available. Its relationships indicate that the larvae are gilled, are algal feeders on rocks, and perhaps have habits similar to \textit{Parargyractis}.

\textbf{Genus Argyroactoides} Lange, new genus.

(Figures 35, 48, 54.)

Labial palpi long, slender, attaining or surpassing apex; first segment with roughened scales below. Maxillary palpi very short, filiform. Ocelli present. Antennae in male densely ciliate, with a longitudinal row of closely appressed scales; female filiform and slightly tufted. Forewings elongate; apex slightly pointed; anal angle broadly arcuate; \(R_1\) free; \(R_2, 3, 4\) forked; \(R_5\) free; \(M_{2, 3}\) and \(Cu_1\) approximate at base; 1A vestigial. Hindwings broadly pointed; with contrasting subapical, triangular mark; indented slightly below apex; Sc and Rs forked about half way to apex; \(M_1\) free; \(M_2\) absent; \(M_3\) and \(Cu_1\) approximate at base; 1A vestigial; black dots centered approximately on veins, \(M_1, M_3, Cu_1,\) and \(Cu_2\). Tegulae very long. First pair of legs with apical tufts of scales; meso- and metathoracic legs with row of tibial, swimming hairs; metathoracic legs with median, tibial spurs long, outer spur half length of inner, and similar, but shorter, apical spurs.

\textbf{Male Genitalia:} Valva peaked; apex with long, wide, recurved spines; a spine-like process situated medially from extension of costa; base of sacculus armed with spines. Saccus wide, well developed. Uncus long, constricted in middle, enlarged apically.

\textbf{PLATE 12}

Wing venation of: fig. 96. \textit{Geshna cannalis} (Quaintance), New Orleans, Louisiana, U-341A (U.S.N.M.); fig. 97. \textit{Synclita guritalis} Lederer, Parana, Brazil, U-440A (B.M.); fig. 98. \textit{Contiger vittatilis} (Dyar), co-type, Hastings, Florida, U-454A (U.S.N.M.); fig. 99. \textit{Neurophyseta} sp., Nova Teutonia, Brazil, U-437A (W.H.L.); fig. 100. \textit{Geshna primordialis} Dyar, White Sulfur Springs, West Virginia, U-72 (W.H.L.); fig. 101. \textit{Nymphuliella daececlais} (Haimbach), Southwest Harbor, Maine, U-471A (E.G.M.): fig. 102. \textit{Hydrelletis tullialis} (Walker), Australia, U-435A
(B.M.); fig. 103. _Diathrausta reconditalis_ (Walker), Patagonia, Arizona, U-349A (W.H.L.); fig. 104. _Hygraula nitens_ (Butler), Nelson, New Zealand, U-439A (U.S.N.M.). Male genitalia of: fig. 105. _Kasania arundinalis_ (Eversmann), U-432 (U.S.N.M.); fig. 106. _Synclita gurgitalis_ Lederer, Paramaribo, Surinam, U-443 (B.M.).

Scale for figs. 105 and 106 only.

**Female Genitalia:** Base of ductus bursae scobinate. Ductus bursae lacking collar area, but longitudinally striate and extending just before bursa into an arcuate, greatly widened section which is greatly strengthened and sclerotized posteriorly and ends its are in a lobe-like process closely set with spines. Bursa an elongate sac, closely covered with spines.

**Type Species:** *Argyractis leucogonialis* Hampson, 1906, by present designation.

This genus is part of the *Argyractis* complex, but can be differentiated in the species examined by the contrasty subapical triangular marking on the forewing, long labial palpi, long tegulae, presence of ocelli, characteristic male genitalia with large hook-like cornutus, and the characteristic arc-like structure in the ductus bursae of the female.

*Argyractoides* is probably Neotropical in origin. The known species occur north into Panama and Mexico.

**Biology:** No biological data are available. As part of the *Argyractis* complex the larvae should be gilled rock-dwellers as in *Parargyractis*.

**Genus Usingeriessa** Lange, new genus.

(Figures 19, 32, 115, 124, 142.)

Labial palpi long, ascending; reaching apex; first segment with projecting scales below; second segment with short, projecting scales; third segment long, smooth. Maxillary palpi moderately long, tapered apically. Ocelli present. Antennae in male ciliate, with apical tufts of scales; in female filiform with slight apical tufting. Forewing moderately broad; outer margin wide, straight, anal angle angulate, slightly rounded; R₁ free; R₂, ₃, ₄ stalked; R₅ free, with cell arising near base; 1A vestigial. Hindwing moderately broad; apex rounded; incised slightly below apex; outer margin evenly rounded; Sc and R anastomosing about half distance to apex; Sc and Rs stalked; M₁ free; M₂ absent; M₃ and Cu₁ approximate at base; 1A partly vestigial. Metathoracic legs with
subequal, tibial spurs arising about $\frac{2}{3}$ distance from base; a pair of apical, stout, subequal spines; swimming hairs on tibiae of middle and hind pair of legs.

**Male Genitalia:** Valva peaked; apex with group of curved spines; costa well developed; sacculus strong, with projecting, marginal spines. Uncus stout, with small spines. Gnathos stout; base wide, narrowed terminally; apex with several large and many smaller dorsal teeth. Juxta with two lateral arms. Saccus projected downwards, well developed. Aedeagus large, with group of many small spines. Eighth sternite with or without two sexual tufts in male; with a U-shaped sclerotized arm.

**Female Genitalia:** Base of ductus bursae large, cup-shaped; seobinate. Ductus bursae long; narrowed beyond base to collar area which may or may not be seobinate; a valve-like structure present, followed by a long, gradually increasing ductus leading directly into bursa; neck area of ductus may contain a few to many spicules. Bursa large; spheroidal to ovate; with a few spicules to many, evenly dispersed spines with star-like bases.

**Type Species:** *Elophila brunnildalis* Dyar, 1906, by present designation.

*Usingeriessa* is named for R. L. Usinger who first introduced me to the aquatic Lepidoptera and who has been a source of encouragement in my studies.

This genus contains a group of species, formerly placed in *Cataclysta (Elophila)* and *Argyractis*, which show uniform dark brown to fuscous coloration, and ocellate black and metallic spots on the hind wings. The peaked valva with characteristic gnathos and juxta, and the seobinate, cup-like base to the female genitalia are diagnostic features. Sexual tufts are absent on the abdomen in *U. brunnildalis*, but present in *U. onyxalis* and *U. symphonalis*. *Usingeriessa* is thought to be of tropical origin and related to *Arargyractis, Argyractoides*, and *Neargyractis*. The known distribution is from Peru to northern California. In California it seems to be Sonoran and associated with larger streams or rivers.

**Biology:** The biology is not known. *Usingeriessa brunnildalis* is taken at light in California near water and it is presumed that the larvae are gilled and are associated with rocks similar to *Parargyractis*.
Genus **Neargyractis** Lange, new genus.
(Figures 20, 126, 141.)

Frons slightly elevated. Labial palpi slender, ascending almost to vertex; first and second segments with a few downwardly projecting scales; third almost smooth. Maxillary palpi very short, with projecting scales. Ocelli absent. Vertex of head swollen centrally, knob-like. Antennae of male ciliate, with apical tufts; of female, more filiform. Forewings short, wide; arcuate apically; termen a little expanded outwardly; anal angle angulate; R₁ free; R₂, ₃, ₄ stalked; R₅ free with cell arising near base; 1Å vestigial. Hind wings with costa slightly expanded outwardly; apex rounded; incised slightly below apex; Se anastomosing with R for considerable distance; Se and Rs stalked near apex; M₁ free; M₂ absent; M₃, ₄ stalked at base; 1Å vestigial. Legs short; meso- and metathoracic legs with median tibial and apical spurs moderately long, subequal; tibial swimming hairs present. Base of abdomen in males with sexual tufts.

**MALE GENITALIA:** Valva blade-like; broadly rounded apically; with long apical spines; costa well developed; a thumb-like process with several long spines subapically. Saccus well developed. Uncus long, narrowed medially, and enlarged apically. Gnathos sword-like, with numerous small, lateral teeth. Juxta plate-like. Saccus well developed. Aedeagus large, tapered at both ends, with a group of small spicules. Eighth sternite with two lateral arms. Base of abdomen with sexual tufts.

**FEMALE GENITALIA:** Base of ductus bursae wide, spicate. Ductus bursae a long, narrow tube leading to bursa; neck of bursa with a few scattered spines and a group of about 5 very long spines projecting down into bursa. Bursa an elongated sac closely set with numerous spicules.

**TYPE SPECIES:** *Elophila slossonalis* Dyar, 1906, by present designation.

This genus is in the *Argyractis* complex and close to *Usingeriessa*. Unlike *Usingeriessa*, ocelli are absent, the maxillary palpi are smaller, the gnathos is armed with numerous small teeth in-
Opelousas, Louisiana, U-474 (E.G.M.); fig. 110. *Theila gibbosalis* (Guenée), Tjibodas, Indonesia, U-475 (W.H.L.); fig. 111. *Hygraule nitens* (Butler), New Zealand, U-442 (B.M.); fig. 112. *Munroessa nebulosaalis* (Fernald), St. Petersburg, U-426 (U.S.N.M.); fig. 113. *Munroessa serratinealis* (B. and B.), paratype, Hymers, Ontario, Canada, U-456 (U.S.N.M.); fig. 114. *Neurophyseta* sp., Nova Teutonia, Brazil, U-473 (W.H.L.).

Scale as fig. 113, unless indicated.
stead of large teeth, and the group of long spines in the bursa is characteristic. Spines in the neck of the bursa are found in *Argyractis*, and in *Usingeriessa symphonalis*, but they do not form the large compact group found in this genus.

An examination of *N. moniligera* (Lederer) from Jamaica sent by H. W. Capps indicates that it is close, but distinct from *N. slossonalis*. The female bursa in *N. moniligera* is covered with much larger spines.

The known distribution of *Neargyractis* is eastern United States to the West Indies.

**Biology:** The biology remains to be investigated. It is believed that the larvae should be rock inhabitants similar to *Parargyractis*.

Genus *Parargyractis* Lange, new genus.

(Figures 17, 21, 22, 23, 24, 25, 38, 65, 70, 73, 75, 79, 80, 81, 82, 123.)

Frons slightly elevated. Vertex inflated dorsally. Ocelli absent. Labial palpi ascending; not reaching beyond center of frons; first and second segments with projecting scales; third segment with rough scales, or smooth. Maxillary palpi almost reaching end of second segment of labial palpi; pointed apically. Antennae in male ciliate, with a row of scale tufts; in female less ciliate, scales not in rows, tufted apically. Forewings elongate; pointed apically; termen areuate; anal angle evenly rounded; R₁ free; R₂, 3, 4 stalked; R₃ free, with cell arising near base; M₁ from cell; M₂, 3 and Cu₁ approximate at base; 1A vestigial; cell extending to about 2/₃ distance from base. Hind wings subtriangular; apex rounded, to almost pointed; Sc anastomosing with R for ½ or almost complete distance to apex; Sc and Rs forked; M₁ free; M₂ absent; M₃ and Cu₁ forked or approximate at base; 2A vestigial; cell extends about ¾ distance from base; black and metallic spots on outer margin of hind wings usually present. Legs moderately long; meso- and metathoracic legs with row of tibial swimming hairs in females; metathoracic legs with median spurs at about 2/₃ distance from base, outer spur a little over half as long as inner and a similar, but shorter, apical pair of spurs.

**Male Genitalia:** Valva simple, usually expanded apically; blade-like; costa and sacculus reduced; saccus may or may not be developed; uncus usually wide, but can be elongate, often with projecting spines. Juxta plate-like. Gnathos wide at base, but
narrowed and tapered apically; dorsal teeth absent or reduced to a few small spicules. Aedeagus variable; with several groups of closely attached cornuti, small groups of inconspicuous spicules, with apical teeth, or with hook-like spines.

**Female Genitalia:** Base of ductus bursae enlarged, sclerotized, with or without scobinations or spicules; usually separated from terminal portion. Ductus bursae elongate, distinct from or leading directly to elongate or spheroidal bursa copulatrix; collar, or valve-like basal portion present or absent. Bursa with no spines, a few, or an incomplete, or a complete, spiral composed of numerous spines.

**Type Species:** *Elophila truckeealis* Dyar, 1917, by present designation.

This genus is erected to include a large number of species which show a remarkable similarity in external coloration. Due to the black and metallic spotting on the hind wings many species in the past have been placed in *Cataclysta*. The relationships of *Parargyraictis* seem to be with an *Argyractis* type. One observed species, *P. cineralis* (Schaus), from Mexico, lacks the characteristic spots on the hind wings.

*Parargyraictis* has its greatest development of species in South America, Central America, and Mexico. A relatively few species invade continental United States, and a few species such as *P. jaliscalis* (Schaus) range from Mexico to northern California. A few species have become adapted to a more northern climate, for example *P. truckeealis* (Dyar), which ranges from central California north to British Columbia and east to Wyoming.

The male genitalia are rather simple and generalized, but in the female structures we find all types of variations in the form of the base of the ductus bursae and in internal spining.

**Biology:** The biology of several California species have been studied in some detail. We can use *P. truckeealis* (Dyar) as an example. The females enter the water, using the legs for oars and utilize a plastron type of respiration. The eggs are laid on rocks, usually on the undersides in groups and the small larvae upon hatching are gill-less. Eggs are often laid on rocks under several feet of water in swiftly flowing rivers, streams, or in some cases in lakes. The larvae feed on algae under silken webs, and after the first molt acquire blood gills. The larvae form tough, silken cocoons which are equipped with holes on each end to allow for
water circulation, and pupation occurs in an inner, apparently airtight, silken cocoon. The adults emerge through a slit at one end of the outer cocoon. Several generations occur a year. The different species seem to be adapted to waters of varying oxygen contents. For example, the larvae of *P. jaliscalis* (Schaus) have been taken in stagnant water, and some species occur in hot springs.

**Parargyractis cappsi** Lange, new species.

(Figures 77, 81.)

Closely related to *P. bifascialis* (Robinson) in genital features, and to *P. kearfottalis* (Dyar) in general maculation, but with more extensive yellow bands and spots.

**Male**: Expanse 18 mm. Labial palpi buff-white with few darker scales; rough-sealed; ascending to beyond center of frons. Maxillary palpi short, white. Antennae ciliate, with apical tufts of scales. Forewings with white background; a costal, brown, longitudinal area extending into a median, interrupted band; median band interrupted in center with white line, yellow below; a postmedian white area, irrorated with fuscous scales; a subapical V-mark of brown scales above, yellow below, and a yellow streak at base extending into postmedian area; a marginal white area which has metallic and white scales below; a silvery group of scales near anal margin; a median group of yellow scales, outlined with silvery scales on each side and margined with dark scales; an irregular, subapical dark-outlined area on a white, immaculate field; marginal black spots not distinct, with silvery scales between and yellow spots of scales on margin; cilia with darker bases.

**Male Genitalia**: Valva blade-like, narrowed basally; costa strong; sacculus not developed. Uncus finger-like, widened basally; with numerous, small spines. Gnathos long; pencillate, pointed apically; with a few microscopic teeth. Saccus produced slightly below. Juxta a wide plate, appearing notched above, and

**PLATE 14**

Male genitalia of: fig. 115. *Usingeriessa onyxalis* (Hampson), Jalapa, Mexico, U-121 (U.S.N.M.); fig. 116. *Eoparargyractis irroratalis* (Dyar), Stemper, Florida, U-283 (W.H.L.); fig. 117. *Argyactis* *argyrolepta*
(Dyar), Rio Trinidad, Panama, U-219 (U.S.N.M.); fig. 118. *Oxyelophila harpalis* (Snellen), Guapiles, Costa Rica, U-237 (U.S.N.M.); fig. 119. *Eoparargyractis plevie* (Dyar), Barnstable, Massachusetts, U-376 (E.G.M.); fig. 120. *Acetropus niveus* (Olivier), Wantsad, Ontario, Canada, U-329 (W.H.L.); fig. 121. *Nymphuliella daeckealis* (Haimbach), Southwest Harbor, Maine, U-471 (E.G.M.); fig. 122. *"Argyractis" multipicta* (Dyar), Porto Bello, Panama, U-242 (U.S.N.M.).

Scale as fig. 119.
with small teeth. Aedeagus long, stout; with subterminal band of closely placed spines; apex with several thorn-like spines.

**FEMALE:** Similar to male, but larger. Expanse 20 mm. Antennae more filiform, and with more overlapping scales. Swimming hairs of meso- and metathoracic legs conspicuous.

**FEMALE GENITALIA:** Base of ductus bursae wide, attenuate distally; with numerous small spicules; narrowing to small, sclerotized collar. Ductus bursae gradually enlarging into the bursa; a linear group of spicules distal of collar. Bursa an elongated sac; with a spiral of 12 flattened spines with wide bases and saw-tooth edges.

**HOLOTYPE:** Male, Kerrville, Kerr County, Texas, April 11, 1907, at light, F. C. Pratt. Slide U-42.

**ALLOTYPE:** Female, Kerrville, Texas, no date, Barnes collection. Slides U-194, U-194-A.

**PARATYPE:** Female, same data as allotype. Slide U-171.

Holotype and allotype to be deposited in the United States National Museum with corresponding slides. Paratype and slide in Lange collection.

This species is named for Hahn W. Capps who submitted the specimens for study and who has assisted me in many ways in connection with the present paper.

*Parargyractis cappsi* belongs to a group of closely related species which are similar in coloration, but have distinct genital features. The general pattern of markings in *P. cappsi* is similar to *P. kearfottalis* (Dyar), but there are many small differences. In *P. cappsi* the median transverse band of the forewings is more restricted, and in the hind wings the median spot is yellow, separated by silvery spots instead of silvery spots separated by yellow. The solid costo-discal bar in *P. bifascialis* (Robinson) will distinguish it from *P. cappsi*, but some *P. bifascialis* specimens lacking the solid bar may have to be separated on the basis of genitalic differences. In *P. bifascialis* there is less white coloration, particularly in the outer apical and subapical white streaks and a more over-all fuscous iroration in the males.

The male genitalia of *P. cappsi* differ from that of *P. bifascialis* by the much larger valva, longer uneus and gnathos, less downwardly produced saccus, and stouter aedeagus. The female genitalia have the base of the ductus bursae wider in *P. cappsi* than in *P. bifascialis* and the spines in the bursa number about 12.
In *P. bifascialis* the spines in the bursa vary from 2 to 4 in number. The male and female genitalia of *P. kearfottalis* are quite distinct; the aedeagus has a much more produced apical spine, and shorter uncus and gnathos; and the females have the base of the duetus bursae with rows of larger spines.

**Genus Eoparargyractis** Lange, new genus.  
(Figures 29, 30, 76, 116, 119, 127, 138.)

Frons slightly elevated. Labial palpi long, thin, ascending; in male attaining apex; segments rough-sealed. Maxillary palpi very short; pointed apically. Ocelli absent. Antennae as in *Parargyractis*. Forewings similar to *Parargyractis* except R₂ fused with R₃-₄ as in *Oxyelophila*. Hindwings subtriangular; Sc fused with R almost to apex; Sc and Rs forked at apex; M₁ free; M₂ absent; M₃ and Cu₁ stalked basally; 1A almost obsolete; cell open. Legs well developed; swimming hairs present; median tibial spurs of metathoracic legs with outer spur half as long as inner.

**Male Genitalia**: Valva blade-like; costa developed; sacculus enlarged basally. Uncus long, subpencillate. Gnathos long, wide basally, pointed apically; with row of small, dorsal spicules; origin at tegumen near union of valva. Sacculus wide, well developed; with two large curved or straight cornuti and many apical spicules. Eighth sternite with a row of long hair arising from a sclerotized arm, and with a conspicuous row of long hair above on dorsal surface, overhanging genitalia.

**Female Genitalia**: Base of duetus bursae enlarged, weakly separated from a narrowed, sclerotized, collar area; often with minute spicules. Duetus bursae with a membranous portion past the collar area from which the duetus seminalis arises; base of duetus seminalis enlarged and often lobe-like; narrowed and membranous prior to bursa. Bursa an elongate to subspheroideal sac, lacking ornamentations.

This genus is considered to be evolved from *Parargyractis*, but is distinct in wing venation, palpi, and male and female genitalia. The long gnathos, arising from near the junction of the valva is diagnostic, as is the open discal cell. The sexual tufting of the eighth sternite is reminiscent of a possible tropical origin, and is a feature not found in any of the species examined to date in *Parargyractis*.

Of the three species known to occur in the genus two are known
from Florida and eastern localities and one extends its range into Canada.

**Biology:** The biology is unknown. It is believed that these species occur in lakes, and it is presumed that the larvae are rock-dwellers feeding on algae similar to *Parargyractis*.

**Eoparargyractis floridalis** Lange, new species.  
(Figure 127.)

Related to *E. irratoralis* (Dyar), but larger, forewings wider, black spots on outer margin of hind wings distinctly rounded, and with genital differences.

**Female:** Expanse 16 mm. Labial palpi white, ascending; with some rough-scaling above and below. Maxillary palpi white, short; pointed apically. Antennae white; minutely ciliate; scaled, and tufted apically. Forewings with ground color white; a weak transverse subbasal brown line; a weak submedian transverse band, with outer margin outlined in brown; a median, white area with brown scales; a subapical triangular, reddish-brown mark, preceded by a dark dash on costa; an apical white, triangular mark; a marginal orange-brown band interrupted at anal angle by a white dash and white cilia; marginal band with brown on inside, and brown and silver scales extending to inner margin; cilia dark basally, with some white scaling. Hindwings with a postbasal transverse band, but only margins outlined in brown; a median area with white background irrorated with fuscous scales; area before marginal black dots white; four primary, circular, black dots on veins M₁, M₃, Cu₁ and Cu₂, in a band of silvery, metallic scales; margin lined with black; cilia with dark bases. Legs whitish to buff-colored; swimming hairs on hind tibia well

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**PLATE 15**

Female genitalia of: fig. 123. *Parargyractis triumphalis* (Schaus), Porto Bello, Panama, U-261 (U.S.N.M.); fig. 124. *Usingeriessa brunnilalis* (Dyar), Bear River, California, U-298 (W.H.L.); fig. 125. *Parapoynx maculalis* (Clemens), Bilby, Alberta, U-56A (C.A.); fig. 126. *Neargyractis slossonalis* (Dyar), Tamiami Trail, Florida, U-281 (E.G.M.); fig. 127. *Eoparargyractis floridalis* Lange, n. sp., paratype, U-486 (W.H.L.); fig. 128. *Parapoynx seminealis* (Walker), Punta Gorda, Florida, U-477 (E.G.M.); fig. 129. *Parapoynx curviferalis* (Walker), Strathoy,
Ontario, Canada, U-475 (E.G.M.); fig. 130. Hydreauretis tulliana (Walker), Australia, U-452 (B.M.); fig. 131. Munroessa nebulosalis (Fernald), Hastings, Florida, U-458 (U.S.N.M.); fig. 132. Synclita gurgitalis Lederer, Paramaribo, Surinam, U-441 (B.M.); fig. 133. Kasania arundinalis (Eversmann), U-431 (U.S.N.M.).

Scale as fig. 130 unless specified.
developed, extending on first tarsal segment; median tibial spurs of hind legs with outer spur one-half length of inner.

**FEMALE GENITALIA:** Base of ductus bursae rectangular; partially separated by transverse fold from distal part of ductus; with few microscopic spicules, and longitudinal folds. Ductus bursae with well-sclerotized collar area, followed by an inflated membranous portion; the base of what appears to be the ductus seminalis extends lobe-like for a short distance; narrowed and membranous before bursa. Bursa an elongated, membranous sac, lacking ornamentations.

**Holotype:** Female, Lake Okeechobee, Florida, July 22–31. (Collected by Sweadner; Sweadner collection Acc. 12938). Slide U-291.

**Paratypes:** 3 females, same data as holotype. Slides U-286, U-486. The paratypes range in size from 16–18 mm. There is some variation in the extent of the transverse lines, and in one there is a distinct discal spot.

The holotype and two paratypes and associated slides are deposited in the Canadian National Collection, and one paratype in the Lange collection. The specimens were sent for study by E. G. Munroe.

This species is close to *E. irroratalis* (Dyar), but can be distinguished by the more uniform brownish east, the wider forewings and the more distinct black spots on the outer margin of the hind wings. The marginal orange-brown band of the forewing in *E. floridalis* is wider and more extensive, and the apex of the forewing is distinctly more rounded. The female genitalia of *E. floridalis* are similar in general aspect to *E. irroratalis*, but in the latter species the base of the ductus bursae is narrower and covered with distinct spicules, and the basal separation is inconspicuous. In addition, the entire length of the genital tract is much shorter and narrower in *E. irroratalis*.

**A PHYLOGENETIC RELEGATION OF THE NORTH AMERICAN SPECIES**

I. Genera of uncertain tribal status

- *Undulambia* Lange
  - *striatalis* (Dyar)
  - *arnoultalis* (Schaus)
- *Oligostigma* Guenée
  - *junceale* Druce
- *Oligostigmoides* Lange
  - *cryptale* (Druce)
  - *cuernavacale* (Lange)
AQUATIC MOTHS OF NORTH AMERICA—LANGE

II. Tribe Nymphulini

*Neocataclysta* Lange
  *magnificalis* (Hübner)
  *Parapoyz Hübner
  *obscuralis* (Grote)
  *badiusalis* (Walker)
  *curviferalis* (Walker)
  *maculalis* (Clemens)
  *allionealis* Walker
  *seminealis* (Walker)
  *Chrysendenton* Grote
  *medicinalis* Grote
    *(claudialis* Walker)
  *vacuolata* (Dyar)
  *imitabilis* (Dyar)
  *autobella* (Dyar)
  *kimballi* Lange

*Munroessa* Lange
  *icciusalis* (Walker)
  *faulalis* (Walker)
  *gyralis* (Hust)
  *nebulosalis* (Fernald)
  *serralinealis* (Barnes and Benjamin)
  *Nymphula* Schrank
    *ekhthipsis* (Grote)
  *Syncilia* Lederer
    *obliteralis* (Walker)
    *occidentalalis* Lange
    *gurgitalis* Lederer
    *Contiger* Lange
    *vittatalis* (Dyar)
  *Nymphulietta* Lange
    *daeckealis* (Haimbach)

III. Tribe Argyractini

*Oxyelophila* Forbes
  *callista* Forbes
  *harpalis* (Snellen)
  *necomalis* (Dyar)
  *melanographa* (Hampson)
  *Argyractis* Hampson
    *argentilinealis* Hampson
    *dodalis* Schaus
  *Argyractoides* Lange
    *leucogonialis* (Hampson)
    *gontranalis* (Schaus)
    *catenalis* (Guenée)
  *Usingeriessa* Lange
    *brunnildalis* (Dyar)
    *onyzalis* (Hampson)
    *symphonalis* (Dyar)
  *Neargyractis* Lange
    *moniligeralis* (Lederer)
    *slossonalis* (Dyar)
    *Parargyractis* Lange
      *truckeealis* (Dyar)
      *bifascialis* (Robinson)
      *cappsi* Lange
      *jaliscalis* (Schaus)

*fulicalis* (Clemens)
  *daemonalis* (Dyar)
  *schaefferalis* (Dyar)
  *cronialis* (Druce)
  *opulentalis* (Lederer)
  *drumalis* (Dyar)
  *kearffatalis* (Dyar)
  *triumphalis* (Schaus)
  *jalapalis* (Schaus)
  *bifonalis* (Dyar)
  *sintalalis* (Schaus)
  *longipennis* (Hampson)
  *cineralis* (Schaus)
  *miglonalis* (Dyar)
  *cycloalis* (Schaus)
  *guadalarensis* (Schaus)
  *brunneodora* (Dyar)
  *auspicalalis* (Schaus)
  *annulalis* (Guenée)
  *herminialis* (Schaus)
  *Eoparargyractis* Lange
    *plevie* (Dyar)
    *irrotalis* (Dyar)
    *floridalis* Lange

IV. Species of uncertain generic association

*Cataclysta argyrolepta*
  *Dyar*

*Cataclysta multipicta*
  *Dyar*
V. BIOLOGY

The Nymphulinae exhibit remarkable adaptations to an aquatic existence. On the basis of our existing knowledge the larvae separate into two main groups, those adapted to feeding upon floating or submerged hydrophytes, and those adapted to feeding upon algae growing on rocks. The rock inhabiting forms show a greater adaptation toward an aquatic existence as the adult females enter the water to deposit eggs upon the rocks, utilizing a plastron type of respiration.

The immature stages of many of the plant-feeding forms are fairly well known in the United States, but much remains to be discovered concerning the rock-dwelling forms. Packard (1884) and Hart (1895) were among the first in this country to study our aquatic, plant-feeding caterpillars, followed by Forbes' (1910) studies at Lake Quinsigamond and a study of a case-forming species on *Lemna* (Forbes, 1911). The investigations of Welch (1914, 1915, 1916, 1919, 1922, 1924) and Welch and Sehon (1928) have added greatly to our knowledge of the biology and respiratory mechanisms of the plant-feeding forms. Some caterpillars of species such as *Bellura melanopyga* Grote solve the oxygen problem by making periodic trips to the surface (Welch, 1914). Welch (1916, 1922) demonstrated that the first larval instar of *Nymphula maculalis* Clemens (*Parapoynx*) are gill-less and obtain oxygen cutaneously. They later possess as many as 400 gills and in addition, as shown by Welch and Sehon (1928), perform periodie lashing movements of the anterior part of the body to insure the replenishing of oxygenated water.

Many other lepidopterous larvae mine or bore in aquatic plants,

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PLATE 16

Female genitalia of: fig. 134. *Munroessa serralinealis* (B. and B.), paratype, Hymers, Ontario, Canada, U-455 (U.S.N.M.); fig. 135. *Theila gibbosalis* (Guenée), Tjibodas, U-476 (W.H.L.); fig. 136. *Contiger vitatalis* (Dyar), cotype, Hastings, Florida, U-454 (U.S.N.M.); fig. 137. *Parapoynx obscuralis* (Grote), Algonquin, Illinois, U-478 (I.N.H.S.); fig. 138. *Eoparargyraactis plevie* (Dyar), Lake of Bays, Ontario, Canada, U-289 (W.H.L.); fig. 139. *Hygraula nitens* (Butler), Parramatta, New South Wales, Australia, U-446 (B.M.); fig. 140. *Neurophyseta* sp., Nova Teutonia, Brazil, U-472 (W.H.L.). Male genitalia of: fig. 141. *Neargy-
mctis moniligemlis (Lederer), Jamaica, U-113A (U.S.N.M.); fig. 142.

Usingriessa brunnilialis (Dyar), Bear River, California, U-400 (W. H.L.). Scale as fig. 141, unless specified.
obtaining oxygen from plant intercellular spaces, and can therefore endure prolonged submergence. Frohne (1938, 1939b, 1939c) discussed the role of higher aquatic plants with respect to the food cycles of insects and particularly in reference to the food habits of three semi-aquatic moths, *Schoenobius melinellus dispersellus* Robinson, *Chilo forbesellus* Fernald, and *Occidentalia comptulatalis* (Hulst), and a nepticulid leafminer, *Neptica sp.* Ainslee and Cartwright (1922) and Welch (1919) discuss the aquatic adaptations of *Pyrausta penitalis* Grote.

Berg (1949, 1950) greatly increased our knowledge of the various aquatic caterpillars associated with plants of the genus *Potamogeton*. He found that the larva of *Nymphula icciusalis* (Walker) unlike *N. maculalis* (Clemens), *N. obscuralis* (Grote), *N. badiusalis* (Walker), and *N. allionealis* (Walker) lack tracheal gills. Also, in contrast with the other species, *Nymphula maculalis* (Clemens) significantly changes its method of feeding during the larval period. Berg indicated that the larva of *Nymphula icciusalis* has an open tracheal system and microscopic projections covering the body, which would suggest a plastron type of respiration as outlined by Thorpe (1950).

The work of Berg and Frohne was continued in an investigation by McGaha (1952) covering the limnological relations of insects to a number of species of flowering plants. Pennak (1953) gives one of the more recent reviews of aquatic Lepidoptera, placing them all in two genera, *Elophila* and *Nymphula*. McGaha (1954) presented additional information concerning the biology of our plant-feeding types.

Lloyd (1914) was apparently the first investigator in this country to record the immature stages of one of the Argyractini, *Elophila fulicallis* (Clemens) (now in the genus Parargyractis) from swift waters in New York. He also reported two similar species from Colombia in South America. I have found members of *Parargyractis* well represented in western streams and certain lakes, but the ecology of the group is imperfectly known. It is a common group in parts of South America, and many species occur in Central America and Mexico. Larvae have been taken in hot springs in Mexico.

The biology of the European aquatic pyralidoid moths have been studied by many investigators and reviewed in many standard references. Reaumur (1736) reported on the habits of *Nym-
*Hydr-euretis tullialis* Walker, is reported to be entirely aquatic by Tillyard (1926). It lives in a large cylindrical case made of reed stems and breathes by means of filamentous, tracheal gills. This species shows close relationships with our *Parapolyx*.

Certain Oriental species are rock-dwelling forms similar to *Parargyractis* in general habitat, but morphologically they have vein M2 present and in other ways show more primitive characteristics. The adult moths of *Aulacodes simplicialis* (Snellen) are reported by Muir and Kershaw (1909) to take to the water and dive in using the legs for swimming. *Eoöphyla peribocalis* Walker and *Aulacodes crassicornalis* (Guenée) are reported by Pruthi (1928) and Lieftinck (1932) as being aquatic. The larvae of these species construct pupal cases in swiftly flowing streams, not unlike *Parargyractis*, and the adult females enter the water to deposit their eggs on rocks. Lieftinck (1932) also mentions rearing a *Parthenodes* sp. from a cocoon found among *Aulacodes* on a rock under water. Iwata (1930) describes the larvae and pupae of an *Aulacodes* sp. from a mountain stream in Formosa and mentions the fact that similar forms occur in Japan.

*Acentropus niveus* (Olivier) according to Thorpe (1950) is the only true plastron insect studied by him in the Trichoptera and Lepidoptera. The brachypterous form of this species remains submerged for the whole period of the adult life according to the fine work of Berg (1942). Studies on this insect were also reported by Nigmann (1908) and reviewed by most European books on aquatic insects. There appears to be some uncertainty as to whether *Acentropus* is a new world group or whether it was introduced. After examining a large number of specimens, and its distribution, I am of the opinion that *Acentropus niveus* was accidentally introduced into the United States and has spread more rapidly in the last few years. The first record was made by Forbes (1938), followed by reports by Sheppard (1945) and Munroe (1947), Judd (1950), and Treat (1954, 1955).

The larval and pupal stages of the Nymphulinae are imper-
fectly known. For this reason adequate keys to the North American genera cannot be given at this time. Forbes (1923) utilized gill numbers to separate out the eastern species. The investigations of Berg (1950) indicate that gill numbers are difficult to use for taxonomic purposes as the number vary with the instar available and with individuals of the same instar.

**Generic Key to Known Larvae of North America**

1. Mandibles small, teeth arranged in a semicircle; species constructing cases and feeding on floating or partially submerged plants ........................................ 2
   Mandibles large, flattened, teeth arranged in a flat plane; with simple blood gills; species living under webs on rocks under water, feeding on algae and diatoms............ *Parargyractis* Lange, 1956

2. With branching, tracheal gills; in cases made of excised portions of leaves of aquatic plants.................. *Parapoyx* Hübner, 1826

   Gills absent............................................. 3

3. Case spheroidal, made of *Lemma* leaves....... *Neocataclysta* Lange, 1956

   Case oblong, with sharp lateral edge, made of excised portions of leaves of various aquatic plants............... *Nymphula* Schrank, 1802;
   *Synclita* Lederer, 1863; *Munroessa* Lange, 1956

**Parasites**

Aquatic nymphuline caterpillars are attacked by several dipterous and hymenopterous parasites although records are not too numerous. Townsend (1892) described an aquatic tachinid, *Ginglymyia acirostris* Townsend, which was later reported to parasitize as high as 50 per cent of the pupae of *Elophila fulicalis* (Clemens) by Lloyd (1919). Hart (1895:178–79) records a hymenopteran, *Cryptus cyanzeventris* Riley [Cushman, 1933, reports this as *Trichocryptus hirtifrons* (Ashmead)] entering the water and supposedly associated with a *Hydrocampas* sp. (probably *Synclita oblitteralis* Walker). *Cremastus hartii* Ashmead

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**PLATE 17**

Fig. 143. female genitalia, "*Nymphula" nomophilalis* Dyar, Oneco, Florida, U-514 (C. P. Kimball). Fig. 144. male genitalia, *Chrysendeton kimbali* Lange, n. sp., paratype, Oneco, Florida, U-504 (W.H.L.). Female genitalia of: fig. 145. *Nymphulietta dacekealis* (Haimbach) (paratype of *Nymphula broweri* Heinrich, Heinrich slide No. 2, U.S.N.M.); fig. 146. *Munroessa ictealis* (Walker), Barnstable, Massachusetts, U-510 (W.H.L.). Male genitalia of: fig. 147. *Parapoyx altionealis* (Walker), Siesta Key, Florida, U-518 (W.H.L.); fig. 148, *P. altionealis*
(Walker), Siesta Key, Florida, U-524 (W.H.L.); fig. 149, *P. allionealis* (Walker), Biloxi, Mississippi, U-523 (W.H.L.); fig. 150. *Parapoynx icciusalis* (Walker), Barnstable, Massachusetts, U-509 (W.H.L.). Fig. 151. wing venation, *Theila gibbosalis* (Guenée), Tjibodas, U-476A, (W.H.L.).

Scale as fig. 144, unless specified.
was also described in the same article, but no host was given (Hart, 1895:271). Cushman (1933) records that *Trichocryptus* spp. enter water and parasitize *Hydrocampa* spp. The record of Chagnon (1932) was reported by Cushman (1933) as either a *Trichocryptus* sp., or a *Neostricklandia* sp.

Frohne (1939a, 1939b) listed several parasites of the semi-aquatic moths he studied, including *Cremastus chilonis* Cushman, and *Neostricklandia sericata* Viereck from Chilo forbesellus Fernald and *Occidentalia comptulatalis* (Hulst), and *Pseuderipternus* sp. and *Trichocryptus* sp., from *Schoenobius melinellus dispersellus* Robinson. The present author has reared an ichneumon near the genus *Pseuderipternus*, in the Cremastini, from the pupal cases of a *Parargyractis* sp. in Colusa County, California.³

The ichneumon parasites *Rhachioplex javanicus* Ferriere and *R. aulacodis* Bischoff are aquatic, being associated in Java and Sumatra with *Aulacodes* spp. occurring on rocks in a habitat corresponding to our California *Parargyractis* (Lieftinek, 1932).

³ Determined by Miss L. M. Walkley.

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AQUATIC MOTHS OF NORTH AMERICA—LANGE 137

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