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PROCEEDINGS

OF THE

Washington Academy of Sciences

VOL. II

1900

WASHINGTON
MARCH-DECEMBER 1900

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ABSTRACT OF PROCEEDINGS.

January 17, 1900. Annual meeting. Election of officers.

February 21, 1900. Reception to the American Institute of Mining Engineers in the Corcoran Gallery of Art.

May 29, 1900. Business meeting. Amendment to by-laws prescribing that the annual meeting shall be held on the third Thursday in January in each year.

November 9, 1900. Business meeting. Admission of additional members. Purchase of a lot for a building site.

The following addresses have been delivered under the auspices of the Academy:

February 13, 1900. Annual address of the President of the Anthropological Society, Mr. W J McGee, on 'The Cardinal Principles of Science.'

December 8, 1900. Annual address of the President of the Philosophical Society, General George M. Sternberg, M.D., on 'Malaria.'

Also the following series of addresses for the exposition of Photography as an Aid to Research:

February 6, 1900.

The History and Chemistry of Photography, LYMAN J. BRIGGS.

Photomicrography, Gen. GEO. M. STERNBERG.

Photography in Vegetable Physiology and Pathology, M. B. WAITE.

February 15, 1900.

Photography as an Aid in the Study of Plants, F. V. COVILLE.

Photography in Animal Physiology and Pathology, Dr. D. S. LAMB.

Photography as an Aid in Medicine and Surgery, Dr. W. C. BORDEN.

March 6, 1900.

Photography as an Aid in Zoology, Dr. C. HART MERRIAM.

Outfits and Methods of the Bird Photographer, FRANK M. CHAPMAN.

Photography as an Aid in Entomology, Dr. L. O. HOWARD.

March 20, 1900.

Photography as an Aid in Surveying, D. B. WAINWRIGHT.

Photographic Surveying with the Ordinary Camera, Prof. H. F. REID.

Geologic Research as Illustrated by Photography, G. K. GILBERT,
N. H. DARTON, and F. L. RANSOME.

April 3, 1900.

Photography applied to Sidereal Astronomy, Dr. H. S. PRITCHETT.

Photography in Astrophysics, Prof. J. G. HAGEN.

Photography as used in Eclipse Observations, Prof. S. J. BROWN.

Photography in Physics, Prof. FRANK H. BIGELOW.

April 18, 1900.

Photography in Anthropology, W. H. HOLMES.

Photography in Physical Anthropology, W. J. MCGEE.

Photography in History and Literature, Dr. CYRUS ADLER.

May 1, 1900.

The Applications of the Krömsköp, FREDERICK E. IVES.

The Applications of the Phantascope, E. FRANCIS JENKINS.

Color Photography and Color Printing, N. H. DARTON.

The addresses of April 18, 1900, were followed by a *conversazione* in honor of the National Academy of Sciences; those of May 1, 1900, were complimentary to the Congress of American Physicians and Surgeons.

For the winter of 1900-1901 a series of addresses has been arranged on The Progress and Tendency of Science during the Nineteenth Century. The first of this series was given on December 11, 1900, by Professor F. W. Clarke, on 'The Progress and Tendency of Chemistry.'

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 1-12.

MARCH 14, 1900.

CARDINAL PRINCIPLES OF SCIENCE.¹

BY W J MCGEE.

SCIENCE may be defined as *consciously organized knowledge*. It rises far above that unconsciously integrated experience called instinct in animals and intuition in men; it passes beyond that semi-conscious summation of experience called common-sense; it even transcends that consciously integrated but only half-formulated experience called wisdom, which grows with the years and ends with the life of the sage; yet it spans all these and other grades of actual knowledge, and seeks to reduce them to simple order.

As the general definition implies, Science involves (1) methods of acquiring knowledge, (2) methods of formulating or organizing knowledge, and (3) the sum of knowledge (including knowledge of methods) acquired and formulated in accordance with experience. There are several branches of Science, each defined by the phenomena with which it directly deals; yet the methods are alike, and all, from eldest-born Astronomy to youngest-born Anthropology, have contributed to the methods as well as to the sum of consciously organized knowledge.

Reduced to simple terms, the scientific methods of acquiring knowledge may be defined as (1) observation, (2) generalization, and (3) inference; though the three processes overlap to the extent that practically there is no observation without some generalization, no generalization apart from observation and unaided

¹ Address as President of the Anthropological Society of Washington; delivered before the Washington Academy of Sciences and the Affiliated Societies, February 13, 1900.

by some inference, and no inference completely dis severed from observation and generalization—indeed, generalization is little more than spontaneous expansion of simple observation, and inference little else than normal extension of generalization through the aid of memory. The source of scientific knowledge is experience, though some part of the experience may be indirect, *i. e.*, that of other individuals and generations communicated in ways implying measurable similarity in experience. The methods of acquisition are shared not only by the several sciences but by all other lines of knowledge; yet the proportion of intuitive (or unconsciously integrated) experience called deductive knowledge decreases, while the ratio of consciously organized experience called inductive knowledge increases from pre-science to Science, and from branch to branch of the special sciences—Astronomy, Chemistry, Physics, Phytology, Zoölogy, Geology, Anthropology—in about the order of their historical development.

It is in the methods of organizing knowledge that Science attains its most distinctive aspect; and these methods are reducible to a few simple formulas, of which the greater part are expressed in phrases made familiar by long use in scientific speech and literature. Each of these formulas sums a vast body of experience, each was contributed by one or more of the family of sciences, and all are sustained jointly by the several special sciences: and since they are not shared by other branches of knowledge, they may be fairly held to represent the *Cardinal Principles of Science*.

The origin of Science can be scried but dimly amid the shadows of antiquity, yet enough of the earliest traces may be caught to show that organized knowledge began with counting and grew into mathematics: there are, indeed, unmistakable indications that primitive numbers were largely mystical or almagabalic¹: but the indications are equally clear that the counting whence the number-systems sprang expressed at least partly conscious recognition of the veritable existence and persistence

¹ As described in 'The Beginning of Mathematics,' American Anthropologist, New Series, Vol. I, 1899, pp. 646-671.

(or the integrality) of the things counted—and this may fairly be deemed the inception of Science. Patient search among the lighter shadows of less remote antiquity discovers traditions and records of an epoch in which men living under the clear skies of arid regions were impressed with the apparent stability of the star-decked firmament, and gradually grouped the heavenly bodies into systems; the early grouping was largely mystical or astrological, the primal constellations were mainly beast-gods translated to the heavens, and the crystal spheres invented to carry the greater luminaries and planets were but supernal figments; yet the crude system marked conscious effort to organize experiences of consciously recognized things—and it is fair to date the definite conception of Science from this primitive Astronomy. The gradually multiplying records of olden times indicate that the mental processes fixed by counting and stargazing were steadily extended to other things, which were slowly recognized as entities: Even before 450 B. C., Parmenides had held that substance may neither become nor perish, and about this early date Empedocles taught (of course in metaphysical wise) that the ultimate particles of matter must be indivisible, immutable, and indestructible; while Democritus summed the philosophical opinion of his period (460 B. C. to 357 B. C.) in a proposition which may be rendered, “Out of nothing nothing arises; nothing that is can be destroyed; change is only combination or separation of atoms;” and a like view was held by Epicurus and his disciple Lucretius during the century before the opening of our era. The progress of the notion lagged during the Dark Ages but revived with the Renaissance and the physical researches of Gassendi, Leibnitz, and especially Lavoisier (1743–1794), who showed experimentally that matter is neither lost nor gained in chemical change—and this experimental demonstration may justly be held to mark the full birth of Science as consciously organized knowledge. At the same time the demonstration established that cardinal principle of Science commonly phrased *The Indestructibility of Matter*. Essentially, the integration expressed in this formula involved in the first place the extension of macroscopic observation into microcosmic nature, and in the second place the ex-

tension of human faculty to purposive pre-combinations of such sort as to afford prompt verification of inferences and confident demonstration of natural relations; so that this first pillar of Science may be deemed the gift of Astronomy as to material, and of Chemistry as to structure and useful setting.

The doctrine of the indestructibility of matter was at once the fruit of a philosophical renovation and the seed of an intellectual reformation; for, as it ripened in mind after mind and was sown broadcast by the slow but persistent processes of the times, it generated new inquiry and experiment, which at the same time gave sustenance to many hungry minds and furnished fresh seed for yet other minds. Among the consequences of the intellectual quickening were certain experiments by Benjamin Thompson, or Count Rumford, which, when described in 1798, served to transfer the discussion of temperature from the domain of metaphysics to that of physical inquiry and to demonstrate that heat is a manifestation of motion; Thompson was soon followed by Sir Humphry Davy and half a century later by Dr. J. P. Joule, who repeated and extended the experiments and fixed the mechanical equivalent of heat. Then came a brilliant coterie of physicists, Grove, Faraday, Helmholtz, Tyndall, and others, who verified the determinations by means of special experiments and by comparison with general human experience, established the interchangeability (or correlation) of forces, and gradually organized their growing knowledge in a system revealing another cardinal principle—the conservation of energy, or (preferably, in view of Thompson's terminology and of later researches) *The Persistence of Motion*. This new principle met a mental need, and found so many applications that it came to be regarded as the most important discovery of the century. Originally the gift of Physics, it was soon extended into the realm of organic life by Liebig and others in Germany and by Carpenter in Britain, and only a few years later it was pushed into the realm of mental action by LeConte and Barker in America. For half a century the inconstructible and indestructible motion enlivening the universe was assumed to be constant only in the universe as a whole and constantly variable in the constituent

bodies ; this assumption served to pair fundamental notions of matter and motion, the one persisting^m only in the particle and the other only in the sum of particles, in such [manner as to satisfy the dualistic instinct expressed in most earlier philosophies ; but at the same time it introduced an indefinite, if not forever indeterminate, element, into the formula—for under the assumption the finality of the formula can never be ascertained until the universe is measured and weighed to its uttermost limits. An alternative assumption, recently proposed by Powell, is that motion, like matter, is persistent in the ultimate particle ; this assumption has the merit of harmonizing principles otherwise (apparently) discordant, and the special excellence of integrating general human experience ; but it still awaits that direct demonstration through laboratory experimentation, so prearranged as to test all possible inferences, which alone carries conviction to conservative minds.

As Lavoisier's doctrine of indestructibility spread, the method of observation under voluntarily controlled conditions was extended into new fields ; and even while Joule's mechanical experiments were still progressing at Manchester, Darwin was arranging a series of vital experiments at Down and comparing his results with the voluminous observations recorded by naturalists in all parts of the world. Meantime Alfred Russell Wallace and Herbert Spencer were also seeking to organize anew the facts collected on the Linnæan plane, already become chaotic by reason of their very number ; and when the three thinkers independently generalized the teeming experiences of organic life in terms of sequence, the coincident opinions and the incomparable thoroughness of Darwin's methods combined to force a new principle on an unwilling world of contemporary thought. At first the Darwinian doctrine was burdened by its own infantile feebleness—for there is no Minervan birth in Science—and bound by the swaddlings of scholasticism ; but support came from all sides, and it grew apace and soon became the sturdiest of that trinity of scientific principles recognized up to the sixth decade of the nineteenth century. For some years the doctrine was largely limited to the organic realm, and was deemed applicable solely to the evolution of animal

and vegetal species; later it was extended (first intuitively and then purposively) to other realms of nature, and was found equally applicable to species of the sub-organic realm, such as minerals and mountains, and to those of the super-organic realm, such as knives and nations—when it became evident that the principle involves involution as well as that evolution so conspicuous in the organic world. With this extension the doctrine becomes *The Development of Species*, and this phrase expresses the third cardinal principle of Science—the gift of biology, *i. e.*, of phytology and zoölogy jointly.

Naturally the promulgation of three revolutionary doctrines within a century (1760–1860) produced an intellectual surfeit. The principle of indestructibility had lain germinant for two millenniums, and so found men's minds ready for the final planting; even the principle of persistence met a need of thought, and encountered little opposition; but the principle of development found most mental fields already stocked with long-set growths and little prepared for the latest seeding. A consequence of the indifference or antipathy of the average mind was voluminous discussion, with the spontaneous separation of thinkers into opposing schools; and in due course Science became a cult, and Thomas H. Huxley its most vigorous exponent. As the discussion proceeded, the principle of development was rounded out and applied to new problems; and as the applications multiplied, it was found to present many analogies with the principles of indestructibility and persistence. Meantime a science of the earth was rapidly crystallizing about Sir Charles Lyell's idea of uniform process in earth-building—the 'uniformitarianism' of that day of redundant doctrines—while under the masterly interpretation of Huxley and others, paleontology was resurrecting the record of early life on the earth; and the several movements eventually joined in the formulation of a fourth principle, complementary to those of earlier decades and so harmonious with them as to facilitate the apprehension and adoption of the entire series. This fourth principle has ever since been regarded as a (if not *the*) cardinal principle of science; in Huxley's happy phrase it is *The Uniformity of Nature*. The principle must be credited largely to Geology

(including paleontology), but partly to the biotic and physical sciences jointly.

At this end of the century, these four principles form the commonly accepted platform of Science: the indestructibility of matter, the persistence of motion, the development of species, and the uniformity of nature. There may be, indeed is, a question as to whether they constitute the entire platform of human knowledge; but in the minds of scientific men there is no question as to the verity of these principles so far as they go. True, the temperate scientist must admit the possibility that any or all of the principles may be erroneous; but he does so, if at all, in full realization that the admission is tantamount to denial of the truth and trustworthiness of experience as a source of knowledge. The scientist cannot deny that the cosmos is shrinking toward nothingness, or growing by miraculous accretion toward greater magnificence; he is very far from denying that the universe may be kept in motion by some extra-cosmic source of power; he hardly ventures to dispute the transitional halting-place held by those who claim that at least the first life and the highest mind transcend natural development and demand a special supernatural explanation; in certain circumstances he is deterred by the tolerance of good breeding from denying that the world was fashioned from a lump of mud brought up by a muskrat from the bottom of the sea, as taught in sincere, albeit primitive, philosophy—he can only say that all such explanations of things are outside the range of experience, and hence beyond the domain of Science. It is also true that the unscientific thinker—whose name is Legion—enjoys the fullest freedom of rejection of any or all of the principles; and it can only be said that thereby he keeps without the straight-laid fields of Science and within the broad and often attractive purviews of not-science. Yet a significant sign of the times is found in the fact that most men of civilized and enlightened lands are coming to appreciate the coin of experience above the dust of tradition, and are gradually entering, whether intentionally or not, into the ways of Science. Only a generation ago the very name of Science was the symbol of a cult to one class of thinkers and a juggler's gaud to another class; to-day

Science is an actual part of the everyday life of all enlightened folk. So, at this end of the century, four principles of Science are held implicitly or proclaimed explicitly throughout the leading nations; and the adherents of the principles justify their confidence by the unimpeachable testimony of experience.

On summing the principles forming the present platform of Science, it becomes manifest that they are interrelated in such wise as to form a harmonious series, each dealing with an aspect of nature and the whole covering all nature in its more conspicuous aspects; it becomes manifest, too, that the four principles are alike in two respects: in the first place they are each and all integrations of experience along the lines to which they respectively pertain; in the second place they each and all rest on the postulate that experience furnishes a key—and the only key—to nature. This correspondence would seem to indicate that the four principles might themselves be integrated in terms of their common attributes; it also suggests that the principles may have been really integrated, albeit intuitively or subconsciously only, even before they were finally formulated. Thus, the principle of indestructibility was but a generalization of experiences of indestructibility, yet it could not have become clear to any mind devoid of the assumption (howsoever implicit or vague) that experience accurately reflects actualities; the principle of persistence was similarly a generalization of experiences, yet it could not have been grasped without the assumption that experiences of motion and duration are veritable; so, too, the principle of development involves the postulate that the sequence pictured in the mind is the reflection of a real sequence in nature; while the principle of uniformity demands the assumption that the mind of man is a faithful mirror of nature. Doubtless the essential postulate remained unformulated and half unrealized because of the preoccupation of the knowledge makers: Lavoisier was too busy over chemical reactions to give much thought to the mechanism of his own mind, Joule confined his apperception to extra-mental phenomena, Darwin remained naïvely negligent of his own admirable mentations, and even Huxley deliberately dropped the veil of un-

thinkableness between his conscious self and the mysteries of his subconsciousness; yet these men made no observations, framed no generalizations, formed no inferences, without confident realization that experience is a reflex of nature—and it seems evident that without this realization the signal advances in knowledge summed in the cardinal principles could not have been made.

On seeking explanation of the constantly implied but never declared confidence reposed by the knowledge-makers alike in their own experiences and in their own mental operations, it is soon seen that the two bases of scientific procedure are closely akin; for the evident source of confidence in experience is found in experience itself, while the source of confidence in mentality just as evidently arises in experience of mental working. Now in every stage of culture the several faculties are manifestly coördinated, at least to the extent that bodily activities affect thought and thinking measurably controls action; hence the suggestion naturally arises that the largely intuitive development of confidence in external realities and in the power of the mind to grasp and interpret them was a normal sequence of the Renaissance following the Dark Ages, in which men turned to the most inspiring duties of their kind—the twin tasks of nature-conquest and nation-building; and, if the suggestion be valid, it would seem to follow that the confidence in Nature and Mind expressed by successful effort was rather a forerunner than a mere attendant of those advances in knowledge marked by the framing of the cardinal principles. Fortunately the suggestion is supported by contemporary testimony. Nearly two centuries before Lavoisier, Francis Bacon laid a foundation for definite knowledge in the *Novum Organum*, the cornerstone of which appears in the initial aphorism of the first of the two books comprised in this memorable essay. Rendered into the more trenchant and vigorous language of the present, this aphorism reads:

Man, as the minister and interpreter of nature, does and understands as much as his observations on the order of nature, either with regard to things or the mind, permit him, and neither knows nor is capable of more.¹

¹ Translation edited by Joseph Devey and published in Bohn's *Philosophical Library* under the title 'The Physical and Metaphysical Works of Lord Bacon.' London, 1889 (p. 383).

Divested of immaterial qualifications, and interpreted in the light of other propositions in the same book, this aphorism is a specific affirmation that man's mind is a mirror of Nature, reflecting observations of Nature and nothing more—*i. e.*, it is an explicit definition of the platform implicitly accepted by Lavoisier and Joule and Darwin and Huxley in their epoch-making researches. True, these men made little acknowledgment to Bacon, and at least one of them mildly decried his work; yet the *Novum Organum* was one of the most notable treatises of its time, and must have been read widely and at least measurably assimilated into the common knowledge of succeeding centuries; so it seems evident that the Baconian concept lay germinant, much as did the Greek concept of indestructibility, though for a lesser period—and hence that the framers of the four cardinal principles were debtors to Bacon none the less that the debt was not consciously recognized.

Long after Bacon, and even after the biotic and geologic sciences bore fruit in cardinal principles, the Science of Man began to take shape. As in other sciences, the observations began with the rare, the remote, and the abnormal, and gradually passed toward the near and the normal; and as the observations became chaotic by reason of their number, they were from time to time integrated in such manner as to raise the system to successively higher and higher planes. A quarter-century ago the leaders of Anthropology were beginning to classify mankind in terms of mind-shaped activities and activital products—arts and industries, social institutions, languages, and beliefs with their attendant ceremonies and symbols. One of the consequences of this classification was the discovery that the human activities and their products are so frequently alike in widely separated regions as to indicate that they must have arisen spontaneously and independently among unrelated peoples; and twenty years ago Powell formulated this discovery into a law of 'activital similarities'—or a law of cultural coincidences, as it might now be called. Further observations supported the first discovery, and finally gave warrant for the inference that the human mind, wheresoever placed, reflects its environment with striking fidelity. Brinton held that this par-

allelism between Man and Nature expresses a unity of the human mind imposed by some extraneous power; but the later researches indicate that the relation varies with the degree of cultural development—*i. e.*, that savage minds respond nearly alike to like stimuli, that all barbaric minds are measurably similar in their responses to environmental stimuli, that civilized minds work in largely similar ways under similar conditions, and that all enlightened minds are alike in their efforts to dominate nature, but that minds of the different culture grades do not respond alike—and hence that the interaction itself conforms with the lines of serial development characteristic of the inorganic and organic realms of nature. Accordingly the present-day anthropologist is in a position to at least provisionally integrate the sum of experiences concerning intellectual mankind in a formula expressing the interrelation of psychic and non-psychic interactions. The formula may be framed in conscious accordance with the Baconian platform which so well (albeit so unwittingly) served to support the earlier principles, and in conformity with these it may be phrased *The Responsivity of Mind*.

In weighing this latest integration of experience, it is to be borne in mind that it stands for much more than a generalization of special observations along a single line; it is at once the first and most brilliant intellectual gem of the Renaissance, the unformulated complement of that quartet of principles so evidently framed through its unacknowledged aid, and the most comprehensive generalization of that youngest of the sciences which depends on all the others for its methods and fundamental laws. Thus far the formula is new; it has not yet been tested by generations of thinkers, like the four formulas already crystallized in the speech and literature of Science; yet it is so harmonious with these and so essential to their integrity as to give promise of finding a place in the group. If so, it must be considered to represent at the same time the earliest and the latest of the cardinal principles, the first-cut block and the last-set keystone in the structure of consciously organized knowledge, and the common gift of budding naturalism and maturing Anthropology.

So the cardinal principles of Science may be reckoned as

five: the indestructibility of matter, the contribution chiefly of Chemistry; the persistence of motion, the gift mainly of Physics; the development of species, the offering of the biotic sciences; the uniformity of nature, the guerdon of Geology and the older sciences; and the responsivity of mind, the joint gift of several sciences, though put in final form by Anthropology.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 13-30.

MARCH 14, 1900

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

I.

DESCRIPTORS OF TWENTY-SIX NEW MAMMALS
FROM ALASKA AND BRITISH
NORTH AMERICA.

BY C. HART MERRIAM.

IN the early spring of 1899 Mr. Edward H. Harriman of New York, in coöperation with the Washington Academy of Sciences, organized, at his own expense, an expedition to Alaska. He invited as his guests about twenty-five scientific men, representing various branches of research. The expedition sailed from Seattle May 30, on the iron steamship 'Geo. W. Elder,' especially chartered for the purpose, and was gone just two months. The details of the route and work were arranged by special committees, and the vessel was equipped and operated in such manner as to secure maximum results with a minimum expenditure of time.

Work was done at a large number of localities, from British Columbia to Bering Strait, and extensive collections were made, particularly in the fields of zoölogy and botany. The technical results will appear from time to time in these Proceedings, and later will be collected in a special report on the expedition. Mr. Harriman will provide the illustrations.

In studying the material brought back by the expedition, comparisons have been made with material collected by others in Alaska and adjacent parts of boreal America, and in some

instances new species from points outside of Alaska have been thus brought to light. In such cases the new species have been included in order to render the results more complete and useful.

The present paper comprises descriptions of twenty-six mammals believed to have escaped previous recognition. Papers on other subjects will follow in the near future.

The new mammals here described, with their type localities, are :

<i>Vulpes harrimani</i>	Kadiak Island, Alaska
<i>hallsensis</i>	Hall Id., Bering Sea, Alaska
<i>Sorex glacialis</i>	Glacier Bay, Alaska
<i>tundrens</i>	St. Michaels, Alaska
<i>personatus arcticus</i>	St. Michaels, Alaska
<i>alascensis shumaginensis</i>	Popof Id., Shumagin Ids., Alaska
<i>navigator alaskanus</i>	Glacier Bay, Alaska
<i>Spermophilus osgoodi</i>	Ft. Yukon, Alaska
<i>barrowensis</i>	Point Barrow, Alaska
<i>beringensis</i>	Cape Lisburne, Alaska
<i>Microtus inuitus</i>	St. Lawrence Id., Bering Sea, Alaska
<i>yakutatensis</i>	Yakutat Bay, Alaska
<i>popofensis</i>	Popof Id., Shumagin Ids., Alaska
<i>abbreviatus fisheri</i>	St. Matthew Id., Bering Sea, Alaska
<i>macfarlani</i>	Ft. Anderson, north of Gt. Bear Lake
<i>Erotomys orca</i>	Orca, Prince William Sound, Alaska
<i>Dicrostonyx unalascensis</i>	Unalaska, Alaska
<i>nelsoni</i>	St. Michaels, Alaska
<i>richardsoni</i>	Ft. Churchill, Hudson Bay
<i>Lemmus alascensis</i>	Point Barrow, Alaska
<i>yukonen</i>	Charlie Creek, Yukon River, Alaska
<i>Erethizon epixanthus myops</i>	Portage Bay, Alaska Peninsula
<i>Lepus othus</i>	St. Michaels, Alaska
<i>podromus</i>	Stepovak Bay, Alaska Peninsula
<i>americanus dalli</i>	Nulato River, Alaska
<i>americanus macfarlani</i>	Ft. Anderson, north of Gt. Bear Lake, Arctic America.

VULPES HARRIMANI sp. nov. Kadiak Island Fox.

Type (skin) from Kadiak Island, Alaska. No. 99626 ad. U. S. National Museum, Biological Survey Collection. Purchased in July 1899, at Kadiak, by C. Hart Merriam. Skull of another specimen, from Uyak Bay, Kadiak Island, no. 98144 U. S. National Museum, Biological Survey Collection, July 1899, collected and presented by Geo. Bird Grinnell.

Characters.—Size largest of the known North American foxes; ears small; tail enormous, constricted at base, largest on basal

fourth and tapering thence to tip; color tawny yellow; fur of posterior half of back grizzled and much coarser than that on rest of body; black of fore and hind feet greatly reduced.

Color.—Nose to between eyes pale dull fulvous, grizzled with whitish; top of head from between eyes to nape buffy whitish, grizzled with yellowish fulvous; anterior half of back bright yellowish fulvous, the color extending down over sides and belly nearly to median line; posterior half of back coarsely grizzled buffy whitish and dull fulvous, reddest along median line; underparts yellowish fulvous except chin, throat, inguinal region, and a narrow strip on belly, which parts are grayish buffy; ears black; fore and hind legs and feet dull pale fulvous with an irregular black patch on dorsal surface of forefoot, and a much smaller one on hind foot; tail grizzled grayish and yellowish fulvous, the fulvous most marked on median line of upper surface, the black tipped hairs less abundant than in related species but sufficiently plentiful on basal fourth of dorsal surface to form an indistinct black patch or spot; tip inconspicuously white or buffy white.

Cranial characters.—Skull large and massive; *postorbital processes only slightly developed* (much less prominent than in any other known species); frontal sulcus very deep and reaching forward over posterior third or half of nasals; palate and maxillaries broad; bullæ large. Dentition heavy; premolars more robust than in related species.

Measurements.—Type specimen [a dry skin]: total length 1260; tail vertebrae [approximate] 450; tail to end of hairs 550; greatest diameter of tail, hairs laid naturally 160; greatest diameter of tail, hairs spread, 250.

Cranial measurements.—Skull no. 98144 from Uyak Bay, Kadiak Island: basal length 140; zygomatic breadth 77; palatal length 74.5; postpalatal length 65; breadth across postorbital processes 33; interorbital breadth 27.5; postorbital constriction 22.5; greatest breadth of rostrum over roots of canines 26.3; lateral series of teeth (from front of canine to back of last molar) 66.

VULPES HALLENSIS sp. nov. Hall Island Arctic Fox.

Type from Hall Island, Bering Sea. No. 98067 ♀ old, U. S. National Museum, Biological Survey Collection. July 14, 1899. C. Hart Merriam. Orig. no. 2177. (Shot by W. B. Devereux.)

Characters.—Externally similar in general to *V. lagopus*. Skull shorter and broader.

Color.—Head sooty, grizzled between eyes and on sides of face with whitish hairs; back (rather narrowly), shoulders, and upper surfaces of legs sooty brown; sides and underparts buffy; chin and anterior part of throat dusky grayish; ears dusky, edged with buffy

white; sides of nose and extreme tip of chin whitish; ankles and hind feet dusky, sprinkled or grizzled with whitish hairs; tail strongly bicolor; above dusky at base like back, becoming yellowish buff distally; below, yellowish white.

Cranial characters.—Compared with *Vulpes lagopus* from Lapland, the skull is shorter both anteriorly and posteriorly (rostrum shorter, and also base of skull behind molars); the bullæ larger, with an inflated posterior projection pushing out behind the meatus tube and directed outward as well as backward, giving a semicircular curve to the axis of the bullæ (viewed from below); meatus tube more sharply defined; basioccipital narrower between bullæ. Lower premolars (especially 2d and 3d) smaller; 4th upper premolar and 1st molar more robust. Ratio of zygomatic breadth to basal length of skull 66.8. [In a Lapland skull this ratio is 58.]

Measurements.—(Measured in flesh by C. H. M.) Total length 825; tail vertebrae 290; hind foot 140.

Cranial measurements.—Basal length 114; zygomatic breadth 69; palatal length 61; postpalatal length 53.5.

SOREX GLACIALIS sp. nov. Glacier Bay Shrew.

Type from Point Gustavus, on east side of entrance to Glacier Bay, Alaska. No. 97709 ♂ ad. U. S. National Museum, Biological Survey Collection. June 12, 1899. A. K. Fisher. Orig. no. 2056.

Similar to *S. longicauda* but with decidedly smaller fore and hind feet (hind foot 14 or less instead of 15 +), much smaller skull and teeth, and smaller and less conspicuous ears; upperparts darker, underparts whiter and lacking the brownish fulvous wash which is conspicuous in *longicauda*.

Color.—Upperparts dark dusky brown; underparts abruptly whitish with distinct line of demarkation on side of face and neck; tail above and at tip all round, brownish dusky; below buffy.

Cranial characters.—Skull and teeth as in *longicauda* (3d unicuspid smaller than 4th) but skull smaller and shorter, and molariform teeth much smaller.

Measurements.—Type specimen: total length 122; tail vertebrae 52; hind foot 14. Another male from type locality: total length 123; tail vertebrae 53; hind foot 13.5.

SOREX TUNDRENSIS sp. nov. Tundra Shrew.

Type from St. Michaels, Alaska. No. 99286 U. S. National Museum, Biological Survey Collection. Sept. 13, 1899. W. H. Osgood. Orig. no. 902.

Characters.—Size large; tail rather short; coloration strikingly peculiar: bicolor in winter; tricolor in summer; the drab brown of back restricted to a sharply defined dorsal area in strong contrast to paler color of sides, which in winter is silvery, in summer overlaid with a brownish wash. The only related species having the same pattern is the larger and very much darker *S. richardsoni*, whose sides are never silvery.

Color.—*Summer pelage* (tricolor): top of head and broad dorsal area brown (usually drab brown); flanks and sides abruptly paler, usually pale buffy brown; underparts soiled whitish; tail above brown, becoming dusky all round at tip, below buffy. *Winter pelage* (bicolor): dorsal area drab brown, darkest posteriorly; flanks, sides, and underparts silvery whitish in striking contrast. Owing to the much greater length of fur in winter the animal appears larger.

Cranial characters.—Skull and teeth (3d unicuspid larger than 4th) as is *S. richardsoni*, but slightly smaller; constriction slightly broader; large premolar and unicuspidate series smaller and shorter.

Measurements.—Type specimen: total length 108; tail vertebrae 32; hind foot 13. Average of ten adults from type locality: total length 108; tail vertebrae 32; hind foot 13 (the same as the type).

SOREX PERSONATUS ARCTICUS subsp. nov. Arctic Shrew.

Type from St. Michaels, Alaska. No. 99305 ♀ ad. U. S. National Museum, Biological Survey Collection. Sept. 14, 1899. W. H. Osgood. Orig. no. 910.

Similar to *personatus* but slightly larger; tail larger; color much paler, particularly on underparts, which in both summer and winter pelages are conspicuously whiter. In summer pelage the upperparts are pale drab brown, the underparts ashy whitish. In winter pelage the fur is much longer and fuller; the upperparts dusky brownish with a fine 'pepper and salt' appearance; the underparts (encroaching on flanks) silvery whitish with only the palest buffy suffusion, and this sometimes absent. The skull is slightly longer than in *personatus*; the unicuspidate teeth decidedly larger.

Contrasted with subspecies *streatori*, which it resembles in size, it differs markedly in coloration, being very much paler both above and below, and lacking entirely the brownish fulvous wash on the underparts.

Measurements.—Type specimen: total length 108; tail vertebrae 39; hind foot 12. Average of ten adults from type locality: total length 103; tail vertebrae 37; hind foot 12.

SOREX ALASCENSIS SHUMAGINENSIS subsp. nov.
Shumagin Islands Shrew.

Type from Popof Id., Shumagin Islands, Alaska. No. 97993 ♂ ad. U. S. National Museum, Biological Survey Collection. July, 1899. DeAlton Saunders. Orig. no. 2210 (Fisher catalogue).

Similar to *S. alascensis* but slightly smaller and paler; upperparts more pepper and salt; underparts much whiter and without the brownish or fulvous wash; flanks showing a tendency to the development of a pale buffy-fulvous band.

Cranial characters.—Skull and teeth as in *alascensis* (3d unicuspid much smaller than 4th) but slightly smaller.

Measurements.—Type specimen: total length 112; tail vertebrae 42; hind foot 14.

Subgenus **NEOSOREX**.

SOREX NAVIGATOR ALASKANUS subsp. nov.
Alaska Water Shrew.

Type from Point Gustavus, Glacier Bay, Alaska. No. 97713 ♂ ad. U. S. National Museum, Biological Survey Collection. June 12, 1899. A. K. Fisher. Orig. no. 2058.

Similar to *navigator* but smaller; skull shorter and more massive; interpterygoid fossa shorter; braincase less abruptly inflated behind constriction; constriction broader; sagittal crest much more highly developed and appearing in relatively young skulls; tooth row shorter.

Color.—Upperparts plumbeous or slate gray with a decided 'pepper and salt' appearance; underparts and feet whitish; tail above and at tip all round, dusky; below whitish.

Measurements.—Type specimen: total length 145; tail vertebrae 65; hind foot 18.5. Another male from type locality: total length 160; tail vertebrae 72; hind foot 19.

SPERMOPHILUS OSGOODI sp. nov. Fort Yukon Spermophile.

Type from Fort Yukon, Alaska. No. $\frac{127889}{37823}$ ♂ ad. U. S. National Museum. April 29, 1877. L. M. Turner. Original no. 1635.

Characters.—Size rather large; tail longest of the group, and *very red* below; nose patch extending over top of head; *belly very red* in summer pelage: dorsal vermiculations tending to break into spots.

Color.—*Summer pelage*: Whole top of head (from nose to ears) deep ferruginous; neck, shoulders, and sides, grayish, becoming deep fulvous on flanks; dorsal area fulvous, irregularly spotted with whitish; underparts, including sides of face, fore and hind legs and feet varying from deep fulvous to ferruginous. *Winter pelage*: Similar, but

gray of neck and shoulders clearer and pushing forward on sides of face nearly to eye; dorsal vermiculations less broken into spots; thighs and flanks intense ferruginous: deep rusty of underparts interrupted by areas of grizzled grayish and fulvous.

Cranial characters.—Skull large and heavy like that of *barrowensis*, from which it differs in the greater length of premaxillæ: in *barrowensis* the premaxillæ fall short of the nasals; in *osgoodi* they surpass the nasals.

Remarks.—*S. osgoodi* differs from all its relatives in the large size of the red nose patch, which covers the whole top of the head, the presence (normally) of a fulvous dorsal area, the intensity of the red on the belly (rusty-red instead of fulvous), and the great length of the tail. The thighs are usually as red¹ as in *columbianus* and *erythrogluteus*, thus differing markedly from all other known Alaska forms. I have named this striking and handsome species in honor of my assistant, Wilfred H. Osgood, who, during his recent trip down the Yukon, recognized it as new and obtained a fine series, which series, unhappily, was afterwards lost as a sequel to the capsizing of his boat in the great river.

SPERMOPHILUS BARROWENSIS sp. nov.

Point Barrow Spermophile.

Type from Point Barrow, Alaska. No. $\frac{14061}{37824}$ ♂ ad. U. S. National Museum.

Characters.—Size largest of the known forms (hind foot 62 mm.); coloration (in May, left-over winter pelage) pale; prevailing tints buffy; back indistinctly spotted; skull large and massive.

Color.—Nose patch rather pale fulvous (not chestnut or ferruginous), fading on top and back of head to buffy fulvous; neck and sides buffy, grizzled with black hairs; back buffy fulvous irregularly speckled with whitish (the spotting partly due to wear); underparts, including legs and feet, buffy, palest on throat and around mouth, deepest on pectoral region, belly, and upper sides of hind foot; eyelids whitish; tail above, buffy, grizzled with black; below buffy fulvous, bordered with black and edged with buffy.

Cranial characters.—Skull largest of the group, though only slightly larger than that of *S. osgoodi* from Fort Yukon; rostrum broad; frontal shield broad, its orbital margin strongly thickened and elevated, but not noticeably notched by supraorbital foramen; zyg-

¹An October specimen has the red thighs partly overlaid and concealed by a superficial grizzling of buffy gray and black.

omata convergent, the anterior angle thickened but hardly apparent from above; jugal broad, but less expanded than in the much smaller *kadiacensis*; temporal impressions obsolete; bullæ large; meatus tube short and without distinct 'neck'; underjaw rather delicate, the angle strongly inflected but not massive as in *kadiacensis*. Molariform teeth large and heavy.

In cranial characters *S. barrowensis* is very close to *osgoodi*, both having large, broad, and massive skulls with faint or obsolete temporal impressions. In *barrowensis* the ascending arms of the premaxillæ are short, ending anterior to the nasal endings; in *osgoodi* they are long, passing the nasals. The unfortunate absence of an authentic skull of *S. empetra* prevents comparison with that species.

Remarks.—Compared with skins of *empetra* from Hudson Bay *barrowensis* is much larger and paler with a decidedly more marked tendency to spotting, the whitish dorsal vermiculations being more distant and more distinctly broken into spots. Compared with *S. beringensis* from Cape Lisbourne, *S. barrowensis* is not only larger and paler, but differs in the following particulars: ground color of back grayish buffy instead of fulvous; dorsal whitish bands narrower, more numerous, and less broken into spots; fulvous of nose patch and underside of tail much paler; upperside of tail grizzled buffy instead of fulvous and black; black border of tail absent except at and near tip; sides of head buffy instead of buffy gray; dorsal area not well defined.

SPERMOPHILUS BERINGENSIS sp. nov.

Cape Lisbourne Spermophile.

Type from Cape Lisbourne (Coal Veins), Alaska. No. 15253 ♂ ad. U. S. National Museum, May 1885. H. D. Wolfe.

Characters.—Similar to *S. empetra* from Hudson Bay but back more strongly fulvous, with the whitish dorsal vermiculations broken into *distinct and distant spots*; tail (apparently) longer and deeper fulvous, or even ferruginous; nose patch larger and less defined.

Color.—*Summer pelage* (worn): Entire animal fulvous; becoming ferruginous on nose patch and underside of tail; palest on back; back distinctly spotted with buffy-whitish; tail broadly bordered with black. *Winter pelage*: Nose patch brighter rusty, and in more abrupt contrast to surrounding parts, which are buffy grayish; sides of face and neck buffy grayish; back deep fulvous, sparsely sprinkled with whitish spots; sides and underparts buffy to buffy fulvous.

Remarks.—This species differs from all others in the *distinctness*

of the *spottings*, and in the large size and relative broad spacing of the spots. It differs from *barrowensis* in smaller size and much greater intensity of the fulvous markings. The nose patch is bright ferruginous instead of pale fulvous; the dorsal area fulvous and well defined, and the underside of tail rusty instead of fulvous, with the black border reaching back along the sides [in *barrowensis* it hardly extends beyond the tip]. The sides of the face are distinctly *grayish* instead of *buff*, and the fur on these parts is much longer and more fluffy, giving the head a very different expression. The dorsal spots are decidedly larger and farther apart.

MICROTUS INNUITUS sp. nov. Inuit Vole.

Type from St. Lawrence Id., Bering Sea. Skull no. 99373 ad. U. S. National Museum, Biological Survey Collection. July 13, 1899. C. Hart Merriam.

Characters.—External characters unknown.

Cranial characters.—Skull conspicuously different from any known species. Size large (considerably larger than *unalascensis*, somewhat larger than *abbreviatus* from Hall Island, and nearly double the size of *operarius* from St. Michaels); cranium angular and strongly marked by muscular impressions; zygomata heavy and broadly bowed outward, their anterior roots (seen from above) standing outward and forward; the jugals slightly expanded and parallel; braincase large, squarely truncate anteriorly; nasals large, long and cuneate; rostrum large and massive, with prominent lip at anterior border of antorbital foramen; incisive foramen constricted posteriorly; *audital bullæ large* (much larger than in any other known species from the region about Bering Sea); incisors produced and *strongly protruding*; molars of same size as in *abbreviatus*; m^3 with 3 closed triangles; m_1 with 4 closed triangles (2 on each side).

Measurements.—Total length unknown; tail vertebrae 43–45; hind foot 22–24. Skull (type): basal length 32.5; zygomatic breadth 19.5; mastoid breadth 15.5; nasals 9; molar series 7.2.

Remarks.—During our brief stop at Northeast Cape on St. Lawrence Island, on the afternoon of July 13, several of these voles were seen but no fresh specimens were secured. The borders of a long slough or series of ponds on the tundra were cut up by an interlacing network of their deeply worn trails and tunnels near which I gathered a pocketful of pellets containing their remains, doubtless dropped by owls or jagers. From these pellets a dozen more or less perfect skulls and many parts of skeletons were obtained. The skull is easily

recognized by its large size, broadly spreading zygomata, large bullæ, and strongly protruding upper incisors.

MICROTUS YAKUTATENSIS sp. nov. Yakutat Vole.

Type from north shore of Yakutat Bay, Alaska. No. 98005 ♂ ad. U. S. National Museum, Biological Survey Collection. June 19, 1899. C. Hart Merriam. Orig. no. 2101.

Characters.—Size rather large; tail very short; coloration grayish brown or bister; feet and underparts whitish. Similar to *sitkensis* but feet smaller; *tail much shorter*; upperparts less fulvous; underparts and feet whitish instead of dark. Cranial characters as in *sitkensis*.

Color.—Upperparts bister or grayish brown, intimately mixed with black hairs (which sometimes form a darker area along median line from occiput to shoulders), and grizzled with buffy fulvous; underparts whitish or buffy whitish, the plumbeous of underfur showing through; fore and hind feet whitish; tail sharply bicolor, narrowly blackish above, broadly whitish or buffy beneath.

Cranial characters.—Skull like that of *sitkensis* but differing slightly; nasals somewhat longer; jugals slightly larger.

Measurements.—Type specimen: total length 172; tail vertebrae 38; hind foot 21. Average of ten adults from type locality: total length 165; tail vertebrae 37; hind foot 21.

MICROTUS UNALASCENSIS POPOFENSIS subsp. nov.

Popof Island Vole.

Type from Popof Id., Shumagin Islands, Alaska. No. 97956 ♂ ad. U. S. National Museum, Biological Survey Collection, July 16, 1899. W. E. Ritter. Orig. no. 2200 (Fisher catalogue).

Characters.—Size, external appearance, and coloration similar to *unalascensis* and *kadiacensis*, but cranial characters differing from both: contrasted with *unalascensis* the anterior end of frontal is less broadened and fails to develop a lachrymal tubercle; auditory bullæ smaller and less inflated; incisive foramina larger and more broadly open anteriorly; zygomata more sharply elbowed at anterior base (as seen from above); jugal narrower. Contrasted with *kadiacensis* the anterior end of frontal is narrower and fails to develop a lachrymal tubercle; bullæ more inflated, blunter, and more rounded anteriorly; molars slightly larger.

In young specimens (and one adult, apparently in left-over winter pelage) the fur is longer and softer, the upperparts are more buffy fulvous, and the white of the underparts is washed with yellowish buff.

Measurements.—An adult female from type locality: total length 188; tail vertebrae 43; hind foot 22.

MICROTUS ABBREVIATUS¹ FISHERI subsp. nov.

St. Matthew Island Vole.

Type from St. Matthew Id., Bering Sea. No. 97976 ♂ ad. U. S. National Museum, Biological Survey Collection. July 15, 1899. A. K. Fisher. Orig. no. 2189.

Characters.—Similar to *M. abbreviatus* but yellow suffusion even more intense, particularly on belly; nasals and rostrum (above) decidedly longer; zygomata more strongly bowed outward; bullae broader, less pointed anteriorly, and less flattened on outer side.

¹ Since the original description of *Microtus abbreviatus* was based on a poor alcoholic specimen and does not fairly present the characters of the species, I have drawn up the accompanying description from a series of adults collected by me at the type locality:

MICROTUS ABBREVIATUS Miller.

Hall Island Vole.

Type from Hall Island, Bering Sea.

Characters.—Size large; ears rather small; tail exceedingly short, thick and densely covered with long hairs; fur long, full and soft; appearance lemming-like; color deep yellowish gray unlike any other *Microtus* known to me, except the closely allied form from the adjacent St. Matthew Id.

Color.—Upperparts uniform deep yellowish gray, intimately but inconspicuously mixed with black hairs, becoming light ochraceous buff or bright buff on the sides, and darkening to grayish fulvous on head; underparts whitish, strongly washed with yellowish buff; fore and hind feet whitish, washed with buffy; tail bicolor, dusky above, overlaid with long buffy hairs, buffy below. *Young*; upperparts yellowish or buffy brown; underparts plumbeous washed with buffy ochraceous.

Cranial characters.—Skull large (largest of the Bering Sea species except *innuitus* from St. Lawrence Id.); zygomata moderately bowed outward, their outer sides parallel; jugal only slightly if at all expanded; frontal 'pinched in' between orbits, its muscular impressions uniting in a low ridge along median line; braincase large and broad; interparietal in adults pentagonal, the anterior border straight with a pointed projection on median line; the hinder border produced posteriorly so as to be broadly triangular, forming two sides; bullae of moderate size, pointed anteriorly and flattened on outer side; incisive foramina shortly open anteriorly, broadly constricted posteriorly; antorbital foramen without protruding anterior lip; incisors not protruding as in *innuitus*: molars of median or rather large size; m^2 with only 2 completely closed triangles; m_1 with 5 closed triangles.

Measurements.—Adult male: total length 170; tail vertebrae 29; hind foot 24. Average of 3 females: total length 156; tail vertebrae 25; hind foot 23.2. Skull of male adult (97981): total length, 30.3; zygomatic breadth 18; mastoid breadth 14; nasals 8.8; molar series 7.

Measurements.—Type, ♂ ad.: total length 178; tail vertebræ 32; hind foot 24. Average of 5 females from type locality: total length 166; tail vertebræ 26.5; hind foot 22.5. Skull of type: basal length 31.5; zygomatic breadth 19; mastoid breadth 14; nasals 9.8; molar series 7.3.

MICROTUS MACFARLANI sp. nov. MacFarlane Vole.

Type from Fort Anderson, north of Great Bear Lake, Arctic America.

No. $\frac{9155}{37347}$ ad. U. S. National Museum. R. MacFarlane. Orig. no. 3179.

Characters.—Size medium or rather large; tail short. Similar externally to *operarius* but (apparently) larger; tail decidedly shorter; skull larger; molars small.

Color.—Upperparts uniform dull fulvous brown mixed with black hairs; underparts whitish, washed with buffy; hind foot brown with more or less whitish on toes; tail sharply bicolor, dusky above, soiled whitish below.

Cranial characters.—Skull similar to that of *operarius* but braincase broader; zygomata with outer sides longer and parallel (not broadest in middle); bullæ much more fully and roundly inflated; nasals shorter; mandible decidedly larger; incisors decidedly thicker (anteroposteriorly); molar series slightly if at all longer. Compared with *yakutatensis* the skull is shorter, flatter, and somewhat smaller; with molars decidedly smaller.

Measurements.—No measurements of fresh specimens are available. In the dry skin of the type the hind foot measures 18.5 and the tail approximately 32.

EVOTOMYS ORCA sp. nov. Orca Evotomys.

Type from Orca, Prince William Sound, Alaska. No. 98028 ♀ ad.

U. S. National Museum, Biological Survey Collection. June 28, 1899. A. K. Fisher. Orig. no. 2139.

Characters.—Size medium; coloration dark; feet and tail dusky.

Color.—Dorsal area dark chestnut or hazel; sides yellowish or buffy drab, intimately mixed with black hairs and darkest on rump; face very dark, grizzled with buffy-gray and black; underparts deep buffy or buffy ochraceous, the plumbeous underfur showing through; hind feet dusky; tail above dusky from base to tip, below buffy.

Cranial characters.—Skull similar to that of *dawsoni* (with large subquadrate braincase and strongly developed postorbital crest of squamosal) but with decidedly smaller bullæ and decidedly larger incisors, particularly the upper ones. The underjaw is thicker and the angular process less flaring.

Measurements.—Type: total length 138; tail vertebrae 30; hind foot 20. Average of 6 specimens from type locality: total length 140; tail vertebrae 32; hind foot 20.

Remarks.—The coloration varies somewhat, and the differences are probably seasonal. The type, which appears to be in fresh summer pelage, is in the darkest stage. Other specimens, apparently in left-over winter pelage, or in the molt, are paler, but still have the characteristic dark feet and tail. In 6 out of the 7 specimens secured by us in Prince William Sound, the underparts are strongly suffused with buffy ochraceous; in one only they are whitish (no. 98035).

DICROSTONYX UNALASCENSIS sp. nov.

Unalaska Lemming.

Type from Unalaska, Alaska. No. 99622 ad. U. S. National Museum, Biological Survey Collection. July 8, 1899. C. Hart Merriam. Found in owl pellets.

Characters.—Size rather large, equalling or exceeding *D. hudsonius* from Labrador; external characters unknown. Skull large and broad with subquadrate braincase, broadly spreading rounded zygomata, broadly sulcate frontal, and prominent peg-like postorbital processes of squamosal.

Compared with *D. hudsonius* from Chimo, Ungava, the anterior angle of the zygoma is less expanded, jugal longer, angle of mandible broader and more strongly everted, bullæ much larger; upper incisors much broader; m^1 with 3 (instead of 2) closed triangles on inner side in addition to posterior (or heel) loop; m^2 with 2d loop on inner side normal and separated by full interspace from anterior crescent of m^3 , and with posterior (heel) loop on outer side complete. In *hudsonius* the 2d loop on inner side is narrowed or flattened and in contact with m^3 , and the posterior loop on outer side is absent or reduced to a small remnant.

DICROSTONYX NELSONI sp. nov. White Tundra Lemming.

Type from St. Michaels, Alaska. No. $\frac{5488}{6163}$ ♀ yg. ad. Merriam Collection.

Characters.—Size rather small; a dark dorsal stripe present in summer pelage; winter pelage white.

Color.—Type specimen in change from winter to summer pelage (date unknown): Upperparts from halfway between nose and eyes to rump finely mixed chestnut and yellowish white (hairs with chestnut tips and a broad subapical zone of yellowish or buffy) becoming

darker posteriorly; rest of animal (including nose, cheek, feet and tail) yellowish white with indistinct fulvous markings as follows: a patch on each side posteriorly, one on pectoral region, reaching up on sides of neck to ears, and a ring around (but not reaching) base of tail; a dark brownish median stripe reaching from middle of back to ring around tail.

Cranial characters.—Skull similar to that of *unalascensis* in general form, form of zygoma and jugal, and in enamel pattern, but smaller, and differing from all known species in the bullæ, which are very *small and narrow*; incisive foramina short; molars small and rather narrow, but not quite so narrow as in *richardsoni*.

Measurements.—Type specimen (measured from alcohol by C. H. M.): total length 118; tail vertebræ 13; hind foot 18.

DICROSTONYX RICHARDSONI sp. nov. Churchill Lemming.

Type from Fort Churchill, Hudson Bay. No. $\frac{54}{61} \frac{8.9}{6.4}$ ♂ ad. Merriam Collection. July 1859. W. MacTavish.

Characters.—Size large; fur long and silky; 3d nail of forefoot much larger than 4th; *bullæ broadly rounded and somewhat depressed*.

Color.—Type specimen in winter pelage: silky white all over.

Cranial characters.—Skull large; zygomata very broad and squarely spreading; rostrum and nasals long, frontals rather narrow inter-orbitally; *bullæ depressed, broadly and roundly inflated*. Molar series *narrow*; enamel pattern as in *nelsoni* and *unalascensis* (not as in *hudsonius*).

This species resembles *nelsoni* but differs from all others in the small size and narrowness of the molar teeth, and is distinguishable at a glance from *all* known species by the broadly rounded and rather depressed bullæ.

Measurements.—Type specimen (measured from alcohol by C. H. M.): total length 143; tail vertebræ 14; hind foot 20.

LEMMUS ALASCENSIS sp. nov. Point Barrow Lemming.

Type from Point Barrow, Alaska. No. $\frac{54}{61} \frac{9.1}{6.6}$ ♀ ad. Merriam Collection.

Characters.—Size medium (slightly smaller than either *lemmus* or *nigripes*); ears smaller than in *nigripes*; feet and nose pale.

Color.—Type specimen (in alcohol) from Point Barrow, and a skin (alcoholic) from St. Michaels: entire animal golden fulvous, darkest on head, where it is mixed with black hairs; brightest on sides, where it is almost orange fulvous; palest on feet and around mouth.

Cranial characters.—Skull similar to that of *L. lemmus* but slightly smaller; braincase smaller and less flattened; zygomata less widely spreading; angle of mandible much less everted; upper incisors heavier (broader). Compared with *nigripes* from the Pribilof Islands the differences are more marked: skull decidedly smaller and less massive; nasals much shorter and smaller; rostrum more slender; frontals not elevated into tubercles anteriorly; *bullæ larger* (more broadly inflated); angle of jaw much smaller and less everted. Molar series shorter.

Measurements.—Type specimen (measured from alcohol by C. H. M.): total length 115; tail vertebræ 15; hind foot 18.

LEMMUS YUKONENSIS sp. nov. Yukon Lemming.

Type from Charlie Creek, Yukon River, Alaska. No. 98849 ♀ ad. U. S. National Museum, Biological Survey Collection. Aug. 9, 1899. W. H. Osgood. Orig. no. 769.

Characters.—Size small, ears relatively large; general color dark anteriorly, with bright fulvous or rufous rump and flanks; *audital bullæ immense*.

Color.—Head, shoulders, and anterior half of back grayish brown, grizzled with black and yellowish fulvous, darkest on top of nose; rump and hinder part of back rich rusty fulvous or orange fulvous; lower sides and belly golden fulvous; deepest and brightest on flanks; sides of nose grayish or grayish brown; a band of golden fulvous on lower part of face from nose to below ear; fore and hind feet dusky; tail bicolor, dusky above, buffy below.

Cranial characters.—Skull very different from any species known to me: braincase (seen from above) large, broad, and *produced posteriorly* to cover the enormously enlarged bullæ; frontal narrow inter-orbitally, with a narrow median sulcus, but not 'pinched in' as in *L. alascensis*; rostrum small; zygomata squarely set but not widely spreading, the sides parallel; interparietal large, usually pentagonal; incisive foramina rather short; *bullæ remarkably large* and strongly inflated.

Measurements.—(From well made dry skin:) total length 130; tail vertebræ 17; hind foot 19.5.

ERETHIZON EPIXANTHUS MYOPS subsp. nov. Alaska Porcupine.

Type from Portage Bay, Alaska Peninsula. No. 59140 ♀ old, U. S. National Museum. September 1893. Chas. H. Townsend.

Characters.—Similar to *E. epixanthus* but tail and hind feet shorter; body, flanks and sides of tail even yellower; face whiter from more abundant admixture of yellowish white hairs on sides of face and between eyes, so that the fore part of head appears almost grayish instead of sooty.

Cranial characters.—Compared with typical *epixanthus* from California the skull as a whole is much shorter, broader, and more rounded (less angular); occipital and sagittal crests absent or much less developed; zygomata bowed strongly outward [instead of subtriangular], the outer side convex outward [not flat]; braincase short, broad between posterior roots of zygomata, and tapering posteriorly so that the breadth between squamosals anteriorly is much greater than breadth of occiput [instead of subequal]; outer wall of antorbital vacuity (seen from the side) nearly straight and vertical [instead of strongly concave].

Remarks.—An immature female collected at Stepovak Bay, Alaska Peninsula, July 9, 1899, by Charles Palache is the yellowest porcupine I ever saw. It measured 630 mm in total length.

LEPUS OTIUS sp. nov. Tundra Polar Hare.

Type from St. Michaels, Alaska. Skull no. 15883 U. S. National Museum. L. M. Turner.

Characters.—Size very large (hind foot 174); winter pelage white all over except extreme tips of ears, which are black.

Cranial characters.—The skull of *Lepus othus* is so large, broad, and massive that it does not require comparison with the *glacialis* series from eastern Arctic America, but only with *tschuktshorum* from the region about Plover Bay, Siberia. From *tschuktshorum* it differs in the following particulars: frontals slightly broader interorbitally; nasals narrower and less flattened; supraoccipital shield narrower, *much longer than broad* [in *tschuktshorum* decidedly broader than long]; *jugal decidedly narrower* (less expanded vertically), longer posteriorly (protruding farther behind squamosal root of zygoma), and with muscular impression on outer face decidedly narrower anteriorly; basioccipital narrower; incisive vacuity smaller.

Cranial measurements.—Type specimen: basal length 86.5; zygomatic breadth anteriorly .49; at widest point .52; postpalatal length .46.5; greatest breadth across postorbital processes .39; greatest breadth of nasals posteriorly .22; anteriorly .20.

LEPUS POADROMUS sp. nov. Peninsula Arctic Hare.

Type from Stepovak Bay, Alaska Peninsula. No. 98068 U. S. National Museum, Biological Survey Collection. July 8, 1899. C. Hart Merriam. (Shot by Charles Palachie.) Orig. no. 2207 (Fisher catalogue).

Characters.—Size smaller than *Lepus othus* from St. Michaels, but larger than the members of the *glacialis* series from eastern Arctic America; ears about as in *L. othus*, but hind feet and tail shorter; color in summer pelage *grizzled gray* with a fulvous tinge on head.

Color.—Nose and head dull fulvous with a buffy ring around eye; cheeks dull fulvous, grizzled with longer hairs tipped with black and buffy; ears grizzled fulvous and black on anterior face, becoming white posteriorly, and narrowly edged with white except on basal third of anterior margin, which is grizzled fulvous and black like rest of anterior face; back, sides, and outer surface of hind legs gray, grizzled with buffy and black; forelegs grizzled grayish fulvous, becoming pale dull fulvous on dorsal surface of feet and mixed with white hairs about toes; hind feet mainly white; tail hoary or grayish white, becoming dusky along median line above; chin and lips whitish; throat with a broad grayish collar; pectoral region, strip down belly, and inner sides of legs, whitish.

Cranial characters.—Compared with its nearest known relative, *L. othus* from St. Michaels, the rostrum, nasals, braincase, palatal bridge, and incisive vacuity are narrower, the frontal breadth remaining essentially the same; nasals in particular *much narrower* and more arched transversely; pterygoids broader; hamular processes more produced and hooked; angular process of underjaw with everted edge much broader posteriorly.

Remarks.—*Lepus poadromus*, compared with a skin of *tschukthorum* from Arikamehichi Island (No. 3384 U. S. Nat. Mus.) has the fulvous of the nose and head very much darker. Unfortunately no skins of *L. othus* in summer pelage are available for comparison.

Measurements.—(From dry skin of type:) Hind foot 152; ear from notch 80.

Cranial measurements.—Basal length 82; zygomatic breadth anteriorly 47.5; postpalatal length 43; greatest breadth across post-orbital processes 37; greatest breadth of nasals posteriorly 20; anteriorly 16.

LEPUS AMERICANUS DALLI subsp. nov. Dall's Varying Hare.

Type (skull) from Nulato River, Alaska, no. 7579. U. S. National Museum. W. H. Dall.

Characters.—External characters unknown.

Cranial characters.—Skull large; nasals long and slender; posterior part of mandible large. Compared with typical *americanus* from Ungava, Hudson Strait, the skull of *dalli* is very much larger (basal length 65 mm. or more instead of 61 or less): rostrum, nasals, and incisive vacuity decidedly longer; jugal longer and somewhat broader (vertically); mandible very much larger and more expanded posteriorly; molariform teeth larger.

Remarks.—Superficially the skull of *dalli* resembles that of subspecies *virginianus* from Ossipee, New Hampshire, much more closely than typical *americanus*; the agreement in size is better and both have rather long, slender nasals. But *dalli* has a much broader braincase, longer and heavier zygomata, broader jugals, and differs in other particulars. Compared with its geographical neighbor, *L. macfarlani* from Fort Anderson, it may be distinguished at a glance by its slender nasals and rostrum, longer zygomata, and larger mandible.

Cranial measurements.—Type skull: Basal length 65; zygomatic breadth anteriorly 37.5; at middle 38; postpalatal length 33.5; frontal breadth across middle of postorbital processes 21; breadth of nasals posteriorly 15; anteriorly 11.

LEPUS AMERICANUS MACFARLANI subsp. nov.
MacFarlane Varying Hare.

Type (skull) from Fort Anderson, north of Great Bear Lake, Arctic America. No. 14467 U. S. National Museum. R. MacFarlane.

Characters.—External characters unknown.

Cranial characters.—Skull similar to that of typical *americanus* from Hudson Strait but very much larger and heavier; nasals very broad (anteriorly as well as posteriorly); braincase less flattened; supraoccipital shield narrower and tapering posteriorly; mandible, molariform teeth, and lower incisors decidedly larger. Compared with *dalli* from Nulato River the nasals are very much broader and blunter; rostrum broader and more massive; braincase higher (almost ridged along median line) and much less flattened; supraoccipital shield narrower posteriorly (more tapering); mandible somewhat smaller.

Cranial measurements.—Basal length 67; zygomatic breadth anteriorly 38.5; at middle 11; postpalatal length 34.5; frontal breadth across middle of postorbital processes 21; breadth of nasals posteriorly 17.5; anteriorly 14.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 31-38.

MARCH 30, 1900.

THE BATS OF THE GENUS *MONOPHYLLUS*.

BY GERRIT S. MILLER, JR.

HITHERTO *Monophyllus* has been regarded as a monotypic genus, with *M. redmani* of Jamaica, and perhaps Cuba also, as its only representative. Material in the United States National Museum, though throwing no light on the question of the identity of the Cuban bat with that from Jamaica, shows that the genus contains at least three additional species, one from Porto Rico, one from Barbados and a third from an unknown locality. The four may be distinguished from each other as follows :

SYNOPSIS OF THE SPECIES OF *MONOPHYLLUS*.

Size small, forearm about 36, greatest length of skull less than 20 ;
second upper premolar with well developed postero-internal lobe.

M. portoricensis.

Size large, forearm about 40, greatest length of skull more than 20 ;
second upper premolar with postero-internal lobe rudimentary or
absent.

Second lower premolar shorter than first and in contact with third ;
no space between upper premolars.....*M. plethodon*.

Second lower premolar longer than first and not in contact with
third ; a space between upper premolars.

Ventral surface of basioccipital (when viewed from under side)
dipping forward at conspicuous angle (about 32°) with surface
of presphenoid ; bony palate narrow and conspicuously arched.

M. clinedaphus.

Ventral surface of basioccipital (when viewed from under side)
dipping forward at inconspicuous angle (about 16°) with sur-
face of presphenoid ; bony palate broad and slightly arched.

M. redmani.

MONOPHYLLUS REDMANI Leach.

1822. *Monophyllus redmani* Leach, Trans. Linn. Soc. London, XIII, p. 76.

1878. *Monophyllus redmani* Dobson, Catal. Chiropt. Brit. Mus. p. 504.

1898. *Monophyllus redmani* H. Allen, Trans. Am. Philos. Soc. N. S., XIX, p. 248.

Type locality.—Jamaica.

Geographic distribution.—Jamaica. It is doubtful whether the specimens from Cuba recorded by Dobson are actually this species.

General characters.—See synopsis.

Ears.—The ears are short: laid forward they reach about 3 mm beyond eye. Anterior border strongly convex at base, then nearly straight but strongly oblique to narrowly rounded tip. Posterior border slightly concave below tip, then straight to a little below level of anterior base; below this abruptly convex. There is no antitragus. The posterior border terminates directly beneath anterior base, and about 7 mm. behind angle of mouth. A few rudimentary cross striations are faintly indicated on inner side of conch near posterior border. Two well developed ridges run outward along the meatus, one directly over the other. Anterior border of tragus straight, very slightly thickened above. Tip narrowly rounded. Posterior border straight from tip to two tooth-like projections, the lowermost of which is opposite anterior base, then distinctly convex.

Muzzle and chin.—Horizontal portion of noseleaf oval, broader than high, indistinct along upper lip, distinct at side. Height of upright portion about equal to width of horizontal portion, narrowing gradually to rounded tip the width of which is a little less than 1 mm. For a short distance below tip the sides are parallel. Whole leaf finely pubescent. Chin divided by a deep groove.

Membranes.—The membranes are ample, moderately coarse in texture. Width of wing membrane at elbow about 30 mm. Width of propatagium at elbow, 15. Width of uropatagium at middle of femur, 8. Propatagium continued along forearm to include metacarpal of thumb. The membranes are practically naked throughout, though the fur extends in a narrow line on wings close to body, and also over proximal third of forearm and on most of propatagium. On the latter it is very sparse and irregular.

Feet.—The feet are large, slightly more than half as long as tibia. Toes a little shorter than metacarpals, free from membrane. They are armed with very strong claws. All five toes are essentially equal in length. Calcar distinct, but reduced to a mere rudiment, about 4 mm. long.

Tail.—The tail is about as long as the foot, and a little less than half free from membrane.

Fur and color.—The fur is loose in texture and very short (scarcely 5 mm. on middle of back). It is closely confined to body, scarcely reaching membranes except as stated above.

Color of a specimen after five years' immersion in alcohol, rather pale Prouts brown above, Isabella color below, the hairs tipped with pale gray. These tips are inconspicuous above but very noticeable below.

Skull.—The skull of *Monophyllus redmani* is slender but at the same time rather robustly built, in form almost precisely like that of the somewhat larger *Glossonycteris geoffroyi*. Rostrum nearly as long as braincase, its sides essentially parallel. It is narrowest just behind canines. A distinct swelling in lachrymal region over each orbit. Antorbital foramen directly above space between premolars, its upper and posterior margins swollen. Zygomata slender, distinctly expanded vertically near anterior and posterior base, the anterior expansion upward, the posterior downward. Braincase slender, considerably longer than broad, the forehead rising above rostrum at angle of about 20°. Highest point of braincase over middle of mesencephalon. Audital bullæ small, the area of each scarcely exceeding that of glenoid surface. That part of base of braincase formed by basioccipital and basisphenoid forms a plane dipping uninterruptedly forward (when skull is viewed with its dorsum down) from anterior lip of foramen magnum to well developed basisphenoid pits at an inconspicuous angle, about 16°, with surface of presphenoid. The entire ventral surface of the presphenoid lies in one plane, broken only by a narrow but well defined median longitudinal ridge which terminates posteriorly in a pointed projection lying ventral to the ridge separating basisphenoid pits.

Measurements of an adult skull (♂) from Kingston, Jamaica : Greatest length 22.4; basal length 21.4; basilar length 19.4; zygomatic breadth 10; least interorbital breadth 4; mastoid breadth 9.8; greatest breadth of braincase 9; frontopalatal depth (at middle of molar series) 2.4; depth of braincase 8; maxillary toothrow (exclusive of incisors) 8.6; mandible 15.4; mandibular toothrow (exclusive of incisors) 9.

Teeth.—The teeth are small relatively to the size of the skull, though not different in this respect from those of members of related genera. Both upper and lower toothrows are broken by a conspicuous gap in front of posterior premolar. Second upper premolar broader posteriorly than anteriorly, but without postero-internal lobe.

First lower premolar shorter than second or third, but relatively less narrow. Its posterior border is scarcely imbricated over anterior extremity of second premolar.

Measurements.—For measurements of *Monophyllus redmani* see table, page 38.

Specimens examined.—One, from Kingston, Jamaica.

Remarks.—*Monophyllus redmani* is readily distinguishable from the other members of the genus by its large size, heavy rostrum, and nearly flat base of braincase. The peculiarities of the tragus in the only specimen that I have examined may be due to the effect of strong alcohol.

MONOPHYLLUS PORTORICENSIS sp. nov.

Type.—Adult male (in alcohol), no. 86261 United States National Museum, collected in a cave near Bayamon, Porto Rico, January 18, 1899, by Paul Beckwith.

General characters.—See synopsis.

Ears.—The ears are essentially like those of *M. redmani*. The tragus, however, is very conspicuously thickened along its anterior border. Inner surface of conch with scarcely a trace of cross striation.

Muzzle and chin.—Noseleaf smaller than in *M. redmani* and less tapering above, the sides not parallel below tip. Groove in chin apparently deeper and narrower than in *M. redmani*.

Membranes, feet and tail as in *M. redmani*.

Fur and color.—Fur slightly longer than in *M. redmani* (about 6 mm. long on middle of back) but not different in quality or distribution.

Color of a specimen (topotype) skinned after two months' immersion in formalin, seal brown above, broccoli brown below, the extreme tips of the hairs grayish. The light tips are conspicuous on the ventral surface, but scarcely noticeable above.

Skull.—The skull of *Monophyllus portoricensis* is considerably smaller than that of *M. redmani*, and as the reduction in size affects the rostrum relatively more than the braincase the general appearance of the skull is considerably altered. In fact at first glance the skull strongly suggests that of *Glossophaga soricina*, though it is slightly smaller. The rostrum is very noticeably shorter than the braincase. Its sides are nearly parallel and scarcely divergent at base of canines. The braincase rises above rostrum at a slightly greater angle (about 25°) than in *M. redmani*. Base of braincase exactly as in *M. redmani*, except that median ridge of presphenoid is somewhat flattened posteriorly and perfectly continuous with ridge separating basisphenoid pits.

Measurements of skull of type: Greatest length 19.6; basal length 18; basilar length 16; zygomatic breadth 8.8; least interorbital breadth 4; mastoid breadth 8.8; greatest breadth of braincase 8.4; fronto-palatal depth at middle of molar series 2; depth of brain case 7.6; maxillary toothrow (exclusive of incisors) 7; mandible 12.8; mandibular toothrow (exclusive of incisors) 7.

Teeth.—Teeth as in *M. redmani* except that the gap in toothrow in front of posterior premolar is greatly reduced, and in the lower jaw nearly obliterated. Second upper premolar with well developed postero-internal lobe. First lower premolar slightly shorter than second or third, and conspicuously less narrow. Its main axis is set obliquely to that of the other premolars and its posterior border is noticeably imbricated over outer edge of second premolar.

Measurements.—For measurements of *Monophyllus portoricensis* see table, page 38.

Specimens examined.—Six, all from the type locality.

Remarks.—*Monophyllus portoricensis* is the smallest of the four species thus far known. It is further distinguished by the form of the posterior premolar.

MONOPHYLLUS PLETHODON sp. nov.

Type.—Adult male (in alcohol) no. 101530, United States National Museum, collected in St. Michaels Parish, Barbados, August 1, 1899, by P. McDonough.

General characters.—See synopsis.

Ears.—The ears are essentially as in *M. redmani* though somewhat broader relatively to their length. Inner surface without cross ridges. Tragus as in *M. portoricensis*.

Muzzle and chin.—Noseleaf like that of *M. portoricensis*, but with upright portion even broader and more bluntly pointed. Groove in chin broader and shallower than in the Porto Rican species.

Membranes, feet and tail as in *M. redmani*.

Fur and color.—Fur similar to that of *M. redmani* in both quality and distribution. Color of type after five months' immersion in alcohol, broccoli brown slightly paler below.

Skull.—The skull of the type specimen has been injured, though not sufficiently to obscure its essential characters. In size it closely agrees with that of *M. clinedaphus*, but in form it suggests that of *M. portoricensis*. Its peculiarities are in some respects carried even further than in the latter, as the rostrum though deeper is relatively narrower, the palate is more arched, and the canines actually closer

together than in the smaller animal. Antorbital foramen over anterior extremity of second premolar and region of contact between it and first. Pterygoids imperfect, but evidently further apart than in *M. redmani*. Base of braincase as in *M. redmani* and *M. portoricensis*. Presphenoid injured, but apparently as in these species and not like that of *M. clinedaphus*. Zygomata very lightly built, even more slender than in *M. portoricensis*. Mandible about as long as that of *M. clinedaphus*, but more lightly built than in any of the known members of the genus; while distinctly longer than that of *M. portoricensis* it is scarcely if any deeper.

Measurements of skull of type: Greatest length 21.6; basal length 19.4; basilar length 17.8; zygomatic breadth 9.8; least interorbital breadth 4.6; mastoid breadth 9.6; greatest breadth of braincase 10; frontopalatal depth (at middle of molar series) 2.4; depth of braincase 6; maxillary toothrow (exclusive of incisors) 7.2; mandible 14; postdental portion of mandible 5.8; mandibular toothrow (exclusive of incisors) 7.8.

Teeth.—The teeth of *Monophyllus plethodon* differ conspicuously from those of the other members of the genus in that they are so crowded that all trace of the characteristic space in front of posterior premolar of both jaws is obliterated. This tendency to crowding is also evident in the upper incisors, the innermost pair of which are almost in contact, while in the three other species they are separated by a noticeable space. Canines slender, relatively closer together than in other members of the genus, *their shafts parallel or a little convergent*. Maxillary teeth otherwise essentially as in *M. redmani*. Mandibular incisors very minute, but normal in form and position. First lower premolar distinctly longer than second, over which its posterior edge is imbricated, much as in *M. portoricensis*. The remaining mandibular teeth do not differ conspicuously from those of the other members of the genus.

Measurements.—For measurements of *Monophyllus plethodon* see table, page 38.

Specimens examined.—One, the type.

Remarks.—*Monophyllus plethodon* is immediately recognizable by its crowded teeth and slender rostrum.

MONOPHYLLUS CLINEDAPHIUS sp. nov.

Type.—Adult male (in alcohol) no. $\frac{5219}{37465}$ United States National Museum. No history.

General characters.—See synopsis.

Ear.—The ears exactly resemble those of *M. redmani* except that they are slightly broader and the inner surface of the conch is marked by seven distinct parallel cross ridges.

Muzzle and chin.—Noseleaf smaller than in *M. redmani*, the upright portion less tapering at tip, its sides nowhere parallel. Groove in chin apparently narrower and deeper than in *M. redmani*.

Membrane, feet and tail as in *M. redmani*.

Fur and color.—Fur similar to that of *M. redmani* in distribution and quality. Color after nearly forty years' immersion in alcohol, mars brown above, wood brown below.

Skull.—The skull of *Monophyllus clinedaphus* is slightly smaller than that of *M. redmani*, though in general appearance it is not noticeably different. In *M. clinedaphus* the rostrum is slightly narrower anteriorly, and the antorbital foramen is placed further forward, its anterior half lying over the first premolar. The striking differences between the two species are seen in the base of the braincase when the skull is held back down. In *M. clinedaphus* the plane of the basioccipital and basisphenoid, instead of sloping forward at a faint angle as in the other species of the genus, pitches abruptly forward and downward at an angle of 32° . The resulting secondary changes in form of the adjacent parts are noticeable on comparison, though not easy to describe. Presphenoid with ventral surface in two planes, the change from the anterior more ventral level to the posterior more dorsal level taking place abruptly at a point about half way between tip of hamulars and line joining posterior molars. The median ridge extends as far back as the anterior (ventral) level only, leaving the posterior level essentially flat.

Measurements of skull of type: Greatest length 21.8; basal length 19.4; basilar length 17.4; zygomatic breadth 9; least interorbital breadth 4; mastoid breadth 9; greatest breadth of braincase 9; frontopalatal depth (at middle of molar series) 2.4; depth of braincase 8; maxillary tooththrow (exclusive of incisors) 8; mandible 14; mandibular tooththrow (exclusive of incisors) 8.4.

Teeth.—The teeth are slightly smaller than in *M. redmani*, but of the same form.

Measurements.—For measurements of *Monophyllus clinedaphus* see table, page 38.

Specimens examined.—One, the type.

Remarks.—This species is strongly characterized by the form of the presphenoid as well as by the more conspicuous peculiarities of the base of the braincase. It requires no special comparison with the other members of the genus.

MEASUREMENTS OF SPECIES OF MONOPHYLLUS.

Name.	Locality.	Number.	Sex.	Total length.	Tail.	Tibia.	Foot.	Calc. ar.	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear.		Noseleaf.		Tragus.	
															from meatus.	from crown.	width.	height.		width.	height.
<i>M. redmani</i>	Jamaica.	64480	♂	68	10	18	11	3.4	40	11.4	38	88	65	57	13	11	8	5.5	4	4.4
<i>M. dinedaphus</i> .	?	5210	♂	65	8	16.4	9	4	39	9	33	77	56	51	12	9	10	4.6	3.6	5
<i>M. portoricensis</i> .	Porto Rico.	86256	♀	60	9.4	16	9	4	36	9	32	73	55	48	12	10	8.6	5.4	3.8	4
"	"	86259	♀	65	8	16.4	9.4	4	36	9	29	72	53	49	12.8	9.6	8	5	3.8	4
"	"	86260	♀	67	7	16	9	3	37	10	28	72	53	48	12	9	8.8	4.8	3.8	5
"	"	86258	♂	65	9	16	8.4	4	37	8.4	31	76	55	48	12.6	10	9	5	3.6	4
"	"	86261	♂	62	9	15	9	3	36	8.8	29	74	53	49	12.4	10	9	5	3.6	4
<i>M. plethodon</i> .	Barbados.	101530	♂	68	9	17	11	2.4	38	12	32	77	57	50	13.6	8.8	10	5	3.6	4.8

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 39-40.

MARCH 30, 1900

A NEW SHREW FROM EASTERN TURKESTAN.

BY GERRIT S. MILLER, JR.

ON January 10, 1894, Dr. W. L. Abbott collected a small shrew in the jungle east of Maralbashi, near the Yarkand river, eastern Turkestan. The specimen represents a *Crocidura* smaller than the *C. myoides* Blanford of Kashmir¹ and strikingly different in color; but unfortunately its skull has been mislaid or lost. The lack of the skull has hitherto deterred me from describing the species, but a careful re-examination of the specimen shows that its characters are too strongly marked to be ignored. It may be called:

CROCIDURA LIGNICOLOR sp. nov.

Type.—Adult female (skin) no. 62180 United States National Museum, collected in jungle east of Maralbashi, eastern Turkestan, near the Yarkand river, January 10, 1894.

Characters.—Smaller than *Crocidura russula* and *C. myoides*, the tail more densely haired and relatively much shorter. Color strongly suggesting that of *Mus pachycercus*.

Tail.—The tail is about half as long as head and body, therefore much shorter than in *C. russula* and *C. myoides*. It is densely furred throughout, so that the annulation is completely hidden. Interpersed with the finer appressed hairs are the usual slender bristles, about 6 mm in length. Pencil distinct, 4 mm long.

Feet.—The feet are small and slender, both palms and soles 6-tuberculate. Palmar tubercles as in *Crocidura russula*. Plantar tubercles as in *C. russula*,² except that the posterior and penultimate on

¹ The type was collected at Leh. The National Museum contains a specimen taken by Dr. Abbott in a pine forest among the mountains of central Kashmir, at an elevation of about 10,000 feet.

² In *C. myoides* the tubercles are apparently like those of *C. russula*, but the soles of the Kashmir specimen are injured.

the outer side are larger, and placed almost directly opposite those of inner side.

Ears.—The ear is slightly smaller than that of *C. myoides*; therefore much smaller than in *C. russula*. It is not peculiar in form.

Fur.—The fur is dense and silky, that on middle of back about 7 mm. in length. The hairs throughout have a distinct gloss, producing a strong contrast with the dull fur of *Crocidura myoides*.

Color.—Entire dorsal surface of head and body wood brown, almost exactly matching the plate in Ridgway's Nomenclature of Colors. Tail wood brown, slightly paler below than above, its dorsal surface like back. Sides, legs, feet and entire ventral surface of head and body grayish-white. Fur of body slate-black through basal two-thirds or three-fourths, the dark portion crossed by several indistinct narrow pale bands which produce an effect like watered silk when the hairs are smoothly parted.

Measurements.—Total length 82; head and body 54; ¹ tail vertebrae 28.5; ¹ hind foot 12 (11); ² ear from meatus 5.6; ear from crown 3; width of ear 6.8.

Remarks.—^{*}In its peculiar color this species differs widely from described members of the genus and shows a striking parallelism with the small *Mus pachycercus* inhabiting the same region. What its cranial and dental characters will prove to be can only be conjectured, but there is every reason to suppose that they will essentially agree with those of *Crocidura myoides* and *C. russula*.

¹ From fresh specimen by collector.

² Measurement of hind foot in parenthesis taken without claws.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 41-68.

JULY 25, 1900.

A NEW STONY METEORITE FROM ALLEGAN,
MICHIGAN, AND A NEW IRON METEORITE
FROM MART, TEXAS.¹

BY GEORGE P. MERRILL AND H. N. STOKES.

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THE ALLEGAN METEORITE.

HISTORY AND PETROGRAPHY.

A LITTLE after eight o'clock on the morning of July 10, 1899, there fell on what is locally known as Thomas Hill, on the Saugatuck Road, in Allegan, Michigan, a stony meteorite, the total weight of which cannot have been far from seventy pounds, although, unfortunately, it was badly shattered in striking the ground, and its exact weight can never be known.

¹These meteorites have been the subject* of a preliminary notice by Dr. Merrill in *Science* for November 24, 1899, and the Allegan stone by Mr. H. L. Ward in the *American Journal of Science* for December, 1899. The general and petrographic description are by G. P. Merrill, and the chemical examination is by Dr. H. N. Stokes. The chemical analyses were made in the laboratory of the U. S. Geological Survey and are published here by permission of the Director.

The main mass of the stone (see Pl. I, figs. 1, 2 and 3) weighing $62\frac{1}{2}$ pounds, came into the possession of the National Museum, with an additional fragment weighing about $1\frac{1}{2}$ pounds. This, with a 4-pound fragment, sold to other parties, and many small pieces stated as varying from the size of a pea to that of a hickory nut, carried away by school children and others, would readily bring the total weight to the figure mentioned.

According to Mr. Walter Price, as quoted by H. L. Ward¹ the stone came from the northwest and passed within about forty feet of where he was working, striking the ground about ten rods beyond, in sand, and burying itself to the depth of about a foot and a half. The attention of the observers, it is stated, was first attracted by a cannon-like report, followed by a rumbling sound lasting about five minutes (?), which was followed, as the stone came nearer, by a hissing sound, compared to that of an engine blowing off steam.² When first seen in the air the stone had the appearance of a black ball about the size of a man's fist. As it passed the observer, it is stated, "there seemed to be a blue streak behind it, about six feet long, which tapered back to a sharp point." The stone was dug up about five minutes after striking and is stated to have been too hot for handling, necessitating removal with a shovel. "The sand was hot for about two feet round where it struck." Messrs. H. Stern & Company, of Allegan, from whom the National Museum obtained the main mass of the stone, furnished corroborative evidence. They state that the sand about the hole made by the meteor was quite warm an hour after the fall, and that the stone itself was still warm when placed in their shop window, some two and a half hours later.

The general appearance of the stone is well shown in Plate I, figs. 1, 2 and 3. From a study of the mass it would appear that at the time of entering our atmosphere, and for most of its course, the point *A* (uppermost in fig. 1) was in advance,

¹ Am. Jour. Sci., December, 1899.

² It is well to note that there is no evidence to show that the report was accompanied by a breaking up of the stone. But the one mass was seen to fall, and though this is somewhat angular in outline nothing indicates a fracturing after entering the earth's atmosphere and before striking the ground.

but that the broad side (lower surface in the figure) was first to strike the ground. These conclusions are based on the facts that the crust at the top *A*, where friction would have been greatest if this side had been foremost, is scarcely more than a millimeter in thickness, and, as shown by the microscope, is almost wholly glassy, enclosing only residual portions of unfused silicates; while on the other side it is from 2 to 3 mm. in thickness, blebby, and, as seen under the microscope, vesicular, and often crowded with minute silicate crystallites imperfectly secreted from the glassy base¹ (Pl. III, fig. 2). Further, the furrows on the outer surface of the crust, due to atmospheric friction, radiate in all directions from this uppermost point *A*. These furrows show somewhat indistinctly near *B* in fig. 1. That the stone struck broad side down is shown by the grass stems and earth still adhering to this surface.

A point of no inconsiderable interest in this connection lies in the fact that these grass leaves, which were welded to the surface of the stone through impact, or were even driven into the fractures caused by the same, are not charred in the least, nor is there other evidence of heat than that furnished by the black crust already referred to. The grass leaves and earthy matter adhering to the surface of the stone are shown somewhat indistinctly at *C* in Pl. I, fig. 1.

To the unaided eye this stone shows on the broken surface a quite even granular structure of gray color and, on closer inspection, abundant, beautifully spherulitic chondrules, averaging not more than one or two millimeters in diameter (Pl. II). In two cases chondrules nearly 5 mm. in diameter were observed. These are sometimes beautifully spherulitic, or again elongated and irregular in outline, and sometimes have pitted surfaces, such as are seen in compressed pebbles in conglomerates (see Pl. IV, figs. 1-7). The majority of them are dark gray in color, but some are greenish white. They are composed of both olivine and enstatite, as will be noted later. Numerous brilliant metallic points of a silver-white color indicate the presence of disseminated iron. Viewed more closely the

¹A similar thickening of the crust at the rear (rückseite) was noted by Tschermak on the Gopalpur meteorite (Min. Mittheil., 1872, p. 96).

stone is seen to be made up of the chondrules, iron, and dark gray silicate materials, imbedded in a light gray, ashy groundmass.

The stone is exceedingly friable, crumbling away readily between the thumb and fingers. Indeed it is pronounced by Dr. Merrill to be without exception the most friable meteorite that has come to his attention. Naturally it is beautifully fresh and free from all oxidation products.

Examined under the microscope, in thin section, the stone exhibits in a very marked degree the granular fragmental structure which sometimes characterizes chondritic meteorites, as those of Gopalpur, San Miguel, etc., and which is regarded by Tschermak and some other authorities as indicative of a tuffaceous origin. Three types of chondrules are noted: first, the ordinary enstatite chondrules showing the eccentric, fan-shaped structure, too well known to need further description (Pl. V, figs. 3 and 4); second, those composed of olivines, sometimes quite idiomorphic, developed in a black glass (Pl. V, fig. 6): and, third, those which are apparently of enstatite but almost completely structureless (Pl. V, figs. 5, 7 and 9); these last form the greenish chondrules referred to above. There are also occasional olivine chondrules showing the barred or grate structure.

As already noted, some of these chondrules are beautifully spherical and others are in the form of elongated blebs (Pl. IV, figs. 1 and 2). They are sharply differentiated in most cases from the groundmass and break away so readily as to make the preparation of satisfactory thin sections extremely difficult. When isolated they often show one or more shallow concavities, such as might be formed by the pressure of one against another, but no two were found in such contact as to produce this result (Pl. IV, fig. 1). Similar concavities have been noted by Tschermak and Makowsky in chondrules from the Tieschitz (Moravia) meteorite.¹ Many of the enstatite chondrules are distinctly fragmental in outline (Pl. IV, figs. 3-7), and none of them show a holocrystalline internal structure.

¹Denkschriften Kais. Akad. der Wissenschaften, Math. Nat. Classe, B. 39, 1879, p. 195.

Some of them, as separated mechanically from the groundmass, are simply blebs of enstatite slag with cavities resembling the steam cavities in terrestrial rocks or in slags from smelting furnaces (Pl. IV, fig. 5). In a few cases small chondrules show little depressions on one side which are continued as holes into the interior for a third the diameter of the spherule. Pl. IV, figs. 1-7, and Pl. V, figs. 1-6, show the forms and outlines of the chondrules as seen under the microscope in thin section, or isolated. It is to be noted that in the case of a fragment, such as is shown in Pl. V, figs. 3, 4 and 5, no other portions of the same chondrule are recognizable in the slide, showing that the shattering took place prior to the consolidation of the stone. This same feature is emphasized by a study of the chondrules as picked out by hand, many of them being but fragments, with the broken surface covered by the grayish dust of the groundmass, showing that the fractures are old and not due to the breaking of the stone since it reached the earth. Some of the larger of these, showing surface fractures antedating consolidation, are shown in Pl. IV, figs. 2, 3, 4, 5, 6 and 7. The material obtained by passing the sand from the broken stone through a sieve of about 2 mm. mesh is made up in very large part of chondrules in all conditions, from mere fragments to nearly perfect spheres.

The groundmass of the stone is a confused agglomerate of olivine and enstatite particles with interspersed metallic iron, iron sulphide, and chromic iron. In no case do the silicates occur with perfect crystallographic outlines, nearly all, both olivine and enstatite, being of fragmental nature and of varying size, ranging from particles a millimeter in diameter down to the finest dust. The iron has the usual form of blebs and extremely irregularly outlined patches serving as a cement, as shown in Pl. V, figs. 6, 7, 8 and 9. By reflected light it shows up in strong contrast with the dull brassy yellow sulphide. This last is in irregular form also, sometimes associated with the iron, sometimes quite isolated. So far as observed, it never occurs as rounded blebs enclosed in the iron, as sometimes found in large masses of meteoric iron. On the other hand, the silicate minerals do thus occur. This is mentioned

as having some bearing on the origin of the iron meteorites, the writer regarding them as residual masses of larger, coarse, granular forms from which the silicates have been lost through disintegration, perhaps before reaching the earth. Chromite in black specks is often associated with the sulphides, but does not in the section present good crystal outlines.

The presence of alumina and alkalies, as indicated by Dr. Stokes's analyses, caused a careful search to be made for the presence of feldspar, but none was found,¹ though it is possible that sundry minute, clear and colorless, doubly refracting particles may be thus referred. These never show twin structure, cleavage lines, nor other physical properties such as permit a definite determination. It is more probable, however, that these elements are accessory constituents of the enstatite. If such is the case, the stone, as shown by the analyses and microscopic investigation, is composed of nearly equal parts of highly feriferous olivine and enstatite, the latter being low in magnesia in proportion as it is high in the accessory elements.

Much of the interstitial material of the groundmass is so fine and dust-like that it is impossible to determine its mineral character in the thin section. After repeated trials the device was adopted of taking some of the fragments, several grammes in weight, and after dusting them carefully with a camel's hair brush and blowing upon them to remove all external dust particles, placing them in a funnel upon a piece of silk bolting cloth and allowing a half liter or so of distilled water to trickle over them, drop by drop; the liquid was then evaporated in a porcelain dish and the resultant dust, which is believed to correctly represent the true groundmass in an unaltered condition, was collected and submitted to a microscopic examination. It was found to be composed of beautifully fresh, sharply angular splinters, mainly of enstatite, though with some olivine and black glass (Pl. III, fig. 1).

Cross sections of the thin portions of the crust (the highest

¹ H. L. Ward (Am. Jour. Sci., Dec., 1899, p. 414) states that the stone is feldspathic, and classes it with Meunier's montrejites. I cannot agree with him in this. It is essentially nonfeldspathic and belongs more nearly to Brezina's group 29, Kugelchen chondrite (C^c).—G. P. M.

point in fig. 1, Pl. I) show a black glass, interspersed with numerous residuary particles of unfused silicates, which passes down gradually into the unchanged granular stone. Sections of the thicker blebby glass from the lower surface show air vesicles and numerous crystallites imperfectly secreted from the glassy base and too small to be seen in the figure, together with residuary, unfused particles of the original minerals (Pl. III, fig. 2).

CHEMICAL COMPOSITION.

As the nature and extent of the action of such solvents for nickel-iron as mercuric ammonium chloride on the troilite and the silicates of stony meteorites has not been satisfactorily determined, the method of magnetic separation was adopted. This, if thoroughly carried out, yields two portions, the one entirely free from metal, the other consisting of metal mixed with more or less silicate, troilite, and chromite.

About 27 grams of the pulverized material was submitted to fractional separation by an electro-magnet, the more magnetic portions being finally separated by a weak magnet. Two fractions were thus obtained, the larger being entirely free from metal, but containing some material attracted by a strong magnet. The relative proportions were :

- a.* Portion free from metal, 72.05 percent.
- b.* Portion consisting mainly of metal, . 27.95 percent.

Of each of these a complete analysis was made. By subtracting from the figures obtained for *b* the silica, oxides, and troilite the composition of the metal was deduced, while by combining them in proper proportion with the figures expressing the composition of *a* the composition of the total stony part of the meteorite was found. The usual separation of the stony part into portions soluble and insoluble in hydrochloric acid was also made, and of each a practically complete analysis was obtained.

The analysis of the non-metallic portion, *a*, gave :

		I.	
	SiO ₂		45.60
	TiO ₂		.11
	P ₂ O ₅		.35
	Al ₂ O ₃		3.04
	Cr ₂ O ₃		.66
	FeO		11.11
	FeS		6.79
	MnO		.25
	NiO		trace
	CaO		2.26
	MgO		28.82
	K ₂ O		.32
	Na ₂ O		.92
	Li ₂ O		faint trace
H ₂ O	{	at 110°	.08
		above 110°	.26
			100.58

No BaO or SrO could be detected. The .66 percent Cr₂O₃ corresponds to about 1.3 percent chromite. I have isolated a small amount of chromite in a state of imperfect purity by treating a large quantity of the silicate repeatedly with hydrofluoric and sulphuric acids. .1147 gram of this gave :

Cr ₂ O ₃	50.31
Al ₂ O ₃	9.67
FeO	28.78 ¹
MgO	2.76
TiO ₂	1.20

The portion *b*, containing all the metal, gave :

		II.	
Fe	75.65	}	82.748 percent metal.
Cu	.038		
Ni	6.51		
Co	.55		
SiO ₂	8.18	}	17.48 percent stony.
P ₂ O ₅	.07		
Al ₂ O ₃	1.32		
Cr ₂ O ₃	.21		
FeO	1.84		
FeS	.68		
CaO	.39		
MgO	4.85		
			100.228

¹ Total iron as FeO.

The portion *b*, therefore, contains 17.48 percent stony matter, but a comparison of the ratio of SiO_2 and MgO shows that this has not the same composition as that of the main silicate portion. While 50 percent of the latter is soluble in hydrochloric acid, the former contains 39 percent soluble and 61 percent insoluble material, which may be due in part, at least, to the more magnetic properties of the enstatite. It is, therefore, erroneous to assume that the silicate accompanying the metal has the same composition as the main portion. The above data give the means of calculating approximately the amount of FeO in the magnetic portion, while the troilite is found from a sulphur determination. The relatively greater amount of chromite in the magnetic portion is also noteworthy.

For the separation of iron from nickel and cobalt, the ammonium sulphocyanate method of Zimmermann¹ was used with satisfactory results. It is necessary to add a little more sodium carbonate than is sufficient just to destroy the red color of the ferric sulphocyanate and to heat to boiling, but even then the precipitation of the iron is not absolutely complete, a small portion always remaining in solution and being removed by ammonia after destroying the sulphocyanate by nitric acid, and concentrating. The bulk of the iron is free from nickel and cobalt after one repetition of the precipitation. Like all other methods for separating iron from nickel and cobalt, this is approximative, but it avoids the tedious repetition of the acetate method and the precipitates filter well.

The separation into a soluble and an insoluble portion was effected by repeated treatments with hot dilute hydrochloric acid and alternate digestion with caustic soda. The insoluble portion, after ignition, was 49.96 percent, and the analysis of this and of the solution gave :

¹ Ann. Chem. (Liebig), 199: 10.

III.		IV.
Soluble in HCl.		Insoluble in HCl.
SiO ₂	17.26	28.17
TiO ₂	trace	.11
P ₂ O ₅	.35 ¹	trace
Al ₂ O ₃	.67	2.41
Cr ₂ O ₃	.04 ¹	.62
FeO	6.91	4.16
FeS	6.79	none
MnO	.09	.08
CaO	.49	1.64
MgO	17.17	11.57
K ₂ O	.18 ¹	.14 ²
Na ₂ O	.08 ¹	.84 ²
Li ₂ O	. . . .	none
	.01 ¹	22 ¹
	<hr/>	<hr/>
	50.04	49.86

From analysis II is deduced the percentage composition of the metal, as follows:

Fe	91.42
Cu	.046
Ni	7.87
Co	.66
	<hr/>
	99.996

From analyses I and II the composition of the total stony portion is as follows:

SiO ₂	45.42
TiO ₂	.10
P ₂ O ₅	.35
Al ₂ O ₃	3.31
Cr ₂ O ₃	.69
FeO	11.02
FeS	6.57
MnO	.23
NiO	trace
CaO	2.24
MgO	28.60
K ₂ O	.30
Na ₂ O	.86
Li ₂ O	faint trace
H ₂ O	{ at 110° .07
	{ above 110° .24
	<hr/>
	100.

¹ By difference.

² The figures for alkalis are not to be implicitly depended on, owing to the possible partial substitution of Na₂O for K₂O during digestion with caustic soda.

and, finally, the composition of the entire sample examined is:

Fe	21.09	} Metallic part 23.06 percent.
Cu	.01	
Ni	1.81	
Co	.15	
SiO ₂	34.95	} Stony part 76.94 percent.
TiO ₂	.08	
P ₂ O ₅	.27	
Al ₂ O ₃	2.55	
Cr ₂ O ₃	.53	
FeO	8.47	
FeS	5.95	
MnO	.18	
NiO	trace	
CaO	1.73	
MgO	21.99	
K ₂ O	.23	
Na ₂ O	.66	
Li ₂ O	faint trace	
H ₂ O	{ at 110°	.06
	{ above 110°	.19
	<hr/>	
	100.	

Specific gravity 3.905. An average of two determinations in a picnometer flask at 27° C. by Dr. Merrill.

THE MART IRON.

HISTORY AND GENERAL FEATURES.

The second meteorite to be described, which will be known as the Mart Iron, was found early in 1898, on the farm of H. T. Vaughan, near Mart, in McLennan County, Texas.

This iron weighed originally 15¾ pounds. From it a slice weighing 456 grams was cut for the collection of the National Museum, the iron having been donated by the finder to the museum of Baylor University, at Waco, Texas. For the privilege of removing this slice we are indebted to Mr. O. C. Charlton, Curator of the museum. The original shape of the iron, as shown in Pl. VI, figs. 1 and 2, was that of an irregular oval, somewhat flattened at one side and rounded above, with two large and deep pittings on the broader surface. The original dimensions were about 8.5 by 15 by 25.5 cm. It was not

seen to fall and had evidently lain in the soil some time, as the exterior was considerably oxidized and the troilite, which presumably once occupied the pits, was completely eliminated. On cutting and etching the iron gave the surface shown in fig. 1 of the plate. The small dark points are due to troilite. Sundry cracks in the iron at various points on the etched surface, shown most plainly at the upper right in fig. 1, are also filled with troilite. The blotches shown are due to the oxidation of the troilite in process of etching. Mr. Tassin, by whom the etching was done, calls attention to the perfection of the Widmannstätten figures, and particularly to the relief of the tænite bands.

As shown by this etching, the iron belongs to the octahedral variety, and is of moderately coarse crystallization. Its general appearance is so similar to that of the Hamilton County (Texas) iron described by Howell¹ as to suggest that it may be a part of the same fall. The probability is still more evident when it is considered that the two localities are not over 50 miles apart in a straight line.

The chemical evidence, as shown by a comparison of Mr. Eakins's analysis of the Hamilton iron with that of Dr. Stokes, is, however, not favorable to this view, though we believe the possible (if not probable) variation in composition in different parts of the same iron has not yet been fully worked out.

	Mart.	Hamilton Co.
Fe	89.68	86.54
Ni	9.20	12.77
Co	0.33	0.63
Cu	0.037	0.02
P	0.158	0.16
S	0.017	0.03
C		0.11
Chromite	trace	
Fe ₂ O ₃	"	
	99.422	100.26

CHEMICAL COMPOSITION.

The samples submitted were cut from the outer portion of the meteorite, including the oxidized crust; this was carefully re-

¹ Proc. Rochester Acad. Sci., Vol. I, 1890, pp. 87-89.

moved by scraping and filing. There was a small quantity of rust in the cracks on the cut surface, but its amount was trivial.

During the solution in aqua regia scales of schreibersite were observed. A few small black grains were left which showed crystal faces under the microscope, and which were identified as chromite by the usual reaction. A minute amount of colorless granular matter was also noted, the nature of which could not be determined.

All determinations were made in a solution of the same portion of 3.8636 grams, the residue having been brought into solution and added.

The analysis gave :

	.9659 gram	1.9318 grams
Fe	89.68	.....
Ni	9.20	.....
Cu	.....	.037
Co	.33	.....
P		.158
S		.017
Cr		trace
Total,	99.422 percent.	

The separation of iron from nickel and cobalt was effected by the Zimmerman method (see preceding section on the Allegan meteorite).

From the above data the composition of the iron may be expressed as follows :

Nickel-iron (Fe, Ni, Cu, Co)	98.31
Schreibersite	1.06
Troilite	.05
Chromite	trace
Fe ₂ O ₃	trace
	<hr/> 99.42

SUPPLEMENTARY NOTE BY DR. MERRILL.

The structure of the Allegan stone is such as to bring up prominently the question of the origin of meteorites in general. It is not, however, my intention to go into or review the matter exhaustively, but rather to call attention to a few points here illustrated that have an important bearing on the subject.

As is well known, structures such as this stone possesses have been accepted by Tschermak and others as indicative of a tuffaceous origin—that is, they result not from the direct cooling of a molten magma, but from the agglomeration of already solidified particles, as is the case with volcanic tuffs. Others, of whom Dr. M. E. Wadsworth is a prominent example, regard them as the result of the hasty crystallization of an igneous magma.¹ That many meteoric stones result from the cooling and crystallization in place of igneous magmas is beyond question; yet there is an almost equal certainty that others are of tuffaceous origin, though the nature of the evidence is not such as to be fully appreciable except by petrographers.

In 1888 I described a meteorite from the San Emigdio range of California,² and announced my conclusion in favor of a tuffaceous origin. Nevertheless, as the stone was badly weathered there has always been a question in my mind as to how much of the apparent fragmental appearance was due to weathering and how much was original. The absolutely fresh character of the Allegan stone, which is of a surprisingly similar nature, gives me an opportunity to reconsider the subject, and as it happens, to confirm the views first expressed.

The general structure of the Allegan stone can, I believe, be accounted for only by regarding it as an agglomerate of chondrules imbedded in a fragmental groundmass or matrix, the materials for which were derived from the trituration of other chondrules.

One fact which, in my mind, has always mitigated against the theory which would account for the peculiar structure of a meteorite of this type on the assumption of hasty crystallization, has been the complete absence of a glassy base in any but the chondritic portions. Obviously, if the stone is a product of crystallization in mass the chondrules are products of the earliest crystallization, and should, judged by the standard of terrestrial petrography, be the most highly crystalline, while the base in which they are imbedded might be glassy or crystalline, accord-

¹ For a very clear exposition of Dr. Wadsworth's views see his *Lithographic Studies*, pp. 106-117.

² *Proc. U. S. Nat. Museum*, Vol. XI, 1888, pp. 161-167.

ing to conditions. In reality the reverse is the case, the chondrules being more or less glassy, or at least imperfectly crystalline, as in the barred and fan-shaped forms, while the groundmass of the rock is of crystalline particles, and of particles of the chondrules themselves. So far as I have observed there is no true glassy base in meteorites of this type.

That certain conditions of crystallization will give rise to the spherulitic forms of the enstatite is undoubted, but from a study of the crust of the Allegan stone it appears that when meteoric material is fused and allowed to re-crystallize, even so rapidly as must have been the case in this crust, it is not spherulitic, but takes the form of crystallites in a glassy base, as among terrestrial rocks. It is evident that time is not the only factor that should be considered.

The subject of the spherules in liparite has been pretty well worked out by Cross and Iddings,¹ and while it is easy to conceive of the abrupt transition from a wholly or partly crystalline spherule to a glassy base, as sometimes seen in spherulites of obsidian, it will, in the present state of knowledge, puzzle any petrographer to account for an equally sharp transition from a glassy spherule (chondrule) to a base composed wholly of crystalline particles, shown in many meteorites. Even could we account for such anomalies of crystallization as are above noted, the presence of plainly fragmental chondrules—chondrules which were fragments at the time of the final consolidation of the stone—remains to be explained. The forms shown in Pl. IV were all carefully picked from the rock. That they are original fragments, *i. e.*, not due to fracturing in place, is shown by the dull and sometimes abraded character of the surface of fracture, and further by the fact that in no case was the remainder of the chondrule represented by one of these pieces found in the vicinity. Fig. 6 of this plate is one of the most striking illustrations of this nature, being that of a portion of an oval enstatite chondrule some 8 mm. in greatest diameter, imbedded in a fine granular groundmass. The flat surface of fracture is dull and lusterless, and the fracture is, I believe, unquestionably an old one. Fig. 7 shows a side view of the

¹ Bull. Phil. Soc. Washington, Vol. XI, 1891.

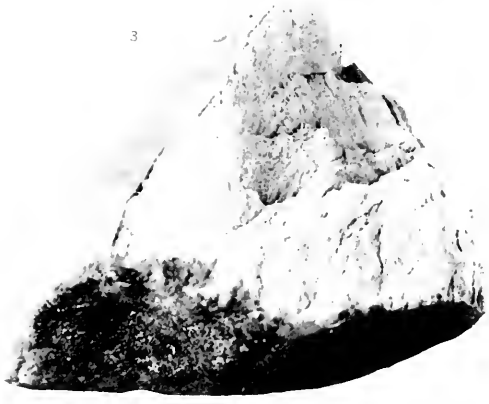
same chondrule. In other cases, as in figs. 3 and 4 of the same plate, the fractures are old and show abraded surfaces. Figs. 2 and 5 are plainly those of fragments of elongated chondrules that have been broken across. Figs. 3, 4, 5 and 9, Pl. V, are evidently sections of just such fragments, and in fig. 4 the splintering fracture along a cleavage plane of the enstatite (below in the figure) is plainly evident under the microscope. With reference to such forms as that shown in fig. 6, Pl. V, one can assume that after the olivines had become imperfectly secreted the magma was resolved into spherical drops which cooled too rapidly for further crystallization, while in the enstatite forms crystallization may have been in some cases prior to the assumption of the globular form and in others subsequent thereto. Such forms seem to lend support to the theory of Sorby¹ that "some at least of the constituent particles of meteorites were originally detached glassy globules, like fiery rain." It is possible to conceive that these chondrules, first as blebs of molten matter and then as consolidated particles, may have been triturerated in the deep throat of some volcano. The spherical form, however, I do not regard as due to trituration, like volcanic lapilli, as formerly held by some writers, but rather to a previous molten condition. Be this as it may, consolidation must obviously have taken place before the mass was shot forth into space. The manner in which the metallic portions are wrapped about or even injected into the silicate particles and the chondrules (see figs. 6, 7, 8 and 9, Pl. V) suggests the possible reduction of the iron—or at least a remelting in an atmosphere from which oxygen was largely excluded—after the stony portion assumed its present form.

¹ *Nature* (London), Vol. 15, April 5, 1877.



PLATE I.

Figs. 1, 2, and 3. Allegan meteorite, as received at the National Museum.
Fig. 3 on reduced scale and introduced to show outline of cross-section.



THE ALLEGAN METEORITE.

PLATE II.

Broken surface of Allegan meteorite, magnified about five diameters.

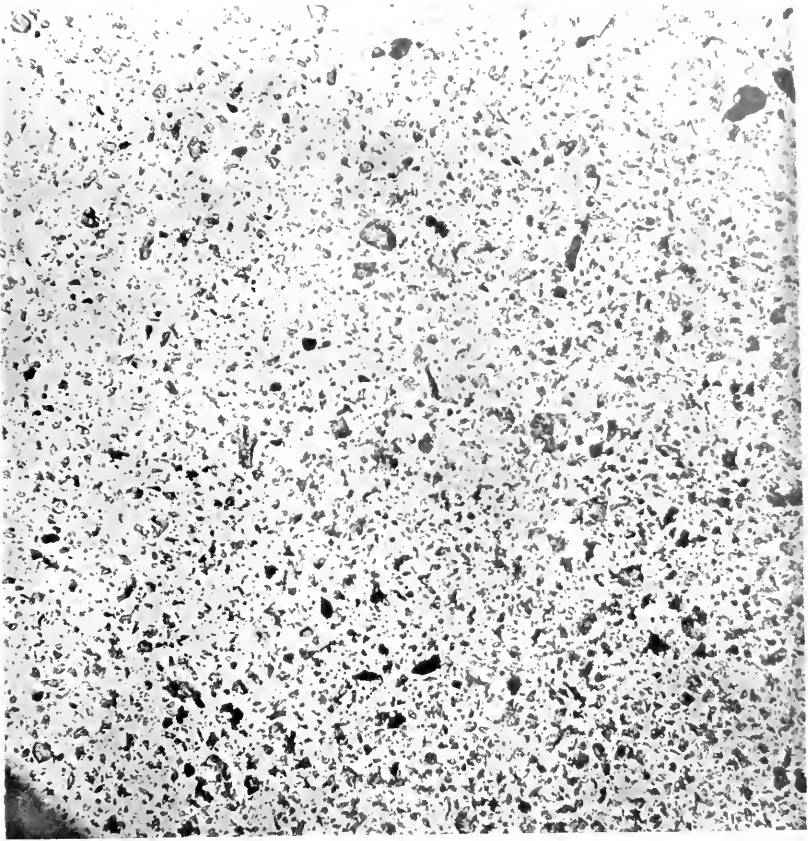
(60)



THE ALLEGAN METEORITE.

PLATE III.

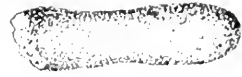
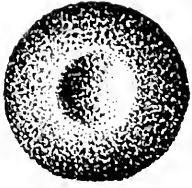
- Fig. 1. Fragmental particles washed out of Allegan meteorite.
2. Cross-section of thick crust from under surface of Allegan meteorite.
The oval colorless areas are air vesicles ; the angular areas, residual particles of unfused silicates. Actual thickness of crust, 3 mm.



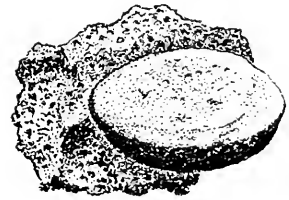
THE ALLEGAN METEORITE.

PLATE IV.

Fig. 1. Indented chondrule. Allegan meteorite.
2-7 inclusive. Fragmental chondrules showing old surfaces of fracture, indicating that the chondrules were fragments at the time of the consolidation of the stone in its present form. Actual sizes: fig. 1, 2 mm.; figs. 2, 3 and 4, about 3 mm.; fig. 5, 4 mm. in length; figs. 6 and 7, 8 mm.



3



5

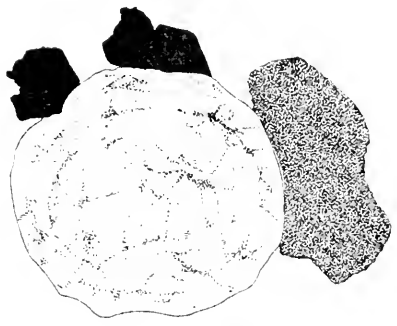
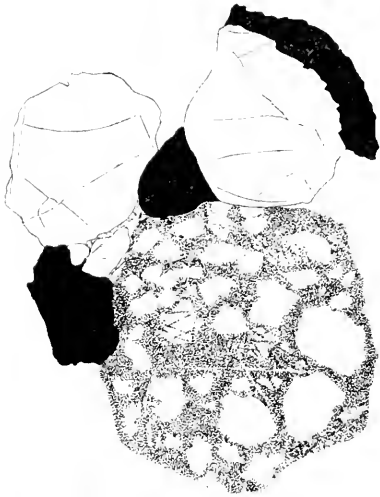
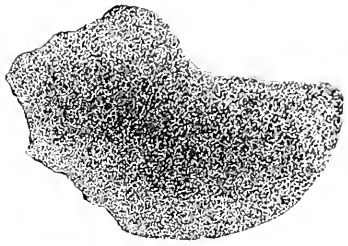
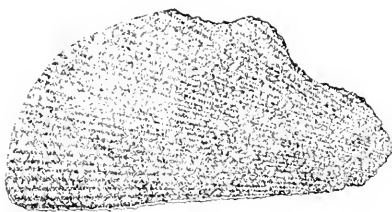


THE ALLEGAN METEORITE.

PLATE V.

Allegan meteorite. All greatly magnified.

- Figs. 1 and 2. Clear colorless olivines in groundmass.
3. Radiating enstatite with clear olivines and iron (black).
 - 4 and 5. Fragmental chondrules of nearly amorphous enstatite.
 6. Chondrule composed of olivines imperfectly secreted from a black glass. The clear colorless portions in close contact represent olivines, the black areas, iron.
 7. Imperfectly crystalline enstatite chondrule in contact with a fragment of a nearly amorphous one of the same mineral nature.
 8. Iron, drawn to show the very irregular nature of the masses.
 9. Nearly amorphous enstatite chondrule in contact with metallic iron.



THE ALLEGAN METEORITE.

PLATE VI.

Figs. 1 and 2. The Mart Iron.

(68)



THE MART IRON.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 69-77.

JULY 25, 1900.

THE GIANT SQUIRRELS OF BURMAH AND THE
MALAY PENINSULA.

BY GERRIT S. MILLER, JR.

AT least four giant squirrels occur in Burmah and the Malay Peninsula.¹ They are currently united under the name *Ratufa* 'bicolor' notwithstanding the facts that their characters are well defined and that the *Sciurus bicolor* of Sparram was a Javan animal. The species may be distinguished as follows:

Nasal bones scarcely or not at all expanded posteriorly; teeth relatively heavy; color of upperparts (in fresh pelage) black or blackish brown, sometimes a little yellowish tinged.

Hind foot about 90 (85); outer surface of front legs entirely black; ears tufted.....*Ratufa gigantea*.

Hind foot about 80 (75); outer surface of front legs partly yellowish brown; ears not tufted.....*Ratufa melanopepla*.

Nasal bones conspicuously expanded posteriorly; teeth relatively light; color of upperparts (in fresh pelage) yellowish brown or grayish brown.

Hind foot under 80 (75); mandible heavily built; underparts whitish in strong contrast with back*Ratufa affinis*.

Hind foot over 80 (75); mandible lightly built; underparts dark yellowish brown in slight contrast with back..*Ratufa pyrsonota*.

¹These are represented in the United States National Museum chiefly by material presented by Dr. W. L. Abbott. This paper is published here by permission of the Secretary of the Smithsonian Institution.

RATUFA GIGANTEA (McClelland).

1839. *Sciurus giganteus* MCCLELLAND, Proc. Zool. Soc. London, VII, p. 150.
 1892. *Sciurus bicolor* THOMAS, Ann. Mus. Civ. Storia Nat. Genova, ser. 2,
 Vol. x, p. 20. Not of Sparram.

Type locality.—Assam.

Characters.—Size very large (total length about 1 m., hind foot about 90 mm.); ears distinctly tufted; general color black above, tawny yellow below, the latter extending down front legs to wrists, but strictly confined to inner surface; skull with nasal bones narrowed posteriorly, and with audital bullæ broad and low.

Color.—Back, sides, top of head, ears, outer surface of legs, dorsal surface of feet, and entire tail glossy black. The color at first sight appears to be pure, but on close inspection it is seen that while the longer hairs are actually black the shorter hairs of the underfur are deep reddish brown, and that each is very faintly tipped with a minute yellowish speck. In certain lights the reddish under color becomes very apparent, while in others the yellowish tips of the shorter hairs produce a distinct variegation. The hairs of the tail are black at the tips only; the greater portion of each is distinctly tinged with reddish brown. Cheeks, entire ventral surface of head and body, and inner side of front legs to wrists tawny yellow (very nearly the orange buff of Ridgway). This color extends down inner side of thighs, but on lower leg it soon becomes mixed with black, practically disappearing between knee and ankle. A black stripe about 30 mm. in length runs backward under eye from base of whiskers. It is separated by the yellow of cheek from both eye and lip. Two small black spots on chin.

Skull.—The skull of *Ratufa gigantea* is very large (75 mm. in greatest length). Its general form is that characteristic of the genus. Outer border of nasals converging rapidly and uniformly to point about 6 mm. from posterior border, then nearly parallel. Front border irregularly convex, not double convex as in the other species. Palate strongly concave between premolars. Audital bullæ broad and low, a line joining their summits (when skull is held upsidedown) barely clears the tips of the very prominent lateral processes of the basioccipital. Mandible heavily built, the ramus exceedingly robust in region between molars and incisor. Angular process broad and short.

Teeth.—The teeth are heavily built but not peculiar in form. The crowns of the upper teeth in an adult male measure as follows: premolar 4×4 ; first molar 3.6×4 ; second molar 3.6×4.4 ; third molar 4×4.4 .

Measurements.—External measurements of an adult male: total length 1020; head and body 410; tail 610; pencil 100; hind foot 93 (88).

Cranial measurements of some specimen: greatest length 75; basal length 65; basilar length 61; palatal length 30; length of nasals 24.6; breadth of nasals anteriorly 14.6; breadth of nasals posteriorly 9; interorbital breadth 29; breadth between tips of postorbital processes 43; zygomatic breadth 48; mastoid breadth 36; breadth of palate between premolars 11; depth of rostrum at posterior extremity of nasals 22; mandible 47; depth of mandible at posterior root of premolar 12.6; maxillary toothrow (alveoli) 15.4; breadth across both upper incisors together at rim of alveoli 8; mandibular toothrow (alveoli) 16.

Specimens examined.—One, collected at Taho, Kareni, Burmah, by Fea.

Remarks.—In its large size, tufted ears, wholly black outer surface of front legs, and broad, low audital bullæ *Ratufa gigantea* differs conspicuously from the more southern representatives of the genus.

RATUFA MELANOPEPLA sp. nov.

Type.—Adult male (skin and skull) no. 83230 United States National Museum, collected in Trong, Lower Siam, February 27, 1896, by Dr. W. L. Abbott.

Characters.—Similar to *Ratufa gigantea* but smaller (total length about 800 mm., hind foot about 80 mm.); ears never tufted; tawny of inner side of front leg spreading conspicuously over outer surface between wrist and elbow. Skull and teeth essentially as in *R. gigantea*.

Color.—Fresh pelage: cheeks, throat, sides of neck, inner surface of legs, and entire ventral surface of body rich tawny yellow (in the type very nearly matching the ochraceous of Ridgway), the hairs mostly blackish at base. Remainder of pelage and entire tail glossy blue-black, the basal portion of the hairs tinged with dark reddish brown *which never appears on surface unless the fur is disarranged*. Yellow of inner side of front leg spreading conspicuously over outer surface between elbow and wrist, where, like that on cheeks and side of neck, it becomes distinctly paler (generally somewhat yellower than the buff of Ridgway). A black spot on chin. *No black stripe on cheek behind roots of whiskers*. Bleached pelage: yellow portions of body essentially as in fresh coat; black areas to a greater or less extent a dull indefinite, reddish brown (not far from the cinnamon

of Ridgway, but often even lighter) becoming slightly more yellow on flanks.

Skull.—The skull is as in *Ratufa gigantea*, though not so large. Audital bullæ narrower and lateral processes of basioccipital less developed. Palate distinctly concave between premolars but less so than in *R. gigantea*. Anterior margin of each nasal concave, so that the outline of the two together is distinctly double concave, the region of the median suture projecting as a conspicuous decurved point. Mandible with angular process narrower and longer than in *R. gigantea*.

Teeth.—The teeth are essentially as in *Ratufa gigantea*, though the crown of the middle upper molar appears to be less nearly square in outline.

Measurements.—External measurements of type: total length 800; head and body 368; tail 431; pencil 80; hind foot 80 (74). Average of eight specimens from the type locality: total length 776 (762–835); head and body 350 (305–381); tail 427 (406–462); hind foot 81.5 (79–85); hind foot without claws 73.7 (68–76).

Cranial measurements of type: greatest length 70; basal length 59; basilar length 53; palatal length 26.4; diastema 16; length of nasals 23.4; breadth of nasals anteriorly 13; breadth of nasals posteriorly 7; interorbital breadth 28; breadth between tips of postorbital processes 41; zygomatic breadth 44; mastoid breadth 32.6; breadth of palate between premolars 10; depth of rostrum at posterior extremity of nasals 18.8; mandible 41.6; depth of mandible at posterior root of premolar 11; maxillary toothrow (alveoli) 14; breadth across both upper incisors together at rim of alveoli 8; mandibular toothrow (alveoli) 14.4.

Specimens examined.—Twelve, all from the type locality.

Remarks.—*Ratufa melanopepla* is readily distinguished from *R. gigantea* by its size, untufted ears, color of front legs, absence of faint annulation of underfur of back and absence of black stripe on cheek. The cheek stripe is occasionally indicated, but apparently never well developed. The striking change in color due to bleaching of the black fur is closely paralleled by that recorded by Thomas¹ in *Ratufa bingurancensis*. In one animal, however, the change is from black to cinnamon, and in the other from Prouts brown to “dirty whitish fawn.” The fresh black coat first appears on the anterior half of the body, gradually spreading backward and encroaching on the area occupied by the brown. The abrupt contrasts of color thus brought about are frequently very striking. A yellowish brown

¹ *Novitates Zoologicae*, II, p. 491, December, 1895.

suffusion occasionally appears on the nape in fresh pelage; but the different quality of the fur will at once distinguish such marking from the effect of sunburn; while the hairs are never annulated as in the related species *Ratufa pyrsonota*. This species is closely related to the Javan *Ratufa bicolor*, but differs in the clear black of the upper-parts.

RATUFA AFFINIS (Raffles).

1822. *Sciurus affinis* RAFFLES, Trans. Linn. Soc. London, XIII, p. 259.

Type locality.—Singapore.

Characters.—Size less than that of the other giant squirrels of the Malay Peninsula (total length about 700 mm., hind foot about 75 mm.); ears not tufted; general color grayish brown or yellowish brown above, the hairs without annulation, *dull white below in abrupt and striking contrast*; skull with nasal bones expanded posteriorly, and with deep, heavily built mandible.

Color.—In fresh pelage: back a fine grizzle of ecru drab, Isabella color and grayish white, the under fur entirely Isabella color, the longer hairs whitish at base and Isabella color at extreme tip *but not annulated*, the general effect intermediate between the drab and ecru drab of Ridgway. On shoulders and neck the ecru drab and grayish white predominate, giving way posteriorly to the Isabella color which also becomes more pronounced along middle of sides, to deepen on lower part of sides and outer surface of front legs to cinnamon, and on thighs to brownish russet. The hairs of the darker areas of outer side of thighs and front legs are obscurely annulated at tip. The cinnamon forms a distinct band on sides separating color of back (into which it fades) from whitish cream buff of belly. Top of head like shoulders and neck, but somewhat darker; cheeks grizzled hair brown, this color continuous across chin in a band about 15 mm. wide; sides of muzzle dull whitish, the pale area extending back a short distance along upper lip; upper part of muzzle marked with seal brown. Ears seal brown externally, grizzled hair brown internally. Whiskers black. *Feet white or light grizzled buff*. Tail dull ochraceous buff above, marked with about fifteen faintly shaded cross bars of drab, and tinged with drab at tip. The hairs are all buffy white at extreme base, and this color appears irregularly and inconspicuously along median line. Lower surface of tail much like upper, but distinctly clouded with bister, and with the cross bars even less noticeable. The buffy white bases of the hairs form a distinct median longitudinal area about 25 mm. in width, divided

down the middle by the narrow, sharply defined line formed by the short bister hairs with which the median ventral surface of the tail is clothed. Inner surface of legs concolor with belly but much tinged with the color of the surrounding parts. This is especially the case with the hind legs. *In bleached pelage* the drab areas of the fur are faded to a pale dirty buff, strikingly different from the color of the fresh coat, but the cinnamon lateral band and the hair brown cheeks remain unchanged.

Skull.—Though the skull of *Ratufa affinis* is much below the maximum size of members of its genus it differs from the others in minor details only. The nasal bones are distinctly expanded posteriorly, that is the width of the two together along naso-frontal suture is considerably greater than it is at a point about 5 mm. further forward. This character alone is sufficient to distinguish the species from *Ratufa gigantea* and *R. melanocephala*. Pterygoids short, the length of the interpterygoid fossa not twice as great as the width at middle, instead of much more than twice, as in the related species.

Teeth.—The teeth are of the same form and relatively of the same size as in *R. gigantea* and *R. melanocephala*.

Measurements.—External measurements of an adult male topotype (no. 86886): total length 711; head and body 330; tail vertebrae 381; pencil, 75; hind foot 77 (70). A second specimen (also a topotype, (no. 86887): total length 686; head and body 305; tail vertebrae 381; pencil, 90; hind foot 78 (73).

Cranial measurements of adult male: greatest length 61; basal length 52; basilar length 49; palatal length 24; length of nasals 19.8; breadth of nasals anteriorly 12; breadth of nasals posteriorly 10; least breadth of nasals 6.6; interorbital breadth 26; breadth between tips of postorbital processes 37; zygomatic breadth 39; mastoid breadth 29; breadth of palate between premolars S.4; depth of rostrum at posterior extremity of nasals 17.4; mandible 37; depth of mandible at posterior root of premolar 10.4; least depth of mandible between incisors and premolar S; maxillary toothrow (alveoli) 12.8; breadth across both upper incisors together at rim of alveoli S; mandibular toothrow (alveoli) 14.

Specimens examined.—Two, both from the type locality.

Remarks.—In the absence of Javan and Sumatran material it appears preferable to use the name *affinis* for this squirrel rather than attempt to apply to it one of the earlier names based on animals of the same general size and color. In a group so plastic as the genus *Ratufa* the chances that any one form occurs in both Java and the

Malay Peninsula are infinitesimally small. It is worthy of note that the seasonal changes in color of this squirrel were described though not fully interpreted by Raffles.

RATUFA PYRSONOTA sp. nov.

Type.—Adult male (skin and skull) no. S₃-183 United States National Museum, collected in Trong, Lower Siam, September 29, 1896, by Dr. W. L. Abbott.

Characters.—General appearance much as in *Ratufa affinis*, but size larger (essentially as in *R. melanopepla*) and color throughout darker and more rich, the underparts *tawny yellowish brown scarcely contrasted with that of sides and back*; hairs of back noticeably annulated near tip; skull with nasal bones as in *Ratufa affinis*, but mandible slender and lightly built.

Color.—Back, sides, outer surface of legs, and top of head uniform grizzled ochraceous, the general effect almost exactly matching No. 7 of Ridgway's Plate V. The individual hairs are all slate gray at base (this color does not appear at surface), those of the soft underfur light ochraceous at tip, those of the longer fur ochraceous at middle then dark tawny to tip, each, however, with a sharply defined subterminal band of light buff about 2 mm. in width. The color is remarkably uniform over entire dorsal surface, but is faintly paler across shoulders and darker in lumbar region. On sides, flanks and thighs it becomes more nearly tawny ochraceous and the speckling due to the light subterminal bars nearly disappears. Outer side of thigh with conspicuous patch, 40–50 mm. in length, of whitish cream buff, lying mostly within the area occupied by the color of the side but bordering on the area of color of ventral surface. This pale area although not sharply defined is very noticeable, and none of the specimens are without it. Underparts of body and inner surface of legs clear ochraceous *to base of hairs* in very slight contrast with color of sides (such difference as there is mainly due to absence of speckling on ventral surface), darker on throat, under side of neck, and middle of belly, paler on inner surface of legs. Cheeks and chin grizzled hair brown. Side of muzzle whitish; top of muzzle seal brown. Ears clear seal brown externally, grizzled hair brown internally. *Feet clear seal brown* or occasionally somewhat less dark, but never grizzled. Whiskers black. Tail very dark Prouts brown turning to rather light burnt umber at tip, the whitish bases of the hairs appearing inconspicuously at surface above and much more noticeably below. Line of short hairs on

ventral surface of tail seal brown. *Bleached pelage* not known. In the type and one or two other specimens the last remnants are still visible in the form of some irregular patches of hair in the tail much lighter than that of the surrounding parts.

Skull.—Skull nearly equal to that of *Ratufa melanopepla* in size, but in form of nasal bones agreeing with that of *R. affinis*. Pterygoids long, the length of interpterygoid fossa much more than twice the breadth.

Teeth.—While the teeth show no marked peculiarities in form they are actually as well as relatively smaller than in *Ratufa affinis* and *R. melanopepla*, and the upper premolar is narrower.

Measurements.—External measurements of type: total length 756; head and body 356, tail vertebræ 400; pencil 50; hind foot 85 (77). Average of seven specimens from the type locality: total length 749 (717-775); head and body 341 (330-356); tail vertebræ 408 (400-432); hind foot 81.4 (75-85); hind foot without claws 72.5 (69-77).

Cranial measurements of type: greatest length 65; basal length 55; basilar length 51; palatal length 25.4; length of nasals 21; breadth of nasals anteriorly 12; breadth of nasals posteriorly 11.4; least breadth of nasals 8; interorbital breadth 26; breadth between tips of postorbital processes 38.6; zygomatic breadth 41; mastoid breadth 31; breadth of palate between premolars 10; depth of rostrum at posterior extremity of nasals 17.4; mandible 37; depth of mandible at posterior root of premolar 9.8; least depth of mandible between incisor and premolar 6.4; maxillary toothrow (alveoli) 13; breadth across both upper incisors at rim of alveoli 7; mandibular toothrow (alveoli) 11.6.

Specimens examined.—Seven, all from the type locality.

Remarks.—*Ratufa pyrsonota* differs so widely from *R. affinis* in both size and details of color that no close comparison between the two species is required. The fine speckling of the upperparts, due to the minute pale subterminal bands of the longer hairs, is alone sufficient to distinguish the northern animal. Another noticeable character is the color of the feet. This is much darker than the leg in *Ratufa pyrsonota*, and conspicuously lighter than the leg in *R. affinis*. From *Ratufa melanopepla* this species is readily separable by its smaller teeth and differently shaped nasal bones, aside from the totally different color. Even bleached specimens of the black-backed animal show only the most superficial likeness to *R. pyrsonota*, a similarity that at once disappears when the details of coloration are examined.

For instance, no amount of sunburn of the black-backed species could produce the speckling characteristic of the other; and, however much alike the coloring of the underpart may appear, the hairs are always conspicuously blackish at base in *Ratufa melanopepla*, while in *R. pyrsonota* they are uniform throughout, or possibly slightly paler proximally.

Note.—Since this article has been in type I have received Mr. J. Lewis Bonhote's paper 'On the squirrels of the *Ratufa* (*Sciurus*) *bicolor* group' (Ann. and Mag. Nat. Hist., 7th ser., V, pp. 490-499. June, 1900). Three species are there recognized as occurring in the Malay peninsula: *Ratufa gigantea*, *R. bicolor*, and *R. affinis*, the last divided into two races, *R. affinis typica* and *R. affinis aureiventer*. Mr. Bonhote's *Ratufa gigantea* is the same as that of the present paper, and his Malayan *R. bicolor* is probably my *R. melanopepla*. His two races of *R. 'affinis'*, however, I cannot identify with either of the light colored species that I have examined. From *Ratufa pyrsonota* they are both separable by their pale feet, while from *R. affinis* they are equally well distinguished by the annulation of the hairs of the back. The *Ratufa aureiventer*, with its yellowish orange belly, is evidently quite different from *R. affinis*, and should doubtless be recognized as a distinct species. The *Ratufa affinis typica* of Bonhote, though less strikingly distinct from *R. affinis*, can hardly be the same as Raffles's animal. In addition to the annulated fur of the back it appears to differ in the wholly yellowish brown head, in the absence of the cinnamon tints on sides, thighs, and front legs, and in the pure white underparts. This last discrepancy may be due to individual choice of descriptive terms; but the absence in the description of *typicus* of all reference to the dark brown cheeks and ears, and cinnamon at least of sides—these characters all equally conspicuous in both pelages of *affinis*—is scarcely to be thus explained. I am inclined to believe that the *Ratufa* of Johore is distinct from that of Singapore Island. Should this supposition prove to be correct the Johore animal will need a name, as *typica* Bonhote 1900 is preoccupied in the genus *Ratufa* by *typicus* Sclater 1891 (Catal. Mamm. Ind. Mus. Calcutta, II, p. 7). In any event Mr. Bonhote's paper and mine supplement each other to the extent of increasing the number of mainland forms of *Ratufa 'bicolor'* from four to five or six.



PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 79-81.

JULY 25, 1900.

DESCRIPTIONS OF TWO NEW SQUIRRELS FROM
TRONG, LOWER SIAM.

BY GERRIT S. MILLER, JR.

Two of the squirrels collected by Dr. W. L. Abbott in Trong, Lower Siam, and presented to the United States National Museum, are at least subspecifically distinct from the forms of the same species occurring at Singapore. Neither appears to have hitherto received a name. This paper is published here by permission of the Secretary of the Smithsonian Institution.

SCIURUS NOTATUS MINIATUS subsp. nov.

Type.—Adult female (skin and skull) no. 84415 United States National Museum, Trong, Lower Siam, February 25, 1897.¹

Characters.—Similar to the form of *Sciurus notatus* inhabiting Singapore Island, but red of underparts much darker, and terminal pencil and often the entire distal half or third of tail uniform red beneath.

Color.—Entire dorsal surface of head and body, a fine grizzle of black and yellowish wood brown, the individual hairs black with two or often three brown rings. The wood brown is (at the surface) everywhere in excess of the black. Cheeks, outer surface of legs, and upper surface of feet dull cinnamon, faintly grizzled. Underparts and inner side of legs rich clear rufous, the extreme base of hairs slaty. On sides the color of belly is separated from that of back by two longitudinal stripes extending from just behind axilla to flanks;

¹"Shot in heavy forest on the hills at about 1,000 feet; apparently not common in heavy forest." Collectors' note.

the lower blackish brown, the upper buff. Each is about 10 mm. in width, though this is variable. The tail at extreme base, both above and below, is colored like back. On both surfaces the grizzle soon becomes much more coarse, giving way near middle below and at extreme tip above to clear rufous slightly darker than that of belly. Whiskers black.

Skull and teeth.—The skull and teeth do not differ appreciably from those of the Singapore form.

Measurements.—External measurements of type: total length 381; head and body 203; tail vertebræ 177; pencil 50; hind foot 50 (46). Average of ten specimens from the type locality: total length 391 (381–413); head and body 205 (197–216); tail vertebræ 185 (165–197); hind foot 49.2 (48–51.6); hind foot without claws 45.7 (45–48).

Remarks.—The peculiarities of this race of the plantain squirrel were noted as long ago as 1886 by Thomas, who says: “. . . one is struck by the greater prevalence and greater intensity of the red colour of the belly in the northern Malay specimens as compared with the southern ones . . . red bellied specimens have in all cases red-tipped tails, while white and yellow-bellied ones have the tip annulated like the rest of the tail.”¹ This exactly states the differences between the races inhabiting Trong and Singapore, though the rich tawny ochraceous underparts of the latter would hardly lead one to call the animal “yellow-bellied.” The extent of the clear red on the under surface of the tail is somewhat variable; occasionally this color is confined to the pencil.

SCIURUS TENUIS SURDUS subsp. nov.

Type.—Adult male (skin and skull) no. 84412 United States National Museum, Trong, Lower Siam, February 3, 1897.

Characters.—Similar to the typical form of *Sciurus tenuis* Horsfield from Singapore, but color paler and duller throughout; flanks and shoulders with scarcely a trace of the ochraceous wash so noticeable in topotypes of *S. tenuis*.

Color.—Dorsal surface almost precisely as in *Sciurus notatus miniatus*, except that the colors are more closely blended owing* to the greater extent of the light rings on the individual hairs and their less sharp demarkation from the black. Shoulders, flanks, and outer surface of legs just perceptibly tinged with dull ochraceous. Sides

¹ Proc. Zool. Soc. London, 1886, p. 77.

like back but slightly paler. Underparts and inner surface of legs whitish smoke gray faintly washed with buff on throat, the pale ventral area much narrower than the red in *S. notatus*. Tail coarsely grizzled black and ochraceous, the individual hairs ochraceous at base (2 mm.), then narrowly (1 mm.) ringed with black, then again with ochraceous (2 mm.), then with black (8 mm.), and finally tipped (5 mm.) with pale buff; pencil clear buff. On under side of tail the colors tend to a definite arrangement in longitudinal bands. Whiskers black. A light buff area behind each ear.

Skull and teeth.—The skull and teeth are not distinguishable from those of typical *S. tenuis*.

Measurements.—External measurements of type: total length 244; head and body 130; tail vertebræ 114; pencil 45; hind foot 37 (35). Average of five specimens from the type locality: total length 247 (235–257); head and body 137 (127–149); tail vertebræ 108 (102–127); hind foot 36.2 (35.4–37); hind foot without claws 33.7 (33–35).

Remarks.—As compared with the race occurring at Singapore this squirrel is less differentiated than the Trong form of *Sciurus notatus*, and, curiously enough, toward dullness instead of richness of color.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 83-109.

JULY 26, 1900.

PRELIMINARY REVISION OF THE EUROPEAN
REDBACKED MICE.

BY GERRIT S. MILLER, JR.

It has been generally supposed that only three redbacked mice, *Evotomys rutilus*, *E. rufocanus*, and *E. 'glarcolus'*, occur in Europe, some writers assuming that even this small number should be reduced. That this view is highly incorrect is shown by the material recently collected for the United States National Museum by Mr. J. Alden Loring, Miss Thora Steiner, and Mr. Robert T. Young, supplemented by series presented and loaned by Mr. Oldfield Thomas and the specimens in my private collection, a total of about 300 specimens. While it is clear that the number of recognizable forms must be increased from three to ten or thereabouts, it is almost equally certain that still others remain to be discovered in the many unexplored portions of Europe. At present, therefore, I am able to give nothing more than a preliminary revision of the group, limited to the mice occurring west of Austria. Even in this small area much more collecting must be done before it will be possible to solve all of the systematic problems relating to this one genus.

During the preparation of this paper, published here by permission of the Secretary of the Smithsonian Institution, I have received aid from Mr. Oldfield Thomas, Mr. G. E. H. Barrett-Hamilton, Dr. Robert Collett, and Mr. Vernon Bailey.

NOMENCLATURE.

While it is not necessary to enter into any further discussion of the generic names that have been applied to the redbacked

mice¹ the specific names based on European members of the genus *Evotomys* must be examined in detail. There are eleven of these.

Bicolor. *Myodes bicolor* Fatio, Revue et Magasin de zoologie, 2^e sér., XIV, p. 257, July, 1862. Although I have seen no topotypes of this animal I have little doubt that it is the boreal redbacked mouse of northern Switzerland, *Evotomys nageri* Schinz. The type was taken in the Genthal, Berne, Switzerland, at an altitude of 1800 m.

Fulvus. *Arvicola fulvus* Millet, Faune de Maine-et-Loire, II, p. 40, 1828. This name, as pointed out long ago by De Selys-Longchamps,² applies to the redbacked mouse of France.³ It is, however, a mere misidentification of the *Lemmus fulvus* of Étienne Geoffroy St. Hilaire⁴ and the *Arvicola fulvus* of Desmarest, a species of *Microtus* (see De Selys-Longchamps, Faune Belge, I, pp. 34-35. 1842).

Glareolus. *Mus glareolus* Schreber, Säugthiere, IV, p. 680. The specific name *glareolus* was applied by Schreber to a short-eared mouse found by O. F. Müller among the beach vegetation of the Island of Laaland, Denmark.⁵ The animal is described in the text at the end of the account of *Mus aconomus*, and is figured on plate 190 B. The description is as follows: "It is cinnamon brown, darker on the middle of the back and whitish gray on the belly. The whiskers

¹ For detailed treatment of the subject see North American Fauna, no. 12, July 23, 1896. Note on the name *Anaplogonia*: Proc. Biolog. Soc. Washington, XIII, p. 154, June 13, 1900.

² "Nota. L'*Arvicola fulvus* de M. Millet, Faune-de-Maine-et-Loire, se rapporte à l'*Arv. rubidus* [= *Evotomys hercynicus rubidus*] et non à notre *Fulvus*. Le même erreur existe dans plusieurs musées d'Allemagne." Monogr. de Micromamm., pp. 99. 1839.

³ The original description is as follows: "Pelage roux-fauve en dessus; d'un gris roussâtre sur les côtés; d'un blanc teint de jaunâtre en dessous; queue velue; un peu plus courte que la moitié du corps, noirâtre en dessus blanchâtre en dessous; pieds blanchâtres; oreilles courtes, ovales, arrondies, tres-velues en dedans et en dehors. Longueur du corps et de la tête 3 pouces 9 lignes [95 mm.], de la queue 22 lignes [47mm.] . . ." This copy was kindly furnished by Mr. Witmer Stone.

⁴ Cat. Mamm. Museum d'Hist. Nat., Paris, p. 187. 1803. The original description, a copy of which was recently made for me by Miss Thora Steineger, is as follows: "Queue plus courte que la moitié du corps, et plus velue que dans les précédens [?]; les poils sont tous cendrés dans leur presque totalité et fauves seulement à l'extrémité; les ongles sont jaunes, les oreilles presque entièrement cachés par les poils."

⁵ ". . . in der Insel Laaland zwischen dem *Elymus arenarius* im Saule am Ufer der Ostsee. . ."

also are brown.”¹ The plate represents a misshapen animal with slender body, disproportionately large head, and no ears. In color it is light woodbrown reddening toward fawn. The name appears to have been left unused until 1834, when Melchior applied it, not without considerable misgiving,² to the redbacked mouse of Denmark. Melchior recognized the insufficiency of Schreber’s description and plate (he suggests that the latter is a “bad drawing of a badly stuffed specimen”) and suspected that the redbacked mouse might be an undescribed species. He preferred, however, to use the name *glareolus* provisionally for the animal until specimens could be obtained from the type locality.³ Subsequent authors have accepted Melchior’s use of the name, but have lost sight of the difficulties that it involves. These difficulties are: that nothing in Schreber’s description or plate points to the redbacked mouse, while both strongly suggest a young *Microtus agrestis*; that *Mus glareolus* inhabited the beach, a locality where *Evotomys* is rarely seen, but where *Microtus* generally abounds; and finally that if the name, as it undoubtedly must, be assumed to receive fixity of application to the redbacked mouse not earlier than 1834, it is certainly antedated by the *Hypudæus hercynicus* of Mehlis (1831) and possibly by the *Lemmus rubidus* of Baillon (1834) also. Therefore, if the name *glareolus* is not transferred to the synonymy of *Microtus agrestis*, its most proper disposition, it must be placed in that of *Evotomys hercynicus*.

Hercynicus. *Hypudæus hercynicus* Mehlis, Isis, Jahrg. 1831, p. 876, 1831, is the first tenable name for the small redbacked mouse of central Europe. The type locality is in the higher part of the Harz Mountains, Germany.⁴

¹ “Sie ist zimmtbraun, mitten auf dem Rücken dunkler, und auf dem Bauche weissgrau. Die Bartborsten sind ebenfalls braun.”

² “Den her beskrevne siellandske [Art] kan altsaa ei være Pallas’s *mus rutilus*, og den maa altsaa enten være en aldeles ny Art, eller Schreber’s *mus glareolus*, som man hidtil ikkun kiender af et Exemplar, fundet i Lolland af vor berømte Landsmand Conferentsraad O. Fr. Müller; dette sidste anseer Forf. for sandsynligt, og har derefter valgt Benævnelsen da den Schreberske Figur (Tab. 190), skjøndt den synes at være en slet tegning efter et slet udstoppet Exemplar, dog har endeel Lighed med vores. Sagen vilde Først med Sikkerhed kunne oplyses, naar man var saa heldig at erholde et lollandsk Exemplar til Sammenligning, hvilket hidtil ikke har villet lykkes Forf.” Den danske Stats og Norges Pattedyr, p. 119. 1834.

³ Redbacked mice are now known to be common in Laaland; but *Microtus agrestis* abounds there also, robbing the fact of the significance it would otherwise have.

⁴ “Sie ist in dem höhern Harze, z. B. am Bruchberge und in dessen nähern Umgebungen häufig. . .”

Nageri. *Hypudæus nageri* Schinz, Synopsis Mammalium, II, p. 237, 1845, is the first name based on the large, boreal redbacked mouse of the Alps. The type was collected on Mt. St. Gotthard near Andermatt.¹

Pratensis. *Arvicola pratensis*, F. Cuvier, Histoire Naturelle des Mammifères, VII, Table Générale et Methodique, 1842 (Description and figure in same volume, livr. 68, March, 1834) is probably the redbacked mouse of northern France, *Evotomys hercynicus rubidus*. Type locality, Abbeville, Somme, France.

Riparius. *Arvicola riparius* Yarrell, Proc. Zool. Soc. London, 1832, p. 109, May 22, 1832, is the only name thus far based on the redbacked mouse of England. It is antedated by *Arvicola riparius* Ord 1825, a name applied to the common meadowmouse of the eastern United States (= *Microtus pennsylvanicus*). No definite type locality is given in the original description.

Rubidus. "*Lemmus rubidus* Baillon, Mém. Soc. Emul. Abbeville, 1834." This name I have been unable to verify. That it was originally applied to the redbacked mouse of the vicinity of Abbeville, Somme, France, was shown by DeSelys-Longchamps in 1847.² It is tenable for the dark race of *Evotomys hercynicus* occurring in Belgium and northern France.

Rufescens. *Arvicola rufescens* De Selys-Longchamps, Essai monographique sur les Campagnols des Environs de Liège, p. 13, 1836, is a synonym of *Evotomys hercynicus rubidus*. That it was based on specimens taken at Waremmé, Belgium, I have recently been informed by the author himself.

Rufocanus. *Hypudæus rufocanus* Sundvall, Oefversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, Årg. 3, p. 122, May 13, 1846. This is the first and only name for the European member of the subgenus *Craseomys*.

Rutilus. *Mus rutilus* Pallas, Nov. Spec. Quadr. e Glir. Ord. p. 246, 1778, was based on a short-tailed arctic redbacked mouse from Siberia east of the Obi. No specimens from this region are available for comparison with the European animal to which the name *rutilus* is now applied.

¹ "Habitat in valle ursorum montis St. Gotthardi."

² Revue zoologique par la Société Cuvierienne, 10^e année, p. 309. October, 1847.

THE GENUS EVOTOMYS AND ITS SUBGENERA.

Genus EVOTOMYS Coues.

1874. *Evotomys* COUES, Proc. Acad. Nat. Sci. Philadelphia, p. 186. Type, *Mus rutilus* PALLAS.

1899. *Anaptogonia* COPE, Journ. Acad. Nat. Sci. Philadelphia, 2d ser., 11 p. 201 (part).

Generic characters.—Teeth rooted as in *Phenacomys*; palate terminating in a thin-edged shelf between alveoli of posterior molars.

Remarks.—The genus *Evotomys* as thus defined includes two well characterized subgenera, one represented by the aberrant *Evotomys rufocanus* alone, the other containing the typical species. It is a boreal genus of circumpolar distribution, extending south to the transition zone in America, and apparently somewhat farther in Europe.

Subgenus EVOTOMYS Coues.

Type.—*Evotomys rutilus* Pallas.

Characters.—Skull smooth and rounded, the postorbital processes obsolete; teeth relatively much smaller than in *Microtus*, the molar row considerably shorter than diastema; roots of molars fully formed relatively early in life; root of posterior lower molar not forming an obvious swelling where it comes in contact with root of incisor.

Remarks.—The subgenus *Evotomys* is a very compact and well characterized group. It contains all the known species of the genus, *Evotomys rufocanus* excepted, and its range is coincident with that of the genus.

Subgenus CRASEOMYS subgen. nov.

Type.—*Evotomys rufocanus* (Sundevall).

Characters.—Skull as strongly angular as in *Microtus*, the postorbital processes well developed; teeth relatively as large as in *Microtus*, the molar row about equal to diastema; roots of molars developed late in life; root of posterior lower molar lying in a distinct capsule on lingual side of incisor root.

Remarks.—The subgenus *Craseomys* shows a distinct approach to *Microtus* in the general character of the skull, and in the encapsuled posterior lower molar. The palate, on the other hand, and the molar roots, are typical of *Evotomys*.

THE EUROPEAN SPECIES OF EVOTOMYS.

Ten forms, species and subspecies, of redbacked mice are now known to inhabit Europe. Their characters are as follows:

SYNOPSIS OF THE REDBACKED MICE OF EUROPE.

Skull strongly angular as in *Microtus*, the postorbital processes well developed; teeth large, rooted late in life, the maxillary molar row about as long as diastema; posterior lower molar distinctly encapsuled; red area of back very strongly contrasted with clear gray sides (subgenus *Craseomys*)EVOTOMYS RUFOCANUS

Skull much less angular than in *Microtus*, the postorbital processes obsolete or very small; teeth small, rooted early in life, the maxillary molar row conspicuously shorter than diastema; posterior lower molar not encapsuled; red area of back not very sharply contrasted with yellowish gray of sides (subgenus *Evotomys*).

Tail densely furred, forming about 20 percent of total length, its pencil at least one-fourth as long as caudal vertebræ.

EVOTOMYS RUTILUS

Tail sparsely furred, forming about 33 percent of total length, its pencil never more than one-sixth as long as caudal vertebræ.

Greatest length of skull about 26 mm.; hind foot 20 (18) or more.

Ratio of tail vertebræ to total length 35 to 38; skull broad and rounded, the zygomata light, generally convergent anteriorly and never abruptly flaring.

EVOTOMYS NAGERI

Ratio of tail vertebræ to total length 32 to 36; skull narrow and ridged, the zygomata heavy, abruptly flaring anteriorly and generally convergent posteriorly.

Nasals narrow (greatest width of both together distinctly less than half length); ratio of tail vertebræ to total length generally 34 to 36.

EVOTOMYS NORVEGICUS

Nasals broad (greatest width of both together about half length); ratio of tail vertebræ to total length about 33EVOTOMYS VASCONIÆ

Greatest length of skull about 24 mm.; hind foot 20 (18) or lessEVOTOMYS HERCYNICUS

Skull relatively broad and audital bullæ relatively large; dorsal red area (in winter pelage) ill defined and much intermixed with gray*E. h. helveticus*

Skull relatively narrow and audital bullæ relatively small; dorsal red area never conspicuously mixed with gray. Summer pelage clear russet slightly darkened by chestnut tipped hairs; winter pelage more yellowish.

E. h. hercynicus

Summer pelage bister, mars brown, Vandyke brown, Prouts brown, mummy brown, etc., never clear russet; winter pelage so far as known never strongly tinged with yellowish.

Summer pelage with red dorsal area sharply defined and very narrow*E. h. succicus*

Summer pelage with red dorsal area broad, diffuse.

Hind foot usually more than 18 (17); ratio of tail vertebræ to total length about 36.

E. h. rubidus

Hind foot usually less than 18 (17); ratio of tail vertebræ to total length about 31.

E. h. brittanicus

Subgenus **CRASEOMYS** Miller.

EVOTOMYS RUFOCANUS (Sundevall).

1846. *Hypudæus rufocanus* SUNDEVALL, Oefversigt af Köngl. Vetenskaps. Akademiens Förhandlingar, Årg. 3, p. 122, May 13, 1846.

1897. *Evotomys rufocanus* BAILEY, Proc. Biolog. Soc. Washington, XI, p. 122. May 13, 1897.

Type locality.—Lappmark, Sweden (specimens mentioned from Altawaara, Karesuando, Lule, and Pite).

Faunal position.—Upper and middle boreal zones.

Geographic distribution.—Northern Europe, south in the mountains of Norway to Dovre.¹

General characters.—Size large (hind foot, 20 (18) or more; greatest length of skull, 26); fur long and dense; dorsal stripe narrow-bright, and sharply contrasted with clear gray of sides.

Color.—A specimen in fresh autumnal pelage has a well defined dorsal stripe of a color intermediate between the hazel and cinnamon rufous of Ridgway,² evenly but not conspicuously sprinkled with black-tipped hairs. This stripe begins between the eyes and extends

¹ Collett, *Nyt Mag. for Naturvidenskaberne*, XXXVI, p. 280, March, 1898.

² *Nomenclature of Colors*, pl. IV, Nos. 12 and 16.

nearly to base of tail. Ears colored like dorsal stripe. Sides an indescribable grizzle of hair brown, whitish, black, and slate color, the general effect clear light gray. Whole underparts soiled buffy white, darkened by the slaty bases of the hairs, which show through irregularly on the surface, especially when the fur is disarranged. Cheeks, muzzle, and sides of head similar to sides of body, but slightly darker. Tail sharply bicolor, brownish above, dirty white below. Feet dirty white.

In a half-grown specimen from Finmark, Norway, loaned by Mr. Robert Collett, the dorsal stripe is bister scarcely tinged with red except in the region between the ears. Here it is dull russet. Otherwise the coloring is essentially as in the adult.

Skull.—The skull of *Evotomys rufocanus* has the general appearance of that of a medium sized *Microtus* with teeth slightly weaker than usual. Braincase relatively deeper than in *Microtus agrestis* from Upsala, Sweden, slightly longer than broad, squarely truncate posteriorly, its outline carried squarely forward by the large postorbital processes. It is strongly marked by ridges for muscular attachment. Interorbital region narrow, with a deep longitudinal median furrow. Rostral protuberances¹ smaller than in the species of true *Evotomys* and placed close to root of zygomatic process of maxillary. Rostrum short, deep, and heavy. Palate and ventral aspect of skull much as in *Evotomys norvegicus* except for the relatively larger teeth and audital bullæ, the latter even larger than in *Microtis agrestis*.

Measurements of an adult skull from Tanen, Postanger, Finmarken, Norway: Greatest length 26; basal length 26; basilar length 25; zygomatic breadth 15.4; mastoid breadth 13.6; interorbital constriction 4; diastema 8; palatal length 13; occipital depth (in median line) 7.6; frontopalatal depth (at middle of molar series) 7.8; mandible 17; maxillary toothrow (alveoli) 6.8; mandibular toothrow (alveoli) 6.

Teeth.—The teeth of *Evotomys rufocanus* as compared with those of other members of the genus² are chiefly remarkable for their large size, great strength, and sharply pointed salient angles. In robustness the teeth perhaps slightly surpass those of an adult *Microtus agrestis* from Upsala, Sweden, though this appearance may be due to the broader dentine spaces. It is especially noticeable in the mandibular

¹ See Proc. Acad. Nat. Sci., Philadelphia, 1898, p. 361.

² Among the European members of the subgenus *Evotomys*, I can find no tangible differential characters in the teeth. In the larger species the teeth are slightly larger than in the smaller ones; but the proportions and the pattern of enamel folding remain the same.

teeth and in the second and third upper molars. The triangles in the upper molars are closed throughout; those of the lower molars are occasionally and apparently quite irregularly open. In arrangement the triangles are essentially as in *Evotomys norvegicus*. In the first lower molar, however, the anterior loop is longer, and deeply cut by a well developed reentrant angle on the inner side (scarcely indicated in *E. norvegicus*) which isolates a third closed triangle fully equaling the others of the same side in size. In the posterior upper molar the two external reentrant angles are approximately equal in depth, while in *E. norvegicus* the more anterior of the two is exceedingly shallow and often obsolete.

Measurements.—A well made skin from Quickjock, Sweden, measures: total length 150; tail vertebræ 40; hind foot with claws 19.8; hind foot without claws 18.

Specimens examined.—Five, from the following localities: Norway; Stabursnaes, Porsanger, 1, Tanen, Finmarken, 2. Sweden; Quickjock, 1, Tornea, 1.

Remarks.—*Evotomys rufocannus* is so readily distinguishable by its subgeneric characters that it needs no special comparison with other members of the genus.

Subgenus **EVOTOMYS** Coues.

EVOTOMYS RUTILUS (Pallas).

1778. *Mus rutilus* PALLAS, Nov. Spec. Quadr. e Glir Ord, p. 246.

1874. *Evotomys rutilus* COUES, Proc. Acad. Nat. Sci., Philadelphia, p. 187.

1899. *A[naptogonia] rutila* COPE, Journ. Acad. Nat. Sci., Philadelphia, 2d ser., XI, p. 201.

Type locality.—Siberia, east of the Obi.

Faunal position.—*Evotomys rutilus* is strictly confined to the upper boreal zone.

Geographic distribution.—Arctic Europe and Asia, south in Norway to Tromsø.¹

General characters.—Size small (total length about 125, hind foot 18, greatest length of skull 24); tail forming about 20 percent of total length, very densely haired, its pencil at least $\frac{1}{4}$ as long as vertebræ; dorsal stripe clear bright chestnut, sharply but not conspicuously contrasted with color of sides.

Color.—An adult male from northern Sweden taken in December has the dorsal stripe clear bright chestnut, faintly darkened by a slight admixture of black-tipped hairs. Sides ochraceous buff.

¹ Collett, *Nyt Mag. for Naturvidenskaberne*, XXXVI, p. 282. March, 1898.

Belly dirty white or cream color, darkened by the plumbeous bases of the hairs which show through irregularly at the surface. Feet whitish. Ears like dorsal stripe. Tail sharply bicolor, brownish tinged with red above, dirty white below. Fur everywhere slaty plumbeous at base.

Individual variation among adult skins is too inappreciable to need special comment. I have seen no immature specimens.

Skull.—The skull of *Evotomys rutilus* is small, smooth, and rounded, in general appearance hardly distinguishable from that of *E. hercynicus*. The zygomata are rather abruptly though not very widely flaring anteriorly, so that in the malar region the two arches are parallel with each other and with the main axis of the skull. Rostral protuberances small but well developed and standing out conspicuously in front of zygomatic processes of maxillaries. Lateral outline of nasals nearly straight from base to tip. Posteriorly the nasals extend slightly beyond nasal branches of premaxillaries. They are squarely truncate. Postorbital processes essentially obsolete. Braincase low and flat (the skull distinguishable by this character alone from that of any of the members of the *hercynicus* group), subrectangular in outline when viewed from above. Palate normal except that the foramina immediately in front of lateral bridges are so large and numerous that the bridges are generally somewhat encroached upon and rendered imperfect. Audital bullæ as in *E. hercynicus*, therefore slightly smaller than in *Microtus agrestis* and much smaller than in *Evotomys rufocanus*.

Measurements of an adult skull from Lapland: Greatest length 24; basal length 22.4; basilar length 20.6; zygomatic breadth 13; mastoid breadth 11.8; interorbital constriction 4; nasals 7; incisive foramen 5; diastema 7.4; palatal length 10.8; occipital depth (in median line) 7; frontopalatal depth (at middle of molar series) 6; mandible 13.8; maxillary toothrow (alveoli) 5; mandibular toothrow (alveoli), 5.

Teeth.—The teeth of *Evotomys rutilus* present no characters of special importance. Relatively to the size of the skull they are proportioned as in *E. hercynicus*. I can see no tangible specific characters in the enamel pattern.

Measurements.—Two specimens from northern Sweden measure respectively: Tail vertebrae 34 and 39; pencil 11 and 9; hind foot with claws 18 and 18.4; hind foot without claws 17.

Specimens examined.—Five, from the following localities: Norway: South Varanger, Finmark, 2. Sweden: Karesuando, 1; Lapland, 2.

Remarks.—This arctic species is instantly recognizable by its small

size, bright colors, and very short densely haired tail. It is in no way closely related to any of the other European members of the genus.

EVOTOMYS NORVEGICUS sp. nov.

1898. *Microtus glareolus* COLLETT, Nyt Mag. for Naturvidenskaberne, XXXVI, p. 278. March, 1898. (Not *Mus glareolus* of Schreber.)

Type.—Adult ♀ (skin and skull) no. 84674 United States National Museum, collected at Bergen, Norway, May 31, 1898, by Thora Steineger. Original number 20.

Faunal position.—This species is probably characteristic of the middle and lower boreal zones.

Geographic distribution.—The forested portions of Norway, north to the Saltdal (67° N.).¹

General characters.—Size large, skull of adults about 26 mm. in greatest length, total length of adults 150–170, hind foot 20 or more; ratio of tail vertebrae to total length 33–36; skull narrow and noticeably ridged for muscular attachment, the zygomata heavy and abruptly flaring; color rather dull.

Color.—*Summer pelage*: Dorsal stripe fairly well defined, extending from forehead to rump. It is dark, dull ferruginous, slightly varied with light wood-brown and much darkened by a uniform sprinkling of black tipped hairs. Face, cheeks and sides light wood-brown fading to broccoli-brown on lower part of sides, especially posteriorly. Rump wood-brown tinged with red in median line and forming no noticeable contrast with color of back. Whole ventral surface pale drab-gray, irregularly tinged with yellowish along median line, the plumbeous bases of the hairs appearing irregularly at surface. Feet dull white. A dark shade at inner side of ankle. Sides of muzzle slightly yellower than face. Ears nearly naked externally, covered with very short reddish hairs internally. Tail sharply bicolor, dark brown above, whitish below.

Skull.—The skull of *Evotomys norvegicus* is large, and, for a true *Evotomys*, rather strongly ridged and angled. In this respect it surpasses all other European members of the genus, *E.* (*Crascomys*) *rufocanus* excepted. The zygomata are heavily built, and so abruptly flaring anteriorly that the greatest zygomatic breadth is near anterior extremity of molar; back of this region the arches distinctly converge. Rostral protuberances well developed, placed close to base of zygomata. Postorbital processes distinct but very small. Braincase moderately high and rounded, distinctly rectangular in outline when viewed

¹ Collett, Nyt Mag. for Naturvidenskaberne, XXXVI, p. 278.

from above. Lateral outline of nasals bowed inward near middle. The nasals are squarely truncate posteriorly a little in front of tips of nasal branches of premaxillæ. Palate normal, the lateral bridges well developed, and the foramina in front of bridges small. Audital bullæ as in *E. hercynicus*.

Measurements of an adult skull (the type): Greatest length 26.8; basal length 25; basilar length 23; zygomatic breadth 14.6; mastoid breadth 11.6; interorbital constriction 4; nasals 8; incisive foramen 5.2; diastema 7.8; palatal length, 11.8; occipital depth (in median line) 7.4; frontopalatal depth (at middle of molar series) 6.8; mandible 16; maxillary toothrow (alveoli) 5.8; mandibular toothrow (alveoli) 5.4.

Teeth.—The teeth of *Evotomys norvegicus* present no tangible characters by which they may be distinguished from those of *E. rutilus* and *E. hercynicus*. They are, of course, larger in proportion with the greater size of the skull.

Measurements.—Average of nineteen specimens from the neighborhood of the type locality: total length 163; tail vertebræ 56.3; hind foot with claws 20.8. For details see table, page 106.

Specimens examined.—Twenty-one from the following localities: Norway: Asker, 1; Bergen, 4; Granvin, 14, Opheim, 2.

Remarks.—*Evotomys norvegicus* needs no close comparison with *E. rutilus* of the upper boreal zone or *E. hercynicus* of the transition zone and upper austral zone. From both of these it is separated by its much larger size; while from *E. rutilus* it is immediately distinguishable by its long, thinly haired tail. The only European species with which it is likely to be confused are the geographically remote *E. nageri* of the Alps and *E. vasconicæ* at present known from the Pyrenean foothills only. Both of these animals agree with *E. norvegicus* in size, but the former is readily separable from it by the long tail, pale sides, and broad smooth skull, while the latter differs in its shorter, less hairy tail, duller color, and heavier molar teeth.

This species is the '*glareolus*' of authors dealing with the fauna of Norway exclusively. A form of *E. hercynicus* is, however, included under the name *glareolus* by those who refer to the Scandinavian fauna as a whole.

EVOTOMYS NAGERI (Schinz).

1845. *Hypudous nageri* SCHINZ, Synopsis Mammalium, II, p. 237. (Mt. St. Gotthard, Switzerland.)
 1862. *Myodes bicolor* FATIO, Revue et Magasin de Zoölogie, 2d ser., XIV, p. 257. July, 1862. (Genthal, Berne, Switzerland.)

1867. *Hypudaus glarcolus* FATIO, Les Campagnols du Bassin du Léman, p. 28 (part).

Type locality.—Mount St. Gotthard, Switzerland.

Faunal position.—This species is probably characteristic of the middle and lower boreal zones; at lower elevations it is replaced by *E. hercynicus helveticus*.

Geographic distribution.—Evergreen forests of the Alps, except in the lower valleys; exact limits of range not known.

General characters.—Size large, skull of adults about 26 mm. in greatest length, total length of adults 150–170, hind foot 20 (18) or more; ratio of tail vertebræ to total length 35–38; skull broad and little ridged for muscular attachment, the zygomata weak and gradually flaring; colors dull.

Color.—*Summer pelage*: Dorsal stripe well defined, extending from forehead to rump. It is cinnamon rufous slightly varied with pale broccoli-brown and inconspicuously darkened by a sprinkling of black tipped hairs; the resulting color very nearly chestnut. Face, cheeks, and sides light hair-brown fading to smoky gray on lower part of sides. Rump light broccoli-brown tinged with red in median line and forming a noticeable though not very strong contrast with color of back. Whole ventral surface pale smoke-gray, faintly tinged with yellowish along median line, the plumbeous bases of the hairs appearing irregularly at surface. Feet dull white. A dark shade at inner side of ankle. Sides of muzzle pale Isabella color. Ears thinly haired, dull reddish. Tail bicolor, dark brown above, whitish below.

Skull.—The skull of *Evotomys nageri*, while of the same size as that of *E. norvegicus*, is readily distinguishable by its relatively broader braincase, more slender rostrum, shorter, broader interorbital region, and lighter, less abruptly flaring zygomata. The latter flare so gradually that the greatest zygomatic breadth is at the posterior extremity of the jugals, from which point the arches converge forward. Rostral protuberances well developed, placed slightly further forward than in *E. norvegicus*. Postorbital processes nearly obsolete, though slightly more apparent than in *E. rutilus*. Nasals rounded posteriorly, terminating in line with nasal branches of premaxillæ. The dorsal profile of the nasals is more rounded than in *E. norvegicus*, and the constriction near middle is less abrupt. Braincase broad and so rounded and slightly angular that the usual rectangular outline is much obscured. Audital bullæ more globular than in *E. norvegicus*, the difference, however, appreciable on comparison only.

Measurements of an adult skull (♂) from Brünig, Switzerland:

Greatest length 26.4; basal length 2.4; basilar length 2.2; zygomatic breadth 1.4.6; mastoid breadth 1.2.8; interorbital constriction 4.4; nasals 8; incisive foramen 4.8; diastema 7; palatal length 1.2; occipital depth (in median line) 7.2; frontopalatal depth (at middle of molar series) 6.8; mandible 1.5; maxillary toothrow (alveoli) 6; mandibular toothrow (alveoli) 6.

Teeth.—Except that the incisors are slightly less robust the teeth of *Evotomys nageri* do not differ from those of *E. norvegicus*.

Measurements.—Average of thirty-six specimens from the neighborhood of the type locality: total length 156; tail vertebrae 56.9; hind foot with claws 20.3; hind foot without claws 19.2. For details see table, page 105.

Specimens examined.—Eighty-two, from the following localities: Switzerland: Andermatt, 41; Brünig, 30; Meiringen, 11.

Remarks.—*Evotomys nageri* is a much larger animal than its near geographical ally, *E. hercynicus helveticus*. From the large *E. vasconica* of the Pyrenees it is distinguishable by its relatively much longer tail, paler sides, heavier teeth and broader, less angular skull. For comparison with *E. norvegicus* see description of latter.

EVOTOMYS VASCONIÆ sp. nov.

Type.—Adult ♂ (skin and skull) no. 86994 United States National Museum, collected at Montrejean, Hautes-Pyrenees, France, July 4, 1899, by Robert T. Young.

Faunal position.—*Evotomys vasconica* is probably a boreal Pyrenean species whose range extends downward in the cool woodlands to the foothills.

Geographic distribution.—Although nothing is at present known of its geographic distribution this animal probably occurs throughout the isolated boreal region of Spain and southern France.

General characters.—Closely related to *Evotomys norvegicus*, but with shorter, more thinly haired tail, duller colors, broader nasals, and heavier teeth.

Color.—*Summer pelage:* Essentially as in *E. norvegicus*, but dorsal stripe less well defined and less red—more nearly cinnamon-rufous than ferruginous. Sides and flanks slightly darker than in *E. norvegicus*. *Winter pelage* not known.

Skull.—The skull of *Evotomys vasconica* is of essentially the same form and size as that of *E. norvegicus*. The zygomata are heavily built and abruptly flaring, therefore quite different from those of *E. nageri*. Nasals short and broad, the greatest width of both together

about one half length. Audital bullæ shorter and broader than in *E. norvegicus*.

Measurements of an adult skull (the type): Greatest length 25.8; basal length 23.6; basilar length 21.8; zygomatic breadth 14; mastoid breadth 12; interorbital constriction 4.2; nasals 7.4; incisive foramen 5; diastema 7; palatal length 11.4; occipital depth (in median line) 7; fronto-palatal depth (at middle of molar series) 6.6; mandible 15.4; maxillary tooththrow (alveoli) 6; mandibular tooththrow (alveoli) 5.6.

Teeth.—The teeth are more heavily built than in *E. norvegicus*, the difference most noticeable in the second and third molars.

Measurements.—Average of two specimens from the type locality: total length 160; tail vertebræ 52; hind foot with claws 20.2; hind foot without claws 18.5. For details see table, page 106.

Specimens examined.—Two, both from the type locality.

Remarks.—The discovery of *Evotomys vasconia* completes an illustration of the distribution of a boreal group of mammals in western Europe. Three isolated but closely related species of large European redbacked mice are now known, one each in the boreal zone of Norway, the Alps, and the Pyrenees.¹ The small *E. hercynicus* occupies the lower zones throughout the region intermediate between the ranges of *E. norvegicus* and the two other large species. That these are similarly isolated from each other is scarcely to be doubted. *Evotomys hercynicus* has been traced southward to the lower Garonne, less than 150 miles from the type locality of *E. vasconia*, while there is no apparent barrier to its occurrence throughout the lowlands from the Department of Gironde to the Gulf of Lyons, thus effectually separating *E. vasconia* from *E. nageri*.

EVOTOMYS HERCYNICUS (Mehlis).

(Synonymy under subspecies.)

Type locality.—Harz Mountains, Germany.

Faunal position.—*Evotomys hercynicus* is probably a characteristic species of the transition and upper austral zones.

Geographic distribution.—Non-mountainous portions of Europe, from southern France and the valleys of northern Switzerland, north to

¹ Montréjeau, the type locality of *E. vasconia*, is probably in the Transition zone. *Evotomys*, however, can readily descend to this level at the base of a mountain chain by taking advantage of local conditions (see Miller, Science, NS., VIII, pp. 615-618. November 4, 1898.) Mr. Young's specimens were taken in heavy woods.

Scotland, northern Sweden (Quickjock) and southern Finland (Tammerfors). Limits of range not known.

General characters.—Size small, skull of adult about 24 mm. in greatest length, total length of adult animal 140–150 mm., hind foot 20 (18) or less; ratio of tail vertebræ to total length generally between 30 and 35.

Color.—See descriptions of subspecies.

Skull.—The skull of *Evotomys hercynicus* is readily distinguishable from that of other European members of the subgenus *Evotomys*. From skulls of *E. norvegicus*, *E. nageri* and *E. vasconicæ* its small size immediately separates it; while from *E. rutilus* it differs in higher, more rounded braincase and less prominent¹ rostral protuberances. On the whole the skull perhaps most closely resembles that of *E. nageri*, from which it is separated chiefly by smaller size and by the parallel zygomata. From the skull of *E. norvegicus* the differently shaped zygomatic arches will always serve to distinguish it. Among themselves the skulls of the different races show no diagnostic characters, except in the case of *E. hercynicus helveticus*.

Teeth.—Except in their small size the teeth of *Evotomys hercynicus* present no peculiarities.

Measurements.—See descriptions of subspecies.

Specimens examined.—One hundred and ninety-one. For details see lists under subspecies.

Remarks.—*Evotomys hercynicus* is separable from *E. rutilus* by its long, thinly haired tail and deeper, narrower skull, and from *E. norvegicus*, *E. vasconicæ*, and *E. nageri* by its much smaller size. It is a widely distributed, plastic species, its extensive, nearly unbroken range and great variability as compared with the other red-backed mice of Europe dependent on the physiographic conformation of the life zones which it inhabits. Five races are represented by the material thus far brought together.

EVOTOMYS HERCYNICUS HELVETICUS subsp. nov.

1867. *Hypudæus glareolus* FATIÖ, Les Campagnols du Bassin du Léman, p. 28 (part).

Type.—Adult male (skin and skull), in British Museum, collected at Montauban, Haute Savoie, France (near Geneva, Switzerland) at altitude of 900 m., November 8, 1899, by Alphonse Robert. Original number, 22.

¹That is, less far removed from base of zygomata.

Geographic distribution.—Lowlands between the Alps and Jura.

General characters.—Skull broader and audital bullæ larger than in any of the other known races of *Evotomys hercynicus*. Size rather large (hind foot 19 (18), total length 145); tail forming 31–33 percent of total length. Winter pelage: dorsal red area diffuse, hazel, much intermixed with gray; belly slightly washed with buff; tail nearly black above.

Color.—Summer pelage not known. *Winter pelage:* red dorsal area very diffuse and ill defined, extending from eyes to base of tail, but not widely spreading over sides. In color it is hazel, slightly darkened by black tipped hairs, and intermixed with broccoli-brown or ecru drab (the subterminal color bands) and grayish white. The brown and gray is always noticeable and occasionally almost in excess of the red. Sides and cheeks broccoli-brown or ecru drab, inconspicuously sprinkled with black. Face slightly darker than cheeks. Belly whitish gray washed with cream buff and darkened by the slaty underfur. The buff wash is variable. It is nearly absent in two specimens among eighteen, and in a few it is considerably more heavy than usual, spreading noticeably over cheeks, face and sides. Tail very conspicuously bicolor, blackish above, buffy white beneath. Feet white. Ears like dorsal stripe. A tuft of whitish hairs springs from near posterior base of conch. This tuft forms a distinct spot in some specimens.

Skull.—The skull of *Evotomys hercynicus helveticus* is slightly larger than that of the other races, the braincase is less elongated and the audital bullæ are larger. The differences are not easily described, but on comparison of series of skulls they at once become apparent.

Measurements of skull of type: greatest length 24; basal length 22.2; basilar length 21; zygomatic breadth 13.6; mastoid breadth 11.8; greatest breadth of braincase above roots of zygomata 11.4; interorbital constriction 4; nasals 7; incisive foramen 5; diastema 6.8; palatal length 11; occipital depth (at front of basioccipital) 7; fronto-palatal depth (at middle of molar series) 6.2; mandible 15; maxillary toothrow (alveoli) 6; mandibular toothrow 5.6.

Measurements.—Average of sixteen topotypes: total length 138; tail vertebræ 44.6; hind foot with claws 19.2; hind foot without claws 17.9. For details see table, page 107.

Specimens examined.—Twenty, from the following localities: France, Montauban (near Geneva, Switzerland) 17; Switzerland, Vand (near Lausanne) 1 (skull); St. Gallen, 2.

Remarks.—This animal is so well differentiated from true *Evotomys*

hercynicus in both cranial characters and color that I hesitate to give it a trinomial name. So far as known it is confined to the low country lying between the Alps and the Jura, where it is probably insulated. If intergradation with *E. hercynicus hercynicus* does occur it is to be looked for in the region about St. Gallen or in extreme southwestern Bavaria. The two specimens from St. Gallen though closely agreeing with the type in color show an approach to the usual narrow form of skull. At Marxheim, Bavaria, about 50 miles northeast of St. Gallen, *E. h. hercynicus* occurs in its most extreme phase.

EVOTOMYS HERCYNICUS HERCYNICUS (Mehlis).

1831. *Hypudæus hercynicus* MEHLIS, Isis, 1831, p. 876.

1857. *Arvicola glareolus* BLASIUS, Fauna der Wirbelthiere Deutschlands, 1, Säugethiere, p. 337 (part). Not *Mus glareolus* SCHREBER.

Type locality.—Harz Mountains, Germany.

Geographic distribution.—Dry interior region of Germany and western Russia. Limits of range not known.

General characters.—Most brightly colored of the races of *Evotomys hercynicus*. Size rather large (hind foot 19 (18), total length 140); tail forming 30–33 percent of total length. Red dorsal area in both pelages well defined and narrow, rufous, not intermixed with gray. Belly very slightly washed with buff. *Sides and rump in summer pelage strongly contrasted with back*. Tail always brown above.

Color.—*Summer pelage*: dorsal stripe narrow and well defined, not tending to spread over sides. It is rufous slightly varied with yellowish wood-brown, and rather thickly sprinkled with black-tipped hairs. Face, cheeks and sides pale yellowish wood-brown tinged with gray and fading to grayish white on belly. Rump like sides, strongly contrasted with dorsal stripe. Feet grayish white. A dark shade at ankle. Sides of muzzle essentially like cheeks. Ears thinly haired, like dorsal stripe in color. Tail sharply bicolor, brown above (darker at tip), soiled white below. *Winter pelage*: dorsal stripe slightly less sharply defined than in summer, the rufous paler and warmer, considerably varied with yellowish wood-brown, but very inconspicuously sprinkled with black-tipped hairs. Face, cheeks, and sides more yellowish wood-brown than in summer, and scarcely tinged with gray. Rump slightly suffused with color of dorsal area, and therefore less contrasted with back than in summer. Feet pure white.

Skull.—Measurements of an adult (♂) skull from Brunswick, Germany: greatest length 24; basal length 22.2; basilar length 20;

zygomatic breadth 13.8; mastoid breadth 11; interorbital constriction 4; nasals 5.8; incisive foramen 4.8; diastema 6.6; palatal length 10.8; occipital depth (in median line) 7; frontopalatal depth (at middle of molar series) 6; mandible 14; maxillary toothrow (alveoli) 5.6; mandibular toothrow (alveoli) 5.

Measurements.—Average of seventeen specimens from Brunswick, Germany: total length 141.5; tail vertebræ 46.6; hind foot with claws 19; hind foot without claws 18.5. Average of twenty specimens from Marxheim, Bavaria, Germany, total length 137; tail vertebræ 44.3; hind foot with claws 18.8; hind feet without claws 17.8. For details see table, page 108.

Specimens examined.—Eighty-four, from the following localities: Germany, Brunswick, 56 (12 in alcohol); Marxheim (on one of the branches of the upper Danube), Bavaria, 27; Roumania, Busetenari, 1.

Remarks.—*Evotomys hercynicus hercynicus* is characterized by its light bright color and narrow, clear rufous dorsal stripe, which in summer is sharply contrasted with the pale sides and rump.

EVOTOMYS HERCYNICUS SUECICUS subsp. nov.

Type.—Adult female (skin and skull) no. S5046, United States National Museum, collected at Upsala, Sweden, August 6, 1898, by J. Alden Loring. Original number 5009.

Geographic distribution.—This race is, so far as known, confined to non-boreal Sweden.

General characters.—Dorsal red area dull ochraceous rufous, narrower than in any of the other forms of *Evotomys hercynicus*. Rump and buttocks noticeably gray in contrast with back. Ratio of tail vertebræ to total length 28–30. Size large (hind foot 19 (18), total length 145). Only summer pelage known.

Color.—*Summer pelage:* dorsal stripe very narrow, neither sharply defined nor tending to spread over sides. It is dull ochraceous rufous, much lightened by an irregular suffusion of pale wood-brown and very faintly darkened by a sprinkling of black-tipped hairs. Face, cheeks and sides light broccoli-brown, fading abruptly to pale smoke gray on ventral surface. Belly irregularly clouded by the slaty underfur. Rump scarcely darker than sides, well contrasted with dorsal stripe. Feet light gray. A dark shade at ankle. Sides of muzzle very faintly yellowish than cheeks. Ears thinly haired, essentially like dorsal stripe in color. Tail sharply bicolor, dark brown above, whitish below. Winter pelage not known.

Measurements.—Average of seven specimens from the type locality: total length 139; tail vertebrae 40; hind foot with claws 19; hind foot without claws 17.8. For details see table, page 109.

Specimens examined.—Seven, all from the type locality.

Remarks.—In *Evotomys hercynicus succicus* the colors are darkened about as in *E. h. rubidus*, but the dorsal red area is at the same time distinctly narrowed. The difference is readily seen when a number of specimens are laid with the sides in contact. In *E. h. rubidus* as in *E. h. hercynicus*, the gray of the sides is then quite hidden, while in *E. h. succicus* it is still conspicuously visible.

EVOTOMYS HERCYNICUS RUBIDUS (Baillon).

1828. *Arvicola fulvus* MILLET, Faune de Maine-et-Loire, II, p. 40. Not of GEOFFROY and DESMAREST.

1834. "*Lemmus rubidus* BAILLON, Mém. Soc. Emul. Abbeville, 1834."

1834. ? *H[ypudæus] glarcolus* MELCHIOR, Den danske Stats og Norges Patetdyr, p. 116.

1836. *Arvicola rufescens* DE SELYS-LONGCHAMPS, Essai Monographique sur les Campagnols des Environs de Liège, p. 13.

1842. *Arvicola pratensis* CUVIER, Histoire Naturelle des Mammifères, VII, Table Generale et Methodique (Described and figured in Livr. 68 of same work, 1834).

Type locality.—Abbeville, Somme, France.

Geographic distribution.—Humid coast district of Belgium and northern France, probably extending north to Denmark. Limits of range quite unknown.

General characters.—Size as in *E. hercynicus hercynicus*, but tail relatively longer, forming 33 to 37 percent of total length. Red dorsal area in winter pelage broad and diffuse, dull ferruginous, not intermixed with gray. Belly heavily washed with buff. Tail dark brown above.

Color.—Summer pelage not known. *Winter pelage:* red dorsal area diffuse and ill defined, extending from eyes nearly to base of tail and tending to spread slightly over sides. In general color it is very nearly mars brown or Prouts brown, though occasionally approaching russet, the general effect resulting from a mixture of cinnamon rufous, vinaceous rufous, and black. Sides and cheeks dull brownish buff thickly sprinkled with black. The color of sides fades insensibly into that of back and abruptly into the strongly buff-tinged gray of the belly. The buff wash on the ventral surface is variable but always conspicuous. On sides and belly the slaty underfur appears irregularly at the surface. Face slightly darker than cheeks. Tail sharply bi-

color, dark brown above, soiled white below. Feet white, distinctly tinged with brown. Ears like dorsal stripe. A few very inconspicuous whitish hairs on back of ear.

Skull.—The skull is as in typical *Evotomys hercynicus*.

Measurements.—Average of eighteen specimens from Waremmé, Belgium: total length 134; tail vertebræ 46.9; hind foot with claws 19.2; hind foot without claws 18.3. For details see table, page 107.

Specimens examined.—Thirty-seven, from the following localities: Belgium; Waremmé, 34 (7 in alcohol). France; Dinon, Brittany, 1 (Miller coll.); exact locality unknown, 2 (Miller coll.).

Remarks.—*Evotomys hercynicus rubidus* is distinguished from *E. h. hercynicus* by its darker, duller color, from *E. h. britannicus* by its larger hind foot, and from *E. h. succicus* by its broad ill defined dorsal stripe. It differs furthermore from all the other races of *Evotomys hercynicus* in its relatively longer tail.

While the race finds its full development in Belgium and in northern France the limits of its range are still unknown. It probably occupies the entire coast district of northern central Europe.

A single specimen from Cadillac, Gironde, France (♀ ad. no. 86-980, R. T. Young, collector) is in many ways so peculiar that I hesitate to refer it to *Evotomys hercynicus rubidus* or to any of the known forms of the species. Taken on June 25, 1899, it represents the perfectly developed summer pelage. In general color it is a brownish cinnamon rufous, becoming slightly paler and more ochraceous on the sides; ventral surface and feet solid whitish buff. Tail dull brown above, whitish below. Measurements: total length, 139; head and body, 96; tail vertebræ, 41; hind foot, 19 (18); ratio of tail vertebræ to total length, 30. The skull is peculiar in the unusual width of the incisive foramina.

EVOTOMYS HERCYNICUS BRITANNICUS subsp. nov.

1832. *Arvicola riparius* YARRELL, Proc. Zool. Soc., London, 1832, p. 109.

May 22, 1832. Not of ORD, 1825.

1898. *Evotomys glareolus* THOMAS, The Zoologist, 4th ser., II, p. 101. March, 1898. Not *Mus glareolus* of SCHREBER.

Type.—Adult female (skin and skull), no. 2944, Miller collection, taken at Basingstoke, Hampshire, England, August 6, 1894, by Gerrit S. Miller, Jr.

Geographic distribution.—England and Scotland.

General characters.—In color similar to *Evotomys hercynicus rubidus*, but slightly darker. Summer pelage with red of dorsal area

tending to spread widely over sides, *with which as well as with rump it forms no marked contrast*. Feet and tail shorter than in *E. hercynicus rubidus*.

Color.—*Summer pelage*: dorsal stripe broad, very ill defined and spreading irregularly over sides. Its general color is mummy brown or somewhat more red, resulting from a slightly different combination of the tints that produce the mars brown of *E. hercynicus rubidus*. Sides and cheeks broccoli-brown slightly tinged with buff and like the back thickly sprinkled with black tipped hairs. Underparts buff, sometimes clear and pale, often dark and brownish. Rump forming no distinct contrast with back. Ears like dorsal stripe. Tail bicolor but not very conspicuously so, blackish brown above, dull white below. Feet whitish, much tinged with brown. *Winter pelage* as in *E. hercynicus rubidus*.

Measurements.—Average of twenty specimens from southern England: total length 146; tail vertebræ 46.6; hind foot with claws 17.8; hind foot without claws 16.8. For details see table, page 109.

Specimens examined.—Forty-three (Miller collection) from the following localities: England: Aberia, Merionethshire, 3; Basingstoke, Hampshire, 19; Eversley, Hampshire, 9; Graftonbury, Hereford, 2; Leigh Woods, Clifton, 2; Lilford, Northants, 1; New Forest, Hants, 4; Oundle, Northants, 1. Scotland: Dumphail, Elgin, 4.

Remarks.—The British redbacked mouse needs comparison with only one of the Continental races, *Evotomys hercynicus rubidus*. With this form it agrees in color, though carrying the peculiarities to a slightly greater extreme. In general size it equals the other races: but the hind foot is distinctly smaller, while in shortness of tail it is exceeded by *E. hercynicus suecicus* only. This animal is the ‘*glarcolus*’ of all authors dealing exclusively with British mammals.

MEASUREMENTS OF THIRTY-SIX SPECIMENS OF EVOTOMYS
NAGERI.

Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot. (c.u.)	Hind foot. (s.u.)	Ratio of tail vert. to total length.
Switzerland: Andermatt.	85703	♂	145	93	52	20	19	35+
“ “	85707	♂	148	95	53	19	18	35+
“ “	85711	♂	149	93	56	20	19	37+
“ “	85700	♀	147	92	55	19	18	37+
“ “	85704	♀	184	112	72	20	19	38+
“ “	85705	♀	148	93	55	20	19	37+
“ “	85708	♀	145	93	52	20	19	35+
“ “	85709	♀	171	106	65	20	19	38
“ “	85710	♀	160	101	59	20	19	36+
“ “	85714	♀	148	92	56	20	19	37+
“ “	85715	♀	165	106	59	20	19	35+
“ “	85716	♀	170	105	65	20	19	38+
“ Brünig.	85795	♂	162	105	57	21	20	35+
“ “	85796	♂	161	104	57	22	20	35+
“ “	85797	♂	149	95	54	20	19	36+
“ “	85805	♂	154	100	54	20	19	35+
“ “	85806	♂	154	99	55	20	19	35+
“ “	85813	♂	155	99	56	21	20	36+
“ “	85798	♀	176	105	71	20	19	39+
“ “	85799	♀	155	100	55	20	19	35+
“ “	85800	♀	149	97	52	20	19	35—
“ “	85803	♀	150	94	56	20	19	37+
“ “	85808	♀	171	109	62	21	19	36+
“ “	85809	♀	146	94	52	20	19	35+
“ “	85810	♀	151	100	51	20	19	33+
“ “	85811	♀	151	97	54	21	20	35+
“ Meiringen.	85910	♂	165	106	59	22	20	35+
“ “	85913	♂	157	102	55	20	19	35+
“ “	85914	♂	146	91	55	20	18	37+
“ “	85916	♂	157	99	58	21	20	36+
“ “	85917	♂	147	95	52	21	20	35+
“ “	85909	♀	152	98	54	20	19	35+
“ “	85911	♀	166	105	61	21	20	36+
“ “	85912	♀	157	102	55	21	20	35+
“ “	85915	♀	173	109	64	20	19	37—
“ “	85919	♀	144	94	50	21	20	34+

MEASUREMENTS OF NINETEEN SPECIMENS OF EVOTOMYS
NORVEGICUS.

Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot. (c. u.)	Hind foot. (s. u.)	Ratio of tail vert. to total length.
Norway: Bergen	84672	♂ ¹	167	—	56	21.5	—	33+
" "	84673	♂	159	—	54	20.5	—	33+
" "	84675	♂	164	—	56	20.5	—	34+
" Graven, Hardanger	84678	♂	153	—	52	21	—	34-
" " "	84680	♂	157	—	55	21	—	35+
" " "	84683	♂	166	—	56.5	21	—	34-
" " "	84684	♂	175	—	60.5	20.5	—	34+
" " "	84685	♂	172	—	57.5	20.5	—	33+
" " "	84686	♂	161	—	55.5	21	—	34-
" " "	84687	♂	152	—	55	20.5	—	36-
" Bergen	84674	♀ ²	165	—	57	21.5	—	34+
" Graven, Hardanger	84676	♀	156	—	57	21	—	36+
" " "	84677	♀	164	—	54	20	—	32-
" " "	84679	♀	172	—	57	21	—	33+
" " "	84681	♀	169	—	57	20.5	—	33+
" " "	84682	♀	173	—	60	21	—	34+
" " "	84688	♀	160	—	55.5	21	—	34+
" " "	84689	♀	165	—	57	20.5	—	34+
" Opheim	4462 ³	♀	156	—	57	21	—	36+

MEASUREMENTS OF TWO SPECIMENS OF EVOTOMYS
VASCONIÆ.

Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot. (c. u.)	Hind foot. (s. u.)	Ratio of tail vert. to total length.
Montréjeau, France	86994	♂ ⁴	162	107	53	20.4	19	35-
" "	86995	♀	159	105	51	20	18	32+

¹U. S. National Museum.

²Type.

³Miller collection.

⁴Type.

MEASUREMENTS OF SIXTEEN SPECIMENS OF EVOTOMYS HER-
CYNICUS HELVETICUS.

Locality.	Num-ber.	Sex	Total length	Head and Body.	Tail verte-bræ.	Hind foot. c. u.	Hind foot. s. u.	Ratio of tail vert. to total length.
Montaubau, Hte. Savoie, Fr.	102019	♀	152	101	51	20.6	19	33+
" " "	102020	♂	133	91	42	20	18	31+
" " "	102021	♂	134	90	44	18.4	17	32+
" " "	102022	♂	128	88	40	19.8	18	31+
" " "	102023	♂	142	97	45	19	18	31+
" " "	102024	♂	157	107	50	19.4	18	31+
" " "	102025	♂	150	100	50	19.5	18	31+
" " "	102026	♂	143	100	43	20	19	30+
" " "	102027	♂	123	86	37	19	18	30+
" " "	102028	♂	137	93	44	19.5	18	31+
" " "	102029	♂	138	93	45	18.6	17	32+
" " "	102031	♂	141	95	46	19	18	32+
" " "	102032	♂	135	91	44	18.4	17	32+
" " "	102033	♂	134	90	44	18.4	17	32+
" " "	102034	♂	127	83	44	19	18	34+
" " "	21	♂	140	95	45	19.5	18	32+

MEASUREMENTS OF EIGHTEEN SPECIMENS OF EVOTOMYS
HERCYNICUS RUBIDUS.

Locality.	Num-ber.	Sex	Total length.	Head and Body.	Tail verte-bræ.	Hind foot. c. u.	Hind foot. s. u.	Ratio of tail vert. to total length.
Wareme ; Belgium.	86028	♂	149	96	53	19	18	36+
" " "	86029	♂	134	86	48	19	18	35+
" " "	86036	♂	130	86	44	20	19	34+
" " "	86037	♂	131	85	46	19	18	35+
" " "	86042	♂	125	81	44	19	18	35+
" " "	86043	♂	139	90	49	19	18	35+
" " "	86030	♀	127	82	45	19	18	35+
" " "	86033	♀	127	82	45	19	18	35+
" " "	86038	♀	146	93	53	20	19	36+
" " "	86039	♀	123	81	42	20	19	34+
" " "	86040	♀	123	77	46	20	19	37+
" " "	86041	♀	130	85	45	18	17	34+
" " "	86044	♀	144	96	48	20	19	33+
" " "	86045	♀	129	82	47	20	19	36+
" " "	86046	♀	139	92	47	19	18	34-
" " "	86047	♀	155	101	54	19	18	35-
" " "	86049	♀	128	85	43	19	18	33+
" " "	86050	♀	133	87	46	19	18	34+

MEASUREMENTS OF FORTY-FIVE SPECIMENS OF EVOTOMYS
HERCYNICUS HERCYNICUS.

Locality.	Num-ber.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot (c. u.)	Hind foot (s. u.)	Ratio of tail vert. to total length.
Germany: Brunswick.	85291	♂	132	91	42	18	17	31+
" "	85292	♂	139	94	44	19	18	31+
" "	85293	♂	141	94	46	19	18.5	32+
" "	85294	♂	143	100	43	19	18	30+
" "	85295	♂	138	94	43	19	18	31+
" "	85298	♂	138	91	44	20	19	31+
" "	85299	♂	142	98	43	20	19	30+
" "	85301	♂	132	89	42	19	18	31+
" "	85302	♂	145	98	47	19	18	32+
" "	85303	♂	137	90	44	19	18	32+
" "	85301	♂	137	95	42	19	17	30+
" "	85315	♂	147	102	45	19	18	31+
" "	85646	♂	158	108	50	18	17	31+
" "	85296	♀	147	98	45	19	17	30+
" "	85297	♀	145	99	45	19	18	31+
" "	85305	♀	152	102	48	20	19	31+
" "	85320	♀	132	92	40	18	17	30+
" Marxheim.	101993	♀	134	92	42	17	16	31+
" "	101994	♀	137	91	46	18	17	33+
" "	101995	♀	135	92	43	19	17.4	32
" "	101996	♀	143	98	45	19.4	18	31
" "	101997	♀	143	98	45	19	18	31
" "	101998	♀	126	85	41	19	18.8	32+
" "	102001	♀	130	90	40	—	—	30+
" "	102003	♀	125	90	35	18.8	18	29+
" "	102006	♀	132	88	44	18	17	33+
" "	102010	♀	140	92	48	19	18	34+
" "	102002	♂	133	89	44	19	17.8	33+
" "	102004	♂	144	94	50	19.4	18	34+
" "	102005	♂	133	89	44	19	17.8	33+
" "	102007	♂	141	94	47	19	18	33+
" "	102008	♂	136	88	48	19	18	34+
" "	102009	♂	138	95	43	19	17	31+
" "	102013	♂	134	90	44	18.6	17.4	33+
" "	102014	♂	140	95	45	18.6	17.6	33+
" "	102017	♂	130	86	44	19.4	18	33+
" "	102018	♂	140	93	47	19	18	33+

MEASUREMENTS OF TWENTY-SIX SPECIMENS OF EVOTOMYS
HERCYNICUS BRITANNICUS.

Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot (c. u.).	Hind foot (s. u.).	Ratio of tail vert. to total length.
England ; New Forest.	2968 ¹	♂	138	—	43	18	—	31+
“ “	2969	♂	138	—	42	17	—	30+
“ Eversley.	2970	♂	146	—	44	18	—	30+
“ “	2971	♂	148	—	45	18	—	30+
“ “	2972	♂	146	—	46.6	18	16.5	31+
“ “	2973	♂	148	—	51	17.8	17	33+
“ Basingstoke.	2974	♂	147	—	48	18	—	32+
“ “	2975	♂	139	—	46	17.8	—	33+
“ “	2976	♂	139	—	41	18	17	30—
“ “	2977	♂	139	—	44	18	17	31+
“ Eversley.	2979	♂	137	—	43	17.4	16.6	31+
“ New Forest.	2937	♀	134	—	41	18	16.6	30+
“ Eversley.	2938	♀	145	—	47	17	—	32+
“ “	2940	♀	140	—	46	17	16	32+
“ Basingstoke.	2941	♀	141	—	46.8	17.8	—	33+
“ “	2942	♀	158	—	52	19	—	32+
“ “	2943	♀	140	—	47.6	18.4	17	33+
“ “	2944	♀ ²	156	—	51	17.4	16.6	32+
“ “	2945	♀	159	—	52	17	—	32+
“ “	2946	♀	160	—	54	18	—	33+
“ “	2947	♀	147	—	44	18	17	30—
“ “	2949	♀	158	—	51	18	—	32+
“ “	2950	♀	161	—	54	18	—	33+
“ “	2951	♀	137	—	42	18	17	30+
“ “	2952	♀	137	—	43	18	17	31+
“ Eversley.	2956	♀	150	—	51	18.8	17	34

MEASUREMENTS OF SEVEN SPECIMENS OF EVOTOMYS
HERCYNICUS SUECICUS.

Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebrae.	Hind foot (c. u.).	Hind foot (s. u.).	Ratio of tail vert. to total length.
Sweden : Upsala.	85047	♂	135	90	40	19	17.5	29+
“ “	85048	♂	135	94	41	20	18	29+
“ “	85049	♂	137	92	42	19	17	30+
“ “	85050	♂	134	92	38	19	18	29+
“ “	85051	♂	143	99	40	18	17	28—
“ “	85052	♂	148	103	43	19	18	29+
“ “	85046	♀ ³	146	96	42	19	18	29+

¹ Miller collection.² Type.³ Type.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 111-132.

AUGUST 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

II.

HARRIMANIA MACULOSA, A NEW GENUS AND
SPECIES OF ENTEROPNEUSTA FROM ALASKA,
WITH SPECIAL REGARD TO THE CHAR-
ACTER OF ITS NOTOCHORD.

BY WM. E. RITTER.

THE preparation of my report on the Enteropneusta of the Pacific Coast of North America, which is to form a part of the scientific results of the Harriman Alaska Expedition, has, owing to the unexpected richness of the material, proved a considerably greater task than I had anticipated. Since it has been impossible to complete the work at as early a date as was originally hoped, and since one of the five or six new species is of more than ordinary interest, it seems desirable that a brief account of it should be published without delay.

This species is the type of a new and very distinct genus which I take great pleasure in dedicating to Mr. E. H. Harriman. I do this not merely in acknowledgment of the fact that he was the patron of the expedition, but also in recognition of the way his own personal management contributed to its scientific success.

In its superficial characters *Harrimania maculosa* resembles *Balanoglossus kuppferi* v. Willemoes-Suhm and *B. canadensis* Spengel more closely than it does any other known species. It may be known by the diagnosis following.

HARRIMANIA gen. nov.

EXTERNAL CHARACTERS.

Animal short in proportion to its thickness, not only as a whole, but in each of its three regions. Proboscis somewhat depressed, conical, but little longer than broad; in preserved specimens almost always contracted so as to become considerably shorter than broad. Collar short, always broader than long, usually in preserved specimens greatly so. Pharyngeo-genital region without genital pleuræ; not clearly set off from the abdominal region; frequently much depressed, so as to be considerably broader than deep. Gonads beginning immediately behind the collar and extending either not at all or only a short way behind the pharynx, in the form of rather large, irregular lenticular masses. An inter-, as well as an extra-branchial series on each side. Maximum number of branchiæ about 40 pairs, these opening wholly on the dorsal aspect of the animal, in a well-defined ditch on each side; both walls of each ditch composed chiefly of the extra- and inter-branchial gonad series, respectively (Pl. VII, fig. 2). Length of pharynx about double that of proboscis. No external liver lobes; no constriction between pharynx and abdomen. Abdomen nearly round in transverse section, relatively short, and tapering rather abruptly to its posterior extremity. The following measurements in millimeters are from an average adult living specimen: Length of proboscis 13; length of collar 4; length of pharynx 25; length of gonad series 27; length of abdomen 89; total, 131.

Color.—General shade dark. Proboscis dark gray, mottled, particularly on dorsal side, with many somewhat elongated, almost coal-black spots. Collar also dark and mottled, though less strikingly so than the proboscis. Gonads a yellowish white, but all the remaining portions of the pharyngeo-genital region dark, the dorsal side considerably more so than the ventral, the latter yellowish green; anterior portion of abdomen dark grayish green; posterior portion similar to it, but somewhat lighter. On the whole this is probably the darkest species of *Enteropneusta* known.

ANATOMICAL CHARACTERS.

Proboscis.—Circular muscle layer about equal in thickness to the nervous layer of the ectoderm. Longitudinal muscle fibers arranged in radiating plates as in *Ptychodera*. No central proboscis cavity, but in place of this a core of considerable size of very fine-fibered close-meshed connective tissue containing many small nuclei. In place of

the ventral proboscis septum, a plate of the connective tissue core wedges itself between two radial muscle plates, and reaches nearly to the ectoderm. Into this plate there extends to a point considerably beyond the anterior extremity of the proboscis complex a small but very distinct tube with clear-cut lumen and wall of well-defined cubical epitheloid cells. This tube is connected with the globus on its ventral side and toward the anterior end, and is probably a blood vessel, though the character of its wall as indicated above, contrasts sharply with the usual enteropneustic blood vessels. This structure is not connected with the notochord, hence is not homologous with the 'vermiform process' of *Schizocardium*. Glomus well developed, though the two halves not confluent excepting slightly antero-ventrally.

The facts relative to the proboscis-cœlom and its pores are as follows: 1. As stated above, unpaired central cavity wanting, this being replaced by the connective-tissue core. 2. The cœlom confined to the extreme base of the proboscis and consisting of two wholly separate lateral halves of equal size. 3. Posteriorly, each of these cavities bifurcate, the two legs or pouches of each being placed, the one dorsal to the other. 4. The ventral pouch on each side ends blindly, while the dorsal ones open to the outside, each through its own pore, so that *two proboscis pores are always present*. 5. The proboscis pores open very close in front of, sometimes actually into, the anterior neuropore.

Collar.—Dorsal nerve cord sometimes with and sometimes without a distinct anterior neuropore; throughout its length numerous small, entirely closed cavities within its substance. 'Giant cells' present. No dorsal crest or dorsal 'nerve roots.' Perihæmal diverticula not reaching forward quite to the anterior neuropore; the septum between them complete to their extreme anterior end, containing only longitudinal muscle fibers. Dorsal blood vessels not situated within this septum, but a sinus bounded by the nerve cord dorsally, and by the walls of the perihæmal diverticula ventrolaterally. Collar cœlom extending far into the neck. Peripharyngeal spaces apparently absent. Crura of nuchal skeleton *reaching into the pharyngeal region and overlapping two or three pairs of branchial bars*. Body of the skeleton also extending usually far back, reaching nearly to the middle of the collar. The skeleton moderately strong, but the chondroid tissue not abundantly developed. Notochord consisting of *two distinct parts*: the anterior pouch-shaped part corresponding to that found in all Enteropneusta, and a *posterior gutter-shaped part directly continuous with the first*

mentioned part, and coextensive with the esophagus, with which it is connected. Collar funnels of the usual form, though very short; directed outward at nearly a right angle to the long axis of the body, instead of forward; opening into the first gill pouch. (Pl. VII, figs. 3, 4, and 7.)

Pharyngeo-genital region.—Separation of the enteric wall into pharyngeal and esophageal portions by deep longitudinal folds on each side. At the anterior end the pharynx occupies but little more than the dorsal half of the wall, while posteriorly the esophageal portion becomes much reduced. No synapticulæ in branchial bars. Epibranchial ridge very prominent. Male gonads both extra- and inter-branchial, the extra-branchial far more voluminous, in the form of large, more or less globular lobes, the extra-branchial lobes much larger than the inter-branchial ones. Female gonads apparently extra-branchial only. Gonads retained in the body cavity, and not raised up into genital pleuræ to overarch the branchial orifices.

Abdominal region.—No external liver lobes, but a single pair of broad laminar appendages attached to the dorsal side of the intestine immediately behind the pharynx, and for some distance in this region the intestinal wall much thickened, and the lumen correspondingly reduced in size as compared with the portions farther back. No intestino-cutaneous pores. Ventral longitudinal muscle layer broad and but little thicker than the same layer in the dorsal and lateral regions. No circular muscle layer in this portion of the body.

The trunk cœlom narrows off on each side anteriorly and terminates immediately behind the posterior limit of the collar. The structureless membrane lining the cavity becomes thickened and dense in this narrowed anterior end, and at the extreme tip there is a patch of this membrane on which is situated some peculiar epitheloid cells. These are high and slender, sometimes tailed, and are set on both sides of the membrane, perpendicular to it, and close together. In some individuals this patch is thrust forward and outward in its middle so as to produce a definite though short and narrow pouch, into which the epitheloid cells of the inner surface project so as to divide the cavity of the pouch into narrow spaces.

This peculiar structure seems to be present in every specimen, but varies considerably in form and definiteness. It is usually in close relation to the collar funnels, though there seems to be no connection between them. I am unable to find anything comparable to them in any other species. The most plausible suggestion that I can make about them at present is that they may represent the peripharyngeal

spaces of other species. But to this suggestion I do not attach much importance.

GENERAL REMARKS.

From this brief diagnosis there is no doubt that *Harrimania maculosa* belongs to the family Balanoglossidæ, if we accept Willey's proposal to separate the Enteropneusta into families, as I am disposed to do. Of the two genera hitherto known into which the species of this family naturally group themselves, *Balanoglossus* and *Dolichoglossus*,¹ *Harrimania* is unquestionably closer of kin to *Balanoglossus*. From this, however, it is clearly set off by the *persistence of the esophageal notochord in the adult animal*, the *invasion of the pharyngeal region by the skeleton crura*, and probably by the peculiar structures at the anterior ends of the trunk cœlom.

This species was found at Prince William Sound and Kadiak, Alaska. At Prince William Sound it was collected at two points, Orca and Port Valdes. All the specimens from the latter place were taken by Dr. Wesley R. Coe, to whom I am indebted for well-preserved specimens, as I did not myself do any collecting at that point.

It is an interesting and significant fact that *this animal is not a burrower* in the sense in which most Enteropneusta are. It lives under stones, where it often makes its way through the mud at the plane of contact between the stone and the earth. So far as my observations have gone it rarely plunges directly into the ground, as do other species. In collecting, one turns over the rocks and picks up the animals as he does various holothurians, etc., and does not need to dig in the mud for them. At Prince William Sound, where we found it in by far the greater abundance, it was collected at extreme low tide only. At Kadiak, however, the few specimens secured came from nearer high water mark than I have ever before seen Enteropneusta living. These two facts relative to the animal's life

¹ Spengel suggested these terms as subgeneric designations for the short and long proboscised species, respectively, of the genus *Balanoglossus* as restricted by him. The knowledge obtained since Spengel wrote, added to the considerations which led him to suggest such a subdivision of the genus, convinces me of the wisdom of recognizing the two groups as distinct genera.

habits, particularly its non-burrowing habit, may, it seems to me, be correlated with its primitiveness among Enteropneusta.

The characteristic *Balanoglossus* odor is stronger and more persistent in this species than in any other with which I am acquainted. My alcoholic specimens still retain it (now nearly a year since they were taken) so strongly that in handling them it clings to one's hands for some time in spite of vigorous washing.

I may mention here that between Dr. Coe and myself more than one hundred specimens were collected, so that I have had ample material to work with. I have sectioned about twenty individuals in various ways, so that every anatomical point has been confirmed by a goodly number of examinations, and all tell essentially the same story so far as the important facts are concerned.

Perhaps in view of the great variation which Spengel, Willey, Hill, and others have found in the number and character of the proboscis pores in some other species, I ought to expressly state that I have given particular attention to this point in *Harrimania maculosa*, and in not a single instance have I failed to find both present and equally well developed.

SPECIAL REMARKS CONCERNING THE NOTOCHORD.

Although in the present communication I can neither describe in detail the structure of the animal nor discuss in full the theoretical conclusions to which I am led by the study of this and the other species in my possession, a brief consideration of a few points beyond what has already been suggested must be given. And first, because most important, something more about the notochord—and at the outset a word concerning the use of the term as applied to the organ. It is well known that Bateson (1886) was the first to contend for the homology of the organ with the notochord of vertebrates; and hence that it was he who first designated it by this name. Spengel (1893), as is also now well known to all zoölogists who have interested themselves in the problem of chordate phylogeny, takes strong grounds against Bateson's view, and consequently refuses to use the name notochord, but adopts the term 'Eicheldarm.' And recently Willey (1899), whose utterances on all matters pertain-

ing to the protochordata are deserving of high regard, has expressed the view that "What has been called the notochord in the Enteropneusta does not correspond with this definition [of it as used in the Chordata] except in its capacity of skeletal product of the gut wall." And he proposes for it the term 'stomochord,' though declaring at the same time that "this term involves no sacrifice of conviction whatever, since it leaves the question of the morphological relationships of the structure to which it refers quite open." From the evidence now at hand it appears to me there can be no serious doubt *that we have in this organ the immediate genetic forerunner of the vertebrate notochord, and that it does not differ sufficiently either in structure or relations from the essential nature of the vertebrate organ to warrant giving to it as a whole a different designation.* I shall, consequently, follow Bateson and call it the notochord. The anterior pouch-like portion of the organ, the part corresponding to the entire organ as it exists in the adults of other species, I shall speak of as the *nuchal notochord*; and the trough-like, posterior portion as the *esophageal notochord*. These terms I adopt as having reference not merely to the morphological relations of the respective parts—the nuchal notochord being situated chiefly within the neck or peduncle, while the *esophageal notochord* is in the esophagus—but also from the functional relations which I conceive to have been the prime factor in differentiating the organ into these two distinct parts. The nuchal notochord¹ has in all probability been produced secondarily from the original simple structure in coördination with the development of the proboscis and neck. This view has been held as a theory by various authors, but hitherto the only direct evidence in support of it has been the longitudinal constriction on each side of the esophagus behind the notochordal evagination in the embryo, observed by Bateson (1884) and Morgan (1891). But the imperfect knowledge of the history of these constructions has left their significance in doubt until now.

Concerning the structure of the nuchal notochord, little need

¹ Willey's term 'stomochord' might well be retained for this part, but for the fact that a separate substantive applied to it in this way would imply that it is an independent organ, and this the facts do not warrant.

be said here. The cavity in the anterior end is unusually voluminous, and in some places the walls become relatively thin, though everywhere they show distinctly the characteristic notochordal structure. The ventral cœcum immediately in front of the body of the nuchal skeleton is well developed. The isthmus is, as in all other species, much reduced, both in diameter and thickness of wall, as compared with the portion farther forward in the proboscis. It, however, maintains its size and distinctness in a greater degree than is usual. A few facts in connection with the portion of it immediately in front of the communication with the esophagus deserves particular attention. A section from this locality is shown in Pl. VII, fig. 5. As may be seen from this figure, the isthmus is here divided lengthwise, sharply, into three portions, a median portion with a well-defined lumen (*m.n.noc.*), and two lateral depressed, wing-like portions (*l.w.* and *r.w.*), in which the lumen is nearly obliterated. It will be noted that the wing to the left in the figure is entirely separated from the median portion by a lamina of the nuchal skeleton. A few sections farther back the cut-off wing disappears entirely. The right wing undergoes the same cutting off and disappearance, though the separating skeletal lamina comes in on this side a few sections behind the one here figured. Eighteen sections still farther back the body of the nuchal skeleton becomes divided lengthwise by a narrow slit, *i. c.*, the skeletal crura arise, and the cubical celled epithelium forming the ventral wall of the notochord (Pl. VII, fig. 5, *v. cp.*) reaches down through this slit and becomes continuous with the dorsal gut epithelium, thus producing an appearance in section like that shown in fig. 6. This lengthwise division of the isthmus is not a constant feature in all specimens, and the cutting off and disappearance of the wings I have found in the one case only. The condition is, however, none the less significant from its inconstancy.

The thickening of the dorsal esophageal wall adjacent to the notochord and the vacuolation of the outer layer of its cells should be noticed here (Pl. VII, fig. 5).

From the level at which the wings disappear the lateral projections of the isthmus, seen at *x* and *y* (fig. 5), extend

rapidly and incline downward, until at the point of communication with the esophagus the isthmus is a broad chamber, much depressed and applied ventrally close against the dorsal esophageal wall (fig. 6). At this point a prominent ridge begins in the middle of the dorsal wall of the isthmus (*m. r.*). At its anterior end this ridge is sharply triangular in section with its apex pointing downward into the narrow slit between the closely approximated skeletal crura (fig. 7, *m. r.*).

This is the point at which the nuchal notochord passes directly over into the esophageal notochord. Fig. 7 presents a characteristic appearance of a section of the esophageal notochord a short distance behind its beginning. By the ridge (*m. r.*) mentioned above, it is divided into two well-marked lateral, pocket-like portions (*l. p.* and *r. p.*). The ridge is composed of much elongated, closely appressed epithelial cells with their nuclei closely crowded in the apical part of the ridge. This ridge broadens and becomes relatively lower as it extends backward (fig. 4). The walls of the lateral pockets are composed of much vacuolated cells, with comparatively few nuclei confined to their inner ends. The histological similarity between the walls of these pockets and the nuchal notochord is perfect. In fact, as the description shows, the continuity from the one to the other is nowhere broken. The skeletal crura (*sk.c.*) mark the region at which the esophageal wall passes over into the notochordal pockets, as the figures show, and as these pass backward they diverge from each other and trend gradually ventrad (figs. 6, 7 and 4).

From this disposition of the crura the esophageal notochord becomes gradually broader, this broadening being effected chiefly by the broadening of the median dorsal ridge already described—the pockets retaining nearly their same size and character far back. As has been stated in the diagnosis, the skeletal crura reach into the pharyngeal region and overlap two or three branchial bars (fig. 3). As their posterior ends lie some distance ventral to the branchial apparatus, it follows that the first two or three branchial orifices are in the portion of the esophageal wall that is a direct backward continuation of the esophageal notochord. In fact, one might say that the extreme posterior portion of the

notochordal pockets are pierced by the most anterior branchial orifices. But of course this is a region of transition. The skeletal crura gradually shade off into strands and thin laminae of skeletal substance; the notochordal pockets are gradually lost, and the vacuolated notochordal tissue gradually disappears. Attention should be directed to the fact that the tissue of the median ridge of the notochord (*m. r.*) has more the character, histologically, of the general esophageal wall than have the pockets, and that this comes to constitute a larger and larger proportion of the entire esophageal notochord as we pass posteriorly. It is nevertheless true that the outermost layer of the ridge is to the very last devoid of nuclei, and is more highly vacuolated than is the epithelium in other parts of the esophagus. The middle portion of this ridge continues on throughout the pharynx as the *cpibranchial band*. This latter organ is unusually prominent in the present species, and its histological structure resembles closely the notochordal tissue where this reaches its best expression. Its cells are large and vacuolar, and its nuclei are few (fig. 8). Its most characteristic development is reached at some little distance behind the beginning of the pharynx, but I am inclined to believe that in this species *a mid-dorsal band of enteric wall differentiated into chordoid tissue extends without interruption throughout the collar and pharyngeal regions*. It is impossible to discuss in the present paper the theoretical bearings of this proposition. Indeed, it may be as well that it is impossible. However, a somewhat fuller statement of the facts on which it rests is undoubtedly due. Spengel has pointed out¹ that in the genus *Balanoglossus* the epibranchial band is a thickened strip of the mid-dorsal wall of the pharynx that is not encroached upon by the series of branchiæ. It is, then, interposed between the dorsal portions of the two branchial series. In the other genera, notably *Ptychordera*, on the other hand, the branchial series of the opposite sides come into actual contact dorsally, so that none of the enteric wall is retained between them. The former condition he regards

¹See, for example, his description and figures of the structure in *B. kuppferi* and *B. canadensis*, and his diagrammatic text figures on page 545 of his monograph.

as more primitive, and I should certainly agree with him in this view. The epibranchial ridge of *Harrimania* is of the same type as that of the species of *Balanoglossus* above mentioned, and it is here, as I have already pointed out, that its histological structure is notochordal in character. Unfortunately Spengel was unable from scarcity of material to study exhaustively *B. canadensis*, and he gives us no information about this structure beyond the fact of its great breadth. Fig. 8 represents a section of the epibranchial band and the adjacent dorsal ends of a pair of septal bars between which it is included. The thickness of the epithelium, the complete absence of nuclei and of staining in the outer half of it, and the large, crowded, irregular, deeply-stained bodies among the nuclei in the inner half, make the band a striking object in a general view of the section of the animal as a whole. The wall of the gut ventral to the pharynx, not shown in the figure, is entirely different. In the first place it is scarcely more than half as thick. Structurally the nuclei are abundant to its very outermost stratum, and the long, narrow cell-bodies belonging to them can be seen stained, to some extent, through the entire thickness of the wall. Careful examination of sections of the band with higher magnification, and a comparison of these with sections of the nuchal notochord in the same individuals, convinces one of the close similarity of the two. What appear to be sharply defined fibers anastomosing with one another in a complicated way, with a few small nuclei scattered here and there at the points of anastomosis, and with large vacant spaces among the fibers, are the characteristics which distinguish both tissues alike. The abruptness with which the epithelium of the band passes over into the much thinner, fully nucleated, and non-vacuolar epithelium, lining the inner surface of the branchial bar, will also be noted (*cp. b.* and *br. cp.*, fig. 8).

Having now presented in outline the facts relative to the presence of an esophageal notochord in *Harrimania maculosa*, and also those which suggest that the epibranchial band in this species is to be interpreted as a continuation of the notochord into the pharynx, we may inquire whether there is any evidence afforded by other species of Enteropneusta of the presence,

either now or at some earlier time, of such an extension of this organ.

In the first place, I present the results of my own observations. In a new species of *Dolichoglossus* which I am naming *D. intermedius*, from the California coast, I find a condition of the supra-crural esophageal wall that I can interpret in no other way so satisfactorily as by supposing that it retains a strong reminiscence of the esophageal notochord. The lateral pockets and median ridge which so distinctly characterize the organ in *Harrimania* are absent. The supra-crural portion of the esophageal wall is, however, considerably broader than the thickness of the esophagus immediately, and for some distance, ventral to the crura. Furthermore, the wall is here thicker by a third or more than it is elsewhere in its circumference. But the most significant thing about it is its histological character. Fig. 9 represents a section of the dorsal half of the esophagus of this animal taken some distance behind the origin of the skeletal crura. The non-nucleated vacuolar condition of the cells in the supra-crural epithelium as compared with the infra-crural, is seen. I must say, furthermore, that the difference is in reality considerably more marked in some sections than in the one here figured. In some places the nuclei, excepting for a thin stratum at the inner surface of the epithelium, are almost wholly wanting, and the vacuolated condition is more pronounced. This structure is most distinct anteriorly, and gradually disappears posteriorly, the epithelium taking on, by the time the extreme posterior limit of the collar is reached, the characters of the esophageal wall in general. There is very little or nothing in the epibranchial band of *Dolichoglossus intermedius*, so far as I am able to determine from the material at hand, to suggest its notochordal affinities.

Without doubt the esophageal notochord exists in *Balanoglossus kuffneri*. Spengel shows it clearly in Pl. XV, figs. 29 and 44, of his monograph. The scant attention which he gives it compels me, however, to suppose that its characters, particularly its histological ones, are much less clearly expressed here than in *Harrimania*. I should expect that it is present in *B. canadensis* also, but Spengel's few and poorly

preserved fragmentary specimens of this species did not enable him to make an exhaustive study of it.

As to the epibranchial band, Spengel has also shown this to have much the character in *B. kuffferi* that it has in *Harrimania*.¹ Unfortunately, however, he tells us nothing about its histology. From the developmental side we have excellent evidence from both Bateson (1885) and Morgan (1891), of the presence of the esophageal notochord in ontogeny. Neither investigator has given a full history of the organ; in fact their references to it are rather meager. They are sufficient, nevertheless, to leave no doubt about its existence. Bateson, for example, in summarizing the method of growth of the notochord, states the matter in these words: The growth of the notochord is due to: "1. A forward growth of the dorsal anterior portion of the archenteron. This is supplemented by, 2, a longitudinal constriction of the dorsal region of the pharynx, which gradually travels backward, separating a hollow hypoblastic tube which remains open to the gut behind." Statement 2 is, of course, the one that particularly concerns us here. His further description and figures show that the skeletal crura are at the 'longitudinal constrictions' of which he speaks. How far back these constrictions 'travel' and what their relations are to the gill clefts he does not make clear. Morgan's description of the organ in the metamorphosing *Tornaria* studied by him is as follows: "The digestive-tract œsophagus in this section shows a tendency to division into two parts by lateral constrictions in its walls, forming a larger lower part and a smaller upper—the latter is directly continuous into the notochord farther forward. In the corners of the folds are two thickened chitin-like rods." (Page 424; italics are the author's.) His figures 58 and 59, Pl. XXVIII show it in characteristic form. In his theoretical discussion (p. 445) the author remarks: "It is certainly significant that the cavity of the notochord of *Balanoglossus* is continuous with the strongly marked dorsal groove of the œsophagus."

It would be of great interest to know more about the peculiar thick plate with rolled-up edges found on the dorsal side of the

¹ Pl. XVI, figs. 53, 54, and 55.

gut which Morgan shows in fig. 64, of a section taken from the extreme posterior portion of the collar region of his oldest young *Balanoglossus*. The author mentions that the histological differentiation peculiar to the anterior pouch of the notochord, extends to the 'strongly marked dorsal groove' of the esophagus.

There is no room for doubt, then, that both Bateson and Morgan have seen the esophageal notochord in the young *Balanoglossus* of both the species studied by them. And since these two investigators have carried out their studies more completely, both as to methods and details, and also as to stages of advancement in the ontogeny of the animal, than have any other zoölogists, we may confidently predict that fuller knowledge of the life history of other species *will reveal its presence generally, at some stage of development, in the entire group of Enteropneusta.*

REMARKS ON THE PRIMITIVENESS OF THE BALANOGLOSSIDÆ.

While, as already said, it is not my purpose to discuss the theoretical bearings of the facts presented in this paper, one point is so close at hand that I cannot ignore it entirely. The fact that the esophageal notochord is present, highly developed, in the adult of *Harrimania*, while it exists only in the embryos of other species, and disappears wholly or almost so in the adult, is in itself strong evidence of the primitiveness of the species, and I conclude from this and other reasons *that Harrimania stands at the very bottom among living species of the Enteropneusta.* But this view is in direct opposition to Willey's, who sees in the Ptychoderidæ the most primitive forms, and in the Balanoglossidæ the most modified, and hence the oldest, forms. After carefully considering the evidence on which Willey bases his views, the facts relating to the notochord left entirely aside, I must believe that his conclusions will not stand. That the species of animals of a homogeneous and well circumscribed group like the Enteropneusta, which are clearly the most highly differentiated and specialized, and are on the whole by far the largest in size, should be regarded as the most primitive; while the simpler, smaller species are held to be the oldest and most modified, and this in face of the fact that all have essentially

the same habits of life, is a proposition that turns topsy-turvy our morphological and phylogenetic notions to such an extent that I imagine it can gain little favor among zoölogists.

Willey's arguments in support of his view are presented categorically in what I suppose him to regard as the order of their importance in his paper on *Ptychodera flava*.¹ Stated in substance only, they are as follows: (1) The gonads are diffuse in *Ptychodera*, while they are disposed in masses with some suggestion of metameric order in some at least of the *Balanoglossidæ*. (2) The gill slits of *P. flava* and of some other species open directly to the exterior throughout their entire length, thus making the pharynx 'exposed' as the author expresses it; whereas the gill slits open into pockets which in turn communicate with the exterior by dorsal pores in the typical *Balanoglossus*. (3) The respiratory region of the enteron in *Ptychodera* is divided into a dorsal branchial portion, and a ventral esophageal portion, while in most of the *Balanoglossidæ* there is no such division. (4) *Ptychodera* inhabits the littoral zone, while some of the *Balanoglossidæ*, notably *Glandiceps talaboti* Marion, and *G. abyssicola* Spengel, are deep-sea species.

We will examine briefly these arguments one by one. The diffuse arrangement of the gonads, says the author, bears all the marks of an archaic type. In reply, I will quote another statement from the same paper (p. 174), and parallel it, slightly modified, with one of my own. In describing the gonads of *P. flava*, he says: "They are not in the remotest degree arranged one after the other, in a manner resembling a paired metameric series, as they are more or less in most other Enteropneusta, but they are scattered in the most irregular way in the substance of the genital pleura." My parallel to this is as follows, making the comparison between *Amphioxus* and *Bdellostoma* instead of between *Balanoglossus* and *Ptychodera*: They (the gonads of *Bdellostoma*) are not in the remotest degree arranged one after the other, in a manner resembling a paired metameric series, as they are in *Amphioxus*, but are scattered in the most irregular way in the substance of the genital fold. So far as the evidence as to primitiveness is concerned, I believe

¹ Willey, 1897, p. 179.

this parallel is perfectly fair. Diffuseness of the gonads is no more a trustworthy index in this regard in the one case than in the other. But should it be objected that *Amphioxus* and *Bdellostoma* are so much more remote from each other, taxonomically, than are *Balanoglossus* and *Ptychodera*, that the comparison is not altogether just, let us take another instance. In the genus *Polycarpa* among the simple ascidians, the gonads in some of the species are scattered widely over the mantle to which they are attached in what are known as polycarps; whereas in *Ascidia* the gonad forms a somewhat lobulated, but yet a compact, single mass. In short the gonads are diffuse in the one case, and are not so in the other; yet no one would conclude from this that *Polycarpa* is a more archaic genus than is *Ascidia*. I should not have expected that so excellent a morphologist as Willey would have staked so much on this point, familiar as he is with the wide differences to which the gonads are frequently subject, even within the range of rather circumscribed groups of animals.

The truth of the matter is, as Willey himself has shown (see his *more recent* and much fuller memoir, 1899), that the gonads of *Ptychodera*, like those of all other Enteropneusta, are well defined, more or less globular masses, each with its own enveloping basement membrane, central cavity, and short duct opening directly or indirectly to the exterior. And the only way in which they are more diffuse in *Ptychodera* than in *Balanoglossus* is that these masses are much smaller, probably in correlation with the smaller size of the ova in the female, are much more numerous, and more closely crowded in the former than in the latter genus.

On the whole, I am quite sure that so far as the gonads of *Ptychodera* indicate anything regarding the ancestry of the animal, they indicate it to be more highly modified and hence presumably older than *Balanoglossus*. One thing among others pointing in this direction is the apparent fact that the gonadal cavities, which are unquestionably primitive, are more completely obliterated in *Ptychodera* than in the *Balanoglossidæ*.

Concerning the exposed pharynx of *Ptychodera flava* and its congeners, I would say that while I am not at all confident

about its meaning, it seems to me that at least as strong a case can be made for the supposition as against it, that the condition is the result of secondary modification from the more typical enteropneustic arrangement. Willey's observations relative to the closing over and mucous fusion of the genital pleuræ at their free edges to produce a transient atrial chamber in this species, and his reflections upon the possible significance of the facts, are exceedingly interesting. Holding as he does, that the genital pleuræ are primitive structures, he is, of course, justified in assuming that in case there is a causal relation between them and the peculiarities of the pharynx, the two have developed *pari passu*, and hence that the one is as old as the other. On the other hand, granting such a relation between the two, if one holds as I do, following Spengel, that the pleuræ are secondary acquisitions, then it might follow likewise that the peculiarity of the pharynx is secondary. But I doubt if there is yet sufficient evidence at hand to warrant a positive opinion one way or the other. I may add, for what it is worth, that in my new species *Dolichoglossus intermedius*, in which the outline of the body in the pharyngeal region is less broken by genital ridges and branchial grooves than in any other known Enteropneust, the gill orifices are more elongated transversely and more laterally directed than in any species except *Ptychodera* of the *flava* type.

As to Willey's third point, that the absence of division of the anterior region of the alimentary canal into branchial and esophageal portions in the Balanoglossidæ "militates strongly against their being regarded as more primitive than *Ptychodera*" (p. 180), I must confess that I fail to catch the author's idea; and in the absence of an explanation as to how the facts militate in this way, I must hold to the orthodox method of interpreting such conditions, and regard the divided as contrasted with the non-divided state as more highly differentiated, and hence as pointing to a more instead of a less primitive nature of the animals under consideration. It seems to me that we have here only another instance of a common occurrence in the Cordata, namely, a tendency of an original simple, unmodified section of the enteron to become differentiated into two distinct parts, the one subser-

vient to the respiratory function, and the other to the alimentary function.

As to the contention that *Ptychodera* is littoral in its habits while *Balanoglossus* is abyssal; and that these facts are to be taken as evidence of the primitiveness of the latter, I will only refer to what I have already said with reference to the mode of life of *Harrimania maculosa*: that it is not only a littoral species, but that it is not a burrower; and that both *B. kuppferi* and *B. canadensis*, the species with which *Harrimania* is undoubtedly most closely related, are neither of them deep-sea forms.

In conclusion, I cannot refrain from calling attention to the fact that Willey's arguments on this question are all advanced in his preliminary communication, written while he was far away from libraries and facilities for doing detailed morphological work; and that his completed memoir, written in England with every facility at hand for exhaustive investigation, gives us next to nothing, not only in extension of his former argument on this question, but on the main question itself.

After a careful study of both his papers, I can not escape the feeling that the more careful study and maturer reflections from which his later utterances came have not strengthened his earlier views.

This subject has received more attention than would have been given it in a preliminary paper but for the fact that I realize how much weight, and deservedly so, Willey's opinions have in all portions of this field of zoölogy; and I have thought it important to set matters right here if possible before they become fixed in a twisted condition.

Spengel (1893) has given a list of the characters which he regards as indicating the primitiveness of *Balanoglossus* as compared with *Ptychodera*. Some of these—the ones I regard as of most importance—are here enumerated, together with others which are the results of my own studies. Those from Spengel are as follows:

1. The presence of synapticulæ in the branchial skeleton of *Ptychodera* and their absence in *Balanoglossus*.
2. The presence of external liver lobes in the former and their absence in the latter,

3. The presence of 'lateral septa' in the former and their absence in the latter.

4. The presence of dorsal 'roots' to the dorsal collar nerve cord in the former and their absence or imperfect development in the latter.

My own contributions are as follows :

1. The persistence of the esophageal notochord in the adult animal in *Harrimania*, and its non-existence in *Ptychodera*.

2. The persistence in full development of the proboscis pores in *Harrimania* and the disappearance, usually, of one of them in *Ptychodera*. [Spengel was in doubt about the primitiveness of this character.]

3. The presence of genital pleuræ in *Ptychodera*, generally, and their absence in the Balanoglossidæ. Other characters having, with somewhat less certainty, the same significance might be presented, but to my mind these are sufficient to place the matter beyond the reach of successful attack.

Such questions as that of the significance of the peculiar relation of the gill slits to the esophageal notochord as seen in such a form as *Harrimania*; of the reasons for the disappearance of this portion of the notochord in most species; of the probable significance of it in the light of Masterman's studies on the Diplochorda; and of various others of a speculative nature I must leave untouched for the present.

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JUNE 2, 1900.

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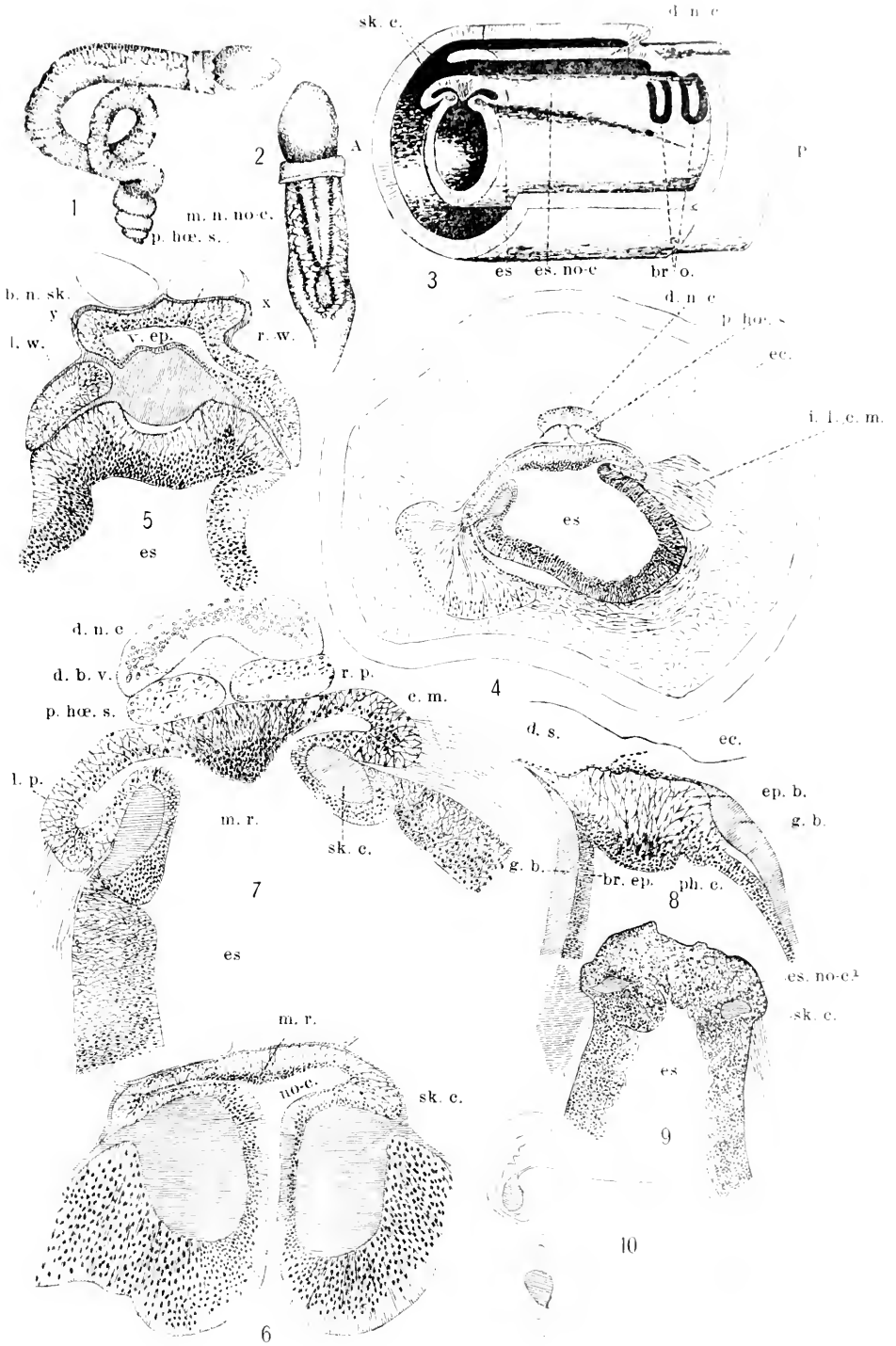
PLATE VII.

[All of the sections were drawn in outline by the aid of a camera lucida. All the figures except 9 are of *Harrimania maculosa*.]

- FIGS. 1 and 2. Lateral and dorsal views, respectively; original drawing, from living specimen; $\frac{2}{3}$ natural size.
- FIG. 3. Schematic representation of dissection; collar and small portion of anterior pharyngeal region of same species. The anterior section is far forward in the collar, slightly behind the anterior neuropore.
4. Mid-collar region.
 5. Dorsal portion of esophageal wall, body of nuchal skeleton, and isthmus of nuchal notochord.
 6. Transitional region from nuchal to esophageal notochord.
 7. Dorsal portion of esophagus with esophageal notochord in sections farther back than the last figure.
 8. Epibranchial band, *ep. b.*, with a pair of gill bars, *g. b.*
 9. Dorsal portion of esophagus of *Dolichoglossus intermedius*, showing remnant of esophageal notochord at *es. no. c'*.
 10. Outline drawing of esophagus and esophageal notochord a short distance behind body of nuchal skeleton.

ABBREVIATIONS USED IN THE FIGURES.

- A.*Anterior.
b. n. sk.Body of nuchal skeleton.
br. ep.Epithelium of branchial bar.
br. o.Branchial orifices.
d. n. c.Dorsal nerve cord.
d. b. v.Dorsal blood vessel.
d. s.Dorsal septum.
ec.Ectoderm.
ep. b.Epibranchial band.
es. no-c.Esophageal notochord.
es.Esophagus.
g. b.Gill bar.
i. l. c. m.Inner longitudinal collar muscle.
l. p. and *r. p.*Left and right notochordal pockets.
l. w. and *r. w.*Left and right wings of nuchal notochord.
m. n. no-c.Median portion of nuchal notochord.
m. r.Median ridge of esophageal notochord.
P.Posterior.
ph. c.Pharyngeal cavity.
p. hc. s.Perihæmal spaces.
sk. c.Skeletal crura.
v. ep.Ventral epithelium of nuchal notochord.



Harrimania maculosa.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 133-156.

AUGUST 20, 1900.

RESULTS OF THE BRANNER-AGASSIZ EXPEDI-
TION TO BRAZIL.

I.

THE DECAPOD AND STOMATOPOD CRUSTACEA.

BY MARY J. RATHBUN.

DURING the summer of 1899, Dr. J. C. Branner visited Brazil for the purpose of studying the stone and coral reefs of the coast between Cape St. Roque and Rio de Janeiro. The expenses of the trip were borne chiefly by Professor Alexander Agassiz, of Harvard University. Mr. Arthur W. Greeley, of the San Diego State Normal School, California, accompanied the expedition as naturalist, and the biological collections were made chiefly by him, with such assistance as other members of the party could give from time to time. The collecting was all done between June 3 and August 8, 1899, between Natal, in the State of Rio Grande do Norte, and Maceio, State of Alagoas.

The decapod and stomatopod crustaceans collected number seventy species. Six of these were undescribed, and the known ranges of many other species have been extended. The types of new species are in the U. S. National Museum.

Order **DECAPODA.**Family **OCYPODIDÆ.****OCYPODE ALBICANS** Bosc.

Ocyrode albicans BOSCH, Hist. Nat. Crust., I, 196, pl. IV, fig. 1, 1802 (figure inaccurate).¹

Ocyrode arenaria SAY, Jour. Acad. Nat. Sci. Phila., I, 69, 1817.

Ocyrode arenaria MILNE EDWARDS, Hist. Nat. Crust., II, 44, pl. XIX, figs. 13-14, 1837.

Traição, near Mamanguape River; one male.

Maccio, Alagôas, on coral reef and sand beach; two males.

UCA MARACOANI (Latreille).

Ocyrode maracoani LATREILLE, Hist. Nat. Crust., VI, 46, 1803.

Gelasimus maracoani LATREILLE, Dict. Hist. Nat., XII, 519, 1817; MILNE EDWARDS, Ann. Sci. Nat. (3), XVIII, 144 [108], pl. III, fig. 1, 1852.

Natal, Rio Grande do Norte; six males, one female.

Mangroves, Rio Parahyba do Norte at Cabedello; one male, one female.

UCA MORDAX (Smith).

Gelasimus mordax SMITH, Trans. Conn. Acad. Sci., II, 135, pl. II, fig. 3; pl. IV, figs. 4, 4a, 1870.

Uca mordax RATHBUN, Proc. U. S. Nat. Mus., XXII, 276, 1900.

Pernambuco, on mangroves; one male.

UCA THAYERI sp. nov.

Plate VIII, figs. 1 and 2.

Carapace very broad in its anterior fourth, narrowing rapidly in its posterior three-fourths; antero-lateral angles almost rectangular, blunt. Sometimes the carapace is narrower at the orbital angles than a little behind that point, caused by the curving inward, at the lateral angle, of one or both of the lateral margins. The dorsal furrows are deep, especially the cervical, and the transverse gastro-cardiac furrow; less deep are the obliquely longitudinal branchial furrow and the post-orbital. Surface finely and densely granulate through the lens, and tomentose, the hair retaining particles of mud.

¹ I have restored Bosc's name to this crab, as his description was made from specimens on the coast of Carolina, where no other species of the genus occurs. The fact that in the figure the artist has represented the eyes with stalks beyond the cornea does not, I think, invalidate the species. Say was the first binomial writer to use the specific name *arenaria*.

Front very narrow, not linear nor spatuliform, but subtriangular, at base or posteriorly less than one-fifth the width between the antero-lateral angles of the carapace, anteriorly truncate or nearly so; sides oblique and almost straight. Superior orbital surface, or eyebrow, shallow, not varying much in length throughout its width; margins finely granulate. Inferior margin of orbit with large truncate tubercles, increasing in size and distance apart toward the outer extremity.

Large cheliped very heavy. Merus and carpus elongate, thick, rugose on the outer surface, and without armed margins. Outer surface of palm coarsely tuberculate on its upper half, the tubercles gradually becoming fine granules below; upper and lower margins set off by deep grooves. Inner surface of palm with a ridge marked by a single line of large tubercles, leading obliquely upward from the lower margin to the carpal cavity, where it turns at a little less than a right angle and is continued less than half way to the upper margin, or when continued further, the tubercles are obsolete. On the palm at the base of the dactylus are two tuberculate lines, the distal one very short; both are slightly oblique to the lower margin. In full grown males the fingers are very long, the lower margin of the propodus sinuous, the pollex bent down for its distal third. The dactylus equals or overreaches the pollex. The prehensile tubercles are irregular, but not strikingly so. The dactylus is roughened at its base on the upper side, and has a short longitudinal groove on the outer side below the upper margin.

The smaller cheliped is rather long, the fingers longer than the palm and somewhat gaping to the tips. The meral joints of the ambulatory legs are dilated and very broad, especially those of the second and third pairs.

TABLE OF DIMENSIONS.

Locality.	Sex.	Length.	Width at antero-lateral angles.	Width at about $\frac{1}{2}$ the distance behind antero-lateral angles.	Width between last pair of legs.	Width in front of bases of penultimate pair of legs.	Length of propodus of larger cheliped.	Width of same.	Length of dactylus.
Rio Parahyba do Norte.	♂	17.2	27.1	27.5	11.6	21	48.3	14.5	35.4
do.	♀	13	19	17.5	9.5	15.5			
do.	♂	15	23.4	22.5	10.5	17.3	42.5	12.7	31.6

Sexual and age variations.—Old males show a tendency to widen behind the antero-lateral angles; this tendency is stronger on

the side of the large claw than on the side of the small one. In males which are young or have not reached their fullest development, the pollex of the large chela is straight, not bent down, and the lower margin of the propodus is convex, not sinuous. The meral joints of the ambulatory legs are wider in the female than in the male, as is the case in other species of the genus.

Range.—This species was first taken by the Thayer Expedition on the coast of Brazil, at Rio Parahyba do Norte, Saõ Matheos and Victoria. Specimens from these localities are in the Museum of Comparative Zoölogy, and one male from the Rio Parahyba do Norte is in the U. S. National Museum. In 1884, the 'Albatross' collected at Jamaica one male, the claw of which was not reproduced at its last shedding.

Types.—Eight males and one female were taken on the Branner-Agassiz Expedition, among the mangroves on the Rio Parahyba do Norte at Cabedello. Cat. No. 23753.

Additional locality.—Natal, Rio Grande do Norte; one male.

UCA SPINICARPA Rathbun.

Uca spinicarpa RATHBUN, Amer. Nat., xxxiv, 586, 1900.

Mamanguape stone reef; one male, soft shell.

This specimen is too shapeless to be determined with certainty, but it appears to be *U. spinicarpa*, which has been taken in the Gulf of Mexico on the coast of Alabama, Mississippi, Texas, and Mexico. The species is distinguished by the truncate anterior margin of the front between the eyes, and the outline of the lateral margins, which are straight and subparallel in their anterior portion, and then curve abruptly inward and backward. The carpus of the large cheliped has a stout spine or tooth at the middle of its inner surface. The inner face of the palm has a prominent crest crowned by a single row of large tubercles extending obliquely upward from the lower margin to the cavity in which the carpus fits, thence it turns at a right angle and meets the upper margin; there are two rows of tubercles at the base of the dactylus; the remainder of the surface is smooth or nearly so.

UCA LEPTODACTYLA Rathbun.

Uca leptodactyla RATHBUN, in Rankin, Ann. N. Y. Acad. Sci., xi, No. 12, 227, 1898, and synonymy.

Mangroves, Rio Parahyba do Norte; one male.

Family **GEARCINIDÆ**.**UCIDES CORDATUS** (Linnaeus).

Cancer cordatus LINNÆUS, Amœn. Acad., VI, 414, 1763.

Uca una GUÉRIN, Icon. Règne Anim. Cuvier, pl. V, fig. 3, ♀.

Uca cordata WHITE, List Crust. Brit. Mus., 31, 1847.

Ucides cordatus RATHBUN, Ann. Inst. Jamaica, 1, 25, 1897, and synonymy.

Mangroves, Rio Parahyba do Norte, Cabedello; three females.

Family **GRAPSIDÆ**.**GONIOPSIS CRUENTATUS** (Latreille).

Grapsus cruentatus LATREILLE, Hist. Nat. Crust., VI, 70, 1803.

Grapsus (Goniopsis) cruentatus DE HAAN, Fauna Japon., 33, 1835.

Goniograpsus cruentatus DANA, Crust. U. S. Expl. Exped., 342, 1852; atlas, pl. XXI, fig. 7, 1855.

Rio Parahyba do Norte, Cabedello, on mangroves; one male, one female.

Pernambuco, on mangroves; three males.

PACHYGRAPSUS TRANSVERSUS Gibbes.

Pachygrapsus transversus GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 181, 1850.

Goniograpsus innotatus DANA, Proc. Acad. Nat. Sci. Phila., 249, 1851; Crust. U. S. Expl. Exped., 345, 1852; atlas, pl. XXI, fig. 9, 1855.

Mamanguape stone reef; two males.

Rio Parahyba do Norte, Cabedello, on mangroves; one male, one female.

Rio Goyanna stone reef; four males.

Pernambuco stone reef; one male.

Stone reef at Boa Viagem, five miles south of Pernambuco; one male.

Coral reef, Maceio, Alagôas; one male, one female.

PACHYGRAPSUS GRACILIS (Saussure).

Metopograpsus gracilis SAUSSURE, Mém. Soc. Phys. Hist. Nat. Genève, XIV, 443, pl. II, fig. 15, 1858.

Pachygrapsus gracilis STIMPSON, Ann. Lyc. Nat. Hist. N. Y., X, 113, 1871.

Rio Parahyba do Norte, on mangroves; one male, one female.

SESARMA (HOLOMETOPUS) RECTUM Randall.

Sesarma recta RANDALL, Jour. Acad. Nat. Sci. Phila., VIII, 123, 1839.

Sesarma mullerii A. MILNE EDWARDS, Nouv. Arch. Mus. Hist. Nat. Paris, V, 27, 1869.

Pernambuco, on mangroves; one male, one female.

SESARMA (HOLOMETOPUS) MIERSII Rathbun.

Sesarma (Holometopus) miersii RATHBUN, Proc. Biol. Soc. Washington, XI, 91, 1897, and synonymy.

Rio Parahyba do Norte, Cabedello, on mangroves; one male.

ARATUS PISONII Milne Edwards.

Sesarma pisonii MILNE EDWARDS, Hist. Nat. Crust., II, 76, pl. XIX, figs. 4 and 5, 1837.

Aratus pisoni MILNE EDWARDS, Ann. Sci. Nat. (3), XX, 187, 1853.

Rio Parahyba do Norte, Cabedello, on mangroves; five males, nine females.

Lagoa do Norte, Maceio, on mangroves; three females.

PLAGUSIA DEPRESSA (Fabricius).

Cancer depressus FABRICIUS, Syst. Ent., 406, 1775.

Plagusia depressus SAY, Jour. Acad. Nat. Sci. Phila., I, 100, 1817.

Mamanguape stone reef; one female.

Rio Goyanna stone reef; three females.

Pernambuco stone reef; one female.

Color.—Brilliant; for the most part a white ground thickly covered with fine red dots; also blotches of clear red.¹

Family PILUMNIDÆ.

CARPILIUS CORALLINUS (Herbst).

Cancer corallinus HERBST, Natur. Krabben u. Krebse, I, 133, pl. v, fig. 40, 1783.

Carpilius corallinus LEACH, in Desmarest, Consid. sur les Crust., 104, 1825.

Goyanna stone reef; one male.

CYCLOXANTHOPS DENTICULATUS (White).

Xantho denticulatus WHITE, Ann. Mag. Nat. Hist. (2), II, 285, 1848. A.

MILNE EDWARDS, Crust. Rég. Mex., 252, pl. XLV, fig. 2, 1879.

Cycloxanthops denticulatus RATHBUN, Ann. Inst. Jamaica, I, 14, 1897.

Stone reef at Boa Viagem; one female.

Coral reef, Maccio, Alagôas; thirteen males, seven females.

Color.—Gay and not constant, varying from shades of light purplish red through bright red to orange red.

¹Color notes have been made from specimens in formalin.

MENIPPE NODIFRONS Stimpson.

- Pseudocarcinus rumphii* MILNE EDWARDS, Hist. Nat. Crust., 1, 408, 1834.
 Not *Cancer rumphii* FABRICIUS.
Menippe rumphii DANA, Crust. U. S. Expl. Exped., 1, 179, 1852. A. MILNE
 EDWARDS, Crust. Rég. Mex., 263, pl. XLVIII, fig. 4, 1879.
Menippe nodifrons STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, 53, 1859.

Mamanguape stone reef; two young.

Rio Goyanna stone reef; one female.

Pernambuco stone reef; three young.

Pernambuco stone reef at Ilha de Nogueira; one young.

Coral reef, Maccio, Alagôas; one male, two females.

PILUMNUS RETICULATUS Stimpson.

- Pilumnus reticulatus* STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, 214, 1860.
Pilumnus tessellatus A. MILNE EDWARDS, Crust. Rég. Mex., 295, pl. LI, fig. 2,
 1880.

Pernambuco stone reef at Ilha de Nogueira; one male, one female.

PILUMNUS ANDREWSII Rathbun.

- Pilumnus andrewsii* RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV,
 266, pl. v, fig. 2, 1898.

Coral reef, Maccio, Alagôas; one male.

In this specimen, which is a little smaller than the type, the frontal lobes are more sinuous than truncate, the lateral spines are less acuminate, and the spinules of the carpal joints of the chelipeds less sharp.

PILUMNUS DASYPODUS Kingsley.

- Pilumnus dasypodus* KINGSLEY, Proc. Boston Soc. Nat. Hist., XX, 155, 1879.
Pilumnus vinaceus A. MILNE EDWARDS, Crust. Rég. Mex., 283, pl. L, fig. 2,
 1880.

Pernambuco stone reef at Ilha de Nogueira; three females.

Stone reef at Boa Viagem; three males, one female.

Coral reef, Maccio, Alagôas; one male, one female.

LEPTODIUS FLORIDANUS (Gibbes).

- Chlorodius floridanus* GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 175, 1850.
Leptodius floridanus A. MILNE EDWARDS, Crust. Rég. Mex., 268, pl. XLIX,
 fig. 2, 1880.

Mamanguape stone reef; two males, one female.

Rio Goyanna stone reef; three males, one female.

Coral reef, Maccio, Alagôas; one male, three females.

EUPANOPEUS HERBSTII (Milne Edwards).

Panopeus herbstii MILNE EDWARDS, Hist. Nat. Crust., 1, 403, 1834. BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 358, pl. XIX, figs. 1 and 2; pl. XXIII, figs. 10-12, 1891, and synonymy.

Eupanopeus herbstii RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, 273, 1898.

Mamanguape stone reef; one female.

Rio Parahyba do Norte, Cabedello, on mangroves; four males, five females.

EUPANOPEUS OCCIDENTALIS (Saussure).

Panopeus occidentalis SAUSSURE, Rev. Mag. Zoöl. (2), IX, 502, 1857. BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 360, pl. XX, fig. 3; pl. XXIII, fig. 14, 1891, and synonymy.

Eupanopeus occidentalis RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, 273, 1898.

Rio Parahyba do Norte, on mangroves; two males.

Pernambuco stone reef; one female.

EUPANOPEUS AMERICANUS (Saussure).

Panopeus americanus SAUSSURE, Rev. Mag. Zoöl. (2), IX, 502, 1857; Mém. Soc. Phys. Genève, XIV, 432, pl. 1, fig. 8, 1857.

Panopeus arcolatus BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 361, pl. XXI, fig. 3, 1891.

Eupanopeus americanus RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, 273, 1898.

Rio Parahyba do Norte, on mangroves; one female.

EUPANOPEUS BERMUDENSIS (Benedict and Rathbun).

Panopeus wurdemannii BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 372, pl. XXIV, figs. 6 and 7, 1891 (not *P. wurdemannii* GIBBES).

Panopeus bermudensis BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 376, pl. XX, fig. 2; pl. XXIV, figs. 14 and 15, 1891.

Eupanopeus bermudensis RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, 273, 1898.

Coral reef, Maceio, Alagôas; one female.

EUPANOPEUS HARTTII (Smith).

Panopeus harttii SMITH, Proc. Boston Soc. Nat. Hist., XII, 280, 1869; Trans. Conn. Acad. Sci., II, pp. 5 and 34, pl. 1, fig. 5, 1869.

Eupanopeus harttii RATHBUN, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, 273, 1898.

Coral reef, Maceio, Alagôas; two males.

EUPANOPEUS ABBREVIATUS (Stimpson).

Xantho parvulus MILNE EDWARDS, Hist. Nat. Crust., 1, 395, 1834; not
Cancer parvulus FABRICIUS.

Panopeus abbreviatus STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, 211, 1860.

Eurypanopeus parvulus A. MILNE EDWARDS, Crust. Rég. Mex., 322, pl.
LIX, fig. 5, 1880.

Eurypanopeus abbreviatus A. MILNE EDWARDS, Crust. Rég. Mex., 320, pl.
LIX, fig. 3, 1880.

Panopeus parvulus BENEDICT and RATHBUN, Proc. U. S. Nat. Mus., XIV, 369,
pl. XXI, fig. 1, pl. XXIII, figs. 2 and 3, 1891.

Mamanguape stone reef; five males, seven females.

Rio Goyanna stone reef; two males.

Boa Viagem stone reef; one male, one female.

Maceio coral reef; three males, one female.

ERIPHIA GONAGRA (Fabricius).

Cancer gonagra FABRICIUS, Sp. Ins., 505, 1781.

Eriphia gonagra MILNE EDWARDS, Hist. Nat. Crust., 1, 426, pl. XVI, figs. 16
and 17, 1834.

Mamanguape stone reef; one male.

Rio Goyanna stone reef; seven males, two females.

Pernambuco stone reef; three males, two females.

Boa Viagem stone reef; one female, soft shell.

Maceio coral reef; eight males, three females.

Color.—Variable, but always bright. Some are reddish brown or yellowish brown with darker patches; spines and margins of front and orbits orange. Others show no red nor yellow, only browns and orange. Legs with light yellow ground, covered in great part with fine red dots. Claws with the tubercles of the upper half dark red or blue, of the lower half yellow; fingers dark red.

DOMECIA HISPIDA Eydoux and Souleyet.

Domecia hispida EYDOUX and SOULEYET, Voy. *Bonite*, 1, Crust., 235, 1842;
atlas, pl. II, figs. 5-10 (*Domecie hérissée*, on plate).

Maceio coral reef; one female.

Family PORTUNIDÆ.

CALLINECTES DANÆ Smith.

Lupa dicantha DANA, Crust. U. S. Expl. Exped., 1, 272, 1852; atlas, pl.
XVI, fig. 7, 1855.

Callinectes danae SMITH, Trans. Conn. Acad. Sci., II, 7, 1869.

Mamanguape stone reef; one young female.

Rio Parahyba do Norte, Cabedello, on mangroves; one male, one young female.

CALLINECTES MARGINATUS (A. Milne Edwards).

Neptunus marginatus A. MILNE EDWARDS, Arch. Mus. Hist. Nat. Paris, x, 318, pl. xxx, fig. 2, 1861. *

Callinectes larvatus ORDWAY, Boston Jour. Nat. Hist., vii, 573, 1863.

Callinectes marginatus RATHBUN, Proc. Biol. Soc. Washington, xi, 149, 1897, and synonymy.

Mamanguape stone reef; four young.

Rio Goyanna stone reef; one male.

Rio Parahyba do Norte, on mangroves; two young.

Pernambuco stone reef; one male.

Maceio coral reef; four males, one young female.

Color.—Dull brown, with areas of bluish black; claw brown above, blackish blue below and on the inner side; last segments of swimming feet a brighter brown.

ARENÆUS CRIBRARIUS (Lamarck).

Portunus cribrarius LAMARCK, Hist. Nat. Anim. sans Vert., v, 259, 1818.

Arenæus cribrarius DANA, Crust. U. S. Expl. Exped., i, 290, 1852; atlas, pl. xviii, fig. 2, 1855.

Mamanguape stone reef; one male, two females.

Family MAIDÆ.

ACANTHONYX PETIVERII Milne Edwards.

Acanthonyx petiverii MILNE EDWARDS, Hist. Nat. Crust., i, 343, 1834.

Acanthonyx petiveri A. MILNE EDWARDS, Crust. Rég. Mex., 143, pl. xxvii, fig. 7, 1878, and synonymy.

Mamanguape stone reef; one female.

Boa Viagem stone reef; one female.

MICROPHRYS BICORNUTUS (Latreille).

Pisa bicornuta Latreille, Encyc. Méth., Hist. Nat., Insectes, x, 141, 1825.

Microphrys bicornutus A. MILNE EDWARDS, Nouv. Arch. Mus. Hist. Nat. Paris, viii, 247, 1872; Crust. Rég. Mex., 61, pl. xiv, figs. 2-4, 1875, and synonymy.

Mamanguape stone reef; two males.

Pernambuco stone reef at Ilha de Nogueira; two males, four females.

Maceio coral reef; five males, five females.

MITHRAX VERRUCOSUS Milne Edwards.

Mithrax verrucosus MILNE EDWARDS, Mag. Zoöl., ii, pl. iv, 1832.

Mamanguape stone reef; one young.

Pernambuco stone reef at Ilha de Nogueira; one young.

Maceio coral reef; two young.

MITHRAX BRAZILIENSIS Rathbun.

Mithrax braziliensis RATHBUN, Proc. U. S. Nat. Mus., xv, 268, pl. xxxvi, fig. 2, 1892.

Maccio coral reef; two males.

Color.—A rich dark crimson.

MITHRAX FORCEPS (A. Milne Edwards).

Mithraculus forceps A. MILNE EDWARDS, Crust. Rég. Mex., 109, pl. xxiii, fig. 1, 1875.

Mithrax forceps MIERS, *Challenger* Rept., Zoöl., xvii, pp. 87 and 88, 1886. RATHBUN, Proc. U. S. Nat. Mus., xv, 269, 1892, and synonymy.

Natal, Rio Grande do Norte; two males.

Pernambuco stone reef at Ilha de Nogueira; one male.

Maccio coral reef; four males, seven females.

MITHRAX CORYPHE (Herbst).

Cancer coronatus HERBST, Natur. Krabben u. Krebse, I, 184, pl. xi, fig. 63, 1785; not *C. coronatus* MOLINA, 1782.

Cancer coryphe HERBST, op. cit., III, Heft 2, p. 8, 1801.

Mithrax coronatus MIERS, *Challenger* Rept., Zoöl., xvii, pp. 87, 89, 1886. RATHBUN, Proc. U. S. Nat. Mus., xv, 272, 1892, and synonymy.

Mithrax coryphe RATHBUN, Ann. Inst. Jamaica, I, 11, 1897.

Rio Goyanna stone reef; two males.

Pernambuco stone reef at Ilha de Nogueira; three males.

Boa Viagem stone reef; two females.

Maccio coral reef; eleven males, four females.

TELEOPHRYS CRISTULIPES Stimpson.

Teleophrys cristulipes STIMPSON, Ann. Lyc. Nat. Hist. N. Y., vii, 190, pl. II, fig. 2, 1860.

Mithrax cristulipes RATHBUN, Proc. U. S. Nat. Mus., xv, 273, 1892, and synonymy.

Maccio coral reef; five males, four females.

Family DROMIIDÆ.

DROMIA ERYTHROPUS (George Edwards).

Cancer marinus chelis rubris CATESBY, Nat. Hist. Carolina, Florida and Bahama Islands, II, 37, pl. 37, 1743.

Cancer erythropus GEORGE EDWARDS, Catalogue of Animals in Catesby's Nat. Hist. of Carolina, with the Linnæan names, 1771.

Dromia lator MILNE EDWARDS, Hist. Nat. Crust., II, 174, 1837.

Dromia erythropus RATHBUN, Ann. Inst. Jamaica, I, 39, 1897.

Pernambuco stone reef at Ilha de Nogueira; one young male.

Family **PAGURIDÆ**.**PETROCHIRUS INSIGNIS** (Saussure).

Pagurus insignis SAUSSURE, Mém. Soc. Phys. Hist. Nat. Genève, XIV, 453 [37], pl. 111, fig. 20, 1858.

Rio Goyanna stone reef; one specimen.

Maceio coral reef; one specimen.

Color.—Ambulatory legs with four transverse reddish bands.

CALCINUS SULCATUS (Milne Edwards).

Pagurus sulcatus MILNE EDWARDS, Ann. Sci. Nat. (2), VI, 279, 1836.

Calcinus sulcatus STIMPSON, Proc. Acad. Nat. Sci. Phila., X, 234 [72], 1858.

Mamanguape stone reef; one specimen.

Pernambuco stone reef; two specimens.

Maceio coral reef; two specimens.

Color.—Gastric region green or greenish in the center, dark red at the sides. Eye stalks light brownish yellow in basal half, turning to red distally; band next to the cornea white; cornea black. Claws dark brown, with red margins; fingers deep yellow, white near the tips. Second and third pairs of feet yellow, dactyli with a red band in the center, nails black.

CLIBANARIUS VITTATUS (Bosc).

Pagurus vittatus BOSCH, Hist. Nat. Crust., II, 78, pl. XII, fig. 1, 1802.

Clibanarius vittatus STIMPSON, Proc. Acad. Nat. Sci. Phila., X, 235 [73], 1858.

Mamanguape stone reef; two specimens.

Rio Parahyba do Norte, Cabedello, on mangroves; six specimens.

CLIBANARIUS CUBENSIS (Saussure).

?*Cancer scolopetarius* HERBST, Natur. Krabben u. Krebse, II, 23, pl. XXIII, fig. 3, 1791.

Pagurus cubensis SAUSSURE, Mém. Soc. Phys. Hist. Nat. Genève, XIV, 455 [39], 1858.

Clibanarius scolopetarius STIMPSON, Proc. Acad. Nat. Sci. Phila., X, 235, 1858. RATHBUN, Ann. Inst. Jamaica, I, 43, 1897.

Rio Parahyba do Norte, Cabedello, on mangroves; six specimens.

CLIBANARIUS ANTILLENIS Stimpson.

Clibanarius antillensis STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, 85, 1859.

Rio Goyanna stone reef; one specimen.

Color.—Claws orange-red with a white spot at each spine. Ambulatory legs with a white stripe through the middle of the outer and of the inner surface.

Family PORCELLANIDÆ.

PETROLISTHES ARMATUS (Gibbes).

Porcellana armata GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 190, 1850.

Porcellana leporina HELLER, Reise Novara, 78, pl. VI, fig. 7, 1865.

Petrolisthes armatus STIMPSON, Proc. Acad. Nat. Sci. Phila., x, 227, 1858.

Mamanguape stone reef; eleven specimens.

Rio Goyanna stone reef; six specimens.

Maccio coral reef; one specimen.

Color.—Bright red and yellowish mottled. On the chelipeds the red strongly predominates, the tubercles being red, the interspaces yellow. Propodal joints of ambulatory legs with two light transverse bands, one at the distal end, the other near the proximal.

PETROLISTHES SEXSPINOSUS (Gibbes).

Porcellana sexspinosa GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 190, 1850.

Porcellana egregia GUÉRIN, in La Sagra's Hist. Cuba, 2d part, vol. VIII (Atlas), pl. II, fig. 1, 1857.

Petrolisthes sexspinus STIMPSON, Proc. Acad. Nat. Sci. Phila., x, 227, 1858.

Mamanguape stone reef; three specimens.

Stone reef at Boa Viagem, Pernambuco; three specimens.

Coral reef, Maccio, Alagôas; seven specimens.

Color.—Dark crimson in transverse broken lines on a white ground. Similar oblique lines on chelipeds, showing a tendency to break up into spots; outer margin, and also the margin of the dactylus, with a row of crimson spots. Ambulatory legs with meral joints spotted; carpal joints speckled with crimson and with a white stripe on the upper surface; propodal joints crimson with two white bands, one at the distal end, the other on the proximal half. Dactyli crimson, with white toward the nail.

PETROLISTHES SERRATUS Henderson.

Petrolisthes serratus HENDERSON, *Challenger* Rept., Zool., xxvii, 107, pl. XI, fig. 2, 1888.

The single specimen, a male, agrees with Henderson's description and figure, excepting that the inner border of the carpus of the right cheliped (the left is missing) has only four teeth, the small distal fifth tooth figured by Henderson being absent, and the dactylus is shorter than in the type, being 4.2 mm. long, while the inner margin of the propodus measures 6.4 mm. The dactylus has a large basal tooth, and a smaller tooth next it. Henderson says that the dactylus is "almost equal in length to the hand." His type was from off Bahia in

7 to 20 fathoms. The specimen in hand is from the coral reef at Maceio, Alagôas; like the type it is an adult male, but smaller; the carapace is cracked, so that it cannot be accurately measured.

The ground color is a deep crimson, covered with narrow and closely interlacing stripes of white, leaving small irregular interstices of crimson. The stripes are narrower and the interstices smaller near the margin of the carapace. Chelipeds similar in coloring. On the ambulatory legs the white stripes are broken, forming small irregular detached patches of white; the propodal joints have three narrow transverse bands of white, two at the proximal end, and one near the distal end.

P. serratus is closely allied to, if not identical with, *P. amannus* (Guérin).

PISOSOMA RIISEI Stimpson.

Pisosoma riisei STIMPSON, Ann. Lyc. Nat. Hist. N. Y., VII, 75, 1859.

Pisosoma glabra KINGSLEY, Proc. Acad. Nat. Sci. Phila., XXXI, 406, pl. XIV, fig. 2, 1879 [1880].

Coral reef, Maccio, Alagôas; two females.

In these specimens the front is not the same: in one the upper margin is nearly straight, in the other more advanced at the middle. In the one cheliped present, the carpus is about as broad as long, opposed to Kingsley's figure rather than to his description; the inner margin is sinuous. The palm is subtriangular, wider at the base of the dactylus than its inner length. The outer marginal crest of the palm is continued two-thirds the length of the carpus, and on that segment is more or less tuberculous or broken up by oblique rugæ. Dactylus with a small basal tooth, which when the fingers are closed, fits against a tooth on the propodus between the two fingers; upper margin with a longitudinal groove on the basal half. Fingers gaping. The types of *P. glabra* Kingsley, with which these have been compared, are smaller, the fingers shut tight and their tips cross; the inner margin of the carpus is more distinctly dentate.

Dimensions of female bearing eggs.—Length 4.5 mm.; breadth 5.3 mm.

Color.—A beautiful light crimson, with a small white spot on the lobe above the antenna and behind it on the margin a larger white spot; these two spots unite below the dorsal surface forming a white band extending to the cheliped. A small white dot on the branchial region adjoining the cardiac region. Chelipeds crimson, tips of fingers white. Ambulatory legs crimson with white bands, a narrow one at either end of the propodus and a wide one covering the proximal half of the merus.

PISOSOMA GREELEYI sp. nov.

Pl. VIII, fig. 4.

Male. Carapace slightly broader than long, subcircular. Front with a double margin, the upper margin arcuate, continuous with the line of the orbit; the lower margin produced downwards in an acute median tooth and forming a rectangular preorbital tooth. Postorbital tooth small and blunt; behind this on the antero-lateral margin there is a shallow lobe followed by a notch at the cervical suture. Lateral margin marked by a narrow raised line which turns inward on the carapace at the posterior third of the branchial region. Proto-gastric lobes large, separated by a shallow median sinus. Cervical sutures deep. Branchio-cardiac furrows also well marked. A slight transverse depression across the middle of the branchial region. Surface ornamented with scattered scabrous granules, posterior and postero-lateral portions crossed by fine rugose lines.

The upper surface of the merus of the chelipeds is crossed by fine transverse rugæ; inner margin with a blunt and granular prominence near the distal angle; distal margin of lower surface with two or three spinules. Upper surface of carpus, propodus and dactylus covered with coarse granules, some of which are large and tubercular. The carpus at its widest portion is about as wide as long; its inner margin is convex, and furnished with several small irregular granulated teeth. The outer margin of the propodus is convex, with a slight sinuosity toward the distal end of the palm. The palm is as wide as its length on the inner side. The fingers gape when closed; the tip of the dactylus fits into a sinus on the inner edge of the pollex near the tip. Ambulatory legs smooth. Last three segments sparsely hairy.

Dimensions.—Male, length 5 mm.; width 5.2; length of propodus of cheliped 5.8; width of same 3. Female with eggs, length 5.2; width 6; length of propodus of cheliped 7.5; width of same 4.3 mm. Females are more swollen laterally than males.

Color.—In formalin, a light brick red. Terminal half of fingers white.

Type locality.—Coral Reef, Maceio, Alagôas; three males, three females. Cat. No. 23754.

Additional localities.—Mamanguape stone reef, one female with eggs; Pernambuco stone reef at Ilha de Nogueira, one male.

PACHYCHELES MONILIFER (Dana).

Porcellana monilifera DANA, Crust. U. S. Expl. Exped., 1, 413, 1852; pl. xxvi, fig. 3, 1855.

Pachycheles moniliferus STIMPSON, Proc. Acad. Nat. Sci. Phila., x, 228 [66], 1858.

Mamanguape stone reef; one specimen.

Pernambuco stone reef at Ilha de Nogueira; five specimens.

Stone reef at Boa Viagem, Pernambuco; nine specimens.

Color.—Light yellowish red, deeper on the chelipeds.

PORCELLANA ROSEA sp. nov.

Pl. VIII, fig. 3.

Length and breadth of carapace subequal. Carapace subtriangular. The front viewed from above has a well-marked median tooth, and between the middle and the orbit two sinuses. The orbit is very small and has a preorbital and a postorbital lobe. The lateral margin is interrupted by a slight notch at the cervical suture. Behind the suture there is a well-defined, coarsely granulated margin set off from the carapace by a furrow. This margin at a point far back on the branchial region turns obliquely inward and backward upon the carapace. The posterior margin has a deep median indentation. The carapace is very convex in an antero-posterior direction, slightly convex from side to side. A deep median furrow leads from the frontal tooth to the mesogastric region, the anterior portion of which is faintly outlined. On either side of the median furrow are two tubercular elevations. From the notch anterior to the preorbital lobe a furrow runs obliquely backward and joins the cervical suture, which is very deep. The cardiac region is sufficiently distinct. A shallow furrow, curving forward, crosses the branchial region transversely. The surface is covered with large punctæ bearing short bristles, and the branchial region has scattered irregular tubercles.

The merus of the cheliped has a blunt inner distal tooth; distal and outer margins of upper surface bordered by acute tubercles. Carpus with inner and distal margins thickened; inner margin with a blunt tooth at its proximal third; outer margin tuberculous, a somewhat larger tubercle at the distal third; upper surface very uneven, tuberculous and granulous, three tubercles much larger than the others. The outer margin of the propodus is nearly straight for most of its length, and is marked by sharp granules; the inner margin forms a very prominent lobe behind the dactylus; the upper surface has four

blunt longitudinal crests, the innermost one being very short. Each finger has a similar crest; the fingers meet along their prehensile edges. The lower surface of palm and fingers is also granulous.

The second, third and fourth pairs of feet are granulous, the carpal joints each with a large tubercle on the outer side.

Dimensions.—Of female with eggs, length and breadth 5.7 mm.; of immature female (figured), length 4.3, breadth 4.6 mm.

Localities.—Mamanguape stone reef, one male, soft shell; one female, type, Cat. No. 23755. Pernambuco stone reef at Ilha de Nogueira; one female, figured.

Color.—In formalin, a light pink, without spots.

This species approaches *P. sociata* Say, but in *P. rosea* the lateral marginal line extends much further back before turning inward; and the ornamentation of carapace and chelipeds is quite different.

MINYOCERUS ANGUSTUS (Dana).

Porcellana angusta DANA, Crust. U. S. Expl. Exped., 1, 423, 1852; pl. XXVI, fig. 12, 1855.

Minyocerus angustus STIMPSON, Proc. Acad. Nat. Sci. Phila., x, 229 [67], 1858.

Porcellina stelicola MÜLLER, Arch. f. Natur., XXVIII, part I, 194, pl. VII, 1862.

This species was described by Dana from a specimen from Rio de Janeiro, one half as large as the one in hand. Dana's type is not extant. The individual in Dr. Branner's collection is an egg-bearing female. It does not accord in every respect with Dana's description and figure, but allowance has been made for difference in size and possible mutilation.

The front between the orbits is two-spined instead of three; of these spines, the one on the left side is much shorter than the one on the right, and apparently was broken previous to the last moult; it is possible that the median spine was also broken off and not renewed, there being only a very shallow lobe in its place. The outer orbital spines are advanced beyond the frontal sinuses. The eye is intermediate in length between its adjacent spines.

The right cheliped only is present. The merus has an inner distal spine. The carpus has a strong spine on the inner margin just anterior to the middle, and two smaller spines at the inner distal angle; the distal margin is spinulous. The palm increases gradually in width from the carpus to the fingers, which are less than one-third the length of the palm; fingers stout and narrowly gaping.

Dimensions of female.—Length, measured from tip of longest frontal spine, 6.7 mm.; width 4.8 mm.

Locality.—Mangroves, Parahyba River.

Color.—White, with marblings of orange-brown; a narrow median stripe of white extends from the posterior margin to a point in advance of the lateral spine. There is an irregular oblong patch of white on each branchial region, and in front of it a smaller transverse patch, and a third still smaller near the lateral spine.

Müller's figure is of a small individual, and shows the frontal teeth shorter, the carpus without spines, the fingers short as in our specimen; the color marks in general resemble those of our specimen, but in the latter the light median stripe is not continued to the front.

Family CALLIANASSIDÆ.

GLYPTURUS BRANNERI sp. nov.

Pl. VIII, figs. 5-8.

Dorsal suture very deep. Front with a short, acute, depressed rostrum, and on either side above the insertion of the antennæ, a shallower subacute projection.

Eyestalks subtriangular, with convex upper surface, and contiguous nearly to their narrow truncate extremities, which are obscurely dentate.

Terminal joint of the peduncle of the antennulæ about $1\frac{2}{3}$ times as long as the penult joint. Antennulæ nearly as long as the carapace.

The peduncle of the antenna is more slender than that of the antennula; its penult joint reaches the middle of the terminal joint of the peduncle of the antennula. The flagellum is more than twice as long as that of the antennula.

Outer maxillipeds similar to those of *G. acanthochirus*; the ischium and merus are wider, the propodus somewhat longer and narrower, the dactylus more slender than in that species. The outer surface is pubescent, the inner margin long-hairy.

The larger cheliped is finely and inconspicuously dentate on its lower margin. The merus is twice as wide as the ischium. The carpus is nearly as wide as the manus, and twice as wide as long. The palm is nearly as wide as long. The fingers cross when closed. The dactylus has three teeth on the prehensile edge. Smaller cheliped with the carpus and manus less than half as wide as in the larger cheliped, and elongate. Both chelipeds have tufts of long hair on the margins.

Inner caudal lamella as broad as long. Outer branch of the outer

lamella completely overlapping and coalesced with the inner branch, and only slightly shorter.

This species can be distinguished from *G. acanthochirus* Stimpson and *G. grandimanus* (Gibbes, as *Callianassa*) by its non-spinous front and chelipeds and the subequal length of the two branches of the outer caudal lamella.

Dimensions.—Length in median line, exclusive of antennæ, 52.2 mm.; length of carapace 14.9; length of carpus and propodus together, measured to end of pollex, 18.5 mm.

Type.—A male, from Mamanguape stone reef. Cat. No. 23756.

UPOGEBIA AFFINIS (Say).

Gebia affinis SAY, Jour. Acad. Nat. Sci. Phila., 1, 241, 1818. SMITH, Vineyard Sound Report, 549 [255], pl. II, fig. 7, 1874.

Upogebia affinis STERBING, Hist. Crust., 185, 1893.

Mamanguape stone reef; six specimens.

Parahyba River, mangroves; one specimen.

Maceio coral reef; three specimens.

Family PANULIRIDÆ.

PANULIRUS ECHINATUS Smith.

Panulirus echinatus SMITH, Trans. Conn. Acad. Sci., 11, 20, 1869. POCOCK, Jour. Linn. Soc. London, Zool., xx, 516, 1890.

Pernambuco; one male.

Carapace, antennæ, first two segments of abdomen and upper half of meral joints of legs pinkish red; remainder of abdomen and legs dark blackish blue. No round spots as in *P. guttatus* (Latreille), which is green with yellow spots. The median spines of the carapace as well as all the prominent spines behind the anterior margin are smaller in *echinatus* than in *guttatus*; there are no rudimentary spines on the antennular segment, and its two large spines are less divergent and less ascending. The penult segments of antennæ and antennulæ are considerably shorter in *echinatus*.

Family PENÆIDÆ.

PENÆUS SETIFERUS (Linnæus).

Cancer setiferus LINNÆUS, Sys. Nat., ed. 12, 1, pt. 2, 1054, 1767.

Penæus fluviatilis SAY, Jour. Acad. Nat. Sci. Phila., 1, 236, 1818.

Penæus setiferus MILNE EDWARDS, Hist. Nat. Crust., 11, 414, 1837.

Maceio, on coral reef; one specimen.

PARAPENÆUS GOODEI Smith.

Parapenæus goodei SMITH, Proc. U. S. Nat. Mus., VIII, 176, 1885.

Maceio, on coral reef; one specimen.

XIPHOPENEUS KROYERI (Heller).

Penæus kroyeri HELLER, SB. Acad. Wiss. Wien., XLV, 1 Abth., 425, pl. II, fig. 51, 1862.

Xiphopeneus harttii SMITH, Trans. Conn. Acad. Sci., II, 28, pl. I, fig. 1, 1869.

Xiphopeneus kroyeri SMITH, Proc. U. S. Nat. Mus., VIII, 188, 1885.

Maceio, on coral reef; one specimen.

Family ALPHEIDÆ.

ALPHEUS HETEROCHÆELIS Say.

Alpheus heterochæelis SAY, Jour. Acad. Nat. Sci. Phila., I, 243, 1818.

Alpheus heterochæelis HERRICK, Mem. Nat. Acad. Sci., v, 372, pl. II (colored), 1891.

Mamanguape stone reef; eleven specimens.

Rio Parahyba do Norte, on mangroves; three specimens.

Rio Goyanna stone reef; one specimen.

Pernambuco stone reef at Ilha de Nogueira; one specimen.

Stone reef at Boa Viagem; one specimen.

Maceio coral reef; nine specimens.

ALPHEUS FORMOSUS Gibbes.

Alpheus formosus GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 196 (32), 1850.

Alpheus pocyi GUÉRIN, in La Sagra's Hist. Cuba, 2nd part, vol. VII, p. XIX; vol. VIII, pl. II, fig. 10, 1857.

Natal, Rio Grande do Norte; one specimen.

Pernambuco stone reef at Ilha de Nogueira; one specimen.

Maceio coral reef; six specimens.

ALPHEUS CRISTULIFRONS Rathbun, nom. nov.

Alpheus obesomanus POCKOCK, Jour. Linn. Soc. London, Zool., XX, 520, 1890 (nec Dana).

Maceio coral reef; two specimens.

SYNALPHEUS MINUS (Say).

Alpheus minus SAY, Jour. Acad. Nat. Sci. Phila., I, 245, 1818.

Synalpheus minus COUTIÈRE, Bull. Soc. Entom. France, 1898, No. 8, 190, fig. 4.

Maceio coral reef; three specimens.

Family **HIPPOLYTIIDÆ**.**HIPPOLYSMATA WURDEMANNI** (Gibbes).

Hippolyte wurdemanni GIBBES, Proc. Amer. Assoc. Adv. Sci., III, 197
[33], 1850.

Hippolysmata wurdemanni KINGSLEY, Proc. Acad. Nat. Sci. Phila., xxx,
1878, 89 [1].

Mamanguape stone reef; one specimen.

HIPPOLYSMATA RHIZOPHORÆ sp. nov.

Pl. VIII, fig. 9.

Female. Carapace with a median carina on its anterior fifth. Median spines three, one on the carapace proper, and two on the rostrum; extremity of rostrum a slender spine not reaching to the end of the first antennular segment; no inferior spines. An antennal spine present.

Antennular peduncles elongate, the second segment twice as long as the third; two slender flagella, the upper a little thicker than the lower in its basal portion, or for about 32 segments; the lower one twice as long as the carapace; the upper one shorter, at least in the single specimen in hand.

Basal antennal spine short. Scale short, extending half the length of the third antennular segment, broad, extremity rounded; outer distal spine strong. Peduncle equal to the scale in length; flagellum two-thirds the length of the body.

External maxillipeds extending beyond the antennular peduncle by the length of the dactylus and half the propodus. Propodus with a distal spine. Dactylus with a marginal row of spines in pairs, and two or three spines at the extremity.

First pair of feet reaching a little beyond the propodus of the maxilliped. Carpus intermediate in length between the palm and the propodus. Palm with subparallel margins; fingers two-thirds as long as palm.

The carpus of the second pair of feet, when extended, reaches to the end of the maxilliped. The carpus is 24-jointed. Palm and fingers subequal in length.

The sixth segment of the abdomen is one and one-half times as long as the fifth. The telson has four rather large spines forming a rectangle on the dorsal surface; the extremity is subtruncate, with two long submedian spines and two shorter spines outside of these. The inner caudal lamina is oval-lanceolate and extends behind the telson

to a distance equaling one-third the length of the telson; the outer lamina is longer and broader than the inner, its distance behind the telson equaling fully one-half the length of the telson.

Dimensions.—Female: Length from tip of rostrum to tip of telson 27 mm.; length of carapace and rostrum 9; length of rostrum 2.5 mm.

Type locality.—Rio Parahyba do Norte, on mangroves; one ovigerous female. Cat. No. 23757.

Family PALÆMONIDÆ.

PALÆMON BRACHYLABIS sp. nov.

Pl. VIII, fig. 10.

Female. Dorsal crest arising a little in front of the middle of the carapace, or about two-fifths the distance behind the orbits. Crest slightly ascending for its proximal half, strongly ascending for its distal half. Rostrum overreaching the antennal scale for its distal fourth. Upper margin of crest armed with 9 or 10 teeth; the proximal 7 or 8 are near together and equidistant; the next one is about twice the distance from the others; the last one is near the tip of the rostrum; 2 or 3 of them are posterior to the orbit. The inferior margin is armed with 3 or 4 teeth, the distal one at some distance from the extremity. Terminal third of rostrum very slender. Upper flagellum of inner antennæ with 10 segments united, 14 free.

Carpus of second pair of feet reaching a little beyond the rostrum. Carpus as long as the palm and half the fingers. Palm two and a half times as long as the fingers, not swollen. Fingers not gaping.

Dimensions.—Female: Length of body 37.2 mm.; length of carapace and rostrum 16.4; length of rostrum 9.4 mm.

Type locality.—Mamanguape stone reef; five specimens.

Additional locality.—Rio Parahyba do Norte, on mangroves; two specimens. Cat. No. 23758.

The long upturned rostrum with $\frac{9-10}{3-4}$ teeth, and the very short fingers of the second pair of feet readily distinguish this species.

BITHYNIS ACANTHURUS (Wiegmann).

Palæmon acanthurus WIEGMANN, Arch. f. Natur., 11, part 1, 150, 1836.

Palæmon forceps MILNE EDWARDS, Hist. Nat. Crust., 11, 397, 1837.

Palæmon forceps VON MARTENS, Arch. f. Natur., xxxv, part 1, 28, pl. 11, fig. 4, 1869.

Pernambuco, on mangroves; two specimens.

Market at Maceio, Alagoas; said to have come from Lagoa do Norte, a large lake near Maceio.

UROCARIS LONGICAUDATA Stimpson.

Urocaris longicaudata STIMPSON, Proc. Acad. Nat. Sci. Phila., XII, 39 [108], 1860. KINGSLEY, Proc. Acad. Nat. Sci. Phila., XXXI, 424, 1879 [1880].

Off Jacuma, Parahyba, 15 feet; one specimen.

Order STOMATOPODA.

Family CHLORIDELLIDÆ.

GONODACTYLUS CHIRAGRA (Fabricius).

Squilla chiragra FABRICIUS, Ent. Syst., II, 513, 1793. DESMAREST, Consid. Crust., 251, pl. XLIII, 1825.

Gonodactylus chiragra LATREILLE, Encyc. Méth., Hist. Nat., Entom., X, 473, 1825.

Off Jacuma, Parahyba, 15 feet; one specimen.

Pernambuco stone reef at Ilha de Nogueira; three specimens.

Maceio coral reef; 31 specimens.

PSEUDOSQUILLA OCULATA (Brullé).

Squilla oculata BRULLÉ in Webb and Berthelot, Hist. Nat. Isles Canaries, II, part 2, p. 18, 1840.

Pseudosquilla oculata MIERS, Ann. Mag. Nat. Hist. (5), v, 110, pl. III, figs. 3 and 4, 1880.

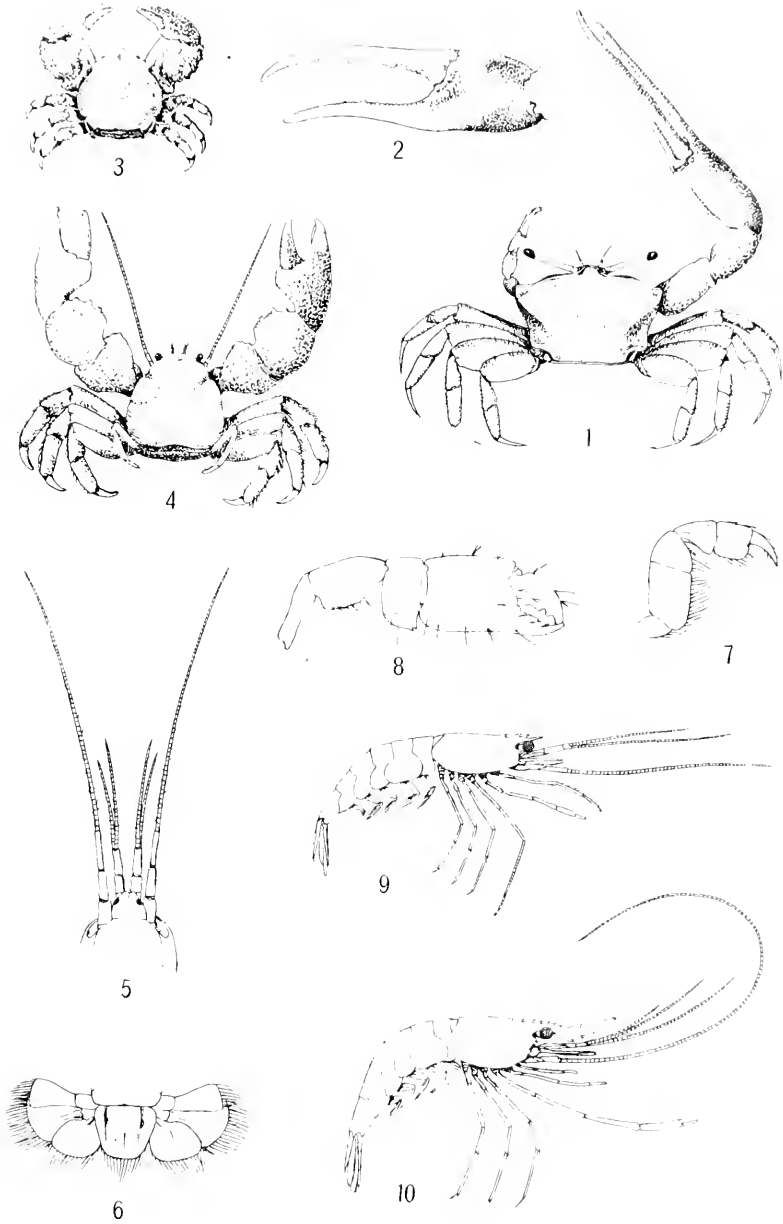
Maceio coral reef; two specimens.

Besides the localities indicated by Bigelow,¹ there are specimens in the National Museum from Honolulu and from Clarion Island, off the west coast of Mexico.

¹Proc. U. S. Nat. Mus., XVII, 500, 1894.

PLATE VIII.

- Fig. 1. *Uca thayeri*, ♂, $\frac{1}{3}$ nat. size.
2. *Uca thayeri*, ♂, inner surface of large chela, $\frac{1}{3}$ nat. size.
3. *Porcellana rosea*, ♀, $2\frac{2}{3}$ nat. size.
4. *Pisosoma greeleyi*, ♂, $2\frac{2}{3}$ nat. size.
5. *Glypturus branneri*, ♂, front and antennæ, $1\frac{3}{5}$ nat. size.
6. *Glypturus branneri*, ♂, caudal extremity, $1\frac{1}{5}$ nat. size.
7. *Glypturus branneri*, ♂, outer maxilliped, $1\frac{3}{5}$ nat. size.
8. *Glypturus branneri*, ♂, large cheliped, $1\frac{1}{5}$ nat. size.
9. *Hippolysmata rhizophoræ*, ♀, $1\frac{1}{5}$ nat. size.
10. *Palaemon brachylabis*, ♀, $1\frac{1}{5}$ nat. size.



Decapod and Stomatopod Crustaceans from Brazil.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 157-159.

AUGUST 20, 1900.

RESULTS OF THE BRANNER-AGASSIZ EXPEDITION TO BRAZIL.

II.

THE ISOPOD CRUSTACEA.

BY HARRIET RICHARDSON.

Family **CORALLANIDÆ**.

CORALLANA ACUTICAUDA (Miers).

Corallana acuticauda MIERS, Proc. Zool. Soc. London, 1881, Pt. 1, pp. 78-79, pl. VII, fig. 13.

Hab.: Maceio coral reef, Alagôas (Branner-Agassiz Expedition); Hotspur Bank (S. Atlantic), lat. $17^{\circ} 32' S.$, long. $35^{\circ} 45' W.$ (Miers).

The female of this species was described by Miers. Two specimens, a male and female, were collected by the Branner-Agassiz Expedition at Maceio coral reef, Alagôas. The female is identical with *Corallana acuticauda* as figured and described by Miers. The description of the male follows.

Male.—Body convex. Last two thoracic segments and postabdomen not hairy, as characteristic of female.

Head transverse, with a prominent median point projecting between the basal joints of the first pair of antennæ. On either side of the median point, the anterior margin of the head is deeply excavate for the reception of the much enlarged basal joints of the first pair of antennæ. The antero-lateral angles of the head are acute, and extend anteriorly nearly as far as the median point. The eyes are large, black, and composed of many facets. At their base they are separated



FIG. 1. Head of *Corallana acuticauda*, ♂.

by more than half the width of the head; at their apex by more than a third. The first pair of antennæ have the basal joints very much dilated; they extend nearly to the posterior margin of the head. The second pair of antennæ reach the posterior margin of the third thoracic segment.

The mandibles are very prominent, the pair much overlapping, with the apical part forming a single cone.

First five thoracic segments sub-equal, the last two being somewhat shorter. The first two epimera are not longer than the segments and are rounded posteriorly; the last four are acute, and produced beyond the segments. The abdominal segments are tuberculate on

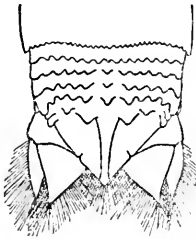


FIG. 2. Abdomen of *Corallana acuticauda*, ♂.

their posterior margins, with a median longitudinal excavation, ornamented in the median line with low tubercles. The terminal segment is acute at the apex, triangulate, with a median longitudinal excavation. At the base of the segment are four tubercles in a transverse line, the two centre ones being largest. A double tubercle is situated laterally on either side. The uropoda have both branches equal in length and not longer than the terminal segment. The inner branch is broad, and posteriorly acute; the outer branch is narrow, and acutely produced. Both branches and also the terminal segment of the body are fringed with long hairs.

The male of this species resembles the male of *Corallana antillensis* Hansen, especially in a comparison of the abdomens. They are, however, specifically distinct, as more careful examination has shown.

Family BOPYRIDÆ.

BOPYRUS ALPHEI sp. nov.

A specimen of *Bopyrus* parasitic on *Alpheus heterochaelis* Say, collected on mangroves on the Rio Parahyba do Norte is probably identical with the *Bopyrus* mentioned by Fritz Müller¹ as being found on a species of *Alpheus* on the coast of Brazil. Fritz Müller's species has been recorded as *Bopyrus alpheii* although no description or figure of it has ever been published.

The body of the female is broadly oval, its greatest width being equal to its length, broadened anteriorly and narrowed posteriorly.

¹ Jenaische Zeitschrift, VI, p. 68, 1871.

Head widening posteriorly, its antero-lateral angles being produced into lobes, directed upward. Eyes absent. The thoracic segments have their lateral margins somewhat elevated and contiguous. The abdominal segments are not contiguous along the lateral margins but are separated by broad lateral incisions.

The incubatory lamellæ are very wide apart, surrounding a broad open space, the marsupium, on the ventral side of the body.

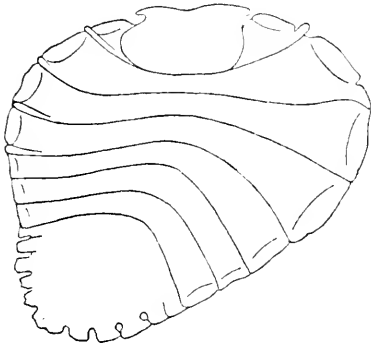


FIG. 3. *Bopyrus alpheii*, ♀.

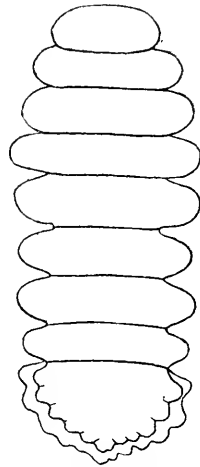


FIG. 4. *Bopyrus alpheii*, ♂.

Pleopoda simple, lamellar, placed on either side of the median line. Color, white.

Male, oblong oval. Eyes wanting. Thoracic segments well defined. Abdominal segments imperfectly defined, except along the margin. Color white.

Type locality.—Mangroves, Rio Parahyba do Norte, Brazil, in the branchial cavity of *Alpheus heterochaelis* Say. Cat. No. 23759.

PROCEEDINGS
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WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 161-184.

AUGUST 20, 1900.

RESULTS OF THE BRANNER-AGASSIZ
EXPEDITION TO BRAZIL.

III.

THE FISHES.

BY CHARLES H. GILBERT.

DURING his connection with the Branner-Agassiz Expedition to Brazil in the summer of 1899, Mr. A. W. Greeley made a small but interesting collection of fishes from that part of the coast lying between Mamanguape and Maceio. Most of the specimens were purchased from fishermen at Pernambuco and Maceio, but a few of the smaller kinds were collected in the tide-pools of the reefs. Of the 85 species obtained, 4 are here described as new, and a number of little known forms are redescribed. The collection is deposited in the Zoological Museum of Stanford University.

I take pleasure in expressing my indebtedness to Dr. J. C. Branner, who, as leader of the expedition, encouraged in every way the gathering of biological material.

1. *Ginglymostoma cirratum* (Gmelin).

A female about 12 feet long, obtained at Maceio, was found to contain young, many of which were preserved.

2. *Mustelus canis* (Mitchill).

Maceio.

3. *Scoliodon terrænovæ* (Richardson).

Maceio.

4. *Sphyrna zygæna* (Linnæus).

Maceio.

5. **Felichthys marinus** (Mitchill).

Pernambuco; Maceio.

In two young specimens the pectoral and the dorsal spines are about equal, and are much shorter than the length of the head. The anal fin has 21 rays. The occipital buckler tapers rapidly backward, its posterior half being very narrow and of nearly uniform width.

Eigenmann is probably right in referring *F. bahiensis* to the synonymy of this species.

6. **Selenaspis herzbergii** (Bloch).

Maceio.

7. **Aspistor luniscutis** (Cuvier & Valenciennes).

Pernambuco; Maceio.

8. **Netuma grandicassis** (Cuvier & Valenciennes).

Maceio.

9. **Tetragonopterus bahiensis** Steindachner.

Two specimens, 85 and 70 mm. long, from the stone reef at Mamanguape.

T. bahiensis seems to differ from *T. lacustris* in the slightly larger head and slenderer body. Our specimens agree well with the original description, differing only in having one or two more scales along the lateral line, and in having but two rudimentary anal rays.

The humeral and caudal spots are intensely black, with well-defined margins. The former is longitudinally oval, surrounded by a wide lighter area, the posterior portion of which is slightly darkened. The spot on caudal peduncle is widest opposite the base of the outer caudal rays and is continued as a narrow streak to the tips of the median rays. A faint darker band runs forward along the sides, and becomes fainter and narrower anteriorly.

The head is contained $2\frac{2}{3}$ times in the total length to base of caudal; depth $2\frac{2}{7}$. Eye $3\frac{1}{4}$ in head. Scales 34 or $35\frac{5\frac{1}{2}}{1\frac{1}{2}}$, the longitudinal rows counted from origin of dorsal to base of outer ventral ray. The lateral line is complete.

D. I, 10 or I, 11; A. II, 25 or II, 29.

The maxillary reaches to below the anterior part of the eye. The distance from the tip of the snout to the end of the maxillary is less than that from the tip of the snout to the hinder edge of the pupil. By the aid of a lens, the maxillary in the larger specimen can be seen to have its entire edge finely crenulated.

10. *Tetragonopterus unilineatus* Gill.

Two small specimens were obtained among the mangroves near Pernambuco.

11. *Ahlia egmontis* (Jordan).

One specimen, 150 mm. long, from the coral reef near Maccio. It agrees in nearly all respects with the description of the types. The dorsal fin begins behind the origin of the anal a distance equal to the length of the gape of the mouth. The pectorals are broad and rather short, their length slightly less than the length of the snout. The length of the head equals one-fifth the distance from the snout to the anus. The head and trunk are a little shorter than the tail. The teeth are in a single series in each jaw, there being a few stronger ones anteriorly on the head of the vomer. No teeth on the shaft of vomer. The color is rather bright olive, the upper parts being densely dusted with black specks. The only differences of importance between this specimen and the types as described consist in the smaller eye and smaller mouth in the Brazilian specimen. The eye is very small, about $\frac{1}{2}$ the length of the snout; but the apparently larger eye in the types may be due to imperfect state of preservation. The smaller mouth is doubtless dependent upon immaturity, the types being 15 inches long.

12. *Myrophis punctatus* (Lütken).

One specimen was obtained at the mouth of the Rio Goyanna. The head is contained $2\frac{5}{7}$ times in the trunk, $5\frac{1}{2}$ in the tail.

13. *Lycodontis moringa* (Cuvier).

Mouth of the Rio Goyanna; Pernambuco; coral reef near Maccio.

14. *Lycodontis funebris* (Ranzani).

Stone reef at Pernambuco.

15. *Albula vulpes* (Linnæus).

Pernambuco; Maccio.

16. *Stolephorus browni* (Gmelin).

Stone reef at Mamanguape.

17. *Lycengraulis grossidens* (Cuvier).

Pernambuco; one specimen.

Head $4\frac{1}{8}$; depth 4. D. II, 14; A. II, 25. Lateral line about 40.

There are about 14 large teeth in a series along the middle of the lower jaw. These are rather widely separated, the middle of the interspace being occasionally occupied by a smaller tooth. Both toward the angle of the jaw and toward the symphysis these larger teeth are

replaced by smaller ones continuing the series. The maxillary teeth are more uniform in size and about equal the smallest of those in the lower jaw. Along front and sides of jaw the teeth are slightly incurved and are directed downward and backward; laterally they become decidedly retrorse, pointing downward and forward.

The anal begins under the middle of the dorsal. The origin of the dorsal is midway between the base of the caudal fin and the middle of the eye. The fins are somewhat mutilated and the scales have fallen. There seems to have been a wide silvery band along the sides, on a level with the eye.

18. *Pœcilia vivipara* Bloch and Schneider.

Four specimens from a fresh-water swamp, and from the mangroves, near Pernambuco.

D. 6, 7 or 8; A. 7 or 8. L. L. 27. Basal half of dorsal dusky, with a narrow black convex cross-bar separating basal region from the distal area; the latter with a wide dusky margin. In the largest specimen the coloration of the side is nearly uniform, without spots. Smaller specimens show a black spot on each side of back, in advance of the origin of the dorsal fin. In the youngest specimens these spots are very conspicuous.

19. *Hyporhamphus roberti* (Cuvier & Valenciennes).

One specimen, 160 mm. long, from Pernambuco, seems to belong here rather than with *H. unifasciatus*, as the body is very slender (depth 9 in length) and the beak is very long, its length beyond the premaxillaries being half longer than the distance from tip of upper jaw to opercular margin. Dorsal with 15 rays; anal with 16.

20. *Hyporhamphus unifasciatus* (Ranzani).

Maccio.

21. *Mugil curema* Cuvier & Valenciennes.

Maccio.

22. *Mugil trichodon* Poey.

Stone reef at Mamanguape.

23. *Sphyræna barracuda* (Walbaum).

Maccio.

24. *Polydactylus virginicus* (Linnaeus).

Pernambuco; Maccio.

25. *Myripristis jacobus* Cuvier & Valenciennes.

One specimen from a coral reef near Maccio.

In Jordan and Evermann's 'Fishes of North and Middle America' (Vol. I, p. 846), this species is described as having the head $\frac{1}{4}$ the length (to base of caudal), the depth $\frac{1}{3}$. These measurements are copied from Günther's Catalogue of Fishes, Vol. I, p. 19, no note being made of the fact that, as there given, they refer to $\frac{1}{4}$ and $\frac{1}{3}$ of the total length, including the caudal fin. In the specimen at hand the head is $\frac{1}{3}$ and the depth $\frac{2}{3}$ the length to base of caudal.

26. **Holocentrus ascensionis** (Osbeck).

Mouth of the Rio Goyanna.

27. **Upeneus maculatus** (Bloch).

Maceio.

28. **Upeneus dentatus** Gill.

Maceio.

29. **Upeneus caninus** new species.

One specimen, 200 mm. long, from Pernambuco.

Characterized by the large scales, the outer canines in upper jaw, the long hog-like snout, the profusely branched tubes of the lateral line and the coloration.

The profile rises in a straight or slightly incurved line from the tip of snout to front of orbit, thence in a well arched curve to front of dorsal, where the depth is greatest. The snout is very long. The distance from front of eye to tip of snout is greater by more than half the diameter of pupil than the distance from front of eye to end of opercular spine. The mouth is nearly horizontal, the maxillary greatly broadened at tip and hooked upward. The distance from tip of snout to the end of the maxillary is contained $2\frac{2}{3}$ times in the length of the head.

The teeth in the lower jaw are strong, bluntly conic, in a single series, none of them definitely canine-like. On the middle of one side of the jaw two of the teeth are larger than the others, but this is not true of the other side. The premaxillary teeth are in a single series, similar to those in the lower jaw, those anteriorly more widely spaced than those on the side of the jaw. In front of this series anteriorly are two strong canines on each side, the anterior of which is directed downward, the posterior one curved almost directly backward, parallel with the jaw. There are no teeth on the vomer or the palatines. There are three rows of scales on the cheeks, one on the interopercles, three on the opercles.

The angle of the preopercle and a portion of the vertical limb have fine cross-ridges, which form minute crenulations at the free margin

of the bone. Gill-rakers $6 + 21$, this number including five anterior spinigerous rudiments. The longest gill-raker is contained $1\frac{2}{5}$ times in the diameter of the pupil. Eye $2\frac{4}{5}$ in snout, 5 in head.*

The barbels extend to the anterior margin of the first median scale in front of the ventral base, their length $3\frac{3}{4}$ in length of fish (to base of caudal). Bony interorbital width $2\frac{4}{5}$ in the snout.

The dorsal spines are slender, rather high, the second and third about equal, half the length of the head. The ventrals reach the vent, and equal the length of the snout and eye. The pectorals are shorter, and equal snout and half eye.

D. VIII-I, 8; A. II, 6; P. 16; V. I, 5. 32 scales in the course of the lateral line, $2\frac{1}{2}$ rows above it, $5\frac{1}{2}$ rows below. The tubes of the lateral line are profusely branched, the branches covering the greater part of each scale, there being as many as 12 branches present along the middle of the course of the lateral line.

In spirits almost uniform olivaceous, with a remaining trace of red on some of the scales. Two narrow yellow streaks, separated by an interspace slightly less than diameter of pupil, run horizontally from the opercular spine, converging gently backward to meet where they join lateral line on caudal peduncle.

30. **Scomberomorus maculatus** (Mitchill).

Pernambuco; Maceio.

31. **Trichiurus lepturus** (Linnaeus).

Maceio.

32. **Oligoplites saliens** (Bloch).

A single specimen from Maceio, 235 mm. long, is very close to *O. saurus*, but differs from all specimens which I have seen of that species in the deeper body, the larger more oblique mouth, the narrower maxillary, the relative size and shape of the suborbital bones, and in having four instead of five detached spines in the first dorsal fin. As these are the characters said to distinguish *O. saliens*, I place it provisionally in that species. Abundant material will be needed to determine the status of these two forms.

The maxillary reaches the vertical from the posterior edge of the eye; its length is contained $1\frac{2}{3}$ times in the head. The mouth is considerably more oblique than in *O. saurus*, the maxillary is narrower at the tip, and does not curve downward so perceptibly. The mandible is also slightly slenderer. The tip of the snout is thus higher, being above the upper edge of the pupil, while in *O. saurus* it is plainly below the upper edge of the pupil. The snout is shorter than the eye.

The lower suborbital bone is a third wider than the one above it, a deep re-entering angle between the two. Such a concavity in the posterior margin of the suborbitals is supposed to characterize a distinct species or subspecies (*O. palometta*) from Lake Maracaibo. It is not probable that this character is of value. In our specimen, none of the suborbitals reach the preopercle.

The dorsal spines are but four in number and the anterior rays of the soft dorsal and anal are more elevated than in *O. saurus*, making the anterior profile of the fins decidedly falcate. The dorsal seems to have been yellow in life with a large black blotch on the anterior rays. The caudal was yellow, and traces of light yellow still persist on the anal fin.

The depth of the body is $3\frac{2}{3}$ in the length ($3\frac{5}{7}$ in *O. saurus* of equal length).

33. **Caranx bartholomæi** Cuvier & Valenciennes.

Maceio.

34. **Caranx hippos** (Linnaeus).

Pernambuco.

35. **Caranx latus** Agassiz.

Maceio.

36. **Vomer spixii** (Swainson).

Maceio. Two specimens similar to those from Jamaica reported on by Jordan and Rutter,¹ and evidently agreeing with the figure and description by Agassiz and Spix which served as Swainson's basis for the species.

Our specimens are 210 and 230 mm. long. The head is contained $2\frac{3}{4}$ times in the total length to base of caudal, the depth $1\frac{1}{2}$ times. The eye is contained $3\frac{2}{5}$ times in the head.

The chord of the curved portion of the lateral line is contained $1\frac{1}{4}$ times in the straight portion (not " $1\frac{1}{4}$ the straight part," as given by Jordan and Rutter). The pectoral fins are longer, their tips reaching to or nearly to the middle of the straight part of the lateral line. The origin of the anal fin is slightly behind the front of the second dorsal (well in advance of this point in *V. setipinnis*). The eye is much nearer the anterior profile of the head than the gill opening in *V. setipinnis*; about equidistant between the two in *V. spixii*.

37. **Chloroscombus chrysurus** (Linnaeus).

Stone reef at Mamanguape; coral reef near Maccio.

¹ Proc. Acad. Nat. Sci., Phila., 1897, 101.

Four small specimens, the largest 66 mm. long, agree with *C. chrysurus* in all respects in which this species is said to differ from *C. ectenurus*. Compared with two specimens of *C. ectenurus*, 85 mm. long, from Jamaica (collector, J. S. Robert), these Brazilian specimens show a much deeper body, with a much more strongly arched abdominal profile, which rises rapidly toward the snout and also along base of anal fin. The eye is also larger, $2\frac{3}{5}$ in head, and the chord of the curved portion of lateral line is contained $1\frac{2}{3}$ times in the straight portion. In the young *C. ectenurus* referred to, the eye is $3\frac{1}{5}$ in the head, and the chord of the curved portion of the lateral line is contained $1\frac{3}{4}$ times in the straight portion.

D. VIII-I, 27; A. II-I, 26. Depth of body $2\frac{1}{5}$ to $2\frac{1}{4}$ in the length. Depth of caudal peduncle $1\frac{1}{3}$ to $1\frac{1}{2}$ in its length (the latter measured from base of last dorsal ray to base of first caudal ray).

The two species are probably valid, with their ranges overlapping.

The young specimens of *C. ectenurus* here referred to are not mentioned among the types of this species. They are from the same locality as the types, and were sent in by the same collector. They are numbered 4966 in the register of the Zoölogical Museum of Stanford University.

38. *Trachinotus falcatus* (Linnaeus).

Maceio.

39. *Apogon brasilianus* new species.

Type 61 mm. long. Mamanguape stone-reef, Brazil. June 23, 1899. A. W. Greeley, collector.

Closely related to *A. imberbis* and *A. dovii*, but without trace of a black spot on caudal peduncle. This spot becomes obscure with age in *A. dovii* and probably also in *A. imberbis* and may be wholly wanting in adults; but it is always conspicuous in young specimens of the size here described.

Total length	62 mm.
Length to base of caudal	47 mm.
Head (to end of opercular flap) . . . . .	.38
Snout . . . . .	.09
Interorbital width . . . . .	.09
Eye . . . . .	.13
Maxillary . . . . .	.20
Pectoral . . . . .	.24
Ventral . . . . .	.21
Highest (2d) dorsal spine . . . . .	.16
Highest soft dorsal ray . . . . .	.23
Distance from last dorsal spine to first soft ray . . . . .	.08

Second anal spine . . . . .	.13
Longest anal ray . . . . .	.21
Longest ray of upper caudal lobe . . . . .	.32
Middle caudal ray . . . . .	.24
Depth . . . . .	.31
Depth of caudal peduncle . . . . .	.16½
Length of caudal peduncle from base of last anal ray . . . . .	.25

In outline closely resembling *A. dovii*, with snout acute as in that species, and the lower jaw included. There are broad bands of villiform teeth in the jaws, and narrow bands (sometimes scarcely more than irregular single series) on the vomer and the palatines. The mouth is oblique, the maxillary reaching a vertical midway between pupil and hinder edge of orbit. The eye is large, $1\frac{2}{3}$ times the inter-orbital width, which is equal to the snout. The vertical limb of the preopercle is rigid, its posterior margin finely serrulate; the horizontal limb is membranous, flexible, with entire margin.

The gill-rakers are long and slender, the longest half the diameter of the orbit; there are 3 movable ones on the vertical and 10 or 11 on the horizontal limb, and in addition 3 anteriorly-placed immovable tubercles.

The longest dorsal spine is contained $1\frac{1}{2}$ times in the longest soft ray. The ventrals reach the vent. The long narrow pectorals slightly overlap the front of the anal.

In life, doubtless reddish, sparsely dusted with coarse black specks, which are somewhat more numerous posteriorly; no indication of a black spot on caudal peduncle. A dark spot on opercle (black in the younger co-type) formed by the close juxtaposition of black specks. The vertical portion of the cheeks and the sides of snout are covered with coarse black specks. In the co-type these are concentrated into a small blotch behind the eye; those on side of snout suggesting a band such as is often seen in the young of *A. dovii*. Fins translucent, the caudal and the anterior dorsal and anal rays black-edged.

Scales ctenoid, 26 or 27 in the lateral line, $2\frac{1}{2}$ series between the lateral line and the base of the dorsal; 7 series between the lateral line and the base of the anal.

This species may eventually prove to be identical with *A. imberbis*, if the young of the latter are ever seen to lack the caudal spot and to possess an opercular spot. Such accounts as we have of the species do not indicate this.

The American records of *A. imberbis* are all doubtful, and the species should be omitted from our lists until its occurrence in American waters is verified. It seems improbable that this common Medi-

terranean form should have been found at Newport, Rhode Island, and at Fernando da Noronha Island, Brazil.

40. **Centropomus undecimalis** (Bloch).

Maccio.

41. **Bodianus fulvus** (Linnæus).

Maccio.

Four specimens, of which three represent the '*ruber*' phase, one the brown colored '*punctatus*' phase. The latter has a reddish tinge on the lower fins and on the lower half of the sides. It is extremely improbable that the red, yellow and brown forms (*B. ruber*, *B. fulvus* and *B. punctatus*) represent more than color phases of a single species.

42. **Epinephelus adscensionis** (Osbeck).

Maccio.

43. **Promicrops guttatus** (Linnæus).

Maccio.

44. **Alphestes afer** (Bloch).

Pernambuco.

45. **Lutjanus apodus** (Walbaum).

Maccio.

Four specimens, the longest 190 mm. These are darker in color than is usual in this species, three of the specimens being deep reddish-brown on the head, body, and fins, with a vertical light streak on the marginal half of each scale. The fourth specimen is lighter, but appears faded. The outer ventral ray and the anterior margin of the anal are whitish. The spinous dorsal has a deep maroon terminal bar. A series of small round, or rarely oblong, blue spots crosses the middle of the preorbital below the eye, and extends to, and sometimes across, the middle of the opercle. There are sometimes one or more spots present, belonging to a second series, parallel to the first, and extending from the preopercular notch across the cheek to just above the angle of the mouth. One or more spots may also be present in a line behind the middle of the orbit. All of these spots are distinctly bordered by a blackish ring and do not look like the remains of streaks which were uninterrupted at an earlier age.

In all structural details these specimens agree with *L. apodus*, having a deep body, large scales, an anchor-shaped patch of vomerine teeth, few gill-rakers, and low rounded fins. The caudal is shallowly forked, and the pectoral falcate, the latter reaching the vertical from the front of the anal. The scales above the lateral line run in series

parallel with the latter, but lose their orderly arrangement in characteristic fashion below the second dorsal.

46. *Lutjanus analis* (Cuvier & Valenciennes).

Pernambuco.

47. *Lutjanus synagris* (Linnaeus).

Coral reef near Maceio.

The snout is marked by two parallel golden streaks, the lower of which curves around the lower border of the eye and extends backward across the opercle. A third streak traverses the middle of the cheek and opercle to just above the base of the pectoral. A fourth runs horizontally backward from the upper edge of the maxillary. The color agrees in other respects with current descriptions.

48. *Ocyurus chrysurus* (Bloch).

Pernambuco; Maceio.

49. *Hæmulon carbonarium* Poey.

Pernambuco.

50. *Hæmulon plumieri* (Lacépède).

Pernambuco; coral reef near Maceio.

51. *Bathystoma aurolineatum* Cuvier & Valenciennes).

Maceio.

52. *Conodon nobilis* (Linnaeus).

Pernambuco; Maceio.

53. *Brachydeuterus corvinæformis* (Steindachner).

Pernambuco; Maceio.

54. *Eucinostomus harengulus* Goode & Bean.

Mouth of the Rio Goyanna; Maceio.

55. *Gerres rhombeus* Cuvier & Valenciennes.

Pernambuco; Maceio.

56. *Gerres lineatus* (Humboldt).

Gerres brasilianus CUVIER & VALENCIENNES, Hist. Nat. Poiss., VI, 458.

Gerres embryx JORDAN & STARKS, in Jordan and Evermann's Fishes of North and Middle America, p. 1379, 1898.

Maceio.

A single specimen, 170 mm. long, sustains the opinion expressed by Jordan and Evermann that the characters supposed to distinguish *G. brasilianus* from *G. lineatus* would not be permanent. This specimen has the second dorsal spine decidedly longer than the third, and has 11 horizontal rows of scales between the vent and the lateral line, as in *G. lineatus* from the Pacific. No other characters have been

pointed out as separating the two, so I use the oldest name for the species. *Gerres embryx* is known from a single very large specimen, the size of which may well account for the slightly longer pectoral. There seems to be no other difference between the two.

57. **Cynoscion jamaicensis** (Vaillant & Bocourt).

Maceio.

Two specimens, which agree entirely with those reported on by Jordan and Rutter from Jamaica.¹

The species is evidently distinct from *C. obliquatus*, having a greater depth, a larger eye, a longer snout, a shorter anal fin, and biconcave caudal. Its relationship with *C. nothus* is much closer. I have no specimens of the latter at hand for comparison, but from current description can find nothing to distinguish *C. jamaicensis* but a somewhat longer head and deeper body. The anal may also be shorter. In *C. nothus*, the lateral line becomes straight under the seventh ray of the second dorsal, not under the seventh dorsal spine, as stated by Jordan and Eigenmann² and by Jordan and Evermann.³ *C. acoupa* is certainly different, as it has very different proportions and smaller fins.

58. **Cynoscion virescens** Cuvier & Valenciennes.

A fine specimen, 50 mm. long, agrees perfectly with Steindachner's account of *C. microps*. Steindachner is correct in enumerating 55 enlarged scales in the lateral line. Our specimen has 57. It is not clear what can have led Jordan and Eigenmann⁴ and later Jordan and Evermann⁵ to state that the lateral line contains 80 pores.

59. **Menticirrus martinicensis** (Cuvier & Valenciennes).

Maceio.

60. **Eupomacentrus fuscus** (Cuvier & Valenciennes).

Mamanguape. Maceio; Rio Goyanna.

This is certainly identical with *E. diencæus* Jordan and Rutter. The latter is based on very dark specimens from Jamaica. The dark pigment thus involves the whole axil of the pectorals, appearing in a dark spot below as well as above the base of the fin. In one of our Brazilian specimens, the dark color almost reaches the lower edge of the axil. The ventral fins are subject to much variation in this species,

¹ See Proc. Acad. Nat. Sci. Phila., 1897, 114.

² Report U. S. Com'r Fish and Fisheries (1886), 1889, 357.

³ Fishes of North and Middle America, p. 1406, 1898.

⁴ Review of the Sciaenide of America and Europe, Report Com'r Fish and Fisheries for 1886, p. 362.

⁵ Fishes of North and Middle America, p. 1415, 1898.

extending to the middle of the anal fin in some of our younger specimens. Whether the difference may be sexual is not evident. There is no apparent variation in the length of the axillary scale, which I find to be the same in one of the types of *E. diencæus* and in the specimens of *E. fuscus* with which the authors compared it. The apparent difference in the height of the vertical fins and in the forking of the caudal was due to the circumstance that the specimens of *E. fuscus* which the authors used for comparison had lost the tips of all the vertical fins, these being brittle owing to preservation in strong alcohol.

Ten young specimens from the coral reef near Maceio vary greatly in general tint, some being uniformly blackish with the margins of the scales still darker, and all of the fins except the pectorals blackish. Others have the hinder half of the body much lighter, this being in one specimen distinctly yellowish. The spots are as given in current descriptions.

61. **Abudefduf saxatilis** (Linnæus).

Stone reef at Rio Goyanna, at Mamanguape, and at Pernambuco.

62. **Iridio poeyi** (Steindachner).

Julis crotaphus CUV. & VAL., Hist. Nat. Poiss., XIII, 395; not of Cuvier, Règne Animal.

Iridio kirschii JORDAN & EVERMANN, Fishes of North and Middle America, p. 1598, 1898.

One specimen, 145 mm. long, from Pernambuco. The colors in alcohol (after prolonged immersion in formaldehyde) give doubtless but a faint clue to the colors in life. The sides of head and body are dull brownish violet, a line along middle of sides dividing into a darker dorsal and a lighter ventral half. Each scale on the back and sides has the basal half dusky (perhaps blue in life). There are two darker spots between the lateral line and the middle of the sides, one just behind the head, another beyond the tip of the pectorals, the latter most conspicuous. These may be the lower ends of dark bars from the back, or they may not have existed in life. The dark spot behind the eye is conspicuous. Behind it, on the uppermost part of the opercle, is a lighter spot, probably brightly colored in life, with a narrow dark crescent above and below it. Below this is a diffuse darker shade on the opercle. A darker shade proceeds from the postocular spot in a curve toward the angle of the mouth, a second similar streak from the corner of the mouth backward across the cheek. The narrow curved streak on the base of the pectoral is very evident. The opercular flap and the axil of the pectoral are greenish. No trace is evident of the blue

band described by Steindachner, and by Cuvier and Valenciennes, which is said to run obliquely from the opercle in front of the pectoral base to the ventral outline, nor of the second line described by Steindachner from the angle of the mouth to the base of the ventral fins. The vertical fins appear yellowish green and the caudal has no trace of the lines converging backward from the basal angles. The dorsal is margined with blue or violet, but exhibits no distinguishable marks at the base of any of the rays except the last two. On each of these is a small black spot extending onto the adjacent part of the back. The anal is more obscurely greenish than the dorsal, and may have shown bluish or violet shades in life. The margin is distinctly violet or blue. A narrow line of the same color is visible on the anterior part of the fin, running horizontally nearer the base than the margin. Below this are traces of the blue spots margined with yellow, as described by Steindachner.

This is evidently the *Iridio* [*Julis*] *crotaphus* of Cuvier and Valenciennes and of authors generally, a species common in Brazil and the West Indies. Dr. Jordan has pointed out that in Cuvier's first use of the name *crotaphus* it is a synonym of *I. radiatus*, and is hence not available for the present species, for which he therefore adopts Steindachner's later name *poeyi*. Subsequently Jordan and Evermann revise this judgment and point out certain alleged differences between the common Brazilian form, *crotaphus*, and Steindachner's description of *I. poeyi*. The former they now recognize as a distinct species under the name *I. kirschii*. The most important difference between the two is stated to be in the size of the eye, which is nearly 3 in snout, $6\frac{1}{2}$ in head in *I. poeyi*; $1\frac{2}{3}$ in snout, $4\frac{2}{3}$ in head, in *I. kirschii*. In the specimen before me, which is 2 inches shorter than the type of *I. poeyi*, the eye is $2\frac{2}{3}$ in snout, 6 in head, therein agreeing essentially with Steindachner's measurement. A more serious disagreement is in the depth of the body, stated by Steindachner to be $3\frac{1}{2}$ in the total length. In my specimen the depth is $3\frac{1}{2}$ in the length to base of caudal. The striking coincidences in the description and the comparatively unimportant differences lead me to adopt Dr. Jordan's earlier view, identifying *I. poeyi* with *I. crotaphus* (Cuvier & Valenciennes) and using the former as the earliest available name for the species.

63. *Sparisoma frondosum* (Cuvier).

Pernambuco; Maccio.

Closely related to *S. rubripinne*.

D. IX, 10; A. II, 9. Lat. L. 25, $\frac{11}{6}$.

Head 4 in length to end of middle caudal rays; depth $3\frac{3}{5}$ in the

same. Teeth as in *S. rubripinne*, distinctly outlined and slightly protruding convexly, the marginal teeth in each jaw forming an irregular cutting edge; no posterior canines. Subocular region and angle of preopercle covered with profusely branching canals. A series of five large scales below the eye, of which 3 are on the cheeks. The exposed portion of the eye $5\frac{1}{3}$, the orbit $4\frac{1}{3}$, in head.

The tubes of the lateral line branch profusely and cover the scales. This branching occurs sometimes pinnately from a horizontal stem, sometimes palmately from the base of the scales. The primary branches are sparingly forked.

The dorsal spines are slightly stiffer than in *S. rubripinne*, but are flexible. The longest equals $\frac{1}{3}$ length of head. The caudal is lunate. The pectorals are short, not reaching the vertical from the tips of the ventrals, $1\frac{2}{3}$ in head.

Color uniform dark purplish, apparently including all the fins except the caudal, which appears more nearly grayish. The middle caudal rays have a light margin, and the outer ones are alternately light and dark, as in *S. rubripinne*. I cannot make out, however, that these are the beginnings of light and dark cross-bars which, in *S. rubripinne*, traverse the fin.

The species seems to differ from *S. rubripinne* in the greater depth of the body, in the more steeply rising anterior profile, which describes an even curve, in the shorter, blunter snout, which is but little more than $\frac{1}{3}$ the head, in the somewhat more complexly branching tubes of the lateral line, and in the color.

The preceding notes are based on an adult specimen, 206 mm. long. A young specimen, 145 mm. long, shows a general reddish-gray tint, but is much lighter and more variegated in coloration. The pectoral is distinctly orange-red at base after immersion for some time in formaldehyde and alcohol. The caudal is shallowly concave, with produced points. It shows a distinct lighter margin and is very irregularly cross-banded with light and with dark reddish-brown. The dorsal is variegated, as in *S. rubripinne*. The tubes of the lateral line are typically branched.

Two specimens, each 190 mm. long, are darker and more uniformly vinaceous than the young one noticed. They seem to have been somewhat mottled with darker in life. All the fins are dark, of about the same tint as the body. The dorsal shows some obscure darker markings, without pattern, and the caudal has the irregular dark cross-bars most distinct near the upper and the lower margins. There is a very distinct narrow white border to the caudal. Other fins are uniform.

In one specimen there is a broad white transverse bar below the chin as in *S. rubripinnis*; in the other this marking is not evident, and the bars on the caudal are indicated on the outer rays only.

64. *Scarus croicensis* (Bloch).

Two specimens, 93 and 76 mm. long, from the coral reef near Maceio. These show the characteristic lengthwise dark streaks, but not the narrow silvery lines along the sides of the belly. This may, however, be due to their preservation in formaldehyde, which dissolves silvery pigment.

65. *Chætodon ocellatus* (Bloch).

Mamanguape.

66. *Chætodon striatus* Linnæus.

Pernambuco.

67. *Teuthis bahianus* (Castelnau).

Mamanguape; mouth of the Rio Goyanna; Pernambuco.

In one specimen from Pernambuco, 160 mm. long, there is a very short dorsal fin, with but 20 soft rays. In the same specimen the anal formula is III, 22.

68. *Balistes vetula* Linnæus.

Maceio.

69. *Lagocephalus lævigatus* (Linnæus).

Maceio.

70. *Spheroides testudineus* (Linnæus).

Pernambuco; Maceio.

71. *Spheroides greeleyi* new species.

Two specimens from the coral reef near Maceio, 112 and 105 mm. long, the larger taken as the type of the species.

Very close to *S. spengleri*, from which it differs principally in coloration, as it entirely lacks the conspicuous series of black spots along the lower edge of the sides, which is so characteristic of *S. spengleri* and its near allies.

The space between the bony orbital ridges is narrow, concave, its least width $1\frac{1}{2}$ in the exposed portion of the eye, 4 in the snout. Eye 5 in head; snout half head. Width of gill-slit equaling exposed portion of the eye. Upper caudal rays longest, equaling distance from tip of snout to posterior edge of pupil. Dorsal with 8 rays, its height contained $2\frac{2}{3}$ times in head. Anal with 7 rays, its height contained 3 times in head. Pectorals broad, the width of the base contained $1\frac{2}{3}$ times in the longest ray, which is $2\frac{1}{3}$ in head. Pectoral rays 15.

Prickles cover the belly from the chin back to the anal fin and up on the sides as far as the base of the pectoral fins. They cover also the interorbital area and extend back as far as the origin of the dorsal fin, and send downward under the terminal portion of the pectoral fin a band connecting the prickly areas of the back and the belly. Along the line separating the ventral prickles from the smooth area of the sides is a series of conspicuous fleshy slips, all of which are white. A few smaller, dark-colored slips are scattered over the back and sides. Caudal peduncle and side of head without prickles.

Belly and lower side of head and caudal peduncle white. Back and sides thickly spotted with blackish, the two areas sharply distinguished along a lengthwise line running just below the pectoral fin. The spots grow somewhat larger along the lower part of the cheeks and the flanks, but none can be taken to represent the definite line of spots present in *S. spengleri*. The upper part of the back has its darker color broken up into polygonal areas by finely vermiculating light lines; these faintly-defined areas are still further indented or broken up into very small spots by incursions of light lines. The caudal is dusky at the base and on the terminal half, but has no well-defined bars. Other fins are unmarked.

72. *Prionotus punctatus* (Bloch).

One specimen, 210 mm. long, from Pernambuco.

It is perhaps as well to follow Cuvier's identification of this species as the very doubtful *Trigla punctata* of Bloch, awaiting the discovery of a West Indian species more nearly agreeing in color with Bloch's figure.

We have compared our specimen with the young individual from Bahia reported on by Jordan,¹ and find substantial agreement except that in our adult the minute spine present in the young on the middle of the cheek has been lost, and the groove behind the eye is still less conspicuous. The latter is in fact no groove at all, merely a wider interval between transverse lines of granulation.

The series of very fine serrations on the lateral margin of the snout terminates in a single stronger spine directed backward. A single spine is present halfway between the latter and the middle of the cheek. The center of radiation of the ridges on the cheek is without spine, a sharp low ridge beginning at that point and continuing on to the preopercular spine, which has a definite cusp at the base. The preopercular spine extends to or slightly beyond the subopercular margin. The nuchal ridge is obsolete on one side, very low on the

¹Proc. U. S. Nat. Museum, 1890, 328.

Proc. Wash. Acad. Sci., August, 1900.

other (these being higher and sharper, ending in spines in the young specimen). Spines otherwise as described.

Mouth large, $2\frac{1}{3}$ in head; interorbital space narrow, deeply concave, $1\frac{1}{3}$ in eye. Gill-rakers slender, 1 + 9 movable ones, the longest $\frac{1}{3}$ diameter of orbit. The anal has 11 rays in both individuals (not 12, as given by Jordan and Evermann, *Fishes of North America*, p. 2169).

The color in spirits is brownish above, whitish below, the upper parts appearing faintly blotched and with obscure round spots. Two dusky blotches on spinous dorsal. Soft dorsal with roundish dusky spots arranged in about 10 oblique series. Caudal with four ill-defined dark cross-bars. Pectorals blackish, the upper rays with a black blotch at the end of the basal third, and a fainter one at the end of the second third of their length. These are also present in the young specimen, and seem responsible for the statement that the pectorals are barred. The younger specimen shows a distinct blue line along the lower margin of the pectoral, as well as some lighter markings on the upper part of the fin, which do not appear in our adult.

There are 53 pores in the lateral line, and about 98 vertical series of scales above the lateral line. In commenting on a specimen in the Paris Museum of Natural History, labeled *Trigla punctata*, "apparently in the handwriting of Valenciennes," Dr. Jordan states¹ "pores in lateral line 85 to 90." Unless reference is made to the vertical series of scales rather than to the pores, the specimen cannot belong with this species.

73. **Cephalacanthus volitans** (Linnæus).

Maceio.

74. **Dormitator maculatus** (Bloch).

From among the mangroves at Pernambuco.

75. **Guavina guavina** (Cuvier & Valenciennes).

Among the mangroves at Pernambuco.

76. **Gobius soporator** (Cuvier & Valenciennes).

Mouth of Rio Goyanna; Mamanguape.

77. **Echeneis naucrates** (Linnæus).

Maceio.

78. **Malacanthus plumieri** (Bloch).

Maceio.

This species had been previously reported from Brazil by Cuvier and Valenciennes and by Castelnau. Our specimen answers well to the detailed description given by the first named authors. Jordan and

¹ See Proc. U. S. Nat. Museum, 1886, 545.

Evermann are in error in ascribing to this species but 49 articulated rays in the dorsal fin. Cuvier and Valenciennes give the dorsal formula as VI, 55, Gunther gives it as VI, 59. Our specimen has the dorsal VI, 59, the anal 55.

The bright colors which are said to characterize this species in the fresh state are mostly lost in spirits. Our specimen still shows traces of the alternating blue and yellow streaks before the eye. The dorsal and caudal are bright yellow, the dorsal dusky at base. The lower margin of the caudal and the lower half of the upper lobe of the fin are black. The anal has a more reddish tinge, and the pectorals and ventrals are bluish or violet.

79. **Malacoctenus delalandi** (Cuvier & Valenciennes).

Mouth of the Rio Goyanna.

So. **Labrisomus nuchipinnus** (Quoy & Gaimard).

Stone reef at Mamanguape; coral reef near Maccio.

Jordan and Evermann are in error in stating that *Labrisomus* has no palatine teeth, and in the further statement that *L. nuchipinnis* has the vomer provided "with a patch of smallish teeth."¹ The facts had been stated by Gill² with substantial correctness and in considerable detail. I have examined numerous specimens from Brazil, two from Sta. Lucia Island, one from Jamaica, and two from the Canary Islands. The teeth are strong, conic, rather widely spaced, arranged typically in a single angulated series on the vomer and on the anterior portion of the palatines. The anterior vomerine tooth is often enlarged, but in some specimens this is scarcely noticeable. The palatine teeth are usually in small number, there being often not more than two present, sometimes as many as six in the single series. Occasionally an inner tooth may be present along the inner side of the palatine series, or there may be two or three, thus forming a double series. The inner teeth are, when present, entirely similar to those of the outer row. This variation has been found in specimens from Brazil and from Sta. Lucia. In the two specimens from the Canary Islands two equally well developed series are present on both palatines, suggesting a permanent condition which may properly be investigated. In the Canary Island specimens there is also present a number of vomerine teeth behind those in the outer row. In two specimens only from the western Atlantic, from Brazil and from Sta. Lucia, respectively, have I found a single vomerine tooth occupying this inner position.

¹See Fishes of North and Middle America, Vol. III, pp. 2361-2362, 1898.

²Proc. Acad. Nat. Sci. Phila., 1860, p. 106.

L. nuchipinnis and *L. xanti* do not appear to differ in dentition. In six specimens of *L. xanti* from Mazatlan, Mexico, five have the palatine teeth in two distinct series, as in the Canary Island specimens of *L. nuchipinnis*; in the sixth no palatine teeth were present. In the specimens of *L. xanti* examined, the vomer contained a single series in all but one individual, where a few teeth were present behind the outer row. The middle vomerine teeth are usually the largest.

L. xanti seems, however, to be sufficiently distinguished by its slightly more elongate form, and by one constant difference in coloration. The conspicuous round, black, opercular spot, universally present in *L. nuchipinnis*, is never developed in *L. xanti*. Our specimens of *L. nuchipinnis* from Brazil and elsewhere, show that this spot is normally surrounded by a white border, though this is sometimes wholly lacking.

BRANNERELLA new genus (*Blenniidae*).

Type, *Brannerella brasiliensis* new species.

Closely allied to *Starksia* Jordan and Evermann,¹ differing only in the elongate detached first anal spine and in the absence of any well-defined notch behind the third dorsal spine.

♂1. ***Brannerella brasiliensis*** new species.

Type, a specimen 31 mm. long, from the coral reef near Maceio.

D. XVIII, III, 7; A. I-I, 16. Lat. 1, 37 or 39. Form and general appearance much as in *Auchenopterus*, but the head is larger than is usual in that genus.

The mouth is large and very slightly oblique, the maxillary reaching to the vertical from the posterior margin of the orbit. The jaws are equal, the lips are thickened, the upper jaw is protractile. The pre-maxillaries have an outer close-set series of cardiform teeth and an inner band of villiform teeth. The teeth on the mandible are similar, but those on the outer series are slightly coarser and more conical. A single series of small conical teeth on the vomer and the front of the palatine.

Interorbital space very narrow, concave. The posterior nostrils are each in a short tube, which bears a slender cirrus. A similar cirrus on the upper posterior part of the eye, and one on each side of the median line of the nape. No nuchal fringe of filaments. The series of pores on the head are well developed. The branchiostegal rays are

¹ Fishes of North and Middle America, p. 2365.

6 in number, the membranes broadly joined, free from the isthmus. The opercle is rounded, without ridges or spines.

Scales large, cycloid, the lateral line running high anteriorly, descending to the middle of the flanks behind the pectoral fin, and traversing 37 to 39 scales.

Dorsal largely spinous, the last 7 rays articulated. A faint notch or none behind the third dorsal spine. A decided notch behind the eighteenth spine, the three following spines gradually increasing in length.

Two anal spines, the first elongate, detached, running along the posterior margin of a broad membranous or fleshy expansion, which extends beyond its tip. The second spine is much shorter and is joined by membrane in the usual way to the first soft ray. Both dorsal and anal fins are distinct from the caudal, the last dorsal membrane nearly touching the base of the first caudal ray. No hook on shoulder girdle.

Color in spirits, dark brown, with some lighter rivulations and with occasional black spots or blotches. A small black spot on the opercular membrane above the base of the pectoral. Back with ten dusky bars which are continued on to the basal portion of the dorsal fin, where each divides to form a pair of black blotches; 7 or 8 dark spots along the base of the anal. An irregular light-colored Y-shaped mark on the cheek; two or three small round spots on the opercle, and three vertically placed on the basal portion of the pectoral fin. All of these light markings may have been brightly colored in life.

Length to base of caudal	26½ mm.
Total length	31 mm.
Head (to end of opercular flap) . . . . .	.34 of length.
Tip of snout to end of maxillary . . . . .	.16
Snout . . . . .	.06½
Orbit . . . . .	.09½
Interorbital width . . . . .	.02½
Depth of body . . . . .	.21½
Least depth of caudal peduncle . . . . .	.09
Length of caudal peduncle from last anal ray . . . . .	.06
Tip of snout to base of first dorsal ray . . . . .	.30
Tip of snout to base of first anal ray . . . . .	.53
Tip of snout to base of first ventrals . . . . .	.28
Longest pectoral ray . . . . .	.23
Longest (inner) ventral ray . . . . .	.18
Highest (middle) dorsal spines . . . . .	.10
Shortest (18th) dorsal spines . . . . .	.06
(19th) dorsal spines . . . . .	.06 +
(20th) dorsal spines . . . . .	.07½
(21st) dorsal spines . . . . .	.10

Highest dorsal ray . . . . .	.15
1st anal spine (including soft tip) . . . . .	.10½
2nd anal spine . . . . .	.06½
Highest anal ray . . . . .	.13½
Caudal . . . . .	.25

82. *Blennius cristatus* Linnæus.

Numerous specimens from the stone reef at the mouth of the Rio Goyanna, at Mamanguape, and at Pernambuco.

The following notes are principally corrections of statements in the description by Jordan and Everman.¹

Depth of preorbital slightly more than $\frac{3}{5}$ diameter of orbit. The interorbital space is slightly grooved, $\frac{2}{3}$ the diameter of the eye. The posterior canine in the lower jaw is much longer than the front teeth, but is declined. The supraocular flap is divided from the base into 4 or 5 filaments. The filaments on the nape are mostly in a linear series surmounting the dermal crest, but occasionally some are scattered at the sides of the crest; the number varies greatly, from 10 to 30 in our specimens. The dorsal formula is XII, 14 or 15. The anal, II, 16. No white spots are visible in this material, possibly because of its preservation in formaldehyde.

83. *Rupiscartes atlanticus* (Cuvier & Valenciennes).

Coral reef near Maceio. The three specimens in the collection have a narrow light margin to the dorsal. In one specimen the light area of the pectoral is decidedly yellow.

84. *Salariichthys textilis* (Quoy & Gaimard).

Mouth of Rio Goyanna; stone reef at Mamanguape and at Pernambuco.

85. *Syacium micrurum* Ranzani.

Two adult males, 230 and 235 mm. long, and a young specimen, 130 mm. long, from Maceio.

D. 88, 88, 89; A. 69, 70, 72.

The adults have the interorbital space very wide, shallowly concave, the front of the upper eye in a vertical falling slightly behind the middle of the lower eye. Interorbital width $\frac{1}{3}$ greater than the horizontal diameter of the lower eye; it equals the length of the snout and is contained $4\frac{2}{5}$ times in the length of the head. The gill-rakers are short and broad, scarcely $\frac{1}{3}$ the diameter of the pupil, 2+7 in number. (I find the same number in a specimen from Jamaica.)

The two upper pectoral rays are elongate, equally so in one male,

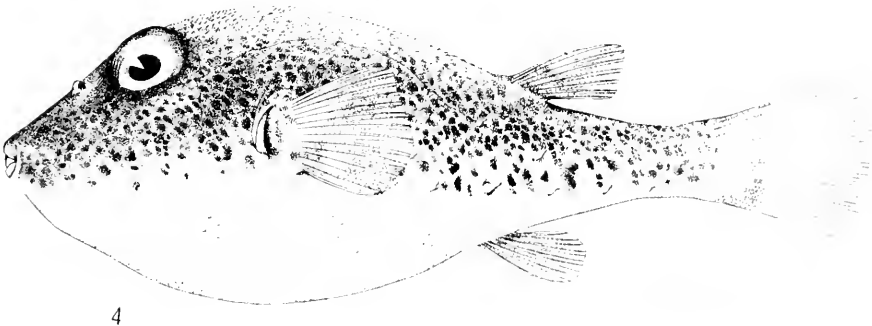
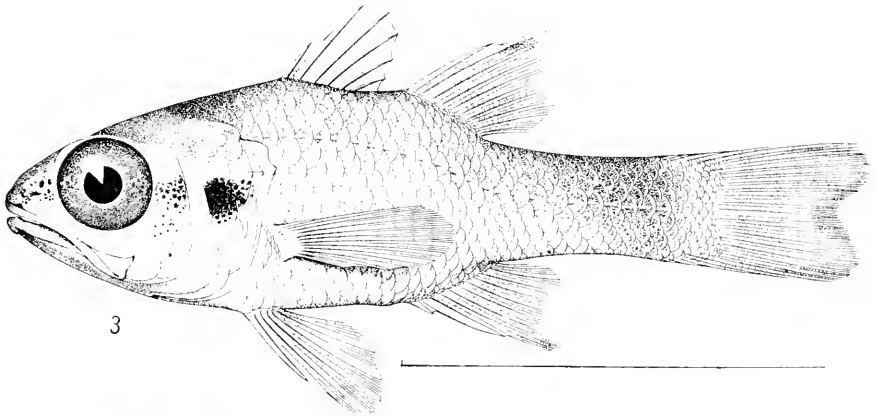
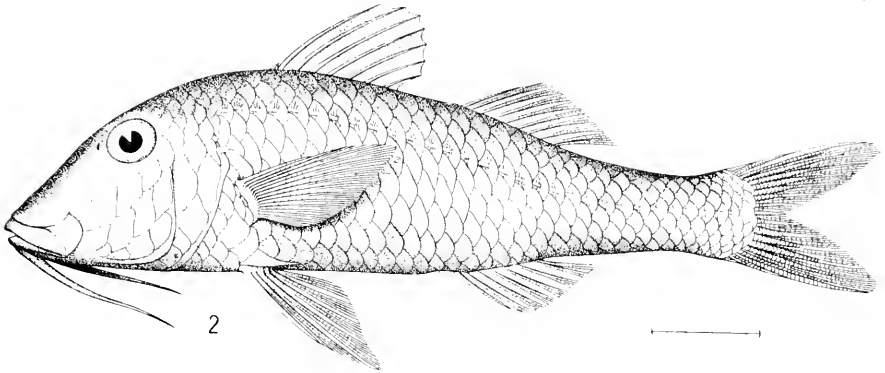
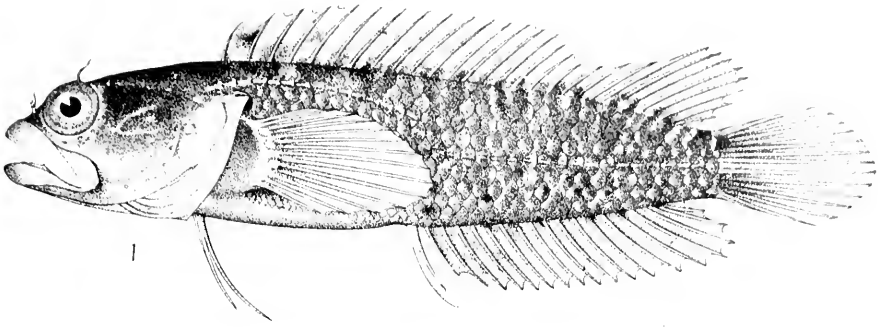
¹Fishes of North and Middle America, pp. 2382-2383.

the lower very little produced in the others. The longest ray extends beyond the middle of the anal, and is contained $2\frac{1}{3}$ times in the length.

The color is light grayish-brown, finely mottled and with a number of rather definitely placed round light spots with darker centers. The most conspicuous of these form a series of five or six parallel with the dorsal outline, and a similar series parallel with the ventral outline. Others occupy the intermediate territory. A narrow curved dark bar extends from the upper eye obliquely across the interorbital space to the lower eye, bounded by a light line in front and behind; another dark line and another light line may follow these. From the front of the upper eye, a narrow scaleless area runs downward and forward to the profile of the snout. This area is bounded above and below by narrow, dark lines, which were probably dark blue in life. The upper line ceases opposite the origin of the dorsal; the lower extends down along the profile to the tip of the snout, and is continued along the mandible to its joint. A dark streak—also probably blue in life—runs along the back at the base of the anterior $\frac{2}{7}$ of the dorsal fin, on the colored side. This streak is formed of spots, one for each ray, the hinder ones more or less coalescent. The dorsal and anal fins are grayish, speckled with darker, a dark streak on the base of each eighth to tenth ray. Pectorals not barred. The blue streaks on the head have not been mentioned in any previous description of this species. They are doubtless developed only in adult males. I find a trace of them in a specimen from Jamaica (collector, Roberts).

PLATE IX.

- FIG. 1. *Brannerella brasiliensis* gen. and sp. nov. **Type.**
Maceio, Brazil.
2. *Upeneus caninus* sp. nov. **Type.**
Pernambuco, Brazil.
3. *Apogon brasilianus* sp. nov. **Type.**
Mamanguape, Brazil.
4. *Spheroides greeleyi* sp. nov. **Type.**
Maceio, Brazil.



New Fishes from Brazil.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 185-201.

AUGUST 20, 1900.

RESULTS OF THE BRANNER-AGASSIZ
EXPEDITION TO BRAZIL.

IV.

TWO CHARACTERISTIC GEOLOGIC SECTIONS ON
THE NORTHEAST COAST OF BRAZIL.

By JOHN C. BRANNER.

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NOTES ON GEOLOGY ALONG THE BAHIA AND MINAS RAILWAY.

IN September, 1899, I made two trips over the Bahia and Minas Railway for the purpose of getting some idea of the geology of the region it crosses. The following observations were made upon those trips, and, notwithstanding their obvious imperfections, are here published as a contribution to the geology of a little-known part of Brazil. Although railway geology is proverbially untrustworthy, this bit was done under circumstances that redeem it somewhat. The Director of the railway,¹ whose guest I was at the time, kindly had the train stopped wherever and whenever I wished, not to mention many other stops at stations, for inspection, and on account of tree trunks and telegraph poles fallen across the line. In order that the geology might be better seen the entire run was made

¹I am under obligations for many courtesies in connection with this trip to Dr. João Bley Filho, of Theophilo Ottoni, the able Director of the Bahia and Minas Railway.

very slowly and during daylight. The only other geological observations we have upon the region traversed by this railway are those made by Hartt, who went from Santa Clara to Theophilo Ottoni in 1866, by the newly opened road across the country, some leagues south of the railway and parallel with it

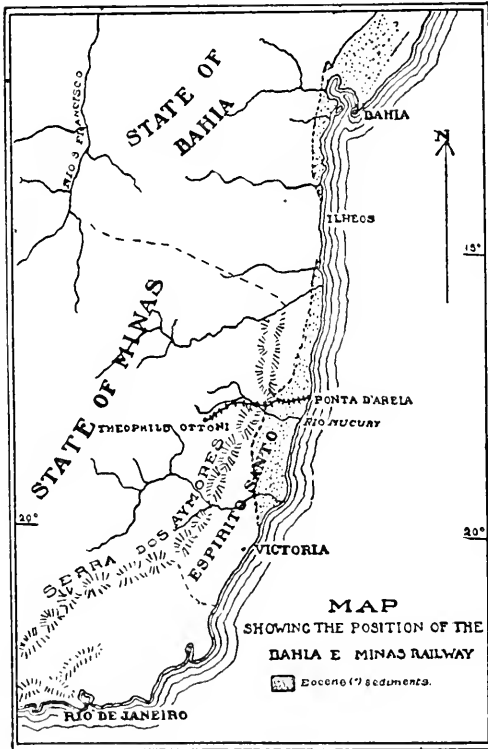


FIG. 5. Coast of Brazil from Rio to Bahia.

save near its upper end, where both the road and the railway are in the valley of the Rio Todos os Santos.¹ Hartt speaks of the crystalline rocks as gneiss veined with granite.

The Bahia and Minas Railway leaves the sea coast at Ponta d'Areia, the terminal station, near the city of Caravellas, in the State of Bahia, and runs nearly due west to the city of Theophilo Ottoni (formerly called Philadelphia) in the State of Minas Geraes, a distance of 376 kilometers. The region traversed consists of three well-defined

belts: a flat coastal plain, a belt of table lands, partly forest covered and partly campos, and a region of crystalline rocks.

Along the first ten kilometers the line passes over a flat, sandy, coastal plain that rises less than three meters above high tide level. The highest point measured over this coastal belt is near the village of Barra de Caravellas, where it is 2.2 meters

¹ Geology and Physical Geography of Brazil, by C. F. Hartt; pp. 129-134. Boston, 1870.

above high tide level. It is possible that there is a little higher ground at the city of Caravellas. At Ponta d'Arcia the highest ground is only one meter above high tide. Changes of level over the surface of the plain are usually either very gentle or very abrupt, the slopes being long, even, and imperceptible on one side and dropping off abruptly on the other. The soil of this coastal belt is all sandy. At the surface it is blackened by the decay of vegetation, but from two to six decimeters beneath the surface this sand is of various shades of yellow—sometimes almost orange colored. It is worthy of note in this connection that the great sand bars off the mouth of the Caravellas River have about the same yellow color. At many places where pits have been dug for wells in these sands of the coast belt, large quantities of marine shells have been thrown out, while at other places ants and other burrowing animals bring these shells or their fragments to the surface. At two places I found pieces of coral in the sand from such pits. One of these was a fragment of *Heliastrea aperta* as big as one's fist, a coral growing abundantly on the great coral reefs off the coast. The other form was a small specimen of the little *Astrangia solitaria*. Oysters and other bivalves, worm tubes, and gasteropods are abundant in this sand. The molluscan remains found in the sands of this coast plain look very like the forms now living along the coast, but in the absence of collections of both the fossils and of the existing coast fauna no opinion can be expressed in regard to the precise geologic age of the coast plain. It may be either Pliocene, Pleistocene, or recent.

Beyond kilometer ten the railway passes gradually from the low sandy coast plain into open sandy campos. The loose sands along this portion of the line are white and have the appearance of having been leached by acidulated waters. The country is nearly flat and only a little higher than the coast plain. The only rocks visible are soft black sandstones exposed in the trenches beside the railway track. Similar sandstones are found at many places along the northeast coast of Brazil, always at a low level, usually black to snuff-colored, and wherever their relation to the adjacent rocks is apparent, they rest unconformably against and upon the eroded Eocene (?)

beds. At the city of Caravellas such sandstone is used occasionally in retaining walls. I was told that it was all brought in canoes from several miles up the estuary, but that it could be taken out only when the tide was low. No fossils have ever been found in these black sandstones. On the line of the railway the black sandstones are found here and there from kilometer 10 to about kilometer 18.

At kilometer 19 the railway makes a three or four meter cut in a low ridge of light red sandy clay, which I take to be the approximate eastern margin of the Eocene (?) sediments. From this point until after the Serra dos Aymores is passed the road passes over beds of more or less similar materials. These beds are referred with some doubt to the Eocene upon evidence collected farther north in the States of Bahia, Sergipe, Alagôas, Pernambuco, etc. Along the line of the Bahia and Minas railway no fossiliferous beds have been found, but in general appearance and structural relations this series corresponds to the weathered portions of the Eocene (?). In this region the Eocene (?) beds are brown, yellow, pink, red, of various shades of gray, and mottled. They are mostly soft sandstones or sand clays. At a few places only do these sandstones form hard rocks: these are on the grade between Peruhype and Helvetia, about kilometer 68; in the vicinity of kilometer 136.5, near the Pasto de Godinho; and about the caixa d'agua, at kilometer 141.5, where the sandstone is from four to six meters thick. At many places the upper parts of the beds contain irregular lumps of iron or of sand cemented with iron, about the size of two fists. These sedimentary beds are so nearly horizontal that no dip is apparent anywhere along the line of the road. The railway elevations, however, show that they have a gentle coastward dip. The Eocene (?) beds continue to and beyond the Serra dos Aymores, ending at kilometer 160. The Eocene (?) area forms extensive open campos or prairies, bare of trees, covered with a sparse and stunted vegetation, but in places dotted with small patches or 'islands' or forests. Over other portions of the Eocene (?) belt are also some of the finest forests I have seen in any part of Brazil. The great forests begin about kilometer 73 and extend almost

to Theophilo Ottoni, kilometer 376. A large number of splendid rosewood and mahogany logs lie decaying along the line of the railway, while the forests contain vast quantities of these valuable woods.

Peruhype station (kil. 65) is on Rio Peruhype, at an elevation of about only six meters above tide level, while the bottom of the river, where the railway crosses the stream a third of a kilometer below the station, is only half a meter above high tide level. The railway has, up to this point, made a wide detour to avoid the marshes about Caravellas, and after crossing the Eocene (?) hills at an elevation of sixty meters has come down almost to tide level again.

The hills along the Rio Peruhype are about thirty meters high, flat on top, and slope down to the stream at an angle of about 35° . Beyond Peruhype station the railway climbs again to the top of the sedimentary plateau. At kilometer 67 a cut exposes well the usual horizontal, mottled and colored beds to a depth of about ten meters. At kilometer 69 the road is again in the open campos on top of the plateau, and from here the campos continues to about kilometer 73, where the railway enters the great forests. The top of this plateau about Helvetia station (kil. 72-73) is more or less rolling, but it is really a flat table-land crossed by gulches and narrow valleys that are visible only when one comes close to them.

At kilometer 128 the railway descends into a small valley cut in the Eocene (?) beds. The beds exposed in the railway cuts are the usual yellow, red, and mottled clays; some of them contain lumps hardened with iron, half a meter or more in diameter. At kilometer 132.5 the road reaches the bottom of a small narrow val-

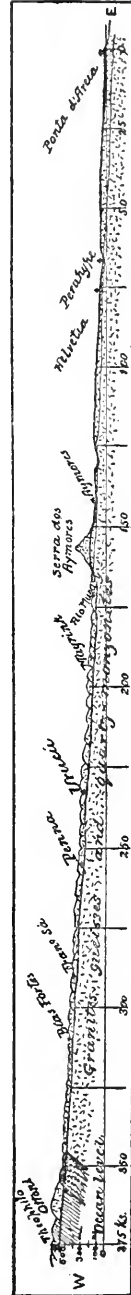


FIG. 6. Section along line of Bahia and Minas Railway.

ley at a place known as the Plasto de Godinho. Here the drainage has cut through the sedimentary beds and exposed beneath them a few small rounded bosses of the old underlying crystalline rocks. These are exposed over a distance of only about one kilometer. The railway continues beyond this over the Eocene (?) rocks. The top of the grade in passing over the Serra dos Aymores is near kilometer 155.¹ For several kilometers along the watershed of the Serra dos Aymores there are no rock exposures, and it is impossible to determine just where the sedimentary rocks come to an end. At kilometer 160, however, the crystalline rocks appear in the bottom of a gulch, and as boulders of sandstone are here mingled with blocks of quartz-monzonite, it seems probable that this place is close to the margin of the Eocene (?) sediments, and that the Serra dos Aymores, where it is crossed by the railway, is capped by the thin landward margin of these sediments. The country is covered with a dense forest, and only occasional glimpses can be had of the topography of the surrounding region. But these glimpses are suggestive. At one point (kil. 145) one sees to the right of the road an almost perpendicular and very sharp peak rising high above the surrounding forests. At another point another lofty peak is visible from the railway, also north of the line. These mountains all have the same rounded and exfoliated appearance so characteristic of peaks of crystalline rocks in Brazil.

The Serra dos Aymores is the northward extension of the Serra do Mar along this part of the Brazilian coast. Seen from the ocean it stands out boldly as a great mountain chain, extending from about S. lat. 16° to about S. lat. 21° 30'. It is therefore a matter of interest to find the railway crossing this serra upon horizontal sediments. But the explanation seems to be that while these Eocene (?) beds abut against the main range of the Serra dos

¹ Unfortunately the elevations along the railway were not to be found when I was at the Director's office. In the '*Memoria descriptora sobre a estrada de Ferro Bahia e Minas por M. de Teive e Argollo*,' Rio de Janeiro, 1883, I found the elevations up to kilometer 138, while the elevation of Theophilo Ottoni is given in Hartt's book. Inasmuch as the road follows the river from where it first reaches the Mucury, the profile is represented as even from that place to Theophilo Ottoni.

Aymores, at this particular place the heart of the Serra is represented by only a few isolated peaks that rose above the water as islands when the sediments were being deposited. The route followed by the railway is, therefore, a sort of gap in the range, where the ancient serra is represented only by these tall peaks.

From kilometer 160, where the railway descends the west slope of the Serra, the exposures of crystalline rocks become more and more abundant until, in the narrow valley from the watershed to the Rio Mucury, the Eocene (?) beds disappear entirely, and the hills on either side are all of crystalline rocks, which continue nearly to the city of Theophilo Ottoni. Professor H. W. Turner, of the U. S. Geological Survey, has kindly examined the rocks collected on this trip; the one found at this place he calls *quartz-monzonite*, adding that it is a rock that most petrographers would call a gabbro.¹

At kilometer 171 the railway reaches the banks of the Rio Mucury. This stream throughout nearly its entire length flows over a bed of coarsely crystalline rocks, mostly of gabbro, or quartz-monzonite. The accompanying illustration (fig. 7) shows the round, exfoliated peak near the watering station, Sete de Setembro, near kilometer 172. This peak itself was not visited, but the many exposures along the railway near its base are all of quartz-monzonite.

The immediate valley of the Mucury is here hardly more than half a kilometer wide in the bottoms, and the hills rise on both sides to a height of a hundred meters or less. Through its entire length this valley remains narrow and its sides are steep and heavily wooded; only near its head-waters do the valleys widen out somewhat. At kilometer 188 the railway crosses to the right side of the river, upon which it continues the

¹The following is Mr. Turner's description :

F. 93. "Quartz-monzonite. Macroscopically a medium-grained, dark, slightly greenish granolite.

"Microscopically composed of plagioclase > orthoclase > = quartz > = rhombic pyroxene > biotite. There are present as accessories iron oxide, apatite and zirconite. The plagioclase, quartz, and pyroxene occur in comparatively small anhedrons, in part inclosed in large untwinned orthoclase grains which show minute interpositions, forming the 'faserige' orthoclase of Becke. The biotite is deep reddish-brown in color, and frequently all the foils in the field extinguish at once, although disconnected in the section."

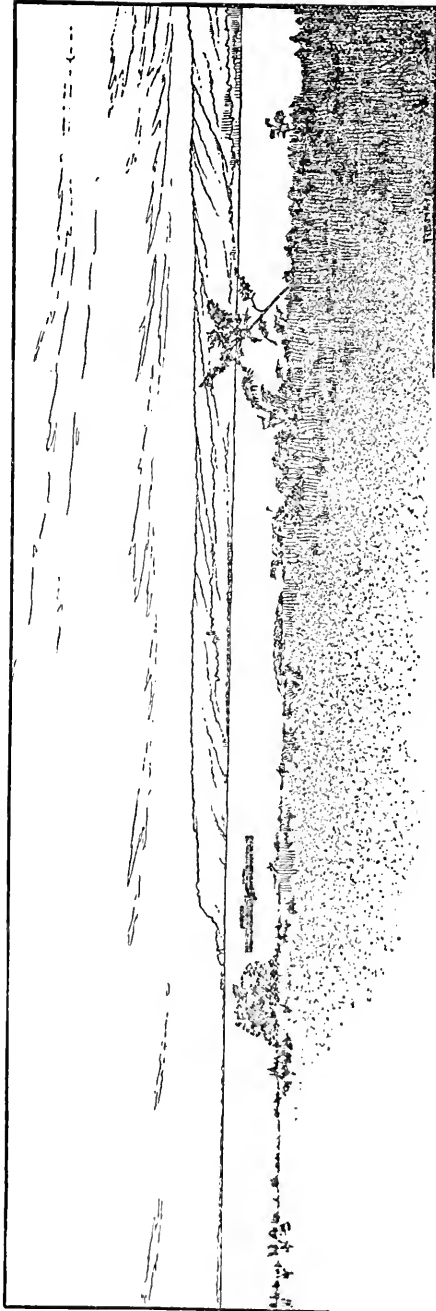


FIG. 7. Plateau between Lagoa do Norte and Lagoa Manguaia, seen from Fernão Velho on the Alagoás Railway.

rest of the way to Theophilo Ottoni. At Mayrink station the rocks are quartz-monzonites and coarse-grained gneiss. In the bed of the stream there are good exposures showing the banding of the rocks to strike N. 25° E. From where the railway enters the narrow Mucury valley at kilometer 172 to kilometer 345 the rocks are all either quartz-monzonites, gneisses, or granites, the quartz-monzonites predominating. I was unable to learn anything of the relative ages of these crystalline rocks. The bed of the Rio Mucury is everywhere of these massive rocks. Here and there hills of the bare, rounded rocks are exposed in the sides of the narrow river channel, and enormous exfoliated boulders are abundant throughout the area of crystalline rocks. There are some fine examples of these boulders at Bias Fortes, kilometer 308. In this lower portion of the crystalline

belt the rocks have a much fresher appearance than they have further inland. Specimens taken at kilometer 281 and at Francisco Sa station, kilometer 290, are described by Mr. Turner as quartz-monzonites.¹

At Bias Fortes the rocks are quartz-monzonites again.²

At kilometer 344 and at kilometer 363 bare peaks of exfoliated crystalline rock are visible on the right of the railway 100 to 150 meters above the valley. About kilometer 345 there is a marked geological change. The quartz-monzonites disappear altogether, the rocks are no longer coarse in texture and fresh in appearance, but are fine-grained gneisses, and profoundly decomposed. At kilometer 355 the change is still more marked, for from this point to Theophilo Ottoni the rocks are mostly mica and other schists, much faulted, wrinkled and cut by veins. All these rocks are so decomposed that one seldom sees a hard rock face in the many and deep railway cuts. Within seventy-five meters of the terminal station at Theophilo Ottoni is a nearly perpendicular face ten meters high, cut in faulted and decomposed schists filled with small quartz veins. The city of Theophilo Ottoni is in a very hilly country, and the streets of the town follow narrow valleys between the hills. Here and there deep cuts have been made through the lower slopes of these hills for street grades or to make room for houses. Everywhere these cuts are in rock, decayed in place, and the earth is so soft that a knife can be thrust into it anywhere. This earth, however, stands up in perpendicular walls like stone or brick walls through all kinds of tropical weather.

¹"F. 79. Quartz-monzonite. Macroscopically a coarse, dark, granitic rock, composed of large feldspars of an olive-green tint, quartz, and black mica.

"Microscopically composed of orthoclase in large anhedrons, micropegmatite, plagioclase, quartz, biotite, and brown amphibole. There are present as accessories apatite, iron-oxide, pyrrhotite, titanite, zircon, and muscovite. The plagioclase gives extinctions on 010 up to 16° and is probably chiefly basic andesine and labradorite."

²Mr. Turner says of them: "F. 83. Quartz-monzonite. Microscopically composed of plagioclase > orthoclase and micropegmatite > quartz > rhombic pyroxene. There are present as accessories iron oxide and apatite. The plagioclase gives extinctions on trace of 010 up to a maximum of 19°, and is probably chiefly basic andesine or labradorite. The rhombic pyroxene is slightly pleochroic, *ab*, faint reddish, *c*, light green."

The soils of the surrounding country are of various shades of red and yellow.

Before making the trip into Minas along this railway I found one day in the vicinity of the terminal station at Ponta d'Areia, mingled with pieces of the quartz-monzonite so abundant along the upper Mucury, two fragments of blue limestone about the size of the two fists. These fragments contained the following fossils: *Lingula umbonata* Cox, *Orthetes* sp., pieces of crinoids, one piece of a *Pleurotomaria*, and several fragments of shells belonging to the *Rhynchonellacea*. Most of these forms, so far as they can be identified, range from the Silurian to the upper coal measures, while the *Lingula* is found only in the lower and upper coal measures. I made diligent inquiry in regard to the origin of these pieces of limestone and was told that such rocks were common all along the Rio Mucury above Sete de Setembro. It was, therefore, largely in the hope of finding these fossiliferous limestones in place that the trip was made to Theophilo Ottoni. After what has been said of the geology of the region it is hardly necessary to state that these fossiliferous beds were not found, although the most careful lookout for them was kept up from one end of the road to the other, in the natural exposures, in the railway cuts, and in the ballast of the road bed. It may be added also that no other fragments of similar material were found in the stone paved streets and stone walls of the old city of Caravellas, or elsewhere about Ponta d'Areia or Barra de Caravellas. Of course it cannot be positively stated that these fossils do not come from the Mucury River, but I do not think now that they were found there originally. My opinion is that the fragments in which they were found came to Ponta d'Areia upon some vessel from some other port. I was told of limestone burned for lime west of Theophilo Ottoni, in the belt of decayed schists, but these rocks appear to be marbles. No fossils have been found in this Brazilian schist series, but it has generally been regarded as older Paleozoic, possibly Silurian.

In regard to the age of the quartz-monzonites and the other fresher looking crystalline rocks nearer the coast, I have no facts upon which to base an opinion.

NOTES ON THE GEOLOGY ALONG THE ALAGÔAS RAILWAY,
STATE OF ALAGÔAS.

The part of the Alagôas Railway of greatest geologic interest is the section between Maceio and Albuquerque. This portion of the line was passed over three times in August, 1899. Mr.

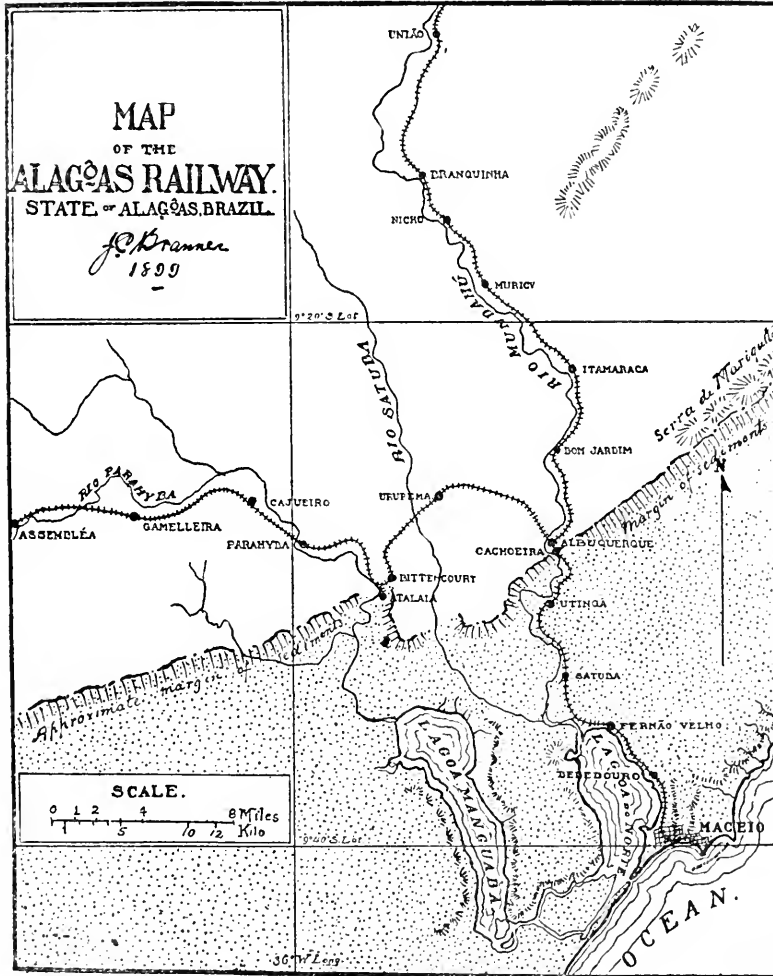


FIG. 8. Map of the Alagôas Railway, Brazil.

H. Haynes, the able superintendent of the railway, to whom I am under obligations for many courtesies, kindly placed a loco-

motive and special car at my disposal on one trip from Maceio to Assembléa, and had them stopped whenever the geology made it desirable.

As a rule the geology of the region of metamorphic and crystalline rocks is complicated, and in notes made as these were but little else can be done than to indicate the margin of the area where the crystalline rocks are overlapped by the later sedimentary beds.

The Lagôa do Norte is of interest in connection with the geography and later geology of the region. This lake, although large, is so shallow that only very small boats can navigate it. It has a depth of channel of only two or three meters along its south side. The water is brackish, and the tides are but little felt in the lake; the rise and fall is only about 0.3 meter.

This lake and Lagôa Manguaba, a similar body of water eight kilometers southwest of it, were valleys carved in the sediments of this region in Miocene Tertiary times, when the continent stood at a higher level. After these valleys were excavated the region sank and the valleys were converted into bays. These bays, in the course of time, had their mouths closed by the silts thrown back into them by the ocean, and still later they silted up as we now find them. Newly made land has already filled up the stream valleys emptying into these basins, and the land is constantly encroaching upon the lakes. They are rapidly silting up and must disappear soon, in the geological sense.

Plate X, made from a photograph, is a view looking south across Lagôa do Norte from Fernão Velho, and showing the Eocene (?) plateau and its steep oceanward escarpment south of the town of Coqueiro Secco.

The Maceio end of the railway is upon the low, flat, sandy lands upon which stands the business portion of the city, known as Jaraguá. Behind this low ground rises a line of flat-topped hills—the margin of a plateau—of parti-colored sediments supposed to be of Eocene Tertiary age. These hills follow the coast northeast for hundreds of miles, broken here and there by the valleys about the mouths of streams. From the lighthouse on top of the hills at Maceio this sedimentary plain appears to



An eroded peak of quartz monzonite at Sete de Setembro, Rio Mucury, in the Bacia do Mucury, R.

be almost perfectly flat, but away to the north and northeast one sees three clusters of rounded hills rising above it and resembling the granites that everywhere form the landward margin of these diments. These are the peaks of the Serra de Mariquita.

Mr. Haynes informed me that a few years ago at the railway shops on the flat ground near the terminal station at Maccio a driven well was put down to the depth of 200 meters. The water obtained was brackish and the well was abandoned. No detailed record was kept of the strata passed through in sinking this well, but the materials are all soft and appear to be the newer beds that abut against the strata which form the high plateau of the upper city and the surrounding country.

On leaving Maccio station the railway follows the strip of low ground between the north side of the Lagôa do Norte and the plateau. In some places the road bed has the steep hill rising on the north and the water of the lake on the south, while at others there is a wide strip of mangrove swamp between the lake and the hills, and at still others there are strips of arable land on these flats. Wherever rocks are exposed along the north side of the railway between Maccio and Caihoeira they are the yellow, red, purple, gray, white, and mottled beds so characteristic of the weathered portions of the Eocene (?) along this part of the Brazilian coast. These Eocene (?) hills have slopes as high as 45° , and in places they are even steeper. At Bebedouro station (kil. 6) a stream from the north enters the lake through a flat-bottomed, steep-sided valley.

At Fernão Velho (kil. 14) there are good exposures of the parti-colored beds near the station, and half a kilometer beyond the station a cut shows the horizontality of these beds fairly well; but they are all more less oxidized, even to the lowest ones exposed.

At the Instituto Archeologico e Geographico Alagoano in Maccio, I was shown some fossil fishes said to have been found at the town of Fernão Velho. These fossils are in hard gray or cream-colored lumps or concretions of limestones. Lithologically the rocks bear a strong resemblance to the Ceará limestone that contains the fossil fishes, and very little to most

of the rocks exposed in the railway cuts and about the town. I have some doubt about these fossils having come from Fernão Velho, and yet it is not impossible that in the alteration and oxidation of such beds, the more resisting lumps might be left in this form. This seems all the more probable, too, because I found fossil fishes on the coast at Riacho Doce, only twelve kilometers north of Maceio, in beds that stratigraphically seem to be the same as these at Fernão Velho.

Shortly after passing Fernão Velho the railway leaves the lake shore and follows up the valley of Rio Mundahú. At several places heavy water-worn boulders are exposed in the railway cuts, sometimes rising as much as six or seven meters above the track. At Usina Leão (kil. 23-24) the granite boulders exposed in the cut by the reservoir are too large to have traveled far.

A kilometer or more east of Utinga station horizontal gray shales are exposed beside the railway track. These shales have a general lithologic resemblance to the Eocene (?) shales of Riacho Doce. They were not closely examined for fossils, but they look promising. Between this exposure and the Utinga station (kil. 26.6) are large water-worn blocks of granite; similar blocks appear a hundred meters north of the station. These boulders have the appearance of being recent deposits, but they are probably either the basal conglomerate beds of the Eocene (?) series, or else loose materials lately washed from such a basal conglomerate. The material is too heavy to have been moved far from its original source.

About kilometer 29 the Rio Mundahú flows close to the foot of high hills known as the Serra de Ouro, and the roadbed of the railway has been cut in the steep face of the mountain close to the river. These cuts show almost throughout, and for a distance of two or three kilometers heavy beds of decayed granitic boulders. I was unable to determine certainly whether these boulder beds were formed by the Rio Mundahú, or were the decayed basal conglomerates encroached upon by the stream. Less than one kilometer south of the Cachoeira station these heavy conglomerates are exposed again in the railway cuts, with a thickness of about ten meters. At and immediately



Deep cut near Bittencourt on the Alagôas railway, exposing sedimentary rocks of the Alagoas Group.

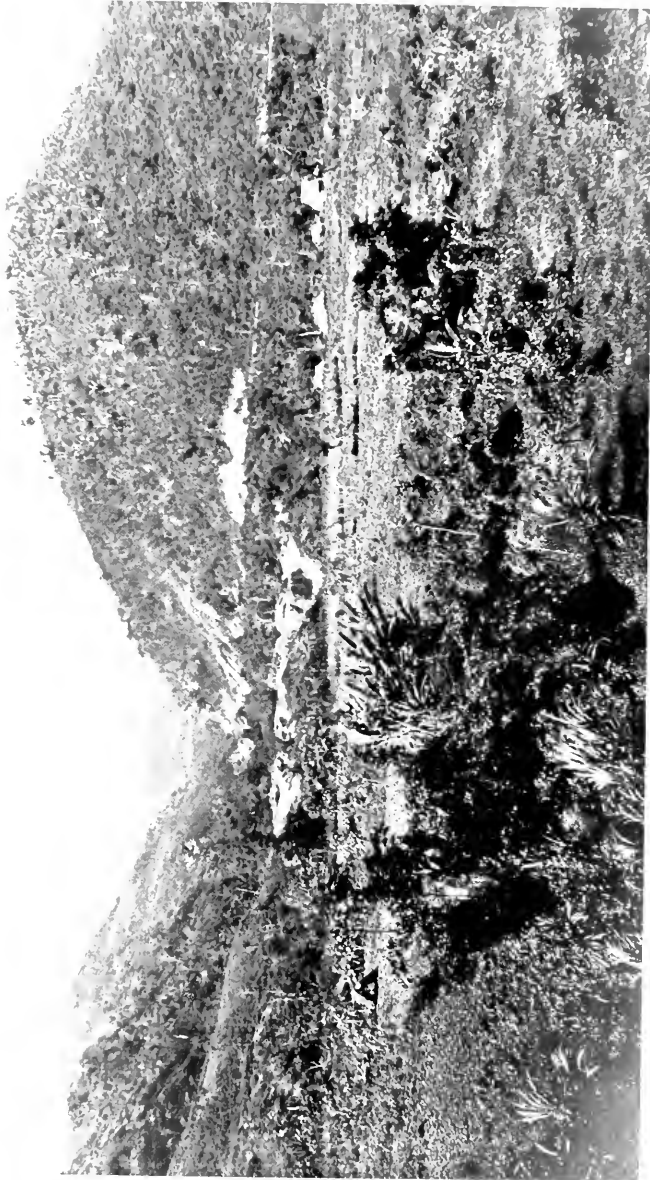


At this Bittencourt cut they are somewhat higher than the basal beds near Cachoeira, but this due to the Bittencourt beds being higher than in the series.

From Parahyba (or Capella) station (kil. 38+), looking north and northeast, one sees the mountains in the distance, while below and to the east of them the lower hills appear to be planed off so as to make an even sky-line. It looks as if this were an old base level of erosion, possibly formed at the time of the deposition of the sedimentary beds along this coast. The granites are well exposed in the Parahyba River at Capella, and at the railway station. The river in many places flows over a rocky bed of granite. Four or five kilometers below Gamelleira the granite in the river bed has a more or less sheeted appearance. At Gamelleira station, to the east of the line, is an exfoliated granite peak about 150 to 200 meters above the railway, or about 350 meters above tide level. The angle of the slope of this peak is from 50° to 85° .

Between Gamelleira and Viçosa the railway passes through a gap in the main range of the Serra dos Dois Irmãos. Plate XII shows a view of this gap in the granite hills. Here the Rio Parahyba has a beautiful fall and a series of cataracts, with some fine examples of pot-holes in the granite bed of the stream. The channel is strewn in places with exfoliated granite slabs. Viçosa (or Assembléa), the terminal station of this branch line, is upon granites, ninety-seven kilometers from Maceio, and has an elevation of 214 meters. The surrounding hills are of granite and have an elevation of a hundred meters or more above the valley. These hills are mostly forest-covered, but one of them exposes a bare rock surface.

From Albuquerque the main line of the Alagôas Railway continues northward up the Rio Mundahú to Imperatriz (now called União). This portion of the line is all upon the old crystalline rocks, and a brief reconnaissance of the region offers but little of variety or especial interest. At Bom Jardim (kil. 44.7) the valley of the Mundahú opens broadly, and the granite hills are only from fifty to sixty meters high. Near the station the rocks are decayed to a depth of about two meters. At Muricy station (kil. 64.3) the valley of the Mundahú is somewhat broader; the



Gruta de São Gonçalo in the Alagoas railway, State of Alagoas, Brazil. The *Parohyba* river flows through the grotto.

rocks are gneiss and granite. The hills are about 100 meters high (184 above tide) and they all appear to rise to about this general level. This flatness of the hilltops continues to and beyond Nicho (kil. 71), and is apparent again as one looks southward and eastward from near União. This seems to be the region of flat-topped hills seen from Capella on the Assembléa branch of this same railway.

About Nicho are many exposures of granite bosses, and up stream from the station there are many exposures of granite in the bed of the river.

Granites and gneisses continue past Branquinha to União, exposed on the slopes of the mountains, in the railway cuts, and in the bed of the river.

At União (kil. 88, elevation 106 meters) the Alagôas Railway connects with the government road running northward to Palmares and Pernambuco, and the crystalline rocks continue to its junction at Glycerio with the Sul de Pernambuco line.

CONCLUSION.

These two sections, although nearly a thousand kilometers apart, are essentially the same: a series of Mesozoic beds along the coast lapping back over old crystalline rocks.

The question of the age of the sediments cannot be discussed in this place: it is too large a problem to be treated briefly. Without going into detail, it is enough to say that the evidence seems to point to these conclusions:

I. The Bahia basin, formerly referred to the Cretaceous, is probably either Eocene, Tertiary, or Laramie.

II. The parti-colored beds along the coast, formerly referred provisionally to the Tertiary, are the same as the Bahia Eocene.

III. The sediments of the Alagôas section are of fresh-water origin, like those of Bahia.

IV. No fossils have been found in the section along the Bahia and Minas Railway, but it seems probable that these beds are the southward continuation of the Bahia beds.

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Systematic list of species	241

CORRECTION.

Page 203. In title, and again in 3d line of 2d paragraph, for North read South.

though numbering about 200 specimens, form only a part of the very extensive collections obtained, all of which have been presented to the United States National Museum.

Leaving Singapore on June 29, 1899, accompanied by Mr. C. B. Kloss, Dr. Abbott spent about three months among the islands of the North China Sea. Mammals were collected on the following islands, the location of which is shown on the accompanying map (fig. 1): Linga (July 7th to 25th), Ste. Barbe (August 1st and 2d), Tambelan group (August 13th to 15th), Anambas group (August 17th to September 28th), and Tioman (September 30th to October 4th).

So far as it is represented by this collection the mammal fauna of the islands consists of local forms of the widely distributed and

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INTRODUCTION.

DURING the spring of 1899 Dr. W. L. Abbott fitted out a schooner at Singapore for the special purpose of exploring the less known coasts and islands of the East Indies. The results of the first cruise, so far as concerns the mammals, are embodied in the present paper, which is published here by permission of the Secretary of the Smithsonian Institution. The mammals, though numbering about 200 specimens, form only a part of the very extensive collections obtained, all of which have been presented to the United States National Museum.

Leaving Singapore on June 29, 1899, accompanied by Mr. C. B. Kloss, Dr. Abbott spent about three months among the islands of the North China Sea. Mammals were collected on the following islands, the location of which is shown on the accompanying map (fig. 1): Linga (July 7th to 25th), Ste. Barbe (August 1st and 2d), Tambelan group (August 13th to 15th), Anambas group (August 17th to September 28th), and Tioman (September 30th to October 4th).

So far as it is represented by this collection the mammal fauna of the islands consists of local forms of the widely distributed and

characteristic Malayan types. Each island and group of islands has its representatives of the common genera and species; but

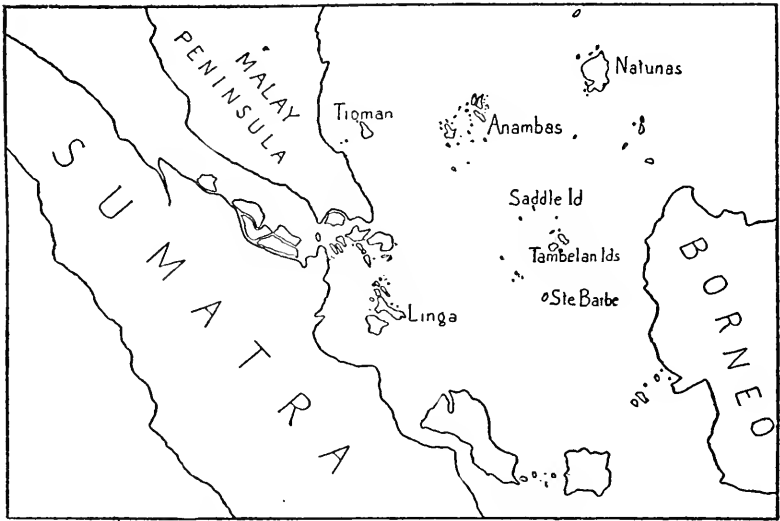


FIG. 10. Islands visited by Dr. Abbott.

in scarcely an instance is an insular race identical with that occurring on another island, unless of the same group, or on the mainland.

SYSTEMATIC LIST OF SPECIES.

MUS FLAVIVENTER sp. nov.

Type.—Adult male (skin and skull). No. 101739 United States National Museum. From Pulu Jimaja, Anambas Islands. Collected September 18, 1899.

Characters.—Similar to *Mus cremoriventer* Miller¹ from Trong, Lower Siam, but slightly larger and with entire pelage much more strongly suffused with yellow.

Fur.—The elements of the fur are as in *M. cremoriventer*.

Color.—General color above ochraceous, fading to orange-buff or buff-yellow on sides, the sides nearly clear, but back, shoulders, neck and head uniformly sprinkled with black-tipped hairs and bristles, which are nowhere in excess of the ochraceous. Cheeks clear orange buff. Muzzle broccoli-brown. Scarcely a trace of a dark eye ring.

¹ Proc. Biolog. Soc. Washington, XIII, p. 144, April 21, 1900.

Underparts and inner surface of legs pale straw-yellow to base of hairs. sharply defined from color of sides and extending to wrists and nearly to ankles. Feet yellowish white, faintly shaded with sepia. Tail and naked ears uniform dark brown throughout.

Tail as in *Mus cremoriventer*.

Skull.—The skull closely resembles that of *Mus cremoriventer*, differing only in slightly larger size and relatively smaller audital bullæ, characters that may prove to be purely individual.

Teeth as in *Mus cremoriventer*.

Measurements.—External measurements of type: total length 304; head and body 133; tail vertebræ 171; hind foot 28.5 (26.5); ear from meatus 16; ear from crown 11.5; width of ear 14. A second specimen, also a male: total length 285; head and body 133; tail vertebræ 152; hind foot 27 (25).¹

Cranial measurements of type: greatest length 34; basal length 29; basilar length 26.8; palatal length 14.4; least width of palate between anterior molars 3.8; diastema 9.4; length of incisive foramen 5.4; combined breadth of incisive foramina 3; length of nasals 13.6; combined breadth of nasals 3.8; zygomatic breadth 15.4; interorbital breadth 5.6; mastoid breadth 12.8; breadth of braincase over roots of zygomata 14; depth of braincase at front of basioccipital 10.4; frontopalatal depth at posterior extremity of nasals 7.8; least depth of rostrum immediately behind incisors 6.4; maxillary toothrow (alveoli) 5.8; width of first upper molar 1.6; mandible 17.4; mandibular toothrow (alveoli) 5.6.

Specimens examined.—Two, from the type locality.

Remarks.—*Mus flaviventer* is a yellowish, insular form of *M. cremoriventer*. It is not closely related to any of the species thus far recorded from the Natuna Islands, unless to the *Mus cphippium* of Thomas.

MUS ANAMBÆ sp. nov.

Type.—Adult female (skin and skull). No. 101737 United States National Museum. From Pulo Jimaja, Anambas Islands. Collected September 21, 1899.

Characters.—Like *Mus surifer* Miller² from Trong, Lower Siam, but with tail always much shorter than head and body.

Color.—Upper parts uniform tawny-ochraceous, heavily sprinkled with blackish brown on posterior half of back, less so on shoulders

¹ Measurement of hind foot in parenthesis is taken without claws.

² Proc. Biolog. Soc. Washington, XIII, p. 148, April 21, 1900.

and head. Sides, flanks, cheeks and outer surface of legs clear tawny-ochraceous. Underparts soiled yellowish white to base of hairs. The white extends down inner side of front legs to wrists, but on hind legs, as in *Mus surifer*, it is usually interrupted between knee and heel. Feet dull white. Ears and dorsal surface of tail to terminal third or fourth dark brown. Underside of tail and whole of terminal third or fourth dull white. Underfur of back light slate color.

Skull and teeth as in *Mus surifer*.

Measurements.—Three adults measure as follows: No. 101737, ♀, Pulo Jimaja (type); total length 330; head and body 178; tail vertebræ 152; hind foot 40 (39); ear from meatus 21; ear from crown 17; width of ear 16. No. 101738, ♂, Pulo Jimaja; total length 330; head and body 178; tail vertebræ 152; hind foot 40 (39). No. 101701, ♀, Pulo Siantan; total length 343; head and body 184; tail vertebræ 159; hind foot 41 (39).

Specimens examined.—Five, all from the Anambas; two taken on Pulo Jimaja and three on Pulo Siantan.

Remarks.—Though closely related to *Mus surifer* this species is readily distinguishable by its much shorter tail.

MUS LINGENSIS sp. nov.

Type.—Adult male (skin and skull). No. 101614 United States National Museum. From Linga Island. Collected July 15, 1899.

Characters.—Closely related to *Mus surifer* and *M. pellax*; size and cranial characters as in the former, color more nearly like that of latter. White of inner side of hind leg broadly continuous with that of dorsal surface of foot. Bony palate narrower than in the allied species.

Color.—Dorsal surface an indescribable grizzle of dark hair-brown, clay color, and drab, darkest on middle of back, lightest and most tinged with yellow on neck. Sides drab, slightly varied with hair-brown and clay color. Ventral surface of body and inner side of legs white tinged with cream color. The white of the hind leg is broadly continuous with that of dorsal surface of foot. A distinct blackish eye ring. Tail bicolor, whitish below and at tip, elsewhere dark brown.

Skull and teeth.—The skull closely resembles that of *Mus surifer* except in the form of the bony palate. This is more elongate than in either of the related mainland species or in *M. anamba*. The ratio of width of palate between anterior molars to distance between posterior border of incisive foramen and anterior border of interpterygoid space is 42 and 43 respectively in two specimens of *Mus lingensis*,

while in two of *M. surifer* it is 57 and 60, in the type of *M. anambæ* 60, and in the type of *M. pellax* 55. Teeth as in *Mus surifer*.

Measurements.—External measurements of type: total length 387; head and body 216; tail vertebræ 171; hind foot 42 (40.4); ear from meatus 21; ear from crown 16; width of ear 16. Average of five adults: total length 381 (362–400); head and body 215 (203–229); tail vertebræ 169 (159–184); hind foot 40.2 (38–43); hind foot without claws 38.7 (37–42).

Cranial measurements of type: greatest length 47.5; basal length 40.4; basilar length 37.5; palatal length 21.8; least width of palate between anterior molars 4.4; diastema 13.4; length of incisive foramen 7; combined breadth of incisive foramina 4; length of nasal 19; combined breadth of nasals 5.4; zygomatic breadth 20; interorbital breadth 6.8; mastoid breadth 15.4; breadth of braincase over roots of zygomata 17; depth of braincase at front of basioccipital 11.4; frontopalatal depth at posterior extremity of nasals 11; least depth of rostrum immediately behind incisors 8.8; maxillary tooth-row (alveoli) 8; width of first upper molar 2.2; mandible 25.4; mandibular tooth-row (alveoli) 7.2.

Specimens examined.—Six, all taken on Linga Island, at an altitude of about 1000 feet.

Remarks.—The dull color of the six specimens of *Mus lingensis* is evidently due in part to the abraded condition of the pelage in most of the individuals taken. After due allowance is made for this, however, the differences separating the animal from *Mus surifer* are still very appreciable.

MUS STREPITANS sp. nov.

Type.—Adult female (skin and skull). No. 101697 United States National Museum. From Pulo Siantan, Anambas Island. Collected September 10, 1899.

Characters.—Similar to *Mus vociferans* Miller¹ from Trong, Lower Siam, but color darker throughout, and ventral surface pale yellow instead of dull white. Skull as in the Bornean *Mus sabannus*.

Color.—Back and sides ochraceous-buff, duller on back, clearer on sides, everywhere sprinkled with blackish brown. The brown predominates on back and shoulders, gradually giving way on sides to the ochraceous-buff which, however, is nowhere without at least a faint sprinkling of brown. Cheeks and outer side of front legs nearly clear ochraceous-buff. Entire ventral surface and inner side of front legs

¹ Proc. Biolog. Soc. Washington, XIII, p. 138, April 21, 1900.

pale straw-yellow, brighter on chest, duller and more nearly cream color posteriorly. The yellow of legs is continuous with dirty white of upper surface of feet. Metapodials heavily shaded with brown. Tail dull light brown, indistinctly paler beneath and throughout terminal third.

Skull and teeth.—The skull differs from that of *Mus vociferans* and resembles that of *M. sabanus* in the elevation of the region about posterior extremity of nasals. The character is one that is almost impossible to describe, but which is readily appreciated on comparison of specimens. Teeth as in the related species.

Measurements.—External measurements of type: total length 565; head and body 241; tail vertebræ 324; hind foot 47 (43.6); ear from meatus 22; ear from crown 20; width of ear 18. Four specimens from Pulo Siantan average: total length 546 (509–584); head and body 235 (222–248); tail vertebræ 311 (298–336); hind foot 46.4 (45–47); hind foot without claws 44.1 (43–45). Three specimens from Pulo Jimaja average: total length 551 (547–559); head and body 233 (229–241); tail vertebræ 318; hind foot 45.5 (45–46); hind foot without claws 44 (43–45).

Cranial measurements of type: greatest length 57; basal length 48; basilar length 45; palatal length 25.4; least width of palate between anterior molars 5; diastema 15.6; length of incisive foramen 8; combined breadth of incisive foramina 4; length of nasals 11.8; combined breadth of nasals 6; zygomatic breadth 25; interorbital breadth 9.6; mastoid breadth 19; breadth of braincase over roots of zygomata 20; depth of braincase at front of basioccipital 13.8; frontopalatal depth at posterior extremity of nasals 14; least depth of rostrum immediately behind incisors 10; maxillary tooththrow (alveoli) 10; width of first upper molar 3; mandible 32.4; mandibular tooththrow (alveoli) 9.6.

Specimens examined.—Seven; four from Pulo Siantan and three from Pulo Jimaja.

Remarks.—Its dark color immediately distinguishes this rat from *Mus vociferans* and *M. sabanus*. The seven specimens are remarkably constant in all their characters, both external and cranial. None of them show a tendency to become markedly paler and yellower across the shoulders so conspicuous in *Mus vociferans*. Dr. Abbott notes that the animal is quite as noisy as its mainland representative.

? MUS VOCIFERANS Miller.

A single much abraded specimen (♀ No. 101756) taken on Tioman Island, October 3, 1899, is probably referable to this species. Its

tail is defective and the pelage is so worn that the underfur appears at the surface in irregular patches. Under the circumstances any exact determination is impossible. In its whitish belly and in the form of the skull the animal agrees with *Mus vociferans* and shows no approach toward the characters of *M. strepitans*.

MUS TIOMANICUS sp. nov.

Type.—Adult male (skin and skull). No. 101763 United States National Museum. From Tioman Island. Collected October 4, 1899.

Characters.—In size, proportions, quality of fur, and cranial characters similar to the form of *Mus alexandrinus* occurring in Trong, Lower Siam, but color throughout much darker.

Color.—Dorsal surface raw umber heavily and finely grizzled with blackish brown, the fur faintly lustrous in certain lights. Sides and cheeks slightly paler than back and much less profusely sprinkled with dark hairs. Ventral surface dull white, the chin and throat tinged with cream-buff, the chest faintly washed with brown. Throughout the pelage except on chin and throat the hairs are light slate-gray at base. Outer surface of front legs drab-gray. Inner surface of all four legs like belly. Muzzle and dorsal surface of feet dull sepia. Tail uniform dark brown throughout.

Skull and teeth.—In both cranial and dental characters this species is practically identical with the form of *Mus alexandrinus* found in

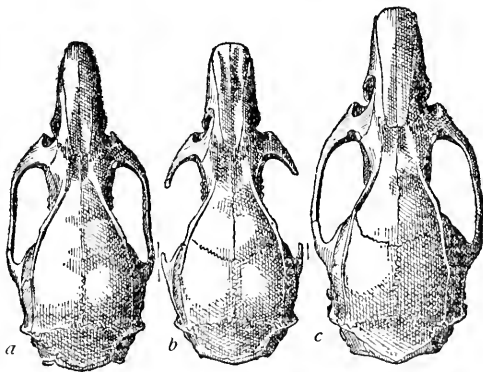


FIG. 11. a *Mus tiomanicus*. b *M. siantanicus*. c *M. tambelanicus*.
Natural size.

Trong, Lower Siam. The skull as a whole is, however, slightly more elongate than in the mainland animal, the difference most noticeable

in the region of the anterior zygomatic roots, and in the posterior portion of the braincase. The antero-posterior diameter of the interparietal is usually greater than in the mainland form; though this character is not wholly constant it is sufficiently so to differentiate series of specimens.

Measurements.—External measurements of the type: total length 362; head and body 171; tail vertebræ 191; hind foot 37 (35); ear from meatus 20.4; ear from crown 15.8; width of ear 15.6. Average of four adults from the type locality: total length 375 (362-381); head and body 184 (171-197); tail vertebræ 189 (184-197); hind foot 36.5 (34-38); hind foot without claws 34.5 (33-35).

Cranial measurements of type: greatest length 43 (41);¹ basal length 37 (36); basilar length 34 (33.6); palatal length 20 (19.4); least width of palate between anterior molars 4.4 (4.4); diastema 11.6 (11.4); length of incisive foramen 7.8 (7.6); combined breadth of incisive foramina 3 (3); length of nasals 15.4 (14.4); combined breadth of nasals 4.4 (3); zygomatic breadth 19 (20); interorbital breadth 6 (6.4); mastoid breadth 16.4 (16.6); breadth of braincase over roots of zygomata 15.4 (16.4); depth of braincase at front of basioccipital 11.6 (11); frontopalatal depth at posterior extremity of nasals 9.4 (9.6); least depth of rostrum immediately behind incisors 7.8 (7.8); maxillary toothrow (alveoli) 7 (7.6); width of first upper molar 2 (2); mandible 23.6 (22.4); mandibular toothrow (alveoli) 7 (7).

Specimens examined.—Eleven, all from the type locality.

Remarks.—On comparison of the eleven specimens of *Mus tionanicus* with ten of the continental race of *Mus alexandrinus* from Trong the differences in color are seen to be remarkably constant. The slight cranial peculiarities of the insular form, while hardly sufficient by themselves to separate the animal, are of undoubted significance when considered in connection with the external characters. For comparison with the allied insular species see description of *Mus tambelanicus*, p. 213.

MUS SIANTANICUS sp. nov.

Type.—Adult male (skin and skull). No. 101705 United States National Museum. From Pulo Siantan, Anambas Islands. Collected September 11, 1899.

Characters.—Size, proportions, quality of fur, and color essentially

¹ Measurements in parenthesis are those of an adult male *Mus alexandrinus* from Trong (No. 84395).

as in the form of *Mus 'alexandrinus'* occurring in Trong, Lower Siam, but skull with noticeably broader, less arched rostrum.

Color.—Dorsal surface a fine grizzle of dull ochraceous-buff and brownish black, the hairs with a distinct gloss in certain lights. On shoulders and middle of back the brown predominates, and at the same time the ochraceous-buff is duller and paler than elsewhere. On sides, flanks and across lumbar region the dark hairs are less numerous and the ochraceous-buff is distinctly tinged with russet. Ventral surface of body and inner side of legs yellowish white, darker, and somewhat brownish tinged across chest. Fur of back pale slate-gray at base, that of ventral surface mostly unicolor to base, but irregularly tinged with gray beneath the surface. Feet light brown. Tail uniform dark brown throughout.

Skull and teeth.—The skull of *Mus siantanicus* is essentially like that of *M. tiomanicus* and *M. 'alexandrinus'* except in the form of the rostrum. This differs conspicuously from that of the related species in its breadth, and in the flatness of the dorsal surface. The characters are most noticeable when the skull is viewed from directly in front. It is then seen that the nasal bones are very slightly depressed at the sides only, while in *Mus tiomanicus* and *M. alexandrinus* they are uniformly arched from suture to periphery, the outline of the two together forming nearly one-half of a circle. Viewed from the side, the dorsal profile of the rostrum appears nearly straight. Viewed from beneath, the sides are seen to be more nearly parallel than in the two related species. Teeth in no way peculiar.

Measurements.—External measurements of type: total length 356; head and body 191; tail vertebræ 165; hind foot 35 (33); ear from meatus 17.8; ear from crown 14.8; width of ear 15. Average of five adults from the type locality; total length 365 (349–382); head and body 186 (178–191); tail vertebræ 179 (165–191); hind foot 35.6 (35–36); hind foot without claws 36.9 (33–35).

Cranial measurements of type: greatest length 42; basal length 37; basilar length 35; palatal length 21; least width of palate between anterior molars 4; diastema 12; length of incisive foramen 8; combined breadth of incisive foramina 3; length of nasals 15.4; combined breadth of nasals 4.6; zygomatic breadth 18; interorbital breadth 6.4; mastoid breadth 15.6; breadth of braincase over roots of zygomatica 16.4; depth of braincase at front of basioccipital 12; frontopalatal depth at posterior extremity of nasals 9.4; least depth of rostrum immediately behind incisors 7; maxillary toothrow (alveoli) 7; width of first upper molar 2; mandible 23.6; mandibular toothrow (alveoli) 7.

Specimens examined.—Six, all from the type locality.

Remarks.—Unlike the Tioman rat, *Mus siantanicus* retains the external appearance of the mainland form, but differs widely in its cranial characters. In the latter it shows an approach to the much larger Tambelan representative of the group.

MUS TAMBELANICUS sp. nov.

Type.—Adult male (skin and skull). No. 101665 United States National Museum. From Big Tambelan Island. Collected August 10, 1899.

Characters.—Much larger than *Mus siantanicus* or the form of *M. alexandrinus* occurring in Trong, Lower Siam. Fur coarser than in the related species; color about as in *Mus tiomanicus*, or slightly more red, but ventral surface darker and more yellow. Skull with rostrum relatively even more heavily built than in *Mus siantanicus*, but with dorsal surface less flattened.

Color.—Back a fine grizzle of dull cinnamon and blackish brown, the two colors nearly equally mixed. Sides nearly clear cinnamon, brightening to russet on flanks. Ventral surface dull buff, faintly and irregularly marked with brownish, and very obscurely contrasted with color of sides. Feet sepia. Tail uniform dark brown throughout.

Skull.—The skull most nearly resembles that of *Mus siantanicus* but is much larger and the rostrum is relatively broader than in the Anambas species. *Region between anterior zygomatic roots convex laterally*, not flat or concave as in the allied species. Dorsal profile of nasals when viewed from in front slightly convex, but much less so than in *Mus tiomanicus* and the Trong form of *M. alexandrinus*. Lateral margins of rostrum nearly parallel. Teeth larger than in the related species, but not disproportionately so.

Measurements.—External measurements of type: head and body (tail imperfect) 216; hind foot 42 (39); ear from meatus 21; ear from crown 15; width of ear 16.4. Two adults from Pulo Bunoa measure: (No. 101646, ♀) total length 425; head and body 203; tail vertebrae 222; hind foot 40 (37); and (No. 101642, ♀) total length 375; head and body 181; tail vertebrae 191; hind foot 40 (37). An adult male (No. 101669) from Pulo Wai measures: total length 393; head and body 191; tail vertebrae 203; hind foot 41 (38).

Cranial measurements of type: greatest length 47; basal length 41; basilar length 38; palatal length 24; least width of palate between anterior molars 4.6; diastema 13; length of incisive foramen 8; combined breadth of incisive foramina 3.8; length of nasals 17; com-

bined breadth of nasals 5.4; zygomatic breadth 22.4; interorbital breadth 7; mastoid breadth 18; breadth of braincase over roots of zygomata 17.6; depth of braincase at front of basioccipital 12.8; frontopalatal depth at posterior extremity of nasals 11.4; least depth of rostrum immediately behind incisors 8.8; maxillary tooththrow (alveoli) 8; width of first upper molar 2.4; mandible 26.4; mandibular tooththrow (alveoli) 7.4.

Specimens examined.—Five, one adult from Big Tambelan Island, two from Pulo Bunoa, an adult from Pulo Wai, and an immature individual from Pulo Gilla.

Remarks.—*Mus tambelanicus* marks, so far as the species represented by the present collection are concerned, the culmination of a series beginning with the light colored, slender skulled animal of Trong. The first step away from this type is represented by *Mus tiomanicus*, in which the color is distinctly darkened, but in which the cranial characters remain practically unchanged. In the representative of the group occurring on the Anambas the rostrum is noticeably altered in form, though the color is less affected than in the Tioman animal. Finally, in the Tambelan Islands a race has been developed carrying the cranial peculiarities even further than in that inhabiting the Anambas; the changes in form of skull accompanied by marked increase in the general size of the animal, in the quality of the fur and in the color. The characters of each of these closely related species are remarkably constant in view of the reputation for variation enjoyed by *Mus alexandrius*. The adult specimen of *M. tambelanicus* from Pulo Wai differs from the skins from Big Tambelan in less yellow ventral surface, but otherwise it is not peculiar.

The specimen from Pulo Gilla is too immature to be comparable with the others.

MUS OBSCURUS sp. nov.

Type.—Adult male (skin and skull). No. 101764 United States National Museum. From Tioman Island. Collected October 1, 1899.

Characters.—Similar to *Mus concolor* Blyth, but larger, and with more coarsely spinous fur. Skull larger than that of *Mus concolor*, the dorsal profile less convex, the audital bullæ larger and teeth relatively smaller.

Color.—General appearance that of a much overgrown house-mouse. Dorsal surface a fine grizzle of seal brown and dull ochraceous-buff, the former predominating on crown of head and in lumbar

region, the latter slightly in excess on rump, flanks and shoulders, as well as on sides of body and outer surface of legs. Ventral surface of body and inner side of legs pale drab, irregularly and faintly washed with brownish yellow. Feet drab-gray. Tail uniform dark brown throughout. Fur of body everywhere slate-gray at base.

Fur.—The fur is rather short, about 8 mm. in length on middle of back, and everywhere thickly and uniformly sprinkled with well developed, slender, grooved bristles. On lower part of sides the bristles become even more slender, while on ventral surface they are at first sight not noticeably different from ordinary hairs.

Tail.—The tail is closely and uniformly annulated; about 16 rings to the centimeter at middle. Though sharply distinguished from each other, the rings are very obscurely divided into scales. Tail uniformly clothed with very short hairs (their length mostly about double width of rings) which neither hide the annulation nor form a terminal pencil.

Feet.—Soles 6-tuberculate, the sixth pad well developed. The surface of the sole appears (on soaking the foot of the dry specimen) to be distinctly and closely reticulate in the region between the pads, but perfectly smooth behind them.

Skull.—As compared with a skull of *Mus concolor* from Bhamo, Burmah (No. 10519 United States National Museum), that of *M. obscurus* differs noticeably in its larger size, more slender rostrum, and particularly in the less convex profile when viewed from the side. The antorbital foramina are larger than in the related species, and less contracted below. Audital bullæ relatively as well as actually larger than in *Mus concolor*, and not very different in form.

Teeth.—The teeth are essentially as in *Mus concolor*, but actually smaller.

Measurements.—Total length 254; head and body 121; tail vertebrae 133; hind foot 24 (22.6); ear from meatus 16; ear from crown 13; width of ear 13.

Skull: greatest length 30 (28.6);¹ basal length 26 (24); basilar length 23 (21.8); palatal length 13 (12); least width of palate between anterior molars, 3.2 (2.8); diastema 8 (7); length of incisive foramen 5.4 (5); combined breadth of incisive foramina 2 (1.8); length of nasals 11 (10.2); combined breadth of nasals 3 (3); zygomatic breadth 13.6 (13); interorbital breadth 4 (5); mastoid breadth 12 (12); breadth of braincase over roots of zygomatics 13 (12.6); depth

¹Measurements in parenthesis are those of an adult female *Mus concolor* from Bhamo, Burmah.

of braincase at front of basioccipital 9 (8.4); frontopalatal depth at posterior extremity of nasals 6.6 (6); least depth of rostrum immediately behind incisors 5 (4.8) maxillary toothrow (alveoli) 4.6 (5); width of first upper molar 1.6 (1.6); mandible 15.4 (14.6); mandibular toothrow (alveoli) 4.6 (5).

Specimens examined.—One, the type.

Remarks.—*Mus obscurus* will probably be found to occur on the mainland of the Malay Peninsula, where its range is likely to coincide with that of *Mus surifer* and *Mus vociferans*.

RATUFA ANAMBÆ sp. nov.

Type.—Adult male (skin and skull). No. 101725 United States National Museum. From Pulo Jimaja, Anambas Islands. Collected September 25, 1899.

Characters.—In color and in cranial characters similar to *Ratufa melanopepla*, but size nearly equal to that of *Ratufa gigantea*. Ears not tufted.

Color.—Cheeks, throat, sides of neck, inner surface of legs, and entire ventral surface of body rich tawny yellow (ochraceous) paler on throat, cheeks, and sides of neck, richer on chest, the belly much darkened by appearance at surface of blackish bases of hairs. Remainder of pelage and entire tail glossy blue-black, with the usual reddish brown cast beneath the surface. Yellow of front leg spreading conspicuously over outer side between elbow and wrist.

Skull and teeth.—Except for their distinctly larger size the skull and teeth scarcely differ from those of *R. melanopepla*. Audital bullæ narrower and more elevated above surface of basioccipital (when skull is held upside down) than in *R. melanopepla*, the peculiarity in form the same as that of the Tioman race, but more accentuated.

Measurements.—External measurements of type: total length 825; head and body 374; tail vertebræ 451; pencil 100; hind foot 83 (76). Average of six specimens from the type locality: total length 806 (781–838); head and body 370 (356–381); tail vertebræ 436 (400–470); hind foot 82.8 (82–84); hind foot without claws 75.8 (75–77).

Cranial measurements of type: greatest length 72; basal length 60; basilar length 56; palatal length 28; length of nasals 25; breadth of nasals anteriorly 13; breadth of nasals posteriorly 8.6; interorbital breadth 26; breadth between tips of postorbital processes 40; zygomatic breadth 45; mastoid breadth 33; breadth of palate between premolars 9; depth of rostrum at posterior extremity of nasals 21; mandible 42; depth of mandible at posterior root of premolar 11.4;

least depth of mandible between incisor and premolar 10.2; maxillary toothrow (alveoli) 14; breadth across both upper incisors at rim of alveoli 9.8; mandibular toothrow (alveoli) 14.8.

Specimens examined.—Six, all from the type locality.

Remarks.—This is an insular race characterized, contrary to the general rule, by increase in size. Its peculiarities are well marked and constant.

RATUFA TIOMANENSIS sp. nov.

Type.—Adult male skin and (skull). No. 101751 United States National Museum. From Tioman Island. Collected October 4, 1899.

Characters.—Color exactly similar to that of *Ratufa anambæ* and *R. melanopepla*, but size smaller and tail relatively longer than in either. Skull like that of *R. melanopepla*, but with more inflated audital bullæ.

Color.—See description of *Ratufa anambæ*, which applies equally well to this animal.

Skull.—In size and general form the skull of *Ratufa tiomanensis* so closely agrees with that of *R. melanopepla* that no special description is necessary. The audital bullæ are, however, slightly though constantly different in form. Though of about the same size as in *R. melanopepla* the bullæ are more inflated, so that when viewed from behind (the skull held upside down) they appear to rise higher and more abruptly above surface of basioccipital. This character, though slight, is readily appreciable when specimens are compared, and its constancy makes it of more importance than would at first sight be supposed.

Measurements.—External measurements of type: total length 724; head and body 368; tail vertebrae 356; pencil 90; hind foot 78 (72). Average of five specimens from the type locality: total length 740 (724-762); head and body 343 (305-368); tail vertebrae 397 (356-419); hind foot 76.4 (74-78); hind foot without claws 69.8 (68-72).

Cranial measurements of type: greatest length 68.4 (70);¹ basal length 56.4 (59); basilar length 52 (53); palatal length 26 (26.4); diastema 15.4 (16); length of nasals 23 (23.4); breadth of nasals anteriorly 12.6 (13); breadth of nasals posteriorly 7 (7); interorbital breadth 26 (28); breadth between tips of postorbital processes 39 (41); zygomatic breadth 42.4 (44); mastoid breadth 31 (32.6); breadth of palate between premolars 10 (10); depth of rostrum at

¹ Measurements in parenthesis are those of the type of *Ratufa melanopepla*.

posterior extremity of nasals 18.6 (18.8); mandible 41 (41.6) depth of mandible at posterior root of premolar 11.4 (11); maxillary tooth-row (alveoli) 13 (14); breadth across both upper incisors together at rim of alveoli 8.4 (8); mandibular toothrow (alveoli) 14 (14.4).

Specimens examined.—Five, all from the type locality.

Remarks.—*Ratufa tiomanensis* is less differentiated from *R. melanopepla* than is the Anambas form. Nevertheless its characters are easily recognizable on comparison, while their constancy is very marked.

FUNAMBULUS CASTANEUS sp. nov.

Type.—Immature male (skin and skull). No. 101696 United States National Museum. From Pulo Siantan, Anambas Islands. Collected September 10, 1899.

Characters.—Similar to the form of *Funambulus insignis* occurring in Trong, Lower Siam, but darker in color, and sides and flanks not grizzled; skull with much larger audital bullæ.

Color.—Sides, flanks, and outer surface of legs clear chestnut, the individual hairs slate-gray at base, ferruginous at middle and black at tip. The color is brightest on flanks and palest on front legs and sides of head. Neck and middle of back grizzled gray faintly washed with tawny. Top of head similar but with tawny tinge more conspicuous. In lumbar region and on rump the gray gives place gradually to color of flanks. The gray area is bounded on each side and divided in the middle by a black stripe about 3 mm. in breadth. These three black stripes begin a little in front of shoulders and extend to rump, where they disappear. The two stripes into which the gray area is thus divided are each about 5 mm. in width. Ventral surface of body and inner side of legs soiled yellowish white to base of hairs, the inner side of hind legs strongly washed with ferruginous. Feet a dull grizzle of black and tawny. Ears brownish internally, whitish externally. The hairs of the tail are black at base (3 mm.) then light, dull ferruginous (5 mm.), followed by black (10 mm.), the extreme tips whitish. On dorsal surface the ferruginous is nearly concealed by the black, but on ventral surface it forms a well-defined median area.

Skull.—The type specimen is so young that no accurate description of the cranial characters can be given. The audital bullæ, however, are actually larger than in a fully adult specimen of *Funambulus insignis* from Trong. They are so large that when viewed from the side they conceal the tips of the pterygoids, which in *F. insignis* are plainly visible.

Measurements.—External measurements of type: total length 241; head and body 152; tail vertebræ 89; pencil 30; hind foot 45 (41).

Specimen examined.—One, the type.

Remarks.—Although the only specimen of this squirrel is immature (crown of last upper molar at rim of alveolus) its characters appear to be quite sufficient to separate the Anambas form from that of the mainland. It is probably more closely allied to the much brighter colored *Funambulus diversus* (Thomas) of Borneo.

SCIURUS MIMELLUS sp. nov.

Type.—Adult male (skin and skull). No. 101668 United States National Museum. From Pulo Wai, Tambelan Islands. Collected August 13, 1899.

Characters.—A miniature of *Sciurus przewostii* (hind foot about 53 instead of 63, greatest length of skull 51 instead of 58).

Color.—Entire tail, dorsal surface of head and body, and outer surface of hind legs glossy black to base of hairs. Underparts, feet, inner side of hind leg, and entire fore leg bright reddish chestnut (brighter than Ridgway's pl. IV, No. 9) fading to cinnamon-rufous on thighs and to light orange-rufous on outer side of upper arms. Black of back separated from red of belly by a lateral band of white beginning just behind axilla and extending down front of hind leg to knee and about 12 mm. wide at middle. Cheeks, chin and sides of neck grizzled bluish gray. Sides of muzzle whitish. Whiskers and ears black. The fur of the red area is everywhere red to base except on sides, close to white stripe. Here it is blackish beneath the surface.

Skull.—Except for its smaller size the skull of *Sciurus mimellus* exactly resembles that of *S. przewostii*.

Measurements.—External measurements of type: total length 451; head and body 229; tail vertebræ 222; pencil 60; hind foot 55 (51). A somewhat younger individual (female) from the type locality: total length 442; head and body 222; tail vertebræ 210; pencil 60; hind foot 54 (51).

Cranial measurements of type: greatest length 51.6 (58¹); basal length 43.6 (52); basilar length 40.6 (48.4); palatal length 22.8 (26); length of nasals 15 (19); breadth of nasals anteriorly 72 (8.8); breadth of nasals posteriorly 4.4 (5); interorbital breadth, 18.4 (24.8);

¹ Measurements in parenthesis are those of an adult female *Sciurus przewostii* from Trong, Lower Siam.

breadth between tips of postorbital processes 27.4 (34); zygomatic breadth 31 (37); mastoid breadth 21.4 (25); breadth of palate between premolars 6.8 (8.4); depth of rostrum at posterior extremity of nasals 12.8 (13.6); mandible 31.4 (37); depth of mandible at posterior root of large premolars 8 (9); maxillary toothrow (alveoli) 10 (11); breadth across both upper incisors together at rim of alveoli 5 (6); mandibular toothrow (alveoli) 10 (11.4).

Specimens examined.—Two, both from the type locality.

Remarks.—*Sciurus mimellus* is distinguished from *S. prevostii*, aside from its size, by the reduction in width of the white lateral band. In the mainland animal this band is so wide that on the hind leg it occupies the entire outer side, reducing the black to a mere inconspicuous line between it and the red. In *S. mimellus* on the other hand the white occupies rather less space on the leg than the black, so that the latter color is more conspicuous than the white when the skin is viewed from above. Six adult specimens of *Sciurus prevostii* from Trong, Lower Siam, measure: total length, 533 (502–553); head and body 262 (248–273); tail vertebræ 275 (254–286); hind foot 62.5 (60–65); hind foot without claws 58 (56–60).

SCIURUS MIMICULUS sp. nov.

Type.—Adult male (skin and skull). No. 101616 United States National Museum. From Ste. Barbe Island. Collected August 1, 1899.

Characters.—Similar to *Sciurus mimellus* but even smaller (hind foot about 40, greatest length of skull about 48).

Color.—In color *Sciurus mimiculus* exactly agrees with *S. mimellus*, even to the narrowing of the white lateral band and consequent increase in the amount of black on the hind leg as compared with *S. prevostii*.

Skull.—The skull (fig. 12, *a*) is as in *Sciurus mimellus*, though much smaller. Audital bullæ slightly less inflated than in the larger species.

Measurements.—External measurements of type: total length 381; head and body 203; tail vertebræ 178; pencil 50; hind foot 42 (38). Average of nine specimens from the type locality: total length 387 (375–406); head and body 198 (191–203); tail vertebræ 189 (178–203); hind foot 43.5 (42–49); hind foot without claws 42.4 (38–45).

Cranial measurements of type: greatest length 48; basal length 41; basilar length 38; palatal length 20; length of nasals 14; breadth of nasals anteriorly 7; breadth of nasals posteriorly 5; interorbital

breadth 19; breadth between tips of postorbital processes 27; zygomatic breadth 29; mastoid breadth 20; breadth of palate between premolars 6; depth of rostrum at posterior extremity of nasals 11.8; mandible 28.8; depth of mandible at posterior root of large premolar 7.2; maxillary toothrow (alveoli) 9; breadth across both upper incisors together at rim of alveoli 4.6; mandibular toothrow (alveoli) 9.

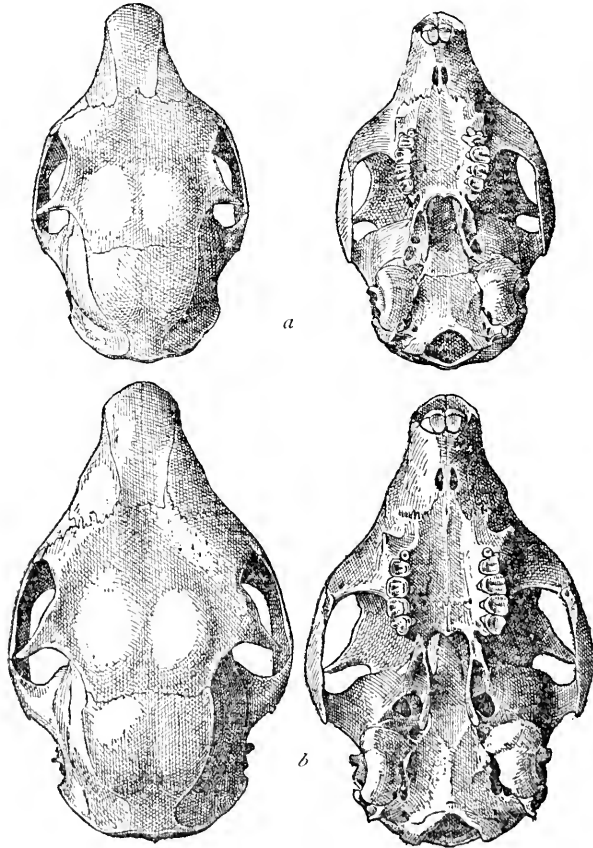


FIG. 12. *a* *Sciurus mimicus*. *b* *Sciurus prevostii*. Natural size.

Specimens examined.—Nine, all from the type locality.

Remarks.—One of the specimens of this species (δ No. 101617, August 1) is in very abraded pelage, the longer hairs of the back being for the most part worn away. Yet there is no appreciable change in color. The tail has become a dark, indefinite brown, but the remainder of the pelage retains its colors practically unaltered.

SCIURUS TENUIS Horsfield.

1824. *Sciurus tenuis* HORSFIELD, Zoölogical Researches in Java and the neighboring Islands. (Pages not numbered.) Type from Singapore.

Specimens of this squirrel indistinguishable from topotypes were taken on the following islands:

Linga; one adult female.

Anambas; Pulo Siantan, nine specimens of both sexes; Pulo Mobur, one adult male; Pulo Jimaja, one adult female.

Tioman; one adult male.

SCIURUS NOTATUS Boddaert.

1785. *Sciurus notatus* BODDAERT, "Elenchus Mammalium, p. 119."

Four females collected on Linga Island, July 9-21, agree in all respects with the form of *Sciurus notatus* occurring at Singapore. Whether this is true *notatus* cannot now be determined.

SCIURUS TENUIROSTRIS sp. nov.

Type.—Adult female (skin and skull). No. 101753 United States National Museum. From Tioman Island. Collected September 30, 1899.

Characters.—Externally similar to *Sciurus notatus* from Singapore. Skull with rostral portion more slender and lightly built than in the continental forms.

Color.—Entire dorsal surface of head and body a fine grizzle of black and yellowish wood-brown, the individual hairs black with two or often three brown rings. The wood-brown is (at the surface) everywhere in excess of the black. Cheeks, outer surface of legs and upper surface of feet dull cinnamon, faintly grizzled. Underparts and inner side of legs orange-rufous, brightest posteriorly (where it closely agrees with Ridgway's figure), considerably paler on chest, throat and inner side of front legs. On sides the color of belly is separated from that of back by two longitudinal stripes extending from just behind axilla to flank, the lower black, the upper buff. Though the width of the stripes is somewhat variable, that of the black is usually about 10 mm., that of the buff slightly less. Dorsal surface of tail like back but less finely grizzled, each hair with five or six brown rings alternating with similar areas of black. Ventral surface even less finely grizzled and the brown distinctly tinged with cinnamon like that of flanks. Pencil in no way different from rest of tail. Whiskers black.

Skull.—The entire skull of *Sciurus tenuirostris* (fig. 13, c) is narrower than that of *S. notatus* from Singapore (fig. 13, a), but the difference is most strikingly apparent in the rostrum. The greatest width

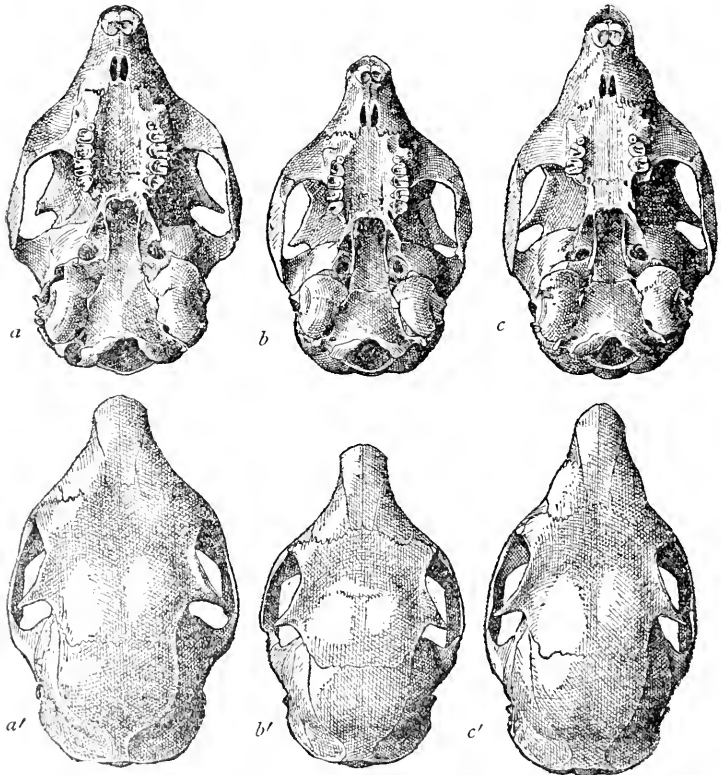


FIG. 13. a *Sciurus notatus*. b *S. klossi*. c *S. tenuirostris*. Natural size.

of both nasals together is more than half of nasal length in *S. notatus*, while in *S. tenuirostris* it is contained in nasal length nearly two and one-half times. Viewed from beneath the sides of the rostrum are seen to be much more contracted in *S. tenuirostris*, so that a distinct ridge extends from incisive foramina to henselion. The palate also is much narrower than in *S. notatus*. Teeth as in *S. notatus*.

Measurements.—External measurements of type: total length 356; head and body 191; tail vertebrae 165; pencil 50; hind foot 42 (40.4). A second specimen (♀ No. 101754): total length 362; head and body 191; tail vertebrae 171; pencil 55; hind foot 43 (41).

Cranial measurements of type: greatest length 50 (51)¹ basal length

¹ Measurements in parenthesis are those of an adult female *Sciurus notatus* from Singapore.

41.6 (43.6); basilar length 39 (40); palatal length 21.6 (22); diastema 11.6 (11.6); length of nasals 15.6 (15); breadth of nasals anteriorly 6 (7.8); breadth of nasals posteriorly 3 (4); interorbital breadth 17.4 (18); breadth between tips of postorbital processes 26 (28); zygomatic breadth 28 (31); mastoid breadth 20.4 (22); breadth of palate between premolars 5.6 (6.4); depth of rostrum at posterior extremity of nasals 11.8 (13); mandible 30 (29.6); depth of mandible at posterior root of large premolar 7 (8); maxillary tooth-row (alveoli) — (9.6); breadth across both upper incisors together at rim of alveoli 4 (5); mandibular toothrow (alveoli) — (9).

Specimens examined.—Two, both from the type locality.

Remarks.—The peculiarities of the skull characterize *Sciurus tenuirostris* as a strongly marked local form of the *S. notatus* group.

SCIURUS ANAMBENSIS sp. nov.

Type.—Adult female (skin and skull). No. 101686 United States National Museum. From Pulo Siantan, Anambas Islands. Collected September 12, 1899.

Characters.—Like *Sciurus notatus* from Singapore but slightly smaller; color, particularly on underparts, paler. Skull similar to that of *S. notatus* (though in some respects resembling that of *S. tenuirostris*) but somewhat smaller and with distinctly narrower palate.

Color.—Upperparts and tail as in *Sciurus notatus* and *S. tenuirostris*, but slightly paler, the difference easily perceptible on comparison but impossible to define in words. Underparts orange-rufous, but everywhere much paler than in Ridgway's figure and on the throat and inner side of front legs fading to ochraceous-buff. Outer surface of legs scarcely if at all tinged with cinnamon. Cheeks, chin, and sides of neck wood-brown. Otherwise as in *S. notatus*.

Skull.—The skull of *Sciurus anambensis*, except for its slightly smaller size, closely resembles that of *S. notatus* from Singapore. The nasals are exactly as in this species, and do not in the least suggest those of *S. tenuirostris*. On the other hand the palate is nearly as narrow as in the Tioman species, while the rostrum when viewed from below has nearly the same form as in the latter. *Audital bullæ* slightly larger than in *S. notatus* and *S. tenuirostris*. When viewed from behind (the skull held upside down) they appear to rise higher and more abruptly above level of basioccipital than in the related species. Teeth in no way peculiar.

Measurements.—External measurements of type: total length 369;

head and body 191; tail vertebræ 178; pencil 70; hind foot 44 (40.4). Average of five specimens from the type locality: total length 367 (355-375); head and body 194 (184-210); tail vertebræ 176 (171-178); hind foot 46.6 (44-49); hind foot without claws 43.6 (42-45.4). Average of five specimens from Pulo Jimaja, Anambas: total length 368 (356-381); head and body 199 (197-203); tail vertebræ 169 (165-178); hind foot 47.1 (45-48); hind foot without claws 44 (42-45). An adult female from Pulo Mata, Anambas: total length 368; head and body 203; tail vertebræ 165; hind foot 48 (44). An adult male from Pulo Riabu, Anambas: total length 362; head and body 191; tail vertebræ 171; hind foot 47 (43.6).

Cranial measurements of type: greatest length 49.6; basal length 41.4; basilar length 39; palatal length 21.4; diastema 11; length of nasals 14.4; breadth of nasals anteriorly 7; breadth of nasals posteriorly 4.2; interorbital breadth 17.4; breadth between tips of post-orbital processes 26; zygomatic breadth 29; mastoid breadth 20; breadth of palate between premolars 6.2; depth of rostrum at posterior extremity of nasals 11; mandible 29; depth of mandible at posterior root of large premolar 7; maxillary toothrow (alveoli) 9; breadth across both upper incisors at rim of alveoli 4; mandibular toothrow (alveoli) 9.

Specimens examined.—Fifteen, from the following islands of the Anambas group: Pulo Siantan, 6; Pulo Jimaja, 6; Pulo Mata, 2; Pulo Riabu, 1.

Remarks.—The plantain squirrel of the Anambas Islands is readily distinguishable from other members of the *Sciurus notatus* group, though no one of its characters alone is very striking. Specimens from the different islands agree closely with each other, the one from Pulo Riabu excepted. This differs from the others in a marked reduction in the size of the audital bullæ, in this respect approaching the Tambelan species. In other respects this specimen is typical.

SCIURUS ABBOTTII sp. nov.

Type.—Adult female (skin and skull). No. 101662 United States National Museum. From Big Tambelan Island. Collected August 10, 1899.

Characters.—Similar to *Sciurus anambensis* but skull with more slender rostrum and smaller, less inflated audital bullæ.

Color.—The color of *Sciurus abbottii* agrees so closely with that of *S. anambensis* that no detailed description is necessary. In many of the specimens there is a distinct sprinkling of grayish hairs in tawny of underparts, especially in region bordering the dark lateral stripe.

Skull.—Skull much like that of *Sciurus anambensis* in size and general form. The rostrum is more slender, particularly when viewed from below, and the audital bullæ are noticeably different in form. The bullæ are so flattened that when viewed from behind (the skull held upside down) they appear to rise scarcely above level of tips of hamulars. Each is constricted near middle by a groove extending from just behind the lateral process of basioccipital over ventral ridge of bulla and disappearing on outer side. This groove, faintly indicated in the related species, is here so greatly developed as strongly to affect the shape of the bullæ, particularly when viewed from the side.

Measurements.—External measurements of type: total length 375; head and body 197; tail vertebræ 178; pencil 60; hind foot 46 (41). Average of six specimens from the type locality: total length 373 (361–394); head and body 200 (197–203); tail vertebræ 177 (158–191); hind foot 45.2 (43–47); hind foot without claws 41.2 (40–44). Average of four specimens from Puló Bunoa, Tambelans: total length 369 (362–382); head and body 197 (184–210); tail vertebræ 171 (158–191); hind foot 44.7 (44–46.4); hind foot without claws 41.6 (40–43).

The skull is so nearly like that of *Sciurus anambensis* in size that it is unnecessary to give detailed cranial measurements. Greatest length 49; length of nasals 16; greatest breadth of both nasals together 6.6; width of palate between premolars 6.

Specimens examined.—Fourteen; ten from Big Tambelan Island, four from Pulo Bunoa.

Remarks.—This is another well marked local form of the *Sciurus notatus* group. Specimens from Big Tambelan Island and Pulo Bunoa do not differ appreciably from each other.

SCIURUS KLOSSII¹ sp. nov.

Type.—Adult male (skin and skull). No. 101678 United States National Museum. From Kaju Ara or Saddle Island, Tambelan group. Collected August 15, 1899.

Characters.—A small, blue-bellied member of the *Sciurus notatus* group, somewhat closely resembling the Bornean *S. orestes* (Thomas), but differing in much duller, more fulvous coloration. Tail with clear black pencil.

Color.—General appearance of upperparts as in *Sciurus anambensis* and *S. abbottii* but light rings on hairs of tail broader and paler, in some specimens producing indistinct cross-bars, and *pencil always*

¹ At Dr. Abbott's request this species is named after Mr. C. B. Kloss.

clear black, without grizzling. Outer surface of hind legs like back, that of front legs encroached upon by the bluish gray of inner surface. Feet slightly more yellow than back, and much more finely grizzled. *Cheeks, chin, muzzle and sides of neck dull ochraceous*, in strong contrast with color of back. Pale lateral stripe *dull ochraceous buff, very slightly different from color of cheeks*. Dark lateral stripe of the usual breadth, but hardly as long as in the related red-bellied species. Ears intermediate in color between cheeks and back. *No light area behind ear*, the hairs in this region colored like those of cheeks, but without grizzling. Underparts and inner surface of legs light gray (very nearly Ridgway's Pl. II, No. 9), slightly grizzled with ochraceous along median line and everywhere irregularly dulled by the appearance at the surface of the slate gray bases of the hairs. Under surface of tail more ochraceous than upper surface, coarsely grizzled, and not showing as strong a tendency to faint cross-barring.

Skull.—The skull of *Sciurus klossii* (fig. 13, *b*) is essentially a miniature of that of *S. notatus* from Singapore. It is, however, broader relatively to its length. Teeth as in *S. notatus*, due allowance being made for difference in size.

Measurements.—External measurements of type: total length 323; head and body 171; tail vertebrae 152; pencil 70; hind foot 41 (38). Average of six specimens from the type locality: total length 320 (310–330); head and body 176 (171–184); tail vertebrae 147 (140–152); hind foot 40 (38–41.6); hind foot without claws 37.1 (35–39).

Cranial measurements of type: greatest length 42; basal length 36; basilar length 33.4; palatal length 17.4; diastema 9.8; length of nasals 12; breadth of nasals anteriorly 6; breadth of nasals posteriorly 3; interorbital breadth 16; breadth between tips of postorbital processes 22.6; zygomatic breadth 26.6; mastoid breadth 19; breadth of palate between premolars 6; depth of rostrum at posterior extremity of nasals 10; mandible 25; depth of mandible at posterior root of large premolar 6; maxillary toothrow (alveoli) 8; breadth across both upper incisors at rim of alveoli 4; mandibular toothrow (alveoli) 7.6.

Specimens examined.—Nine, all from the type locality.

Remarks.—By its small size *Sciurus klossii* is separated from all the other blue-bellied members of the *S. notatus* group except *S. orestes*. I have seen no specimens of this animal, but the original description shows that it differs from the Saddle Island species in several important details of coloration, chief among which are the less fulvous cheeks,¹ white patch behind each ear, and "white"² lateral stripe.

¹ "Cheeks and sides of muzzle less fulvous than back, instead of more so."

² "Sides with the usual lines of black and white."

TRAGULUS NAPU (F. Cuvier).

1822. *Moschus napu* F. CUVIER, Histoire Naturelle des Mammifères, iv, livr. 37. November, 1822. (Sumatra.)

One specimen (an old female with much worn teeth) of a large *Tragulus* was taken on Linga Island on July 23. It is probably identical with the *T. napu* of F. Cuvier, the type of which was collected in Sumatra. In color it is more yellow than the specimens described by Cuvier, though not approaching the red tints of the Tioman form. It measures as follows: head and body 533 (tail lacking); hind foot 120 (105); ear from meatus 34; ear from crown 30; width of ear 22. Skull: greatest length 114; basal length 106; basilar length 99; occipito-nasal length 104; length of nasals 34; breadth of nasals anteriorly 9; breadth of nasals posteriorly 11; median length of bony palate (measured from tip of premaxillary) 72; width of palate between anterior premolars 17; width between posterior molars 21; diastema 15; zygomatic breadth 48; least interorbital breadth 30; breadth between outer edges of paroccipital processes 32; greatest length of audital bulla 23.4; greatest width of audital bulla 13.4; distance between anterior extremities of audital bullæ 11; least distance between audital bullæ 6.8; depth from parietal to lower edge of audital bulla 38; depth from upper rim of orbit to alveolus of last molar 34.4; depth of rostrum at middle of diastema 18; mandible 90; maxillary toothrow (alveoli) 34; mandibular toothrow (alveoli) 39.6.

TRAGULUS RUFULUS sp. nov.

Type.—Young adult¹ male (skin and skull). No. 101767 United States National Museum. From Tioman Island. Collected September 30, 1899.

Characters.—Related to *Tragulus napu* but smaller and more brightly colored; middle permanent upper premolar with inner root nearly opposite posterior outer root, and whole form of crown proportionally altered.

Color.—Upper parts bright tawny red, closely approaching the orange-rufous of Ridgway on back, rump, tail, and outer side of thighs, slightly paler on cheeks, neck and outer side of front legs, duller on crown and face. Sides fading to ochraceous-buff. Except on neck and legs the hairs of this tawny area are everywhere tipped with black, which produces a distinct but irregular clouding

¹ Permanent dentition fully in place but practically unworn.

effect. Underparts (except throat) and inner side of legs to heel white. A dusky shade along median line of belly. Throat like neck, but with a narrow white median stripe, and on each side a well developed white lateral stripe. A white patch beneath each jaw. Tail white beneath and at tip. Ears and naked parts of muzzle, face and legs blackish in dried specimen. Hoofs horn color.

Skull.—The skull is essentially similar to that of the specimen of *T. napu* from Linga Island.

Teeth.—Teeth as in *Tragulus napu* with the exception of the middle upper premolar of the permanent dentition. In this the inner root is equidistant from each of the outer roots, with the posterior of which it is nearly in line. The bases of the three roots therefore stand at the corners of a nearly equilateral triangle. The resulting form of the crown is quite different from that in the other large species of the genus.

Measurements.—External measurements of type: total length 534; head and body 464; tail vertebræ 70; pencil 30; hind foot 120 (107); ear from meatus 31; ear from crown 27; width of ear 21.

Cranial measurements of type: greatest length 104; basal length 97; basilar length 91; occipito-nasal length, 96; length of nasals 29; breadth of nasals anteriorly 9; breadth of nasals posteriorly 11; median length of bony palate (measured from tip of premaxillary) 64; width of palate between anterior premolars 14; width between posterior molars 15; diastema 9; zygomatic breadth 46; least interorbital breadth 26.4; breadth between outer edges of paroccipital processes 28; greatest length of audital bulla 20.4; greatest width of audital bulla 12; distance between anterior extremities of audital bullæ 10; least distance between audital bullæ 6.8; depth from parietal to lower edge of audital bulla 38; depth from upper rim of orbit to alveolus of last molar 32; depth of rostrum at middle of diastema 18.6; mandible 81; maxillary toothrow (alveoli) 37; mandibular toothrow (alveoli) 42.

Remarks.—This is an insular form of the *napu* characterized by its rich, bright, color, and by the peculiar form of the middle upper premolar. It is doubtless confined to Tioman Island.

PARADOXURUS HERMAPHRODITUS (Schreber).

1778. *Viverra hermaphrodita* SCHREBER, Säugethiere, III, p. 426. ('Barbary.')

One specimen, an adult female, with much worn teeth was secured on Tioman Island, October 2, 1899. Its measurements are as follows:

total length 914; head and body 495; tail vertebræ 419; hind foot 76 (71). The fur is much paler in color than specimens from Trong, Lower Siam, and the stripes on the back show a strong tendency to break up into rows of spots. Skull of same size as in Trong specimens, but audital bullæ slightly less inflated, and paroccipital processes shorter and broader. Teeth too much worn to show any characters.

TUPAIA TANA Raffles.

1822. *Tupaia tana* RAFFLES, Trans. Linn. Soc. London, XIII, p. 257. (Sumatra.)

One specimen of this species, an adult male (No. 101597) was taken on Linga Island, July 16, 1899. Its measurements are: total length 324; head and body 191; tail vertebræ 133; pencil 25; hind foot 41 (37).

TUPAIA BUNOÆ sp. nov.

Type.—Adult female (skin and skull). No. 101640 United States National Museum. From Pulo Bunoa, Tambelan Islands. Collected August 5, 1899.

Characters.—Externally similar to *Tupaia tana* but fulvous of underparts, and especially that of under side of tail paler. Skull with broader antorbital region and larger, more inflated audital bullæ than in *T. tana*.

Color.—Back behind shoulders glossy seal-brown, the shorter hairs narrowly ringed with orange-rufous subterminally and thus producing an inconspicuous grizzle better defined in some lights than in others. On sides and outer surface of legs the brown gradually gives way to the orange rufous, but nowhere entirely disappears. Head, nape, and shoulders a fine grizzle of sepia and yellowish white, the grizzled area narrowing posteriorly and extending back in median line slightly behind shoulders. It is traversed by a median seal-brown line about 3 mm. in width, extending nape to dark area of back. Immediately over each shoulder is a faintly defined oblique pale stripe. Entire ventral surface of body and inner side of legs ochraceous, fading to ochraceous-buff on throat and chin and becoming somewhat darker and more dull (nearly clay color) on inner side of hind legs. Tail ferruginous throughout, the dorsal surface strongly washed with seal brown, especially near base. Feet, ears, and muzzle dull brown. The fur of the body is everywhere slate gray at base, less noticeably so below than above.

Skull.—The skull of *Tupaia bunoæ* closely resembles that of *T. tana* from Linga Island but is slightly larger and has a distinctly less

attenuate rostrum. The suborbital vacuity is wider than in the Linga animal. Audital bullæ larger and more inflated than in *T. tana* and less distinctly triangular in outline.

Teeth.—The teeth are as in *Tupaia tana* from Linga Island. First and second upper molars with small but distinct hypocone.

Measurements.—External measurements of type: total length 362; head and body 210; tail vertebræ 152; pencil 35; hind foot 45 (42). Average of three specimens from the type locality: total length 349 (330–362); head and body 197 (178–210); tail vertebræ 152; hind foot 44.4 (43.4–45); hind foot without claws 41.3 (40–42).

Cranial measurements of type: greatest length 57.6 (54.6);¹ basal length 53 (50.4); basilar length 50 (47); median palatal length 32 (30.6); length of nasals (posterior extremity not clearly determinable) 21 (20.4); distance from lachrymal notch to a tip of premaxillary 28.4 (27.6); diastema 6 (5.6); width of palate at middle of diastema 5.2 (4.6); width of palate between anterior molars 9 (8.8); lachrymal breadth 19.8 (19); breadth of both nasals together at middle 3.6 (3); breadth of rostrum at middle of diastema 6 (5.4); least interorbital breadth 15 (14.4); zygomatic breadth 25.4 (25); breadth of braincase above roots of zygomata 19.6 (19); occipital depth 12.8 (13); depth from middle of parietal to lower surface of audital bulla 18 (18); depth of rostrum at base of nasals 6.6 (6); depth of rostrum at middle of diastema 4.6 (5); mandible 39 (36); maxillary toothrow (behind diastema) 20 (19); mandibular toothrow (behind diastema) 17 (16.4).

Specimens examined.—Four: three from Pulo Bunoa, one from Big Tambelan Island.

Remarks.—The specimen from Big Tambelan agrees in all respects with those from Bunoa. Its hind foot measures 44 (41) mm. Tail imperfect. In color *Tupaia bunoa* is very constant, the four specimens showing practically no individual variation. The under side of the tail in *Tupaia tana* is a very deep ferruginous, approaching chestnut, while the ventral surface of the body is rich tawny ochraceous.

TUPAIA MALACCANA Anderson.

1879. *Tupaia malaccana* Anderson, Anat. and Zool. Researches, p. 134. ('Malacca.')

Three specimens from Linga Island agree in all essential characters with those given in the original description of this species, though the color of the underparts appears to be darker and that of the lower side

¹ Measurements in parenthesis are those of the specimen of *Tupaia tana* from Linga Island.

of the tail lighter than indicated by Anderson's account. Average measurements of the three individuals: total length 302 (298-305);

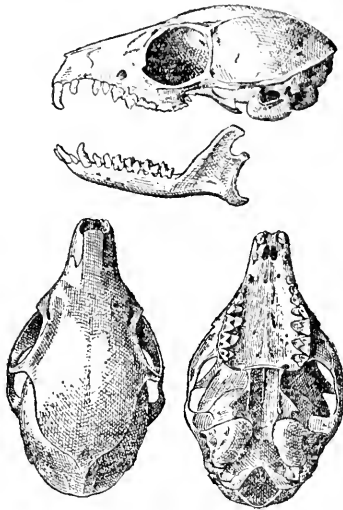


FIG. 14. *Tupaia malaccana*. Natural size.

head and body 138 (133-140); tail vertebræ 165; hind foot with claws 33.7 (32-34); hind foot without claws 31.5 (30-32.4).

TUPAIA SORDIDA sp. nov.

Type, adult male (skin and skull). No. 101747 United States National Museum. From Tioman Island. Collected October 2, 1899.

Characters.—Very similar to *Tupaia ferruginea* but slightly smaller, and color of flanks and underparts darker and less yellow. Skull shorter and broader than in *T. ferruginea*, but with distinctly narrower bony palate.

Color.—The color is so closely similar to that of *Tupaia ferruginea* that no detailed description is necessary. Underparts dull brownish buff, not very different from lower side of tail, slightly more yellow along middle of throat. Flanks somewhat darker and browner than in *T. ferruginea*.

Skull.—The skull of *Tupaia sordida* differs from that of *T. ferruginea* in slightly shorter rostrum, distinctly broader, less elongate braincase, broader frontal region and narrower palate; this last character in direct contradiction to the general features of the skull.

Teeth.—The teeth do not differ appreciably from those of *Tupaia ferruginea*.

Measurements.—External measurements of type: total length 336; head and body 171; tail vertebræ 165; pencil 25; hind foot 41 (38.8). External measurements of an adult female from the type locality: total length 318; head and body 178; tail vertebræ 140; pencil 20; hind foot 40 (37.6).

Cranial measurements of type: greatest length 49.6 (49.4)¹; basal length 46 (45.6); basilar length 43 (42.4); median palatal length 27 (25); length of nasals (posterior extremity not clearly determinable) 15.4 (—); distance from lachrymal notch to tip of premaxillary 22 (19); diastema 4 (3.6); width of palate between anterior molars 8 (9.4); lachrymal breadth 19 (17.4); breadth of rostrum at middle of diastema 7 (6.8); least interorbital breadth 15.4 (14); zygomatic breadth 25.4 (25); breadth of braincase above roots of zygomata 19.4 (18.8); least distance from inion to rim of orbit 21 (23); occipital depth 12 (13); depth from middle of parietal to lower surface of audital bulla 17.2 (17); depth of rostrum at base of nasals 7 (7.8); depth of rostrum at middle of diastema 5 (5.4); mandible 33.4 (32.6); maxillary toothrow (behind diastema) 15 (17); mandibular toothrow (behind diastema) 13 (13.6).

Specimens examined.—Two, both from the type locality.

Remarks.—*Tupaia sordida* differs from its mainland representative to about the same degree as the other insular members of the Tioman fauna.

TUPAIA CHRYSOMALLA sp. nov.

Type, adult female (skin and skull). No. 101710 United States National Museum. From Pulo Siantan, Anambas Islands, collected August 24, 1899.

Characters.—Size, proportions, and cranial characters as in *Tupaia ferruginea*. Color as in *T. ferruginea* except that shoulder stripes are even more indistinct. The back is tinged with dull ferruginous and the whole tail is suffused with golden yellowish brown which forms a clear band on under surface.

Color.—Summer pelage: back, sides, and outer surface of legs a fine grizzle of ferruginous and seal-brown, the former predominating, particularly in region between shoulders, the latter most conspicuous on legs. Head essentially like back but more finely grizzled and slightly tinged with gray. Underparts and inner side of legs dull

¹ Measurements in parenthesis are those of an adult male *Tupaia ferruginea* from Trong, Lower Siam.

grizzled tawny-olive, buff tinged on chest. Feet and ears seal brown, faintly grizzled. Shoulder stripes ill defined, dull ochraceous. Tail glossy seal-brown above, irregularly lightened and grizzled, especially through terminal half, by the appearance at surface of the light basal portion of the hairs. The basal portion of the hairs of the entire tail is a bright golden yellowish brown. Above this color is mostly hidden by the seal-brown tips, but beneath it forms a broad, clear area extending from base to and including pencil, and only a little darkened along extreme edge. Short hairs of under surface of tail less yellow than others, slightly grizzled with brown. Autumn pelage similar to summer coat but paler, the ferruginous of the back and sides replaced by ochraceous. The new coat first appears on shoulders and head, gradually extending backward and producing peculiar contrasts with the darker and brighter summer pelage.

Skull.—The skull of *Tupaia chrysomalla* so closely resembles that of specimens of *T. ferruginea* from Trong, Lower Siam, that I can see no characters to distinguish them.

Teeth.—The teeth are exactly as in *Tupaia ferruginea*.

Measurements.—External measurements of type: total length 330; head and body 178; tail vertebræ 152; pencil 30; hind foot 43 (40). Average of three specimens from Pulo Jimaja: total length 315 (305–330); head and body 180 (171–191); tail vertebræ 146 (140–152); hind foot 42.5 (42–43); hind foot without claws 41.

Specimens examined.—Four: one from Pulo Siantan, the others from Pulo Jimaja.

Remarks.—Except for the differences due to pelage, the four specimens are very uniform in color. The yellow of the tail is occasionally darker than in the type, approaching tawny-ochraceous, but never tinged with red. Under surface of tail never grizzled as in *T. palawanensis*.

MAGADERMA SPASMA (Linnæus).

1758. [*Vespertilio*] *spasma* LINNÆUS, Systema Naturæ I, 10th ed., p. 32. (Asia.)

Six specimens, two of which are skins, were collected on Pulo Bunoa, Tambelan Islands, August 5–7, and one on Big Tambelan Island. The color is faintly darker than in specimens from Trong, Lower Siam; but in size as well as in cranial and dental characters the insular bats show no peculiarities.

HIPPOSIDEROS BARBENSIS sp. nov.

Type.—Adult male (skin and skull). No. 101625 United States National Museum. From Ste. Barbe Island. Collected August 1, 1899.

Characters.—Like specimens of *Hipposideros larvatus* from Trong, Lower Siam, but smaller in size and duller in color.

Color.—Back dark hair-brown, the hairs yellowish drab-gray through basal two-thirds, the extreme tips wood-brown. On shoulders and head the hair-brown disappears, giving place on the former to the drab-gray and on the latter to the wood-brown. Entire underparts rather light and dull wood-brown, the extreme bases of the hairs tinged with slaty. Ears and membranes blackish. Immature specimens are less yellowish than the adults, but are otherwise similar.

Skull.—The skull of *Hipposideros barbensis* is throughout slightly smaller than that of mainland specimens of *H. larvatus*. Its form is peculiar in the shortness and relative breadth of the braincase; but in all structural details it closely agrees with that of the Siamese animal. Interpterygoid space shorter and relatively broader than in *H. larvatus*.

Teeth.—The teeth are slightly smaller than those of *Hipposideros larvatus*, but in form they show no peculiarities. In one specimen there is on the right mandible a minute premolar wedged between the two normally present.

Measurements.—For external measurements see table, page 240.

Cranial measurements of type: greatest length 21 (23);¹ basal length 18.2 (20); basilar length 16.2 (17.8); zygomatic breadth 12.4 (13); least interorbital breadth 3 (3.4); mastoid breadth 10.6 (11); greatest length of braincase 12 (14); greatest breadth of braincase above roots of zygomata 8.6 (9.6); frontopalatal depth (at middle of molar series) 4 (4); depth of braincase 6.4 (6.4); maxillary tooththrow (exclusive of incisor) 8.2 (9); mandible 14.4 (15); mandibular tooththrow (exclusive of incisors) 9 (9.8).

Specimens examined.—Five, all from the type locality.

Remarks.—By its dull color and small size this species is readily separable from its mainland representative, though in all details of structure and form the two animals are scarcely distinguished.

? RHINOLOPHUS ROUXII Temminck.

1835. *Rhinolophus rouxii* TEMMINCK, Monographies de Mammalogie, II (Huitieme Monographie), p. 30 b. Type locality, Calcutta.

1892. *Rhinolophus affinis rouxii* THOMAS, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, X, p. 923.

A bat in formalin, collected on Pulo Siantan, Anambas Islands, during September is apparently referable to the species recorded from

¹Measurements in parenthesis are those of an adult female *Hipposideros larvatus* from Trong, Lower Siam.

Burmah by Thomas, under the name *Rhinolophus affinis rouxi*. In size it agrees with the measurements of the Burman specimens; while the ridge beneath the free margin of the noseleaf is much more developed than in *Rhinolophus affinis*, and might readily be described as a supplemental leaflet. Without further material it is impossible to decide whether the island species is identical with that from the peninsula, or whether either is the same as the animal described by Temminck. That all three are closely allied there can be no doubt.

RHINOLOPHUS MINUTUS sp. nov.

Type.—Adult male (in alcohol). No. 101715 United States National Museum, Pulo Siantan, Anambas Islands, September, 1899.

Characters.—Similar to *Rhinolophus minor* Horsfield, but with shorter ear and tibia. First lower premolar in contact with third.

Color.—General color broccoli-brown, somewhat lighter below than above, the hairs everywhere with glossy pale tips, these most noticeable on underparts. Ears and membranes blackish brown.

Skull and teeth.—The skull is smaller than that of a specimen of *Rhinolophus minor* from the mainland of India, and the braincase is more narrow, but otherwise no important differences are apparent. Teeth as in *R. minor*, but first and third lower premolars strongly in contact, the second, therefore, wholly external to the tooth row.

Measurements.—For external measurements of *Rhinolophus minutus* see table, page 240.

Cranial measurements: greatest length 15; basal length 13.4; basilar length 11.8; zygomatic breadth 7.8; least interorbital breadth 2; mastoid breadth 7.8; greatest length of braincase 9.6; greatest breadth of braincase above roots of zygomata 6.8; frontopalatal depth (at middle of molar series) 3; depth of braincase 5; maxillary tooth-row (exclusive of incisors) 6.2; mandible 10.2; mandibular tooth-row (exclusive of incisor) 6.4.

Specimens examined.—Two (both in alcohol): one from Pulo Siantan, the other without definite locality.

Remarks.—Although this species is closely related to *Rhinolophus minor* its differently proportioned leg and foot appear to present sufficient reason for its recognition as a local form. The measurements of the type as given by Dobson show that *Rhinolophus minor* from Java (the type locality) agrees in proportions with specimens from the mainland.

EMBALLONURA ANAMBENSIS sp. nov.

Type, adult female (in alcohol). No. 101716 United States National Museum, Pulo Mobur, Anambas Islands, August 26, 1899.

Characters.—Similar to *Emballonura peninsularis* Miller¹ from Trong, Lower Siam, and *E. discolor* Peters from the Philippine Islands, but with fur nowhere whitish at base. Skull more slender than that of *E. peninsularis*.

Color.—General color above sepia, the hairs darkening nearly to seal-brown through terminal fourth, and becoming broccoli-brown at base. Beneath broccoli-brown tinged with drab, the extreme bases of the hairs slightly paler.

Skull.—The skull of *Emballonura anambensis* (fig. 15, a) differs from that of *E. peninsularis* (fig. 15, b) in its much more slender

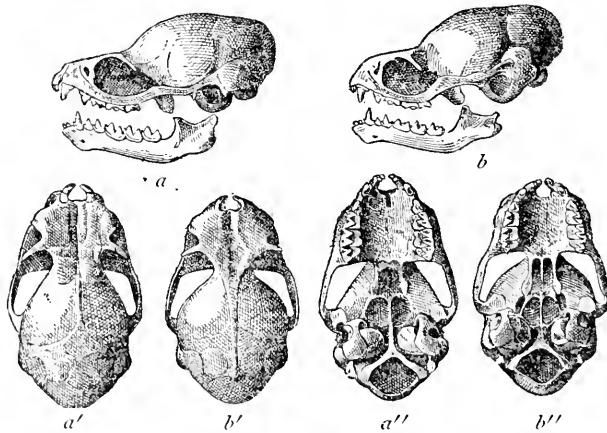


FIG. 15. a *Emballonura anambensis*. b *E. peninsularis*. Twice natural size.

general form. This is particularly noticeable in the braincase, but is visible in the rostral portion also. Viewed from the side and from below the differences are less apparent.

Teeth.—The teeth, though similar in form to those of *Emballonura peninsularis*, are smaller throughout, particularly the molars of the lower jaw.

Measurements.—For external measurements of *Emballonura anambensis*, see table, page 240.

Cranial measurements of type: greatest length 15; basal length 13.2; basilar length 11.4; greatest antorbital breadth 6; least interor-

¹ Proc. Acad. Nat. Sci., Philadelphia, 1898, p. 324.

bital breadth 3.4; zygomatic breadth 8.8; mastoid breadth 7.4; greatest length of braincase 9.6; greatest width of braincase above roots of zygomata 7; depth of braincase 5.6; frontopalatal depth (at middle of molar series) 1.8; maxillary toothrow (exclusive of incisors) 5.6; mandible 10.2; mandibular toothrow (exclusive of incisors) 5.8.

Specimens examined.—Four (in alcohol): two each from Pulo Mobur and Pulo Siantan, Anambas Islands.

Remarks.—*Emballonura anambensis* is a member of the group of large species containing *E. discolor* and *E. peninsularis*. From both of these it differs in the absence of the whitish bases of the hairs, while from the latter it is further distinguished by the form of the skull. Together with *E. peninsularis* it differs from *E. semicaudata*, the type of which is still extant in the collection of the United States National Museum, in the nearly parallel sides of the tragus.

PTEROPUS VAMPYRUS Linnaeus.

1758. [*Vespertilio*] *vampyrus* LINNÆUS, Systema Naturæ, 1, 10th ed., p. 31. (Asia.)

Eight specimens from Linga Island, July 19, 20, and 21. These appear to differ little if any from a skin secured in Java by Mr. D. G. Fairchild.

PTEROPUS LEPIDUS sp. nov.

Type.—Adult female (skin and skull). No. 101670 United States National Museum. From Kaju Ara, or Saddle Island, Tambelan Islands. Collected August 15, 1899.

Characters.—Similar to *Pteropus condorensis* Peters from Pulo Condor, off the coast of Lower Cochin China, but quite different in color; the shining light gray back sharply contrasted with the dark reddish brown or blackish brown shoulders and neck.

Fur.—The fur of the back is silky in texture and closely appressed; the individual hairs about 12 mm. in length. On rump it becomes slightly woolly, but much less so than on other parts of the body. It extends down legs to knee, beyond which a narrow line runs down inner side of tibia to middle. Fur of shoulders, head, neck, and underside of body loose and somewhat woolly in texture, not at all appressed, and therefore appearing much longer than that of back, though the individual hairs are only about 14 mm. in length. It extends on lower side of legs to knees, and on humerus nearly to elbow, also sparsely over lower side of propatagium and on wing membrane along basal half of forearm. Upper surface of membranes naked except for a sprinkling of hairs along forearm.

Color.—Back a mixture of pearl-gray and pale broccoli-brown, the latter predominating posteriorly, the former anteriorly and along edge of wing membranes. The hairs have a distinct silky gloss. Shoulders, neck, chest, and upper side of head chestnut clouded irregularly with seal-brown and fading to light russet on forehead. Cheeks, region behind ears, and whole under side of head and throat seal brown faintly tinged with chestnut, and irregularly sprinkled with glistening

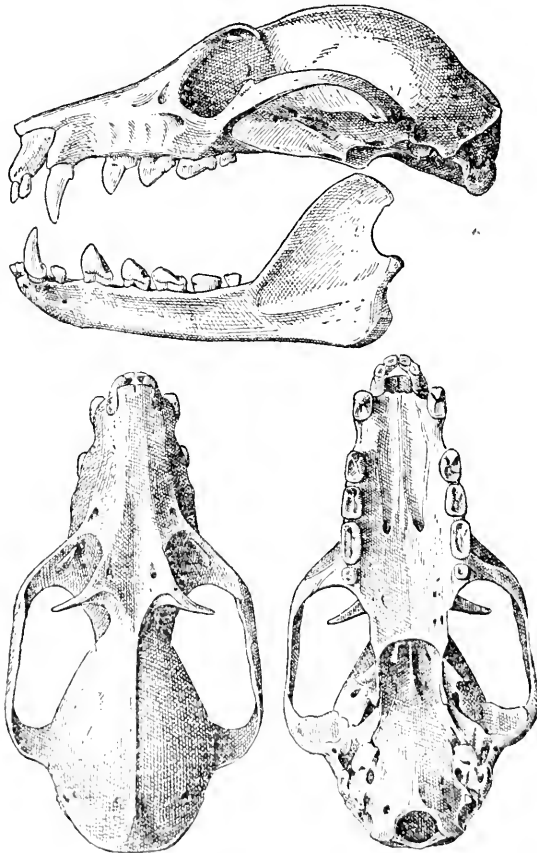


FIG. 16. *Pteropus lefilus*. (Type). Natural size.

silvery hairs. Underparts of body mostly broccoli-brown, irregularly shaded with seal-brown at sides of chest and with an undefined yellowish brown on middle of chest. Ears, membranes, and muzzle blackish. The four individuals show marked variation in color, chiefly through extension of the seal brown areas at the expense of

the chestnut. In one specimen the chestnut is almost hidden by the darker brown, though still visible beneath the surface when the fur is disarranged. Another skin, probably melanistic, is nearly uniform seal-brown throughout, though both chestnut of shoulders and gray of back are still faintly indicated.

Skull and teeth.—The skull and teeth of *Pteropus lepidus* (fig. 16) closely agree with that of *Pteropus condorensis* as figured by Matschie.¹ The palate appears to be narrower and the teeth less robust.

Measurements.—For external measurements of *Pteropus lepidus*, see table, page 240.

Cranial measurements of type: greatest length 64; basal length 60; basilar length 58; median palatal length 36; palatal breadth (between anterior molars) 11.4; zygomatic breadth 33.6; least interorbital breadth in front of postorbital processes 8; least interorbital breadth behind postorbital processes 7; breadth between tips of postorbital processes 21.6; greatest breadth of braincase above roots of zygomata 22.8; greatest depth of braincase 17.8; occipital depth 11.8; depth of rostrum at middle of diastema 8; mandible 50; maxillary toothrow (exclusive of incisors) 25; mandibular toothrow (exclusive of incisors) 27.6; crown of third upper premolar 4.4×3 ; crown of first upper molar 5.6×3 ; crown of first lower molar 4.4×2.4 .

Specimens examined.—Four: one from Saddle Island, the rest from Big Tambelan.

Remarks.—This light bright colored species is evidently a near relative of the sombre *Pteropus condornesis*. It apparently needs no comparison with other species.

SEMNOPIITHECUS MAURUS (Schreber).

1775. *Simia maura* SCHREBER, Säugthiere, 1, pl. XXII B.

One specimen (adult female, No. 101601) taken on Linga Island, July 19, 1899.

MACACUS 'CYNOMOLGUS' Auct.

Two males of this species were taken on Linga Island, July 23, 1899, and another on Tioman Island, October 4. The Linga specimens agree in all respects with those previously collected by Dr. Abbott on the mainland. That from Tioman Island is smaller, but the peculiar condition of the skull shows it to be a dwarfed and abnormal individual.

¹ Die Fledermäuse der Berliner Museums für Naturkunde, pl. 8, fig. 2.

MEASUREMENTS OF BATS FROM ISLANDS OF THE NORTH CHINA SEA.

Name.	Locality.	No.	Sex.	Length.	Tail.	Tibia.	Foot.	Calc.†	Forearm.	First digit.	Second digit.	Third digit.	Fourth digit.	Fifth digit.	Ear from meatus.	Ear from crown.	Width of ear.
<i>Rhinolophus minutus.</i>	Siantan, Anambas.	101715 ¹	♂	58	16.4	14	7.8	10	39	5	27	56	45	47	15.6	13.6	12
" <i>minor.</i>	Lingasuqur, India.	14533	♂	67	19	16	7.4	10	39	6	32	60	51	50	17	14.4	12
<i>Hipposideros barbensis.</i>	Ste. Barbe I.	101625 ¹	♂	78	19.4	19.4	9.8	11	55.4	10	43	78	61	60	18.4	15	16
<i>Emballonura anambensis.</i>	Siantan, Anambas.	101716 ¹	♀	59	13	17	7	13	41	7	36	70	48	45	10.6	10.4	9
" "	" "	101712	♀	58	13.4	17.4	6.4	13	46	7.4	37	75	50	48	11	10.4	10
" "	" "	101713	♀	64	14.4	16	6.6	14	44	6	37	73	50	47	13	11.4	9
<i>Pteropus lepidus.</i>	Saddle I.	101670 ¹	♀	222	—	58	40	13	133	61	103	255	200	175	22	20	14.4
" "	Big Tambelan I.	101649	♀	229	—	63	43	14	135	61	99	260	205	184	24	22	16
" "	" "	101650	♀	216	—	57	41	14	128	59	96	255	200	177	22.4	21	16
" "	" "	101651	♀	222	—	65	43	15	136	62	100	260	207	185	21	19	15

¹Type.

MACACUS PUMILUS sp. nov.

Type.—Adult male (skin and skull). No. 101639 United States National Museum, Pulo Bunoa, Tambelan Islands, August 6, 1899.

Characters.—A dwarf form of *Macacus* '*cynomolgus*.' Colors slightly paler than in specimens from the mainland.

Color.—The color is so nearly like that of the common *Macacus* '*cynomolgus*' of the mainland that no detailed description is necessary. Throughout it is a shade more pale, particularly on the throat, chest, belly, and inner side of thighs.

Skull and teeth.—Except for their smaller size the skull and teeth resemble those of *M.* '*cynomolgus*,' though the palate appears to be broader and less arched. The crowns of the molars are more squarish in outline than those of the mainland animal and the posterior upper tooth is relatively smaller.

Measurements.—External measurements of type: total length 990; head and body 431; tail vertebræ 559; hind foot 120. External measurements of an adult male from Pulo Siantan, Anambas Islands: total length 1003; head and body 470; tail vertebræ 533; hind foot 117.

Cranial measurements of type: greatest length (exclusive of incisors) 110 (123);¹ basal length 83 (92); basilar length 77 (87); least palatal length 37.4 (45); palatal breadth (between front molars) 21.6 (19); zygomatic breadth 77 (81); mastoid breadth 56 (61); greatest breadth of braincase above roots of zygomatics, 53 (53); least breadth of braincase immediately behind orbits 39.4 (39.6); orbital breadth, 59 (64); least distance from orbit to alveolus of inner incisor 36 (43); greatest depth of braincase (exclusive of sagittal crest) 45 (45); mandible 81 (92); greatest depth of ramus 17.8 (21.4); maxillary toothrow (exclusive of incisors) 35.6 (41.4); mandibular toothrow (exclusive of incisors) 41 (46.4); crown of middle upper molar 7×8 (7.8×7.8) crown of middle lower molar 6.8×7 (8×6.8).

Specimens examined.—Four, from the following localities: Pulo Bunoa, Tambelan Islands, 2; Pulo Wai, Tambelan Islands, 1; Pulo Siantan, Anambas Islands, 1.

Remarks.—The small macac of the Tambelan and Anambas islands appears to differ very constantly in size from the large *Macacus* '*cynomolgus*' of the mainland and Linga Island. In color the two animals are essentially alike.

¹ Measurements in parentheses are those of a younger male *M.* '*cynomolgus*' from Trong, Lower Siam.

NOTES ON THE FAUNA OF THE ISLANDS VISITED.

Dr. Abbot writes that in physical characteristics the islands differ from each other very slightly. All are of granite formation and toward the interior are elevated above sea level to a height of about 1,000 to 2,000 feet. Tioman and Linga rise somewhat higher, the former to 3,500 feet, the latter to 4,000 feet. The surface was originally covered with a uniform growth of heavy forest; but clearings have been made on the larger islands, while some of the smaller ones are nearly stripped of the original growth. Cocoanuts and sago are grown in the Anambas and Tambelans.

LINGA ISLAND.

Mus lingensis.—Taken in heavy forest at elevation of about 1000 feet. "Very numerous."

Sciurus tenuis.—"Common."

Sciurus notatus.—"Very common, especially in the cocoanut plantations."

Ratufa sp. ?—"Not met with, but natives said that a large squirrel existed."

Tragulus javanicus?—

Tragulus napu.—

Tragulus sp.—"Two kinds of napu were said by the natives to exist, a small or common kind, of which they brought me a female [*T. napu*], and a large species which they said was confined to the mountain forests and which I did not meet with. The little kanchil was said to be plentiful in the mangroves, but I saw no specimens."

Sus sp.—"A pig was common, especially about the sago plantation. Saw the bed of one on the mountain side at an elevation of 3,000 feet." None taken.

Tupaia tana.—"Only one shot. Saw a few others; all on the mountains and in heavy forest." A specimen is marked "2,000 feet."

Tupaia Malaccensis.—"Common in the plantations. One shot on mountain at 2,000 feet altitude. Generally found in trees."

Pteropus vampyrus.—"Common in the plantations at night. Especially fond of rambutans."

Macacus cynomologus.—"Very common."

Semnopithecus maurus.—"Less common than *Macacus*. I saw it in both lowland jungle and in mangroves; also on the mountains up to about 2,000 feet."

In addition to these species a *Manis* and two small carnivores probably occur. Of the latter Dr. Abbott writes: "Natives said there were two sorts of musangs. One, the larger, which they called tangalunga, was probably *Viverra tangalunga*; the other, a smaller animal may have been *Paradoxurus hermaephroditus*."

PULO TAYA.

"No mammals obtained. Some fishermen who were visiting the island said that squirrels and rats existed. We saw some rats, but no squirrels."

PULO PENGIKI OR STE. BARBE ISLAND.

"The island is about three miles long and one and one-half broad. Covered with heavy forest."

Sciurus mimculus.—"Common, especially near sea shore."

Hipposideros barbensis.—"Very numerous. Flying about the forest all day."

Macacus cynomolgus.—"Common." No specimens taken.

"Mr. Kloss saw a small mammal like a musang, but did not get a shot at it."

TAMBELAN ISLANDS.

PULO BUNOA.

"Contains 4,000 or 5,000 acres. Covered with heavy forest except where a few clearings were being made along the coast."

Mus tambelanicus.—"Rats were common."

Sciurus abbotti.—"A pale variety of *Sciurus notatus* was common."

Tragulus sp.—"Plandok (*Tragulus javanicus*) were said by the natives to be common." None obtained.

Tupaia bunoa.—"Fairly common, especially in low brushwood."

Megaderma spasma.—"A bat (*Megaderma*) was common in some caves and crevices near the shore."

Pteropus lepidus?—"A single *Pteropus* of small size and gray color was seen. It was probably the same as the species afterward obtained on Big Tambelan Island."

Macacus pumilus.—"Common."

"Two small islands, Pulo Gilla and Pulo Selindang, close by, contained only monkeys and rats."

BIG TAMBELAN ISLAND.

Mus tambelanicus—One specimen. No notes.

Sciurus abbottii.—Ten specimens. No notes.

Tragulus sp.—“Plandok said to be very common in the mangroves, but I could get none of them trapped. Of course it is impossible to shoot them.”

Tupaia bunoa.—“Very common.”

Megaderma spasma.—One specimen. No notes.

Pteropus lepidus.—“Three specimens of a small *Pteropus* obtained. All were shot while they hung to the leaves of avvenga palms. The natives said that a large species was also found.”

Macacus pumilus.—“Plentiful and tame.”

PULO WAI.

Mus tambelanicus.—One specimen taken.

Sciurus mimellus.—“Several squirrels seen and a pair shot. They were considerably larger than the similar ones [*S. mimiculus*] obtained on Ste. Barbe Island.”

Macacus pumilus.—“Monkeys were common.”

“Natives said that a *Tupaia* and the variety of *Sciurus notatus* [*S. abbottii*] which we got on Big Tambelan and Bunoa were also on this island, but we saw neither.”

KAJU ARA OR SADDLE ISLAND.

“This island is formed of two hills joined by a ridge. It is about $\frac{1}{2}$ mile long and $\frac{1}{4}$ mile wide.”

Sciurus klossii.—“A small variety of *Sciurus notatus* was very numerous.”

Pteropus lepidus.—“A single *Pteropus*, the same as that taken on Big Tambelan, was shot.”

ANAMBAS ISLANDS.

“Natives said that musanges (*Paradoxurus*) and plandok (*Tragulus*, 2 sp.?) were common on all the islands of the group, but we saw none.”

PULO PILING.

“Saw no mammals except monkeys” [probably *Macacus*].

PULO RIABU.

Sciurus anambensis.—One taken. No notes.

“Saw monkeys, but obtained none.”

PULO SIANTAN.

“The second largest of the group. Contains about 20,000 acres, mostly covered with heavy forest.”

Mus anambæ.—

Mus strepitans.—

Mus siantanicus.—"We trapped rats of several species. They seemed very numerous in individuals."

Sciurus tenuis.—"Common."

Sciurus anambensis.—"Common."

Funambulus castaneus.—"Only one seen."

Tragulus sp.—"One seen."

Tupaia chrysomalla.—"Common."

Rhinolophus rouxi? One specimen. No notes.

Rhinolophus minutus.—One specimen. No notes.

Emballonura anambensis.—Two specimens. No notes.

Nycticebus sp.—"A wretched caged specimen of *Nycticebus* was brought me, but it was in such bad condition that I would not take it. Am sorry I did not, as I never saw another."

Macacus pumilus.—"Common."

PULO MATA AND PULO MOBUR.

"These are large islands lying north of Siantan and separated from it by a narrow strait. On each we saw monkeys, squirrels and tupaïas." Two specimens of *Emballonura anambensis* taken on Pulo Mobur are not mentioned in the field notes.

PULO TELAGA.

"Monkeys and a variety of *Sciurus notatus* seen."

PULO JIMAJA.

"This is the largest island in the group. It probably contains 30,000 acres."

Mus flaviventer.—

Mus anambæ.—

Mus strepitans.—No special notes on the rats obtained.

Ratufa anambæ.—"Fairly common, and frequenting both heavy forest and secondary jungle. Especially plentiful and tame along a small creek (Sungei Maras) which is much used by canoes."

Sciurus tenuis.—"Common."

Sciurus anambensis.—"Common."

Tragulus sp.—"Common."

Tupaia chrysomalla.—"Common."

Nycticebus sp.—"Saw a miserable specimen in captivity."

Macacus pumilus.—"Common."

TIOMAN ISLAND.

Mus vociferans?

Mus tiomanicus.—

Mus obscurus.—No special notes on these three species.

Ratufa tiomanicus.—“Common.”

Sciurus tenuis.—“Common.”

Sciurus tenuirostris.—“Common.”

Tupaia sordida.—“Common.”

Paradoxurus hermaphroditus.—“One obtained.” No detailed notes.

Tragulus rufulus.—“Common. Six specimens were brought in by natives.”

Macacus “*cynomlogus.*”—Common. Natives say there is no other monkey found on the island.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 247-274.

OCTOBER 10, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

III.

MULTIPLICATION OF RAYS AND BILATERAL
SYMMETRY IN THE 20-RAYED STAR-FISH,
PYCNOPODIA HELIANTHOIDES (STIMPSON).

BY WM. E. RITTER AND GULIELMA R. CROCKER.

[Pls. XIII and XIV, figs. 1-13.]

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INTRODUCTION.

HAVING had the good fortune to spend the early summer of 1899 in Alaska, as a member of the scientific staff of the Harriman Alaska Expedition, I was able to collect a fine series of the Pacific coast star-fish (*Pycnopus helianthoides*) which follows the coast northward from central California to southeastern Alaska. At Yakutat Bay, near the northern limit of its range, I found it about the middle of June in greater abundance than I have ever seen it elsewhere.

The reef near the anchorage off the Indian village of Yakutat, a large area of which is exposed at extreme low tide, was everywhere strewn with large specimens, and on the Laminaria, which grows here in great luxuriance, were thousands of young ones of all sizes, from a few millimeters in diameter to practically the full grown state. Observing that the smallest had only six or eight rays, it occurred to me that the study of a complete series of growing animals would probably reveal a law of their multiplication and might possibly also throw light on the important and difficult problem of the axial relations of the adult star to the larva; a problem in which I was deeply interested from my interest in the question of the relationship between the Echinodermata and the Enteropneusta.

I consequently collected and preserved a large number of specimens, the results of the study of which are recorded in the following pages.

W. E. R.

LACK OF KNOWLEDGE REGARDING PRODUCTION OF ACCESSORY RAYS IN MULTIRADIATE STAR-FISHES.

Not much is known about the multiplication of rays in the many-rayed star-fishes. Not only the embryology, but even the early post-larval life of so well known a species as *Asterias tenuispina* are, according to Ludwig, '97,¹ wholly unknown. Here, in a group of approximately one-half the entire number, the rays are, in many specimens, considerably smaller than those of the other half. Whether this is ever due to the addition of new rays during a portion of the early adult life does not seem to be positively known. It is certain, however, from the observations of a number of zoölogists, Ludwig in particular, that in some cases at least, this disparity in size is due to the regeneration of the halves of automatically bisected animals.

It appears to be the belief of most students of asterids that in general the multi-rayed forms begin adult life with the full complement of rays. Thus Perrier, '93, states positively that in all species excepting *Labidiaster radiosus* the number of rays "est constant à partir de la période embryonnaire" (p. 781).

¹ See Bibliography, p. 269.

Brisinga corona has probably been studied more frequently and exhaustively than any other many-rayed species, first of all by G. O. Sars, '75, and last by Ludwig, '97; and these authors agree in the conclusion that the arms are all present from the outset; that, in the words of Ludwig, "ein nachträglicher Einschub von Armen nicht stattfindet."

But there is some evidence that *Heliaster* as well as *Labidiaster* (and *Pycnopodia* also, as we now show) forms an exception to this rule. Rathbun, '87, points out that in *H. cumingii* Gray, while the full number of rays is from thirty-five to thirty-seven, one small specimen examined by him had only twenty-four.

And Leitpoldt, '95, has made essentially the same observation with reference to the same species, but carries the evidence a step farther by the remark that his twenty-four-rayed small specimens "noch zwei sprossende Arme besitzen, so dass eigentlich deren schon 26 vorhanden sind." This last statement not only furnishes almost conclusive proof that in *Heliaster* rays are added until far into adult life (in Leitpoldt's smallest specimen $r = 20$ mm.), but it also makes it probable that they are added in pairs as they are in *Pycnopodia*. Therefore, from the little direct evidence at hand and from the affinities of the genera concerned, we are warranted in believing that *Heliaster* will be found to follow the same law of ray multiplication that prevails in *Pycnopodia*.¹

The only case definitely known, until now, of the multiplication of rays during adult life in star-fish, is, as already mentioned, that of *Labidiaster radius*. In this species Perrier, '88, '91, and '93, has shown: (1) that new rays are added until far into adult life; (2) that as many as six of these may bud from the disc practically simultaneously; and (3) that these may be distributed at rather regular intervals around the entire circumference of the disc.

Our studies on *Pycnopodia* raise a number of interesting questions concerning the ray multiplication in *Labidiaster*: Do

¹There appears to be general agreement among authorities that *Pycnopodia* and *Heliaster* are rather more closely related than are *Heliaster* and *Labidiaster*. A. Agassiz, '77; Perrier, '93; Ludwig, '97; Studer, '84; Vignier, '78, etc.

the new rays come in in distinct generations, *i. e.*, in sets all the members of which arise simultaneously? If so, do the generations have typically the same number of members, or does the number increase or diminish in succeeding generations? Do the successive rays arise at the same and definite places? With what number of rays does adult life begin? Are the new rays disposed bilaterally? And, perhaps most important of all, is there a ray that corresponds to the ray *A* of *Pycnopodia*? As the author had but six specimens (Perrier, '88) in which new rays were being produced, the material would be inadequate for answering these questions, and future work must supply the information.

GENERAL REMARKS ON CHARACTERS AND ORIENTATION.

In *Pycnopodia* the full-grown stars vary somewhat in the number of rays, having twenty to twenty-four; but this variation does not depend upon the size of the specimen. The largest individual (R. = 15 cm.) in the museum of the University of California had but twenty rays, while others with twenty-two and twenty-four measured 12 and 13 cm. respectively. The number is generally even, twenty, twenty-two, or twenty-four; but a few specimens with twenty-one have been found.

While the younger stars show a symmetrical arrangement of rays of different sizes, in only one out of some fifteen adults examined could any distinct inequality be observed. The rays are very equally developed, but so soft and flexible that they appeared to differ in size; the better the specimens are prepared, the more regular in size and arrangement are the rays found to be.

In order to orient the star, the madreporite is found in each one. It is a fairly large body, but the full development of the papulae often makes a careful search necessary to find it. In young specimens the difficulty is increased by the coloring. Treating the specimens with clearing fluids is of no avail; but transmitted sunlight brings out the characteristic furrows. At first these are simple, but they increase in complexity of pattern with the growth of the star. After finding the madreporite in a few of the smaller animals, it is discovered to hold a defi-

nite position relative to the multiplying rays, and the task is much lightened by determining in which interradius it belongs from the general outline of the animal. However, careful search has always been made in the other interradii for supernumerary madreporites, but none have been found. The adult stars give more difficulty, for in spite of the contrast between the light buff of the calcareous plates and the dark color of the dorsal wall, and although the madreporite is often 1 cm. across, the papulae are frequently expanded to hide it completely. Moreover, the equality in the size of the rays prevents orientation by general inspection and makes necessary a careful search in each interradius.

Having satisfied ourselves, from general examination of many specimens, that a definite relation exists between the madreporite and the newly forming rays, our next object was to determine the order of development of the latter.

The youngest star in the collection possessed six well developed rays and two so small as at first to escape notice. One somewhat larger is shown in figs. 1 and 2. From this stage onward there are, among the one hundred individuals studied, nearly all the intervening stages up to the full-grown animal. The eighteen-rayed stage is the only one not represented in the series.

We adopt Agassiz's and Ludwig's plan of numbering the radii of the typical five-rayed echinoderm. According to this, when the apical side is uppermost, counting from the madreporite clockwise, the rays are numbered from I to V.

From a study of the metamorphosis Ludwig, '82, considers that the star should be oriented by a line running interradially between I and II and radially along IV, thus bringing the madreporite in the left anterior interradius.

Before Ludwig was consulted this orientation had been adopted for *Pycnopodia*, owing to the striking bilateral symmetry displayed in the young animals. This symmetry determined that the sixth ray is median anterior between I and II and by us has been called A.

GENERAL ACCOUNT OF RAY MULTIPLICATION.

Of the time of origin of A we know nothing. In our youngest specimens it is as large as any of the other five. The first two new rays come in in strictly bilateral order, their place of origin being the interradii A I and A II; *i. e.*, they are on each side of A, and are adjacent to I and II. As they are obviously a pair, we designate them both as x, distinguishing the one on the left as lx, and the one on the right as rx (figs. 1 and 2).

By examining an eight-rayed specimen in which lx and rx are over half grown, it will be found that two more rays are appearing in the interradii I-lx and rx-II. These are obviously again a pair and we may call them lx¹ and rx¹. It will be observed that they, again, are adjacent to I and II respectively. This gives us the ten-rayed stage. Individuals of apparently this stage with lx¹ and rx¹ about half the size, and with lx and rx nearly equal to, the other rays, will be found to possess the beginning of another pair in the interradii I-lx¹ and rx¹-II, or again, adjacent to I and II; and so on (figs. 3 and 4).

The law of ray multiplication that is followed from the six-rayed condition onward is now manifest. New rays are produced in pairs, lxⁿ and rxⁿ, in the interradii, I-lxⁿ⁻¹ and rxⁿ⁻¹-II; *i. e.*, always adjacent to I and II, with the plane A IV as an axis of symmetry. Or we may express the fact by saying that there is a budding area adjacent to I and II on the side toward A which continues to give origin to new rays until late in adult life.

To this law of ray production we have found no exception. In specimens with regenerating rays some difficulty may be experienced in distinguishing these from new ones not yet fully grown. But in almost all such cases careful examination removes all doubt.

The first evidence visible to surface examination of the coming in of a new ray is the proximal pair of ambulacral feet. The new rays grow rapidly and rarely are more than the two youngest pairs smaller than their fellows (figs. 3 and 4).

One member of a pair frequently appears slightly earlier than its mate, or one may grow somewhat more rapidly than the other; but all deviations of this sort fall readily within the

limits of individual variation. No tendency to one-sidedness can be determined, as one side is as likely to show excessive growth as the other. Occasionally, however, one or the other member may be suppressed entirely, producing thus the rather rare specimens with odd-numbered rays.

From what has been said, it will be seen that ray multiplication takes place in this species during a considerable portion, though not the whole, of adult life. The exact time, however, at which any particular pair of rays will appear in any particular individual is subject to a wide range of variation, judging from the difference in size of specimens having the same number of rays. Thus, eight-rayed specimens have been measured in which $R = 40$ mm. to 80 mm., while ten-rayed ones with $R = 35$ mm. to 65 mm. may be found.

TOPOGRAPHICAL AND MORPHOLOGICAL DIFFERENCES BETWEEN
PRIMARY AND SECONDARY RAYS.

The rays of *Pycnopus* being, then, of two categories relative to their period of origin, *i. e.*, larval and post-larval (we assume that at least five, probably all, of the six rays of our youngest specimens are, as in other star-fishes, of larval beginning), the question naturally occurs: Are there any structural differences between the rays of the two groups? So far as the rays in themselves are concerned, there are none. When, however, attention is directed to their relation to various structures of the disc, quite unexpected and rather remarkable differences come to light. These pertain to (1) the pouches of the cardiac stomach; (2) the radial apical muscle bands; and (3) the racemose glands. The gastric pouches turned toward the primary rays are larger and more clearly set off than are those turned toward the secondary ones. The muscle bands of the secondary rays show the history of their origin in their arrangement in an interesting way, to be described a little later. The racemose glands are *never more than ten, sometimes only nine in number, whatever the number of rays in the star*; and they clearly are related to the primary rays, new ones not being produced for the secondary rays (fig. 7). Their exact arrangement we shall speak of later, but may state here that such

a limitation in the number of these structures does not obtain in all multiradiate stars, for in *Solaster endeca*, at least, the only other one which we have been able to examine with reference to the point, the number, though not quite double that of the number of rays, was yet not reduced as in *Pycnopodia*.

Having noted the strict bilateral symmetry of the budding regions, and the consequent bilaterality which this imparts to the animal during the whole period of ray multiplication, we may now inquire whether anything of this symmetry is impressed upon the internal parts, and whether it anywhere persists through the entire life of the animal.

We find that the following structures are disposed more or less bilaterally, with A IV as the axis of symmetry; the anus, the intestinal cœca, the racemose glands, and the apical radial muscle bands.

The anus is situated excentrically in this line and somewhat toward ray A. This, it will be recalled, corresponds to its position in the five-rayed star; *i. e.*, it is in the interradius next, clockwise, to the one containing the madreporite (fig. 4).

The intestinal cœca are well developed, often having as many as ten tubules. These all lie toward A, in the adult often even extending between the interradiial septa of this ray, though frequently also a few tubules get pushed into the bases of the adjacent rays, but they never get far away from A.

The racemose glands have kept a symmetrical arrangement. Invariably a pair is found in the interradii V-IV, IV-III, and III-II. Also a gland is found in the interradius on each side of A, and a gland in the next interradius on the right, and sometimes one on the left. Ten is the largest number found, six of which belonged to the group of rays II-V, and four to the region of A. While, then, these structures are not perfectly bilateral in arrangement, they are very nearly so (fig. 7).

The point of radiation of the muscles is in the same line and very near the anus (fig. 6). Their arrangement is as follows: Of rays III, IV and V, each has its own distinct band, arising from the common center; I and II have bands arising from the same center, *but from these* are given off bands to the secondary rays of their corresponding sides, the older ones being most separated (fig. 6).

ORIGIN AND GROWTH OF NEW RAYS.

Two or three ambulacra are the first external evidence that one sees of the incoming ray. These appear in a cleft, or more properly, a pocket, on the oral side of the disc, and extend outward from the peristome (fig. 5). This is much nearer the oral edge of the peristome than Perrier, '93, describes the base of the newly forming ray to be in *Labidiaster*. A little forcing with a probe at the distal end of the pocket discloses other ambulacra, small, but distinctly formed. The pocket soon lengthens and broadens, revealing more ambulacra, but as yet nothing can be seen of the new ray when the animal is looked at on its aboral side. Until a considerable number more of ambulacra are formed, and the ray projects to some extent from the edge of the disc, it is bent down at its tip over the newly forming tube feet. At the beginning the feet appear to be in a single row, but sections prove them to be in pairs from the very outset.

At first no spines are present, but they soon appear, the furrow-spines first, in form and arrangement corresponding with those of the old rays. As the ray develops the interradial dorsal wall of the disc is carried out, so to speak, to form its dorsum.

From this outline of the early development, it will be gathered that at the outset and for some time the development pertains wholly to structures belonging to the ventral portion of the ray: the floor of the ray, the ambulacral tentacles, the radial water tube, the radial perihæmal tubes, and the radial nerve band. For some time the only part of the ray that exists may be said to be embedded in the interradial tissue. Fig. 9 is a diagrammatic representation of a vertical interradial section showing a new ray at a stage somewhat earlier than the one shown in fig. 5; and fig. 5 represents a ray considerably younger than lx^2 and rx^2 in figs. 3 and 4.

Between what we suppose to be the initial step in the production of a new ray, and a condition in which ambulacral out-pocketings on the radial water-tube are clearly indicated, we have not succeeded in finding stages. However, from the stages which we have, a tolerably complete picture can be obtained of the entire course of things.

The parts involved at this early time are: The ectoderm of the floor of the new ray, and intimately associated with this, the radial nerve band; the radial perihæmal canals; the radial water tube; and the cœlom of the new ray.

The relations of these are made intelligible by an examination of figs. 5, 9, 10, 11, 12 and 13.

Fig. 5 is an oral view of the interradius in which a new ray is coming in sight, three pairs of tube feet having already become visible. The orientation here will be readily understood by noting the peristome, *per*, and two tube feet *amb*, of the old rays between which the new one is forming. Fig. 9 is a vertical radial section through an entire interradius in which a new ray, somewhat younger than the one shown in fig. 5, is forming. The point *x* corresponds in the two figures, and its closeness to the circular nerve band in fig. 9 will be noted. This moves away, either by growth or actual splitting, as development progresses, as seen by reference to fig. 5; but until even a considerably later time than this, the pocket, into which the new tube-feet project, as shown in fig. 9, persists, it having pushed forward as rapidly as the point *x* has.

Fig. 10 is taken from a frontal section of an interradius in which the newly developing ray is still younger than the one shown in fig. 5. The section is low down and consequently cuts the interradiial mass ventral to the ray pocket, the position of which is indicated by dotted outline.

The very narrow chink here, *m.amp.*, by which the pocket communicates with the exterior, will be noted, and indicates clearly how, so far as the ectoderm and radial nerve band of the new ray are concerned, the development began. The narrow ectodermic invagination which began the pocket was at the very outer edge of the circular nerve band, *n.r.*, and some of the latter was taken in, so to speak, to become the radial nerve band of the new ray.

The method by which the new radial water tube and the new cœlom originated are also obvious from fig. 9. The new water canal, *r.w.v.*, in particular, brings out the strong curvature which the new ray has at this time. The terminal tentacle, *ten.*, though already free at its tip, is still held by its base in

connection with the interradial mesenchymatous tissue and the middle portion of the ray grows over beyond this point, thus throwing the whole ray into almost a circle. This mode of growth causes the new cœlum, *cæ'*, to take the form of a thin, rather broad, deep, curved pocket.

Figs. 11 and 12, taken from frontal sections of new rays of about this stage, show the relations and character of the tissues of the various parts. The thick, epithelial character of both the cœlomic and water-vascular walls is noticeable, and at *amb.m.* one sees that the muscular wall of the tube feet has already begun to differentiate. This begins, in fact, when only five feet are present.

An interesting question, though perhaps of no great importance, is how the septum of the radial perihæmal canal is produced. We have not been able to determine this point with certainty, but judging from what we can make out from our sections, and from the nature of the two ring perihæmal canals as this is made known to us by embryology, the process seems to be as follows: The inner perihæmal canal is, it will be recalled, a single, uninterrupted canal derived from the larval enterocœl as a single sac. The outer canal, on the other hand, is not, in reality, a continuous canal at all, but rather a series of five canals, each arising independently of the others, whether from out-pocketings from the enterocœl or in part as mesenchymatous cell-aggregates that become hollow secondarily, does not matter now. The five closed sacs, as they originally are, become arranged interradially as the rays of the young star take form, the two ends of each sac being carried out into the two rays between which it is placed to form half the double radial perihæmal canal of the respective rays. The middle portion of the sac, on the contrary, remains in the disc, interradially located, and becomes closely applied to the inner canal along its outer side; so that the outer canal is interrupted at every radius by the base of the septum of the radial canal, while the lumen of the canal that lies in any given interradius is continuous with the lumina of the two rays between which it is situated. The septum, then, between the inner and outer canals, as also that of each radial canal, is

potentially double. Now, when a new ray is formed the whole of the outer canal at the point of origin, and not its outer wall merely, loops into the new ray. The two limbs of the loop come in contact, and thus the two-layered septum of the new radial canal is produced. The inner canal, then, has nothing to do about the production of the radial canal.

It will be readily comprehended that the growing radial water canal, together with its outpocketing tube feet, is wholly embedded in mesenchymatous tissue from which the muscles of the feet, and also the ambulacral skeleton of the new ray, are formed. It will also be easily understood how the cœlomic epithelium becomes closely applied to the new ampullæ within the ray; and the ectoderm to the tube feet on the outside.

The early time (long before they become functional) at which the tube feet take on their distinctive character, is worthy of note. As already mentioned, the muscle fibers begin to appear when only two pairs are blocked out; and before they become visible externally at all their terminal discs are formed.

Although we have not attempted to trace in full the development of the skeletal parts of the new rays, a few observations with regard to the relation of the ray at its very outset to the older parts of the oral skeleton, may be recorded. No evidence of the resorption of any of the old skeleton, or, in fact, any other tissue, has been seen. The new forming parts penetrate rather into the fibrous septal tissue between the adambulacral plates and wedge these latter apart; and it is in and from this fibrous tissue that the basal skeletal plates of the new ray are formed. These appear very early, being recognizable when two pairs of ambulacra are established. Not only the adambulacral, but also the interbranchial ossicles show, in frontal sections, evidence of this wedging apart.

The gastric, or hepatic, diverticula for the new rays do not develop early: not until the ray has reached the edge of the disc at least.

A vertical interradiial section through an interradius in which no ray is developing shows that while the points at which growth will take place to produce the several parts of the new ray are not far separated from one another, they are yet by no

means in contact, but are separated by some quantity of differentiated, sustentative, or skeletal tissue.

It will be remembered that the independent parts which contribute to the production of the new ray are: the body cœlom, the water ring canal, the outer perihæmal canal, the ectoderm with the ring nerve, the interradiial mesenchyme, and, finally, the digestive tract.

From the description it is obvious that all these, except the last, start off *almost* simultaneously toward the production of the new ray. Is this start *absolutely* simultaneous, or does some one, and if so which one, lead the way?

We have given considerable time to the effort to answer this question, but have not been altogether successful. The evidence that we have is to the effect that *the water ring canal leads off* in the development. Fig. 13 represents an interradiial section in the interradius in which a new ray should develop. The orientation of this section will be understood by noting the ring nerve band, *n.r.*, the peristome *per.*, and the body cœlom, *cœ.c.* The water ring is seen at *w.v.r.* The great thickening on the wall of this at *r.w.v.* is probably the very beginning of the radial water vessel of a new ray.

The definite circumscription of this patch of cells, indicating that it has already begun to evaginate, and the form and staining character of the individual cells leave little doubt that it is the beginning of a definite structure of some kind. Its position both as regards the interradius in which it occurs, and on the outer side of the canal is strong evidence that it is the radial canal. And this presumption is strengthened still further by the fact that no other organ develops from the ring canal in this locality. If it is not the beginning of the radial canal it is an abnormal growth, and this is improbable. If this is what we suppose it to be, the initial step in the production of the new ray is taken in a very positive way by the water ring; for no evidence of new growth can be detected at any of the points where the other elements of the ray would begin. The cœlomic epithelium of the new ray would begin about at the point *y*, and the ectodermal invagination at *x*, which corresponds to *x* in figs. 9 and 10. We should rather ex-

pect that evidences of growth in the mesenchymatous tissue surrounding these parts would appear at this time; but such is not the case. The external perihæmal canal, *a.p.c.*, appears more extensive here than it really is, owing to a break in its outer wall; but no evidence of special growth in connection with it is recognizable.

QUESTIONS RAISED BY THE FACTS PRESENTED, AND AN
EFFORT TO INTERPRET THEM.

The final interpretation of ray multiplication in *Pycnopodia* in relation to the structure of the larva is obviously impossible in the absence of knowledge of the embryology of the species.

Nevertheless the facts at hand raise several questions, answers to which are at least suggested when they are studied in the light of what is known about the development of other echinoderms, particularly species closely related to *Pycnopodia*. The most interesting of these questions are the following: (1) Have not the two definite positions at which rays are produced relation to the place of closure of the hydrocœl ring of the larva; or, perhaps more precisely, to the two ends of the hydrocœl before it becomes a closed ring? (2) Is the definitely expressed axis, A IV, of bilateral symmetry the same as the axis of symmetry of the larva? (3) What is the relation of ray A to the five rays of the asterid ground plan?

Bury, '89, summarized, for the entire class of Echinoderms, all that was then known about the place of closure of the hydrocœl ring. According to this summary, the closure always occurs interradially, but the particular interradius differs for different groups, four of the five original interradii being the place for some one or more groups. For all the *asterids*, so far as known, *the position is the interradius 5-1* relative to the hydrocœl itself. But it is well known that in most star-fishes (A. Agassiz, '77; Ludwig, '80; Bury, '95; MacBride, '96, and Goto, '97) a rotation of the antiambulacral disc takes place during metamorphosis in such a way that, following Ludwig, who designates the primary tentacles of the hydrocœl with Arabic numerals, and the incipient antiambulacral rays with Roman numerals, hydrocœl tentacle 5 comes into relation with anti-

ambulacral I, so that when the two systems unite to produce the complete rays of the adult star they do so in this wise: I, II, III, IV, V.¹

5, 1, 2, 3, 4.

In other words, interradius 5-1 corresponds to I-II, as we are enumerating the rays of the adult star. (Compare fig. 4 with fig. 8 copied from Ludwig.)

All the work that has touched the point since Bury's summary (Bury, '95; MacBride, '96; Goto, '97 and '99) has confirmed this result, so far as the closure of the hydrocœl ring is concerned.

The evidence bearing upon the subject is, then, to the effect that the two *points at which new arms are budded out in Pycnopodia correspond to the positions of the two ends of the larval hydrocœl immediately before and at the time of its closure to form a complete ring.*

Remembering now the fact that the best evidence we have indicates that the water vascular ring initiates the process in the production of the new ray, the supposition is warranted that *the multiplication of rays in Pycnopodia is merely a continuation of the process that gives origin to the original five.*

As to the order of formation of the five primary tentacles of the larval hydrocœl, a matter that would be so significant for the present question, we have but little definite information. A. Agassiz, '77, p. 32, has a statement that appears, if we interpret it correctly, to indicate that the first folds, as he terms them, for the hydrocœl rays are formed about in the region of rays 2 and 3.

Goto, '97, states that in *Asterias pallida* "No. 2 is the first developed and is situated hindmost, 1 and 3 are formed almost simultaneously, then 4, and lastly 5" (p. 254); so that, bearing in mind the relations which the primary hydrocœl rays have to the completed rays, it is seen that the process of ray formation for the original five would lead off with III, and terminate with I, which would, in so far, be in harmony with the supposition

¹ Bury states that in *Bipinnaria asterigera* the usual rotation does not take place, and that corresponding members unite.

formulated above. The difficulty is that ray II does not appear simultaneously with I, but at an earlier time. It should be noted, however, in this connection, that all the information we have is to the effect that there is but very slight difference in the time of origin of the five original tentacles; and it is quite probable, therefore, that more attention to this point will produce surer evidence of their successional appearance from behind forward.

From Ludwig, '82, we get some very significant indirect evidence on this point. Although he gives no information about the time of origin of the primary tentacles with reference to one another, he does point out the order in which the first pairs of ambulacral feet appear on the different tentacles. Thus he shows (p. 149), that they appear on 3 = IV, first, then follow 2 and 4 = III and V, and conclude with 1 and 5 = II and I; and 3 he says has two pairs before 1 and 5 have undergone any changes from their primitive tentacular state. In other words, in *Asterina*, after the very inception of the primary tentacles, the order of which we do not know, the *development of the posterior rays of the radial water system proceeds considerably in advance of those of the anterior ones, the order being: IV in the lead; III and V next in order and together; and lastly II and I, also together.* How easy and natural the deduction, then, that for *Pycnopodia* it would be *rx* and *lx* next; *rx*¹ and *lx*¹ next, and so on!

We, of course, know too much now about the time-order of origin of embryonic structures to permit us to place any reliance on its phylogenetic significance when considered independently of the functional value of the parts concerned. But in a case like the present, where the organs are so entirely alike, both structurally and functionally, as are the rays of a star-fish, we may safely suppose that any constant difference in the time of their origin and rate of development is of phyletic value.

The conception of ray multiplication in *Pycnopodia* thus arrived at is not in accord with that held by some students of the echinoderms. Thus, Cuénot, '91, has stated in a comprehensive and at the same time concise way, what might be called the "decentralization theory," under which he would consider

the phenomenon to fall. His statement we quote in full, as it is much to the point in our present discussion :

“ On voit que les Astérides que nous avons considérés comme le groupe terminal des Echinodermes présentent des indices d'une évolution particulière : 1° l'animal se décentralise pour prendre une apparence radiée (comme les Crinoïdes et les Ophiures) ; 2° les divers antimères formés de trois feuillettes, ectoderme, mésoderme, entoderme, sont devenus relativement indépendants et peuvent en se détachant reproduire un nouvel animal ; 3° le nombre 5 n'a plus sa valeur fatidique : les rayons peuvent être en nombre quelconque, variable même chez les individus d'une même espèce ; enfin les rayons peuvent se bifurquer ou même se trifurquer à leur extrémité, ou en un point quelconque de leur trajet, processus qui peuvent aboutir à la formation de nouveaux bras intercalés entre les anciens. Ce phénomène est toujours inconstant et irrégulier, et n'arrive jamais à la division dichotomique si régulière des bras de Crinoïdes ou d'Euryales ” (p. 634).

The inconstancy and irregularity of the phenomena of new ray formation here affirmed, and apparently necessary to such an interpretation of the process, certainly finds no support in what takes place in *Pycnopodia*, and, as we have shown, the process will probably be found to be perfectly definite in *Helicaster* also.

Concerning the relation of the bilateral symmetry of adult to larva, our observations are of more significance in a general way than for any direct proof which they afford on the question.

In view of the opinion of zoölogists whose knowledge of echinoderm morphology is so extensive as is Ludwig's, Semon's and Cuènot's, that, in the words of the first mentioned, “ Keine derartige Ebene (*i. e.*, of bilateral symmetry common to both adult and larva) am Seesterne vorhanden ist und vorhanden sein kann,” it may seem futile to hazard even a suggestion to the contrary on the strength of such evidence as we have here. Nevertheless, we cannot help thinking that it would be rather remarkable were an adult animal to possess bilateral symmetry so strongly marked as *Pycnopodia* does, and yet that this should be wholly independent of the equally strongly expressed bilaterality of its larval stage.

It is obvious enough that as regards most of the particulars in which the bilaterality of the adult manifests itself, they can have no *direct* relation to the bilaterality of the larva. This would be so, for example, with reference to the radial muscles, the racemose glands, and the position of the pyloric cœca; for all these belong exclusively to the adult animal.

Their peculiar disposition is, however, determined by the incoming of accessory rays; and since, if our interpretation of this process is right, it is already set up during larval life and metamorphosis, and has direct relation to the symmetry of the larva, it would *follow that the whole round of bilateral manifestations of the adult are directly and indirectly referable to the bilaterality of the larva.* And our results would then be in accord with those workers on asterid embryology who, like Goto, insist upon such coincidence of symmetry from the evidence afforded by the metamorphosing larva.

But probably the most interesting question raised by our observations is that concerning the significance of ray A. The facts are all against its being regarded as an accessory ray belonging to the same category as those acquired later. Its singleness while the others are always paired, its possession of racemose glands while the others are without them, the method of origin of its dorsal radial muscle as contrasted with those of the others, and, finally, its presence in full size relative to the group of five, when the first pair makes its appearance—all these facts remove it from intimate association with the other accessory rays, and relate it more with what we must regard as the group of original five.

We might suppose that the original ancestor of *Pycnopus* was a six-rayed star like *Asterias hexactes* or *A. equalis*, and put the question aside at that; and perhaps in the absence of any information whatever about the embryonic history of this or any other echinoderm having more than five rays, this is the best we can do. At the same time, the fact that this is a *sixth* ray and that it holds a unique relation to the two budding zones makes such a superficial disposition of the question quite unsatisfactory, and even though we cannot expect to reach a full solution of the problem in the present fragmentary state of our

knowledge, it still seems worth while to push our inquiry a little farther.

Assuming the truth of our hypothesis that the two budding zones of new rays correspond to the region of closure of the hydrocœl ring, the question more specifically put is this: What is the relation of A to this point of closure, and with reference to both the original five rays and the budding zones? In no echinoderm, so far as is known, does the closure of the hydrocœl ring take place radially. Indeed, in all cases the primary tentacles are already clearly established before the closure. But on our hypothesis it would seem to be necessary to suppose, if we regard A as exactly homodynamous with the other five rays, that it arose at the exact point of closure; *i. e.*, that closure does take place radially here.

Now, of course, this may be precisely what happens. There is no inherent impossibility of its being so. But reference of the question to what is known about the embryology of other star-fishes suggests another explanation which has, at least, enough basis of fact to warrant us in presenting it.

On examining the descriptions and figures of the development of star-fishes, particularly of *Asterina gibbosa* and *Asterias pallida*, which have been so fully investigated recently by Ludwig, Bury, MacBride, and Goto, one finds that *arm A of Pycnopodia occupies the exact position of the preoral lobe, or 'larval organ' of these embryos*. And when it is remembered that this organ is retained for a considerable time after metamorphosis in some species, this coincidence becomes all the more striking. Fig. 8, which we have copied from Ludwig, '82, p. 173, represents diagrammatically the characteristics of *Asterina gibbosa* shortly after metamorphosis; and when it is placed alongside our fig. 4, which, it will be remembered, is an actual tracing of a young *Pycnopodia* with three pairs of accessory arms, the correspondence of which we are speaking is brought out strikingly enough.

Now, of course, we would not be so rash as to imagine that the arm A has arisen as an actual transformation of the preoral lobe. All we wish to do at present, all we can do, indeed, is to make clear the interesting fact of the correspondence in po-

sition of the two organs, and point out certain facts of development that seem to us to give considerable probability to the conjecture that future study will discover some closer relation between them than that of mere chance correspondence in position.

The facts to which we refer concern the relation of the hydrocœl to the anterior cœlom, which is the enterocœl of the larval organ, in the larva, and the method by which the water pore and stone canal communicate with these cavities.

Ludwig, '82, pointed out that in *Asterina gibbosa*, while the dorsal pore is not formed until after the hydrocœl begins to differentiate itself from the enterocœl, it yet does not at first communicate directly with the incipient hydrocœl, but rather with the left enterocœl, so that for a considerable time the hydrocœl communicates with the exterior only by way of the enterocœl. And from these facts the author is led to declare: "Nur scheint es demnach den Thatsachen besser zu entsprechen, wenn man den Rückenporus in seiner primären Bedeutung als einen in den Enterocœl führenden Porus betrachtet, welcher erst sekundär in engere Beziehung zu dem von dem Enterocœl abgespaltenen Wassergefäßsysteme tritt" (p. 144).

As development goes on, the anterior enterocœl, *i. e.*, here the enterocœl of the larval organ, becomes distinctly set off from the left posterior enterocœl, though for a long time remaining in communication with it, and it is not until on the tenth or eleventh day, when the metamorphosis is so far advanced that several pairs of ambulacral tentacles have appeared on the radial canals and the adult star is distinctly blocked out, that the cœlom of the larval organ is finally severed from the water vascular system, as the larval hydrocœl has now become.

These observations of Ludwig's have been fully confirmed, so far as the essential particulars are concerned, by later investigations, MacBride, '96, in fact, affirming that "the conjoined tubes (*i. e.*, stone-canal and pore-canal) still open to the anterior cœlom, and this opening persists in the adult, a fact which Ludwig did not observe" (p. 362).

Numerous other citations of like import might be given: but one or two from Bury to which special weight must be attached

because of his wide range of observations relative to this point, must suffice. In summarizing what is known on the subject with reference to the Asterids, he says, '89 (p. 418): "The water pore and hydrocœl occupy their usual positions, but the latter remains open to the anterior enterocœl, from which it probably arises." And as a more general statement (p. 420): "The water pore always (with the possible exception of Holothurians) arises in connection with the posterior end of the left anterior enterocœl, and only communicates indirectly, if at all, with the hydrocœl."

While quoting Bury on this point, however, it would be unfair to his views not to mention that he believes the distinction between the anterior enterocœl and hydrocœl to be a deep-seated one. It is, at the same time, interesting to find him remarking in connection with the development of these parts in Echinids that "a stage is soon reached in which, but for the evidence afforded by Ophiurids, the fundamental distinction between the anterior enterocœl and the hydrocœl could hardly have been recognized" (p. 413).

And while calling attention to the close morphological relation that exists between the enterocœl of the preoral lobe and the hydrocœl; in other words (to translate the statement into phraseology that would apply more strictly to post-larval life) between the cavity of the peduncle of the late larva and young adult in many species, and the water-vascular system, attention should also be called to the manner in which this peduncle is so frequently used. Thus, Ludwig, '82, p. 154, declares that, "Die Larve benutzt, wie das schon von dem ersten Beobachter, Lacaze-Duthiers, richtig gesehen worden ist, das Larvenorgan in ganz ähnlicher Weise, wie des Seestern seine Saugfüßchen."

Turning to the paper (Lacaze-Duthiers, '74) referred to by Ludwig in this quotation, we do not find that the French author expressly compares the use made of the larval organ by the larva of *Asteriscus* (*Asterina* ?) which he studied, with the ambulacral tentacles of the star-fish; he does, however, after giving a lively account of the movements of the larva, speak of its adhering to foreign bodies by the peduncle "par une sorte de suction" (p. 29).

A long list of genera and species of Asterids might be made out in which the larvæ are now known to attach themselves more or less firmly, usually it appears, by this 'larval organ.' Sometimes the substratum of attachment is an inanimate object, and sometimes, as for example in *Asterias spirabilis* Perrier, '91, it is the parent star-fish, and the organ of attachment is called an 'umbilical cord.'

What is greatly to be desired is much more exact and detailed comparative knowledge of the way the organ is used, and of its structure and relations in late larval and in post-larval life.

But as said above, we think we already have a sufficient body of facts to amply justify the suggestion that *arm A of Pycnopodia is in some intimate way related with the larval organ of the embryo.*

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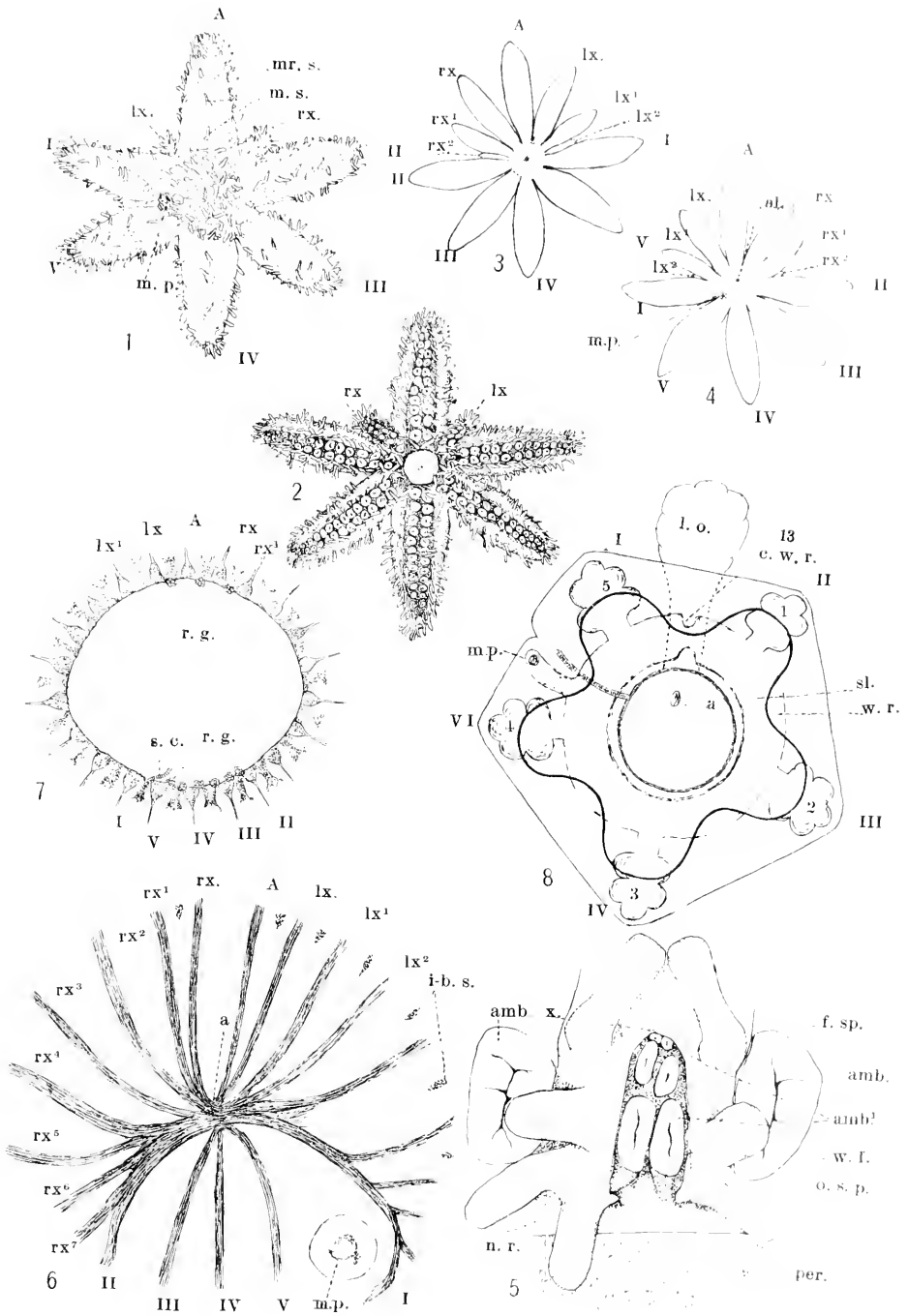
ABBREVIATIONS USED IN PLATES XIII AND XIV.

- A. Sixth ray.
 a. Anus.
 adam.p. Adambulacral plate.
 amb. Ambulacral foot of old ray.
 amb.¹⁺²⁺³, etc. Ambulacral feet of new ray.
 amb.m. Muscle fibers of new ambulacral foot.
 amp'. Ampulla of new ray.
 a.p.c. (See o.p.c.)
 cœ. Body cœlom.
 cœ'. Cœlom of new ray.
 cœ.e. Cœlomic epithelium.
 c.w.r. Point of closure of hydrocœl ring.
 f.sp. Furrow spine.
 ect. Ectoderm.
 i.p.c. Inner perihæmal ring canal.
 lx, lx¹, lx², lx³, etc. Accessory rays of left side.
 o.p.c. Outer perihæmal ring canal.
 m. Mouth.
 mp. Madreporite.
 mr.s. Marginal dorsal spines.
 m.s. Median dorsal spines.
 m.amp. Mouth of pocket of new ray.
 n.r. Nerve ring.
 per. Peristome.
 p.s. Septum between perihæmal ring canals.
 p.c. Radial perihæmal canals.
 r.g. Racemose glands.
 r.p. Pocket of new ray.
 r.n. Radial nerve.
 r.w.v'. Supposed beginning of radial water canal.
 rx, rx¹, rx², rx³, etc. Accessory rays of right side.
 s.c. Stone canal.
 ten. Terminal tentacle of new ray.
 w.r.c. (figs. 9, 11 and 12). Water ring canal.
 w.v.r. (fig. 13). Water ring canal.
 x. Edge of ectodermal lip of pocket of new ray.
 y. Point at which body cœlom evaginates to produce cœlom of new ray.
 I, II, III, IV, V. The original five rays of the five-rayed star.

PLATE XIII.

[All the figures excepting 8, which is taken from Ludwig, '82, and has particular reference to *Asterina gibbosa*, are of *Pycnopodia helianthoides*.]

- FIGS. 1 and 2. A young individual, aboral and oral views respectively, in the 8-rayed stage, with rays lx and rx very small.
- 3 and 4. Outline tracings of an individual. Oral and aboral views respectively, in the 12-rayed stage, lx^2 and rx^2 barely visible from the aboral side.
- FIG. 5. An oral view of an interradius, in which a new ray with three pairs of visible tube feet and several pairs yet concealed in the pocket, is in course of development. At this stage nothing of the new ray can be seen from the aboral side.
6. The aboral disc, seen from the inside, and as though looked down upon, showing the apical radial muscle bands, the madreporite, and the position of the anus close to the origin of the muscle of ray A.
7. The peristomeal region, seen from the inside of the animal and looked down upon, showing the racemose gland, *r.g.*, and the stone canal, *s.c.*, and their relation to the rays which are indicated by the skeletal plates belonging to both radii and interradii.
8. Diagram of metamorphosing young of *Asterina gibbosa*, copied from Ludwig, '82, p. 173. Compare with fig. 4.

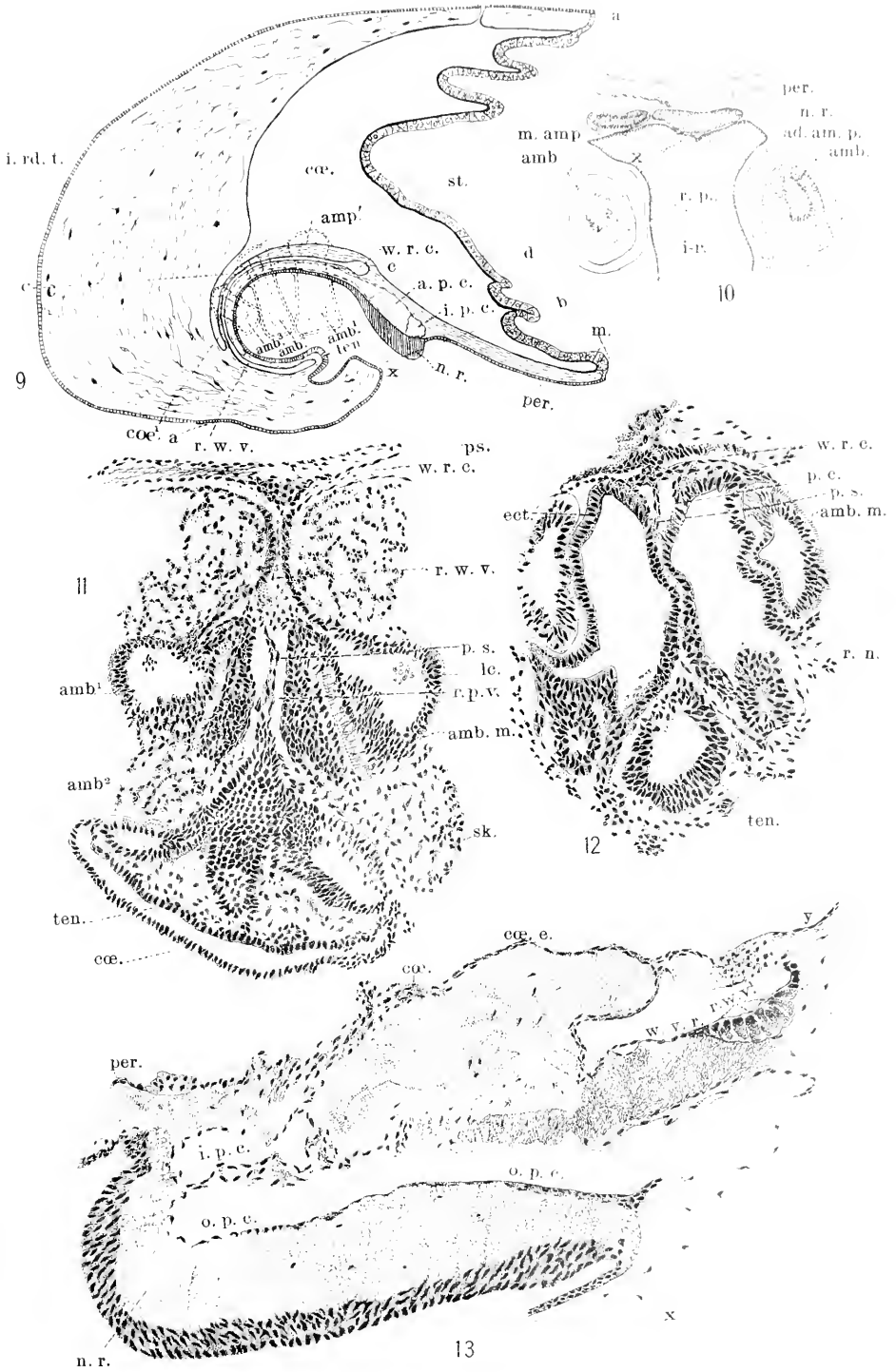


Pycnopia helianthoides.

PLATE XIV.

PYCNOPODIA HELIANTHOIDES.

- FIG. 9. An interradial diagrammatic section, reconstructed from many actual sections, of a young ray with three pairs of tube feet.
10. A frontal section of an interradius with new ray developing, corresponding about to the line *ab*, fig. 9. The pocket of the new ray indicated in dotted outline, *r.p.*
- 11 and 12. Two frontal sections of a young ray showing details of the growing parts and the tissue in which they are embedded. Fig. 11 corresponds about to line *cd*, fig. 9, though the development is somewhat more advanced than the ray shown in this latter. Fig. 11 is at a slightly higher level than 12.
13. An interradial vertical section showing, with other things, the probable initial step in the beginning of a new ray. This consists in the incipient evagination on the water ring canal, *w.r.c.*, of the radial water canal, *r.w.c.* This fig. should be compared with fig. 9.



Pyenopodia helianthoides.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 275-286.

OCTOBER 10, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

IV.

THE TREE WILLOWS OF ALASKA.

[Plate XV, figs. *a-e*.]

BY FREDERICK V. COVILLE.

THE duty of making botanical collections on the Harriman Expedition was officially entrusted to Dr. William Trelease assisted by Professor De Alton Saunders, Professor William H. Brewer assisted by Dr. Wesley R. Coe, and Mr. Frederick V. Coville assisted by Mr. Thomas H. Kearney, Jr. Other members of the expedition also collected plants, incidentally to their specific work, as follows: Professor B. E. Fernow, Dr. Charles Palache, Professor Trevor Kincaid, Mr. Leon J. Cole, and Miss Mary Harriman. The Alaska collections were made between June 4 and July 28, 1899, at about fifty localities along the coast, from the southernmost point of the Territory to Bering Strait. The frequent stops and the exceptional facilities afforded for drying the material brought on board the steamer made it possible to secure an extensive series of specimens. The collections are by far the largest made since the American occupancy of Alaska in 1867, and probably exceed those of any one of the Russian or English expeditions of the early part of the cen-

ture. Representing as they do the three floral districts of the Alaska coast—the heavily forested Sitkan flora, the forestless but temperate Aleutian flora, and the all but perennially frozen Arctic flora—the collections furnish excellent material for studies in geographic distribution. Even the remaining fourth floral district of Alaska, that of the Yukon Valley, in the interior of the Territory, is sparingly represented in the plants collected at Skagway and in Cook Inlet.

In order to give more comprehensive scope to the work as a whole, it was arranged that Dr. Trelease should devote his attention primarily to the cryptogams, except the algæ, which were entrusted to Professor Saunders; Mr. Kearney was to take the flowering plants, except the trees and shrubs, which were to be left to the writer; and the other collectors were to secure such material as they could, particularly in localities visited by only a few members of the expedition. A full set of the cryptogamic plants is to be deposited in the herbarium of the Missouri Botanical Garden at St. Louis, and a full set of the flowering plants in the United States National Herbarium at Washington, Dr. Trelease and the writer having in charge the preparation of the reports on these groups, respectively.

Among the genera of flowering plants that have given difficulty to students of Alaska botany, the willows probably stand first. About fifteen species were collected in Alaska on the Harriman Expedition. By their habit of growth these species fall easily into three groups: they either grow prostrate on the ground, or form upright shrubs 2 to 6 feet high, or develop into small trees. The lack of knowledge of the tree willows of Alaska is shown by the fact that as late as 1896, in the ninth volume of Professor Sargent's 'Silva of North America,' only two species, *Salix sitchensis* and *Salix nuttallii*, were credited to that Territory, while from our present information this number must be increased to five. The three additional species are *Salix bebiana*, which has been discovered in the region of Cook Inlet; the old *Salix speciosa* of Hooker and Arnott, a willow of middle and western Alaska, which clearly attains the dimensions of a tree; and a hitherto undescribed species from Yakutat Bay. The key here given will serve to distinguish the species.

KEY FOR USE WITH SPECIMENS BEARING PISTILLATE CATKINS.

Ovary smooth; fully developed leaves broadly oval or obovate, rounded at the base.....*S. amplifolia*.

Ovary hairy; leaves narrower, usually wedge-shaped at the base.

Ovary short-pedicelled, the pedicel about once or twice the length of the nectary.

Hairs of the catkin scales, except sometimes those of the lower ones, extending about a third or a half the length of the scale beyond its apex; stigmas ovate to lanceolate, entire or 2-lobed; pistillate catkins seldom exceeding 6 mm. in diameter in flower and 10 mm. in fruit; leaves satiny beneath with straight appressed hairs.....*S. sitchensis*.

Hairs of the catkin scales extending about the full length of the scale beyond its apex; stigmas divided into two very slender divisions, the style therefore apparently surmounted by four filiform stigmas; pistillate catkins commonly about 10 mm. in diameter in flower and 15 to 18 in fruit; leaves densely woolly beneath with tangled hairs.....*S. alaxensis*.

Ovary long-pedicelled, the pedicel three to several times the length of the nectary.

Catkins appearing before the leaves; scales black or sometimes dark brown, obovate to oblanceolate; stalk of the ovary commonly 3 to 4 times the length of the nectary, barely elongating in fruit.....*S. nuttallii*.

Catkins appearing with the leaves; scales pale, buff, or straw-colored when dry, linear-oblong; stalk of the ovary several times the length of the nectary, in fruit usually exceeding the scale and sometimes becoming twice or three times as long.

S. bebbiana.

KEY FOR USE WITH SPECIMENS BEARING STAMINATE CATKINS.

Scales of the staminate catkins subtending but a single stamen each.....*S. sitchensis*.

Scales subtending two stamens each.

Scales pale, buff, or straw-colored when dry; staminate catkins about 4 to 5 mm. in diameter exclusive of the exerted portions of the stamens*S. bebbiana*.

Scales black to brown; staminate catkins, exclusive of the exerted portions of the stamens, 8 to 10 mm. or more in diameter.

Catkins appearing before the leaves, on twigs entirely devoid of leaves or green bracts.....*S. nuttallii*.

Catkins appearing with the leaves, the twigs always bearing at the time of flowering some young leaves or green herbaceous bracts.

Leaves densely white-woolly beneath, smooth or nearly so above.

S. alaxensis.

Leaves smooth or with some villous pubescence on either surface.

S. amplifolia.

SALIX SITCHENSIS Sanson. Satin Willow.

Salix sitchensis SANSON; Bongard, Mem. Acad. Petersb. 2: 162. 1831.¹

Type locality near Sitka, Alaska, the precise spot pointed out in detail below.

Salix sitchensis is ordinarily a large shrub or small tree, individual specimens often reaching 10 to 15 or rarely 30 feet in height, with a trunk four to six inches or occasionally even a foot in diameter. In exposed situations it sometimes flowers and fruits as a small shrub a few feet in height, and on the morainal gravels at the Muir Glacier it even joined the other smaller willows in becoming almost prostrate. In addition to the attractiveness of a rather graceful form, this willow bears a foliage of singular beauty. On close inspection the leaves present a satiny sheen of indescribable delicacy and softness, varying in intensity with the unevenness of the leaf surface. This appearance, which is largely lost in the dried specimens, is due to a dense covering, on the lower surface of the leaves, of closely appressed short hairs. No other Pacific Coast willow has the same character, and when one has familiarized himself with it in the field he can readily distinguish the satin willow, by its foliage alone, from all the other species. The leaves are oblanceolate to obovate, broadly acute to obtuse at the apex, narrowed at the base, entire or rarely denticulate, and when fully developed about 4 to 6 cm. long, except on vigorous shoots, where they often reach 10 cm. In different published works the plant has been given the names Sitka willow, silky willow, and velvet willow, but the name satin willow seems preferable to all of these.

Salix sitchensis is a characteristic plant of the Sitkan floral district, extending from the southernmost limit of Alaska northward and westward along the coast to Cook Inlet and the eastern end of Kadiak Island. It was observed at as high an elevation as 1,400 feet. Where the forests of Sitka spruce were dense the willow grew along the streams and beaches and in similar sunshiny situations, but where the forest was open or wanting it might occur anywhere on the solid upland at the proper elevation. South of Alaska, *Salix sitchensis* extends along the coast to California, having been reported from as far south as Santa Barbara, and through British Columbia into the Cascade Mountains of Washington and Oregon.

The distribution of the satin willow in Alaska as observed on the Harriman Expedition is here given in detail.

¹ For synonymy, see Sargent's 'Sylva of North America' and 'Sudworth's Nomenclature of the Arborescent Flora of the United States.'

Wrangell.—Only a few specimens, and these closely grazed by cattle (426).¹

Stephens Passage.—Abundant in Taku Harbor (481).

Skagway.—On the lower mountain slopes.

Juneau.—Abundant in Silver Bow Basin and occurring on the adjacent mountain slopes as far as 1400 feet above sea level (566, 594, 2534).

Glacier Bay.—Abundant all about the bay on soil once denuded by the glaciers but now in process of reclothing with vegetation (624, 698, 701). Normally here a shrub three to five feet high, and on the gravels recently emerged from the retreating Muir Glacier and on a 'nunatak' in the same glacier even occurring almost prostrate. On the east side of Muir Inlet, about six miles below the glacier and at an elevation of about 500 feet, occurred a tree five inches in diameter and about fifty years old.

Sitka.—Scattered along Indian River below the rapids (838). It was undoubtedly here that Henry Mertens, the botanist of Captain Lütke's Expedition, in an excursion from Sitka to the summit of the neighboring Mount Verstovia, in the year 1827, discovered this willow. And here the writer on June 16, 1899, on a similar excursion found it still growing. The dense forests of spruce about Sitka do not afford suitable conditions for the tree, and it was not observed at any other point in the vicinity, the same situation as in Mertens' time, for he says, "Here alone [at the crossing of a 'wild mountain current'] is seen the solitary species of *Salix* which the environs of Sitcha afford."²

Takvat Bay.—Abundant along the west shore (1121, 1154), at the Hubbard Glacier (1082), and at Hidden Glacier (998, 999).

Prince William Sound.—Sprangly on the moraine of Columbia Glacier; seen also by Dr. Merriam at Port Wells.

Cook Inlet.—Sprangly on the delta of a glacier in Halibut Cove, Kachemak Bay.

Kadiak.—Abundant at Eagle Bay, about 10 miles south of the town of Kadiak, along a stream-bottom wooded with balm of gilead trees, the trunks of individual willows here reaching a diameter of six to eight inches (1440).

The wood of the satin willow is sometimes used by the Indians of the southern Alaska coast in the drying of salmon, since the smoke does

¹ The numbers given, unless otherwise specified, refer to the collection of Frederick V. Coville and Thomas H. Kearney, Jr., made on the Harriman Expedition.

² See Hooker, Bot. Misc. 3: 18. 1833.

not give the fish a bad taste as do some other kinds of fuel. The pounded bark is sometimes used, applied directly to a cut or wound, to assist its healing. Its name among the Tlinkit tribes, which extend from Yakutat Bay nearly to the British Columbia line, is 'chahtl,' or, more precisely, 'ch-ä'-tlh.'¹ The fact that the same name is applied to other and probably to all the species of willow in that region indicates how little the willows enter into the useful arts of the aborigines there, for in those parts of the United States in which the willow is employed in basket-making, the widely different textile qualities of the various species have caused the Indians to give them discriminating names. Among the Aleuts of Kadiak the word for various other species of willow 'nimuyok' (ni-mö-yäk'), is doubtless applied also to the satin willow.

SALIX ALAXENSIS (Anders.). Felt-leaf Willow.

Salix speciosa HOOK. & ARN. Bot. Beech. Voy. 130. 1832. Not Host. 1828.

Salix speciosa alaxensis ANDERS. in DC. Prodr. 16, pt. 2: 275. 1868.

Type locality of the original *speciosa*, Kotzebue Sound, Alaska; of *speciosa alaxensis*, "in Alaxa Americae occidentali-borealis."

As Hooker and Arnott's name for this willow had been used earlier for an old world species, the oldest available name, *alaxensis*, is here taken up.

Salix alaxensis extends from the northern part of the Alexander Archipelago westward along the Alaska coast to the peninsula, northward along the eastern side of Bering Sea through Bering Strait to Cape Lisbourne, and apparently more sparingly through the interior of Alaska to the Mackenzie River in British America. East of Kadiak Island it is associated with other species of tree willows, but west and north of that point it is the only willow that presents the form and dimensions of a tree. From the Shumagin Islands eastward full-grown specimens are ordinarily 20 to 30 feet in height with a trunk four to six inches in diameter. Under suitable conditions it doubtless reaches a still larger size. On the wind-swept Aleutian Islands, like all other arboreal vegetation, it appears to be wanting, but on the mainland to the north it appears again, on Buckland River, at the eastern end of Kotzebue Sound, reaching a height of 16 to 20 feet (according to Seemann in the 'Botany of the *Herald*'), farther north in the sound only eight feet, and at its northern limit, Cape Lisbourne, being reduced to a shrub only two feet in

¹The diacritic marks used are those of the Century Dictionary.

height. Like *Salix sitchensis*, it becomes almost prostrate on the naked gravels at the Muir Glacier, while only a few miles away, on older glacial deposits which have been re clothed with an abundant vegetation of shrubs, it develops into a handsome small tree, a difference of habit illustrating the marked effect of different local conditions. This willow differs notably from all the other Pacific Coast species in its foliage, so much so, indeed, that Hooker and Arnott, the conservative authors of the 'Botany of Captain Beechey's Voyage in the Blossom,' described the plant from specimens devoid of flowers or fruit. The under surface of the leaves is covered with a dense white wool or felt made up of curled and tangled hairs, presenting an appearance quite different from the velvety, or satiny, or cobwebby pubescence of other species. The leaves are narrowly to broadly elliptical-lanceolate, acute at the apex and base, smooth or nearly so on the upper surface, of an apparently thick texture, due largely to the dense woolly covering of the lower surface, often corrugate-reticulate, the margins of the very young leaves often minutely glandular-denticulate, at maturity usually entire and sometimes revolute, the stipules usually present, narrowly linear-lanceolate to filiform, and entire. The fruiting catkins are very long and thick, some of those collected reaching a length of 14 cm. and a diameter of 1.8 cm.

The detailed distribution of the felt-leaf willow as observed on the Harriman Expedition is as follows:

Glacier Bay.—Common on all the shores and lower mountain slopes about the bay, its gray foliage conspicuous among the alders. Specimens were collected in Muir Inlet (622, 639), at the Hooniah Village (663), and at Point Gustavus (696, 698, 699, 702).

Yakutat Bay.—Abundant on the west side and at the north end of the bay and its arms. Collected along the west side of the bay (1120, 1149), at Hidden Glacier, Russell Fiord (996), and at Hubbard Glacier, Disenchantment Bay (1058).

Prince William Sound.—At Port Wells (1270).

Cook Inlet.—Sparingly on the delta of a glacier at Halibut Cove, Kachemak Bay (2419).

Kadiak.—Abundant in the same situation as *Salix sitchensis* at Eagle Bay (1441).

Shumagin Islands.—A few trees observed at Sand Point (1798) and found sparingly by Mr. De Alton Saunders at various points on Unga and Popof.

Alaska Peninsula.—In Kukak Bay (1622), and abundant in Ste-povak Bay, along valley-bottoms, according to Dr. Charles Palache, who collected a specimen there.

Unalaska.—A single small tree was seen in cultivation in a yard at Unalaska, but the species was not observed in that vicinity in a wild state.

In addition to the specific localities given above, at which this willow was observed by the members of the Harriman Expedition, it has been found in Alaska to the eastward by Miss Grace Cooley on the moraine of the Davidson Glacier, and to the westward at Nushagak in Bristol Bay by McKay; in Norton Sound, Kotzebue Sound, and at Cape Lisbourne by Seemann; at the type locality, in Kotzebue Sound, by the botanists of the 'Blossom,' and at several points in the interior of the Territory.

SALIX AMPLIFOLIA sp. nov. Yakutat Willow.

Plant a shrub or small tree, attaining a height of 6 meters with a trunk 30 cm. in diameter; twigs stout, densely villous-pubescent the first season and usually retaining their villosity till the second or third year; leaves large, oval to broadly obovate, when fully developed 5 to 8 cm. long and half to two-thirds as broad, rounded at the base, but the lower ones sometimes wedge-shaped, entire or denticulate-serrulate on the margin, particularly below, obtuse and rounded at the apex or broadly acute, villous on both surfaces when young, but becoming smooth or nearly so at maturity, slightly glaucous beneath, on petioles seldom exceeding a centimeter in length; stipules, none on our specimens; catkins appearing with the leaves from bud scales usually densely villous or sometimes, like the twigs, glabrous from the early dropping of the pubescence, on leafy-bracted peduncles commonly a centimeter or two in length, stout, about 1.5 cm. in diameter and 4 to 6 cm. in length; staminate catkins with oblanceolate or lanceolate, dark brown or black, long-hairy scales, the two stamens in each flower with glabrous filaments about three times the length of the scales; pistillate catkins with light to dark brown scales similar to those of the staminate, the pistils on short hairy pedicels one or two millimeters in length and once to twice the length of the nectaries, the lanceolate ovary smooth or rarely showing a tendency to hairiness, the styles smooth, usually 3 to 4 mm. in length, though sometimes shorter, surmounted by the four linear-filiform stigma lobes about 1 mm. long; fruiting catkins often becoming at least 2 cm. in diameter, the capsules ovoid-lanceolate, smooth, and sometimes 9 mm. in length. (See Plate XV.)

Type specimen in the United States National Herbarium, collected on sand dunes on the west side of Yakutat Bay, Alaska, between June 19 and June 23, 1899, by Frederick V. Coville (No. 1153 of Coville & Kearney's collection).

Amplifolia resembles *alaxensis* in its size and robust growth, the usually densely villous character of its twigs, its very large catkins, the staminate catkins of the two being scarcely distinguishable, its long styles, and its slender stigma lobes. It has no real affinity with that species, however, but its nearest relative along the Alaska coast is possibly *Salix barclayi* Anders., a shrubby willow of abundant and wide distribution in that region. At our camp on the west side of Yakutat Bay, among the mouths of the streams that flow from the glaciers of the St. Elias mountain range, a series of sand dunes skirted the beach for a few miles and upon and near the dunes grew this willow, associated with *alaxensis*. It was ordinarily 10 to 15 feet high, with a trunk 3 to 4 inches in diameter, but some trees attained a height of 25 feet, with a trunk a foot thick. The numbers collected here are 1122, 1123, 1153, and 1158. Mr. Kearney, working meanwhile in Disenchantment Bay, a name applied to a portion of the upper waters of Yakutat Bay, collected specimens at the Hubbard Glacier (1061, 1062, 1074), on Egg Island (1013a), and on Haenke Island (1089). At these localities, as on the sand dunes below, it sometimes flowered and fruited as a shrub. Such specimens do not show in all respects the full vigor and typical characters of the larger plants, but they are believed to represent the species as influenced by various adverse conditions, such for example as drifting sand and shifting gravels.

SALIX BEBBIANA Sargent. Bebb Willow.

Salix rostrata RICHARDSON in Franklin, Journ. Pol. Sea. 753. 1823. Not Thuill. 1799.

Salix bebbiana SARGENT, Gard. & For. 8 : 463. 1895.

Type locality not given, but the description was based on specimens collected on Sir John Franklin's first expedition, in the interior of British America.

This willow is widely distributed, extending almost entirely across British America and occurring in most of the northern portions of the United States, extending southward in the East to Pennsylvania, in the Rocky Mountain region to New Mexico and Arizona, and on the Northwest Coast to Oregon. The leaves in the Alaska specimens are elliptical-lanceolate or ovate-lanceolate, either rounded or acute at the base, acute or acuminate at the apex, sparingly pubescent when young, becoming nearly smooth in age, usually crenate-denticulate, but sometimes entire, commonly 3 to 5 cm. long. *Salix bebbiana* was not observed by the members of the Harriman Expedition, but three speci-

mens of it, all from the Cook Inlet country, are now in the National Herbarium: one from the vicinity of Homer, collected in 1897 by Walter H. Evans (No. 470); another at Kussilof, in 1898, also by Mr. Evans (No. 693); and the third by Captain E. F. Glenn in 1899, probably from near the mouth of the Sushitna River. At the Homer locality, on the brushy portion of the sand spit east of the point, it grew as a shrub or small tree 4 to 15 feet in height; at Kussilof it grew 10 to 15 feet high, and 6 to 8 inches in diameter, often forming thickets. This willow is doubtless abundant throughout Cook Inlet, and is a member of that group of plants of the same region which belong geographically not to the Sitkan floral district, of the moisture-laden coast of southern Alaska, nor to the Aleutian flora, but to the flora of the interior of British America. Only further exploration can show decisively whether Cook Inlet forms an isolated western pocket of this interior flora, where certain species, in migrations caused by changing climatic conditions of earlier centuries, have found congenial surroundings similar to those of their intracoastal home, or whether the interior flora, which abuts against the Sitkan coast flora, extends in a continuous strip across the headwaters of the Yukon to the watershed of Cook Inlet, having pushed its way westward around the northern end of the Sitkan flora and between it and the southern limit of the subarctic flora. The data already at hand indicate that the distribution of some at least of these interior species is almost continuous to Cook Inlet, while that of others, like *Salix bebbiana*, may be interrupted over a wide area.

SALIX NUTTALLII Sargent. Nuttall Willow.

Salix flavescens NUTT. Syl. 1: 65. 1842. Not Host. 1828.

Salix nuttallii SARGENT, Gard. & For. 8: 463. 1895.¹

Type locality "in the range of the Rocky Mountains."

This willow belongs to a variable species finding its eastern limit in the Rocky Mountains, its western limit at the shore of the Pacific. It occurs as far south as Utah and Arizona, and in California extends southward along the coast to the bay of Monterey and along the Sierra Nevada to the San Bernardino range. Northward from California it is abundant along the coast and in the mountains to British Columbia. In Alaska it has been very sparingly collected, and along the coastal portion of the Territory it is apparently of rare occurrence. It was observed on the Harriman Expedition only at Wrangell (442), near

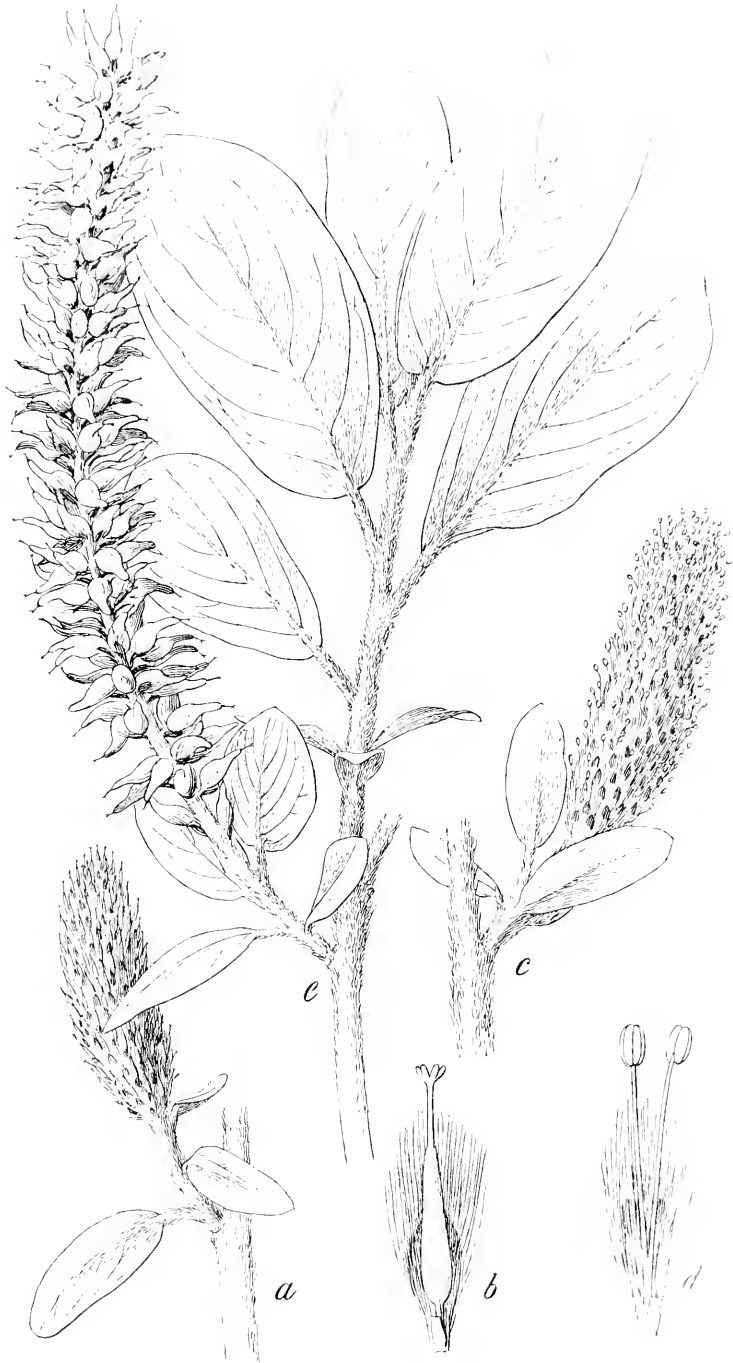
¹ For further synonymy, see Sargent's 'Silva of North America' and 'Sudworth's Nomenclature of the Arborescent Flora of the United States.'

Skagway (493, 503), and at Halibut Cove in Cook Inlet (2116). None of the Alaska specimens that we saw were more than 12 to 15 feet in height and 3 or 4 inches in diameter. The leaves are obovate to oblanceolate, tapering at the base, obtuse or sometimes acute at the apex, entire or occasionally somewhat crenate-denticulate, the lower surface with some scattered appressed hairs or, on vigorous shoots, a somewhat velvety pubescence, but without the satiny lustre of *sitchensis*. The series is so imperfect that, particularly in the lack of a critical revision of the various forms of this species known in the United States and British America, it is impossible to state conclusively the geographical relationship of these localities to the general range of the species. For the benefit of future observers, however, it may be suggested that the Cook Inlet and Skagway localities perhaps represent extensions of the interior or Rocky Mountain form through thin spots in the Sitkan coast flora, while the Wrangell locality may represent a northern extension of the form abundant on the coast of Oregon, Washington, and British Columbia.

PLATE XV.

Salix amplifolia.

- FIG. *a.* Pistillate catkin, seven-eighths natural size.
b. Pistillate flower, enlarged five diameters.
c. Staminate catkin, seven-eighths natural size.
d. Staminate flower, enlarged five diameters.
e. Fruiting branch, seven-eighths natural size.



Salix amplifolia sp. nov.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 287-314.

OCTOBER 10, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

V.

NOTES ON THE HEPATICÆ COLLECTED IN
ALASKA.

[Plates XVI-XVIII.]

BY ALEXANDER W. EVANS.

OUR knowledge of the Hepaticæ occurring in Alaska, although doubtless still very incomplete, has been materially increased by the collections of the Harriman Expedition, the number of known species having been nearly doubled. The collections made by earlier visitors to the Territory were for the most part small and fragmentary, and it was upon these that our previous knowledge was based. Up to the close of 1899, forty-one species had been recorded as Alaskan; the determinations of several of these, however, must be looked upon with a certain degree of doubt. The first reference to Alaska Hepaticæ is found in the 'Synopsis Hepaticarum' of Gottsche, Lindenberg, and Nees von Esenbeck, published in 1844-47. In this volume, five species are quoted, the specimens mentioned (with one or two possible exceptions) being preserved in the herbarium of the Imperial Academy of Sciences at St. Petersburg. It is quite probable that certain of these plants would now be referred to different species. In 1867, Dr. J. T. Rothrock¹ pub-

¹ Sketch of the Flora of Alaska. Rept. Smithsonian Inst. for 1867: 462.

lished a list of six Alaska Hepaticæ. The specimens were apparently collected by himself, and the determinations were made by T. P. James. None of these species are given as Alaskan in the 'Synopsis,' but all are common northern forms with the exception of '*Fimbriaria tenella*,' to which one specimen is doubtfully referred. This determination is probably incorrect; but, as I am informed by Mr. W. R. Maxon, the specimen in question is no longer to be found among the collections of the Smithsonian Institution at Washington, so that the matter cannot be definitely settled. The next list to appear is that of Herr Stephani,¹ published in 1887. It is the longest yet given and includes twenty-two species collected by Drs. Arthur and Aurel Krause in 1881-82. Of the plants mentioned in this list, only five had been previously recorded from Alaska, four are described as new, and several of the others are absent from all later collections.

Since the publication of Herr Stephani's enumeration, three very fragmentary lists by American authors have made their appearance. In the first² of these we find noted thirteen species, collected by Miss Grace E. Cooley, in southeastern Alaska and determined by Professor L. M. Underwood. Six of these species are here recorded for the first time. The second list³ names three species from St. Paul Island, of the Pribilof group, collected by Dr. C. Hart Merriam and likewise determined by Professor Underwood. All of these species had been previously reported from Alaska. In the third list⁴ are eight species collected by General Frederick Funston in the Yakutat Bay region and determined by the present writer. All except two of these were already known from the Territory. In addition to these three lists, which are parts of longer reports dealing pri-

¹ Hepaticæ von der Halbinsel Alaska. Engler's Bot. Jahrb. 8: 96-99. *pl.* 3. *figs.* 9-11. 1887.

² Cooley, G. E., Plants collected in Alaska and Nanaimo, B. C., July and August, 1891. Bull. Torr. Bot. Club, 19: 246, 247. 1892.

³ Merriam, C. Hart, Plants of the Pribilof Islands, Bering Sea. Proc. Biol. Soc. Wash. 7: 150. 1892. The same 3 Hepaticæ are included by J. M. Macoun in his List of the Plants of the Pribilof Islands, Bering Sea; published in Jordan's Report on the Fur Seals and Fur-Seal Islands of the North Pacific, 3: 587. 1899.

⁴ Coville, F. V., Botany of Yakutat Bay: Botanical Report. Contr. U. S. Nat. Herb. 3: 351. 1895.

marily with Alaskan plants, the Hepaticæ of the region in question are included by Mr. W. H. Pearson in his 'List of Canadian Hepaticæ'¹ and by Professor Underwood in his 'Preliminary List of the Pacific Coast Hepaticæ.'² Attention is also called to several interesting species, including four not elsewhere recorded, by Dr. Marshall A. Howe³ in two of his recent publications.

The brief survey just given considers those collections only of which published records have appeared. From time to time occasional specimens have been brought home by other visitors to the Territory, among whom Mr. C. H. Townsend, Mr. J. M. Macoun, and Mr. Thomas Howell should especially be mentioned. It is quite possible that some of the species reported in the present paper as new to Alaska may occur among their collections.

The hepatic flora of northern Alaska is essentially like that of other northern regions. A few of its species are known from Europe and America only, a still smaller number from Asia and America only, but the vast majority occur in a northern belt extending wholly around the earth. As we proceed southward, a few species characteristic of the Pacific Coast region of North America make their appearance and mingle with the more northern types. These include *Ptilidium californicum*, *Porrella navicularis*, *Radula bolanderi*, *Frullania nisquallensis*, and *Frullania franciscana*. The number of endemic species is extremely small, and at present not one of them can be quoted with any degree of certainty. Of the species proposed as new by Herr Stephani, *Scapania albescens* is reduced to a synonym of *Scapania bolanderi* by Mr. Pearson, doubt is thrown upon the two species of *Radula* by Dr. Howe, while the fourth species, *Frullania chilcootiensis*, is too incompletely known to be regarded as thoroughly established. As Dr. Howe has recently pointed out, *Lepidozia filamentosa* is

¹Published in Montreal, 1890.

²Zoe, 1: 361-367. 1891. Two species are here noted as Alaskan for the first time.

³The North American Species of *Porrella*. Bull. Torr. Bot. Club, 24: 512-527. 1897. The Hepaticæ and Anthocerotæ of California. Mem. Torr. Bot. Club, 7: 1899.

now known with certainty from Alaska only, but it has been reported from Japan and from antarctic America, and it is extremely probable that its range extends into British America.

The Hepaticæ brought back by the members of the Harriman Expedition, which are in condition to be identified, number 63 species, of which 38 are here recorded from Alaska for the first time. Adding to these the 42 species previously known from the Territory, gives a total of 80 species. In addition to these there have been recently sent me specimens of *Nardia compressa*, collected on Atka Island by J. M. Macoun in 1891, and specimens of *Grimaldia fragrans*, collected in the Yukon River district by Funston in 1894. Both of these are new to Alaska and increase the number of known species to 82. Of these 82 species, 7 (or about 9%) are Marchantiaceæ, 8 (or about 10%) are Metzgeriaceæ, and 67 (or about 81%) are Jungermanniaceæ. No representatives of the Ricciaceæ or of the Anthocerotaceæ are as yet definitely known from the Territory.

In the following list the principal collectors are indicated by initials only: 'T.' referring to Dr. William Trelease, 'B. & C.' to Professor W. H. Brewer and Dr. W. R. Coe, and 'C. & K.' to Messrs. F. V. Coville and T. H. Kearney, Jr. The other collectors are named in full. A few specimens collected by Professor W. A. Setchell in 1899 are also included in the list, although he was not a member of the Harriman party.

MARCHANTIACEÆ.

1. *Conocephalum conicum* (L.) Dumort.

Sitka (T. 1405); Juneau (B. & C. 694, in part, T. 1403); Orca (C. & K. 1204, T. 1404, in great part); Disenchantment Bay (B. & C. 636); Yakutat Bay (Saunders 1406); Farragut Bay (T. 1402). The species has also been collected in Alaska by Rothrock at Sitka and Iktigalik, by Miss Cooley at Salmon Creek, near Juneau, and by the Drs. Krause. It was also brought from Agattu Island by the Fish Commission in 1894.

2. *Preissia quadrata* (Scop.) Nees.

Juneau (Setchell 1241); Wrangell (C. & K. 408); Muir Glacier (T. 1410); Point Gustavus (Saunders 1411); Hooniah Village (C.

& K. 666); Port Wells (T. 1428). Also collected by the Drs. Krause, by Miss Cooley near Juneau, and by Funston at Coal Creek Hill, Yukon River district.

3. *Marchantia polymorpha* L.

Glacier Bay (T. 1409, C. & K. 757); Orca (T. 1408); St. Paul Island (T. 1413); St. Matthew Island (T. 1401); Hall Island (T. 1414). This cosmopolitan species has also been collected by Rothrock, by Bischoff, by the Drs. Krause, and by Miss Cooley.

Only 3 Marchantiaceæ occur in the collections. Of the other 4 species, already reported from Alaska, 2—the doubtful *Fimbriaria tenella* and *Grimaldia fragrans* (Balb.) Corda—have already been mentioned. The other 2 species are noted by Dr. Howe: one of these is *Asterella fragrans* (Schleich.) Trevis.,¹ which is ascribed simply to Alaska; the other is a species of *Sauteria*, probably *S. alpina* (Nees & Bischoff) Nees,² which was collected by Mr. Kincaid on St. Paul Island in 1897.

METZGERIACEÆ.

4. *Aneura latifrons* Lindb.

Mt. Verstovia (C. & K. 927, in part); Farragut Bay (C. & K. 454, in part, B. & C. 618, in part). New to Alaska.

5. *Pallavicinia hibernica* (Hook.) S. F. Gray, Nat. Ar. Brit. Pl. 2: 584. 1821.³

Jungermannia hibernica HOOK. Brit. Jung. *pl.* 78. 1816.

Dilæna hibernica DUMORT. Comm. bot. 114. 1822.

Marckia hibernica GOTTSCHÉ; Rabenhorst, Hep. eur. exsic. no. 121. 1860 (in obs. *Blyttia lyellii*).

Dioicous: ♂ and ♀ plants mixed together, green: thallus prostrate, often creeping among other bryophytes, dichotomous, of about the same width throughout; midrib 15–20 cells thick in the middle on robust plants, strongly convex below, slightly concave above, narrowing rather abruptly on each side into a broad, translucent wing a single cell thick; margins of the wings more or less crispate-undulate; cells of the thallus everywhere with thin and colorless walls except in the postal part of the midrib, where they are slightly thicker and brownish: rhizoids numerous, white: archegonia in groups of 10 to 20 on the upper surface of the thallus near the apex, surrounded

¹ Mem. Torr. Bot. Club, 7: 39. 1899.

² L. c., 56.

³ A fuller synonymy is given by Lindberg, Not. ur Sällsk. pro F. et Fl. Fenn. 9: 15. 1868.

by very irregular, more or less laciniate scales, connate with each other and with the base of the pseudoperianth; laciniæ of the scales variously dentate or ciliate; pseudoperianth cylindrical or obovate, mouth slightly contracted, irregularly lobed and finely denticulate from projecting cells; calyptra about half as long as pseudoperianth: ♂ scales sometimes distant and arranged in two distinct rows, one along each side of the midrib, sometimes more imbricated and less definitely arranged, variously connate with each other or free, margins irregularly lobed and toothed with sharp and often ciliate divisions; antheridia 1 to 3 in each axil, borne on short stalks; paraphyses few: capsule oval, on a long stalk, brown, valves several cells thick in the middle; spores brownish or greenish, the wall with fine, irregularly curved and angular ridge-like thickenings, scarcely forming a network; elaters rather broad in the middle tapering to each end, spiral bands 1 or 2, broad, brownish.

Thallus 3-3.5 mm. broad, wings 0.7-1 mm. broad on each side of midrib, cells of wing 24 μ in diameter, pseudoperianth 3-4 mm. long, 1-1.3 mm. in diameter, ♀ scales about 1.2 mm. long, antheridia 0.25 mm. in diameter, capsule 1.2 \times 0.6 mm., spores 25 μ in diameter, elaters 0.1-0.2 mm. long, 12 μ wide in broadest part.

Yakutat (C. & K. 1145). New to Alaska.

Pallavicinia hibernica has already been recorded from British Columbia¹ and has a wide distribution in Europe. The Alaskan material includes both male and female specimens. The female plants are old and the pseudoperianths are mostly withered, but a few of them show the characteristic capsules. The male plants are robust and in excellent condition and show several indistinct rows of crowded antheridial scales on the upper surface of the midrib. According to Limpricht² and some of the older European writers, these scales should alternate with each other and be arranged in two longitudinal rows. Among the European material studied, the only male plants which I have been able to examine were collected in Ireland by Moore and distributed by Rabenhorst in Hep. eur. exsic. no. 295. These have old and empty antheridial scales, almost as crowded as in the Alaskan specimens, and certainly arranged in more than two ranks, and this irregularity of arrangement is also described by Leitgeb.³ The scales in the Irish plant are a little more toothed than in the Alaskan, but the specimens agree so perfectly in all other respects that I have no hesitation in pronouncing them the same.

¹ Cf. Underwood, *Zoe*, 1: 365. 1891.

² Cohn, *Kryptogamenfl. von Schlesien*, 1: 326. 1876.

³ *Unters. über die Leberm.* 3: 87. 1877.

Pallavicinia hibernica differs from *P. lyellii*, which is rather common in eastern America, in having in the midrib no central strand composed of elongated thick-walled cells. This difference places it in the subgenus *Mavckia*, which is regarded as a distinct genus by several European writers. Its closest ally is *P. blyttii* (Mörck) Lindb., a widely distributed European species, which may be expected also in northern America. *P. hibernica* differs from this species in its smaller size, in its white and not yellow rhizoids, in the comparatively broader unistratose wings of its thallus, in the sharper points on the divisions of its ♂ and ♀ scales, and in its spores, which are not tuberculate-spinose.

6. *Pellia endiviæfolia* (Dicks.) Dumort.

Yakutat (Saunders). New to Alaska.

7. *Pellia neesiana* (Gottsche) Limpr.

Douglas Island (T. 1418, in part); Juneau (Saunders 1420); Port Wells (T. 1430, in part); Orca (T. 1425a); Yakutat (T. 1440). New to Alaska.

Many other sterile specimens of *Pellia* occur in the collection, but cannot be determined. It is probable that some of them are *P. epiphylla* (L.) Corda, which has been recorded by Miss Cooley from Salmon Creek, Sitka, and which is also mentioned by Professor Campbell¹ as abundant in Alaska.

8. *Blasia pusilla* L.

Juneau (T. 1421). New to Alaska.

Two species of *Metzgeria* have also been recorded from Alaska: *M. hamata* Lindb., collected by Miss Cooley at Gold Creek near Juneau, and *M. pubescens* (Schrad.) Raddi, collected by Miss Cooley in the same locality and also by the Drs. Krause at Chilcoot. Dr. Trelease's 2355 from Sitka, is a species of this genus, but is sterile and gemmiparous, and cannot be clearly identified.

JUNGERMANNIACEÆ.

9. *Gymnomitrium obtusum* (Lindb.) Pears. Journ. Bot. 18: 337. 1880.

Cesia obtusa LINDB. Medd. Soc. F. et Fl. Fenn. 3: 190. 1878.

Dioicous: densely caespitose or scattered among other bryophytes, pale glaucous-green throughout, or at the tips of the stems and branches, brighter green and sometimes tinged with brownish or red-

¹Amer. Nat. 33: 397. 1899.

dish: stems sparingly branched, canaliculate when dry along antical surface (between the rows of leaves), convex postically, on sterile plants of about the same width throughout, on sexual plants broadening clavately upward: leaves transversely inserted, densely imbricated, strongly concave and appressed symmetrically, broadly ovate or oval (when flattened), equally bilobed $\frac{1}{6}$ – $\frac{1}{4}$ the length of the leaf with a very narrow sinus, broadening upward, and rounded or very obtuse lobes, sometimes overlapping slightly at the base; margins distinctly crenulate from projecting cells except in basal portions of leaf; green tissue of leaf limited to a patch extending from the base to, or considerably beyond, the middle, surrounded by a distinct hyaline border, except sometimes close to the antical base; marginal cells in crenulate portion of leaf with rather uniformly thickened walls, remaining hyaline cells with large and often confluent trigones, green cells with thin walls and distinct but sometimes very small trigones; cuticle densely and minutely verruculose, particularly in the hyaline portions of leaf: ♀ inflorescence borne on a principal branch, outer bracts in three or four pairs, closely imbricated, similar in shape to the leaves, but larger, squarrose at the apex and more or less reflexed on margins of lobes; inner bracts much smaller and more delicate in texture, irregular in shape and variously lobed or cleft with subacute divisions, slightly crenulate on the margins from projecting cells and persistent papillæ; archegonia numerous (up to 10 or 12): ♂ inflorescence on a principal branch; bracts in several pairs, closely imbricated, similar to the leaves in shape but more delicate in texture, subsquarrose at apex and often reflexed along margins of lobes; antheridia two in each axil, one on a much longer stalk than the other: capsule dark brown, globose, borne on a short stalk extending slightly beyond the cluster of ♀ bracts, capsule-wall composed of two layers of cells; thickenings in the partition-walls of outer layer very conspicuous, dark brown, rounded, extending $\frac{1}{3}$ – $\frac{1}{2}$ across cell-cavity, more or less confluent at the base; similar thickenings of inner layer smaller and less distinct but deeply pigmented, half-ring thickenings of same layer much paler, often indistinct or wanting; spores brown, somewhat angular, with a thick, very minutely verruculose wall; elaters brown, mostly bispiral.

Leaves 0.8×0.75 mm., leaf-cells at edge of leaf 14μ in diameter, in the middle 17μ , at the base $30 \times 22 \mu$, outer ♀ bracts 1.1×1.1 mm., ♂ bracts 0.85×0.85 mm., spores 13μ in diameter, elaters 40 – 70μ long, 7μ wide.

Orca (T. 1512, in part, ♀ specimens with capsules). New to Alaska.

Gymnomitrium obtusum is probably as common in the northern parts of North America as in northern Europe, but is known with certainty from very few localities. So far it has been recorded from Greenland only, where it was collected many years ago by Vahl. It has, however, been found by Holzinger in northwestern Montana and by J. Macoun on Vancouver Island. The specimens of the latter were distributed as *Cesia concinnata*, in 'Canadian Hepaticæ,' no. 63.

Although *Gymnomitrium obtusum* is the only member of the genus occurring in the Harriman collections, two other species have been reported from Alaska: *G. concinnatum* (Lightf.) Corda, which was collected at 'Tahiti' by the Drs. Krause, and *G. coralloides* Nees, which the same collectors found in the 'Dejathal.' The latter species has also been found on St. Paul Island by Merriam and by J. M. Macoun. *G. coralloides* is rather closely related to *G. obtusum*, but can readily be distinguished even in sterile condition. In *G. coralloides*, the very young leaves are shortly but distinctly bilobed at the apex with rounded or obtuse lobes and narrow sinus. On the margin is a single row of thin-walled projecting cells, making the leaf distinctly crenulate, at least in the upper part. As the leaf becomes older, the walls of these marginal cells remain thin, except where they bound the next inner cells; the cells themselves become perfectly hyaline and lifeless, the projecting outer walls collapse and are sometimes entirely worn away, so that the outlines of the cells become very indistinct. On account of these changes, the shallow sinus of the leaves grows less and less marked, and in mature leaves cannot always be distinguished. The cells just within the empty marginal cells acquire thick walls very early. The thickenings first appear as small but distinct trigones; these increase in size very rapidly and soon become confluent, so that the cell-cavities are oval or circular in outline. Several rows of these cells also become empty and hyaline, but their thick walls prevent them from collapsing. The green cells, which are found in the middle and toward the base of the leaf, have thin walls and small, sometimes very minute, trigones. They pass by gradations into the thick-walled submarginal cells. The cuticle of the leaves is smooth throughout.

10. *Marsupella emarginata* (Ehrh.) Dumort.

Port Wells (T. 2273); Columbia Fiord (C. & K. 1383, in part, 1384a, 1386); Juneau (Setchell 1232). New to Alaska.

The closely related *Marsupella sphacelata* (Gieske) Dumort. has already been collected in Alaska by the Drs. Krause.

11. *Nardia scalaris* (Schrad.) S. F. Gray.

Juneau (B. & C. 694a).

Although this species is rather common in Europe, it has been very rarely collected in America. In addition to the station mentioned above, it was found at Yes Bay, Alaska, by Howell, in 1895, and was also collected by Professor Farlow on Cambobello Island, New Brunswick, close to the Maine boundary, in 1898. It was first recorded as American by Pearson, on the strength of specimens collected by J. Macoun on Vancouver Island.

On account of its strongly concave and closely imbricated leaves, *Nardia scalaris* bears some resemblance to large forms of *N. crenulata*, except that it grows in more compact tufts and is likely to be greener. Even without its characteristic fructification, the species is readily recognized by its lanceolate underleaves, which are persistent and much more conspicuous than in any of our other hepatics with undivided leaves. The large and glistening 'fat-bodies' are also a striking feature in many cases; they are oval in form, though sometimes with an irregular contour, and 2 or 3 of them are usually present in each cell. The trigones of the cells are always distinct but are sometimes small. The species has been well represented by Hooker,¹ and the cell-structure is figured by Gottsche.²

12. *Nardia hæmatosticta* (Nees) Lindb. Musc. scand. S. 1879.

Jungermannia scalaris β *minor* NEES, Naturg. der europ. Leberm. 1: 281. 1833.

Jungermannia hæmatosticta NEES, l. c. 2: 453. 1836.

Alicularia geoscypha DE NOT. Mem. Acc. Tor. II. 18: 486. 1859.

Alicularia scalaris β *minor* NEES; G. L. & N. Syn. Hep. 11. 1844.

Nardia geoscypha LINDB.; Carr. Brit. Hep. 27. 1874.

Alicularia minor LIMPR.; Cohn, Kryptogamenfl. von Schlesien. 251. 1877.

Nardia minor ARNELL, Lebermosstudien im nördl. Norwegen, 39. 1892.

Paroicus: densely and intricately cæspitose, green, sometimes tinged with reddish; stems prostrate, ascending at the tips, attached by a thick felt of whitish rhizoids: leaves on slender and sterile branches distant, on robust and fertile axes imbricated, obliquely inserted or, sometimes, almost transverse, broadly orbicular, rounded or broadly emarginate at the apex, entire or slightly sinuate: cell-walls rather thin, with small but very distinct trigones, cuticle smooth or verruculose: underleaves lanceolate, minute, fugacious except in the inflorescence: ♀ inflorescence borne on a principal branch; stem-apex hollowed out into a rudimentary, radiculose sac, extending downward at right angles to axis; bracts in 3 or 4 pairs, gradually increasing in size

¹ Brit. Jung. pl. 61. 1816.

² Gottsche & Rabenhorst, Hep. eur. exsic. no. 223.

toward perianth, similar to the leaves but broader, irregularly lobed or simply crispate-sinuate on the margins; innermost bracteole large, irregularly bilobed or trilobed, the lobes mostly rounded, second bracteole much smaller, other bracteoles indistinct; perianth extending scarcely if at all beyond the bracts, delicate in texture, contracted at the denticulate or subentire mouth; archegonia about 10: antheridia borne in the axils of the ♀ bracts: capsule on a long and slender stalk, spherical or slightly longer than broad; spores very minutely verruculose.

Leaves 0.7×0.9 mm., underleaves $70 \times 25 \mu$, leaf-cells in the middle and at the edge of leaf 20μ in diameter, at the base $32 \times 23 \mu$, ♀ bracts 0.7×1.2 mm., spores 16μ in diameter.

Disenchantment Bay (B. & C. 637a, in part, 641, 641a, T. 1504); Hidden Glacier Inlet (T. 1505, in part); St. Lawrence Island (T. 1517, C. & K. 2007, in part). New to Alaska.

Nardia hæmatosticta is apparently also new to the American continent, but has recently been reported from Greenland.¹ It seems to be much rarer in Europe than *N. scalaris*, but has a wide distribution there in northern and mountainous regions. By many of the earlier writers it was included under this latter species as a variety; it is, however, well distinguished by its smaller size, its less concave and sometimes emarginate leaves, its parvicous inflorescence, and by the early disappearance of its underleaves. These are, in fact, very difficult to demonstrate except in connection with the inflorescence and in very young apical regions, where the leaves are still undeveloped. The curious 'fat-bodies,' so characteristic of *N. scalaris*, are either absent from the smaller species or are inconspicuous. The rudimentary sac of *N. hæmatosticta* is a most interesting feature and indicates, as has already been pointed out by other writers, an approach to such typically saccate genera as *Arnellia* and *Gyrothyra*. The species has been well figured by Schiffner² and by Massalonga and Carestia.³

13. *Nardia obovata* (Nees) Lindb.

Farragut Bay (T. 1464, in part); Kadiak (T. 1416, in part). New to Alaska.

The present species was first recorded for the United States by Dr. Howe,⁴ who based his determination upon sterile California specimens.

¹Jensen, Medd. om Grønland, 15: 381. 1898.

²Engler & Prantl, Nat. Pflanzenfam. 1³: 78. 1893.

³Nuovo Gior. Bot. Ital. 14: pl. 12, fig. 2 and pl. 13. 1882.

⁴Mem. Torr. Bot. Club, 7: 96. 1899.

It had previously been reported from Greenland¹ and from tropical America (New Granada).² The plant is probably much less rare in America than might be inferred from these meager published notices; and has in fact already been twice distributed under different names in 'Hepaticæ Americanæ' (no. 83, as *N. crenuliformis*, and no. 113, as *Jungermannia cordifolia*). In both instances the specimens were collected by the writer in the White Mountain region. The Alaskan plants referred to *Nardia obovata* agree perfectly with authentic European specimens, except that it is impossible to demonstrate the paroicous inflorescence in a wholly satisfactory manner. Some of the Farragut Bay specimens have ripe capsules and these show, below the adnate perichæatial bracts, a few slightly saccate leaves, which may well be the perigonal bracts. Other specimens show young antheridia, but no archegonia; some of the antheridia, however, are extremely immature, and it is possible that the female organs have not yet begun to develop. It should be noted also that European authors are not unanimous in ascribing a paroicous inflorescence to this species; Herr C. Müller, of Freiburg, in fact, says in a recent paper that it is dioicous.³ The delicate striations in the cuticle of the leaves are sometimes either transitory or poorly developed; it is usually possible to find them, however, even where they are otherwise indistinct, in the somewhat elongated cells near the base of a leaf.

The fourth Alaskan species of this genus, *Nardia compressa* (Hook.) S. F. Gray, from Atka Island (J. M. Macoun), was collected many years ago in Greenland, but has not since been recorded from America. It is our largest species, and, when well developed, grows in compact tufts, the individual stems being erect or nearly so. The leaves are broadly orbicular or reniform, closely imbricated and appressed to the stem. The underleaves are small and fugacious and the rhizoids are very scanty. In many cases the plants give off flagella, which are particularly well seen on young and prostrate stems. On such plants also the leaves are less appressed than on older specimens.

14. *Jungermannia sphærocarpa* Hook.

Hooniah Village (C. & K. 664); Disenchantment Bay (B. & C. 637a, in part); Port Clarence (T. 1514, 2116, Fernow 1515, in great part). New to Alaska.

¹Jensen, Medd. om Grønland, 15: 381. 1898.

²Gottsche, Ann. des Sc. Nat. V. 1: 119. 1864.

³Mitteil. des Bad. bot. Vereins. 1899: 8 (reprint).

15. *Jungermannia atrovirens* Dumort. Syll. Jung. 51. 1831.

Aplozia atrovirens DUMORT. Hep. Europ. 63. 1874.

Virgin Bay (Saunders 1427, in small part). New to Alaska.

The specimens referred to this species, although very scanty, show both male plants and female plants with perianths. They are mixed with sterile specimens of an *Aneura* and a *Lophozia*, both of which are indeterminable. *J. atrovirens* was first described by Dumortier, but his description was so incomplete that the plant remained unrecognized by European hepaticologists until the type-specimens were discovered by Dr. Henri Bernet in the Schleicher Herbarium. Bernet described the species more fully and gave an excellent figure of it, citing numerous Swiss localities where it had been found.¹ The plant has since been recorded from Scandinavia, from Styria, and from Greenland. *J. atrovirens* differs from *J. pumila* With. mainly in its dioicous inflorescence and more plicate perianth. Some of the Alaskan specimens show distinct but often minute trigones in the younger leaves. These seem to become indistinct with age, and are not to be clearly made out in the European material which I have studied.

16. *Jungermannia lanceolata* L.

Juneau (B. & C. 699). New to Alaska.

Jungermannia cordifolia Hook., collected by the Drs. Krause at 'Tlehini,' does not appear in the Harriman collections.

17. *Anastrophyllum reichardtii* (Gottsche) Steph. Hedwigia, 32 : 140. 1893.

Jungermannia reichardtii GOTTSCHÉ ; Juratzka, Verh. zool.-bot. Gesellschaft zu Wien, 20 : 168. pl. 3 B. 1868.

Jungermannia nardioides LINDB. Musc. Scand. 8. 1879.

Dioicous: caespitose or scattered among other bryophytes, blackish-purple varying to brownish or brownish-green, glossy: stems dark, firm and rigid, prostrate or usually ascending, simple or very sparingly branched, in ♀ plants often repeatedly innovant, more or less radiculose below with whitish or brownish rhizoids, mostly eradiculose above: leaves more or less imbricated, ovate to rotund-quadrate when explanate, complicate-bilobed about one-third with more or less incurved, mostly acute lobes and acute or obtuse sinus, antical lobe slightly smaller than the postical, arching across stem at the rounded or subcordate base, margin of leaves entire: leaf-cells with thick walls and large, irregular, and often confluent trigones, but no intermediate thickenings, cell-lumen distinctly stellate except near the edges and

¹ Cat. des Hépat. du Sud-Ouest de la Suisse, 60. pl. 2. figs. 2, 3. 1888.

toward the base of the leaf; cuticle smooth: ♀ bracts a little larger and paler than the leaves but otherwise scarcely distinguishable from them, lobes a little more acute, with entire or very obscurely angular-dentate margins; bracteoles wanting; perianth ovate-cylindrical, gradually contracted and deeply 4- to 5-plicate in the upper part, the mouth lacerate with ciliate divisions, the cilia slender, variously curved and contorted; color of the perianth pale at the base, hyaline at the mouth, reddish or brownish in a broad median zone; cells in a single layer except at the very base, thick-walled, some of the cells in the upper part projecting outward and upward as obtuse or subacute papillæ, one or two cells long; archegonia 10–12: ♂ spike intercalary, bracts in 6–10 pairs, imbricated, smaller than the leaves and more delicate but similar in shape, strongly concave, arching across axis and sometimes bearing a small lanceolate or ovate lobe-like tooth at antical base; antheridia mostly in pairs; paraphyses sometimes present, minute and very variable in shape, from subulate to oblong and from acuminate to obtuse at the apex: sporophyte unknown.

Stem 0.2 mm. in diameter, leaves 0.9×0.8 mm., leaf-cells at edge of leaf 14μ in diameter, in the middle $19 \times 17 \mu$, at the base $35 \times 17 \mu$, ♀ bracts 1.05×0.95 mm., perianth 2.2×1 mm., ♂ bracts 0.7×0.75 mm.

Columbia Fiord (C. & K. 1389); Orca (T. 1512, in part); Port Wells (T.). New to America.

The discovery of this local European species in America is a matter of much interest, more particularly as the specimens are more complete than any that have yet been described. The plant is known in Europe from various parts of Austro-Hungary, from Italy, and from the mountainous regions of southeastern Norway, where, according to Kaalaas, it is not especially uncommon.

It will be noticed that my description of the perichaetial bracts and perianths does not agree in all respects with the published descriptions of European authors. Upon consulting these descriptions, however, it will be found that they are at variance with one another and that all are drawn from specimens with undeveloped perianths. The earliest account of the floral organs is that given by Limpricht,¹ and is as follows: bracts smaller and more tender [than the leaves], hollow, sharply incised, sparingly toothed; bracteole almost rectangular, many times irregularly incised; perianth immersed, very tender, plicate, deeply and irregularly laciniate-ciliate; archegonia about 12, always unfertilized. He states also that scattered cells of the perianth some-

¹ Cohn, Kryptogamenfl. von Schlesien, 1: 279. 1876.

times grow out into long papillæ. According to Stephani,¹ the bracts are much larger than the leaves, orbicular, with a shorter sinus and incurved lobes, forming a terminal incurved bunch; the perianth is immersed, small, almost hyaline, oval, strongly plicate, ciliate-laciniate at the mouth. Massalongo² describes the parts as follows: bracts bifid to quadrifid; perianth erect, oval, immersed in the involucre, plicate, mouth ciliate-laciniate, the laciniaæ on the external surface subechinate from projecting cells. The description given by Kaalaas³ agrees closely with that of Limpricht.

Of European material, I have studied Styrian specimens collected by Herr Breidler and Norwegian specimens collected by Dr. Bryhn. I find in these that the plants are either sterile or female, and that the latter are repeatedly floriferous by means of innovations. The bracts are similar to the leaves except that they are a little larger, and in no case have I been able to find more than two lobes. The perianth is always small and rudimentary, and closely agrees with the descriptions of the European authors. I have, however, been quite unable to find any trace of a bracteole. The Alaskan specimens agree perfectly with this European material, some of them in fact showing the peculiar rudimentary perianths with their innovations. The specimens with fully developed perianths, however, are often destitute of such innovations.

The genus *Anastrophyllum* is most luxuriant in the mountainous regions of the Tropics, where it is represented by numerous species. *A. reichardtii* is not a typical member of the genus, being intermediate between *Anastrophyllum* and the *Sphenobolus* section of *Lophozia*. In fact it was the existence of this species (and of one or two others) that deterred Spruce from elevating his group *Anastrophyllum* to generic rank, as was afterwards done by Stephani. The present species has, in common with the genus, the reddish color, the very thick-walled leaf-cells with stellate cavities, and the lacerate perianth with ciliate divisions. The plants described by Lindberg as *Jungermannia nardioides* do not show the cell-characters of *A. reichardtii* in a very marked degree and are probably to be looked upon as poorly developed individuals.⁴

18. *Lophozia ventricosa* (Dicks.) Dumort.

Juneau (B. & C. 702, in part); Sitka (C. & K. 927, in small part); Douglas Island (T. 1498, in part); Virgin Bay (T. 1457, in small

¹ Ber. des bot. Vereins zu Landshut, 7: 35. 1879.

² Atti Soc. Veneto-Trent. II, 2: (37). 1895.

³ Nyt Mag. for Naturvidensk, 33: 371. 1893.

⁴ Cf. Kaalaas, Vidensk. Skrifter I. Math.-nat. Klasse, no. 9: 18. 1898.

part); Columbia Fiord (C. & K. 1396, 1400, in part); Port Wells (T. 1530, 1475, in part); Orca (T. 1529, in part); Yakutat (Saunders 1438, T.); Kadiak (C. & K. 2321, in part); Port Clarence (Fernow 1515, in small part). This common and widely distributed species occurs in the Krause collections; it has also been found on Popof Island by Townsend, and on St. George and Nagai islands by J. M. Macoun.

19. *Lophozia guttulata* (Lindb. & Arnell).

Jungermannia guttulata LINDB. & ARNELL, Kongl. Sv. Vet. Akad. Handl. 23, No. 5: 51. 1889.

Dioicous: depressed-cæspitose, green, varying to brownish; stems reddish-brown to black, densely radiculose, sparingly branched; leaves distant to imbricated, obliquely inserted, spreading or the upper ones often complicate, slightly decurrent, bifid one-third to one-half with triangular, acute or acuminate, slightly divergent lobes and acute to obtuse, often gibbous, sinus, margin entire: underleaves wanting: leaf-cells with thin walls but distinct and very large, sometimes confluent trigones, projecting out into the stellate cell-cavities; cuticle smooth: innermost ♀ bracts erect-spreading, bifid to quadrifid about two-fifths with triangular, obtuse to short-acuminate, often unequal lobes, margins otherwise subentire; bracteole very variable, lanceolate or bifid, connate on one or on both sides; perianth cylindrical or obovate-clavate, contracted at the ciliolate mouth (the cilia mostly two to four cells long), terete below, plicate in upper fourth: ♂ plants mixed with the ♀, bracts in several pairs, strongly saccate at base, cells in saccate portion often with slightly and uniformly thickened walls, other cells normal.

Leaf-cells at edge of leaf 22 μ in diameter, in the middle 28 μ , and at the base 35 μ .

Point Gustavus, Glacier Bay (C. & K. 758); Columbia Fiord (C. & K. 1397, 1400, in part); Kadiak (C. & K. 2321, in part). New to America.

Lophozia guttulata was first described from Siberian specimens, but is now known also from various parts of Scandinavia, from Austria, and from Italy. Professor Massalongo¹ looks upon it as a variety of *Lophozia ventricosa*, and it approaches somewhat certain forms which were formerly included under *Jungermannia porphyroleuca*. When well developed, however, it is very easily distinguished and is probably entitled to specific rank. The most important differences between it and *L. ventricosa* are the following: the plants are smaller;

¹ Atti Soc. Veneto-Trent. II, 2: (14). 1895.

the leaves are more deeply lobed with more sharply pointed divisions and gibbous sinus; the leaf-cells have very large and conspicuous trigones, which are sometimes confluent; gemmæ are either entirely absent or are extremely rare. The innermost ♀ bracts and bracteole are more variable than the original description represents, and this variability affects not only the Alaskan specimens but European specimens as well. The species is apparently confined to rotten logs.

20. *Lophozia incisa* (Schrad.) Dumort.

Hot Spring, near Sitka (T.); Juneau (B. & C. mixed with 641, 691, 699, and 702, Setchell 1229, in part); Columbia Fiord (C. & K. 1391, in part, 1403); Orca (T. 1444, 1491, in part, 2249); Kodiak (C. & K. 2321, in great part); Hall Island (T. 1442). New to Alaska.

21. *Lophozia obtusa* (Lindb.).

Jungermannia obtusa LINDB. Musc. Scand. 7. 1879.

Juneau (B. & C. mixed with 693). New to America.

There are only a few sterile stems of the present plant in the collection, but there is little doubt that they should be referred to this rare European species. The Alaskan specimens have been carefully compared with authentic plants from Norway, kindly sent me by Dr. Bryhn, and I find that they agree in all essential respects. The species was first described by Lindberg from specimens collected near Stockholm, and has since been found in various other parts of Scandinavia. It is known also from Styria, from Switzerland, and from Italy, but has not been reported either from America or from Asia. The plant is well figured by Bernet¹ and is so fully described by Arnell,² that I add here simply a short account of the stem and leaf characters: Creeping among other bryophytes or rarely caespitose, green; stems mostly simple, becoming more or less pigmented with age, and bearing numerous short, whitish rhizoids: leaves distant or, more rarely, subimbricated, very obliquely inserted, plane or slightly concave, rotund, bifid about one-third with broad, mostly rounded lobes, separated by a narrow, obtuse and gibbous sinus; antical lobe subequal to the postical or a little smaller, in some cases varying from rounded to obtuse, apiculate or even acute on the same stem; margins slightly decurrent, entire, or bearing a small tooth-like lobe near the antical base: underleaves rudimentary and apparently often fugacious, simple or deeply bifid with subulate divisions, sometimes irregularly and

¹ Cat. des Hépat. du Sud-Ouest de la Suisse, *pl. 4.* 1888.

² Lebermoosstudien im nördl. Norwegen, 30. 1892.

sparingly toothed: leaf-cells with thin walls and minute but distinct trigones; cuticle delicately striate-verruculose.

22. *Lophozia inflata* (Huds.) M. A. Howe.

Kadiak (C. & K. 1426). New to Alaska.

23. *Lophozia heterocolpa* (Thed.) M. A. Howe.

Port Wells (B. & C. mixed with 652 and 654). New to Alaska.

24. *Lophozia attenuata* (Lindb.) Dumort.

Virgin Bay (T. 1474, in part). New to Alaska.

25. *Lophozia quinquentata* (Huds.) Schiffn.

St. Matthew Island (T. 1480, 1519, in part, 2161, in part). New to Alaska.

26. *Lophozia floerkii* (Web. & Mohr) Schiffn.

Orca (T. 1529, in part), Port Wells (T.). New to Alaska.

27. *Lophozia quadriloba* (Lindb.).

Jungermannia quadriloba LINDB.; Lindb. & Arnell, Kongl. Sv. Vet. Akad. Handl. 23, no. 5: 55. 1889.

Hooniah Village (C. & K. 665). New to Alaska.

This distinctly arctic and alpine species has not before been recorded from the American continent: it is now known from various parts of northern Europe including the island of Spitzbergen, from Styria, from Siberia, and from Greenland. The Alaskan plants agree closely with Norwegian specimens collected by Dr. Arnell. Lindberg's description is so full that I give here simply an account of the leaves and underleaves, drawn from the sterile Alaskan material: leaves remote or imbricated, almost transversely inserted, widely spreading from the base, almost erect in the upper half, lobed to about the middle with 3 or 4 (rarely only 2) acute or obtuse, triangular lobes separated by narrow sinuses; margins mostly entire, but bearing at the base, both antically and postically, a very few (usually only one or two) small, variously curved cilia, mostly 6-10 cells long and 1-3 cells wide at the base: underleaves deeply bifid with triangular-subulate, long-acuminate lobes separated by a narrow sinus; basilar cilia similar to those of the leaves: leaf-cells with thick walls and distinct, slightly bulging trigones; cuticle densely covered with coarse verrucæ, circular or oval in outline or, near the base of the leaf, tending to be elongated; cells at the edge of the leaf 14 μ in diameter, in the middle 17 μ and at the base 30 \times 17 μ .

The nearest relative of *Lophozia quadriloba* is perhaps *L. floerkii*, which differs in its larger size, in its obliquely inserted and less deeply

lobed leaves, and in its thinner walled leaf-cells with smooth or nearly smooth cuticle and smaller trigones. In *L. kunzeana* (Hübner.), which is also a close ally, the leaves are more distinctly complicate, so that the plant appears flattened rather than terete-foliolate as in *L. quadriloba*; the leaves moreover are usually only bilobed, they lack basal cilia, and their cells have a smooth or minutely striate-verruculose cuticle.

28. *Lophozia minuta* (Crantz) Schiffn.

Columbia Fiord (C. & K. 1388, in part); Orca (T. 1511, in part); Hall Island (T. 1518, in part); St. Lawrence Island (T. 2125, in great part). The species was first collected in Alaska by the Drs. Krause at Chilcoot; it has also been found at Sitka (U. S. Fish Commission, 1894), and on Popof Island (Townsend).

29. *Lophozia ovata* (Dicks.) M. A. Howe.

Yakutat (T. in very small amount, mixed with 1527). New to Alaska.

The generic position of this little species is still a matter for discussion: by certain authors it is placed in the genus *Diplophyllia* Trevis. (*Diplophyllum* Dumort.); by others it is considered a species of the *Sphenobolus* section of *Lophozia*.¹ It forms, in fact, a connecting link between these two groups of Hepaticæ. The closely related *Diplophyllum argenteum* Spruce,² a species apparently confined to the northwestern coast regions of our continent, is also recorded as Alaskan by Professor Underwood.³

Lophozia saxicola (Schrad.) Schiffn., which was collected by the Krause brothers in Alaska, does not appear in the Harriman collections.

30. *Plagiochila asplenioides* (L.) Dumort.

Farragut Bay (T. 1469, a single sterile stem). The species is known also from Sitka (U. S. Fish Commission, 1894) and from near Yakutat (Funston), and ought to be widely distributed in Alaska.

31. *Mylia taylori* (Hook.) S. F. Gray.

Hot Spring (T. 1470); Juneau (Setchell 1229, in part); Douglas Island (T. mixed with 1495, 1496, and 1498); Virgin Bay (T. 1474, in part); Farragut Bay (T. 1485, in part); Orca (T. 1490,

¹ The synonymy of this species, together with a full description, is given by Dr. Howe, Mem. Torr. Bot. Club, 7: 111. 1899.

²Hep. Amaz. et And. 417. 1885 (footnote).

³Zoe, 1: 366. 1891.

also mixed with 1492 and 1508, Setchell 1205); Columbia Fiord (C. & K. 1388, in part); Port Wells (C. & K. 1297, T. 1475, in part). This species has not before been recorded from Alaska, but I have a few sterile scraps of it collected at Sitka, by the Fish Commission in 1894.

32. *Lophocolea cuspidata* (Nees) Limpr.

Cape Fox (T. 2383). New to Alaska.

33. *Chiloscyphus polyanthos* (L.) Corda.

Juneau (B. & C. mixed with 699); Point Gustavus, Glacier Bay (C. & K. mixed with 758); Yakutat (Saunders, 1437, in part). The var. *rivularis* of this species is reported by Miss Cooley from Salmon Creek, near Juneau.

34. *Harpanthus flotowianus* Nees.

Hot Spring (T. 1435, in part); Orca (T. 2247, also mixed with 1424); Port Wells (T. 1430); Yakutat (B. & C. mixed with 689). New to Alaska.

35. *Cephalozia bicuspidata* (L.) Dumort.

Sitka (T. 1501, in part, Setchell 1258, in part, 1269); Mt. Verstovia (C. & K. 927, in part); Juneau (B. & C. mixed with 691); Hidden Glacier Inlet (T. 1505, in part); Orca (T. 1507, also mixed with 1491 and 1510); Columbia Fiord (C. & K. 1394); Farragut Bay (C. & K. 453, also mixed with 454); Yakutat (B. & C. mixed with 689); Kadiak (C. & K. mixed with 2321). This species, which has not before been reported from Alaska, has also been collected on Attu Island (U. S. Fish Commission, 1894).

36. *Cephalozia media* Lindb.

Sitka (T. 1502); Douglas Island (T. mixed with 1495); Orca (T. 1508, 1510, Setchell, 1203); Columbia Fiord (C. & K. 1393, in part); Farragut Bay (B. & C. 621, in part). The species has also been collected by Miss Cooley, at Salmon Creek, near Juneau, and by Funston, near Yakutat.

37. *Cephalozia leucantha* Spruce, on *Cephalozia*, 68. 1882.

Dioicous: depressed-caespitose, pale green: stems not pigmented, sparingly branched from the postical aspect but never bearing true flagella, about 6 cells in diameter, interior cells with uniformly thickened walls, cortical cells (in about 12 longitudinal rows) a little larger than the interior cells and with slightly thinner walls: rhizoids whitish, mostly scattered: leaves distant (except in the apical

region), transversely or slightly obliquely inserted, somewhat spreading, plane or slightly concave, ovate, equally bifid to or beyond the middle with triangular, acute, spreading or connivent lobes, separated by an obtuse or subacute sinus, each lobe about 4 cells wide at the base and 5 cells long, ending in a row of 2 cells: underleaves wanting: leaf-cells with uniformly thickened walls: ♀ inflorescence borne on a usually very short postical branch; bracts in 2 or 3 pairs, innermost bracts broadly orbicular, bifid about one-third with acuminate, spreading divisions and broad sinus, margins slightly and irregularly denticulate, cell-walls thin; innermost bracteole connate on one side, sometimes undivided and acuminate, sometimes bifid, margins denticulate; bracts of second row similar to the innermost, but smaller and with subentire margins, corresponding bracteole undivided and blunt; perianth ovate-cylindrical, one cell thick, terete below, obtusely 3- (or 4-) keeled above, somewhat contracted at the irregularly lobed mouth, the lobes ciliate (each cilium 1 or 2 cells long): ♂ spike occupying the whole or a part of a short postical branch, sometimes intercalary on a longer branch; bracts in 2 to 5 pairs, imbricated, strongly concave, bifid about one-third; bracteoles small, linear-subulate to ovate; antheridia borne singly: capsule purple-brown, borne on a rather long stalk; spores yellowish-brown, with a thickened, very minutely verruculose wall; elaters rather blunt, bispiral.

Stems 0.08 mm. in diameter, leaves 0.17×0.14 mm., leaf-cells at edge of leaf $23 \times 14 \mu$, in the middle and at the base 18μ in diameter, innermost bracts 0.6×0.6 mm., innermost bracteole 0.6×0.5 mm., bract of second row 0.4×0.4 mm., bracteole of second row 0.35×0.25 mm., perianth 1.4×0.5 mm., spores 9μ in diameter, elaters $250 \times 9 \mu$. These measurements are taken from the Alaskan specimens and run a little lower than those given by Spruce.

Columbia Fiord (C. & K. 1393, in part). New to America.

Since the original publication of this species, it has been found to have a wide distribution in Europe, being particularly plentiful in northern regions. It has not yet, however, been reported from northern Asia. The species is intermediate in some respects between Spruce's subgenera *Eucephalozia* and *Cephaloziella*. Spruce himself placed it, with some hesitation, in *Cephaloziella*, but to the writer it seems to fit a little better in the other subgenus. *C. leucantha* resembles *C. divaricata* in size, but differs more particularly in its pale color and in its cladogenous inflorescence. From *C. catenulata*, it differs in its color, in its narrower and more distant leaves, and in its

smaller leaf-cells. *C. media*, which is likewise a pale green plant, differs in its decurrent and differently shaped leaves with lunulate sinus and in the larger cells of its leaves and stems.

Cephalozia divaricata has not yet been found fruiting in Alaska. Sterile specimens collected by Dr. Trelease at Hot Spring (mixed with 1526) probably belong here, as do also similar specimens collected by Funston at Yakutat.

38. ***Kantia trichomanis*** (L.) S. F. Gray.

Douglas Island (T. mixed with 1408 and 1495); Orca (T. mixed with 1508); Columbia Fiord (C. & K. 1399); Farragut Bay (B. & C. 621, in part). Previously collected by Miss Cooley, at Sitka, and by Funston, near Yakutat.

39. ***Bazzania deflexa*** (Mart.) S. F. Gray.

Hot Spring (T. mixed with 1488 and 1489); Wrangell (C. & K. 407a); Juneau (B. & C. 691, in part, Setchell mixed with 1228); Port Wells (T. 1531); Farragut Bay (B. & C. 620 and 623, in part). Known also from Loring (Miss Cooley), from Chlowak (Krause), and from Sitka (Townsend 66, Canby 459).

40. ***Lepidozia filamentosa*** (Lehm. & Lindb.) Lindb.

Douglas Island (T. 1497); Columbia Fiord (C. & K. 1384); Farragut Bay (B. & C. mixed with 620). Reported by Dr. Howe from Prince of Wales Sound (J. M. Macoun) and from Sundum (Miss Jessie Trowbridge).

41. ***Lepidozia reptans*** (L.) Dumort.

Sitka (T. 1501, in part); Douglas Island (T. 1495, 1498, in part); Orca (T. 1491). The species has also been found at Sitka by Miss Cooley and at Yakutat by Funston.

42. ***Lepidozia setacea*** (Web.) Mitt.

Orca (T. 1511, in part); Columbia Fiord (C. & K. 1319, in part). New to Alaska.

43. ***Blepharostoma trichophyllum*** (L.) Dumort.

Juneau (B. & C. mixed with 691, 699, and 702, Setchell mixed with 1229); Orca (T. mixed with 1477, 1491, 1508, and 1510); Yakutat (B. & C. mixed with 689); Hall Island (T. mixed with 1518). Previously collected in Alaska by Rothrock and by Funston.

44. ***Blepharostoma setiforme*** (Ehrh.) Lindb.

St. Matthew Island (T. 2529). First collected in Alaska by the Drs. Krause.

45. *Anthelia julacea* (L.) Dumort.

Virgin Bay (Kincaid 1534); St. Matthew Island (T. 2073, 2161, in part, C. & K. 2130); St. Lawrence Island (T. 1516, C. & K. 2007, in part); Hall Island (T. 1518, in part). New to Alaska.

46. *Anthelia juratzkana* (Limpr.) Trevis.

St. Matthew Island (T. 1519, in part); Hall Island (T. 1445). New to Alaska.

47. *Herberta adunca* (Dicks.) S. F. Gray.

Hot Spring (T. 1525 α , also mixed with 1471). This species is reported from St. Paul Island by Merriam and by J. M. Macoun; it has also been collected at Yes Bay by Howell.

48. *Ptilidium californicum* (Aust.) Underw. & Cook.

Sitka (T. 1453, Setchell, 1268); Virgin Bay (T. 1456, 1458); Port Wells (T. 1416 α); Orca (T. 1459, 1460, also mixed with 1491 and 1529, Setchell 1209); Columbia Fiord (C. & K. 1344, 1390). Although this species has not before been recorded as Alaskan, a few fragmentary specimens were collected by J. M. Macoun, in 1891, on Prince of Wales Island.

49. *Ptilidium ciliare* (L.) Nees.

Juneau (Setchell 1239); Virgin Bay (T. 1457); Port Wells (T. 1461); Kadiak (T. 1454, 1455); St. Matthew Island (T. 1463); Port Clarence (Fernow 1462). First collected in Alaska by the Drs. Krause.

50. *Diplophylleia albicans* (L.) Trevis.

Hot Spring (T. 1488); Mt. Verstovia (C. & K. 927, also mixed with 926); Orca (T. 1508, 1511, 1512, 1529, in part); Columbia Fiord (C. & K. 1392); Port Wells (T. 1475, in part, 1833); Faragut Bay (C. & K. 471). This species occurs in Rothrock's list. I have also seen Alaskan specimens from Barlow Cove (Kellogg) and from St. Paul Island (J. M. Macoun).

51. *Diplophylleia taxifolia* (Web. & Mohr) Trevis.

St. Matthew Island (T. 1519, in part). In the 'Synopsis Hepaticarum' this species is accredited to Unalaska Island. It has also been reported from St. Paul Island (Merriam & J. M. Macoun), and has likewise been collected at Sitka (Townsend).

52. *Diplophylleia plicata* (Lindb.).

Diplophyllum plicatum LINDB. Acta Soc. Sci. Fenn. 10: 235. 1872.

Dioicous: plants loosely tufted, green, varying to brownish or yellowish: stems prostrate or ascending, simple or sparingly branched,

the branches apparently arising in the axils of ordinary leaves: rhizoids sometimes numerous, sometimes few or none: leaves distant or subimbricated, closely appressed at the base, widely spreading above, complicate-bilobed with a distinct strongly arched keel less than half the length of the postical lobe; antical lobe erect-spreading, arching across the axis and sometimes beyond, ligulate, rounded at the apex, subentire or sometimes sharply and irregularly dentate at the apex, and more rarely at the decurrent base; postical lobe longer and broader, widely spreading, oblong or obovate, obtuse or rounded at the sharply and irregularly dentate apex, margins otherwise subentire though sometimes sharply ciliate-dentate at the short-decurrent base; apical teeth mostly one or two cells long; basal teeth, when present, each consisting usually of a single pointed cell: median leaf-cells with thin walls and very distinct trigones sometimes becoming confluent, marginal and submarginal cells with more uniformly thickened walls; cuticle varying from strongly verruculose to nearly smooth: ♀ inflorescence borne on a principal branch, sometimes with one or two innovations; bracts in a single pair, similar to the leaves but more erect and smaller, clasping the base of the perianth, postical margin varying from entire to finely serrate; perianth ovoid-cylindrical, gradually narrowed toward the mouth, deeply plicate throughout with about 16 sharp folds separated by narrow grooves, terete or slightly flattened, mouth irregularly lacerate, the divisions variously curved and contorted, finely ciliate, each slender cilium ending in a long row of cells: andræcium intercalary, bracts imbricated, in many pairs, similar to the leaves but saccate at the base and with more erect antical lobes; antheridia 2-6 in each axil; paraphyses numerous, variable in shape but most frequently linear, entire, often variously curved, one to three cells wide in the middle: gemmæ broadly fusiform, mostly two-celled, occasionally produced both by sterile and sexual plants at and near the apices of the leaves: mature sporophyte unknown.

Stems 0.4-0.5 mm. in diameter, postical lobes of leaves 2-2.5 mm. long, 0.8 mm. wide, antical lobes 1.2-1.7 mm. long, 0.4-0.5 mm. wide, leaf-cells at apex of leaf 14 μ in diameter, in the middle 16-23 μ long, 16 μ wide, at the base 45 \times 16 μ , perianth 3.5-4.2 mm. long, 9-1.4 mm. in diameter, gemmæ 18 \times 14 μ .

Orca (T. 1492, in part); Farragut Bay (B. & C. 619); Hall Island (T. 1478). New to America.

D. plicata was described by Lindberg from specimens collected on the island of Sachalin in eastern Siberia and was also reported by him from two stations in Amur. Quite recently Herr Stephani has

accredited it to Japan.¹ Its discovery in Alaska makes a most interesting addition to our hepatic flora. The specimens collected by the Harriman Expedition would seem to indicate that the species is somewhat more variable than Lindberg supposed. The Hall Island specimens agree best with his description and with the type specimens, kindly loaned me by Dr. Harald Lindberg; the Orca specimens are likewise very similar but have a nearly smooth cuticle; the Farragut Bay specimens, which have a distinctly roughened cuticle, differ in having teeth at the base of both antical and postical lobes and in having cells with less pronounced trigones. It is possible that these last specimens represent a distinct, undescribed species, but it seems wisest not to try to separate them until a more complete series has been obtained.

D. plicata is the largest known member of the genus. It is distinguished from both *D. albicans* and *D. taxifolia* by its robustness and by its leaf-cells, which, with the exception of those near the edge, have thin walls and distinct trigones instead of being uniformly thickened. The absence of the false nerve would, of course, also distinguish it from *D. albicans*.

53. *Scapania bolanderi* Aust.

Scapania albescens Steph. Engler's Bot. Jahrb. 8: 96. 1886.

Sitka (T. 1486, 1487, 1500, 1503, Setchell 1258, in part); Hot Spring (T. 1489, also mixed with 1471); Mt. Verstovia (C. & K. 926, 927, in part); Juneau (B. & C. 702, in part, T. 1484, Setchell 1228, in part); Douglas Island (T. 1483, also mixed with 1495); Orca (T. 1491, 1509, also 1477 and 1510, in part, Setchell 1207, in part); Columbia Fiord (C. & K. 1385, 1395); Farragut Bay (B. & C. mixed with 620, 621, 623*b*, T. 1485, in part); Kadiak (C. & K. 2321, in part). This species, which seems to be very abundant in Alaska, was collected by Kellogg in 1867, and has also been found by J. M. Macoun on Prince of Wales Island, by Townsend at Sitka, and by the Drs. Krause at Chlowak and Chilcoot.

54. *Scapania undulata* (L.) Dumort.

Sitka (T. 1432); Juneau (B. & C. 691, in part); Virgin Bay (T. 1473); Orca (T. 1476); Columbia Fiord (C. & K. 1359, 1383, a large purple form); Farragut Bay (T. 1464); Yakutat Bay (Saunders 1437, in part, 1472); Popof Island (Saunders 1479). Not before reported from Alaska, but collected by J. M. Macoun on St. Paul Island in 1892.

¹ Bull. de l'Herb Boissier, 5: 78. 1897.

55. *Scapania irrigua* (Nees) Dumort.

Port Clarence (B. & C. 673). New to Alaska.

56. *Scapania umbrosa* (Schrad.) Dumort.

Sitka (Setchell 1258, in part); Mt. Verstovia (C. & K. 927, in part); Juneau (B. & C. 691, in part, Setchell 1236); Orca (T. 1477, Setchell 1207, in part); Columbia Fiord (C. & K. 1398); Yakutat (T., B. & C. mixed with 689). New to Alaska.

57. *Scapania curta* (Mart.) Dumort.

Yakutat Bay (B. & C. 645, in part). In the 'Synopsis,' this species is quoted from Unalaska Island.

Scapania nemorosa is included in Rothrock's and Stephani's lists, but does not occur in the Harriman collections.

58. *Radula bolanderi* Gottsche.

Hot Spring (T. mixed with 1471); Sitka (Setchell 1266). Also collected by Townsend at Sitka. *Radula arctica* Steph., collected at Chlowak and at Chilcoot by the Drs. Krause, is doubtfully referred to this species by Dr. Howe.¹

59. *Radula complanata* (L.) Dumort.

Sitka (T. 1501, in part). *Radula krausei* Steph., from Chilcoot, is referred by Dr. Howe² to this species, which has also been collected by Funston near Yakutat.

60. *Porella rivularis* (Nees) Trevis.

Sitka (T. 1465); Yakutat (Saunders 1466). Also collected by Miss Cooley, according to Dr. Howe.³

61. *Porella navicularis* (Lehm. & Lindb.) Lindb.

Hot Spring (T. 1471, in part, also mixed with 1525). This species is noted in the 'Synopsis' as occurring near Sitka. Kellogg collected it also in the same locality, and it has been found at Chilcoot by the Krause brothers.

Porella platyphylla (L.) Lindb. has been reported from Unalaska (Syn. Hep.) and from Guissen (Krause). It does not occur in the present collection.

62. *Frullania nisquallensis* Sulliv.

Cape Fox (T. 1532); New Metlakahtla (T. 1523); Sitka, (Setchell, 1252); Hot Spring (T. 1471, in part, 1525); Wrangell (C. & K.

¹Mem. Torr. Bot. Club, 7: 159. 1899 (footnote).

²L. c. 160.

³Bull. Torr. Bot. Club, 24: 520. 1897.

401, 407a); Orca (T. 1528); Yakutat (T. 1527). Also known from Chilcoot (Krause).

63. *Frullania franciscana* M. A. Howe.

Sitka (T. 1524, Setchell 1253); Hot Spring (T. 1526). New to Alaska.

Two other species of *Frullania* have been recorded from Alaska: *F. tamarisci* (L.) Dumort., from Sitka (Syn. Hep.), and the imperfectly known *F. chilcootiensis* Steph., from Chilcoot (Krause).

YALE UNIVERSITY, June, 1900.

PLATES XVI-XVIII.

Gymnomitrium obtusum (Lindb.) Pearson.

- FIG. 1. Leaf, $\times 32$.
2. Cells from middle of leaf, $\times 290$.
3. Cells from apex of leaf, $\times 290$.

The figures are all drawn from Dr. Trelease's No. 1512, collected at Orca.

Anastrophyllum reichardtii (Gottsche) Steph.

- FIG. 4. Part of stem with perianth, antical view, $\times 18$.
5. Part of stem with andrœcium, antical view, $\times 18$.
FIGS. 6-8. Leaves, $\times 18$.
FIG. 9. Cells from apex of leaf, $\times 290$.
10. Cells from middle of leaf, $\times 290$.
11. Cells from near base of leaf, $\times 290$.
FIGS. 12, 13. ♀ bracts, $\times 18$.
FIG. 14. A part of the perianth-mouth, $\times 230$.
15. Transverse section of perianth in upper third, $\times 32$.
16. ♂ bract, $\times 16$.
17. Antical base of ♂ bract, $\times 32$.

The figures are all drawn from specimens collected by Messrs. Coville and Kearney at Columbia Fiord (No. 1389).

Cephalozia leucantha Spruce.

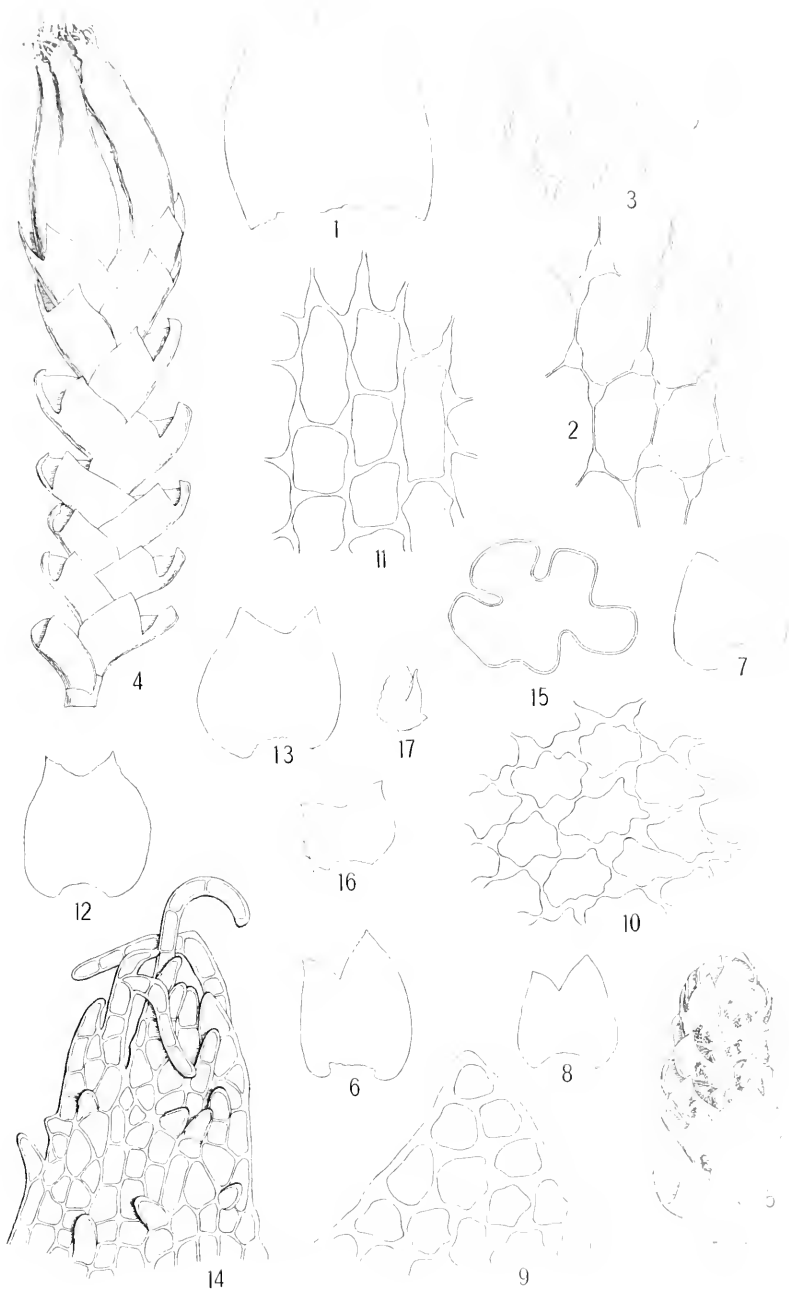
- FIG. 18. Part of stem with ♀ branch and perianth, $\times 32$.
19. Leaf, $\times 230$.
20. Bract with connate bracteole of innermost row, $\times 32$.
21. Remaining bract of the same row, $\times 32$.
FIGS. 22-24. Bracts and bracteole of second row, $\times 32$.
FIG. 25. A part of the perianth-mouth, $\times 230$.
26. Transverse section of perianth above middle, $\times 32$.

The figures are all drawn from No. 1393, collected at Columbia Fiord by Messrs. Coville and Kearney.

Diplophyllia plicata (Lindb.) Evans.

- FIG. 27. Part of stem with perianth, antical view, $\times 15$.
28. Part of sterile stem, antical view, some of the upper leaves gemmiparous, $\times 14$.
29. Postical base of leaf, $\times 28$.
30. Cells from apex of leaf, $\times 270$.
31. Cells from middle of leaf, $\times 270$.
32. Teeth and cells from postical base of leaf, $\times 270$.
33. Part of sterile stem, postical view, $\times 14$.
34. ♂ bract with antheridia, $\times 14$.
35. Cells from middle of leaf, $\times 270$.

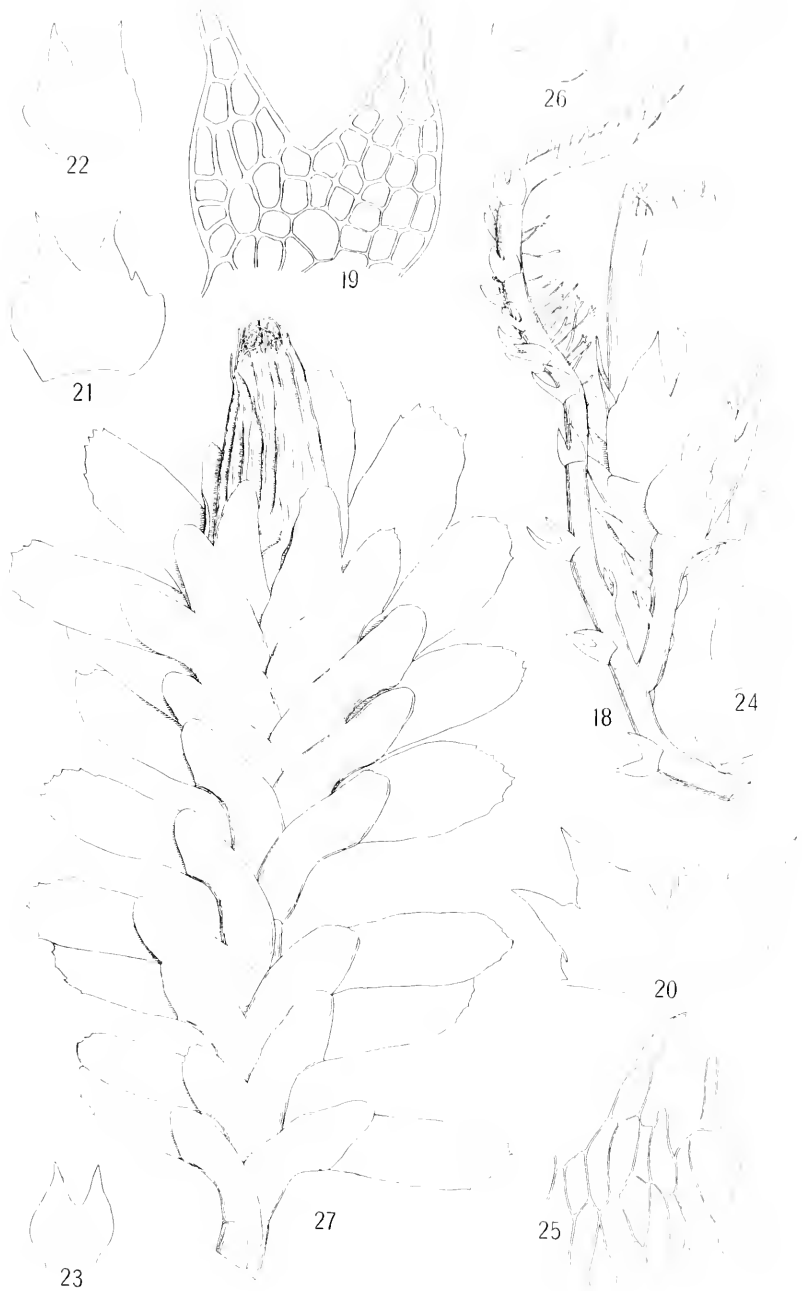
Fig. 1 is drawn from the type-specimen, collected in 1861 by Glehn, at Dui, on the island of Sachalin, Siberia; figs. 28-32 are from specimens collected by Messrs. Brewer and Coe at Farragut Bay (No. 619); and figs. 33-35, from specimens collected by Dr. Trelease at Orca (No. 1492).



Alaska Hepaticae

Figs. 1-3. *Gymnomitrium obtusum* (Lindb.) Pears.

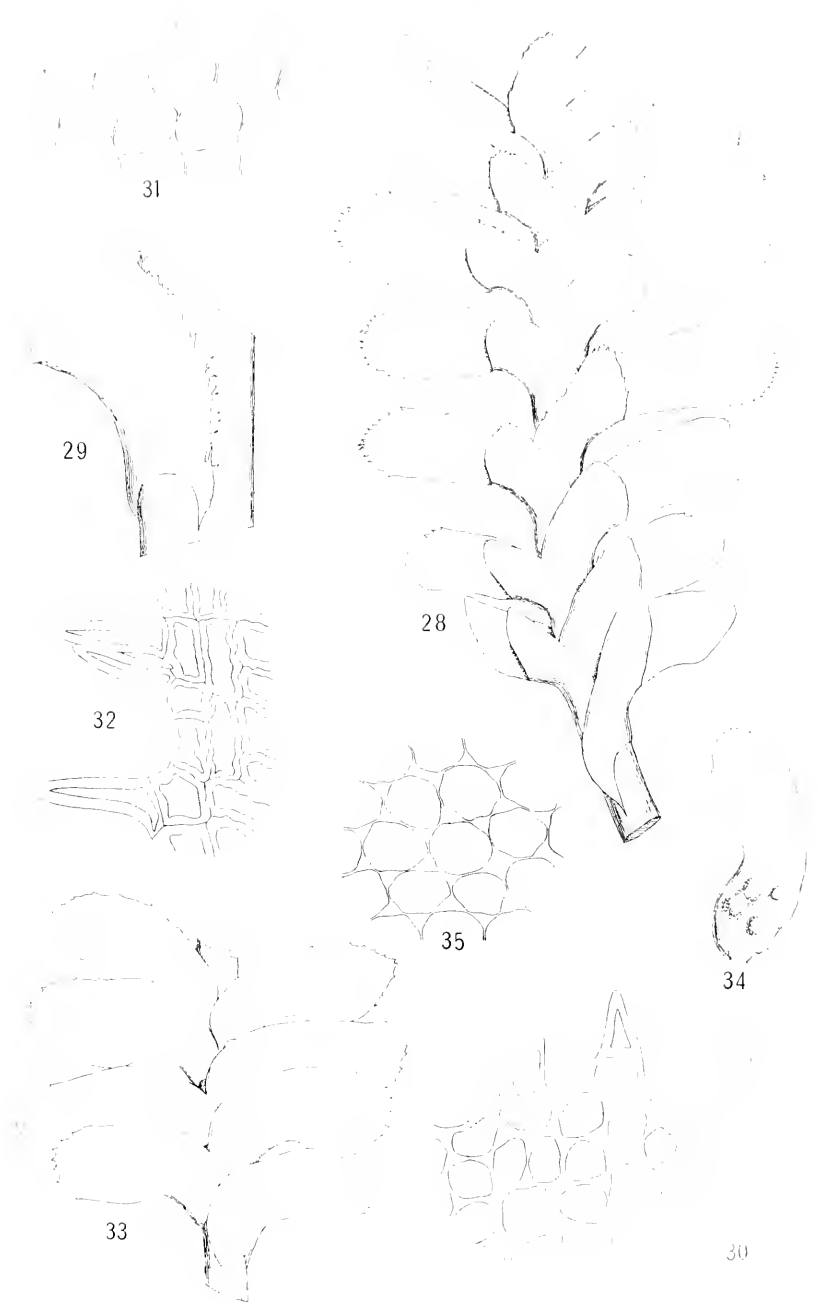
Figs. 4-17. *Anastrophyllum reichardtii* (Gottsche) Steph.



Alaska Hepaticae

Figs. 18-26. *Cephalozia leucantha* Spruce.

Fig. 27. *Diplophyllia plicata* (Lindb.) Evans.



Alaska Hepaticae

Figs. 28-35. *Diplrophyllia plicata* (Lindb.) Evans

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 315-340.

OCTOBER 10, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

VI.

THE BRYOZOA.

[PLATES XIX-XXI.]

BY ALICE ROBERTSON.

THE following report is based on the Bryozoa obtained by Professor W. E. Ritter, of the University of California, while in Alaska as a member of the Harriman Alaska Expedition during the months of June and July, 1899. The localities at which collections were made are: Muir Inlet, Garforth Island, Sitka, Juneau, Yakutat Bay, Prince William Sound, Kadiak, and Fakir Islet. There are in all thirty-seven species, five of which are new. These contain representatives of the three divisions of the Ectoprocta, one of the Entoprocta, and one of the freshwater forms. I have adopted the system of classification which is given by Hincks ('80). As may be seen by perusal of the list of species, the Bryozoan fauna of Alaska is essentially arctic, consequently the work of Smitt ('65-'68), who has made such a complete study of northern forms, has been of invaluable assistance. In order not to crowd the text unnecessarily, and at the same time to make clear what form is intended, the synonymy includes, as a rule, only the specific names of these two writers, and the foreign distribution is given mainly upon their authority.

The only work which has heretofore been published on the Bryozoa of Alaska waters is that of Mr. Hincks in the report on the Polyzoa of Queen Charlotte Islands ('82-'84). Many species are common to Alaska, Queen Charlotte Islands, Puget Sound, and California, and under local distribution I have included all the localities on the western coast of North America, where I know, either from personal knowledge, or on the authority of others, that a particular species exists.

Class **BRYOZOA** Ehrenberg.

Group *ECTOPROCTA* Nitsche.

Order *GYMNOLÆMATA* Allman.

Suborder *CHEILOSTOMATA* Busk.

Family *EUCRATIIDÆ*.

GEMELLARIA Savigny.

GEMELLARIA LORICATA Linnæus.

Gemellaria loricata HINCKS ('80), pl. III, figs. 1-4.

Gemellaria loricata SMITT ('67), pl. XVII, fig. 54.

Habitat.—Very abundant on the rocks at low tide.

Local distribution.—Juneau, 20 fms.; Orca, Prince William Sound; Yakutat; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Scandinavia; Spitzbergen, 3-10 fms.; Greenland; Hammerfest; Havö sund; Labrador; St. George Banks, 50-85 fms.; White Sea; Ostend; Britain, from littoral region to deep water, 80 fms.

Family *CELLULARIIDÆ*.

MENIPEA Lamouroux.

MENIPEA TERNATA Ellis & Solander.

Menipea ternata HINCKS ('80), pl. VI, figs. 1-4.

Cellularia ternata SMITT ('67), pl. XVI, figs. 10-14.

Habitat.—In considerable quantity growing with *Bugula* upon *Styela* and upon the rocks.

Local distribution.—Yakutat, Puget Sound; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen, chiefly in the littoral region; Hammerfest; Lofoten; White Sea; Jütland, 10 fms.; Belgium; Great Britain.

As compared with specimens from Northumberland, England, those from the Pacific Coast are stouter and more vigorous. By measurement the internodes are found to be shorter and slightly wider. Thus, in the Yakutat form the average length of an internode consisting of three zœcia is 42 mm., its width from tip to tip of the avicularia 33 mm.; in the English form the length of an internode is 52 mm., its width 28 mm.

MENIPEA TERNATA Ellis & Solander.

B. forma *gracilis* SMITT ('67), pl. XVI, figs. 16-24.

Habitat.—In considerable quantity on the rocks at low tide.

Local distribution.—Orca, Prince William Sound. This elongated form of *Menipea ternata* is also reported from Cumshewa Harbor, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen at 200 fms; Franklin-Pierce Bay; Barents Sea.

The zœcia of this species are very much elongated, and internodes consisting of three zœcia range from 60 to 90 mm. in length. Many internodes, however, consist of five or seven zœcia, and it is upon these that the œcia seem to occur. The avicularia, both lateral and frontal, may be present or absent. In many instances in which an internode consists of more than three zœcia, a frontal avicularium appears below the aperture of each. In such cases, lateral avicularia are sparingly developed. One may be found on the lower zœcia, but not, as a rule, upon all. When œcia occur, they fill that portion of the next upper zœcium which is below the aperture, and the frontal avicularia occupy a narrow space between the œcium and the edge of the aperture. In some cases they seem to be sessile upon the œcia.

MENIPEA ERECTA sp. nov.

(Pl. XIX, figs. 1, 2.)

Habitat.—On an ascidian.

Local distribution.—Sitka, Alaska, 10 fms.

Zoarium dichotomously branched, internodes usually consisting of 5 to 7 zœcia. Zœcia biserial, alternate, narrowed below; aperture (fig. 1, *ap.*) broadly ovate, occupying two-thirds of the front; margin (*m.*) raised, crenulate, with two blunt spines (*sp.*) on the upper outer angle; operculum (*op.*) a flattened spine; sometimes growing broad, when it is frequently more or less bifid. Lateral avicularia wanting; frontal avicularia (*f. a.*) few. Œcia (*œ.*) large, globose,

more or less striated. Radical fibers (fig. 2, *r.f.*) developed mainly upon the lower zœcia.

The general habit of this colony resembles that of *Scrupocellaria*. The branches are very calcareous and erect, tending to flare outward. They differ in this respect from the preceding species whose branches curl inward. The number of zœcia in an internode is five or seven as a rule, but there is considerable variation in this regard. Toward the middle of a branch the number increases and 9, 11, or 13 are frequently found. In one case 21 zœcia occur before the internode bifurcates. On the lowest one or two zœcia of a colony, very small lateral avicularia may sometimes be detected. Frontal avicularia appear only at infrequent intervals. The zœcium situated at the bifurcation of a branch usually possesses one below the aperture (fig. 1, *ap.*). They appear occasionally upon other zœcia also, but no constancy is maintained.

This species is closely allied to *M. duplex* Smitt ('67), and to *M. jeffreysii* Norman ('68), in its habit of growth. There are differences in zœcial characters, however. Comparing pl. XIX, fig. 1, with pl. XVI, fig. 25, Smitt ('67), it will be seen that this form differs from *M. duplex* in its possession of opercula and spines, and in its lack of avicularia. In comparison also with the original drawing, Norman ('68), or with the figures given by Hincks ('80) it differs from *M. jeffreysii* in the number of spines, in the lack of avicularia, and in the very different shape and inclination of the opercula.

SCRUPOCELLARIA Van Beneden.

SCRUPOCELLARIA SCABRA Van Beneden.

(Pl. XIX, figs. 3, 4.)

Scrupocellaria scabra HINCKS ('80), pl. VI, figs. 1, 2. HINCKS ('89), pl. XXI, fig. 1.

Cellularia scabra SMITT ('67), pl. XVII, fig. 29.

Habitat.—Growing entangled in seaweed.

Local distribution.—Kadiak.

Foreign distribution.—British coast; North Sea; Scandinavian and Arctic seas; Spitzbergen; Davis Strait; Greenland; Reykjavik Harbor; Madeira. Form without vibracula: Greenland; St. Lawrence.

The form of *S. scabra* which occurs in this collection lacks all traces of vibracula. These structures are usually considered a characteristic mark of this genus, nevertheless there seems to be sufficient reason for placing it here, at least provisionally.

The habit of growth is decidedly scrupocellarian. The branches are stiff and calcareous, and the internodes rather long, varying from 3 or 5 in the lower part of a colony, to 12 or 15 in the upper. Both lateral and frontal avicularia are developed upon each zœcium and are of large size (fig. 3, *lat. f.a.*). On those internodes where zœcia (*z.*) occur the frontal avicularia are pushed to one side and form an irregular line between the two series of cells. Commonly but one spine (*sp.*) is developed at the upper outer angle. The opercula (*op.*) vary from a simple, spinous process to a broad, sub-triangular structure marked with the peculiar hand-like sculpturing which characterizes this species. The zœcium which is situated at the bifurcation of a branch possesses a short spine at the top, and in the particular case represented, the aperture is partially covered by two opercula instead of an operculum and a spine, as is the usual case (*op.*, *op'*). In comparison with a specimen from Norway, the appearance of the colony is more robust, the spines are shorter and thicker, and the zœcia slightly longer and broader. Fig. 4 represents the dorsal surface. Upon the zœcia of the lower portion of the colony, radical fibers are developed, but no vibracula are visible.

According to Mr. Hincks, vibracula are of uncertain occurrence in this species. Such as are found are of a rudimentary character, and he remarks: "They are commonly wanting on many of the cells." It is possible that in a larger quantity of material some zœcia may be found upon which vibracula or traces of such structures are present. This form differs from the normal in this one particular only. Both Hincks and Jullien ('82) have described as *S. scabra* a form which not only lacks vibracula, but differs from the type in other important respects, and for the present I shall be guided by the precedent they have set.

CABEREA Lamouroux.

CABEREA ELLISII Fleming.

Caberea ellisii HINCKS ('80), pl. VIII, figs. 6-8.

Caberea ellisii SMITT ('67), pl. XVII, figs. 55-56.

Habitat.—Found growing on a shell dredged at 20 fms.; obtained also on the rocks at low tide.

Local distribution.—Juneau; Orca, Prince William Sound; Cumshewa Harbor, Queen Charlotte Islands; Vancouver Island.

Geographical distribution.—Labrador and Maine; St. George Banks, 28-150 fms.; Greenland, 100 fms.; Iceland, 15-20 fms.; Scandinavia and Finmark, 50-80 fms., not uncommon; Shetland, 40-70 fms., abundant; Orkneys; off the coast of Antrim, 62-72 fms.

Family *BICELLARIIDÆ*.

BUGULA Oken.

BUGULA MURRAYANA Johnston.

Bugula murrayana HINCKS ('80), pl. XIV, figs. 2-9.

Bugula murrayana SMITT ('67), pl. XVIII, figs. 19-22.

Habitat.—Abundant on the rocks.

Local distribution.—Orca, Prince William Sound; Juneau; Houston-Stewart Channel and Virago Sound, Queen Charlotte Islands; Puget Sound, dredged.

Geographical distribution.—Scandinavian coasts; Grötsund, Finmark, 100 fms.; Spitzbergen; Greenland; Labrador; Gulf of St. Lawrence; New England; St. George Banks; North Sea; Orkneys; Shetland; coast of Britain.

Compared with specimens from the Northumberland coast, England, the Orca form attains a very strong and vigorous growth. The normal type prevails, but differs from the English form in the greater opaqueness of the zœcial walls and in the size and greater abundance of the spines. A variety also occurs which is extremely flustrine in appearance. The segments are short and broad, often possessing 18 to 24 zœcia in alternate rows, and they spread out from the center forming a fan-like growth. In all essential marks, size and number of spines, position and size of avicularia and œcia, shape of zœcia, etc., this variety agrees with the typical form.

BUGULA PURPUROTINCTA Norman.

(Pl. XX, figs. 5, 6.)

Bugula purpurotincta HINCKS ('80), pl. XII, figs. 8-12.

Bugula purpurotincta NORMAN ('68).

Habitat.—Very abundant upon *Styela* and upon the rocks.

Local distribution.—Yakutat Bay; Orca; Pribilof Islands; Puget Sound; Tomales Bay, California.

Foreign distribution.—Rather abundant on the northern coasts of Britain: Christiansund; Bejan, 40-60 fms.; Lofoten; Bahusia; Norway, common, 30-130 fms.; St. George Banks, 110-115 fms.

This species grows in large bushy tufts often 7.5 cm. in height, and the colonies are frequently united by a sort of cable formed by the radical fibers. It is remarkable not only for its luxuriant growth but also for the rich purple which most of it displays in the living as well as in the dried condition. The color is particularly noticeable in that

which was obtained at the Point, in the more exposed situation. It is located in part in the tissue lining the zœcia, and in part in the degenerated polypides. These constitute the so-called 'brown bodies' of other Bryozoa which in this species are purple. A small number of specimens was picked up at the Pribilof Islands, Alaska, by Professor Kincaid, of the Washington University. These have been preserved in the dried state and the color is very distinct. Material obtained at other points near Yakutat, and some of the same, or of a closely allied species, from Puget Sound and California, do not show this color, but are rather of a yellowish tinge.

In some respects this species varies from the type described by Norman and Hincks. Thus, these authors report but one spine for *Bugula purpurotincta*, and a denticle in front of it. The Yakutat form possesses three spines and the number seems to be invariable. As represented in Pl. XX, fig. 5, a long spine (*sp.*) is present at the summit of the zœcium. This probably corresponds to the one reported for this species. But at the upper extremity of the aperture, structures occur on each side, which may properly be called spines (*sp.' sp."*), one of which may perhaps correspond to the denticle of the English form. The long spine (*sp.*) at the top of the zœcium frequently measures 15 mm., while the other two are smaller, measuring on an average about 5 mm. The aperture (*ap.*) is long, and extends almost to the bottom of the zœcium. The avicularia (*av.*) are of unusually large size, and are always placed just below the aperture. The œcia (*œ.*) are remarkably small. They do not rise more than 3 or 4 mm. above the zœcium, while in many cases the embryo measures 10 mm. in length. Fig. 5 represents two embryos (*emb.*), which lie for the most part in the upper portion of the zœcia. In his description of *B. purpurotincta*, Mr. Hincks speaks of the extreme shallowness of the œcia, and says that they only partially cover the embryo in its later stages.

Whether these deviations from the type can be considered as mere individual variations or whether they have specific value is still an open question. Provisionally, at least, this form is placed in the present species. If upon further study it should prove to be new, I would suggest the name *Bugula pacifica*, since it seems to be characteristic of this coast.

BUGULA FLABELLATA J. V. Thompson.

Bugula flabellata HINCKS (80), pl. XI, figs. 1-3.

Bugula avicularia forma 2, *B. flabellata* SMITT ('67), pl. XVIII, fig. 11.

Habitat.—On a limpet shell.

Local distribution.—Sitka, 10 fms.

Foreign distribution.—Britain; Heligoland; Ostend; Roscoff; Adriatic; Florida, deep water; Madeira; Cape of Good Hope.

Family *CELLARIIDÆ*.

CELLARIA Lamouroux.

CELLARIA BOREALIS Busk.

Cellaria borealis SMITT ('67), pl. xx, fig. 17.

Salicornaria borealis BUSK ('55), pl. I, figs. 1-3.

Habitat.—Abundant on rocks.

Local distribution.—Yakutat; Orca, Prince William Sound; Houston-Stewart Channel, Cumshewa Harbor, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Greenland.

This fine species is very abundant at Orca, where it grows in thick masses three or four inches in height. The branching is very profuse in the younger portions of the colony. In the older portion, the first six or eight internodes form an articulated stem without lateral branching. At the point where it begins, three and sometimes four internodes arise from the distal end of one. Above this the branching is dichotomous, while the tallest internodes are tipped with three or four very small ones. The young, actively growing portion is conspicuous for its bright flesh-color, which causes it to stand out boldly against the dark background of rock.

Family *FLUSTRIDÆ*.

FLUSTRA Linnæus.

FLUSTRA LICHENOIDES sp. nov.

(Pl. XX, figs 7, 7a, 8.)

Habitat.—Upon shells, worm tubes, ascidians, and upon the rocks at low tide.

Local distribution.—Yakutat; Orca, Prince William Sound; Puget Sound; Point Cavallo, California.

Zoarium unilaminar, consisting of broad, foliaceous fronds. Zœcia in alternate rows, arched above, narrowed below, the upper margin of the cell raised and armed on each side with three or four spines; the uppermost spine on each side stands upright and stiff, the other two or three are flattened and bend inward, the ends frequently meeting. Cœcia globose. Avicularia none. Radical fibers, by which the fronds are attached, growing from the under side of the zœcia.

The zoarium does not rise much above the substratum, but spreads out in convoluted masses. From the point of origin of a colony, smaller fronds spring, frequently overlapping the older ones, and the whole has much the appearance of a brown lichen. The radical fibers spring from the upper corner of the dorsal side of the zœcia (fig. 8, *r. f.*). These frequently anastomose and form a network by which the colony or frond is anchored. In some cases fibers from the dorsal surface of an overlapping frond attach themselves to the margin of the zœcia of the lower frond. Again, the laminae are united back to back. They are easily separable, however, and their union is effected by means of short fibers. The margin of the distal part of the zœcium is much elevated and the spines are very prominent (fig. 7). There is considerable variation in their development, both in number and size. The two horn-like ones at the top are always present. Below these are usually two flattened ones on each side, which fold over the zœcium just below the ovicell (*f. sp.*). Sometimes, however, there are three flattened spines on each side, and again but one. Even on the same frond these variations in number are found, as well as considerable variation in size. No structure which could be called an avicularium has been detected, although a considerable quantity of material has been examined, both from Alaska and from Puget Sound.

Family *MEMBRANIPORIDÆ*.

MEMBRANIPORA Blainville.

MEMBRANIPORA LACROIXII Andouin.

Membranipora lacroixii HINCKS ('80), pl. xvii, figs. 5-8.

Biflustra lacroixii SMITT ('72), *Flor. Bry.* pt. 11, pl. 1v, figs. 85-88.

Habitat.—On shell.

Local distribution.—Kadiak.

Foreign distribution.—Coasts of Britain; Mediterranean; coast of Florida, 13-60 fms.; St. Lawrence.

MEMBRANIPORA MEMBRANACEA Linnæus.

Membranipora membranacea HINCKS ('80), pl. xviii, figs. 5, 6.

Flustra membranacea JOHNSTON ('47), pl. LXVI, figs. 1-3.

Habitat.—Upon kelp forming circular patches.

Local distribution.—Yakutat; Pribilof Islands, Alaska; Queen Charlotte Islands, incrusting stem of a seaweed.

Foreign distribution.—Universally distributed on the coasts of Britain; Hvidingsoe; Hongesund; Roscoff; Adriatic; Lyalls Bay, New Zealand; Australia.

MEMBRANIPORA LINEATA Linnæus.

Membranipora lineata HINCKS ('80), pl. XIX, figs. 3-6.

Membranipora lineata SMITT ('67), pl. XX, fig. 23; Flor. Bry. pt. 11, pl. 11, fig. 62.

Habitat.—A small patch on *Cellaria borealis*.

Local distribution.—Orca, Prince William Sound.

Geographical distribution.—Common on the coasts of Britain; Roscoff; Scandinavia, in shallow water, common; Baltic; Spitzbergen; Davis Strait, 100 fms.; Iceland, 15-20 fms.; Nova Zembla; Kara Sea; South Labrador; Adriatic; Florida; New Zealand.

MEMBRANIPORA UNICORNIS Fleming.

Membranipora unicornis HINCKS ('80), pl. XX, fig. 4.

Membranipora lineata 5, forma *unicornis*, BB, stadium longius adultum SMITT ('67), pl. XX, fig. 30.

Habitat.—Upon other Bryozoa and on hydroid stems.

Local distribution.—Juneau; Yakutat; Orca; Houston-Stewart Channel, Queen Charlotte Islands.

Foreign distribution.—Britain; Bohuslän; Spitzbergen; Greenland; Nova Zembla.

MEMBRANIPORA SPINIFERA Johnston.

Membranipora spinifera HINCKS ('80), pl. XIX, figs. 1, a, b, c.

Habitat.—Upon a stone.

Local distribution.—Orca, Prince William Sound.

Foreign distribution.—Abundant upon the British coast, France.

MEMBRANIPORA SANDALIA sp. nov.

(Pl. XX, figs. 9, 9a, 9b; Pl. XXI, fig. 10.)

Habitat.—Upon sponge.

Local distribution.—Yakutat.

Zoarium forming a rather loose crust, brittle and delicate, and only partially attached; spreading out in a fan-shaped expansion, the gelatinous margin of which is often convoluted; the apposed surfaces often growing together and forming irregular ridges over the colony. Zœcia oblong, quadrangular in the younger stages, much narrowed below in the older, and disposed in alternate series. In the adult stage, the upper half of the zœcial front is occupied by a membranous area, containing the crescent-shaped orifice at its distal end. The lower half is traversed by a network of calcareous lines or ribs

which extend from the lateral margins and converge, either to a central line extending from the base of the zœcia or to the base of a raised portion of the zœcial wall just below the aperture. An avicularium is developed upon this raised portion, with mandible directed to one side. Cœcia ?

This species seems to afford a transition between the Flustridæ and the Membraniporidæ. It possesses flustrine characteristics in the shape of the zœcium in the younger stages, and in the free frond-like growth of part of the colony. Where it is attached, however, the mode of adherence is membraniporidan. The thickened rim of the zœcium grows fast to the substratum, and upon removal of the crust the oblong shape of the under surface is left in outline. The type of avicularia is that of *Membranipora*, as is also the secondary calcification of a portion of the front wall.

In a colony of moderate size, three stages of growth can easily be distinguished. Upon the growing edge the zœcia are but faintly outlined, and the aperture occupies the whole of the front (fig. 9*a*, *ap.*). This shape is retained through the next four or five rows, but the second stage begins in the calcification of the lower half of the zœcia and the strengthening of their lateral walls. Fig. 9*b* represents an early stage of calcification. This begins sometimes as fine lines proceeding from the side and basal walls (*l.*), sometimes as thickened growths resembling denticles (*d.*). Soon the future aperture is outlined by the formation of a calcareous rim which does not quite unite below it (fig. 9, *ap.*). Meanwhile the calcareous thickenings along the lateral (fig. 9, *lat.*) and basal (fig. 9, *bas.*) margins of the proximal end of the zœcia converge toward a smaller area (*ar.*), which is left uncalcified just below the aperture. The secondary thickenings gradually unite more or less, leaving quite wide spaces, or lacunæ between them, which are covered only by the membranous material of the original aperture. In the third stage, represented by Pl. XXI, fig. 10, a large sessile avicularium (*av.*) is present upon the area below the aperture. Calcification has continued, and the whole of the lower portion of the zœcium has become involved. It is now covered by a thin calcareous crust which slightly obscures the calcareous network previously formed, and covers the muscular portion of the avicularium with a delicate granular layer. The avicularium seems elevated upon a kind of mound, and possesses a pointed mandible directed slightly upward or in the direction of the rim of the aperture (fig. 10, *man.*). The mandible turns in some cases to the right, in others to the left. Cœcia are not known.

Family *CRIBRILINIDÆ*.**CRIBRILINA** Gray.**CRIBRILINA ANNULATA** Fabricius.

Cribrilina annulata HINCKS ('80), pl. xxv, figs. 11, 12.

Escharipora annulata SMITT ('67), pl. xxiv, figs. 8-10.

Habitat.—A small colony growing upon an ascidian.

Local distribution.—Yakutat.

Foreign distribution.—Britain; Greenland; Nova Zembla; Kara Sea; Hammerfest; Spitzbergen, 3-30 fms.; Bergen; Labrador; Grand Menan, Bay of Fundy; Gulf of St. Lawrence.

Family *MYRIOZOIDÆ*.**SCHIZOPORELLA** Hincks.**SCHIZOPORELLA BIAPERTA** Michelin.

Schizoporella biaperta HINCKS ('80), pl. xl, figs. 7-9.

Escharella linearis forma *biaperta* SMITT ('67), pl. xxiv, figs. 70, 73.

Hippothoa biaperta SMITT ('72), pl. viii, figs. 173-176.

Habitat.—On shells of brachiopods.

Local distribution.—Juneau; Houston-Stewart Channel; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen; Greenland; Kara Sea; Florida.

SCHIZOPORELLA HYALINA Linnæus.

Schizoporella hyalina HINCKS ('80), pl. xviii, figs. 8-10.

Mollia hyalina SMITT ('67), pl. xxv, fig. 84.

Habitat.—On shells and on other Bryozoa.

Local distribution.—Sitka; Juneau; Orca; Yakutat; Houston-Stewart Channel; Virago Sound; Fort Point and Santa Cruz, California.

Foreign distribution.—Arctic seas; Spitzbergen; Greenland; Mediterranean; Africa; Australia.

SCHIZOPORELLA INSCULPTA Hincks.

Schizoporella insculpta HINCKS ('83), pl. xvii, fig. 5.

Habitat.—On *Alcyonidium mytili*.

Local distribution.—Sitka, both in the littoral region, and dredged at 10 fms.; Virago Sound, Cumshewa Harbor, Queen Charlotte Islands; Vancouver Island; Alki Point, Puget Sound.

MYRIOZOOM Donati.**MYRIOZOOM COARCTATUM** Sars.

Myriozoom coarctatum SMITT ('67), pl. xxv, fig. 92.

Local distribution.—Juneau; Orca; Yakutat; Cumshewa Harbor, Houston-Stewart Channel, Queen Charlotte Islands.

Foreign distribution.—Norway; Finmark; Hammerfest; Komagfyord.

MYRIOZOOM CRUSTACEUM Smitt.

Myriozoom crustaceum SMITT ('67), pl. xxv, figs. 88-91.

Habitat.—Incrusting ascidians, shells, and *M. coarctatum*. Abundant.

Local distribution.—Juneau; Orca; Yakutat; Kadiak.

Geographical distribution.—Common in the Arctic regions; Finmark; Spitzbergen; East Greenland.

Family *ESCHARIDÆ*.**LEPRALIA** Johnston.**LEPRALIA FOLIACEA** Ellis & Solander.

Lepralia foliacea HINCKS ('80), pl. XLVII, figs. 1-4.

Local distribution.—Juneau.

Foreign distribution.—Southern coasts of Britain; Hebrides, most northern locality; Mediterranean; Adriatic; Algiers; Roscoff; Naples; Cape of Good Hope; Indian Ocean.

SMITTIA Hincks.**SMITTIA TRISPINOSA** Johnston.

Smittia trispinosa HINCKS ('80), pl. XLIX, figs. 1-8.

Escharella jacotini SMITT ('67), pl. XXIV, figs. 53-57.

Habitat.—On shell and stone.

Local distribution.—Sitka; Juneau; Houston-Stewart Channel, Cumshewa Harbor, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Common on the coast of Britain; Norway Arctic seas; Gulf of St. Lawrence; Florida; Mazatlan; Cape Horn; Aden; Adriatic; East Indies; Bass Straits.

Family *CELLEPORIDÆ*.**CELLEPORA** (part) Fabricius.**CELLEPORA INCRASSATA** Lamarck.

Habitat.—Incrusting *Cellaria borealis*. The branched form also found.

Local distribution.—Juneau; Berg Inlet; Orca; Pribilof Islands; Houston-Stewart Channel, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Finmark; Spitzbergen; Greenland; Bank of Newfoundland.

Suborder *CYCLOSTOMATA* Busk.

Family *CRISIIDÆ*.

CRISIA (part) Lamouroux.

CRISIA CORNUTA Linnæus.

Crisia cornuta (a : sine cornibus) SMITT ('65), pl. XVI, figs. 2, 3.

Crisia geniculata HARMER ('91), pl. XII, figs. 7, 8.

Habitat.—Upon shells and other Bryozoa.

Local distribution.—Sitka; Juneau; Yakutat; Orca.

Foreign distribution.—Britain; Roscoff; Mediterranean; Bahusia; Norway.

Family *TUBULIPORIDÆ*.

ENTALOPHORA Lamouroux.

ENTALOPHORA CAPITATA sp. nov.

(Pl. XXI, figs. 11, 12, 13.)

Habitat.—Upon stems and roots of hydroids.

Local distribution.—Sitka; Juneau, 10 fms.

Zoarium consisting of a number of zœcia arising from a flattened or incrusting base, many of them uniting to form one or more short columns which terminate in a rounded head. Zœcia tubular, distal ends free; those forming the column opening upon all sides of it. The surface of the head composed of the orifices pressed close together, or projecting slightly through the granular matrix, which is perforated by rather large pores.

This species was obtained in two slightly different forms whose main features, however, are similar. Figs. 11 and 12 represent them of natural size. The one in fig. 11 was dredged in 10 fms., and is a deep purple color. The base is elliptical. The zœcia on the periphery are decumbent, while those in the center are almost upright, their tubular orifices projecting somewhat beyond the granular matrix in which they are imbedded. At each end of the long diameter of the base a number of zœcia have united to form a column. The smaller of these is represented, somewhat enlarged, by fig. 13. Here the column arises out of a forest of tubes so that its base is somewhat

obscured. The top spreads out into a rounded head whose diameter is greater than that of the stalk. Upon the surface the orifices are, for the most part, closely approximated and assume a hexagonal shape. A very few project slightly and are circular. The transition from the top of the column into the mound-like surface is not definitely marked by any border or rim such as is shown for *Stomatopora fungia* (Hincks '80) or for *Tubulipora pencillata* (Smitt '66). The second form, represented of natural size in fig. 12, is white in color, and was obtained at low tide, partially incrusting a hydroid stem. In this case the colony has attached itself by encircling the stem in an irregular way, and has formed a column terminated by the mound-like head.

Family *LICHENOPORIDÆ*.

LICHENOPORA DeFrance.

LICHENOPORA VERRUCARIA Fabricius.

Lichenopora verrucaria HINCKS ('80), pl. LXIV, figs. 4, 5.

Habitat.—Upon *Cellaria borealis*.

Local distribution.—Orca; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Bahusia; Norway; Finmark; Arctic seas; Bay of Fundy; St. George Banks; Britain, north and west.

Suborder *CTENOSTOMATA* Busk.

Family *ALCYONIDIIDÆ*.

ALCYONIDIUM Lamouroux.

ALCYONIDIUM GELATINOSUM Linnæus.

Alcyonidium gelatinosum HINCKS ('80), pl. LXIX, figs. 1-3.

Halodactylus diaphanus FARRE ('37), pls. XXV, XXVI, figs. 1-16.

Local distribution.—Muir Inlet; Orca; Garforth Island; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Coasts of Britain; Norway; Sweden; North America; White Sea; Nova Zembla; Kara Sea; Natal.

ALCYONIDIUM MYTILI Dalyell.

Alcyonidium mytili HINCKS ('80), pl. LXX, figs. 2, 3.

Alcyonidium parasiticum SMITT ('65), pl. v, figs. 8-19.

Habitat.—Growing on ascidians, shell, and on *Fucus*.

Local distribution.—Sitka; Yakutat; Fakir Islet; Garforth Island.

Foreign distribution.—Bahusia, 5-20 fms.; Baltic Sea; coasts of Britain.

ALCYONIDIUM POLYOUM Hassall.

Alcyonidium polyoum HINCKS ('80), pl. LXIX, fig. 9.

Sarchochitum polyoum JOHNSTON ('47), pl. LXXI, fig. 1.

Habitat.—On stones, kelp, and on hydroid stems.

Local distribution.—Orca, Prince William Sound; Yakutat.

Foreign distribution.—Dublin Bay; Northumberland; Roscoff.

The species which I have identified as *A. polyoum* forms circular colonies an inch or more in diameter. In its young state only, can it be described as forming a thin crust. At that stage the boundaries of the zœcia are distinctly marked off, and it resembles *A. mytili* very closely. It may be distinguished, however, by the position of the zœcia and by the orifice. The zœcia toward the center tend to become upright, and those on the periphery are partially raised, so that the upper portion projects from a gelatinous matrix. They are rounded or barrel-shaped, and the orifice opens upon a distinct papilla. The orifice contains a great number of black setæ, some of which project quite far beyond it even when it is closed. The primary crust is quite transparent, but soon thickens into a somewhat fleshy mass of a dark brown color.

ALCYONIDIUM CERVICORNIS sp. nov.

(Pl. XXI, figs. 14, 15, 16, 17.)

Habitat.—On seaweed and on *Cellaria borealis*.

Local distribution.—Orca and Juneau.

Zoarium consisting of a rounded ball-like mass of a dark-brown color. Zœcia imbedded in the gelatinous mass, the orifices projecting above the surface. The surface bristling with tall, red, branching, hollow spines which project from spaces between the zœcia.

The distinguishing mark of this species consists in the great number of hollow branching spines which beset the surface. Figure 14 is a habit sketch, natural size, of a colony. Fig. 15 represents a portion of the surface showing a number of the spines and the projecting orifices (*or.*) of the zœcia. The spines arise from definite portions of the surface, between the zœcia. They are hollow and the interior contains a stainable tissue which extends to the tips of the branches. Each spine consists of a central stem which forks at the top into four branches or prongs. Fig. 16 represents the branches viewed from above. Sometimes the tips of the prongs divide, as represented by fig. 17, and the resemblance to antlers is very marked. In other respects this species bears a resemblance to *A. polyoum*.

The colony is gelatinous and composed of but one layer, and the polypides, which are inclined somewhat to the surface, lie imbedded in the matrix. The orifices are circular and open upon distinct papillæ.

Family *FLUSTRELLIDÆ*.

FLUSTRELLA Gray.

FLUSTRELLA HISPIDA Fabricius.

Flustrella hispida HINCKS ('80), pl. LXXII, figs. 1-5.

Flustrella hispida JOHNSTON ('47), pl. LXVI, fig. 5.

Local distribution.—Yakutat, forming branching masses; Lands End; Fort Point, California.

Foreign distribution.—Common in Britain; Bahusia; Finmark; Greenland; Heligoland; Roscoff; France.

Family *VESICULARIIDÆ*.

BOWERBANKIA Farre.

BOWERBANKIA IMBRICATA Adams.

Bowerbankia imbricata HINCKS ('80), pl. LXXIII, figs. 1, 2.

Bowerbankia densa FARRE ('37), pl. XX and XXI, figs. 1-16.

Habitat.—Creeping over other Bryozoa.

Local distribution.—Orca; Yakutat; Lime Point, California; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Common on the coast of Britain; White Sea; Caspian Sea; Ostend; Roscoff.

Suborder *PHYLACTOLÆMATA* Allman.

Family *PLUMATELLIDÆ*.

PLUMATELLA Lamarck.

PLUMATELLA REPENS Linnæus.

Plumatella repens ALLMAN ('56), pl. v, figs. 1-8.

Plumatella repens JOHNSTON ('47), 2d ed., p. 403, fig. 76.

Local distribution.—Water-lily pond at Kadiak; Lake Washington, Seattle; Mountain Lake, San Francisco.

Foreign distribution.—Through Great Britain; Lake Lucerne; Lake Como; Alpine lakes; lakes in the Pyrenees; France; Italy; Germany; Prussia; Sweden; Denmark.

Group *ENTOPROCTA* Nitsche.Family *PEDICELLINIDÆ*.**PEDICELLINA** Sars.

PEDICELLINA NUTANS (?) Ballyell.

Pedicellina nutans HINCKS ('80), p. 569, woodcut figs. 37, 38, 40.

Habitat.—On roots of hydroids and Bryozoa.

Local distribution.—Yakutat; Tomales Bay, California.

Foreign distribution.—Coast of England.

This form is placed here provisionally. It conforms in general with the diagnoses of Hincks and of Ehlers ('90). Tentacles possess one characteristic, however, which is not mentioned by these writers. They contain a yellowish-brown pigment which is very conspicuous, at least after the animal is killed, and which is very persistent. It is not destroyed even when the tissue is treated with the reagents necessary for imbedding and staining. It seems to be lodged in the outer layer of cells of the tentacles, and is not found in the lophophore nor in any other part of the animal, so far as I have been able to observe.

LIST OF SPECIES.

CHEILOSTOMATA.

<i>Gemellaria loricata</i> .	<i>Membranipora lineata</i> .
<i>Menipea ternata</i> .	<i>Membranipora unicornis</i> .
<i>Menipea ternata</i> forma <i>gracilis</i> .	<i>Membranipora spinifera</i> .
<i>Menipea erecta</i> sp. nov.	<i>Membranipora sandalia</i> sp. nov.
<i>Scrupocellaria scabra</i> .	<i>Cribrilina annulata</i> .
<i>Caberea ellisii</i> .	<i>Schizoporella biapertura</i> .
<i>Bugula murrayana</i> .	<i>Schizoporella hyalina</i> .
<i>Bugula purpurotincta</i> .	<i>Schizoporella insculpta</i> .
<i>Bugula flabellata</i> .	<i>Myrionozoum coarctatum</i> .
<i>Cellaria borealis</i> .	<i>Myrionozoum crustaceum</i> .
<i>Flustra lichenoides</i> sp. nov.	<i>Lepralia foliacea</i> .
<i>Membranipora lacroixii</i> .	<i>Smittia trispinosa</i> .
<i>Membranipora membranacea</i> .	<i>Cellepora incrassata</i> .

CYCLOSTOMATA.

<i>Crisia cornuta</i> .	<i>Lichenopora verrucaria</i> .
<i>Entalophora capitata</i> .	

CTENOSTOMATA.

- Alcyonidium gelatinosum.* *Alcyonidium cervicornis* sp. nov.
Alcyonidium mytili. *Flustrella hispida.*
Alcyonidium polyoum. *Bowerbankia imbricata.*

PHYLACTOLEMATA.

Plumatella repens.

ENTOPROCTA.

Pedicellina nutans (?).

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ABBREVIATIONS USED IN THE FIGURES.

- av.*—avicularium.
ar.—area.
art.—articulation.
ap.—aperture.
b.—beak.
bas.—basal.
bifur.—bifurcation of branch.
d.—denticle.
emb.—embryo.
f. a.—frontal avicularium.
fl. sp.—flattened spine.
l.—lines of calcification.
lat.—lateral.
m.—margin.
man—mandible.
mus. app.—muscular apparatus.
α.—æcium.
op.—operculum.
or.—orifice.
ped.—peduncle.
r. f.—radical fiber.
sp.—spine.
zα.—zæcium.

PLATE XIX.

[All figures drawn by aid of a camera lucida except 7a, 11, 12, and 13.]

- FIG. 1. *Menipca erecta* sp. nov. Frontal view, showing bifurcation of an internode and main points of structure; spine (*sp.*), operculum (*op.*), frontal avicularia (*f. a.*), cecia (*æ.*), and mode of articulation (*art.*).
2. Dorsal view of the same, showing the radical fibers (*r. f.*) and the place of their attachment upon the zœcia.
 3. *Scrupocellaria scabra* Van Beneden, frontal view.
 4. Dorsal view of the same, showing absence of vibracula.

zoe.

r. f.

art.

sp.

r. f.

2

sp.

m

oe.

oe.

l

art.

fa.

sp.

op.

ap.

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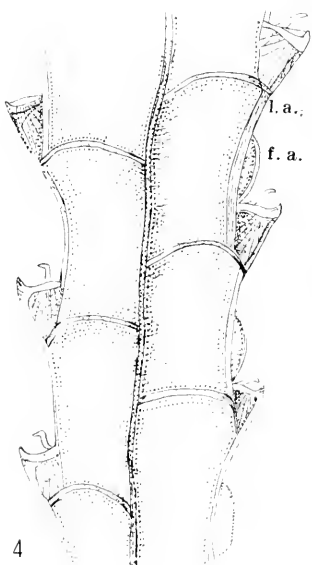
l. a.

f. a.

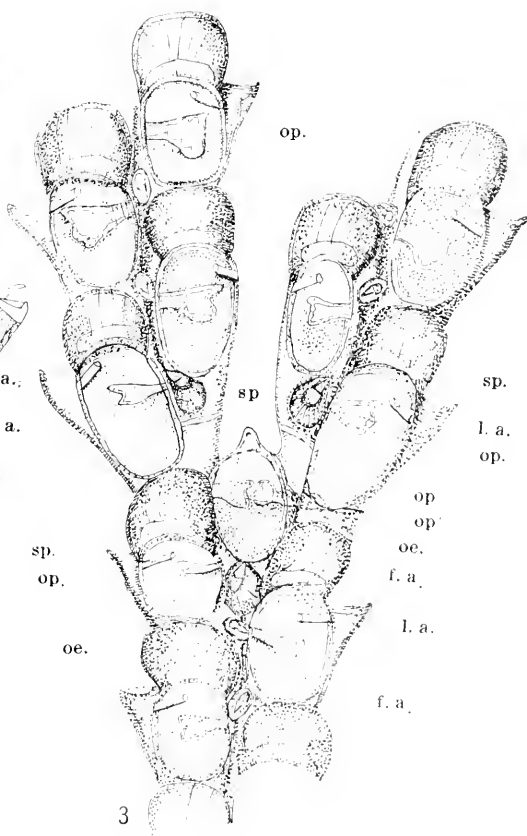
sp.

op.

oe.



4



3

PLATE XX.

- FIG. 5. *Bugula purpurotincla* Norman, frontal view. The two lower zœcia on the left show the small size of the œcia (*æ.*) compared with that of the embryo (*emb.*) (*av.*) avicularium.
- 5a. An avicularium which had broken away from its zœcium; peduncle (*ped.*), mandible (*man.*), beak (*b.*), muscular apparatus (*mus. app.*).
6. Dorsal view of the same, showing spine (*sp.*) and avicularium (*av.*) as seen from the back, and the mode of bifurcation (*bifur.*).
7. *Flustra lichenoides* sp. nov. Frontal view, showing œcia (*æ.*) and variation in the number of flattened spines (*fl. sp.*).
- 7a. A single frond of the same, natural size.
8. Dorsal surface of the same, showing the radical fibers (*r. f.*) and their mode of attachment to the zœcia.
9. *Membranipora sandalia* sp. nov. Upper surface, representing a few zœcia in the second stage. The aperture (*ap.*) occupies the distal end of the zœcium. Below it is the uncalcified area (*ar.*) upon which an avicularium will be formed, and toward which the calcareous thickenings converge.
- 9a. One zœcium of the same near the edge of the colony. It is oblong in shape and the aperture (*ap.*) occupies the whole of the front.
- 9b. A zœcium of the same, showing the beginnings of calcification (*l.*) and (*d.*). The future aperture (*ap.*) is already laid off.

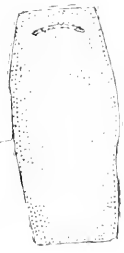
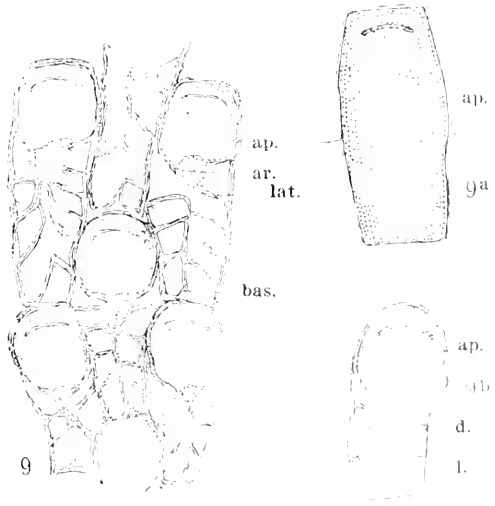
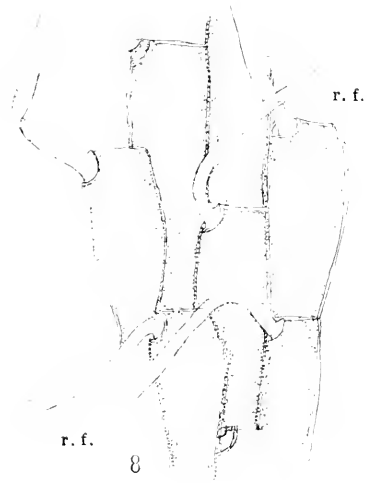
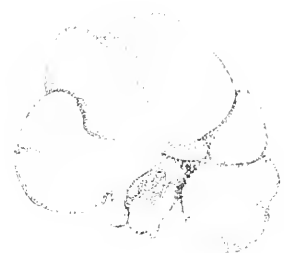
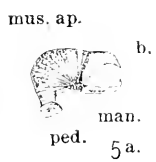
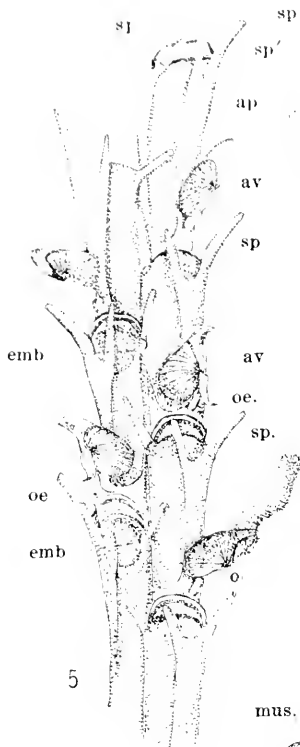
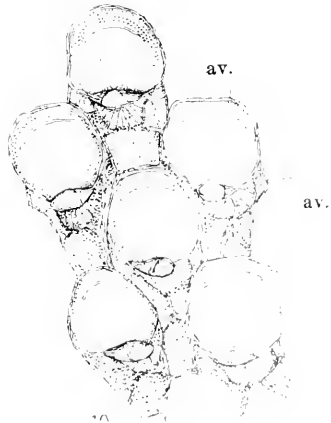
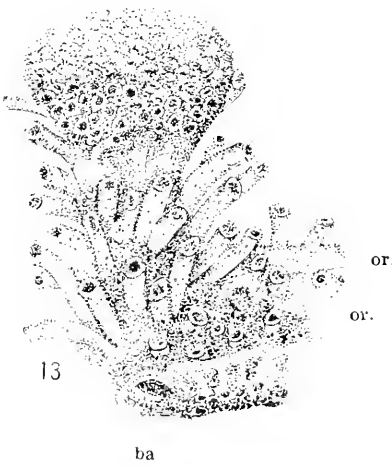
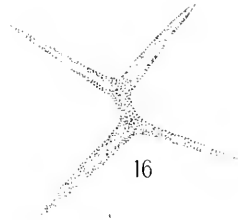
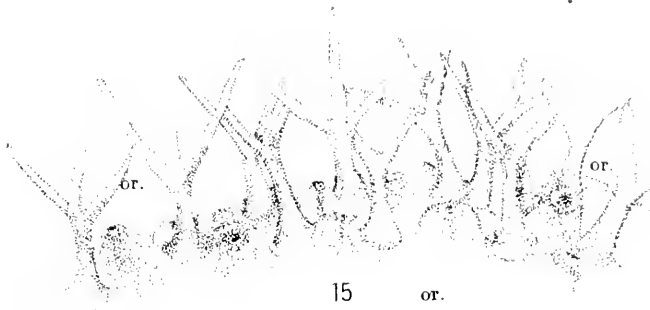


PLATE XXI.

- FIG. 10. The adult stage of *Membranipora sandalia*, in which the surface is covered with a fine calcareous layer, obscuring the network previously formed. A large sessile avicularium (*av.*) is found upon the area below the aperture.
11. *Entalophora capitata* sp. nov. Natural size of the purple variety with elliptical base. Orifices of the upright zœcia (*or.*).
12. The white variety of the same, natural size.
13. The smaller of the two columns represented by fig. 11. Only part of the base (*bas*) shown in the drawing.
14. *Alcyonidium cervicornis* sp. nov. A colony, natural size.
15. Part of the surface of the same, showing spines, and orifices of the zœcia (*or.*).
- FIGS. 16 and 17. Two of the spines of the same, showing two modes of branching. The drawing is intended to show the branching top of the spine as it appears when viewed directly from above.



PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 341-365.

NOVEMBER 24, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

VII.

ENTOMOLOGICAL RESULTS (1):

THE TENTHREDINOIDEA.

BY TREVOR KINCAID.

THE writer being the only member of the Harriman Expedition especially interested in entomology, the duty devolved upon him of securing as large a representation as possible of the insect fauna of the regions visited. Fortunately the conditions were more favorable than is usually the case in the exploration of these northern latitudes. Every facility that experience and forethought could suggest had been provided, and the work was further facilitated by the careful organization of the party. Moreover the labors of the collector were only slightly interfered with by unpropitious weather, which is the more remarkable in a region notorious for its excessive humidity and long continued rains.

Recognizing the fact that almost nothing was known concerning the insect fauna of Alaska outside of the orders Coleoptera and Lepidoptera, a special effort was made to secure representatives of groups which, from the small size or obscure habits of their members, had not hitherto been collected in the Territory. This endeavor was so successful that the resulting collection contains by far the most extensive general series of

insects ever brought from the region. It will enable entomologists to form an idea of the rich field that awaits them in this vast northern possession of the United States.

The collection embraces in all more than 5,000 pinned insects, together with a considerable series of Arachnida, Myriopoda, and larval forms preserved in alcohol. The exact number of species represented cannot be stated at the date of writing, as not all the reports are completed, but the total will not fall far short of 900, distributed in the several groups as follows: Arachnida, 53; Myriopoda, 10; Thysanura, 10; Neuropteroids, 32; Odonata, 10; Aphididæ, 4; Psyllidæ, 3; Jassidæ, 10; Heteroptera, 14; Orthoptera, 1; Coleoptera, 159; Diptera, 276; Rhophalocera, 12; Heterocera, 60; Apoidea, 12; Sphegoidea, 6; Vespoidea, 3; Formicoidea, 4; Parasitic Hymenoptera, 150; Tenthredinoidea, 56. Of the above, upwards of 200 species are new to science, and of the remainder a large number are either new to the North American Continent or not yet recorded from Alaska.

The collections were made between the first of June and the first of August, 1899. Except a small number of specimens obtained in British Columbia, all of the material was collected in Alaska. Most of the stops were made in going northward and westward, a few on the return journey. Collections were made at the following localities, which for convenience are arranged in geographic sequence, with date of visit: Fox Point, July 26-28; Metlakahla, June 4; Farragut Bay, June 5; Taku Inlet, June 6; Muir Inlet, June 9-12; Juneau, July 25; Sitka, June 14-16; Yakutat Bay, June 18-22; Virgin Bay, Prince William Sound, June 25-26; Orca, Prince William Sound, June 27; Saldovia, Kenai Peninsula, July 21; Kukak Bay, Alaska Peninsula, June 29-July 5; Kadiak, July 20; Popof Island, July 7-17.

Upon the return of the Expedition the collections were properly labeled and assorted into groups, after which they were transmitted to Dr. L. O. Howard, Chief of the Division of Entomology of the U. S. Department of Agriculture and Curator of Insects U. S. National Museum, for distribution to specialists for study and report. It is expected that these reports, twenty

or more in number, will appear in the Proceedings of the Washington Academy of Sciences, and later in the final report of the Harriman Expedition. The systematists who have the various groups in hand are as follows:

Aracluida	Nathan Banks.	Diptera	D. W. Coquillett.
Myriopoda	O. F. Cook.	Lepidoptera	H. G. Dyar.
Thysanura	Justus W. Folsom.	Apoidea	Wm. H. Ashmead.
Neuropteroids	Nathan Banks.	Sphagoidea and	
Odonata	R. P. Currie.	Vespoidea	Trevor Kincaid.
Aphididæ	Th. Pergande.	Formicoidea	Th. Pergande.
Psyllidæ	E. A. Schwarz.	Parasitic Hymenop-	
Jassidæ	—	tera	Wm. H. Ashmead.
Heteroptera	O. Heidemann.	Tenthredinoidea	Trevor Kincaid.
Orthoptera	A. N. Caudell.	Life-histories of	
Coleoptera	E. A. Schwarz.	Coleoptera	Trevor Kincaid.

The collection of sawflies upon which the following report is based was gathered by the writer while with the Harriman Expedition in Alaska, and consists of about 350 specimens, representing 56 species, of which a considerable number are believed to be new to science.

Very little is known concerning the sawflies of Alaska, only seven species having been recorded from this great Territory. In 1822 Eschscholtz¹ described four species from Unalaska; in 1872 Norton² recorded a variety of *Dolerus similis* from the Yukon; in 1880 Cresson³ described a form of *Trichiosoma triangulum* from the Aleutian Islands; in 1894 Harrington⁴ described a *Tenthredo* from Fort Wrangell, and in 1896 Marlatt⁵ recorded a species of *Pachynematus* from the same locality.

It is clear that hardly a beginning has been made towards bringing to light the insect fauna of this vast and peculiar region, except perhaps in the Coleoptera, which were carefully collected by the Russians. Among the sawflies we may expect an especially rich series of Nematidæ owing to the immense abundance, both in species and individuals, of various kinds of willows.

¹ Eschscholtz, Entomogr., 1822.

² Norton, Trans. Amer. Ent. Soc., IV, p. 82, 1872.

³ Cresson, Trans. Amer. Ent. Soc., VIII, p. 1, 1880.

⁴ Harrington, Can. Ent., xxvi, p. 194, 1894.

⁵ Marlatt, Monog. Nemet., p. 109, 1896.

In presenting this paper, the writer wishes to thank the authorities of the U. S. National Museum, especially Dr. L. O. Howard and Mr. William H. Ashmead, for many kindnesses, including access to the library and collection and other facilities for research. Thanks are due also to Dr. Henry Skinner and Mr. William J. Fox, of the American Entomological Society for the opportunity of studying the Hymenoptera in the collection at Philadelphia.

Family **LYDIDÆ**.

ITYCORSIA MARGINIVENTRIS.

Itycorsia marginiventris CRESSON, Trans. Amer. Ent. Soc., VIII, p. 29, 1880.
(Lyda.)

A specimen of *Itycorsia* taken at Sitka, Alaska, June 15, agrees with the type of this species except in a few trifling details of coloration. In the Sitka example the spot on the pleura is much more extensive, the bands on the venter of the abdomen are reduced to mere spots at the sides, the femora are black with a reddish spot at apex, and the tibiæ and tarsi are rufous. This species was originally described from New York.

CEPHALEIA NIGROPECTUS.

Cephalcia nigropectus CRESSON, Trans. Amer. Ent. Soc., VIII, p. 32, 1880.
(Lyda.)

One female taken at Sitka, Alaska, June 15. This species was originally described from Nevada.

CEPHALEIA sp. — (?).

A representative of this genus was taken by Mr. Charles Palache on Kadiak Island, but is in too poor condition for determination.

BACTROCEROS SITKENSIS sp. nov.

Female: Length 10 mm; antennæ of moderate length, about twenty-five jointed, slender, tapering, third joint longer by one third than the fourth. Color black; flagellum of antennæ honey yellow; abdomen except basal plates sanguineous; anterior margin of clypeus, two closely united spots just anterior to the front ocellus, fine wavy line partially surrounding the anterior ocellus, spot extending inwards from the middle of eye, small spot between this last spot and the base of the antennæ, large spot extending from the inner posterior margin of

the eye to the temples, where it is considerably dilated, minute spot in the lateral grooves of the occiput, extreme angles of pronotum, tegulæ, scutellum, post-scutellum, yellow; femora white; tibiæ and tarsi yellow.

Two females, Sitka, June 16, 1899.

Type no. 5280, U. S. National Museum.

Family SELANDRIIDÆ.

FENUSA ALASKANA sp. nov.

Male: Length 4 mm.; smooth, shining; head nearly as broad as thorax, polished, impunctate; a deep elongate pit immediately behind the base of each antenna; antennal fovea large, round, deeply impressed, sharply limited; antennæ short, third joint almost as long as fourth and fifth combined; clypeus squarely truncate; posterior tarsi as long as the corresponding tibiæ; stigma broad at base, tapering to apex. Color black; tegulæ and knees white; antennæ beneath, spot on apex of femora above, line outwardly on all tibiæ and apices of tarsal joints, reddish yellow; wings hyaline, nervures and stigma brown.

One female, Kukak Bay, July 3, 1899.

Type no. 5281, U. S. National Museum.

Allied to *Fenusa curta* Norton, from which it differs in the coloration of the antennæ, and in the much greater length of the posterior tarsi.

ERYTHRASPIDES ASHMEADII sp. nov.

Female: Length 6 mm.; clypeus truncate, densely pubescent; antennæ shorter than the head and thorax, stout, third joint nearly as long as fourth and fifth combined, the joints beyond the third enlarged at apex; a stout ridge extending backwards from the base of each antenna with a deep pit close to its posterior termination; antennal fovea broad, shallow, roughened, indistinctly defined; scutellum and base of metathorax finely granulate; stigma broad, rounded below, acuminate at apex; sheath elongate, stout, rather sharp, rounding above and below. Color black, shining; apices of femora and tibiæ, except tips, white; outer margin of tegulæ testaceous; wings hyaline, nervures black, stigma dark brown.

Male: Length 5.5 mm.; resembles female in general structural characters, but the ridges behind the antennæ are much reduced and the pits found in the female close to their posterior terminations are obsolete; antennæ stouter; colored as in the female.

Two females and one male, Sitka, Alaska, June 16, 1899.

Type no. 5282, U. S. National Museum.

Named in honor of Wm. H. Ashmead, of the U. S. National Museum.

MONOPHADNUS INSULARIS sp. nov.

Male: Length 6 mm.; head broad, constricted immediately behind the compound eyes; clypeus slightly emarginate; antennæ robust, of moderate length, slightly compressed at base, third joint equal in length to fourth; antennal fovea large and deep, bounded on each side by a strong ridge; a deep excavation behind each antenna; a short ridge extending forward from each of the posterior ocelli; stigma rounded beneath, tapering at apex. Color black, shining; apices of anterior and medial femora, and a spot anteriorly on front tibiæ, testaceous; wings slightly smoky, nervures black.

One male, Metlakahtla, Alaska, June 4, 1899.

Type no. 5283, U. S. National Museum.

PARASELANDRIA RUFIGASTRA sp. nov.

Female: Length 5.5 mm.; clypeus emarginate; antennæ elongate, slender, tapering, third joint shorter than fourth; frontal area of head with a heart-shaped depression surrounded by a clearly raised ridge; lateral portions of the head finely roughened; frontal ridge sharp and unbroken; antennal fovea broad, rather deep, surrounded by a distinct wall; region behind each antenna with a deep irregular pit; middle lobe of mesothorax sharply keeled posteriorly; stigma narrow, tapering from near base to apex. Color black; clypeus, labrum, angles of prothorax, tegulæ, and legs except base of coxæ, testaceous; tips of posterior tibiæ and all the tarsi more or less infuscated; abdomen except basal plates and first segment rufous, with some black infuscations towards tip; wings hyaline, nervures brown.

One female, Kukak Bay, July 4.

Type no. 5284, U. S. National Museum.

PÆCILOSTOMIDEA MACULATA.

Pæcilostomidea maculata NORTON, Proc. Bost. Soc. Nat. Hist., VIII, p. 157, 1861. (Emphytus.)

Six females and eighteen males taken at Sitka, June 15; Yakutat, Alaska, June 20; Virgin Bay, Alaska, June 25. This species is widely distributed throughout the United States and Canada, and is recorded by Mr. Harrington from Vancouver Island.

Family NEMATIDÆ.

PACHYNEMATUS OCREATUS.

Pachynematus ocreatus HARRINGTON, Can. Ent., XXI, p. 25, 1889. (Nematid.)

Three females taken at Sitka, Alaska. This species was originally described from Ottawa, Ontario.

PACHYNEMATUS AFFINIS.

Pachynematus affinis MARLATT, Revision of the Nematinae of North America, p. 97, 1896.

One female and one male, Popof Island, Alaska, July 13, 1899. The only observed differences between the type of *affinis* and the Alaska form are in coloration. In the latter a small black spot is present on the pectus, and the antennæ are inclined to be testaceous towards tip. *P. affinis* was originally described from Montana.

PACHYNEMATUS ORONUS sp. nov.

Female: Length 6 to 7 mm.; clypeus narrowly and deeply notched, lobes triangular; frontal crest broad and strong, extending laterally to orbits, notched in the middle; sides of ocellar basin broad and rounded; antennal fovea oval, deep, continuous posteriorly with the frontal depression; antennæ longer than head and thorax, slender, third joint slightly shorter than fourth; venation normal except that the third cubital cell is three times as long as wide at base, the sides almost parallel; stigma rather narrow, gently rounded below; sheath narrow, rounding above and below to a rather narrowly rounded tip; cerci extremely long, somewhat clavate at apex; inner tooth of claw minute. Color for the most part reddish yellow; ocelli, two basal joints of antennæ, spot on anterior lobes of mesonotum sometimes absent, variable spot on pectus, basal plates, tergum of abdomen except three or four apical segments, black; venter more or less infuscated basally; wings hyaline, nervures brown, stigma and costa yellowish.

Three females, Yakutat Bay, Alaska, June 21, 1899.

Type no. 5285, U. S. National Museum.

This species is allied to the preceding form, but differs in the more deeply emarginate clypeus and in the absence of black markings on the mesonotum.

PACHYNEMATUS PLEURICUS.

Pachynematus pleuricus NORTON, Trans. Amer. Entom. Soc., 1, p. 208, 1867 ♀. (Nematus.)

Male: Length 6 mm.; head sculptured as in the female; antennæ as long as the entire body, slightly flattened at base, tapering; second recurrent nervure nearly interstitial with second cubital; procidentia broad at base, produced, squarely truncate at apex. Color black; procidentia, hypopygium and legs reddish yellow; coxæ and base of femora black.

One female and two males, Kukak Bay, July 1.

Type ♂, no. 5286, U. S. National Museum.

This species is recorded from Colorado and Idaho, but the male had not been described.

PACHYNEMATUS ORARIUS sp. nov.

Female: Length 6.5 mm.; short, robust; head narrowed back of compound eyes; clypeus very shallowly emarginate; lateral walls of ocellar basin clearly and sharply raised; frontal crest strongly raised but deeply broken into the deep narrow antennal fovea, which is well defined laterally and posteriorly; head rather coarsely and closely punctured except within the ocellar basin, where the punctures are sparse; antennæ of moderate length, tapering to apex, joints three to five subequal; intercostal close to basal; venation normal; stigma narrow, broadest at base, tapering to apex; sheath robust, rounded at tip; cerci slender. Color black; labrum, angles of pronotum, tegulæ, legs, except base of coxæ, testaceous; wings hyaline, nervures brown; the costa and stigma testaceous.

Two females, Kukak Bay, Alaska, July 4, 1899; Sitka, June 16.

Type no. 5287, U. S. National Museum.

Allied to *Pachynematus hoodi* Marlatt, but in that species the frontal crest is unbroken and the venter of the abdomen is yellowish.

PACHYNEMATUS GOTARUS sp. nov.

Male: Length 6 mm.; head strongly roughened and punctured, clothed with long sericeous pile; clypeus broadly and deeply notched, lobes pointed; area in front of ocelli destitute of ridges; antennal fovea obsolete; antennæ nearly as long as the entire body, densely pubescent, third joint slightly shorter than fourth; procidentia broad at base, projecting, broadly rounded at tip; stigma regularly rounded beneath; inner tooth of claw minute. Color black; tips of femora, tibiæ, apex

of abdomen, and the tarsi, testaceous, the last more or less infuscated at tip; wings hyaline, nervures brown, costa and stigma yellow.

One female, Popof Island, July 13.

Type no. 5288, U. S. National Museum.

Allied to *Pachynematus apicalis* Marlatt, but in that species the walls of the ocellar basin are present, the antennal fovea is developed, and the second recurrent nervure is interstitial with the second cubital.

SYNOPSIS OF PRECEDING SPECIES OF PACHYNEMATUS.

Females.

Sheath very large and projecting.....*ocreatus* Harrington.
Sheath normal.

Head black.....*orarius* sp. nov.

Head mostly yellow.

Venation normal.

Antennæ yellow.....*oronus* sp. nov.

Antennæ black.....*pleuricus* Norton.

Second recurrent interstitial.....*affinis* Marlatt.

Males.

Venation normal.

Hypopygium entirely pale, third joint of antennæ much shorter than the fourth.....*pleuricus* Norton.

Hypopygium pale at apex, third joint of antennæ but slightly shorter than fourth.....*gotarus* sp. nov.

Second recurrent interstitial.....*affinis* Marlatt.

PRISTIPHORA ORTINGA sp. nov.

Female: Length 5 mm., smooth and shining; head strongly, but sparsely punctured; vertex smooth, shining, entirely free from ridges; clypeus squarely truncate; antennal fovea indistinct shallow, punctured, merging posteriorly into the frontal area behind; antennæ short, third joint longer than fourth or fifth which are subequal; first cubital vein wanting; outer veins of discal cells in hind wings interstitial; sheath blunt at tip, rounded above and below; cerci minute; stigma narrow, broadest at base, tapering to apex; inner tooth of claw extremely minute. Color black; trochanters, tips of anterior and middle femora, tibiæ except tips of posterior pair, and the tarsi for the most part, testaceous; wings hyaline, nervures and stigma pale-brown, costa hyaline.

One female, Kukak Bay, July 4, 1899.

Type no. 5290, U. S. National Museum.

Allied to *Pristiphora sycophanta* Walsh, but in that species the antennal fovea is small and deep, faint ridges are present in front of

the ocelli and the outer veins of the discal cells in hind wings are not interstitial.

PRISTIPHORA ANAKA sp. nov.

Female: Length 5 mm.; head narrow, not trilobed, rather coarsely roughened and punctured; thorax and abdomen shining; clypeus truncate; area in front of ocelli entirely free from ridges; antennal fovea indistinct, merging posteriorly into the frontal area; antennæ short, third joint slightly shorter than fourth; intercostal cross-vein at right angles to costa a little more than its own length anterior to basal; first cubital nervure wanting; third cubital cell twice as broad at apex as at base; stigma narrow, three times as long as broad, the lower surface very gently rounded; sheath blunt, rounded above and below; cerci minute; inner tooth of claw of moderate size. Color black; outer half of femora, tibiæ except tips of middle and posterior pair, and the tarsi for the most part, testaceous; wings hyaline, nervures brown, the stigma and costa pale.

One female, Kukak Bay, Alaska, July 1, 1899.

Type no. 5291, U. S. National Museum.

Allied to the preceding species but differing in the form of the stigma.

PRISTIPHORA CIRCULARIS sp. nov.

Female: Length 4.5 mm.; head considerably narrower than thorax, not trilobed, evenly convex above, strongly punctured; thorax and abdomen shining, the former with a dense sericeous pile; clypeus truncate; antennal fovea obsolete; antennæ of moderate length, stout, tapering, third and fourth joints subequal; first cubital nervure wanting; upper discal cell considerably exceeding the lower in posterior wings; stigma very broad and short, almost orbicular; inner tooth of claw minute. Color black; apices of coxæ, trochanters, tips of anterior and middle femora, tibiæ except tips of posterior pair, and fore tarsi, testaceous; wings hyaline, nervures and stigma brown, the costa pale.

One female, Popof Island, July 10, 1899.

Type no. 5292, U. S. National Museum.

Allied to *Pristiphora lata* Cresson, but that species is larger and a distinct antennal fovea is present.

PRISTIPHORA BUCODA sp. nov.

Female: Length 7 mm.; head finely granulate, nearly as wide as thorax, not distinctly trilobed; clypeus truncate; area in front of

ocelli without ridges; antennal fovea distinct in front, merging behind into the frontal area; antennæ longer than head and thorax, rather stout, tapering slightly towards tip, third and fourth joints subequal; venation normal; stigma large, regularly rounded beneath; sheath robust, rounded above and below to a rather sharply pointed tip; inner tooth of claw robust and sharp close to apex. Color black; labrum white; clypeus, margin of pronotum, tegulæ, apical segments of tergum, venter in large part, and legs, testaceous; femora with a black spot beneath; tips of posterior tibiæ and the tarsi strongly infuscated; wings hyaline, nervures black, the costa and stigma yellowish.

Two females, Berg Bay, Alaska, June 10; Sitka, June 16.

Type no. 5289, U. S. National Museum.

Allied to *Pristiphora banksi* Marlatt, but that species is much smaller and more slender, the stigma is brown and the apical segments of the abdomen are not pallid.

PRISTIPHORA KOEBELI.

Pristiphora koebeli MARLATT, Revision of the Nematinae of North America, p. 119, 1896.

One female, Kukak Bay, July 4.

Differs from the type in that the medial area of the abdomen is not infuscated. This species was described from Washington.

PRISTIPHORA LENA sp. nov.

Male: Length 5.5 mm., rather slender, shining; head strongly and rather closely punctured, clypeus slightly emarginate; lateral walls of ocellar basin obsolete; frontal crest strongly raised, rounded, extending laterally to the orbits, unbroken in the middle; antennal fovea small, shallow, rounded; antennæ nearly as long as entire body, very stout at base, flattened, tapering, third and fourth joints subequal; stigma moderate, gently rounded beneath; procidentia excavated basally, strongly keeled; inner tooth of claw extremely minute, close to apex. Color black; minute spot at superior angles of pronotum, tegulæ, and tips of femora, testaceous; tips of coxæ, trochanters, tibiæ except tips of posterior pair, and tarsi, white; posterior tarsi black and apices of fore and medial tarsi infuscated; wings hyaline, nervures and stigma brown.

Two males, Sitka, June 16.

Type no. 5293, U. S. National Museum.

SYNOPSIS OF PRECEDING SPECIES OF PRISTIPHORA.

Females.

Body black with yellow markings on pronotum and tegulae.

Dorsulum of abdomen black except at tip.....*bucoda* sp. nov.

Dorsulum of abdomen principally yellow.....*koebeli* Marlatt.

Body entirely black.

Stigma narrow and elongate.....*anaka* sp. nov.

Stigma orbicular.....*circularis* sp. nov.

Stigma normal, regularly rounded beneath.....*ortinga* sp. nov.

Males.

Body black with white trochanters and tibiae.....*lena* sp. nov.

EUURA INSULARIS sp. nov.

Female: Length 4.5 to 5 mm.; slender, shining; clypeus very deeply and narrowly emarginate; ridges about ocellar area distinctly raised, but rounded; frontal crest broad, rounded, with a narrow notch in the middle; antennal fovea small, circular, moderately excavated; antennae short, slender, third to fifth joints subequal; outer veins of discal cells in hind wings interstitial; stigma rounded at base, tapering to an acute point; tarsal claws slender, subequal; sheath stout at base, rather sharply rounded at apex. Color black; labrum, base of mandibles, tips of coxae, trochanters, tips of femora, tibiae except apices of posterior pair, and anterior and middle tarsi, testaceous.

Male: Length 4.0; resembles female in general structural characters; antennae longer, stouter at base, tapering sharply; procidentia well developed, projecting, rounded at the apex; hypopygium sharply rounded at tip. Color black; flagellum of antennae, labrum, tip of clypeus, base of mandibles, spot beneath eyes extending upwards on inner orbits, testaceous; legs colored as in the female.

Twelve females and two males, Popof Island, July 9-15.

Type no. 5301, U. S. National Museum.

Swept from willow bushes.

Allied to *Euura salicicola* Smith, but in that species the ridges about the ocellar area are obsolete, the frontal crest is broad and flat and the sheath is broadly rounded at the apex. In both sexes of *Euura salicicola* the antennae are more or less pallid, while in *Euura insularis* this is true only of the males.

PONTANIA TUNDRA sp. nov.

Female: Length 3.5 mm.; rather slender; clypeus deeply and broadly emarginate, the lobes small and rounded; lateral walls of

ocellar basal sharply raised; frontal crest feebly developed except at the sides where it extends outwardly to the orbits; antennal fovea circular, deeply excavated; antennæ of moderate length, very slender, third joint much shorter than fourth or fifth, which are subequal; venation normal; stigma broad, regularly rounded beneath; claws deeply cleft; sheath broad at base, sharply acuminate at apex, emarginate beneath. Color black; labrum white; tegulæ brown; tips of femora, tibiæ except tips of posterior pair and all the tarsi, testaceous; wings hyaline, nervures pale brown; stigma yellow, hyaline at base.

Male: Length 3.5 mm.; resembles female in general structural characters; antennæ almost as long as the entire body, third to fifth joints subequal; lateral walls of ocellar basin not so sharply raised; procidentia squarely produced, rounded at apex; stigma brownish, paler at base, colored as in the female.

Two females and one male, Popof Island, July 12.

Type no. 5296, U. S. National Museum.

Allied to *Pontania cressoni* Marlatt, but that species is larger and the third joint of the flagellum is larger than fourth.

PONTANIA POPOFIANA sp. nov.

Female: Length 6 to 6.5 mm.; robust; clypeus deeply and narrowly emarginate; ridges about ocellar basin sharply raised; frontal ridge strong, unbroken; antennal fovea oval, deeply incised; antennæ elongate, slender reaching beyond basal plates; anterior discal cell considerably exceeding posterior discal in hind wings; stigma large, gently rounded below; tarsal claws large, stout, deeply cleft; sheath blunt at apex, rounded above and below. Color reddish yellow; dorsal surface of antennæ, eyes, tips of mandibles, spot surrounding ocelli, variable spots on anterior and middle lobes of mesonotum, variable marks on metanotum, dorsulum of abdomen except narrow lateral margins and apical segment, black; wings hyaline, nervures brown, stigma and costa yellowish hyaline.

Male: Length 5 mm.; slender, graceful; antennæ nearly as long as the entire body, joints three to five subequal; procidentia projecting one-half its length, squarely truncate at apex; legs slender, elongate; claws as in the female but more delicate. Color as in the female but the black maculations on the dorsulum are more extensive.

Ten females and six males, Popof Island, July 9-15.

Type no. 5294, U. S. National Museum.

Allied to *Pontania nevadense* Cresson, but in that species the sheath is acuminate at tip.

PONTANIA UNGA sp. nov.

Female: Length 5 mm.; moderately robust; head finely roughened; clypeus shallowly emarginate; walls of ocellar basin obsolete; frontal crest feebly developed, broad and flat; antennal fovea circular, deeply excavated; antennæ of moderate length, slender, third joint slightly shorter than fourth; area at juncture of mesothoracic lobes depressed and finely granulated; venation normal; stigma large, regularly rounded beneath; tarsal claws deeply and evenly cleft; sheath narrow, gently tapering above and below to a rather sharp apex. Color black, including the mouthparts and tegulæ; tips of anterior and middle femora and all the tibiæ testaceous; tarsi testaceous, more or less infuscated; wings hyaline, stigma pale brown, paler at base.

One female, Popof Island, July 12.

Type no. 5298, U. S. National Museum.

Allied to *Pontania atra* Marlatt, but in that species the antennal fovea is indistinct, the region at the juncture of the lobes of the mesonotum is shining and the stigma is narrow.

PONTANIA ORA sp. nov.

Female: Length 4.5 mm.; rather robust; clypeus deeply, circularly emarginate, lobes sharply pointed; frontal crest indistinct, broad, obsolete in the middle; antennal fovea faintly indicated; antennæ moderate in length, third to fifth joints subequal; second recurrent interstitial with second cubital nervure; outer veins of discal cells in hind wings interstitial; stigma narrow, gently curved on lower margin; claws deeply cleft, the inner ray the shorter; sheath narrow, tapering above and below to a rather sharply pointed apex. Color black; labrum, base of mandibles, and apices of femora, testaceous; remainder of legs testaceous, but the tips of posterior tibiæ and all the tarsi more or less infuscated; wings hyaline, nervures brown, stigma yellow.

Three females, Popof Island, July 10-15.

Type no. 5297, U. S. National Museum.

Allied to *Pontania atriventris* Marlatt, but differing in the sculpture of the head, the shape of the stigma, and in coloration.

PONTANIA PENINSULARIS sp. nov.

Female: Length 4 mm.; robust, shining; clypeus broadly and deeply emarginate, lobes rounded; lateral walls of ocellar basin feebly devel-

oped; frontal ridge strongly raised, broadly broken in the middle; antennal fovea large, oval, deeply incised; antennæ longer than head and thorax, slender, joints three to five subequal; sheath acutely pointed, narrow, tapering regularly above and below; claws deeply cleft, rays slender, subequal, parallel; venation normal; stigma broad regularly rounded beneath. Color black; labrum, clypeus, spot below antennæ, inner and outer orbits narrowly, angles of prothorax, tegulæ, greater part of venter except sheath and legs, yellowish; bases of coxæ black and the femora and tibiæ irregularly infuscated; wings hyaline, nervures light brown, base of costa and disk of stigma pallid.

One female, Kukak Bay, July 4.

Type no. 5301, U. S. National Museum.

Allied to *Pontania gracilis* Marlatt, but in that species the abdomen is very broad centrally and the sheath is rounded at the tip instead of acutely pointed.

PONTANIA ISLANDICA sp. nov.

Female: Length 5 to 6 mm.; moderately robust, shining; clypeus deeply and narrowly notched, lobes rounded; walls about ocellar basin distinctly raised; frontal crest strongly raised, deeply notched in the middle; fovea oval, rather deep; antennæ as long as head and thorax, third joint shorter than fourth; venation normal; stigma large, evenly rounded below; claws stout, strongly and evenly cleft; sheath rather stout, gently tapering above and below to a rounded apex; cerci long, stout. Color black; labrum, clypeus, narrow inner orbits, broader outer orbits, margin of pronotum, tegulæ, apex of abdomen, including the sheath and the legs, yellowish; coxæ black at base and all the legs more or less infuscated; wings hyaline, nervures and stigma pale brown.

Four females, Popof Island, July 9-15.

Type no. 5299, U. S. National Museum.

Allied to *Pontania californica* Marlatt, but in that species the antennæ are much shorter and the walls of the ocellar basin are not well defined.

PONTANIA GLINKA sp. nov.

Female: Length 5.5 mm.; robust, shining; clypeus very shallowly emarginate; lateral walls of ocellar basin distinctly raised; frontal crest strong, unbroken; antennal fovea circular, rather deeply incised; antennæ as long as head and thorax, slender, third joint shorter than fourth; venation normal; claws deeply cleft, rays equal; sheath stout, tapering above and below to a narrowly rounded apex; stigma with

lower margin nearly straight, tapering slightly. Color black; face below frontal crest, flagellum beneath, inner and outer orbits, greater part of pronotum, tegulae, spots on pectus and pleura sometimes absent, medial area of venter, apical segment of tergum, and legs, yellowish white; bases of all the coxae and lines above on femora black; wings hyaline; stigma and costa yellowish, remaining nervures brown.

Male: Length 5.5 mm.; antennae longer than in the female, stout at base, tapering; colored as in the female but the antennae are not pale beneath and the stigma is brown; tarsi more or less infuscated.

Nine females and four males, Popof Island, July, 1899.

Type no. 5295, U. S. National Museum.

Allied to *Pontania stigmatalis* Marlatt, but that species is smaller, the clypeus is deeply emarginate and the antennal fovea is shallow.

PONTANIA KUKAKIANA sp. nov.

Female: Length 5.5 mm.; robust; head finely granulated, narrowed behind the compound eyes; clypeus narrowly emarginate; area in front of ocelli without ridges; frontal crest obsolete; antennal fovea shallow, indistinct; antennae as long as head and thorax, slender third joint shorter than fourth; stigma narrow, tapering; sheath moderately robust, tapering above and below to a rather acute apex. Color black; spot between antennae, labrum, clypeus, orbits, prothorax, sutures of mesonotum, tegulae, pleurae, pectus venter of abdomen, and legs, dull reddish; base of medial and posterior femora more or less infuscated.

One female, Kukak Bay, July 2.

Type no. 5300, U. S. National Museum.

Allied to *Pontania desmodioides* Walsh, but in that species the head is strongly punctured and the fovea is deeply excavated.

SYNOPSIS OF PRECEDING SPECIES OF PONTANIA.

Females.

Body black.

Sheath acuminate at tip.....*tundra* sp. nov.

Sheath not acuminate.

Venation normal.....*unga* sp. nov.

Second recurrent interstitial, also outer veins of discal cells in hind wings.....*ora* sp. nov.

Body with pale markings.

Pectus pale.

Antennae yellow.....*popofiana* sp. nov.

Antennae black.....*kukakiana* sp. nov.

Pectus black.

Sheath acutely pointed *peninsularis* sp. nov.

Sheath rounded at tip.

Clypeus shallowly emarginate..... *glinka* sp. nov.

Clypeus deeply notched..... *islandica* sp. nov.

Males.

Head black *tundra* sp. nov.

Head black with narrow yellow orbits..... *glinka* sp. nov.

Head yellow. *popofiana* sp. nov.

PTERONUS SHUMAGENSIS sp. nov.

Female: Length 6.5 to 8 mm.; robust, shining; clypeus not very widely, but deeply emarginate, lobes rounded; ocellar basin distinctly defined, lateral walls sharply raised; frontal crest strong, bituberculate, notched in the middle; antennal fovea elongate, deeply incised; antennæ as long as head and thorax, slender, third to fifth joints subequal; second recurrent nervure interstitial with the second cubital; stigma narrow, rounded at base and tapering to apex; sheath rather sharply pointed at tip, rounded below, almost straight above; cerci robust, reaching tip of sheath; claws deeply and evenly cleft. Color reddish yellow; two basal joints of antennæ, flagellum above, spot surrounding ocelli, spots on lateral lobes of mesonotum, spot on middle lobe of mesonotum, absent in some specimens, apex of scutellum in some specimens, tergum of abdomen, except apical segment, black; tips of tarsi infuscated; wings hyaline; nervures brown, except costa and stigma, which are yellowish.

Four females, Popof Island, July 9-12, 1899.

Type no. 5303, U. S. National Museum.

PTERONUS ZEBRATUS sp. nov.

Female: Length 6 mm.; slender, shining; head narrowed behind compound eyes, somewhat roughened; clypeus shallowly and not very broadly emarginate; sides of ocellar basin distinct, but rounded; frontal crest strongly and sharply raised, curved forward, unbroken; antennal fovea minute, indistinct; antennæ considerably longer than head and thorax, very slender, scarcely tapering, third joint slightly shorter than fourth; venation normal; stigma gently rounded below; sheath blunt at apex, obliquely truncate, upper margin nearly straight; cerci short, stout; claws shallowly cleft, rays subequal. Color of dorsulum black; antennæ pale beneath; broad inner and outer orbits, pronotum, tegulæ, sutures of mesonotum, anterior half of scutellum,

sutures of tergum, and narrow lateral margin of abdomen, light yellow; pectus and pleuræ, except a black spot beneath wings, yellow; face below antennæ and venter of abdomen, white; legs yellowish white; wings hyaline, nervures dark brown, stigma and costa hyaline.

One female, Yakutat, Alaska, June 21, 1899.

Type no. 5305, U. S. National Museum.

Allied to *Pteronus vertebratus* Say, but in that species the head is broadened behind the compound eyes.

PTERONUS RIVULARIS sp. nov.

Male: Length 7 mm.; slender, shining; clypeus narrowly and deeply emarginate, lobes rounded; walls about ocellar basin distinct but not sharply raised; frontal ridge broken in the middle into the shallow, narrow, antennal fovea; antennæ considerably longer than head and thorax, flattened at base, tapering gradually to apex, third joint much shorter than fourth or fifth, which are subequal; procidentia scarcely produced, truncate; venation normal; stigma narrow, rounded at base, tapering to an acuminate apex; claws not very deeply cleft, inner ray shorter. Color black; clypeus, labrum, apex of coxæ, trochanters, apex of anterior femora, and anterior and middle tibiæ, whitish; wings smoky hyaline, nervures, including stigma and costa, dark brown.

Two males, Sitka, June 16.

Type no. 5304, U. S. National Museum.

Allied to *Pteronus iridescens* Cresson, but that species is smaller and the antennæ are much shorter.

AMAURONEMATUS ISOLATUS sp. nov.

Female: Length 10 mm.; robust, covered with a dense sericeous pile; clypeus deeply and triangularly emarginate, lobes triangular, acute; walls of ocellar basin sharply raised; frontal crest bituberculate, deeply notched in the middle; antennal fovea minute, indistinct; antennæ as long as the head and thorax, stout, scarcely tapering, third joint shorter than fourth; second recurrent nervure nearly interstitial with second cubital; stigma narrow, broadest near base, tapering to an acute point; sheath broad, obtuse at apex, rounding above and below; cerci short, somewhat constricted at base; claws stoutly cleft, innermost ray the shorter. Color ferruginous; scape, pedicellum, apical joint of antennæ, spot surrounding bases of antennæ, clypeus, base of labrum, small spots behind posterior ocelli, line on middle lobe of mesonotum, apex of scutellum, metanotum, lower angle of

pronotum, basal plates, spots in center of apical segments of tergum, prosternum, pectus, venter basally and along margins, and coxæ, black; legs ferruginous; wings yellowish hyaline, nervures, including stigma and costa, reddish yellow.

One female, St. Paul Island, Alaska, August 13.

Type no. 5306, U. S. National Museum.

Family TENTHREDINIDÆ.

DOLERUS SERICEUS.

Dolerus sericeus SAY, Keatings, Narr. Exped. II, p. 320, 1824. App.

Four females and ten males: Yakutat, June 21; Berg Bay, June 11; Sitka, June 16; Virgin Bay, June 20; Kadiak, July 21. This species is widely spread throughout the United States and Canada.

DOLERUS APRILIS.

Dolerus aprilis NORTON, Proc. Bost. Soc. Nat. Hist., VIII, p. 152, 1861.

Seven females: Orca, June 27; Virgin Bay, June 26; Yakutat Bay, June 21; Kukak Bay, July 4. This species is also widely distributed in the United States and Canada.

DOLERUS ELDERI sp. nov.

Female: Length 6 to 6.5 mm.; head and thorax strongly punctured, clothed with long sericeous pile; abdomen broad, suddenly narrowed at apex; clypeus deeply and circularly emarginate; antennæ not quite so long as head and thorax, slender, scarcely tapering, third joint longer than fourth; stigma broadest near base, gently rounded below, truncate at apex; sheath broad at base, tapering to a rather sharp point. Color black; broad band on abdomen, including the greater part of segments two to five, sanguineous; legs black, tips of anterior and medial femora and basal half of fore tibiæ, reddish; wings hyaline, nervures and stigma dark brown.

Male: Length 6 to 6.5 mm.; resembles the female in general structural characters; colored as in the female, but the basal half of the medial and posterior tarsi are reddish.

Two females and four males, Popof Island, July 10; Kukak Bay, July 3.

Type no. 5307, U. S. National Museum.

Named in honor of the ship *Geo. W. Elder*, in which the Harriman Expedition made their home during the voyage.

A single specimen from *Saldovia* agrees with the above in structure but lacks the red band upon the abdomen. It may be a variety of this species.

EMPHYTUS ANGUSTUS sp. nov.

Male: Length 6 mm.; body very slender, head shining, finely and sparsely punctured, much narrowed behind the compound eyes; ocellar area very convex; clypeus slightly, circularly emarginate; antennæ a little shorter than head and thorax, slender, third joint considerably longer than fourth; joints six to nine, contracted at base and apex; stigma slender, gently rounded beneath, apex acute. Color black; under surface of antennæ obscurely testaceous; basal joint of antennæ, labrum, clypeus, greater part of pronotum, tegulæ, and triangular spot on pleura, pure white; diamond-shaped spots of a yellowish-brown color on dorsal abdominal segments one to six; legs white; upper surface of femora, the tibiæ and tarsi more or less infuscated; wings hyaline, nervures and stigma brown.

One male, Kukak Bay, July 4.

Type no. 5308, U. S. National Museum.

Allied to *Emphytus apertus* Norton, but in that species the clypeus is more deeply emarginate, the antennæ are shorter, stouter, and more tapering, the basal joint of the antennæ is black and the legs are differently colored.

PACHYPROTASIS NIGROFASCIATA.

Pachyprotasis nigrofasciata ESCHSCHOLTZ, Entomog., p. 96, 1822. (Tenthredo.)

Macrophya (Pachyprotasis) omega NORTON, Trans. Amer. Ent. Soc., 11, p. 280, 1867.

Tenthredo nigrofasciata NORTON, Trans. Am. Ent. Soc., 11, p. 241, 1869.

Emphytus ? nigrofasciatus W. F. KIRBY, List. Hym. Br. Museum, 1, p. 204, 1882.

Pachyprotasis omega PROVANCHER, Faun. Entom. Canada, Hymén., p. 210, 1883.

Emphytus nigrofasciatus DALLA TORRE, Cat. Hym., 1, p. 119, 1894.

In 1822 Eschscholtz described two sawflies from Unalaska, to which he gave the names *Tenthredo nigrofasciata* and *Tenthredo subcærulea*. The latter has since been rediscovered and is a genuine Tenthredo, but the generic position of his *Tenthredo nigrofasciata* has been in considerable doubt. Norton in discussing this species in his catalogue suggests that it might be a *Macrophya*. Kirby in his list of the Hymenoptera in the British Museum places it doubtfully in *Emphytus*, and in this he is followed by Dalla Torre in his catalogue of the Tenthredinidæ and Uroceridæ.

Specimens of a Tenthredinid taken at Unalaska and at other points in Alaska agree very perfectly with the description given of *Tenthredo nigrofasciata*. If this conclusion is correct then Eschscholtz's species must have been a Pachyprotasis, to which genus the species above referred to belongs. On further investigation it was found that this Alaska Pachyprotasis is specifically the same as *Pachyprotasis omega* Norton, which is known to occur throughout the greater part of the United States and Canada, and is recorded from the Pacific coast, Labrador, and Saskatchewan.

Six specimens, Unalaska, August 24; Popof Island, July 13; Unga Island, July 21; Virgin Bay, June 26.

MACROPHYA OREGONA.

Macrophya oregona CRESSON, Trans. Am. Ent. Soc., VIII, p. 19, 1880.

One specimen, Saldovia, July 21. This species was described from Oregon, but is also found in Washington.

TENTHREDO FERRUGINEIPES.

Tenthredo ferrugineipes CRESSON, Trans. Am. Ent. Soc., VIII, p. 22, 1880.

This is one of the commonest of the Alaska Tenthredos, and is represented in the collection by some fifty specimens, from almost every locality touched at, including Sitka, Virgin Bay, Saldovia, Kadiak, Kukak Bay, and Popof Island. It was originally described from Colorado, but it is known to be widely distributed on the Pacific coast and in British America. Males and females were about equally abundant; the former differ considerably from the opposite sex in shape, which is as usual much narrower, and in coloration; the abdomen is bright red in the middle but the basal plates and the three apical segments are black.

TENTHREDO VARIPICTA.

Tenthredo varipicta NORTON, Trans. Am. Ent. Soc., II, p. 234, 1868.

This species is also widely distributed and abundant and is generally found in company with the preceding. The fifty specimens in the collection were taken at Fox Point, Berg Bay, Sitka, Yakutat, Saldovia, Kadiak, Kukak Bay, and Popof Island. The male differs considerably from the female in coloration; the abdomen in the former sex is reddish yellow above with black markings on the basal plates and first segment, the venter of the abdomen is white at base, becoming reddish towards tip, and the pectus is yellowish white.

TENTHREDO MELLINA.

Tenthredo mellina NORTON, Bost. Jour. Nat. Hist., VII, 2, p. 254, 1860.

Three females, Popof Island. Taken on the flowers of *Heracleum lanatum*.

TENTHREDO EVANSII.

Tenthredo evansii HARRINGTON, Can. Ent., XXI, p. 78, 1889. (*Tenthredopsis*.)

Five females and four males, Sitka, June 16; Yakutat, June 21; Saldovia, July 21; Kadiak, July 20; Virgin Bay, June 26. This is a very variable species, the amount of black pigment on the dorsulum of the abdomen varying considerably. The female in some of its variations resembles *Tenthredo californica* Norton, but the males are extremely different; in *californica* the latter sex has the dorsal surface of the abdomen almost entirely black, while in *evansii* the corresponding region is yellowish green with a variable narrow band across each segment.

TENTHREDO LINEATA.

Tenthredo lineata PROVANCHER, Natural. Canad., x, p. 198, 1878.

Three females, Sitka, June 16; Virgin Bay, June 26; Gustavus Point. Previously known from Canada, Colorado, and New Hampshire.

TENTHREDO FLAVOMARGINIS.

Tenthredo flavomarginis NORTON, Bost. Jour. Nat. Hist., VII, 2, p. 254, 1860.

Five females and one male, Berg Bay, June 10; Yakutat, June 21; Saldovia, July 21. The male resembles the female except in the narrower form of the body and in the presence of three reddish-brown spots on the dorsum of the abdomen. This species was originally described by Norton from Connecticut, but is also known from Colorado.

TENTHREDO NIGRICOLLIS.

Tenthredo nigricollis KIRBY, List, Hym. Br. Mus., I, p. 308, 1882.

Three females and one male, Sitka, June 16; Saldovia, July 21; Kukak Bay, July 4. This species was originally described by Kirby from Newfoundland, and is also recorded from New Hampshire. The male differs from the female in the narrower form of the body and in the presence of several pale-brown spots on the upper surface of the abdomen; it agrees very closely with the male described by Mr. Harrington as *Tenthredo semicornis* (Can. Ent., XXI, p. 98, 1889), and may prove to be identical with it.

TENTHREDO ERYTHROMERA.

Tenthredo erythromera PROVANCHER, Addit. Faun. Canada, Hymén., p. 13, 1885.

Ten females, Sitka, June 16; Metlakahtla, June 4; Muir Inlet, June 10; Saldovia, July 21; Kukak Bay, July 4; Yakutat, June 21; Kadiak, July 4. This species was described by Provancher, from Vancouver Island, but it also occurs in Colorado and Washington. The specimens in the collection vary but slightly, except in the coloration of the labrum and clypeus, which range from almost pure yellow to black.

TENTHREDO MELANOSOMA.

Tenthredo melanosoma HARRINGTON, Can. Ent., xxvi, p. 194, 1894.

Six females and one male, Sitka, June 16; Saldovia, July 21; Yakutat, June 21; Kadiak, July 20. This species was described by Mr. Harrington, from Fort Wrangell, Alaska. The male resembles the female, except in the narrower form of the body and in the presence of three brown vittæ on the dorsulum of the abdomen.

TENTHREDO HARRIMANI sp. nov.

Female: Black with the following parts ferruginous: Antennæ, spot externally on jaws, tegulæ, all of legs beyond trochanters, variable obscure spots on disc of third, fourth, and fifth tergal segment of abdomen; clypeus, labrum, base of mandibles, spot between antennæ, narrow line at lower margin of eyes, posterior angles of pronotum, and small circular spot above posterior coxæ, yellow; clypeus squarely and deeply emarginate with the lobes obliquely truncate; antennæ with the third joint one-quarter longer than the fourth; wings yellowish hyaline, nervures brown, stigma pale brown. Length 10 mm.

Four females, Popof Island, July 15, 1899.

Type no. 5310, U. S. National Museum.

Named in honor of Mr. Edward H. Harriman, of New York, in appreciation of his generous aid to scientific investigation.

TENTHREDO DISSIMULANS sp. nov.

Female: Light green with the following parts black: Ocelli, an irregular spot surrounding the ocellar prominence and extending backwards in two bands that almost reach the posterior margin of the head, fine lines in the sutures of the mesonotum, spots at the base of the wings, spot before scutellum, sutures of tergal abdominal segments sometimes expanded into semilunar spots; legs green, with a

short line on upper distal end of all the femora, a line outwardly on all the tibiæ, black; abdomen obscurely tinged with reddish on apical segments; clypeus shallowly emarginate; wings hyaline, nervures black; costa and stigma pale. Length 10 mm.

Male: Marked as in the female but more distinctly; clypeus with a black dot on each side; legs with a black line outwardly extending from the trochanters to the tarsi, which are clothed with a dark pubescence.

One hundred specimens, Popof Island, July 7-12; Kukak Bay, July 1-7, 1899.

Type no. 5312, U. S. National Museum.

Usually found on the flowers of *Heracleum lanatum*.

TENTHREDO BIVITTATA sp. nov.

Female: Body slender, elongate; head of about the same breadth as the thorax; clypeus deeply and squarely emarginate. Color black; clypeus labrum, basal part of mandibles, spot above posterior coxæ, and spot at sides of basal plate, white; tegulæ and faint reflection on third dorsal abdominal segment, ferruginous; coxæ black; remainder of legs reddish; spots at base of middle femora, line on hind femora above broadest at base, and spot at tip of posterior tibiæ, black; posterior tarsi more or less infuscated at tips of joints. Antennæ as long as head and thorax with the third joint one-quarter longer than the fourth. Wings hyaline, nervures and stigma black, costa pale.

One female, Popof Island, July 9.

Type no. 5311, U. S. National Museum.

ALLANTUS HERACLEI sp. nov.

Female: Length 11 mm.; robust; head very heavily pitted and punctured; oculi situated upon a pronounced elevation; clypeus deeply, circularly emarginate; antennæ very short, nine-jointed, hardly reaching to tegulæ, stout, slightly clavate at tip; thorax strongly punctured; scutellum similarly but more closely pitted; pleura very closely pitted but more closely so than the dorsulum; abdomen smooth, delicately striated; stigma narrow, squarely truncate at apex. Color black, with the following parts yellow: Labrum, clypeus, base of mandibles, ventral angles of pronotum, spots on dorsal angles united by a slender line, spots above middle and posterior coxæ, band across posterior margin of basal plates; narrow line across posterior margin of dorsal abdominal segments three, four, and five; row of large spots along outer margins of venter; small

spots at apex of coxæ, anterior surface of fore and medial femora band on basal two-thirds of posterior femora, tibiæ except small spot at apices, tarsi except spots above; wings hyaline, nervures and stigma.

Male: Length 10.5 mm.; body narrower than in the female; sculptured and colored as in female, but the spots on the pronotum are reduced or absent, the band on the basal segment is wanting, venter entirely yellow, coxæ yellow, femora, tibiæ, and tarsi black above yellow beneath; posterior tarsi entirely black.

Two females and four males, Popof Island, July 14.

Type no. 5399, U. S. National Museum.

Taken upon the flowers of *Heracleum lanatum*.

Family CIMBICIDÆ.

CIMBEX AMERICANA.

Cimbex americana LEACH, Zool. Miscell., III, Tab. 61, 1817.

A single specimen captured on Kadiak Island by Mr. L. Cole. This is a variety of this variable species in which the body is entirely blue-black, white maculations being entirely absent, and the wings are clear with some yellow spots along nervures.

TRICHIOSOMA TRIANGULUM.

Trichiosoma triangulum var. *aleutiana* CRESSON, Trans. Am. Ent. Soc., VIII, p. 1, 1880.

Five specimens from Kukak Bay, Kadiak Island, and Popof Island. The specimens agree perfectly with those of the above species in the collection of the American Entomological Society.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 367-388.

NOVEMBER 24, 1900

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

VIII.

ENTOMOLOGICAL RESULTS (2):

THE METAMORPHOSES OF SOME ALASKA
COLEOPTERA.

[PLATES XXII-XXVI.]

BY TREVOR KINCAID.

THE study of the adult forms of the Coleoptera presents such a vast field and is of such a fascinating character that but scant attention has been paid to the early stages of the members of this order. This is especially true in America, where very little has been published on this subject, and as a result we know but little concerning the structure or peculiar habits of the larvæ of our indigenous beetles. In the U. S. National Museum is a large collection of coleopterous larvæ, accumulated mainly through the efforts of Mr. E. A. Schwarz, of that institution, but the majority of the species have never been described.

An opinion is prevalent that it is extremely difficult to rear the larvæ of beetles, but the writer believes this supposition to be exaggerated. It is certainly difficult to rear them from the egg or very young stages, but if specimens be taken when nearly full grown and carefully tended they may be bred without excessive mortality.

Under the circumstances, the writer feels that the following paper will not be unwelcome, although it may be imperfect in some respects, owing to the fact that no comparison has been possible, in the majority of cases, with closely related forms.

The species dealt with in this paper are as follows :

Carabus truncaticollis Fisch.

Dytiscus dauricus Gebler.

Agabus tristis Aubé.

Byrrhus fasciatus Fabr.

Hypnoides musculus Esch.

Cryptohypnus littoralis Esch.

Leptalia macilentata Mann.

Chrysomela subsulcata Mann.

Lepidophorus lineaticollis Kirby.

CARABUS TRUNCATICOLLIS Fisch.

[Plate XXII.]

Larva entirely jet black except the areas between the schlerites on the ventral surface, surface shining, delicately reticulate, five times as long as broad, subcylindrical, tapering slightly at either end, strongly convex above, flattened below. Length 20 mm.

Head broader than long, as wide as the anterior margin of pronotum; frontal sulci strong and broad, surrounding the epistoma; median area of epistoma broad, convex, a little depressed in the center, lateral areas bent obliquely upward; frontal angles well defined, subrectangular, broader by one-third than the clypeus but not exceeding the latter, projecting obliquely upwards, apex rounded, outer margin below apex sinuate, anterior margin arcuate; incisure between angles and clypeus broad and rounded. Clypeus subtriangular in form, transversely ridged on posterior margin, deeply foveate in the center, the fovea bounded on each side by a strong oblique ridge; anterior margin strongly produced, horizontal, quadridentate, the teeth stout, sharp, directed forward, the middle pair the larger and projecting considerably beyond the lateral teeth but not exceeding the frontal angles of the head. Antennæ as long as the mandibles, four-jointed, basal joint subglobular; second more elongate, slightly enlarged towards tip; third as long as second, more slender, with a few hairs at apex; fourth one-half as long as third, slender, oval. Ocelli six, arranged on the perimeter of a well-defined, transversely-oval tubercle, situated just posterior to the antennæ. Mandibles stout,

deeply bidentate, outer margin evenly arcuate; outer tooth long tapering, rather sharp at apex; inner tooth shorter, more robust, anterior margin arcuate, curving inwards at right angles. Maxillæ stout, exceeding the mandibles in length; cardo narrow, wedge-shaped; stipes subquadrangular, the angles rounded, one and one-half times as long as broad, the inner margin ciliate and with a minute conical papilla near the upper angle; galea not quite reaching to apex of second joint of maxillary palpi, composed of two subequal joints, the basal joint a little the larger; maxillary palpi four-jointed, first joint broader than long, second and third subequal, fourth slightly longer than third. Mentum projecting, almost reaching the apices of the maxillary stipes, one and three-fourths times as broad towards apex as at base, apex conical; labial palpi stout, composed of two subequal joints, the second a little the longer and not divided at the apex.

Pronotum trapezoidal, narrower in front by one-sixth than at base, nearly as broad at base as long, sides straight with a longitudinal groove close to the lateral margins; anterior and posterior angles narrowly rounded, mesonotum transverse, about one-half as long as pronotum but a little broader and with a small deep fovea on the disk of the scute towards each side. Metanotum similar to the mesonotum but a little broader. Legs of moderate size, strongly spinose.

Dorsal scutes of first eight abdominal segments transverse, subequal in length, sides distinctly margined, posterior angles acutely rounded; pleural scutes two on each side of a segment, elongate, parallel; ventral scutes four to each segment, anterior one broadly fusiform, transverse, posterior quadrangular, broader than long, lateral scutes subquadrangular, one on each side of the posterior; ninth abdominal segment much narrower than eighth, rounded at the sides, finely tuberculate, emarginate behind; cerci stout, finely tuberculate, three-fourths as long as eighth segment, diverging slightly, curving gently upwards and bearing dorsally near the middle a pair of small conical projections of which the innermost is the larger.

Pupa white, except eyes and jaws, which are black; setæ and hairs entirely absent; form elongately ovate, broadest in the middle. Length 14 mm.

Described from larvæ and pupæ found beneath beds of moss on St. Paul Island, Alaska, during the month of August.

The metamorphoses of none of the American representatives of this genus have been described, so that no comparison is possible with the related American species. The most marked specific characters are in the peculiar structure of the clypeus and the undivided character of

the apical joint of the labial palpi. In most of the European species the labial palpi of the larva are cleft at the apex.

DYTISCUS DAURICUS Gebler.

[Plate XXIII, figs. 1 and 2.]

Larva slender, subcylindrical, strongly convex above, flattened beneath, elongately fusiform; yellowish white, the head and schlerites mottled with pale brown. Length 50 mm.

Head rounded, a fifth longer than broad, flattened in front, convex behind; clypeus broad arcuate, anterior margin with a row of delicate lamellate setæ; frontal sulci shallow, converging behind; hypostoma deeply excavated; temples rounded, unarmed; collar half as wide as head, separated from the latter by a well-marked groove, truncately emarginate above, deeply angularly emarginate beneath; ventral furrow of neck broadening anteriorly, basally with a strong median carina, at the extremity of which there is on each side a small rounded eminence. Antennæ three-fourths as long as the head, slender setaceous, composed of three principal and three small accessory joints; first principal joint twice as long as third; second intermediate in length between first and third; accessory joints successively smaller, the first situated at the base of the antennæ, second between the first and second principals, third between the second and third principals. Ocelli six, arranged on the perimeter of a transversely oval convex eminence situated on the sides of the head close behind the antennæ; above each group of ocelli there is a small, but very prominent, shining papilla. Mandibles three-fourths as long as the head, slender, tapering, slightly curved, apex acute. Maxillæ longer than the antennæ; stipes slender, palpiform cylindrical; lacinia minute, papilliform; maxillary palpi more than twice as long as stipes, composed of three principal and three accessory joints; the principal joints successively shorter, the accessory joints successively smaller, the first situated between the stipes and first principal joint, the second between the first and second principals, and the third between the second and third principals. Mentum broad, bilobed, emarginate in front; ligula absent; labial palpi half as long as maxillary palpi, three-jointed, the first joint elongate, slender, the second and third short, subequal.

Pronotum longer than broad, nearly twice as wide at base as at apex, transversely grooved on each side towards anterior margin; sides sharply margined, bent downwards and inwards touching the coxæ of the anterior legs; mesonotum and metanotum half as long

as pronotum, transverse, not deflexed; prosternum with a large rounded sclerite between the bases of the anterior legs.

Feet slender, elongate, sparsely armed beyond the coxæ with small short spines; coxæ nearly as long as femora; tibia two-thirds as long as the femora; femora and tibiæ densely ciliate above and below; tarsi half the length of the tibiæ; claws short, unarmed.

Abdomen tapering gradually from first segment to apex; ninth segment three times as long as broad, truncate at apex, bearing distally a pair of lamellate cerci which are densely ciliate; eighth and ninth segments laterally with a row of long ciliæ.

Described from larvæ taken at Yakutat and Kukak Bay. The transformation of this species takes place in the earth beneath stones lying along the shores of the ponds inhabited by the larvæ and adults. The larvæ resemble very closely those of the allied species *Dytiscus marginales* L. and differ only in a few small details; the body is more convex than in the latter species, the posterior margin of neck is emarginate above and the furrow on the ventral surface of the neck is strongly carinate.

AGABUS TRISTIS Aubé.

[Plate XXIII, figs. 3-6.]

Larva elongately ovate, acuminate behind, convex above, flattened beneath, dorsal surface light brown mottled with yellowish, ventral surface white. Length 12 mm.

Head rounded, convex above, flattened beneath, delicately reticulate, posterior angles broadly rounded; neck short, the sinus between the latter and head deep; frontal angles strongly produced, obtusely rounded at apex; clypeus transverse, rounded in front, bordered anteriorly with a row of delicate lamellate setæ; frontal sulci faintly marked, surrounding the epistoma, which is slightly convex, circular and depressed in the middle; sides of temples acutely carinate, the margin serrate and spinulose. Mandibles slender, tapering, evenly curved on both external and internal margins, apex rather sharp, sutorial orifice close to tip on inner surface. Antennæ not half as long as head, slender, setaceous, four-jointed, the joints successively shorter. Ocelli six, arranged on an oval prominence situated on the side of the head just behind the antennæ; the two anterior ocelli are round, the remaining four more or less elongate. Maxillæ elongate, slender; stipes twice as long as broad, external margin sinuate; galea consisting of a small, slender, finger-shaped joint not much longer than the basal joint of the palpus; maxillary palpus reaching

almost to apex of antennæ, four-jointed, basal joint squarish in outline, the remaining joints successively shorter. Mentum exerted, corneous, transverse, trapezoidal, three times as broad as long, anterior border straight and wider than at base; labial palpi as long as the second and third joints of the maxillary palpi combined, slender, two-jointed, the first joint longer than the second; ligula absent.

Pronotum a little longer than wide, broadly ovate, narrowed somewhat in front, angles rounded, convex above, finely reticulate, sides distinctly margined. Mesonotum and metanotum transversely oval, three times as wide as long, sides broadly rounded; sterna not chitinized, folded.

Legs slender, elongate, with numerous short spines; coxæ stout, elongate, unarmed, femoral groove distinct, carinated; femora as long as coxæ, more slender, compressed, sparsely setose: tibiæ two-thirds as long as the femora, sparsely setose; tarsi nearly as long as tibiæ, claws long and slender.

Abdominal segments gradually diminishing in size from the first to the sixth; dorsal scutes transversely oval, angles rounded; segments seven and eight are entirely corneous; eighth segment slender, elongate, conical, bearing at apex two cerci that are about as long as the last two segments of the abdomen; the cerci are more or less ciliated apically and at the nodes; segments six to eight are finely tuberculate above; spiracles in abdominal segments one to six are situated at the lateral margins of the schlerites and are visible from above.

Pupa pure white; front of face flattened, concave between the eyes; occiput transversely ridged, with a row of bristles extending from one eye to the other. Length 8 mm. Described from larvæ and pupæ found under a stone on the margin of a small pond near the Muir Glacier.

No description appears to have been published of the metamorphoses of any of the American species of *Agabus*.

BYRRIUS FASCIATUS Fabricius.

[Plate XXIV.]

Larva pale brown, lighter between the schlerites; form elongate, cylindrical; outline in side view a flattened curve. Length 18 mm.

Head rounded, shining, globose, almost as broad as the pronotum, heavily punctured and with scattered hairs on the front and vertex. Clypeus broadly transverse, trapezoidal, frontal margin truncate

Labrum semicircular in form, with a row of bristles along the anterior margin. Antennæ short, not exceeding the labrum, three-jointed; first joint cylindrical, not quite twice as long as broad; second more slender and a little longer; third one-fourth as long as the second, more slender, conical. Ocelli five, in two series; first series a group of three, arranged in a triangle behind the antennæ; second series a group of two, cephalo-ventrad of the first, the uppermost ocellus hardly one-half as large as its companion; jaws stout, subtriangular, apex bluntly rounded; inner margin with a blunt, faintly indicated tooth near the middle; articular condyle at the extreme outer angle. Maxillæ not exceeding the jaws; cardo triangular, imperfectly chitinized; stipes twice as long as broad, with a few scattered hairs, produced apically into a triangular lacinial process which is nearly straight outwardly and oblique on the internal margin, the latter being densely set with setæ and hairs; galea springing from the base of the lacinial process and not greatly exceeding that structure, finger-shaped, curving inwardly, two-jointed, the basal joint obscurely indicated and quadrangular in form, second joint ovate, bluntly rounded at apex, which is crowned with a group of stout setæ. Mentum truncate in front, broadening behind, anterior margin bearing four long hairs; labial palpi short, slightly exceeding mentum, composed of two joints, the basal joint large and fleshy, the apical joint small, conical; ligula wanting.

Pronotum extremely convex, nearly as long as the mesonotum and metanotum combined, densely and coarsely punctured, except a narrow band on the posterior margin which is shining and longitudinally striate, clothed with scattering, elongated hairs; lateral margins strongly incurved, tapering to a rounded tip which reaches the coxæ of the anterior legs. Mesonotum short, transverse, obliquely truncate at the lateral margins, which barely reach the coxæ of the middle legs; transversely ridged; punctured, but not so strongly as in the pronotum; two transverse rows of hairs, blending in the middle, extending across the scute from side to side. Metanotum resembling the mesonotum but with two transverse ridges instead of one, and with a series of long hairs on each ridge, the series joining towards the sides of the scute; lateral margins broadly rounded, distant from the posterior coxæ; venter with a small oval schlerite between the bases of the posterior legs.

Legs short, densely setate and hairy; coxæ large, cylindrical excavated externally; femora and tibiæ subequal, not as long as coxæ; tarsal claws simple.

Abdominal segments from fifth to seventh cylindrical, subequal; dorsal scutes transversely oval, lateral margins rounded, traversed by two delicate transverse ridges each of which bears a series of long hairs, the two series uniting towards the outer margin; pleural schlerites two on each side, convex, prominent, oval, oblique; ventral schlerites five on each segment, convex, corneous, the anterior large, cordate, the posterior pair triangular, the lateral pair elongately ovate; eighth segment resembles seventh but is longer, the ridges are absent and the rows of hairs are not so clearly defined, the lateral scutes are reduced to one and the ventral scutes are small and indistinct. The ninth abdominal segment is nearly as large as the pronotum but smooth and shining, semicircular in outline, the posterior margin projecting over and hiding from view the anal structures, a row of hairs along the outer border; anal organ circular, convex, triangularly fissured, thus forming three papillæ, the posterior pair of papillæ bearing disc-shaped depressions serving in locomotion.

Described from larvæ found beneath moss on St. Paul Island, Alaska, in the month of August. The larvæ construct small chambers in the soil in which they lie, and from the fact that the imagoes were emerging at the time they came under observation, the adults probably winter over in the burrows. The mandibles of the young larva differ considerably from those of the adult, and a figure of the former is given for comparison.

What purports to be a description of the larva of *Byrrhus fasciatus* Fabr., is given by Xamheu,¹ but as there appear to be some structural differences between the larva described by the above writer from France and those taken in Alaska, it was deemed advisable to describe and figure the latter carefully in order to furnish a basis for comparison between the American and European forms. As no figures are given by Xamheu, it is difficult to make a detailed comparison at present.

HYPNOIDES MUSCULUS Esch.

[Plate XXV, figs. 3-7.]

Larva white except head, pronotum, and terminal abdominal segment, which are yellow: form elongate, slender, cylindrical, tapering but slightly at either end. Length 7 mm.

Head squarish in outline, narrower than the pronotum, flattened above and beneath, smooth with a few scattered hairs. Clypeus

¹Ann. Soc. Linn. Lyon., XLII, p. 60, 1896.

rounded in front, the anterior margin bearing three teeth of equal length and size. Antennæ three-fourths as long as the jaws; three-jointed; first and second joint of nearly equal size, the third shorter and more slender with a small accessory article by its side. Ocelli on the side of head close behind antennæ. Mandibles of moderate size, tapering, curving inward sharply from about the middle, apex acute, inner margin with a moderately sized tooth close to the tip, the posterior margin of this latter tooth with a row of five or six fine dentations. Maxillæ elongate, extending beyond the tips of the mandibles; stipes very large, inner margin straight, outer margin arcuate, two and one-half times as long as broad, anterior portion of inner margin densely hairy; galea finger-shaped, unarticulate, reaching to apex of second joint of maxillary palpi; maxillary palpi of moderate length, composed of four successively smaller joints. Mentum six times as long as broad, rounded at the anterior margin which bears in the middle a single stout seta; labial palpi rather long, three-jointed, the joints successively smaller. Pronotum squarish in outline, the chitinized schlerite twice as broad as long; mesothorax and metathorax shorter than the prothorax, the dorsal schlerites delicately chitinized. Legs short, with numerous short setæ. Abdominal segments from the first to eighth without distinctly chitinized schlerites, their lateral margins bearing a few elongate hairs; ninth abdominal segment slightly longer than broad, anterior angles rounded, tapering posteriorly, terminal processes simple; sides of the schlerite with a distinctly raised, smooth rim inclosing the somewhat depressed discal area within which is a smooth and shining posterior emargination transversely oval almost inclosed by the incurved apices of the terminal processes; sides with a few long, slender hairs. Pupa white; pronotal area greatly inflated, arcuate at the sides; wing-pads reaching to apex of first abdominal segment; anal segment bearing at its posterior extremity two sharp styliform processes. Length 5 mm.

Described from larvæ and pupæ found beneath stones along the seashore. Popof Island, Alaska, July 10, 1899.

CRYPTOHYPNUS LITTORALIS Esch.

[Plate XXV, figs. 1 and 2.]

Larva reddish above, yellow beneath; entirely corneous, eight times as long as broad, convex above and below, tapering slightly at either end. Length 15 mm.

Head slightly narrower than the anterior margin of pronotum,

broader at base than long. Clypeus tridentate, the teeth sharp and equal. Mandibles bidentate, the inferior tooth considerably shorter than apical, both teeth sharp at apex. Antennæ three-jointed, the joints successively shorter. Maxillæ reaching to tip of mandibles; stipes three times as long as broad; maxillary palpi one-fourth the length of stipes, three-jointed, the joints gradually diminishing in size. Mentum four times as long as broad, half as broad as stipes, not narrowed behind, anterior margin rounded; labial palpi small, two-jointed, conical.

Pronotum smooth, shining, longer than broad, slightly narrowed in front, anterior margin straight, sides curved downward, but not margined. Mesonotum and metanotum transverse, twice as broad as long. Legs short, thickly setate.

Abdominal segments from first to eighth broader than long, subequal; dorsal scutes punctured and with numerous short transverse striæ, sides not margined; impressed median line strongly developed. Ninth abdominal segment longer than broad at base, tapering slightly, anterior angles strongly punctured; posterior emargination broad, transversely oval; lateral margins with a strongly raised ridge bearing externally three equidistant rounded tubercles, the proximal one the smallest, the second and third successively larger; central area flattened, not deeply depressed, impunctate, with light irregular ridges passing from the sides towards the center, a shallow median groove extending from the posterior margin to the middle; cerci strong, bifurcated, the terminal projection sharp, slender, curving strongly inward, the lateral projection shorter, stouter, at right angles to the terminal process.

Described from larvæ found beneath driftwood along the seashore at Kukak Bay, Alaska, July 2, 1899.

No American representative of this genus has hitherto been reared. The larvæ described above resemble closely those of *Cryptohypnus riparius*, described by Schiödte from Europe.

LEPTALIA MACILENTA Mann.

[Plate XXV, figs. 8-12.]

Larva white, except head and pronotum, which are of a yellowish tinge; extreme anterior margin of the front and mandibles brown; form elongate, cylindrical, broadest at the pronotum, gradually narrowing to the third abdominal segment, fourth to sixth segments of about equal diameter, seventh and eighth slightly swollen and longer, ninth short, broadly rounded posteriorly. Length 15 mm.

Head rounded, broader than long, anterior margin broadly truncate, posterior angles rounded, dorsal surface flattened, shining, frontal margin but slightly thickened or coriaceous, frontal angles reduced to small tubercles. Ocelli five, in two series; first series consisting of three ocelli arranged close together in a transverse line on the lateral margin of the head behind the antennæ; second series of two ocelli, situated a short distance behind the first set. Clypeus transverse, trapezoidal, four times as broad as long. Labrum semicircular, twice as broad as long with a dense fringe of fine hairs on the anterior margin. Mandibles triangular in outline, apex acute with a prominent rectangular tooth near tip on inner margin; articular condyle close to the extreme outer angle of the base. Antennæ minute, not exceeding the clypeus, three-jointed; first joint cylindrical, twice as long as broad; second one-third the length of first, slightly narrower, third joint minute, conical, with a stout seta at apex. Maxilla reaching nearly to the apex of mandible; cardo as large as stipes, irregularly triangular in outline; stipes produced apically to form a lobate galear process, which is thickly setate on its inner margin; maxillary palpi three-jointed, basal joint stout, the following joints successively shorter and more slender. Mentum broadly rounded at the tip, which is finely pubescent, outer margin bearing three setæ near the center; palpi widely separated at base, three-jointed, first and second joints equal in length, third small, conical.

Pronotum transverse, two and one-third times as broad as long, angles broadly rounded, dorsal surface flattened. Mesonotum and metanotum transverse, short, diminishing in width. Legs a little longer than the maxillæ; coxæ short, stout; femora and tibiæ cylindrical, subequal in length, the tibiæ more slender; claw simple. Abdominal segments, except eighth and ninth, bearing both dorsally and ventrally a pair of locomotor callosities.

Described from larvæ found in the stumps of decaying alder bushes on Popof Island, Alaska, July 10, 1899. This is the only known American representative of this genus.

CHRYSOMELA SUBSULCATA Mann.

[Plate XXVI, figs. 1-7.]

Larva pink, shading into red on the dorsal surface, pronotum brown, head and legs black; dorsal surface delicately granulate and with numerous minute tubercles each surrounded by a small spot of brown; form stout, almost semicircular in outline when reviewed from the

side, strongly convex above, flattened beneath, abdomen broadest towards the posterior end. Length 7 mm.

Head broader than long, subglobose, delicately granulose; median impressed line well developed, front with a deep fovea on each side. Clypeus transverse, short, slightly emarginate in front, rounded at the sides. Labrum twice as broad as long, the frontal margin bilobate and deeply incised in the center. Mandibles stout, flattened, broad at base, narrowing towards apex, which is crowned by a series of fine sharp subequal teeth, the tips of the teeth in a regular curve. Antennæ extremely small and short, apparently three-jointed, the basal joint button-shaped, the second much smaller and of similar form, the third minute, conical. Ocelli six, arranged in two series; a group of four, arranged in the form of a square, just behind the antennæ; a second group of two ocelli, immediately below that organ. Maxillæ as long as the mandibles; cardo small, fusiform; stipes stout, quadrangular; galea elongately oval, thickly setate on inner margin towards apex; maxillary palpi not greatly exceeding galea, four-jointed, first joint large and stout, button-shaped, second of the same breadth as first but only one-third as long, third a little longer than first, but not so broad, tapering slightly, fourth joint as long as first, conical. Mentum oval, embracing the ligula, which is conical and which bears a pair of short palpi; the latter are two-jointed, the first joint very broad and short, the second longer and conical.

Pronotum longer than the mesothorax but not so broad, delicately granulate; mesothorax and metathorax similar in appearance to the succeeding abdominal segments. Legs short and stout with a few scattered setæ.

Dorsal scutes of the abdomen each divided by a transverse furrow into an anterior and posterior convex area; each area bears across its middle an irregular row of small tubercles which are surrounded by brown dots and bear at their tips very minute setæ.

Pupa short, compact, dorsal surface moderately convex; pronotum set with numerous fine bristles; dorsal abdominal segments with a row of bristles along their posterior margin; terminal segment bearing a stout spine at apex. Length 7 mm.

Described from larvæ and pupæ found beneath moss on St. Paul Island, Alaska, in the month of August. The larvæ feed upon the dwarf willows, but remain hidden during the daytime.

LEPIDOPHORUS LINEATICOLLIS Kirby.

[Plate XXVI, figs. 8-12.]

Larva white except head, which is yellow; apodous; body cylindrical, fusiform, arcuate; dorsal surface traversed by numerous transverse grooves and rounded ridges, giving the dorsulum a wrinkled appearance; pleuræ with a row of rounded elevations; ventral surface somewhat flattened, ridged and grooved similarly to the dorsulum. Length 8 mm.; thickness 2.5 mm.

Head light yellow, shining, about one-half as broad as the pronotum, broadly truncate in front, rounded behind, convex above, flattened beneath. Clypeus separated from the epistoma by a strong suture, twice as broad as long, rounded at the sides. Labrum semi-circular in outline, densely ciliate on the anterior margin. Antennæ rudimentary, reduced to a rounded papilla above the bases of the mandibles. Mandibles stout, tapering gradually to the apex which terminates in two obtuse dentations. Maxillæ elongate; cardo distinctly developed, one-third the length of stipes; stipes four times as long as wide, arcuate externally, with a few setæ along the margin, emarginate within apex produced to form a rather indefinite galear process, which is thickly set with setæ on its inner margin; maxillary palpus slightly exceeding the galear process, two-jointed, basal joint stout, orbicular, second smaller, conical. Mentum not distinctly separated from the hypostome, oval, rounded in front; palpi short, two-jointed, outer joint as long as basal one but not so thick.

Pronotum oval, transverse, convex, with a few scattered hairs; mesothorax and metathorax, short, similar in appearance to the succeeding abdominal segments; abdominal segments nine, the last one conical; spiracles located on the latero-dorsal aspect of the body, minute, yellow.

Pupa white, closely resembling adult beetle. Length 7 mm.

Described from numerous larvæ and pupæ found buried in the soil beneath the roots of grass, St. Paul Island, Alaska.

This is the only known American representative of this genus.

PLATE XXII.

Carabus truncaticollis Fisch.

- FIG. 1. Dorsal view of adult larva ($\times 3$).
2. Anterior margin of the head ($\times 35$).
3. Mandible ($\times 35$).
4. Antennæ ($\times 35$).
5. Maxillæ and labrum ($\times 35$).
6. Side view of the ninth abdominal segment.

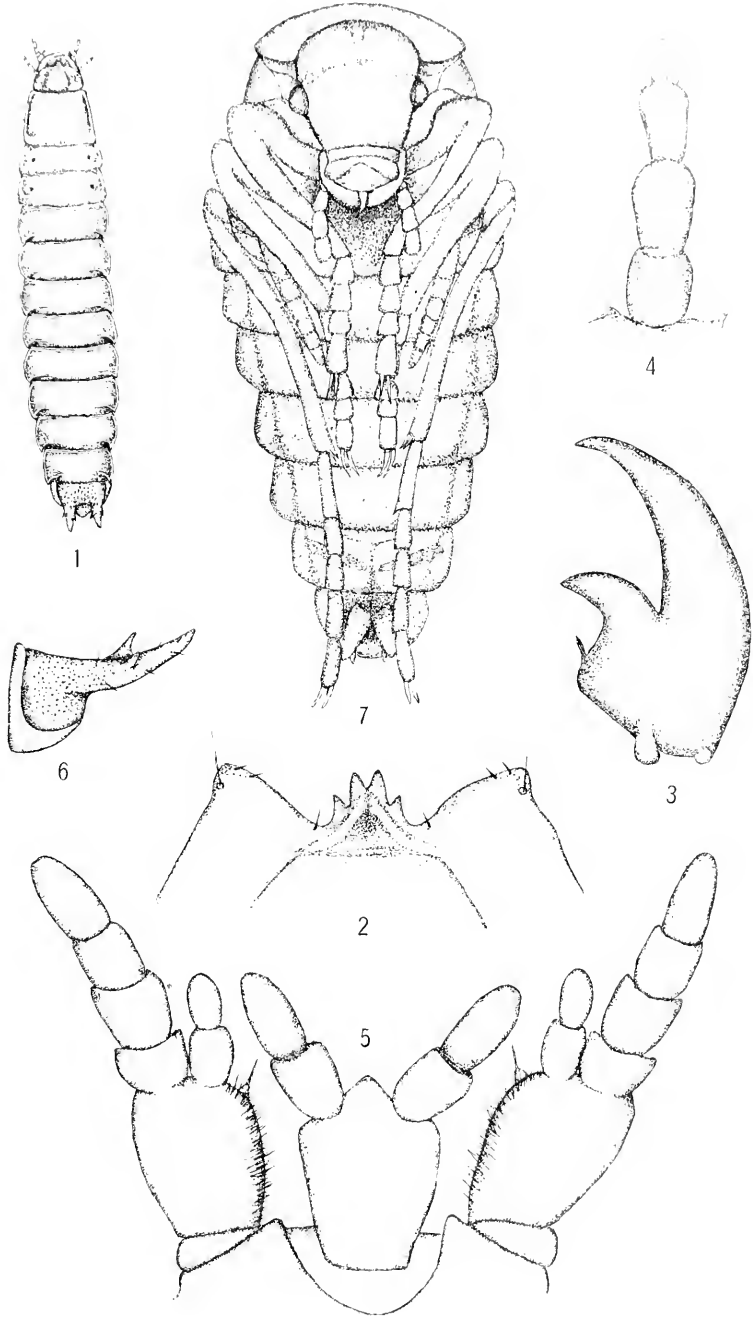


PLATE XXIII.

Dytiscus dauricus Gebler.

- FIG. 1. Dorsal view of larva ($\times \frac{3}{2}$).
2. Under surface of the head ($\times 6.5$).

Agabus tristis Aubé

- FIG. 3. Dorsal view of larva ($\times 7.75$).
4. Maxillæ and labrum ($\times 35$).
5. Mandible ($\times 35$).
6. Ventral view of pupa ($\times 7.75$).

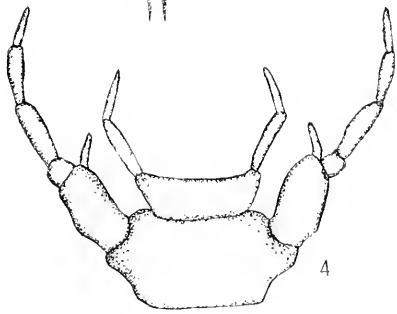
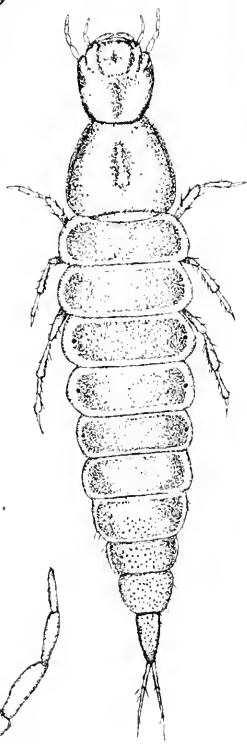
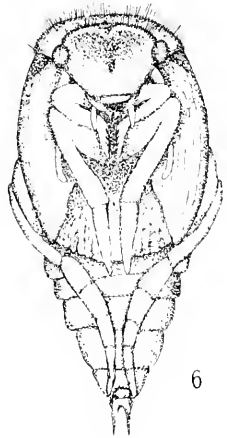
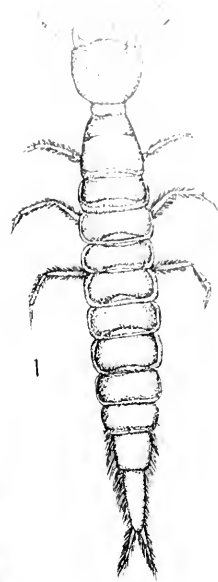
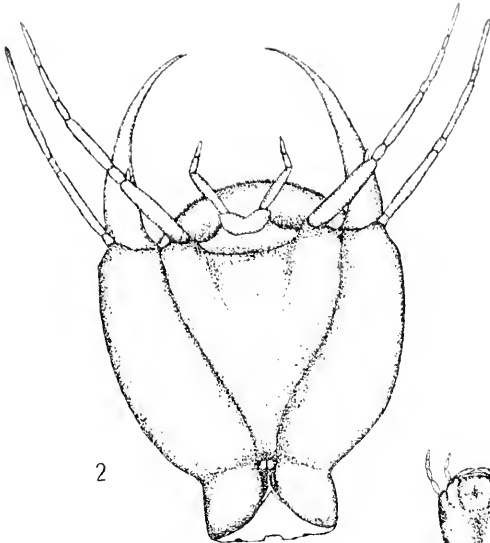
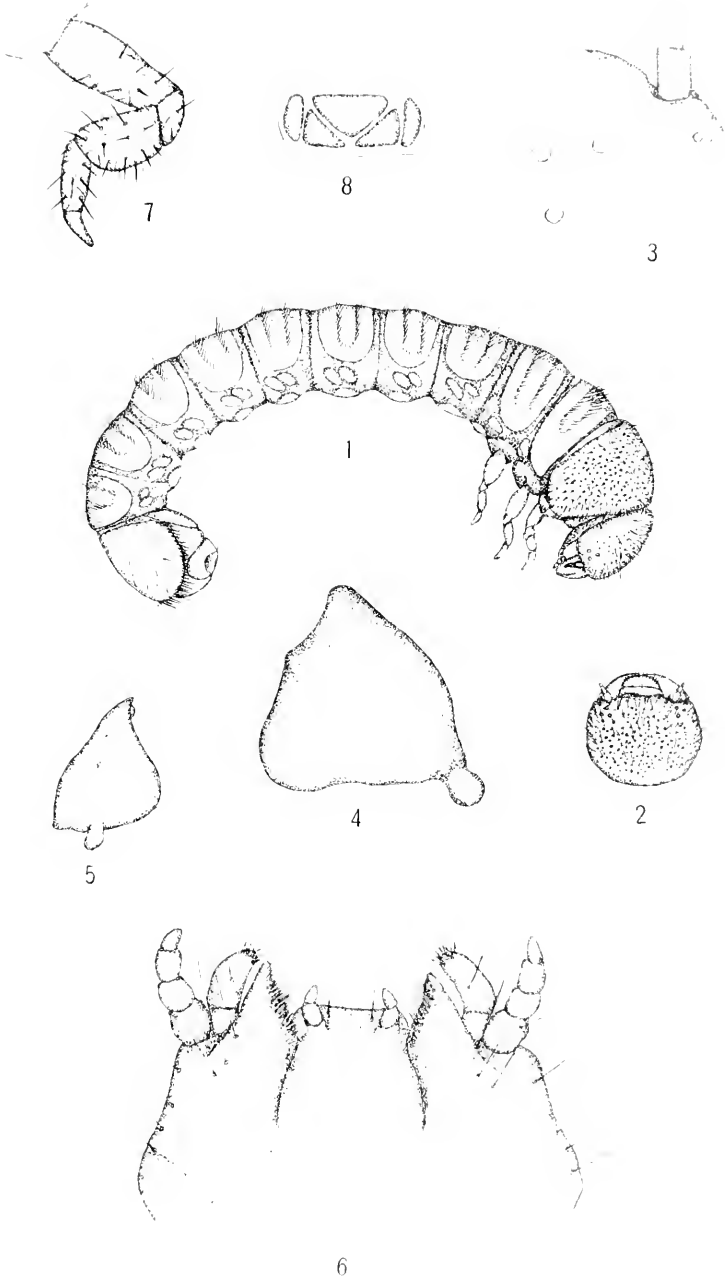


PLATE XXIV.

Byrrhus fasciatus Fabr.

- FIG. 1. Lateral view of larva ($\times 4.3$).
2. Dorsal view of head.
3. Antennæ and ocelli ($\times 35$).
4. Mandible of adult larva ($\times 35$).
5. Mandible of young larva ($\times 35$).
6. Maxillæ and labrum ($\times 35$).
7. Leg ($\times 35$).
8. Ventral sclerites of an abdominal segment.



Metamorphosis of Alaska Coleoptera.

PLATE XXV.

Cryptohypnus littoralis Esch.

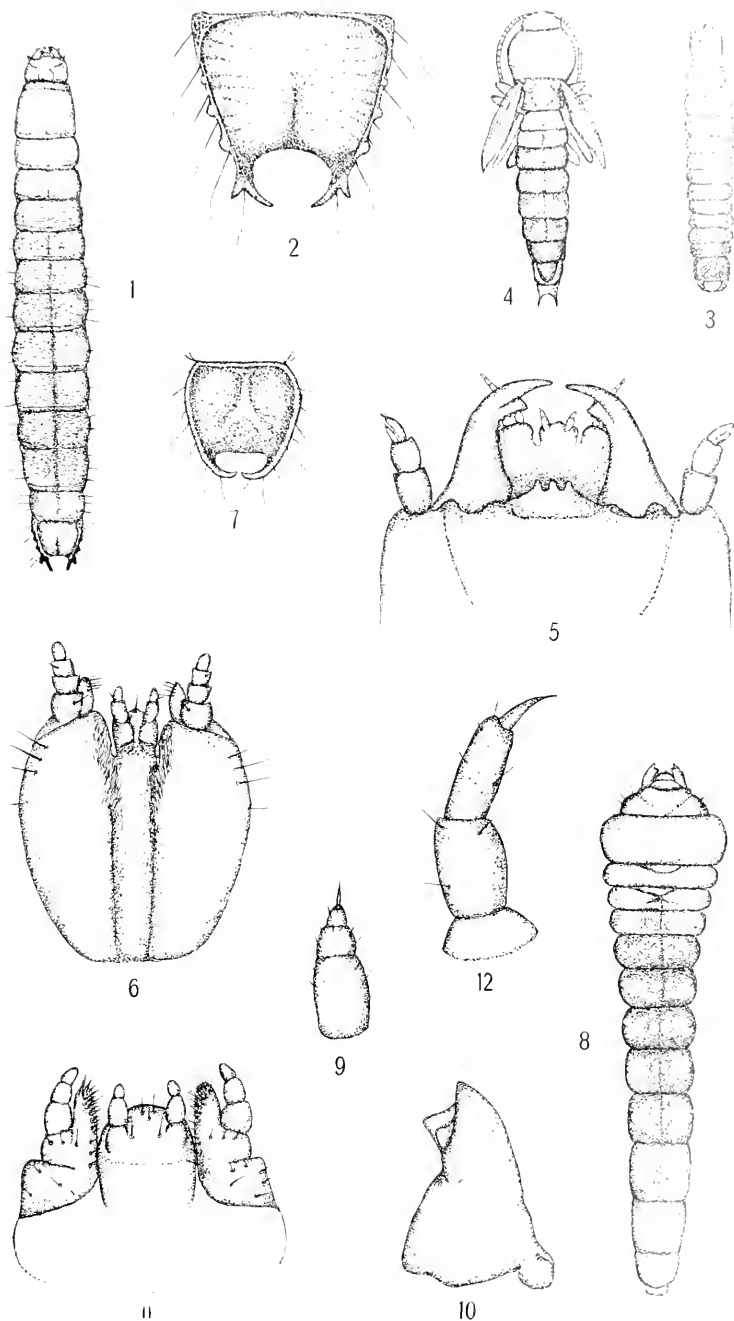
- FIG. 1. Dorsal view of full grown larva.
2. Upper surface of ninth abdominal segment.

Hypnoides musculus Esch.

- FIG. 3. Dorsal view of full grown larva ($\times 5$).
4. Dorsal view of pupa ($\times 8$).
5. Anterior region of the head, from above.
6. Maxillæ and labrum ($\times 75$).
7. Ninth abdominal segment from above.

Leptalia macilenta Mann.

- FIG. 8. Dorsal view of larva.
9. Antennæ ($\times 75$).
10. Mandible ($\times 35$).
11. Maxillæ and labrum ($\times 35$).
12. Leg ($\times 75$).



Metamorphosis of Alaska Coleoptera.

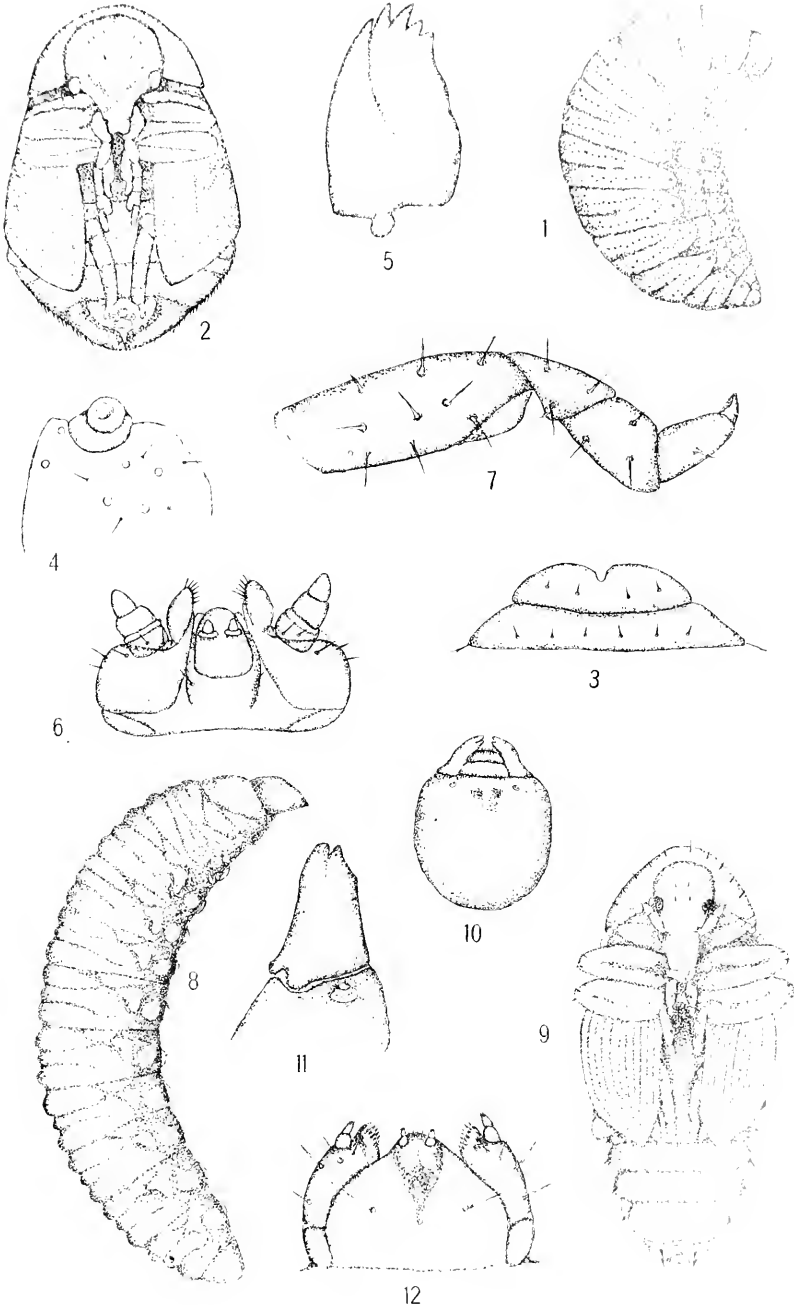
PLATE XXVI.

Chrysomela subsulcata Mann.

- FIG. 1. Lateral view of full-grown larva ($\times 6.5$).
2. Ventral view of pupa ($\times 6.5$).
3. Clypeus and labrum ($\times 35$).
4. Antennæ and ocelli ($\times 35$).
5. Mandible ($\times 35$).
6. Maxillæ and labrum ($\times 35$).
7. Leg ($\times 35$).

Lepidophorus lineaticollis Kirby.

- FIG. 8. Lateral view of larva ($\times 8.5$).
9. Ventral view of pupa ($\times 8$).
10. Dorsal aspect of head.
11. Mandible and antennæ ($\times 35$).
12. Maxillæ and labrum ($\times 35$).



Metamorphosis of Alaska Coleoptera.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES.

VOL. II, PP. 389-464.

DECEMBER 7, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

IX.

ENTOMOLOGICAL RESULTS (3):

DIPTERA.

BY D. W. COQUILLET.

THE series of Dipterous insects collected by Professor Trevor Kincaid while a member of the Harriman Expedition to Alaska during the summer of 1899 is one of the most interesting and valuable collections of insects of that order that the U. S. National Museum has acquired for many years. The specimens themselves, almost without exception, are in first-class condition, and each is accompanied by a label giving the exact locality and date of capture.

The collection contains 2,423 specimens, representing 276 species, distributed in 138 genera and 36 families. One genus and 63 of the species are believed to be new to science, and are described in this paper. In addition to the specimens referred to above, there are a number of others which it is quite impossible to correctly classify in the present condition of the science; these are chiefly female specimens belonging to groups in which the sexes are very dissimilar in appearance, and the principal classificatory characters are present in the male sex alone, obscure groups which have not as yet been thoroughly studied in this country, and for the proper elucidation of which several years of careful study will be required.

As might naturally have been expected, the greater number of the species represented in the present collection are such as occur over the more northern portion of this Continent, not extending farther southward than the mountains of New Hampshire and Colorado. Besides the new genus *Ornithodes*, which belongs to the family Tipulidæ, the most interesting addition to our genera is the genus *Telmatogeton*, of the family Chironomidæ, heretofore known only from St. Paul Island, in the Indian Ocean.

Family MYCETOPHILIDÆ.

Diadocidia borealis sp. nov.

Head and antennæ dark brown, two basal joints of the latter, also the proboscis and palpi, yellow; thorax polished, yellow, the dorsum, except the front corners, dark brown, scutellum yellow, metanotum brown; abdomen dark brown, slightly polished, its hairs yellowish; coxæ and femora light yellow, tibiæ and tarsi brown, front tarsi slender; knob of halteres yellowish brown; wings hyaline, densely covered with short hairs, auxiliary crossvein present, tip of first vein about opposite apex of anterior branch of the fifth. Length 4 mm. A male specimen, collected June 3.

Habitat.—Lowe Inlet, British Columbia.

Type.—Cat. no. 5190, U. S. National Museum.

Closely related to the European *D. ferruginosa* Meigen, of which species the U. S. National Museum contains two specimens from the White Mountains, New Hampshire; but in that species the apex of the first vein is far before the tip of the anterior branch of the fifth, the auxiliary crossvein is wanting, etc.

Hesperinus brevifrons Walker.

Hesperinus brevifrons WALKER, List Dipt. Ins. British Museum, 1, p. 81, 1848.

Popof Island, Alaska: A single specimen, collected July 8. This species was originally described from Hudson Bay, British America, and has been recorded from the mountains of New Hampshire and Colorado. The genus *Hesperinus* has heretofore been placed in the family Bibionidæ, but it differs from all the other members of that family by the elongated antennæ. In this and other structural characters it agrees very well with the members of the present family.

***Neæmpheria kincaidi* sp. nov.**

Head and its members black, second joint of antennæ yellow, about one-half as long as the third, the three ocelli in a transverse row and widely separated from each other; thorax black, opaque, gray pruinose, the mesonotum marked with four polished vittæ, scutellum black, the base narrowly yellow, its hairs and those of the thorax golden yellow; abdomen brownish black, slightly polished, its hairs yellowish; coxæ and femora yellow, tibiæ yellowish brown, tarsi dark brown, front tarsi toward their apices noticeably higher than wide; halteres yellow; wings hyaline, bare, auxiliary vein ending in the first before middle of inner submarginal cell, the latter about twice as long as wide, anterior fork of fourth vein about ten times as long as preceding section of this vein, fifth vein forking far before small crossvein, the latter shorter than first section of third vein. Length 6 mm. A female specimen, collected July 8.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5191, U. S. National Museum.

Readily distinguished by its venation from any of the described species. Respectfully dedicated to Professor Trevor Kincaid, whose extensive captures have added so much to our knowledge of the fauna of this interesting region.

***Anaclinia nemoralis* Meigen.**

Anaclinia nemoralis MEIGEN, System. Besch. Eur. Zweif. Ins., 1, p. 265, 1818,

Sitka, Alaska: Two specimens, collected June 16. A European species now for the first time reported from this country.

***Boletina grænlandica* Staeger.**

Boletina grænlandica STAEGER, Kröjer's Natur. Tidsskrift, p. 356, 1845.

Berg Bay, June 10; Yakutat, June 21; Virgin Bay, June 26; Orca, June 27; Popof Island, Alaska, July 12: Six specimens. Originally described from Greenland. Specimens are in the U. S. National Museum from the mountains of New Hampshire and Colorado.

***Boletina inops* sp. nov.**

Black, the second joint of antennæ and base of the third, the palpi, halteres, coxæ, femora, and male hypopygium yellow, tibiæ brownish yellow; hairs of body yellow; thorax subopaque, thinly gray pruinose; abdomen subopaque; bristles of inner side of middle tibiæ slightly shorter than the diameter of each tibia; wings hyaline, tip of auxiliary vein slightly before base of third vein, no auxiliary crossvein, fourth vein forking slightly beyond, the fifth about opposite to, base of third

vein; third joint of antennæ twice as long as wide, hypopygium of male at least one-half longer than the longest segment of the abdomen preceding it. Length 4.5 mm. A specimen of each sex, taken June 21 and 27.

Habitat.—Yakutat and Orca, Alaska.

Type.—Cat. no. 5192, U. S. National Museum.

Readily recognized among the black forms by the unspotted wings, which have no indication of an auxiliary crossvein.

***Sciara abbreviata* Walker.**

Sciara abbreviata WALKER, List Dipt. Ins. British Museum, 1, p. 109, 1848.

Popof Island, Alaska: Three females, collected June 12, 14, and 16. Originally described from Hudson Bay, British America.

***Sciara grœnlandica* Holmgren.**

Sciara grœnlandica HOLMGREN, Öfversigt Vet.-Akad. Förhand., p. 104, 1872.

Popof Island, Alaska: Three females, collected July 10. Heretofore reported only from Greenland.

***Sciara iridipennis* Zetterstedt.**

Sciara iridipennis ZETTERSTEDT, Insecta Lapp., p. 827, 1840.

Popof Island, July 12 and 15; Muir Inlet, Alaska, June 12: Eight specimens. Originally described from Lappland, and also reported from Greenland.

***Sciara borealis* Rübsaamen.**

Sciara borealis RÜBSAAMEN, Bibliotheca Zool., p. 109, 1898.

Sitka, Alaska: Two specimens, collected June 16. Originally described from Greenland.

***Sciara tridentata* Rübsaamen.**

Sciara tridentata RÜBSAAMEN, Bibliotheca Zool., p. 107, 1898.

Lowe Inlet, British Columbia: A single specimen, collected June 3. It was originally described from Greenland.

***Sciara expolita* sp. nov.**

Head black, mouth parts and antennæ blackish brown, third joint of antennæ almost twice as long as broad, the eighth joint the same, its upper and lower edges parallel; thorax black, mesonotum highly polished, humeri pale yellow, prolonged as a triangular spot on the pleura; scutellum and metanotum black, the latter highly polished; abdomen pale yellow, the sides, hind margin of the segments, also the apical portion of the abdomen beyond the sixth segment, black, the end lamella slightly longer than broad; coxæ and femora pale yellow,

tibiæ brownish yellow, tarsi brown; halteres dark brown, base of the peduncle yellow; wings grayish hyaline, last section of first vein distinctly longer than the preceding section, apex of first vein noticeably beyond the forking of the fourth, lower fork of the fourth vein considerably shorter than the preceding section of this vein. Length 4 mm. A female specimen, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5193, U. S. National Museum.

Family SIMULIIDÆ.

Simulium ochraceum Walker.

Simulium ochraceum WALKER, Trans. Ent. Soc. London, p. 332, 1861.

Lowe Inlet, British Columbia, June 6; Sitka, Alaska, June 16; Virgin Bay, June 26; Kukak Bay, Alaska Peninsula, July 4: Ten specimens. Originally described from Mexico. The U. S. National Museum contains specimens collected in the mountains of Colorado and Montana.

Simulium invenustum Walker.

Simulium invenustum WALKER, List Dipt. Ins. Brit. Mus., I, p. 112, 1848.

Simulium pecuarum RILEY, Report U. S. Dept. Agric., p. 512, 1886.

Metlakahtla, June 4; Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 8, 10, 11 and 16; Kadiak, Alaska, July 20: Twelve specimens. Originally described from Hudson Bay, British America. In the United States its known range extends from New Hampshire southward to Mississippi, and westward to Colorado.

Simulium venustum Say.

Simulium venustum SAY, Jour. Acad. Nat. Sciences, Philadelphia, p. 28, 1823.

Simulium molestum HARRIS, Insects Inj. Vegetation, 3d edit., p. 601, 1862.

Simulium piscicidium RILEY, Amer. Entomologist, II, p. 367, 1870.

Metlakahtla, June 4; Kukak Bay, July 4; Popof Island, July 8 to 11: Twelve specimens. The type locality of this species is given by Say as "Shippingport, Falls of the Ohio." Shippingport is the old landing on the Kentucky side below the Falls of the Ohio. Its site is covered by the present city of Louisville, Kentucky. This species occurs all over the United States, as well as in Canada and British Columbia.

Simulium vittatum Zetterstedt.

Simulium vittatum ZETTERSTEDT, Insecta Lapponica, p. 803, 1840.

Simulium argus WILLISTON, North American Fauna, No. 7, p. 253, 1893.

Yakutat, June 21; Kadiak, Alaska, July 20: Twelve specimens

A European species which is also reported as occurring in Greenland. It ranges over the northern portion of the United States, extending as far southward as New Jersey, Kansas, and southern California.

Family BIBIONIDÆ.

Bibio variabilis Loew.

Bibio variabilis LOEW, Berliner Entom. Zeitsch., p. 53, 1864.

Lowe Inlet, British Columbia, June 3; Metlakahtla, June 4; Berg Bay, June 10; Muir Inlet, June 12; Sitka, June 16; Yakutat, Alaska, June 21: Twenty-two males and eight females. Loew's original specimens came from Sitka and from New Hampshire. The species also occurs in Oregon.

Bibio obscurus Loew.

Bibio obscurus LOEW, Berliner Entom. Zeitsch., p. 52, 1864.

Yakutat, June 21; Saldovia, Alaska, July 21: Four males and one female. This species was originally described from the vicinity of Hudson Bay, British America.

Dilophus serraticollis Walker.

Dilophus serraticollis WALKER, List Dipt. Ins. Brit. Museum, 1, p. 117, 1848.

Metlakahtla, June 4; Berg Bay, June 10; Muir Inlet, June 12; Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 12; Saldovia, July 21; Juneau, Alaska, July 26: Twenty-two males and thirty-four females. Originally described from Hudson Bay, but also occurs in Canada and Colorado.

Scatopse notata Linné.

Scatopse notata LINNÉ, Fauna Suecica, p. 1773, 1761.

Popof Island, July 8 and 10; Juneau, Alaska, July 28: Eight specimens. A European species, which has also been reported as occurring in Greenland. It ranges as far southward at least as Alabama.

Family CULICIDÆ.

Culex impiger Walker.

Culex impiger WALKER, List Dipt. Ins. Brit. Museum, 1, p. 6, 1848.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Popof Island, Alaska, July 8 to 16: Fifty female specimens. This species was originally described for the vicinity of Hudson Bay, British America, and ranges southward to Jamaica, West Indies.

Culex consobrinus Desvoidy.

Culex consobrinus DESVOIDY, Memoirs Soc. Hist. Nat. Paris, p. 408, 1827.

Sitka, June 16; Yakutat, Alaska June 21: Three female specimens. Originally described from Pennsylvania; at the east it does not appear to occur south of the State mentioned, but ranges northward into British America. West of the Mississippi, however, it ranges southward to Nebraska, New Mexico, and southern California.

Family CHIRONOMIDÆ.**Telmatogeton alaskensis** sp. nov.

Head and its members brownish black, the front velvet black, first joint of antennæ velvet brown; antennæ about as long as the head, the first joint nearly three times as wide as the others, the latter subcylindrical, the last joint slightly wider than the others and subconical in profile; thorax opaque, black, the lateral margins and upper part of pleura varied with yellowish; scutellum, metonotum, and abdomen brownish black, the lateral margins of the latter and hind margins of the ventral segments, yellow; coxæ mottled black, brown and yellowish, remainder of legs blackish brown, front femora each bearing a transverse, contiguous pair of blunt tubercles near the tip of the under side, and just beyond them a pair of rather widely separated cavities; front tibiæ each bearing a blunt tubercle on the under side near the base, the inner side of each front tibia rather strongly dilated at its first third; first joint of the tarsi nearly three times as long as the second, each of the last three joints slightly over one-half as long as the second joint, claws cleft almost to the middle; halteres whitish; wings brownish gray, veins brown, first section of the fourth vein yellow, third vein on its basal portion almost touching the first; length 4.5 mm. Four male specimens, collected June 21.

Habitat.—Yakutat, Alaska.

Type.—Cat. no. 5194, U. S. National Museum.

The present genus, which is new to our fauna, was founded on a species inhabiting St. Paul Island, in the southern part of the Indian Ocean. Our species agrees very well with Dr. Schiner's description and figures except in the structure of the legs, but these are not sufficiently different to warrant the establishing of a separate genus for the present form.

Chasmatonotus univittatus sp. nov.

Black, the bases of antennæ, front corners and hind end of thorax, pleura, except the lower portion and one or two spots; halteres, trochan-

ters, and bases of femora and of tibiæ, yellow; posterior margins of abdominal segments whitish; mesonotum polished; abdomen subopaque; wings black, the extreme base and a vitta extending from it three-fourths the length of the wing, between the fourth and fifth veins, white; length 2.5 mm. Five male specimens, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5195, U. S. National Museum.

Readily distinguished from our other two species by the coloring of the wings.

Eutanypus borealis Coquillett.

Eutanypus borealis COQUILLET, The Fur-seals and Fur-seal Islands N Pacific, IV, p. 341, 1899.

Muir Inlet, Alaska: A single specimen, collected June 12. This species was originally described from the Bering Islands, but also occurs in New Mexico and New Hampshire.

Ceratopogon arcticus sp. nov.

Black, the knobs of the halteres and hairs on apical portion of antennæ of male, and entire antennæ of female, whitish; thorax polished, the abdomen opaque; femora slender, destitute of spinous bristles, first tarsal joint at least twice as long as the second, the last joint not spinose below, claws minute and of an equal size; wings hyaline, bare, the third vein on its basal fourth united to the first vein, tip of the latter nearly opposite apex of first third of the third vein, apex of third vein at about three-fourths length of wing, petiole of second posterior cell slightly shorter than the small crossvein. Length 1 mm. One male and eleven females, collected July 8 to 16.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5196, U. S. National Museum.

Ceratopogon femoratus Fabricius.

Ceratopogon femoratus FABRICIUS, Systema Antliatorum, p. 45, 1805.—WINNERTZ, Linnæa Entom., p. 68, 1852.

Popof Island, Alaska: A male specimen, collected July 13. This European species has not heretofore been reported from our Continent.

Ceratopogon hirtulus sp. nov.

Dull black, the legs and halteres yellow, hairs mostly light colored; mesonotum subopaque, thinly dark grayish pruinose; abdomen somewhat polished; femora slender, destitute of spinous bristles, first joint of tarsi longer than the second, fifth joint not spinose below, claws minute and of an equal size; wings grayish hyaline, bare except a few

scattered hairs in the apical portion, most numerous in the costo-apical half of the first posterior cell; third vein greatly dilated, united on at least its apical half with the first, its apex considerably beyond middle of wing, petiole of second posterior cell longer than the small crossvein. Length 1 mm. Two females, collected June 26.

Habitat.—Virgin Bay, Prince William Sound, Alaska.

Type.—Cat. no. 5197, U. S. National Museum.

Ceratopogon cilipes sp. nov.

Black, legs brown, knobs of halteres yellow, hairs mostly light colored, those on basal half of antennæ black; mesonotum polished, the abdomen less so; femora rather robust, destitute of spinous bristles, front and middle tibiæ outwardly ciliate with suberect, scale-like hairs, first two joints of hind tarsi subequal in length, the last joint not spinose below, the claws small and of an equal size; wings wholly covered with hairs, hyaline, the costal cell brownish, third vein united to the first except for a short distance beyond its middle, its apex near middle of length of wing, petiole of second posterior cell shorter than the small crossvein. Length 1.5 mm. Two female specimens, collected June 12.

Habitat.—Muir Inlet, Glacier Bay, Alaska.

Type.—Cat. no. 5198, U. S. National Museum.

Family PSYCHODIDÆ.

Psychoda pacifica Kincaid.

Psychoda pacifica KINCAID, Entomological News, p. 143, 1897.

Lowe Inlet, British Columbia: Two specimens, collected June 3. Originally described from Washington, but also reported as extending from Alaska to northern California.

Pericoma bipunctata Kincaid.

Pericoma bipunctata KINCAID, Entomological News, p. 34, 1899.

Berg Bay, June 10; Yakutat, Alaska, June 21: Thirteen specimens. Originally described from Washington and California. This and the preceding species were identified by Mr. Kincaid, from a comparison with the type specimens.

Family TIPULIDÆ.

Dicranomyia venusta Bergroth.

Dicranomyia venusta BERGROTH, Wiener Entom. Zeitung, p. 193, 1888.

Yakutat, Alaska: A single specimen, collected June 21. This species was originally described from Alaska.

Dicranomyia halterata Osten Sacken.

Dicranomyia halterata OSTEN SACKEN, Monographs Diptera N. Am., IV, p. 71, 1869.

Muir Inlet, June 12; Popof Island, Alaska, July 10 and 16: Eight specimens. Originally described from Labrador, and Bergroth has already reported it from Alaska.

Dicranomyia infusata Doane.

Dicranomyia infusata DOANE, Journal N. Y. Ent. Soc., Sept., p. 185, 1900.

Yakutat, Alaska: A male specimen, collected June 21. Originally described from Collins, Idaho.

Limnobia sciophila Osten Sacken.

Limnobia sciophila OSTEN SACKEN, Bulletin U. S. Geol. Geog. Survey Terr., III, p. 197, 1877.

Kadiak, July 20; Saldovia, Alaska, July 21: Three specimens. Originally described from northern California, but also occurs in Colorado.

Rhypholophus affinis Lundbeck.

Rhypholophus affinis LUNDBECK, Videnskabelige Med. Nat. For. Kjob., p. 266, 1898.

Lowe Inlet, British Columbia: A male specimen, collected June 3. Originally described from Greenland.

Rhypholophus flaveolus sp. nov.

Yellow, the upper side of occiput and posterior part of the front black, gray pruinose, the antennæ and palpi, except first joint of each, also the legs, except the coxæ, trochanters, and bases of femora, dark brown; hairs of body nearly wholly yellow; antennæ reaching slightly beyond insertion of wings, tapering to the apex, the joints beyond the second somewhat elliptical, scarcely longer than broad, the hairs less than twice as long as greatest diameter of the joints from which they spring; wings grayish hyaline, wholly covered with hairs, veins yellow, stigma scarcely apparent, discal cell opening into the second posterior, seventh vein toward its apex strongly diverging from the sixth. Length 4 mm. A male specimen, collected June 27.

Habitat.—Orca, Alaska.

Type.—Cat. no. 5200, U. S. National Museum.

Related to *holotrichus*, but of a much lighter color and with the anal cell greatly dilated at its apex.

Molophilus colonus Bergroth.

Molophilus colonus BERGROTH, Wiener Entom. Zeitung, p. 195, 1888.

Virgin Bay, Alaska: A male specimen, collected June 26. This species was originally described from Alaska.

Molophilus falcatus Bergroth.

Molophilus falcatus BERGROTH, Wiener Entom. Zeitung, p. 196, 1888.

Metlakahtla, June 4; Yakutat, Alaska, June 21: Two males and two females. Originally described from Alaska.

Molophilus paulus Bergroth.

Molophilus paulus BERGROTH, Wiener Entom. Zeitung, p. 196, 1888.

Metlakahtla, June 4; Sitka, June 16; Popof Island, July 9; Kadiak, Alaska, July 20: Two males and two females. Originally described from Alaska.

Helobia hybrida (Meigen).

Limonia hybrida MEIGEN, Klass. Besch. Eur. Zwief. Ins., p. 57, 1804.

Limnobia punctipennis MEIGEN, Sys. Besch. Eur. Zweif. Ins., I, p. 147, 1818.

Symplecta punctipennis OSTEN SACKEN, Monographs Diptera N. Amer., IV, p. 171, 1869.

Saldovia, Alaska: A female specimen, collected July 21. This European species occurs over the greater portion of the United States.

Limnophila unica Osten Sacken.

Limnophila unica OSTEN SACKEN, Monographs Diptera N. Amer., IV, p. 205, 1869.

Sitka, June 16; Yakutat, Alaska, June 21: Two male specimens. Originally described from New Hampshire.

Limnophila indistincta Doane.

Limnophila indistincta DOANE, Journal N. Y. Ent. Soc., Sept., p. 191, 1900.

Yakutat, Alaska: A male specimen, collected June 21. This species was originally described from Collins, Idaho.

Tricyphona vitripennis (Doane).

Amalopis vitripennis DOANE, Journal N. Y. Ent. Soc., Sept., p. 195, 1900.

Lowe Inlet, British Columbia: Two male specimens, collected June 3. Originally described from Washington.

Tricyphona disphana (Doane).

Amalopis disphana DOANE, Journal N. Y. Ent. Soc., Sept., p. 195, 1900.

Yakutat, June 10; Berg Bay, June 21; Popof Island, Alaska, July 15: Three male specimens. Also originally described from Washington.

ORNITHODES gen. nov.

Near *Tricyphona*, but the rostrum about one and a-half times as long as the head; palpi inserted near apex of the rostrum, eyes densely pubescent, head prolonged backward in the form of a rather long neck, prothorax considerably prolonged forward, antennæ sixteen-jointed, tibiæ with large spurs at their apices, tarsal claws simple, empodia narrow but rather long; apex of auxiliary vein opposite base of fourth posterior cell, auxiliary crossvein at more than twice the length of the hind crossvein before base of second vein, the latter slightly before the apex of seventh vein; second vein simple, the third issuing from it slightly before the small crossvein and forking a short distance beyond the latter; five posterior cells, the second petiolate.

Type.—The following species:

Ornithodes harrimani sp. nov.

Black, the halteres, posterior margins of the abdominal segments except the first, apices of coxæ, trochanters, and bases of femora yellow; antennæ nearly reaching insertion of wings, slightly tapering to the apex, bearing a few short bristly hairs, first joint about twice as long as broad, the remaining joints except the last one about as long as broad or only slightly longer; head and thorax opaque, gray pruinose, mesonotum marked with four black vittæ; abdomen slightly polished, its sparse hairs yellowish, claspers transverse oval, one and a-half times as broad as long, destitute of processes, posterior ventral margin of the preceding segment prolonged in the middle in the form of two large tubercles; wings hyaline, veins brownish, stigma pale grayish, a brown cloud at base of second vein, at apex of auxiliary vein, on marginal crossvein, on veins at bases of both submarginal, first, third, fourth, and fifth posterior cells, and beyond middle of second submarginal cell; base of first posterior cell directly above base of discal, hind crossvein about half its length before base of discal cell and more than its length before base of fourth posterior cell, discal cell closed. Length, including the rostrum, 15 mm. A male specimen, collected June 22.

Habitat.—Virgin Bay, Prince William Sound, Alaska.

Type.—Cat. no. 5203, U. S. National Museum.

Respectfully dedicated to Mr. Edward H. Harriman, to whose generosity we are indebted for the discovery of this and many other interesting forms of insect life.

Pedicia obtusa Osten Sacken.

Pedicia obtusa OSTEN SACKEN, Bulletin U. S. Geol. Geog. Survey Terr., 111, p. 205, 1877.—ALDRICH, Psyche, p. 202, 1895.

Kadiak, Alaska: A male specimen, collected July 20. Originally described from northern California, and Professor Aldrich has reported its occurrence in northern Washington.

Dicranota argentea Doane.

Dicranota argentea DOANE, Journal N. Y. Ent. Soc., Sept., p. 196, 1900.

Berg Bay, Alaska: A male specimen, collected June 10. The type locality of this species is Seattle, Wash.

Rhaphidolabis debilis Williston.

Rhaphidolabis debilis WILLISTON, Kansas Univ. Quart., p. 62, 1893.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Saldovia, Alaska, July 21: Eight specimens. Originally described from California.

Cylindrotoma juncta sp. nov.

Head yellow, the middle of the front and the occiput, except next the eyes, dark brown, somewhat polished, upper side of rostrum, the palpi and antennæ also brown; antennæ reaching middle of third abdominal segment, the first two joints broader than long, the others cylindrical, each, except the last one, almost four times as long as broad; thorax yellowish, mesonotum marked with three opaque black vittæ and with a narrow, curved, polished, brown stripe passing in front of them and extending below each of the outer ones, finally uniting with them at their apices; prothorax, except its hind margin, brown, a brown spot near center of pleura, a second below it between the front and middle coxæ, and a brown vitta in front of the halteres; scutellum and lower median part of metanotum brown; abdomen brown, slightly polished, claspers yellow at their apices, destitute of processes, the median yellow, polished projection three-pronged; legs yellow, bases of coxæ and apices of tarsi black; halteres yellow, the knobs brown; wings hyaline, costal cell pale gray, stigma brownish gray, base of submarginal cell far beyond base of discal, five posterior cells, base of the second slightly before base of third. Length 10 mm. A male specimen, collected June 26.

Habitat.—Virgin Bay, Prince William Sound, Alaska.

Type.—Cat. no. 5204, U. S. National Museum.

Closely related to *distinctissima* Meigen, of Europe, but the coloring is different and the male claspers are unarmed.

Tipula septentrionalis Loew.

Tipula septentrionalis LOEW, Berliner Ent. Zeitsch., p. 278, 1863.

Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 10; Kadiak, Alaska, July 20: Two males and three females; one of the females from Popof Island has aborted wings which are shorter than the thorax. Originally described from Labrador; the U. S. National Museum contains a male specimen, collected on Mount Washington, New Hampshire, by Mrs. Annie T. Slosson.

Tipula macrolabis Loew.

Tipula macrolabis LOEW, Berliner Ent. Zeitsch., p. 58, 1864.

Saldovia, Alaska: A male specimen, collected July 21. This species was originally described from the region about Hudson Bay, British America, and a male specimen collected in the White Mountains, New Hampshire, is contained in the collection of the U. S. National Museum.

Tipula fallax Loew.

Tipula fallax LOEW, Berliner Ent. Zeitsch., p. 281, 1863.

Sitka, June 16; Virgin Bay, June 21; Kukak Bay, July 1 and 4; Kadiak, Alaska, July 20: Two males and six females. Originally described from California.

Tipula appendiculata Loew.

Tipula appendiculata LOEW, Berliner Ent. Zeitsch., p. 287, 1863.

Popof Island, July 10; Kadiak, July 20; Juneau, Alaska, July 25: Nine males and seven females. Originally described from the Saskatchewan River, British America.

Tipula besselsi Osten Sacken.

Tipula besselsi OSTEN SACKEN, Proc. Boston Soc. Nat. Hist., p. 42, 1876.

Muir Inlet, Alaska: Three males and one female, collected June 12. The type locality of this species is Grinnel Land, British America, latitude 82° north.

Tipula strigata sp. nov.

Front and occiput black, gray pruinose, marked with a median black vitta; rostrum varying from brown to yellow, palpi brown, antennæ black, the first two joints and base of the third, yellow; antennæ of male, if stretched backward, would reach base of third abdominal segment, slightly tapering toward the apex, third joint the longest, slightly thickening at its apex, bearing several irregularly arranged bristles on its basal two-thirds; remaining joints becoming

successively slightly shorter, each slightly constricted near the middle, bearing a whorl of bristles near the base, the seventh joint over three times as long as wide; antennæ of female almost reaching base of wing, considerably tapering to the apex, formed as in the male except that the joints beyond the fifth are not constricted in the middle, the seventh joint less than twice as long as wide; thorax bare, black, opaque, gray pruinose, a yellow vitta extending from below each humerus to root of wing and from thence to the scutellum, sending a branch downward behind the front coxa; the three usual vittæ are concolorous with the mesonotum, each margined with black, the two black lines bordering the median vitta straight, anteriorly diverging, their anterior ends widely separated, a brown vitta midway between them, which is sometimes almost obsolete; scutellum brown, gray pruinose, its margin and lower side yellow; metanotum black, gray pruinose, the sides spotted with yellow; abdomen bare, yellow, a black vitta on each side of the middle; male hypopygium large, black, the apex and under side yellow, ventral portion of the preceding (eighth) abdominal segment bearing sparse, short, black hairs; claspers almost square, each bearing near the apex of the inner side a pair of spatulate organs which are about as long as the clasper, the upper pair converging, the lower one curving outward; dorsal piece of hypopygium at middle of its posterior margin bearing a pair of conical, blunt-pointed, backwardly projecting processes which are more than one-half as long as the dorsal piece; ovipositor black at its base, the remainder yellow, nearly as long as the second abdominal segment, the upper pair of sheaths tapering to their middle, then of nearly an equal width, not crenulate, the apex bluntly rounded; wings pale grayish, costal cell yellowish, auxiliary vein yellow, the others brown, stigma brown, a white spot before its base, a less distinct one beyond its apex and a similar one in base of discal cell, this cell more than twice as long as wide; legs yellow, apices of femora and of tibiæ black, tarsi changing into black at its apex; halteres brown, the bases yellow. Length of male, 14 mm.; of female, 18 mm. Two males and one female.

Habitat.—Metlakahtla, June 4; Sitka, June 16; Yakutat, Alaska, June 21.

Type.—Cat. no. 5205, U. S. National Museum.

***Tipula tenebrosa* sp. nov.**

Same as the above description of *strigata* with these exceptions: Front and occiput destitute of a median black vitta, rostrum brown, the under side yellow, third joint of antennæ wholly black, antennæ of male not reaching beyond base of abdomen, the third joint bearing a

few scattered bristles, seventh antennal joint of female nearly three times as long as broad; thorax bearing many rather short whitish hairs on its dorsum, scutellum wholly black, yellow spots on sides of metanotum small or wanting; abdomen thinly covered with short, pale yellowish hairs, black, the venter, at least basally, and sometimes the hind margins of some of the segments, yellow; ventral portion of eighth abdominal segment bearing many pale yellowish hairs, claspers nearly twice as long as wide, the lower outer angle considerably prolonged beyond the upper one, each clasper bearing near the apex of the inner side a pair of flattened processes, the anterior one nearly oval, the other subconical, its apex furnished with a brown, corneous tooth; upper pair of sheaths of ovipositor tapering for three-fourths of their length; discal cell less than twice as long as wide; femora and tibiæ of female yellow, in the male brown with bases of femora yellow. Length of male, 12 mm.; of female, 15 mm. A specimen of each sex.

Habitat.—Berg Bay, June 10; Muir Inlet, Alaska, June 11.

Type.—Cat. no. 5206, U. S. National Museum.

***Tipula gelida* sp. nov.**

Differs from the description of the male of *strigata* only as follows: Front and occiput destitute of a median black vitta, rostrum black, third joint of antennæ wholly black, antennæ not reaching base of abdomen, the third joint slightly more than twice as long as wide; the three mesonotal vittæ are black, the median one divided in the middle by a gray line; scutellum and metanotum not marked with yellow; abdomen black, opaque, gray pruinose, the hind margins of the segments, except the first, and a lateral vitta, yellow, sparsely covered with very short yellowish hairs; hypopygium small, black, gray pruinose, ventral portion of eighth abdominal segment sparsely yellowish pubescent, claspers nearly orbicular, each bearing near the apex of the inner side an oval, inwardly curving process which is nearly as long as the clasper; dorsal piece of the hypopygium destitute of processes on its hind margin; whitish spots of wings indistinct, discal cell less than twice as long as broad. Length 14 mm. Six male specimens captured June 4.

Habitat.—Metlakahta, Alaska.

Type.—Cat. no. 5207, U. S. National Museum.

***Tipula cineracea* sp. nov.**

Equals the description of *strigata* with these exceptions: Antennal joints four to eleven in the male strongly constricted in the

middle, the seventh about two and one-half times as long as its greatest width; antennæ of female reaching middle of metanotum, slightly tapering to the apex; of the usual three mesonotal vittæ, the outer ones are wholly wanting, the median one is gray, bordered with a pair of black lines and with a third black line midway between them; abdomen sparsely covered with very short yellowish hairs, yellow, marked with a median black vitta which is usually almost obsolete on base of abdomen and in the male is broadly expanded posteriorly, male hypopygium rather small, yellow, ventral portion of the eighth abdominal segment bearing a few short, yellowish hairs; claspers transversely oval, the upper of the two processes near apex of inner side of each is somewhat clavate, slightly longer than the clasper, the other is about twice as long as this one and about four times as broad, with two large grooves on the outer side toward its apex strongly curving upward, the apex dark brown and terminating in a flattened, rather narrow process in front of the base of which is a large brown lobe; dorsal piece of hypopygium destitute of processes; ovipositor yellow, noticeably longer than the second abdominal segment; white spots of wings indistinct, discal cell only slightly longer than broad. Length of male, 11 to 13 mm.; of female, 15 to 19 mm. Seventeen males and six females.

Habitat.—Yakutat, June 21; Kukak Bay, Alaska Peninsula, July 4; Popof Island, July 10; Kadiak, Alaska, July 20.

Type.—Cat. no. 5208, U. S. National Museum.

The U. S. National Museum contains a female specimen of this species collected at Fort Wrangell, Alaska, by Professor H. F. Wickham.

***Tipula spernax* Osten Sacken.**

Tipula spernax OSTEN SACKEN, Bulletin U. S. Geol. Geog. Survey Terr., III, p. 210, 1877.

Metlakahitla, Alaska: A male specimen, collected June 4. This species was originally described from the mountains of California.

***Pachyrrhina vittula* Loew.**

Pachyrrhina vittula LOEW, Berliner Ent. Zeitsch., p. 63, 1864.

Muir Inlet, Alaska: Two male specimens, collected June 12. The original habitat is the vicinity of Hudson Bay, British America.

Proc. Wash. Acad. Sci., November, 1900.

Family XYLOPHAGIDÆ.

Leptis dimidiata Loew.

Leptis dimidiata LOEW, Berliner Ent. Zeitsch., p. 10, 1863.

Juneau, Alaska: Three specimens, collected July 26. This species was originally described from Alaska.

Leptis pruinosa Bigot.

Leptis pruinosa BIGOT, Bulletin Soc. Zool. France, p. 19, 1887.

Popof Island, Alaska: Two specimens, collected July 10. Originally reported from Mount Hood, Oregon.

Symphoromyia pullata Coquillett.

Symphoromyia pullata COQUILLET, Journal New York Ent. Soc., p. 56, 1894.

Sitka, Alaska: A male specimen, captured June 11. This species was originally described from Colorado and New Hampshire.

Spania edeta Walker.

Spania edeta WALKER, List Dipt. Ins. Brit. Museum, III, p. 489, 1849.

Muir Inlet, June 12; Sitka, Alaska, June 16: Four specimens. Originally described from the Albany River, British America. Specimens are in the U. S. National Museum from the White Mountains, New Hampshire.

Family STRATIOMYIIDÆ.

Beris annulifera (Bigot).

Oplacantha annulifera BIGOT, Annales Soc. Ent. France, p. 21, 1887.

Sitka, June 16; Kukak Bay, July 4; Popof Island, Alaska, July 12: Four specimens. The type locality of this species is stated to be Georgia, but this may be erroneous. Specimens are in the U. S. National Museum from New Hampshire and Colorado.

Family TABANIDÆ.

Chrysops nigripes Zetterstedt.

Chrysops nigripes ZETTERSTEDT, Insecta Lapponica Descripta, p. 519, 1840.

Kukak Bay, Alaska: A female specimen, collected July 4. Originally described from Lapland, but Dr. Loew has also reported its occurrence in Alaska.

Tabanus septentrionalis Loew.

Tabanus septentrionalis LOEW, Verh. Zool.-Bot. Gesell. Wien, p. 593, 1858.

Kukak Bay, July 4; Kadiak, Alaska, July 20: Seven specimens.

This species was originally described from Labrador, and Osten Sacken has already reported its occurrence in Alaska.

Tabanus sonomensis Osten Sacken.

Tabanus sonomensis OSTEN SACKEN, Bulletin U. S. Geol. Geog. Survey Terr., III, p. 216, 1877.

Fox Point, Alaska: Three specimens, captured July 28. Originally described from northern California.

Tabanus insuetus Osten Sacken.

Tabanus insuetus OSTEN SACKEN, Bulletin U. S. Geol. Geog. Survey Terr., III, p. 219, 1877.

Virgin Bay, June 26; Juneau, July 26; Fox Point, Alaska, July 28: Three specimens. Also originally described from northern California.

Family THEREVIDÆ.

Thereva melanoneura Loew.

Thereva melanoneura LOEW, Berliner Ent. Zeitsch., p. 250, 1872.

Kukak Bay, Alaska: Ten specimens, taken July 4. Originally described from California.

Family EMPIDIDÆ.

Empis poplitea Loew.

Empis poplitea LOEW, Berliner Ent. Zeitsch., p. 16, 1863.

Sitka, June 16; Yakutat, June 21; Kukak Bay, July 4; Kadiak, Alaska, July 20: Thirty-three specimens. Originally described from Alaska. Specimens are in the U. S. National Museum from Colorado.

Empis clauda sp. nov.

Black, the palpi, proboscis, humeri, lateral margins of metanotum, scutellum, a large spot below insertion of each wing, the halteres, coxæ, and remainder of legs, also base of venter, yellow, apices of tarsi brown; eyes of male separated less than width of lowest ocellus, third joint of antennæ broad at base, tapering rapidly to the apex, about twice as long as the style, proboscis slightly over twice as long as height of head; hairs and bristles of body and legs black; mesonotum opaque, gray pruinose, marked with four, indistinct, brownish vittæ; scutellum bearing four bristles; abdomen slightly polished, hypopygium small, ascending obliquely, the dorsal piece prolonged at each posterior corner in the form of a flattened, almost linear process, central filament unusually robust, arcuate, free except toward its apex; no ventral process in front of the hypopygium; hind femora of male

each bearing a hook-like process on the under side a short distance before the apex, curved backward and covered with short hairs, while beyond it are two, bare, pimple-like swellings; on the inner side of the femora nearer its apex is a fringe of about five rather short spinous bristles; hind tibiae of male each bearing a bare, slightly arcuate process on the outer side near the base, while opposite it, on the inner side, is a low prominence beset with short bristly hairs; legs of female simple, not fringed with scales; wings grayish hyaline, stigma brown, veins brown, normal. Length 5 to 7 mm. Seventeen males and fourteen females.

Habitat.—Yakutat, June 21; Popof Island, July 8 to 12; Kadiak, Alaska, July 20.

Type.—Cat. no. 5209, U. S. National Museum.

***Empis laniventris* Eschscholz.**

Empis laniventris ESCHSCHOLZ, Entomographien, 1, p. 113, 1823.

Popof Island, Alaska: Seventy-eight specimens, collected from July 10 to 15. Originally described from Alaska.

***Empis virgata* Coquillett.**

Empis virgata COQUILLET, Proc. U. S. National Museum, p. 408, 1896.

Sitka, June 16; Yakutat, June 21; Saldovia, Alaska, July 21: Seventy specimens. This species was heretofore known only from Washington.

***Empis pellucida* sp. nov.**

Black, the palpi and horny part of proboscis, except its base, yellow, halteres yellowish white, bases of tibiae sometimes reddish yellow; eyes of male more widely separated than the posterior ocelli; third joint of antennae rather broad, gradually tapering to the apex, about five times as long as the style, proboscis twice as long as height of head; hairs and bristles of body and legs black; mesonotum slightly polished, marked with a median, light gray pruinose vitta, the lateral margins and pleura gray pruinose; scutellum bearing four bristles; abdomen highly polished, hypopygium of male small, almost bare, obliquely ascending, destitute of elongate processes, central filament robust, rapidly tapering toward the apex, arcuate, free except its apex; hind margin of fifth abdominal segment ventrally fringed with spinous bristles, many of which are as long as this segment; legs in both sexes simple, first joint of hind tarsi slightly thicker than that of the front ones, hind femora spinose on the under side; wings hyaline, veins dark brown, normal, stigma brown. Length 6 mm. Three males and two females.

Habitat.—Virgin Bay, Prince William Sound, June 26; Kukak Bay, July 4; Popof Island, Alaska, July 9 and 11.

Type.—Cat. no. 5210, U. S. National Museum.

Closely related to *virgata*, but in that species the spinous bristles on the ventral portion of the fifth abdominal segment in the male are arranged in a round cluster and none of them exceed one-fourth of the length of this segment; both sexes have the mesonotum dark gray pruinose and marked with three distinct, polished black vittæ.

***Empis fumida* sp. nov.**

Differs from the above description of *pellucida* only as follows: Palpi and proboscis black, legs always wholly black, eyes of male less widely separated than width of lowest ocellus, mesonotum highly polished, not distinctly vittate, scutellum bearing six or more bristles, hypopygium of male quite thickly covered with hairs, the central filament hidden except sometimes its apical portion, wings pale brown, more yellowish at base and in costal cell. Length 7 mm. Six males and four females.

Habitat.—Metlakahtla, in June; Virgin Bay, June 26; Kukak Bay, Alaska, July 4.

Type.—Cat. no. 5211, U. S. National Museum.

***Empis infumata* sp. nov.**

Same as *fumida* except that the palpi and horny portion of the proboscis are yellow, central filament of hypopygium of male free except at the apex, no fringe nor cluster of spinous bristles on ventral portion of the fifth or other abdominal segments, hind femora destitute of spinous bristles on the under side, at most with a few weak bristles on the apical fourth. Length 5 mm. One male and three females, collected July 8 to 11.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5212, U. S. National Museum.

***Empis brachysoma* sp. nov.**

Black, the palpi, horny portion of proboscis, stems of halteres, femora, and tibiæ yellow, front and hind femora in both sexes, and hind tibiæ in the male, yellowish brown, coxæ brown basally, changing into yellow at their apices, tarsi and knobs of halteres dark brown, apex of male abdomen marked with yellow; eyes of male contiguous, third joint of antennæ rather broad at base, quite rapidly tapering to the apex, about twice as long as the style, proboscis twice as long as height of head; hairs and bristles of mesonotum black, hairs of pleura and abdomen

white; thorax opaque, gray pruinose, mesonotum marked with four, slightly polished, black vittæ, scutellum bearing from four to six black bristles; abdomen of male polished black in middle of dorsum, the sides opaque, gray pruinose; in the female the dorsum of segments two to four, and all of abdomen beyond the fifth segment is polished black, remainder of abdomen opaque, gray pruinose; hypopygium of male rather small, obliquely ascending, claspers destitute of processes, dorsal piece with a broad emargination in its posterior end almost reaching its center, central filament hidden, venter destitute of processes and of spinous bristles; legs of male simple, femora destitute of bristles and long hairs, first joint of hind tarsi noticeably thicker than that of the front ones; legs of female ciliate with nearly erect scales on both sides of the hind femora and tibiæ, middle femora and apical half of upper side of the front femora; wings unusually long and narrow, grayish hyaline, stigma and veins, except at base of wing, dark brown, venation normal. Length 7 mm. A specimen of each sex, collected July 21.

Habitat.—Saldovia, Kenai Peninsula, Alaska.

Type.—Cat. no. 5213, U. S. National Museum.

***Empis triangula* sp. nov.**

Black, the halteres and legs dark brown, knees yellow, this color rarely extending over the greater portion of the femora and sometimes of the tibia, venter of abdomen of female largely yellow; eyes of male contiguous, third joint of antennæ nearly linear, at least five times as long as broad, the style scarcely perceptible; proboscis from one and a-half to twice as long as height of head; hairs and bristles of thorax and scutellum black; thorax somewhat polished, very thinly gray pruinose, not distinctly vittate, scutellum bearing ten marginal bristles; abdomen slightly polished, hypopygium of male rather large, obliquely ascending, the lower piece bearing a cluster of rather long, black bristles at its apex, filament hidden, venter of abdomen destitute of processes and of spinous bristles; legs simple, slender, almost bare; wings hyaline, veins and stigma brown, second submarginal cell somewhat triangular, pointed at its base, about one and one-half times as long as broad, discal cell subequal in length to last section of fourth vein, last section of fifth vein half as long as the preceding section. Length 2 to 3.5 mm. Eight males and eighteen females.

Habitat.—Lowe Inlet, British Columbia, June 3; Farragut Bay, June 8; Sitka, June 16; Yakutat, Alaska, June 21.

Type.—Cat. no. 5214, U. S. National Museum.

***Empis conjuncta* sp. nov.**

Differs from the above description of *triangula* only as follows: Legs and venter of abdomen dark brown, proboscis shorter than height of head, hypopygium of male wholly and sparsely covered with bristly hairs, destitute of a cluster of these hairs, the dorsal piece bearing a pair of long, subcylindrical, fleshy processes, which are covered with short hairs, filament free. Length 2.5 mm. One male and two females.

Habitat.—Sitka, June 16; Orca, Alaska, June 27.

Type.—Cat. no. 5215, U. S. National Museum.

Classified by its short proboscis, this species would be placed in the genus *Hilara*; but its elongated third antennal joint with the minute style, the contiguous eyes of the male and the slender first joint of his front tarsi, indicate a nearer relationship with the typical species of the genus *Empis*.

***Hilara aurata* sp. nov.**

Black, the first two antennal joints and the legs dark brown, the knees and halteres yellow; upper part of occiput and sides of front velvet black, middle of front below the lowest ocellus, face, cheeks, and lower part of occiput gray pruinose; eyes of male almost as widely separated as the posterior ocelli, third joint of antennæ conical, slightly longer than broad, subequal in length to the style, proboscis as long as height of head, hairs of palpi and under side of head whitish, those of occiput yellowish brown; thorax slightly polished, marked with three indistinct black vittæ, almost bare, in the middle, behind the suture, with a golden yellow pubescence, no hairs in front of the halteres, scutellum bearing four bristles and a few short hairs; abdomen slightly polished, its hairs yellow, hypopygium of male small, nearly bare; legs destitute of long bristly hairs, first joint of front tarsi of male greatly swollen; wings hyaline, veins yellow, stigma pale yellowish, venation normal. Length 4 mm. A female specimen, collected July 4. The U. S. National Museum contains a male specimen collected at Eastport, Maine, July 1, 1870, by Mr. Edward Burgess.

Habitat.—Kukak Bay, Alaska; Eastport, Maine.

Type.—Cat. no. 5216, U. S. National Museum.

***Hilara transfuga* Walker.**

Hilara transfuga WALKER, List Dipt. Ins. Brit. Museum, III, p. 491, 1849.

Berg Bay, June 10; Popof Island, Alaska, July 6 to 10: Ten specimens. Originally described from Albany River, British America.

Hilara quadrivittata Meigen.

Hilara quadrivittata MEIGEN, Syst. Besch. Eur. Zweif. Ins., III, p. 7, 1822.—SCHINER, Fauna Austriaca, Diptera, I, p. 115.

Kukak Bay, July 4; Popof Island, July 8 to 10; Kadiak, Alaska, July 20: Twenty-eight specimens. This European species has not heretofore been reported from this Continent. The specimens agree perfectly with the descriptions above indicated.

Gloma obscura Loew.

Gloma obscura LOEW, Berliner Ent. Zeitsch., p. 84, 1864.

Yakutat, June 21; Virgin Bay, Alaska, June 26: Two specimens. Originally described from the White Mountains, New Hampshire.

Gloma scopifera sp. nov.

Black, a humeral dot, the halteres, second and third segments of abdomen, except middle of dorsum, under side of the fourth segment and the legs, yellow, the greater portion of the coxæ, middle of femora, apices of tibiæ, last two joints of front and middle tarsi, and whole of hind tarsi, except bases of first two joints, brown; all hairs and bristles black; third joint of antennæ slightly longer than wide, less than half as long as the style; thorax somewhat opaque, thinly gray pruinose; abdomen slightly polished; front tibiæ at apices bearing a dense cluster of rather long bristly hairs, last two joints of front tarsi greatly dilated and fringed along the sides with short bristly hairs, middle femora beyond the middle of the under side bearing a cluster of about three long bristles, middle tibiæ swollen at middle of inner side, the swelling densely covered with short, bristly hairs; wings grayish hyaline, veins and stigma brown. Length 6 mm. Three male specimens, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5217, U. S. National Museum.

Cyrtoma pilipes Loew.

Cyrtoma pilipes LOEW, Berliner Ent. Zeitsch., p. 207, 1862.

Kukak Bay, July 4; Popof Island, Alaska, July 8 to 13: Twenty-five specimens. Originally described from Illinois.

Microphorus atratus sp. nov.

Black, including the hairs; eyes of male contiguous, third joint of antennæ orbicular on its basal half, the remainder narrowed into a styliform process, style one and one-half times as long as the third antennal joint, proboscis less than half as long as height of head, body opaque, not pruinose, the hairs rather long, on the mesonotum abun-

dant, on the abdomen sparse, scutellum bearing four bristles; under side of front and middle femora, both sides of the hind ones and outer side of the hind tibiæ ciliate their entire length with rather long hairs, first joint of hind tarsi noticeably thicker than that of either of the other tarsi, much narrower than the hind tibiæ; wings hyaline, veins and stigma brown, venation normal, last section of fifth vein two-thirds as long as the preceding section, sixth vein obsolete beyond end of anal cell. Length 2 mm. A male specimen, collected July 20.

Habitat.—Kadiak, Alaska.

Type.—Cat. no. 5218, U. S. National Museum.

***Microphorus flavipilosus* sp. nov.**

Black, the hairs, stems of halteres, femora and tibiæ, yellow, knobs of halteres and the tarsi brown; eyes of male contiguous, third joint of antennæ sublanceolate, only slightly tapering to the apex, over four times as long as the style, proboscis noticeably shorter than height of head, mesonotum highly polished, scutellum bearing about ten marginal bristles, abdomen slightly polished, hairs of legs sparse and rather short, first joint of hind tarsi slightly thicker than that of any of the other tarsi; wings hyaline, stigma smoky brown, veins yellowish brown, last section of fifth vein one-fourth as long as the preceding section, sixth vein reaching almost to the wing margin; length 2 mm. Two male specimens, collected June 3.

Habitat.—Lowe Inlet, British Columbia.

Type.—Cat. no. 5219, U. S. National Museum.

***Microphorus crocatus* sp. nov.**

Yellow, the head and its members, a median vitta on mesonotum, dorsum of abdomen, and apices of tarsi dark brown, third joint of antennæ sublanceolate, only slightly tapering to the apex, about twice as long as wide, five times as long as the style; proboscis about as long as height of head; hairs of body sparse and rather short, yellow; mesonotum polished, scutellum bearing about eight bristles, abdomen polished; hairs of legs very short, first joint of hind tarsi slightly thicker than that of any of the other tarsi; wings hyaline, veins yellowish brown, stigma almost obsolete, last section of fifth vein nearly half as long as the preceding section, sixth vein ending a short distance from the wing margin. Length 2 mm. A female specimen, collected June 26.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5220, U. S. National Museum.

Rhamphomyia flavirostris Walker.

Rhamphomyia flavirostris WALKER, List Dipt. Ins. Brit. Mus., III, p. 501, 1849.

Muir Inlet, June 12; Popof Island, Alaska, July 10 and 12: Three specimens. Originally described from Albany River, British America.

Rhamphomyia corvina Loew.

Rhamphomyia corvina LOEW, Berliner Ent. Zeitsch., p. 28, 1861.

Lowe Inlet, British Columbia, June 3; Kukak Bay, July 4; Juneau, Alaska, July 26: Three specimens. Originally described from New York. The U. S. National Museum contains specimens collected in Pennsylvania, District of Columbia, and North Carolina.

Rhamphomyia minytus Walker.

Rhamphomyia minytus WALKER, List Dipt. Ins. Brit. Mus., III, p. 502, 1849.

Berg Bay, June 10; Muir Inlet, June 11; Virgin Bay, Alaska, June 26: Six specimens. Originally described from Albany River, British America.

Rhamphomyia irregularis Loew.

Rhamphomyia irregularis LOEW, Berliner Ent. Zeitsch., p. 81, 1864.

Kukak Bay, Alaska: A female specimen, taken July 4. Originally described from New Hampshire. The U. S. National Museum also contains specimens of both sexes collected in Colorado.

Rhamphomyia limbata Loew.

Rhamphomyia limbata LOEW, Berliner Ent. Zeitsch., p. 32, 1861.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Saldovia, Alaska, July 21: Eight female specimens. Originally reported from the District of Columbia. Specimens are contained in the U. S. National Museum collection from Illinois and Colorado.

Rhamphomyia villipes sp. nov.

Black, the halteres, hypopygium, femora, tibiæ and tarsi yellow, apices of first four tarsal joints, and whole of the fifth, brown, coxæ brown and yellow; eyes of male contiguous, third joint of antennæ about four times as long as wide, two and one-half times as long as the style, proboscis twice as long as height of head; hairs of entire insect black; thorax opaque, gray pruinose, two indistinct brown subdorsal vittæ, hairs abundant and rather long, scutellum bearing four bristles; abdomen opaque, densely whitish pruinose, thickly clothed with rather

long hairs, hypopygium rather small, ascending, the claspers subhemispherical, thinly covered on the outer surface with rather long hairs, on the posterior portion bearing an oval, hairy process, near the middle of the inner side with a short, black, subcylindrical, hairy process, and at the apex bearing a long hairy process nearly as long as the clasper, of the shape of a half cylinder, the processes of the two claspers pressed together and having a circular opening near the apex of the upper side; filament appressed to the body of the hypopygium; front and hind sides of the front and middle tibiae and under side of the middle femora densely covered with rather long hairs, legs elsewhere more sparsely covered with similar hairs, middle femora distinctly arcuate; wings whitish hyaline, stigma pale brown, veins normal, yellow and brown, last section of fifth vein one and one-half times as long as the preceding section, sixth vein reaches the wing margin but is colorless from apex of anal cell two-thirds of distance to the wing margin. Length 10 mm. A male specimen, collected July 9.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5221, U. S. National Museum.

Closely related to *quinquelineata*, but readily distinguished by the unusually hairy legs and processes on the hypopygium.

Rhamphomyia disparilis sp. nov.

Male: Black, the halteres yellowish; hairs of upper part of head, antennae, mesonotum, scutellum, several on the tibiae and many on the tarsi, black, remaining hairs yellowish; eyes separated more widely than the posterior ocelli, third joint of antenna slightly over twice as long as wide, three times as long as the style, proboscis slightly longer than height of head; mesonotum slightly polished, not distinctly vittate, its hairs short and sparse, scutellum bearing four bristles; abdomen polished, its hairs long and sparse, hypopygium very large, porrect, lower outer angle of each clasper prolonged into a narrow, subconical process about as long as the basal portion, hypopygium bearing many very long bristly hairs, filament thread-like, the exposed portion fully seven times as long as the first joint of the hind tarsi, the latter and the second joint bearing many long hairs on their upper side, first joint of front tarsi as thick as the tibiae, much thicker than that of any of the other tarsi, middle tibiae on the outer side ciliate with a row of long bristly hairs; wings hyaline, veins and stigma brown, venation normal, last section of fifth vein nearly twice as long as the preceding section, sixth vein obliterated before reaching the wing margin. Length 3 to 4.5 mm.

Female: Differs from the male as follows: Anterior half of mesonotum opaque, gray pruinose, marked with four polished black vittæ, the remainder of thorax, scutellum, and first five segments of abdomen, densely silvery white pruinose, hairs of abdomen rather short, hind tarsi and middle tibiæ destitute of long, bristly hairs, first joint of front tarsi narrower than the tibiæ, not so thick as that of the hind tarsi; discal cell prolonged almost to the wing margin, fourth vein not prolonged beyond its apex, no vein between second and third posterior cells, last section of fifth vein about one-sixth as long as the preceding section. Length 4 to 5 mm.

Five males and six females.

Habitat.—Yakutat, June 21; Virgin Bay, Alaska, June 26.

Type.—Cat. no. 5222, U. S. National Museum.

Closely related to *limbata* and *irregularis*, but in those species the lower outer angle of the male claspers is rounded, and the fourth vein in both sexes is prolonged to the wing margin.

Rhamphomyia glauca sp. nov.

Black, the halteres light yellow, hairs and bristles black; eyes of male contiguous, third joint of antennæ slightly over twice as long as wide, about four times as long as the style, proboscis about as long as height of head; body opaque, bluish gray pruinose, hairs sparse and rather short, scutellum bearing four bristles, hypopygium rather small, obliquely ascending, bearing several long bristly hairs, claspers elongate conical, filament thread-like, the exposed portion about five times as long as first joint of hind tarsi, the latter much thicker than that of any of the other tarsi, much narrower than the tibiæ, hind tibiæ of male outwardly bearing several rather long bristly hairs, in the female ciliate with nearly erect scales, wings hyaline, stigma pale yellowish, veins yellowish brown, normal, last section of fifth vein over twice as long as the preceding section, sixth vein reaches the wing margin. Length 3 to 4 mm. A specimen of each sex.

Habitat.—Metlakahtla, June 4; Berg Bay, Alaska, June 10.

Type.—Cat. no. 5223, U. S. National Museum.

Near *priapul*, but in that species the sixth vein is obliterated before reaching the wing margin and the hind tibiæ of the female are not ciliate with scales.

Rhamphomyia cineracea sp. nov.

Differs from the above description of *glauca* only as follows: Mesonotum slightly polished, thinly dark gray pruinose, hairs of male hypopygium sparse and rather short, the claspers suboval, near apex of

under side bearing a dense cluster of rather short hairs, filament quite slender, the exposed portion only slightly longer than the first joint of the hind tarsi, hind tibiæ of male outwardly bearing a few rather short bristles, in the female not ciliate with scales, last section of fifth vein sometimes less than twice as long as the preceding section. Length about 3 mm. Two males and five females.

Habitat.—Sitka, June 16; Kukak Bay, July 4; Popof Island, July 8 to 10; Juneau, Alaska, July 26.

Type.—Cat. no. 5224, U. S. National Museum.

More nearly related to *glauca* than to any of our other species.

Rhamphomyia limata sp. nov.

Differs from *glauca* as follow: Mesonotum marked with four polished vittæ which sometimes almost meet each other; segments three to five of abdomen, and sides of the second, polished, the narrow hind margins of these segments whitish, hairs on sides of abdomen rather abundant and long, claspers of male hypopygium somewhat oval, at the apex bearing a dense cluster of rather long hairs, filament robust, the exposed portion less than half as long as the first joint of the hind tarsi, hind tibiæ of female not ciliate with scales, wings tinged with yellow, especially in the costal cell, stigma dark brown. Length 5 to 6 mm. One male and three females, collected June 8 and 9.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5225, U. S. National Museum.

Near *fimbriata*, but in that species the mesonotum is marked with only three polished vittæ, and the middle and hind femora of the female are ciliate on the under side with nearly erect scales.

Rhamphomyia barypoda sp. nov.

Differs from *glauca* as follows: Mesonotum slightly polished, thinly olive gray pruinose and marked with three indistinct black vittæ; scutellum and abdomen polished, lower and posterior edges of male claspers thickly beset with rather long hairs, claspers nearly transversely trapezoidal, filament rather robust, sinuate, the exposed portion only slightly longer than the first joint of the hind tarsi, the latter as thick as the tibiæ, middle and hind femora and tibiæ of female ciliate both sides with nearly erect scales; wings grayish hyaline, tinged with pale yellowish at the bases, stigma dark brown, last section of fifth vein about one and one-half times as long as the preceding section. Length 4 to 5 mm. Four males and six females.

Habitat.—Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kadiak, Alaska, July 20.

Type.—Cat. no. 5226, U. S. National Museum.

Near *flexuosa*, but in that species the mesonotum is nearly opaque, not black vittate; the legs and abdomen are dark brown, and the legs of the female are not ciliate with scales.

Rhamphomyia albopilosa sp. nov.

Black, the knobs of the halteres yellow, hairs white, many of those on the mesonotum, the ten marginal ones on the scutellum, those on the antennæ, palpi, upper part of occiput, vertex, tibiæ, and tarsi, black; hairs on mesonotum and sides of abdomen abundant and rather long; eyes of male contiguous, third joint of antennæ two and one-half times as long as broad, slightly over twice as long as the style; proboscis slightly longer than height of head; mesonotum slightly polished, the sides, front end and pleura opaque, gray pruinose; scutellum and abdomen polished, venter opaque, gray pruinose, hind margin of sixth ventral segment densely fringed with rather short yellowish bristles, the following ventral segment bearing a pair of blunt-pointed, elongate, conical processes; hypopygium small, ascending, thinly pilose, claspers somewhat elongate oval, pointed at the apex, filament robust, usually free, the exposed portion somewhat shorter than the first joint of the hind tarsi, the latter thicker than that of any of the other tarsi, as thick as the tibiæ, the first joint of the front and hind tarsi bearing many long hairs on the upper side; wings hyaline, veins and stigma dark brown, last section of fifth vein over twice as long as the preceding section, sixth vein prolonged to the wing margin. Length 5 mm. Two males, collected June 10.

Habitat.—Berg Bay, Alaska.

Type.—Cat. no. 5227, U. S. National Museum.

Near *gilvipilosa*, but in that species the mesonotum is opaque, the abdomen nearly so, the scutellum bears only two bristles, and the venter of the abdomen is destitute of a fringe and pair of subconical processes.

Rhamphomyia adversa sp. nov.

Black, the halteres and bases of femora yellow, hairs and bristles black; third joint of antennæ four times as long as broad, about five times as long as the style, proboscis slightly longer than height of head; thorax opaque, gray pruinose, mesonotum marked with three black vittæ, scutellum bearing six bristles, abdomen slightly polished, almost bare, legs slender, nearly bare, first joint of hind tarsi much thicker than that of any of the other tarsi; wings very broad, black, the base about to apex of basal cells hyaline, venation normal, last section of fifth vein almost twice as long as the preceding section,

sixth vein prolonged to the wing margin. Length 3 mm. Ten female specimens.

Habitat.—Sitka, June 16; Yakutat, June 21; Orca, Alaska, June 27.

Type.—Cat. no. 5228, U. S. National Museum.

Closely related to *angustipennis*, but in that species the third joint of the antennæ is only about twice as long as wide and twice as long as the style, and the median vitta on the mesonotum is light gray, instead of black.

Rhamphomyia cinefacta sp. nov.

Black, including the hairs; eyes of male contiguous, third joint of antennæ about three times as long as wide, four times as long as the style, proboscis about twice as long as height of head; body opaque, gray pruinose, mesonotum not black vittate, its hairs and those of abdomen of female short and sparse, on abdomen of male abundant and rather long, scutellum bearing from four to six bristles, hypopygium rather small, ascending, claspers suboval, apex of dorsal piece bearing three or four very short spinous processes, filament rather robust toward the base, gradually tapering to the apex, the exposed portion slightly shorter than the first joint of the hind tarsi, the latter noticeably thicker than that of any of the other tarsi; hind tibiæ of male bearing several rather long hairs on the outer and inner sides; wings of male hyaline, stigma and veins dark brown, in the female wholly pale brown, stigma slightly darker, in both sexes venation normal, last section of fifth vein almost twice as long as the preceding section, sixth vein obliterated before reaching the wing margin. Length 2.5 to 4 mm. Two males and one female, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5229, U. S. National Museum.

Near *setosa*, but in that species the sixth vein is prolonged to the wing margin, and the dorsal piece of the male hypopygium is destitute of spinous processes at its apex.

Rhamphomyia setosa Coquillett.

Rhamphomyia setosa COQUILLET, Proc. U. S. Nat. Museum, p. 426, 1896.

Berg Bay, June 10; Yakutat, June 21; Popof Island, July 8 and 10; Saldovia, July 21; Juneau, Alaska, July 26: Nine specimens of both sexes. This species was originally described from the White Mountains, New Hampshire. In the original description, two errors occur, due to imperfect or abnormal specimens which served for the

type and co-types; the middle lamellæ, or claspers, do not bear a process before their tips, the appearance in the type specimen being due to a matting of the bristly hairs at this point, and the enlarged base of the filament is present in most if not in all of the species, but in normal specimens is concealed from view.

Rhamphomyia anthracodes sp. nov.

Black, the hairs of the male abdomen, except dorsally, light yellow; eyes of the male separated almost as widely as the posterior ocelli, third joint of antennæ slightly over twice as long as wide, three times as long as the style, proboscis slightly longer than height of head, body polished, mesonotum not distinctly vittate, its hairs sparse and rather short, scutellum bearing from four to six hairs, abdomen of male bearing many long hairs along the sides, hypopygium very large, ascending, claspers inverted subtriangular, the base truncate, the apex convex, the posterior margin rather densely fringed with long, yellowish, bristly hairs, emargination at apex of dorsal piece not reaching half way to its center, filament thread-like, the exposed portion about one and one-half times as long as the first joint of the hind tarsi, a rather strong curvature a short distance from the base; legs robust, hind tibiæ of male fringed with long hairs on the outer and inner sides, first joint of hind tarsi subequal in thickness to that of the front ones, its upper edge fringed with rather long hairs, in the female the middle and hind femora and their tibiæ are fringed on both sides with nearly erect scales; wings of male hyaline, of female pale brown, more yellowish brown at the base, in both the veins and stigma dark brown, venation normal, sixth vein obliterated before reaching the wing margin. Length 4 to 5 mm. Two males and one female.

Habitat.—Metlakahla, June 4; Sitka, Alaska, June 16.

Type.—Cat. no. 5230, U. S. National Museum.

Rhamphomyia atrata sp. nov.

Black, including the hairs; eyes of male contiguous, third joint of antennæ slightly over three times as long as broad, about three times as long as the style, proboscis twice as long as height of head, body opaque, mesonotum not vittate, its hairs quite abundant and long, scutellum bearing six bristles, hairs on sides of abdomen quite numerous and rather long, hypopygium small, obliquely ascending, claspers of nearly uniform width, the outer lower corner considerably prolonged, dorsal piece cleft from apex to beyond the center, filament rather robust, the exposed portion nearly straight, slightly less than half as long as the first joint of the hind tarsi, the latter about twice as thick

as that of any of the other tarsi; hairs on outer side of hind tibiæ sparse and rather short, the inner side only pubescent; wings grayish hyaline, veins and stigma dark brown, last section of fifth vein over three times as long as the preceding section, sixth vein prolonged to the wing margin. Length 3 mm. A male specimen, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5231, U. S. National Museum.

Rhamphomyia macrura sp. nov.

Black, the hairs also black, stems of halteres yellow, the knobs brown; eyes of male contiguous, third joint of antennæ four times as long as wide, six times as long as the style, proboscis slightly longer than height of head; thorax opaque, gray pruinose, mesonotum marked with three slightly polished, black vittæ, its hairs sparse and rather long, scutellum bearing six bristles, abdomen slightly polished, thinly gray pruinose, rather thickly covered with long hairs, hypopygium unusually long, ascending, claspers subtriangular, very sparsely covered with long hairs, at the apex bearing an elongate ovate process, like a second joint, more than one-third as long as the basal part and densely beset with long hairs on the lower side and apex, filament bristle-like, the exposed portion over five times as long as the first joint of the hind tarsi; hairs of hind tibiæ sparse and rather short, first joint of front tarsi sublanceolate, thicker than the tibiæ and nearly twice as thick as that of the hind tarsi; wings grayish, pale smoky in the costal cell, stigma and veins dark brown, last section of fifth vein one and one-half times as long as the preceding section, sixth vein prolonged to the wing margin. Length 4 to 5 mm. Ten males.

Habitat.—Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Orca, Alaska, June 27.

Type.—Cat. no. 5232, U. S. National Museum.

Near *clavigera*, but in that species the first joint of the front tarsi is not thickened.

Ocydromia glabricula (Fallen).

Empis glabricula FALLEN, Diptera Sueciæ, Empidæ, p. 33, 1816.

Sitka, Alaska: A single specimen, taken June 16. This European species was reported as occurring in this country twenty-two years ago. The U. S. National Museum contains a specimen collected in Colorado.

Platypalpus lateralis Loew.

Platypalpus lateralis LOEW, Berliner Ent. Zeitsch., p. 89, 1864.

Muir Inlet, June 12; Sitka, June 16; Yakutat, June 21; Popof
Proc. Wash. Acad. Sci., November, 1900.

Island, Alaska, July 8 to 12: Twenty-three specimens. The type locality of this species is the White Mountains, New Hampshire.

Platypalpus flavirostris Loew.

Platypalpus flavirostris LOEW, Berliner Ent. Zeitsch., p. 90, 1864.

Popof Island, Alaska: Five specimens, collected July 8 to 11. The type locality of this species is also the White Mountains, New Hampshire. Some of the specimens have the head yellow, as in *P. tersus* Coq., from which they may readily be distinguished by the broad front; in both sexes the front at its narrowest part is about one-third as wide as the distance from the lowest ocellus to the insertion of the antennæ, greatly widening upwardly, whereas, in *tersus* the front only slightly widens upwardly, and at its narrowest point is only about one-eighth as wide as the distance from the lowest ocellus to the antennæ.

Platypalpus diversipes sp. nov.

Black, the palpi and halteres whitish, legs yellow, bases of coxæ, upper side of front femora, broad apices of other femora, of the tibiæ and whole of tarsi, except base of the first joint, black; head polished, the face opaque, whitish pruinose, third joint of antennæ only slightly longer than broad, body polished, pleura opaque, thinly gray pruinose; front femora considerably thickened, about two-thirds as thick as the middle ones; wings hyaline, veins yellowish brown, first and second basal cells subequal in length. Length 1.5 mm. Three males and twelve females, collected July 8 to 13.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5233, U. S. National Museum.

Platypalpus gilvipes sp. nov.

Black, the first two joints of antennæ, palpi, halteres and legs, including the coxæ, yellow, last joint of tarsi brown; third joint of antennæ about twice as long as wide, head polished, the face opaque, white pruinose, body polished, the front end of pleura to posterior side of front coxæ, also the lateral margins of metanotum, encroaching slightly on the pleura, opaque, gray pruinose; front femora noticeably thickened, about two-thirds as thick as the middle ones; wings hyaline, veins brown, first and second basal cells subequal in length. Length 2 to nearly 3 mm. Four males and five females, collected July 8 to 12.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5234, U. S. National Museum.

Closely related to *lateralis*, but in that species the entire pleura, ex-

cept a spot above the middle coxæ, is opaque, gray pruinose, and the entire antennæ are brown or black.

Phoneutisca bimaculata Loew.

Phoneutisca bimaculata LOEW, Berliner Ent. Zeitsch., p. 19, 1863.

Muir Inlet, Alaska: Seven specimens, taken June 12. Originally described from Alaska.

Sciodromia bicolor (Loew).

Synamphoteria bicolor LOEW, Berliner Ent. Zeitsch., p. 18, 1863.

Popof Island, Alaska: Two specimens, collected July 8 and 12. Originally described from Alaska.

Mantipeza valida (Loew).

Hemerodromia valida LOEW, Berliner Ent. Zeitsch., p. 208, 1862.

Popof Island, Alaska: A single specimen, captured July 9. This species was originally described from the region about Hudson Bay, British America.

Family DOLICHOPODIDÆ.

Dolichopus discifer Stannius.

Dolichopus discifer STANNIUS, Isis, p. 57, 1831.—SCHINER, Fauna Austriaca, Dipt., I, p. 216, 1862.—LOEW, Monographs Dipt. N. Am., II, p. 71, 1864.

Dolichopus tanypus LOEW, Neue Beitr. Kennt. Dipt., VIII, p. 24, 1861.

Kukak Bay, July 4; Popof Island, July 8 to 11; Kadiak, July 21; Juneau, Alaska, July 26: Twenty-seven specimens. This European species was reported by Dr. Loew to occur in New Hampshire, the southern part of British America and in Alaska about twenty-six years ago, and Osten Sacken has also recorded it from New York.

Dolichopus plumipes (Scopoli).

Musca plumipes SCOPOLI, Entomol. Carn, p. 334, 1763.

Dolichopus plumipes SCHINER, Fauna Austriaca, Dipt., I, p. 217, 1862.—LOEW, Monog. N. Am. Dipt., II, p. 60, 1864.

Dolichopus pennitarsis FALLEN, Diptera Sueciæ, Dolichopidæ, p. 11, 1823.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 23; Kukak Bay, July 4; Popof Island, July 8 to 10; Kadiak, July 20; Saldovia, Alaska, July 21: Forty specimens. Also a European species, reported by Dr. Loew as occurring in Alaska about twenty-six years ago. It has also been recorded from Canada, South Dakota, and Colorado.

Dolichopus xanthocnemus Loew.

Dolichopus xanthocnemus LOEW, Monog. N. Am. Dipt., II, p. 31, 1864.

Kukak Bay, July 4; Popof Island, July 8 to 12; Kadiak, July 20; Saldovia, Alaska, July 21: Forty-four specimens. Originally described from Alaska.

Dolichopus stenhammari Zetterstedt.

Dolichopus stenhammari ZETTERSTEDT, Diptera Scand., II, p. 521, 1843.

Muir Inlet, June 12; Sitka, June 16; Virgin Bay, June 26; Kukak Bay, Alaska, July 4: Eleven specimens. This European species has been reported from Labrador by Osten Sacken.

Dolichopus festinans Zetterstedt.

Dolichopus festinans ZETTERSTEDT, Diptera Scand., II, p. 507, 1843.

Kukak Bay, July 3; Popof Island, Alaska, July 8 and 9: Four specimens of both sexes. This European species has not heretofore been reported as occurring on this Continent.

Dolichopus barycnemus sp. nov.

Front brassy green, face yellowish gray pruinose, antennæ black, the lower side of the first joint reddish yellow, the third joint ovate, palpi yellow, bristles of sides of occiput yellowish white; body bluish green, tinged in places with brassy, lamellæ of hypopygium white, bordered with black, remainder of hypopygium black; front coxæ yellow, a black, gray pruinose spot at base of outer side, middle and hind coxæ black, gray pruinose, their apices yellow; femora yellow, apices of hind ones black, and with a bristle on the outer side before the tip, front and middle femora bare on the under side, the hind ones ciliate with rather long, black hairs on the median third; front and middle tibiæ yellow, the hind ones, except their extreme bases, black and greatly swollen, more than twice as thick as either of the other tibiæ, all tibiæ bearing many bristles; front tarsi yellow on the first three joints, the remainder black and somewhat compressed, fourth joint slightly dilated, the fifth still more so but less than twice as broad as the third; middle tarsi black, the first joint, except the apex, yellow, about as long as the remaining joints taken together; hind tarsi black, much more robust than the others; halteres yellow, bristles of calypteres black; wings grayish hyaline, smoky brown in front of the third vein, an elongated thickening of the costa at apex of first vein, fourth vein not broken; length 6 mm. A male specimen, collected July 11.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5235, U. S. National Museum.

Closely related to the European *D. atritibialis* Zetterstedt, but the latter is credited with having the antennæ yellow, the apex and upper side of the third joint black, the face silvery white pruinose and the hind femora bare on the under side.

***Dolichopus varipes* sp. nov.**

Differs from the above description of *barycnemus* only as follows: Lower half of first two joints of antennæ yellow, fore coxæ wholly yellow, hind femora wholly black, only pubescent on the under side, middle femora each with a black spot on the median third of the under side, hind tibiæ only slightly swollen, yellow, the apical sixth (less on the outer side) brownish black, last two joints of front tarsi not compressed nor dilated, first joint of middle tarsi shorter than the three succeeding joints taken together, the first three joints slender, yellow, the two others black, compressed and fringed with bristles on the upper side, the fourth joint twice as wide as the third, slightly wider and one-third longer than the fifth; wings wholly hyaline, costa not thickened at apex of first vein; female as in the male except that the middle tarsi are like the front ones. Length about 5 mm. A specimen of each sex, collected July 8 and 10.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5236, U. S. National Museum.

Differs in the coloring of the femora from any other species known to me.

***Dolichopus longimanus* Loew.**

Dolichopus longimanus LOEW, Neue Beitr. Kennt. Dipt., VIII, p. 14, 1861.

Monog. Dipt. N. Am., II, p. 38, 1864.

Metlakahtla, in June; Kukak Bay, July 4; Kadiak, Alaska, July 20: Twenty-seven specimens. Originally described from English River, British America; it has also been reported from New York, New Hampshire, and South Dakota.

***Dolichopus plumitarsis* Fallen.**

Dolichopus plumitarsis FALLEN, Diptera Sueciæ, Dolich., p. 10, 1823.—

SCHINER, Fauna Austriaca, Dipt., I, p. 216, 1862.—ZETTERSTEDT, Dipt. Scand., II, p. 556, 1843.

Kukak Bay, July 4; Popof Island, Alaska, July 10: Three male specimens. A European species, not heretofore reported from this Continent.

***Dolichopus lobatus* Loew.**

Dolichopus lobatus LOEW, Neue Beitr. Kennt. Dipt., VIII, p. 24, 1861. Monog.

Dipt. N. Am., II, p. 72, 1864.

Kukak Bay, Alaska: A specimen of each sex, taken July 4. Originally described from English River, British America, and also reported from South Dakota, Illinois, and Michigan.

Porphyrops consobrinus Zetterstedt.

Porphyrops consobrinus ZETTERSTEDT, Dipt. Scand., II, p. 471, 1843; VIII, p. 3061, 1849.

Yakutat, June 21; Kukak Bay, Alaska, July 4: A specimen of each sex. This is a European species, not heretofore reported as occurring on this Continent.

Sympycnus cuprinus Wheeler.

Sympycnus cuprinus WHEELER, Proc. Cal. Acad. Sciences, p. 50, 1899.

Popof Island, July 10 to 12; Juneau, Alaska, July 25 and 26: Seven specimens. Originally described from the vicinity of Monterey, Calif.

Hydrophorus glaber (Walker).

Medeterus glaber WALKER, List Dipt. Ins. Brit. Museum, III, p. 655, 1849.

Metlakahtla, Alaska: A single specimen, collected June 4. Originally described from Albany River, British America.

Family SYRPHIDÆ.

Pipiza pisticoides Williston.

Pipiza pisticoides WILLISTON, Synopsis N. Am. Syrphidæ, p. 29, 1886.

Fox Point, Alaska: Three specimens, collected July 28. Originally described from New Hampshire; the U. S. National Museum also contains specimens from Maine, New York, and Colorado.

Chilosia occidentalis Williston.

Chilosia occidentalis WILLISTON, Proc. Am. Phil. Soc., p. 305, 1882. Synopsis N. Am. Syrphidæ, p. 41, 1886.

Virgin Bay, June 25; Popof Island, Alaska, July 10 and 12: Three specimens. Originally described from California; there is also a specimen in the U. S. National Museum from Colorado.

Chilosia borealis sp. nov.

Male: Head black; frontal triangle sulcate in middle, its hairs black, those of the vertex mixed yellow and black; face polished, the upper margin and narrow border to the eyes gray pruinose, hairs along the eyes short, sparse, whitish, median portion of face bare, central tubercle prominent, a deep, concave space below it, the oral margin protruding,

face only slightly produced downward; first two joints of antennæ black, the third dark brown, orbicular, as wide as long, the arista black, almost bare; eyes densely covered with rather long yellowish or black hairs; body greenish black, polished, the hairs mixed yellow and black, on front part of mesonotum and sides of abdomen chiefly yellow, scutellum bearing several marginal black, bristly hairs, second and third segments of abdomen, except the sides and front angles, of a purer black color, venter polished, its hairs yellow; legs black, extreme apices of the femora, broad bases and narrower apices of the tibiæ yellow; halteres yellow, center of the knobs brown; wings grayish hyaline, sometimes tinged with yellow on the costo-basal half, the veins brown, stigma pale yellowish.

Female: Differs from the male as follows: Hairs of front and of body almost wholly yellow, front not sulcate, abdomen destitute of purer black portions, halteres wholly light yellow. Length 5 to 7 mm. Four males and seventeen females.

Habitat.—Yakutat, June 21; Virgin Bay, June 25; Kukak Bay, July 1 and 4; Kadiak, July 20; Saldovia, Alaska, July 21.

Type.—Cat. no. 5237, U. S. National Museum.

Closely related to *occidentalis*, but in that species the sides of the median portion of the face are hairy, and the size is much larger.

Chilosia alaskensis Hunter.

Chilosia alaskensis HUNTER, Canadian Entom., p. 124, 1897.

Yakutat, Alaska: A single specimen, collected June 21. Originally described from Alaska.

Chilosia lasiophthalma Williston.

Chilosia lasiophthalma WILLISTON, Proc. Am. Phil. Soc., p. 306, 1882.
Synopsis N. Am. Syrphidæ, p. 40, 1886.

Yakutat, June 21; Kukak Bay, Alaska, July 1: Five specimens. Originally described from Colorado.

Chilosia tristis Loew.

Chilosia tristis LOEW, Berliner Entom. Zeitsch., p. 312, 1863.

Saldovia, Alaska, July 21: Three specimens. Originally described from the Red River, British America.

Chilosia plutonia Hunter.

Chilosia plutonia HUNTER, Canadian Ent., p. 125, 1897.

Chilosia gracilis HUNTER, loc. cit., p. 126.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 1 and 4; Popof Island, July 8 to 15; Kadiak, July 20;

Saldovia, July 21; Fox Point, Alaska, July 28: Seventy-two specimens, of both sexes. Originally described from Alaska, the two sexes having been described as separate species.

Chilosia pulchripes Loew.

Chilosia pulchripes LOEW, Verhandlungen Zool.-Bot. Vereins. p. 19, 1857.—SCHINER, Fauna Austr., Dipt., 1, p. 281, 1862.—BECKER, Revision Gatt. Chilosia, p. 372, 1894.

Kukak Bay, July 1 and 4; Saldovia, Alaska, July 21: Nine specimens. A European species, not heretofore reported as occurring on this Continent.

Melanostoma mellinum (Linné).

Musca mellinum LINNÉ, Fauna Suec., p. 1820, 1761.
Melanostoma mellinum SCHINER, Fauna Austriaca, Dipt., 1, p. 291, 1862.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 49, 1886.

Metlakahtla, June 4; Berg Bay, June 10; Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 1; Popof Island, July 8 to 15; Kadiak, July 20; Saldovia, July 21; Juneau, July 25; Fox Point, Alaska, July 28: One hundred and fifty-one specimens. This is also a European species reported as occurring on this Continent from Canada and Alaska, on the north, to Argentina, South America, on the south.

Melanostoma trichopus Thomson.

Syrphus trichopus THOMSON, Kongliga Sven. Freg. Eng. Resa, p. 502, 1868.

Metlakahtla, June 4; Kukak Bay, July 1; Popof Island, Alaska, July 8 and 9. Four specimens. Originally described from California.

Platychirus peltatus (Meigen).

Syrphus peltatus MEIGEN, Syst. Besch. Eur. Zweif. Ins., III, p. 334, 1822.
Platychirus peltatus SCHINER, Fauna Aust., Diptera, 1, p. 295, 1862.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 58, 1886.

Lowe Inlet, British Columbia, June 3; Sitka, June 16; Kukak Bay, July 1; Popof Island, July 8 to 14; Fox Point, Alaska, July 28: Nineteen specimens. A European species heretofore reported as occurring in this country from New Hampshire and Pennsylvania to Alaska and Colorado.

Platychirus tenebrosus sp. nov.

Male: Head black, its hairs black, those on lower part of occiput whitish, sides of frontal triangle bronze green, head at anterior oral margin noticeably shorter than at base of antennæ, face polished, the tubercle very small; antennæ black, the third joint dark brown, slightly longer than wide, mouth parts polished black; thorax and scutellum

black, polished, the hairs mixed yellow and black, a whitish pruinose spot on lower part of the sternopleura and metapleura; abdomen black, somewhat velvety, opaque, the first segment, sides of abdomen except hind angles of the third and fourth segment, also the fifth segment and genitalia, polished and having a brassy tinge, a pair of yellow spots on the second, third, and fourth segments, not touching the front nor lateral margin of the segments, those on the second the smallest, nearly circular, on the third segment the largest, elliptical, extending lengthwise with the segment, those on the fourth rhomboidal; front legs yellow, the coxæ, posterior side of the femora except at the apex, and a streak on outer side of the tibiæ, black, apices of tibiæ and the first tarsal joint except its apex, whitish, tibiæ greatly dilated at the apex, on the inner side gradually dilated for three-fourths of its length, then slightly narrowed to the apex, on the outer side rather abruptly dilated on the last third of its length, slightly narrowing to the apex, the outer angle prolonged considerably beyond the inner; tarsi dilated, tapering gradually to the fourth joint, the latter slightly narrower than the fifth, the first joint about two-thirds as wide as broadest part of the tibiæ, about one and one-half times as long as broad, femora on the posterior and under sides bearing many rather long black bristly hairs, the tibiæ and tarsi destitute of hairs; middle and hind legs black, the knees and apices of the tibiæ yellowish, femora bearing many rather long hairs, the tibiæ and tarsi destitute of them; wings grayish-hyaline, brownish at base and tinged with smoky along the anterior veins, stigma yellow, halteres also yellow.

Female: Differs from the male as follows: Hairs of head largely yellow, front tinged with bronze, face, except the tubercle, grayish pruinose, extending on sides of front to its middle where it is conically expanded toward the center of the front, thorax and scutellum tinged with bronze, their hairs yellow; abdomen bronze black, polished, the yellow spots nearly circular; front tibiæ gradually and moderately dilated, their tarsi noticeably widened, middle femora, their tibiæ, and first two joints of their tarsi, yellow, both ends of the hind femora and tibiæ also yellow, wings not brown at base nor tinged with smoky. Length 7 mm. One male and two females.

Habitat.—Kukak Bay, July 1; Popof Island, July 8; Kadiak, Alaska, July 28.

Type.—Cat. no. 5238, U. S. National Museum.

Readily recognized by the shortness of the lower part of the head, the remoteness of the abdominal yellow spots from the margins of the segments, the absence of hooked bristles on the front femora of the

male, his simple middle tibiæ and the absence of bristly hairs on all the tibiæ.

Platychirus æratus sp. nov.

Male: Differs from the above description of *tenebrosus* only as follows: Frontal triangle and face, except the tubercle, thinly grayish pruinose, thorax and scutellum bronze black, the hairs yellow; abdomen marked with a pair of gray pruinose, bronze colored, subelliptical spots at the anterior outer angles of the third and fourth segments; front femora, except the apices, black, their tibiæ gradually and moderately dilated toward the apices, their tarsi only moderately dilated and of nearly an equal width, the first joint almost as wide as broadest part of the tibiæ, about twice as long as wide; middle tarsi brownish yellow, the bases broadly yellow.

Female: Resembles the male with these exceptions: Lower half of front thinly gray pruinose, most dense along the eyes, abdomen polished and destitute of spots; front femora sometimes yellow except on the outer side, their tibiæ only slightly dilated, middle femora, tibiæ, and tarsi sometimes yellow except on posterior sides of femora, wings pure hyaline. Length 5 to 7 mm.

Two males and two females, collected June 12.

Habitat.—Muir Inlet, Alaska.

Type.—Cat. no. 5239, U. S. National Museum.

A very slender species, closely related to *albimanus*, but in the latter the head is much longer at the anterior oral margin than at base of antennæ, the front femora of the male bear several hooked bristles on the posterior side before the middle, his front and middle tibiæ have several rather long bristly hairs on the outer side, and the abdomen of the female is spotted nearly the same as in the male.

Platychirus albimanus (Fabricius).

Syrphus albimanus FABRICIUS, Species Insectorum, II, p. 434, 1781.

Platychirus albimanus SCHINER, Fauna Austr., Diptera, I, p. 294, 1862.

Sitka, June 16; Popof Island, Alaska, July 14 and 16: Three males and one female. A European species, not heretofore reported from this Continent.

Leucozona leucorum (Linné).

Musca leucorum LINNÉ, Fauna Suecica, p. 1803, 1761.

Leucozona leucorum SCHINER, Fauna Austriaca, Diptera, I, p. 299, 1862.—
WILLISTON, Synopsis N. Am. Syrphidæ, p. 62, 1886.

Popof Island, July 13; Saldovia, July 21; Juneau, Alaska, July

25: Three specimens. Also a European species, hitherto reported as occurring in Canada, Colorado, and Washington.

Syrphus arcuatus (Fallen).

Scava arcuata FALLEN, Diptera Sueciæ, Syrphidæ, p. 42, 1816.

Syrphus arcuatus SCHINER, Fauna Austriaca, Dipt., 1, p. 305, 1862.—WILLISTON Synopsis N. Am. Syrphidæ, p. 68, 1886.

Popof Island, July 10; Saldovia, July 21; Juneau, Alaska, July 25: Three specimens. A European species, heretofore reported as occurring over the northern portion of this Continent, extending southward as far as Virginia and New Mexico.

Syrphus amalopsis Osten Sacken.

Syrphus amalopsis OSTEN SACKEN, Proc. Boston Soc. Nat. Hist., p. 148, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 69, 1886.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 1; Saldovia, July 21; Juneau, July 25; Fox Point, Alaska, July 28: Thirty-six specimens. Originally described from New Hampshire.

Syrphus contumax Osten Sacken.

Syrphus contumax OSTEN SACKEN, Proc. Boston Soc. Nat. Hist., p. 148, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 71, 1886.

Syrphus bryantii JOHNSON, Entom. News, p. 17, 1898.

Berg Bay, June 10; Muir Inlet, June 12; Kukak Bay, July 1; Popof Island, Alaska, July 8 to 11: Thirty-five specimens. This species was also originally described from New Hampshire; the type of *bryantii* was collected in Alaska, and Mr. Johnson has confirmed the above synonymy in a recent letter.

Syrphus mentalis Williston.

Syrphus mentalis WILLISTON, Synopsis N. Am. Syrphidæ, p. 72, 1886.

Virgin Bay, June 26; Kukak Bay, Alaska, July 1: Two specimens. Originally described from Washington. Its occurrence in Alaska has already been recorded by Mr. W. D. Hunter.

Syrphus velutinus Williston.

Syrphus velutinus WILLISTON, Proc. Am. Phil. Soc., p. 314, 1882. Synopsis N. Am. Syrphidæ, p. 73, 1886.

Fox Point, Alaska: A single specimen, captured July 28. The type locality is Oregon.

Syrphus diversipes Macquart.

Syrphus diversipes MACQUART, Diptères Exotiques, 4^e Sup., p. 155, 1849.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 76, 1886.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 16; Saldovia, Alaska, July 21: Twenty-seven specimens. Originally described from Newfoundland; it has also been reported from New Hampshire, New York, the shores of Lake Superior, and Washington. A specimen in the U. S. National Museum was collected in Colorado.

***Syrphus gracilis* sp. nov.**

Front polished, black, with a brassy tinge, not pruinose, its hairs black; face polished yellow, a broad median vitta, the oral margin, and cheeks black, the hairs black, those on upper part of occiput yellowish, on the lower part white; eyes bare, antennæ black, mouth parts dark brown, facial tubercle very prominent; thorax polished, metallic bluish bronze, its hairs light colored; scutellum polished, yellow, with a metallic bluish reflection, its hairs black; abdomen polished, black, a pair of small, orbicular, yellow spots on the second segment, situated in front of the middle and close to the lateral margins, posterior margin of the fourth segment and front angles of the fifth, yellow; legs black, apices of front femora and bases of front tibiæ brownish yellow; halteres yellow, the stems brown; wings hyaline, stigma brown. Length 7 mm. A female specimen collected July 25.

Habitat.—Juneau, Alaska.

Type.—Cat. no. 5240, U. S. National Museum.

An unusually slender species, easily recognized by the polished, not pruinose front, and absence of yellow markings on the third abdominal segment.

***Syrphus ribesii* (Linné).**

Musca ribesii LINNÉ, Fauna Suec., p. 1816, 1761.

Syrphus ribesii SCHINER, Fauna Austriaca, Dipt., I, p. 310, 1862.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 77, 1886.

Metlakatla, June 4; Popof Island, July 8 to 15; Juneau, July 25; Fox Point, Alaska, July 28: Nine specimens. A European species, reported as occurring over the greater portion of this Continent, from Washington on the north to Argentina, South America, on the south.

***Syrphus torvus* Osten Sacken.**

Syrphus torvus OSTEN SACKEN, Proc. Boston Soc. Nat. Hist., p. 139, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 79, 1886.

Juneau, June 25; Kukak Bay, July 21; Popof Island, Alaska, July 8 to 10: Seven specimens. Also a European species. It has been recorded as occurring in Siberia, while on this Continent its reported range is from Greenland to Rhode Island, and in the West from Washington to Colorado. The U. S. National Museum contains sev-

eral specimens which are labeled as having been collected in North Carolina and Georgia.

Syrphus geniculatus Macquart.

Syrphus geniculatus MACQUART, Diptères Exot., II, Part 2, p. 101, 1841.—
WILLISTON, Synopsis N. Am. Syrphidæ, p. 84, 1886.

Kukak Bay, July 1; Popof Island, Alaska, July 8 to 15: Four specimens. Originally described from Newfoundland; it has also been reported from New Hampshire and Alaska.

Syrphus glacialis (Johnson).

Melanostoma glacialis JOHNSON, Entom. News, p. 18, 1898.

Berg Bay, June 10; Yakutat, June 21; Kukak Bay, July 4; Popof Island, July 8 to 13; Kadiak, Alaska, July 20: Nine specimens. The type locality of this species is Alaska.

Syrphus macularis (Zetterstedt).

Scæva macularis ZETTERSTEDT, Diptera Scand., II, p. 730, 1843.

Yakutat, Alaska: Eight specimens, of both sexes, collected June 21. A European species, not heretofore recorded as occurring on this Continent.

Didea laxa Osten Sacken.

Didea laxa OSTEN SACKEN, Bulletin Buffalo Soc. Nat. Hist., p. 56, 1875.

Saldovia, Alaska: A single specimen, collected July 21. The specimens on which the original description was founded were collected in Maine, New Hampshire, and on the shores of Lake Superior. In the West, this species has been recorded as occurring from Washington to Mexico.

Sphærophoria sulphuripes (Thomson).

Syrphus sulphuripes THOMSON, Kongliga Sven. Freg. Eug. Resa, p. 501, 1868.

Sphærophoria sulphuripes WILLISTON, Synopsis N. Am. Syrphidæ, p. 106, 1886.

Fox Point, Alaska: A single specimen, taken July 28. Originally described from California.

Neoascia globosa (Walker).

Ascia globosa WALKER, List Dipt. Ins. British Museum, III, p. 546, 1849.

Neoascia globosa WILLISTON, Synopsis N. Am. Syrphidæ, p. 111, 1886.

Metlakhtla, June 4; Virgin Bay, June 26; Popof Island, Alaska, July 8 to 18: Fourteen specimens. This species was originally described from New York, and has been reported from Connecticut and

Oregon. The U. S. National Museum also contains a specimen collected in Colorado.

Sphegina infuscata Loew.

Sphegina infuscata LOEW, Berliner Ent. Zeitsch., p. 13, 1863.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 114, 1886.

Lowe Inlet, British Columbia, June 3; Farragut Bay, June 5; Sitka, June 16; Yakutat, June 21; Virgin Bay, Alaska, June 26: Forty-eight specimens. The abdomen of the male is sometimes of the same color as that of the female. This species was originally described from Sitka, and has also been reported from Oregon. The U. S. National Museum contains specimens^s collected in Colorado and New Hampshire.

Baccha obscuricornis Loew.

Baccha obscuricornis LOEW, Berliner Ent. Zeitsch., p. 15, 1863.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 123, 1886.

Lowe Inlet, British Columbia, June 3; Sitka, Alaska, June 16: Three specimens. Originally described from Sitka; it has also been reported from Oregon and New Mexico.

Myiolepta bella Williston.

Myiolepta bella WILLISTON, Proc. Am. Phil. Soc., p. 308, 1882. Synopsis N. Am. Syrphidæ, p. 128, 1886.

Virgin Bay, Alaska: A male specimen, collected June 26. Originally reported from Washington and Oregon.

Brachyopa notata Osten Sacken.

Brachyopa notata OSTEN SACKEN, Bulletin Buffalo Soc. Nat. Hist., p. 68, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 132, 1886.

Sitka, June 16; Yakutat, June 21; Virgin Bay, Alaska, June 26: Ten specimens. Originally described from New Hampshire, and also recorded from Washington and Oregon.

Arctophila flagrans Osten Sacken.

Arctophila flagrans OSTEN SACKEN, Bulletin Buffalo Soc. Nat. Sci., p. 69, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 158, 1886.

Popof Island, Alaska: A single specimen, collected July 10. This species was originally described from Colorado, and has been reported from New Mexico.

Volucella facialis Williston.

Volucella facialis WILLISTON, Proc. Am. Phil. Soc., p. 316, 1882. Synopsis N. Am. Syrphidæ, p. 137, 1886.

Kukak Bay, July 1; Popof Island, July 13; Kadiak, July 20;

Saldovia, Alaska, July 21: Thirteen specimens. The type locality of this species is in California, and the species has also been recorded from Colorado.

Sericomyia chalcopyga Loew.

Sericomyia chalcopyga LOEW, Berliner Ent. Zeitsch., p. 12, 1863.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 156, 1886.

Sitka, June 16; Fox Point, Alaska, July 28: Eight specimens. Originally described from Sitka; it has been reported from Washington and Oregon. The U. S. National Museum also contains a specimen collected by Mrs. A. T. Slosson, at Franconia, New Hampshire.

Eristalis meigenii Wiedemann.

Eristalis meigenii WIEDEMANN, Ausser. Zweif. Insekten, II, p. 177, 1830.

Eristalis brousi WILLISTON, Proc. Am. Phil. Soc., p. 323, 1882. Synopsis N. Am. Syrphidæ, p. 165, 1886.

Juneau, Alaska: Two specimens, collected July 25. This species was originally described from Uruguay, South America; it has also been reported as occurring from Alaska and Canada to Colorado and Pennsylvania. The synonymy is on the authority of Dr. Williston.

Eristalis occidentalis Williston.

Eristalis occidentalis WILLISTON, Proc. Am. Phil. Soc., p. 322, 1882. Synopsis N. Am. Syrphidæ, p. 167, 1886.

Metlakahtla, June 4; Sitka, June 16; Virgin Bay, June 26; Kadiak, July 20; Juneau, July 25; Fox Point, Alaska, July 28: Thirty-one specimens. This species was originally described from Washington, and has already been reported as occurring in Alaska.

Eristalis flavipes Walker.

Eristalis flavipes WALKER, List Dipt. Ins. Brit. Museum, III, p. 633, 1849.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 168, 1886.

Fox Point, Alaska: A single specimen, captured July 28. Originally described from Albany River, British America; it has also been reported as occurring from Washington and Canada to Colorado and Rhode Island.

Eristalis compactus Walker.

Eristalis compactus WALKER, List Dipt. Ins. Brit. Museum, III, p. 619, 1849.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 169, 1886.

Kadiak, Alaska: Two specimens, taken July 19 and 20. This species was originally described from Albany River, British America; it has also been recorded from Canada, New Hampshire, and Connecticut.

Eristalis obscurus Loew.

Eristalis obscurus LOEW, Berliner Ent. Zeitsch., p. 171, 1865.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 175, 1886.

Fox Point, Alaska: Three specimens, captured July 28. Originally described from Red River, British America.

Helophilus lunulatus Meigen.

Helophilus lunulatus MEIGEN, System. Besch. Eur. Zweif. Insekten, III, p. 370, 1822.—SCHINER, Fauna Austr., Dipt., I, p. 340, 1862.

Kadiak, Alaska: A single specimen, collected July 20. This is a European species, not heretofore reported as occurring on this Continent. Specimens are contained in the U. S. National Museum collection taken at Toronto and Ottawa, Canada, by Messrs. W. Brodie and W. H. Harrington. Four of these were received from Mr. Brodie under the name of *Helophilus canadensis* Brodie; this name appears in the published Check-list of the Insects of Canada, but no description accompanies the name, nor has any ever been published so far as I am aware.

Helophilus dychei Williston.

Helophilus dychei WILLISTON, Canadian Ent., p. 136, 1897.

Berg Bay, June 10; Kadiak, July 20; Juneau, July 25; Fox Point, Alaska, July 28: Ten specimens. Originally described from Alaska.

Criorhina armillata Osten Sacken.

Criorhina armillata OSTEN SACKEN, Bulletin Buffalo Soc. Nat. Sci., p. 68, 1875.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 213, 1886.

Fox Point, Alaska: A single specimen, collected July 28. The type locality of this species is Quebec, Canada. The U. S. National Museum contains specimens from New Hampshire and Montana.

Criorhina scitula Williston.

Criorhina scitula WILLISTON, Proc. Am. Phil. Soc., p. 331, 1882. Synopsis N. Am. Syrphidæ, p. 215, 1886.

Fox Point, Alaska: A single specimen, captured July 28. Originally described from Washington. The U. S. National Museum also contains a specimen from Mt. Hood, Oregon.

Criorhina tricolor sp. nov.

Eyes of male separated as widely as the posterior ocelli, upper half of front brownish black, the lower half brownish yellow, on the sides broadly yellow pruinose, face yellow, opaque, yellow pruinose, deeply concave below the antennæ, the lower portion strongly convex, cheeks polished, brownish black, antennæ brownish yellow, upper side of

third joint brownish black, first joint cylindrical, slightly longer than the second, the third transversely oval, nearly twice as wide as long, arista black, proboscis dark brown, rather short and robust; thorax and scutellum polished, bronze black, the hairs long and abundant, whitish, a transverse band of black ones behind middle of mesonotum; abdomen polished, the first two segments light yellow, covered with long, abundant whitish hairs, remainder of abdomen black, its hairs golden yellow; legs black, tibiæ yellowish, with a brown band before the middle and another near the tip, first three tarsal joints brownish yellow; wings hyaline, stigma grayish brown. Length 12 mm. A male specimen, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5241, U. S. National Museum.

Closely related to *coquilletti*, but in that species the first two segments of the abdomen are black, and covered with black hairs, etc.

***Xylota barbata* Loew.**

Xylota barbata LOEW, Berliner Ent. Zeitsch., p. 70, 1864.—WILLISTON, Synopsis N. Am. Syrphidæ, p. 233, 1886.

Juneau, Alaska: A single specimen, collected July 25. Originally described from Alaska, it has also been reported from Washington, Oregon, and California.

Family PHORIDÆ.

***Trineura aterrima* (Fabricius).**

Musca aterrima FABRICIUS, Entom. System., IV, p. 334, 1794.

Trineura aterrima SCHINER, Fauna Austriaca, Dipt., II, p. 347, 1864.

Berg Bay, June 10; Muir Inlet, June 12; Sitka, June 16; Yakutat, June 21; Popof Island, July 8 to 12; Kadiak, July 20; Saldovia, Alaska, July 21: Twenty-seven specimens. A European species, first reported as occurring in this country about forty years ago. The U. S. National Museum contains specimens from the White Mountains, New Hampshire, and Summit County, Colorado.

***Phora rufipes* (Meigen).**

Trineura rufipes MEIGEN, Klass. Besch. Eur. Zweif. Insekten, I, p. 313, 1804.

Phora rufipes SCHINER, Fauna Austriaca, Dipt., II, p. 340, 1864.

Muir Inlet, June 12; Sitka, Alaska, June 16: Two specimens. Also a European species, first recorded from this country at the same time as the preceding species.

***Phora fungicola* Coquillett.**

Phora fungicola COQUILLET, Canadian Ent., p. 106, 1895.

Popof Island, Alaska: Three specimens, collected July 10, 11, and 14. Originally described from New Mexico, it has also been recorded as occurring in New Jersey.

Family ŒSTRIDÆ.

Œdemagena tarandi (Linné).

Œstrus tarandi LINNÉ, Fauna Suecica, p. 1731, 1761.—ZETTERSTEDT, Dipt. Scand., III, p. 973, 1844.

Popof Island, Alaska: A single specimen, captured July 12. This is a European species, first recorded from North America about fifty-eight years ago. The U. S. National Museum contains a specimen collected at Point Barrow, Alaska, August 15, 1872, by Mr. John Murdock.

Family TACHINIDÆ.

Thryptocera flavipes Coquillett.

Thryptocera flavipes COQUILLET, Revision Tachinidæ, p. 58, 1897.

Yakutat, June 21; Virgin Bay, June 26; Orca, Alaska, June 27: Thirty-five specimens. Originally described from the mountains of New Hampshire.

Didyma pullula van der Wulp.

Didyma pullula VAN DER WULP, Biologia Cent.-Amer., Diptera, II, p. 162, 1890.

Farragut Bay, Alaska: A single specimen, collected June 1. The type locality of this species is in the high mountains of Guerrero, Mexico.

Linnæmyia picta (Meigen).

Tachina picta MEIGEN, Syst. Besch. Eur. Zweif. Insekten, IV, p. 261, 1824.

Micropalpus picta SCHINER, Fauna Aust., Diptera, I, p. 429, 1862.

Linnæmyia picta COQUILLET, Revision Tachinidæ, p. 87, 1897.

Fox Point, Alaska: A single specimen, collected July 28. This European species was first recorded from this country by the writer about three years ago, the localities being in New Hampshire and Massachusetts.

Panzeria radicum (Fabricius).

Musca radicum FABRICIUS, Systema Entom., p. 778, 1775.

Nemoræa radicum SCHINER, Fauna Austriaca, Dipt., I, p. 452, 1862.

Panzeria radicum COQUILLET, Revision Tachinidæ, p. 88, 1897.

Fox Point, Alaska: A single specimen, collected July 28. Also a European species, first reported from this country at the same time as the preceding species. It has heretofore been recorded as occurring

from New Hampshire, southward to the District of Columbia, westward to Texas and northward to British Columbia.

Paraphyto borealis sp. nov.

Black, the anterior portion of the cheeks and lower part of sides of face reddish brown, median depression sometimes of the same color; front of male at narrowest point narrower than distance between the posterior ocelli, in the female one and one-half times as wide as either eye, the sides and face dark gray pruinose, a dark brownish spot on each side of face near lower end of front, visible only in certain lights, frontal bristles not descending to base of second antennal joint, two pairs of orbital bristles in the female, wanting in the male, antennæ reaching lowest fourth of face, the third joint nearly one and one-half times as long as the second, arista thickened on the basal sixth, pubescent, the longest pubescence slightly longer than the greatest diameter of the arista; vibrissæ situated slightly above the oral margin, two or three bristles above each, proboscis rigid and rather slender, the labella small; mesonotum thinly gray pruinose, marked with three black, polished vittæ, four dorsocentral, postsutural macrochætæ and three sternopleural; abdomen somewhat polished, anterior portion of the second, third, and fourth segments gray pruinose, the first three segments bearing marginal, the second and third also with discal macrochætæ, hypopygium uniformly covered with hairs; wings hyaline, the base pale brownish, anterior veins indistinctly bordered with brown, calypteres white. Length 9 mm. A specimen of each sex, collected July 28.

Habitat.—Fox Point, Alaska.

Type.—Cat. no. 5242, U. S. National Museum.

Closely related to *gillettei*, but in that species the eyes of the male are at least twice as wide apart as the distance between the two posterior ocelli, the hairs of the hypopygium are arranged in transverse bands widely separated by bare intervals, there are no brown spots on upper part of the face, and the length is from 12 to 14 mm.

Echinomyia algens (Wiedemann).

Tachina algens WIEDEMANN, Ausser. Zweif. Insekten, II, p. 285, 1830.

Echinomyia algens COQUILLET, Revision Tachinidæ, p. 144, 1897.

Fox Point, Alaska: A single specimen, collected July 28. This species was originally described from North America, without any mention of a more precise locality. It has been reported as occurring from Canada to New York and westward to British Columbia and California.

Family SARCOPHAGIDÆ.

Cynomyia cadaverina Desvoidy.

Cynomyia cadaverina DESVOIDY, Essai Myod., p. 365, 1830.

Cynomyia americana HOUGH, Entom. News, p. 105, 1898.

Sitka, Alaska: A single specimen, collected June 16. This species was originally described from "Carolina," and has been reported as occurring from Canada to Georgia, and westward to Colorado.

Cynomyia mortisequa (Kirby).

Musca mortisequa KIRBY, Fauna Bor.-Amer., IV, p. 317, 1837.

Cynomyia hirta HOUGH, Entom. News, p. 166, 1898.

Kukak Bay, July 4; Popof Island, July 8; Kadiak, Alaska, July 20: Ten specimens. Originally described from British America, latitude 65°. It has already been reported from Alaska.

Calliphora vomitoria (Linné).

Musca vomitoria LINNÉ, Fauna Suecica, p. 1831, 1761.

Calliphora vomitoria SCHINER, Fauna Austr., Dipt., I, p. 584, 1862.

Sitka, June 16; Kukak Bay, July 1; Popof Island, July 9 and 10; Saldovia, Alaska, July 21: Seven specimens. A European species reported as occurring in this country over twenty years ago. It has also been recorded from Alaska, and the U. S. National Museum contains a specimen collected as far southward as Alabama.

Calliphora viridescens Desvoidy.

Calliphora viridescens DESVOIDY, Essai Myod., p. 437, 1830.

Lowe Inlet, British Columbia, June 3; Metlakahtla, June 4; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Kadiak, July 20; Saldovia, July 21; Juneau, Alaska, July 25: Fourteen specimens. Originally described from 'Carolina'; it is known to occur over the greater portion of this country.

Lucilia cæsar (Linné).

Musca cæsar LINNÉ, Fauna Suecica, p. 1828, 1761.

Lucilia cæsar SCHINER, Fauna Austriaca, Dipt., I, p. 590, 1862.

Lowe Inlet, British Columbia; Kukak Bay, July 4; Popof Island, July 8; Kadiak, Alaska, July 20: Ten specimens. A European species first recorded from this country about sixty years ago, and now occurring in almost every part of North America.

Phormia terrænovæ Desvoidy.

Phormia terrænovæ DESVOIDY, Essai Myod., p. 467, 1830.—HOUGH, Zool. Bulletin, p. 289, 1899.

Juneau, July 25; Fox Point, Alaska, July 28: Six specimens.

Originally described from Newfoundland, but occurring over the greater part of North America.

Family MUSCIDÆ.

Graphomyia maculata (Scopoli).

Musca maculata SCOPOLI, Entom. Carniolica, p. 326, 1763.

Graphomyia maculata SCHINER, Fauna Austriaca, Dipt., I, p. 582, 1862.

Graphomyia americana DESVOIDY, Essai Myod., p. 404, 1830.

Popof Island, Alaska: A single specimen, collected July 10. A European species, first reported from this country about seventy years ago. It has been recorded from Greenland, and specimens are in the National Museum from Virginia and Kansas.

Mesembrina latreillei Desvoidy.

Mesembrina latreillei DESVOIDY, Essai Myod., p. 401, 1830.

Kukak Bay, July 4; Kadiak, July 20; Saldovia, July 21, Juneau, Alaska, July 25: Four specimens. This species was originally described from Nova Scotia, and its most southern recorded limit is Pennsylvania.

Myospila meditabunda (Fabricius).

Musca meditabunda FABRICIUS, Species Insect., II, p. 444, 1781.

Myospila meditabunda SCHINER, Fauna Austriaca, Dipt., I, p. 598, 1862.

Cyrtoneura 4-signata THOMSON, Kongliga Sven. Fregatten Eugenies Resa, p. 549, 1868.

Metlakatla, June 4; Yakutat, Alaska, June 21: Three specimens. A European species, first reported as occurring in this country about thirty-six years ago.

Family ANTHOMYIIDÆ.

Hyetodesia varipes sp. nov.

Male: Black, the apex of scutellum reddish yellow, apices of front femora and whole of their tibiæ yellowish brown, apices of middle femora, the whole of their tibiæ, also the hind femora and tibiæ, yellow, halteres light yellow; hairs of eyes long and dense, frontal orbits white pruinose, contiguous a short distance in front of the ocelli, or narrowly separated, antennæ reaching about two-thirds of distance to oral margin, the third joint less than twice as long as the second, arista long plumose, the longest hairs about three times as long as greatest diameter of the arista; mesonotum somewhat polished, rather thinly light gray pruinose, marked with four black vittæ; four pairs of post-sutural dorsocentral bristles, no acrostichals in front of the suture,

præsatural intra-alar bristle longer than the adjacent supra-alar, sternopleurals 1 + 2; abdomen yellowish gray pruinose and with darker, olivaceous, reflecting spots; front tibiæ destitute of bristles except at the apices, middle femora ciliate with bristles on the basal two-thirds of the under side, middle tibiæ each bearing three bristles on the posterior side of about their median third, hind femora ciliate the entire length of their anterior-under side and with two bristles on the median third, or penultimate fourth, of their posterior-under side, hind tibiæ each bearing from two to four short bristles on the inner-anterior side, two or three longer ones on the outer-anterior side, all on the median third of the tibia, also one on the outer side near three-fourths of the length of the tibia; front pulvilli as long as the last tarsal joint; wings hyaline, tinged with yellowish brown at base and along the anterior half, hind crossvein strongly sinuous, small and hind crossveins bordered with brown, third and fourth veins diverging, costal spine shorter than the small crossvein, calypteres yellowish.

Female: Same as the male with these exceptions: Middle femora and sometimes the front ones and their tibiæ, yellow; hairs of eyes rather sparse, front nearly twice as wide as either eye, destitute of a pair of præocellar bristles, a dark, changeable spot on upper part of sides of face, front pulvilli much shorter than the last tarsal joint. Length, 8 to 10 mm. Two males and three females.

Habitat.—Sitka, June 16; Kadiak, June 20; Yakutat, June 21; Popof Island, Alaska, July 14.

Type.—Cat. no. 5243, U. S. National Museum.

Hyetodesia lucorum (Fallen).

Musca lucorum FALLEN, Diptera Suec., Muscidae, p. 55, 1820.

Aricia lucorum SCHINER, Fauna Austr., Diptera, 1, p. 600, 1862.

Kukak Bay, July 4; Popof Island, July 8 to 12; Kadiak, Alaska, July 20: Ten specimens, of both sexes. A European species first reported from this country by Mr. P. Stein about two years ago, recorded as occurring in Massachusetts, Pennsylvania, Kansas, and Idaho.

Hyetodesia brunneinervis (Stein).

Aricia brunneinervis STEIN, Berliner Ent. Zeitsch., p. 183, 1898.

Berg Bay, June 10; Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 9 to 12; Kadiak, July 20; Saldovia, Alaska, July 21: Forty-seven specimens. Originally described from Idaho.

Hyetodesia septentrionalis (Stein).

Aricia septentrionalis STEIN, Berliner Ent. Zeitsch., p. 184, 1898.

Sitka, June 16; Virgin Bay, June 21; Kukak Bay, July 4; Popof Island, July 8 to 14; Kadiak, July 20; Saldovia, Alaska, July 21: Fifty-five specimens of both sexes. The type locality of this species is Alaska.

***Hyetodesia villicrura* sp. nov.**

Male: Black, the halteres brown; hair of eyes long and dense, frontal vitta at narrowest point narrower than the lowest ocellus, antennæ three-fourths as long as the face, the third joint one and one-half times as long as the second, a white pruinose spot between bases of antennæ, arista long pubescent, the longest slightly more than greatest diameter of the arista; mesonotum polished, not gray pruinose except on the sides, four pairs of postsutural dorsocentral bristles, sternopleurals 1 + 2; abdomen narrowly subovate, slightly over twice as long as wide, polished, thinly olive gray pruinose, the greater portion of the first segment and a dorsal, indistinct, subtriangular spot on the second and third, blackish, hypopygium only slightly projecting; front tibiæ short haired on the lower half of its inner side, interspersed with about three long and four shorter bristly hairs; middle femora densely long haired on the basal two-thirds of the under side, their tibiæ each bearing about five bristles along the outer-posterior side and with about six bristles and a few shorter bristly hairs on the lower two-thirds of the inner-posterior side; hind femora densely long haired on the under side, their tibiæ with similar hairs along the inner, anterior-inner, and posterior-inner sides, the outer side ciliate with rather short bristly hairs interspersed with about four longer bristles on the lower two-thirds; wings pale brownish, changing into grayish hyaline along the hind margin, nearly wholly hyaline in the younger specimens, costal spine minute, third and fourth veins diverging, hind crossvein almost straight; calypteres yellowish white, the lower extending far beyond the upper.

Female: Differs from the male as follows: Halteres yellow, eyes bare, front at narrowest point slightly narrower than either eye, a præ-ocellar, cruciate pair of bristles present; mesonotum opaque, yellowish gray pruinose; abdomen subovate, slightly polished, grayish yellow pruinose, unmarked; front tibiæ destitute of bristles except at the apices, middle femora sparsely short haired on the under side, their tibiæ pubescent on the inner-posterior side but with two or three bristles on lower half of the outer-anterior side; hind femora bearing five or six bristles on the apical half of the under side, and sometimes with a few long hairs on the basal portion; hind tibiæ pubescent, each bearing

about four bristles on the median two-fourths of the anterior-inner side, two or three on median third of the outer-anterior side, and about five on the lower two-thirds of the outer-posterior side; wings hyaline, strongly tinged with yellow at the base. Length, 6 to 8 mm. Thirty males and thirty-one females.

Habitat.—Yakutat, June 21; Kukak Bay, July 4; Popof Island, July 8 to 15; Kadiak, July 20; Saldovia, Alaska, July 21.

Type.—Cat. no. 5244, U. S. National Museum.

***Lasiops frenata* (Holmgren.)**

Aricia frenata HOLMGREN, Ofversigt Vetans.-Akad. Forh., p. 103, 1872.

Muir Inlet, Alaska: A male specimen, collected June 12. Originally described from Greenland.

***Lasiops hirsutula* (Zetterstedt).**

Anthomyza hirsutula ZETTERSTEDT, Insecta Lapp., p. 673, 1840.

Aricia hirsutula ZETTERSTEDT, Diptera Scand., IV, p. 1494, 1845.

Popof Island, Alaska: Two male specimens, taken July 13 and 15. A European species, not before reported as occurring on this Continent.

***Lasiops calvicrura* sp. nov.**

Male: Black, the halteres light yellow; hairs of eyes rather long and quite dense, frontal vitta at narrowest point narrower than the lowest ocellus, antennæ two-thirds as long as the face, the third joint twice as long as the second, arista rather long pubescent, the longest about equal to greatest diameter of the arista; mesonotum polished, two indistinct gray pruinose vittæ in front of the suture, four pairs of postsutural dorsocentral bristles, sternopleurals 1 + 2; abdomen less than twice as long as broad, subelliptical, yellowish gray pruinose and with darker, olivaceous reflecting spots, the greater part of the first segment and a pair of indistinct, subtriangular spots on the second, black, hypopygium projecting very slightly; front tibiæ destitute of bristles, middle femora ciliate with bristles on the entire length of the under side, their tibiæ each bearing a bristle near the middle of the anterior-outer side and with four on the median two-fourths of the posterior-outer side; hind femora ciliate the entire length of the anterior-under and posterior-under sides with bristles which become gradually shorter toward each end of the femur; hind tibiæ short pubescent, each bearing three bristles on about the median third of the anterior-inner side and with four on the median two-fourths of the anterior-outer side; wings pale brownish, changing into grayish hyaline along the hind margin and in the discal cell, third and fourth veins diverging, hind crossvein slightly sinuous, costal spine not longer than

the small crossvein, calypteres yellow, the lower ones projecting far beyond the upper.

Female: Differs from the male as follows: Eyes bare, front at narrowest part almost twice as wide as either eye, no præocellar bristles, third joint of antennæ scarcely one and one-half times as long as the second, arista short pubescent, the longest scarcely half the length of greatest diameter of the arista, mesonotum opaque, bluish gray pruinose, marked with five dark brown vittæ, sternopleurals 1 + 1, abdomen broadly subelliptical, about one and one-third times as long as wide, densely bluish gray pruinose, a pair of dark brown spots along the hind margins of the second and third segments, middle tibiæ each bearing only two bristles, situated on the median third of the posterior side, besides those at the tip, hind femora bearing a few rather short hairs on the under side of its basal half and with five bristles on the apical half; wings hyaline. Length, 6 to 7 mm. Two males and one female, collected July 9, 10, and 12.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5245, U. S. National Museum.

***Limnophora nobilis* Stein.**

Limnophora nobilis STEIN, Berliner Ent. Zeitsch., p. 207, 1898.

Muir Inlet, June 12; Sitka, June 16; Popof Island, July 8 to 12; Saldovia, Alaska, July 21: Twenty-seven specimens. Originally described from Alaska.

***Cænosia fuscopunctata* Macquart.**

Cænosia fuscopunctata MACQUART, Diptères Exot., 4^e Suppl., p. 270, 1849.
Cænosia ovata STEIN, Berliner Ent. Zeitsch., p. 263, 1898.

Popof Island, July 11; Saldovia, Alaska, July 21: Two specimens. Originally described from North America, without any indication of the exact locality; it has been reported as occurring from New Hampshire to Florida, and westward to Illinois.

***Cænosia lata* Walker.**

Cænosia lata WALKER, Insecta Saund., Diptera, p. 368, 1856.
Cænosia canescens STEIN, Berliner Ent. Zeitsch., p. 265, 1898.

Lowe Inlet, British Columbia; Muir Inlet, June 12; Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 8 to 14; Saldovia, Alaska, July 21: Twenty specimens. Originally described from the United States, without mention of any more definite locality. It has been recorded from the same region as the preceding species, except that its western limits are stated to be Kansas and South Dakota.

Cænosa albifrons (Zetterstedt).

Aricia albifrons ZETTERSTEDT, Dipt. Scand., VIII, p. 3301, 1849.

Muir Inlet, June 11 and 12; Popof Island, July 10; Saldovia, Alaska, July 21: Eight specimens. A European species, first recorded from this country about two years ago by Mr. P. Stein, of Genthin, Germany, whose specimens were collected in Massachusetts.

Homalomyia flavivaria sp. nov.

Male: Black, the halteres, except their bases, and a pair of large spots on the second and third abdominal segments, light yellow, the spots on the second segment subquadrate, those on the third subtriangular, also usually a yellow spot at the anterior angles of the fourth segment; frontal orbits whitish pruinose, in immature specimens contiguous for a considerable distance on the median portion, but rather widely separated in mature ones, antennæ almost as long as the face, the third joint one and one-half times as long as the second; mesonotum slightly polished, the sides and pleura light gray pruinose, three pairs of postsutural dorsocentral bristles, sternopleurals 1 + 1; abdomen nearly linear but sometimes widening posteriorly, very thinly gray pruinose; coxæ destitute of stout spines, front tibiæ without bristles except at apices, middle femora gradually thickening toward the middle, then slightly narrowing, with a small, rounded prominence at two-thirds the length of the under side, which is densely covered with short bristles, beyond this the femur is rather suddenly narrowed, and continues so to the apex, the under-posterior side ciliate with long bristles except on the apical fourth, on the anterior-under side bearing two stout spines at one-fourth its length, beyond which it is ciliate with rather long bristles to the prominence, the basal half of the narrowed apical portion bare, the apical half ciliate with about six very short bristles, middle tibiæ each bearing a small, rounded process at one-third of its inner side, the apical half considerably thickened and with rather long pubescence on the inner side, bearing a pair of bristles at three-fourths its length, one on the anterior and the other on the posterior side; hind femora sparsely ciliate with rather short bristles on the basal two-thirds of the anterior-under side, the posterior-under side bare; hind tibiæ each bearing two bristles on the penultimate fifth of the anterior-inner side, one below middle of anterior side, and two on apical half of the anterior-outer side; wings hyaline, fourth vein usually slightly curving toward the third at its apex, calypteres yellowish, the upper projecting beyond the lower.

Female: Abdomen yellow, hind margins of the first three segments

black, front one and one-half times as wide as either eye, two pairs of orbital bristles, no præocellar bristles, middle legs simple, middle femora destitute of spines, the anterior-under and posterior-under sides sparsely ciliate with short bristles, otherwise as in the male. Length, 4 to 5.5 mm. Fifteen males and eight females.

Habitat.—Metlakahtla, June 4; Berg Bay, June 10; Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, Alaska, July 10 to 12.

Type.—Cat. no. 5246, U. S. National Museum.

Homalomyia flavibasis Stein.

Homalomyia flavibasis STEIN, Berliner Ent. Zeitsch., p. 171, 1898.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Popof Island, July 10 and 12; Juneau, Alaska, July 25: Eleven specimens. The type locality of this species is Illinois.

Hydrophoria ambigua (Fallen).

Musca ambigua FALLEN, Diptera Sueciæ, Muscidæ, p. 56, 1820.

Aricia ambigua ZETTERSTEDT, Dipt. Scand., XII, p. 4719, 1855.

Metlakahtla, Alaska: A single specimen, collected June 4. This is also a European species, recorded from Massachusetts and Illinois about two years ago, by Mr. Stein.

Anthomyia radicum (Linné).

Musca radicum LINNÉ, Fauna Suecica, p. 1840, 1761.

Anthomyia radicum SCHNER, Fauna Austriaca, Diptera, I, p. 645, 1862.

Yakutat, Alaska: A specimen of each sex, collected June 21. This European species was first reported from this country about nineteen years ago, by Mr. R. H. Meade, of Bradford, England. It has been recorded from Canada to Pennsylvania, westward to Idaho.

Anthomyia mystacea sp. nov.

Black, the halteres yellow; front in profile slightly concave, frontal vitta at narrowest part narrower than the lowest ocellus, face strongly concave, oral margin projecting farther forward than the front, vibrissæ not longer than the adjacent bristles; extending obliquely downward and backward from near each vibrissa are several irregular, dense rows of long, upwardly curving bristly hairs, the rows almost equalling length of face, lower part of front projecting more than length of third antennal joint in front of the eyes, antennæ nearly three-fourths as long as the face, the third joint one and one-half times as long as the second, proboscis nearly as long as height of head, the labella very small; mesonotum slightly polished, two median vittæ in front of the

suture, the lateral margins in front of wings and the pleura, gray pruinose, three pairs of postsutural dorsocentral bristles; abdomen depressed, elongate-ellipsoidal, almost one and one-half times as long as broad, subopaque, dark gray pruinose, a broad dorsal vitta and very narrow bases of the segments, black; hypopygium only slightly projecting, opaque, gray pruinose; venter, especially along the sides, densely covered with rather long hairs; middle femora covered on the anterior-under side with short bristles, on the posterior-under side with long bristly hairs, becoming shorter toward apices of the femora; middle tibiæ each bearing a bristle at three-fourths the length of the outer-anterior side, three on lower half of outer-posterior side and two below middle of inner-posterior side; hind femora on the anterior-under side ciliate with long bristles and hairs, the posterior-under side ciliate with shorter bristles which are much shorter on the apical third; hind tibiæ each bearing a bristle below the middle of the inner-anterior side, the outer-anterior side ciliate with about nine rather short bristles on about the median three-fifths, the outer-posterior side ciliate with about three long and three shorter bristles on about the median third; wings hyaline, costal vein pubescent, third and fourth veins slightly converging, hind crossvein very sinuate, calypteres white; length, 6 mm. A male specimen, collected July 28.

Habitat.—Juneau, Alaska.

Type.—Cat. no. 5247, U. S. National Museum.

Hylemyia alcathœ (Walker).

Anthomyia alcathœ WALKER, List Dipt. Ins. British Museum, IV, p. 937, 1849.

Hylemyia flavicaudata BIGOT, Annales Soc. Ent. France, p. 299, 1884.

Hylemyia strigata STEIN, Berliner Ent. Zeitsch., p. 211, 1898.

Sitka, Alaska: Nine specimens, collected June 16. Originally described from Nova Scotia, and has been recorded from Idaho and Washington. The U. S. National Museum also possesses specimens collected at Franconia, New Hampshire, by Mrs. Annie T. Slosson.

Hylemyia variata (Fallen).

Musca variata FALLEN, Dipt. Sueciæ, Muscidæ, p. 59, 1820.—SCHINER, Fauna Austriaca, Dipt., I, p. 628, 1862.

Popof Island, Alaska: Six specimens, collected July 8 to 12. A European species, first reported from this country about two years ago by Mr. P. Stein, who recorded it as occurring from Canada to Virginia, westward to Idaho.

Hylemyia marginata Stein.

Hylemyia marginata STEIN, Berliner Ent. Zeitsch., p. 221, 1898.

Sitka, Alaska: A male specimen, collected June 16. The type locality of this species is Colorado.

Hylemyia linearis Stein.

Hylemyia linearis STEIN, Berliner Ent. Zeitsch., p. 219, 1898.

Kukak Bay, Alaska: Two male specimens, collected July 4. This species was originally described from Minnesota.

Hylemyia spiniventris sp. nov.

Male: Black, the halteres yellow; frontal vitta at narrowest part slightly wider than the lowest ocellus, antennæ about five-sixths as long as the face, the third joint only slightly longer than the second, longest hairs of arista almost twice as long as greatest diameter of the arista, proboscis slightly longer than height of head, very slender, the labella very small; mesonotum slightly polished, two median vittæ in front of the suture, the lateral margins in front of the wings, and the pleura, grayish pruinose, three pairs of postsutural dorsocentral bristles, sternopleurals 1 + 2; abdomen somewhat depressed, almost linear, subopaque, yellowish gray pruinose and with darker, olivaceous reflecting spots, hairs of venter becoming gradually longer toward its apex, the plate on the fifth ventral segment beset along each outer edge with about eight stout, rather short, inwardly curving spines, near the apex of the plate with a transverse pair of clusters of rather long bristles and hairs; front tibiæ each bearing two bristles below the middle of the posterior side and with three below middle of outer side; middle femora ciliate with bristles along the anterior-under and posterior-under sides, middle tibiæ each bearing two bristles on the outer-anterior side, three on the posterior-outer side, and two or three on the inner-posterior side, all on about the median third of the tibia; hind femora sparsely ciliate with long bristles on the anterior-under side and basal half of the posterior-under side, the apical half of the latter side ciliate with short bristles; hind tibiæ each bearing three bristles on the inner-anterior side, four on the outer-anterior side, five on the outer-posterior side, and about four short ones on the basal half of the posterior side; wings dark brown at base, the remainder pale brown, changing into grayish hyaline along the hind margin, costal vein distinctly spined to apex of first vein, costal spine slightly longer than the small crossvein, hind crossvein strongly sinuate, calypteres yellow.

Female: Front at narrowest point almost one and one-half times as wide as either eye, a pair of cruciate præocellar bristles; mesonotum opaque yellowish gray pruinose, marked with five indistinct brown

vittæ, abdomen elongate oval, fifth ventral segment destitute of spines and of long bristles; middle femora each bearing one long bristle on the basal fifth of the anterior-under side and with short ones on the remainder, with three long ones on the basal half of the posterior-under side and with short ones on the apical half; hind tibiæ destitute of bristles on the posterior side; wings grayish hyaline, yellow in the costal cell, the veins largely yellow, otherwise as in the male. Length, 6 to 8 mm. Two pairs, taken in coition, July 10.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5248, U. S. National Museum.

Hylemyia simpla sp. nov.

Black, the halteres yellow, lower part of front yellowish brown; frontal orbits contiguous for a short distance, antennæ nearly as long as the face, the third joint only slightly longer than the second, longest hairs of arista scarcely longer than greatest diameter of the arista; proboscis short and rather slender, labella large; mesonotum subopaque, thinly dark grayish pruinose, the sides in front of wings light gray pruinose, three pairs of postsutural dorsocentral bristles, sternopleurals 1 + 2; abdomen depressed, nearly linear, dark gray pruinose, the first segment and a median vitta, black, hairs of venter slightly increasing in length toward its apex, hypopygium gray pruinose, destitute of long bristles on its apical portion; front tibiæ each bearing a bristle near the middle of its inner-posterior side, the bristle at apex of inner side sharp-pointed; middle femora on the anterior-under side and apical half of the posterior-under side ciliate with rather short bristles, on the basal half of the posterior-under side with very long ones; middle tibiæ each bearing one bristle on the inner-anterior side, one on the outer-anterior, one on the outer-posterior, and two on the inner-posterior side, all near the middle of the tibia; hind femora sparsely ciliate on the anterior-under side with rather long bristles, the posterior-under side with very short ones and near the apex with two or three rather long ones; hind tibiæ each bearing about six rather short bristles on the anterior-inner side, five on the anterior-outer side, three long ones on the outer side, the inner-posterior side ciliate with rather short ones on the basal three-fourths; wings hyaline, costal vein ciliate with very short spines, costal spine much longer than the small crossvein, hind crossvein almost straight, calypteres yellowish; length, 5 mm. A male specimen, collected June 16.

Habitat.—Sitka, Alaska.

Type.—Cat. no. 5249, U. S. National Museum.

Hylemyia fabricii (Holmgren).

Aricia fabricii HOLMGREN, Ofversigt Vetan.-Akad. Forh., p. 101, 1872.

Kukak Bay, July 4; Popof Island, Alaska, July 9 to 11: Thirteen specimens of both sexes. Originally described from Greenland, and the U. S. National Museum contains a male specimen collected at Franconia, New Hampshire, by Mrs. Annie T. Slosson. The two long ribbon-like appendages of the hypopygium are visible only when the hypopygium is disengaged.

Pegomyia costalis Stein.

Pegomyia costalis STEIN, Berliner Ent. Zeitsch., p. 243, 1898.

Kukak Bay, July 4; Saldovia, Alaska, July 21: Two specimens. The type locality of this species is South Dakota.

Phorbia pretiosa (Walker).

Ariphhia pretiosa WALKER, List Dipt. Ins. British Museum, IV, p. 965, 1849.

Lowe Inlet, British Columbia, June 3; Sitka, June 16; Yakutat, June 21; Juneau, Alaska, July 25: Ten specimens. Originally described from the Albany River, British America.

Phorbia biciliata sp. nov.

Male: Black, the halteres yellow, lower part of front yellowish brown; frontal orbits unusually broad, contiguous for a considerable distance, only three or four pairs of very short front bristles, the ocellar bristles not longer than the adjoining hairs, antennæ three-fourths as long as the face, the third joint scarcely one and one-half times as long as the second, arista with a very short pubescence, proboscis rather slender, labella small; thorax, scutellum, and abdomen whitish pruinose, unmarked, abdomen depressed, very elongate oval, hairs of venter sparse and of nearly a uniform length, hypopygium unusually large, its two segments together much longer than the preceding segment, the two lamellæ of the fifth ventral segment very large, each bearing a row of about four short spines at the apex; front tibiæ each bearing a bristle near middle of the posterior side, the bristle at apex of inner side slender and sharp pointed; middle femora ciliate on the anterior-under and posterior-under sides with rather short bristles, middle tibiæ each bearing two bristles on the median third of the outer-posterior side and with one below middle of the inner-posterior side; hind femora ciliate on the anterior-under and posterior-under sides with bristles which are very short on the bases of the femora but gradually become rather long toward the apices; hind tibiæ ciliate with rather short bristles along the entire length of

the inner-anterior side, with five or six rather short bristles on the median two-fourths of the outer-anterior side, with three bristles which are successively longer, located at the first, second and third fifths of the outer side, the inner-posterior side ciliate with rather short, downwardly curving bristles on nearly its entire length; wings whitish hyaline, costal vein not spined, costal spine minute, hind crossvein slightly curved; calypteres white.

Female: Front at narrowest point slightly wider than either eye, ocellar and frontal bristles stout, a pair of præocellar bristles; front tibiæ destitute of bristles except at the apices, middle tibiæ each with one bristle below middle of outer-anterior side and one near middle of outer-posterior side; hind tibiæ each bearing about three bristles below middle of the inner-anterior side, two on median third of the outer-anterior side, and three on the outer-posterior side, otherwise nearly as in the male. Length, 3 mm. A specimen of each sex, collected June 10.

Habitat.—Berg Bay, Alaska.

Type.—Cat. no. 5250, U. S. National Museum.

Hylephila silvestris (Fallen).

Musca silvestris FALLEN, Diptera Sueciæ, Musciæ, p. 70, 1820.

Aricia silvestris ZETTERSTEDT, Dipt. Scand., IV, p. 1527, 1845.

Anthomyza murina ZETTERSTEDT, Insecta Lappon., p. 682, 1840.

Aricia decrepita ZETTERSTEDT, Dipt. Scand., IV, p. 1454, 1845.

Kukak Bay, July 4; Popof Island, July 10; Kadiak, Alaska, July 20: Thirteen specimens, of both sexes. A European species, now for the first time reported from this Continent. The synonymy is according to Mr. P. Stein, who made an examination of Zetterstedt's types. This examination revealed the fact that in the cases of both *murina* and *decrepita*, Zetterstedt had mistaken the females for males.

Chirosia glauca sp. nov.

Male: Black, the arista, except the basal fourth, and the halteres yellow, front at narrowest point almost as wide as either eye, a pair of small, cruciate præocellar bristles; antennæ nearly as long as the face, the third joint one and one-half times as long as the second, proboscis short and rather robust, palpi each bearing about four rather long bristles; body opaque, bluish gray pruinose, about four irregular pairs of præsutural acrostichal bristles, sternopleurals four, the lower two scarcely stouter than bristly hairs; abdomen depressed, elongate-ellipsoidal, hypopygium unusually large, nearly concealed beneath the abdomen; front tibiæ destitute of bristles, front pulvilli about one-half as long as the last tarsal joint, middle femora on under side sparsely

covered with rather short bristles, middle tibiæ each bearing a short bristle at two-thirds the length of the inner-anterior side and with one near middle of the outer-posterior side; hind femora ciliate with long bristles on the anterior-under side and with rather short ones on the basal half of the posterior-under side; hind tibiæ each bearing two short bristles on lower half of the inner-anterior side, three rather long ones on the outer-anterior and four on the outer-posterior sides; wings hyaline, costal vein ciliate with very short spines, costal spine slightly longer than the small crossvein; calypteres yellowish white; length 4.5 mm. A male specimen, collected June 8.

Habitat.—Farragut Bay, Alaska.

Type.—Cat. no. 5251, U. S. National Museum.

Chirosia thinobia (Thomson).

Scatophaga thinobia THOMSON, Kongliga Svenska Fregatt. Engenies Resa, p. 563, 1868.

Metlakahtla, June 4; Sitka, June 16; Saldovia, Alaska, July 21: Twelve specimens. Originally described from California.

Fucellia fucorum (Fallen).

Scatomyza fucorum FALLEN, Diptera Sueciæ, Scatomyzidæ, p. 5, 1819.

Fucellia fucorum SCHINER, Fauna Austriaca, Dipt., II, p. 15, 1864.

Sitka, June 16; Kukak Bay, July 4; Popof Island, July 8; Saldovia, Alaska, July 21: Twenty-eight specimens. A European species, first reported from this country about sixty years ago. It is a maritime species, reported as occurring from Greenland to Florida, and also in the Bering Islands.

Family SCATOPHAGIDÆ.

Scatophaga stercoraria (Linné).

Musca stercoraria LINNÉ, Fauna Suecica, p. 1861, 1761.

Scatophaga stercoraria SCHINER, Fauna Austriaca, Dipt., II, p. 18, 1864.

Kadiak, July 20; Juneau, Alaska, July 25: Ten specimens. Originally described from Europe, but at present almost cosmopolitan.

Scatophaga furcata (Say).

Pyropha furcata SAY, Journal Acad. Nat. Sciences Philadelphia, p. 98, 1823.

Scatophaga squalida MEIGEN, System. Besch. Eur. Zweif. Ins., v, p. 252, 1826.

Lowe Inlet, British Columbia, June 3; Metlakahtla, June 4; Sitka, June 16; Popof Island, July 11 to 14; Kadiak, Alaska, July 20: Nine specimens. This species was originally described from Missouri, but occurs over the greater portion of North America, ranging

Proc. Wash. Acad. Sci., November, 1900.

from Greenland and Alaska to Georgia and Texas. It also occurs in Europe, and is one of the very few species described in this country before it was in Europe.

Scatophaga intermedia Walker.

Scatophaga intermedia WALKER, List Dipt. Inst. Brit. Museum, IV, p. 980, 1849.

Muir Inlet, Alaska: A single specimen, collected June 11. The type locality is Nova Scotia. This species has also been recorded from New Hampshire and from Bering Islands; specimens are in the U. S. National Museum from Maine and Massachusetts.

Scatophaga suilla (Fabricius).

Musca suilla FABRICIUS, Entomol. Syst., IV, p. 343, 1794.

Scatophaga spurca MEIGEN, System. Besch. Eur. Zweif. Ins., v, p. 250, 1826.

Sitka, June 16; Virgin Bay, June 26; Popof Island, July 10 to 13; Kadiak, Alaska, July 20: Twelve specimens. A European species not before recorded from this Continent. The U. S. National Museum contains specimens from New Hampshire, Canada, Washington, and Colorado.

Scatophaga islandica Becker.

Scatophaga islandica BECKER, Berliner Ent. Zeitsch., p. 175, 1894.

Berg Bay, June 10; Yakutat, June 21; Popof Island, July 8 to 11; Kadiak, Alaska, July 20: Fifteen specimens. Originally described from Iceland and Labrador; it has also been reported from Bering Islands.

Scatophaga frigida sp. nov.

Male and female: Black, the frontal vittæ yellowish red, cheeks and sides of face pale yellow, arista beyond the thickened basal part, palpi, and halteres yellow, tibiæ reddish yellow; third joint of antennæ twice as long as the second, arista short plumose on the antepenultimate fourth, the longest hairs one and one-half times as long as greatest diameter of arista; under side of palpi rather thickly beset with long yellowish white bristly hairs, the upper side with very short, the apices with long black bristles; body opaque, bluish gray pruinose, mesonotum marked with four blackish brown vittæ, its bristles and sparse, rather short hairs black; hairs of pleura long and abundant, those of the mesopleura chiefly black, of the sternopleura yellow, pteropleura bare; abdomen densely covered with long hairs, those on the dorsum chiefly black, on the venter yellow; femora, except upper side of the middle ones, rather densely covered with long black and yellow hairs,

tibiæ more sparsely covered with long black ones, hind and middle femora destitute of bristles, middle tibiæ each with two bristles on the anterior and two on the posterior side, hind tibiæ each with two or three on the anterior and two on the posterior side besides those at the apices; wings pale yellowish gray, changing to hyaline along the hind margin, crossveins not clouded with brown; calypteres white; length 8 to 10 mm. Two males and one female.

Habitat.—Kukak Bay, July 4; Popof Island, Alaska, July 9.

Type.—Cat. no. 5252, U. S. National Museum.

The U. S. National Museum also possesses a male specimen collected at Port Chester, Alaska, by Professor H. F. Wickham.

***Pogonota kincaidi* sp. nov.**

Male: Black, the front on lower part, in the middle almost reaching the ocellar triangle, face, cheeks, antennæ, palpi, halteres, anterior portion of front coxæ, and the legs, yellow; third joint of antennæ three times as long as the second, arista bare, vibrissæ and the bristles and hairs along lower side of head yellow, hairs on lower side of occiput extremely sparse; a velvet-black, H-shaped spot near center of front; body slightly polished, thinly grayish pruinose, hairs on dorsum of abdomen very short except a fringe of long black ones near hind margins of the fourth, fifth, and sixth segments; end lamellæ of hypopygium each slightly longer than wide, directed upward, the apex fringed with long pale yellow hairs which curve over the back; in front of the hypopygium is a pair of ventral processes which, near the middle of the anterior side, send forth an anteriorly directed, compressed, obliquely truncated lobe, beyond which the main process is strongly bent backward, but curves slightly forward toward its apex; front femora greatly swollen, considerably narrowed toward the apex of the under side, bearing many very short, black bristles on the under side of the thickened portion and on the inner side of the front tibiæ; wings whitish hyaline, a pale brownish vitta in the middle, most pronounced beyond the small crossvein, second basal cell slightly widening toward the apex, crossvein at base of discal cell almost perpendicular, hairs along the costa extremely short; calypteres whitish.

Female: Differs from the male as follows: Yellow of front extends above lowest ocellus, third joint of antennæ black, proboscis yellow, its apex brown, front coxæ wholly yellow, vibrissæ and two adjacent bristles black, no velvet-black mark near center of front, abdomen not pruinose, highly polished, destitute of long hairs and of ventral processes, depressed at base, strongly compressed at apex, ovipositor

nearly linear, about three times as long as greatest width, tapering to a point at apex, front femora only slightly thickened, no black bristles on their under sides nor on inner sides of the front tibiæ; wings hyaline, unmarked. Length, 5 mm. A specimen of each sex, collected July 11.

Habitat.—Popof Island, Alaska.

Type.—Cat. no. 5253, U. S. National Museum.

This genus has not heretofore been recorded from this Continent. The present species would fall in the genus *Okenia* as defined by Becker (Berliner Ent. Zeitsch., 1894, p. 141), but as that name is preoccupied in the Mollusca, the species previously referred to it may be transferred to *Pogonota*, with which they agree except in a few trifling particulars.

***Cordylura præusta* Loew.**

Cordylura præusta LOEW, Berliner Ent. Zeitsch., p. 96, 1864.

Berg Bay, Alaska: a single specimen, collected June 10. Originally described from Canada, and has been recorded from New Jersey. The U. S. National Museum possesses a specimen collected by Mrs. A. T. Slosson at Franconia, New Hampshire.

***Cordylura vittipes* Loew.**

Cordylura vittipes LOEW, Berliner Ent. Zeitsch., p. 272, 1872.

Metlakahtla, June 4; Berg Bay, June 10; Sitka, June 16; Yakutat, June 21; Popof Island, Alaska, July 8: Seven specimens. Originally described from Sitka.

***Cordylura variabilis* Loew.**

Cordylura variabilis LOEW, Zeitschrift Ges. Naturw., p. 326, 1876.

Metlakahtla, June 4; Berg Bay, June 10; Virgin Bay, June 20; Kukak Bay, July 4; Popof Island, Alaska, July 11: Seven specimens. Originally described from Massachusetts. Specimens are in the U. S. National Museum collection, ranging from New Hampshire to North Carolina, and westward to Texas and Colorado.

***Orthochæta pilosa* (Zetterstedt).**

Cordylura pilosa ZETTERSTEDT, Insecta Lappon., p. 732, 1840.

Orthochæta pilosa BECKER, Berliner Ent. Zeitsch., p. 101, 1894.

Metlakahtla, Alaska: A female specimen, collected June 4. This European species has not heretofore been reported from this country.

***Hexamitocera cornuta* (Walker).**

Lissa cornuta WALKER, List Dipt. Ins. Brit. Museum, IV, p. 1047, 1849.

Yakutat, Alaska: A male specimen, collected June 21. Originally described from the Albany River, British America.

Family HELOMYZIDÆ.

Helomyza zetterstedtii Loew.

Helomyza zetterstedtii LOEW, Zeitschrift Entom. Breslau, p. 37, 1859.

Yakutat, June 21; Popof Island, Alaska, July 8: Two specimens. This is a European species, first reported from this country about twenty-two years ago. Specimens are in the U. S. National Museum from the White Mountains, New Hampshire, and Ungava Bay, British America.

Leria leucostoma (Loew).

Blepharoptera leucostoma LOEW, Berliner Ent. Zeitsch., p. 28, 1863.

Popof Island, July 10; Kadiak, July 20; Saldovia, Alaska, July 21: Three specimens. Originally described from Alaska. Specimens are in the U. S. National Museum from the White Mountains, New Hampshire.

Leria fraterna (Loew).

Scotiocentra fraterna LOEW, Berliner Ent. Zeitsch., p. 27, 1863.

Orca, Alaska: A single specimen, collected June 21. This species was also originally described from Alaska. It has been reported from Mt. Washington, New Hampshire, and the U. S. National Museum contains specimens from Ungava Bay, British America, and Laggan, British Columbia.

Family SCIOMYZIDÆ.

Tetanocera plumosa Loew.

Tetanocera plumosa LOEW, Entom. Zeitung Stettin, p. 201, 1847. Monographs Dipt. N. Am., 1, p. 121, 1862.

Virgin Bay, June 26; Kukak Bay, July 4; Popof Island, July 9 to 16; Kadiak, Alaska, July 20: Eleven specimens. Originally described from Alaska, and also recorded from Connecticut and New Jersey. Specimens in the U. S. National Museum indicate that this species occurs from Maine and Pennsylvania, westward to California and Alaska.

Neuroctena anilis (Fallen).

Dryomyza anilis FALLEN, Diptera Sueciæ, Sciomyzidæ, p. 16, 1820.
Dryomyza pallida DAY, Canadian Ent., p. 89, 1881.

Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, July 4; Kadiak, Alaska, July 20: Six specimens. A European species, first reported from this country about thirty-eight years ago. It has been recorded from Connecticut and New Jersey. Specimens in the U. S.

National Museum show that it ranges northward to New Hampshire, and also occurs in Washington.

***Ædoparea glauca* sp. nov.**

Black, the halteres yellow; head bluish gray pruinose, the entire front brownish gray pruinose, only two vertical bristles (the anterior) present, ocellar and postocellar bristles present, two pairs of fronto-orbitals; face in profile strongly concave, the clypeus unusually large and projecting the length of the third antennal joint beyond the anterior edge of the oral margin, cheeks posteriorly two-thirds as broad as the eye-height, third joint of antennæ orbicular; body bluish gray pruinose, mesonotum largely brownish pruinose, five pairs of dorso-central bristles, scutellum bearing three pairs of marginal bristles, pleura and legs destitute of bristles except at apices of tibiæ; wings grayish hyaline, stigma and base of costal cell yellowish gray, apex of first vein opposite the hind crossvein; length 6 to 7 mm. Four males and three females.

Habitat.—Metlakahtla, June 4; Farragut Bay, Alaska, June 5.

Type.—Cat. no. 5254, U. S. National Museum.

This genus was founded by Dr. Loew in the *Zeitschrift für Entomologie zu Breslau* for 1859, page 10, and has for its type species the *Heteromyza buccata* of Fallen. Dr. Loew draws attention to the fact that in his original definition of the genus *Heteromyza*, Fallen stated that the vibrissæ are present, but as a matter of fact, this is true of only one (*oculata*) of the two species which he places in it; *oculata* therefore must be considered the type species of the genus *Heteromyza*. About three years previous to the publication of Dr. Loew's article, Rondani had selected *buccata* as the type of a new genus, to which he applied the name *Heterostoma*, but upon discovering that this name had been previously used for another genus, he changed it the following year to *Heterocheila*. But this name was, in his opinion, too near to the previously employed generic term, *Heterocheilus*, and, accordingly, eleven years later he again changed it to *Exocheila*. As the name proposed by Dr. Loew had been published about nine years previously, it will, of course, take precedence over the name bestowed by Rondani.

***Sciomyza glabricula* Fallen.**

Sciomyza glabricula FALLEN, *Diptera Succize, Sciomyz.*, p. 15, 1820.—SCHINER, *Fauna Austriaca, Dipt.*, II, p. 44, 1864.

Popof Island, Alaska: A single specimen, collected July 13. This is a European species, not heretofore reported from this Continent.

Family PSILIDÆ.

***Psila levis* Loew.**

Psila levis LOEW, Berliner Ent. Zeitsch., p. 40, 1869.

Sitka, June 16; Yakutat, June 21; Virgin Bay, June 26; Kukak Bay, Alaska, July 4: Seventeen specimens. Originally described from New Hampshire.

Family ORTALIDÆ.

***Melieria canus* (Loew).**

Ortalis canus LOEW, Berliner Ent. Zeitsch., p. 374, 1858.

Ceroxys canus LOEW, Monographs Dipt. N. Am., III, p. 128, 1873.

Fox Point, Alaska: A single specimen, collected July 28. A European species, first reported from this country about twenty-seven years ago. It has been recorded from Alaska and Nebraska, and the U. S. National Museum contains specimens from Colorado.

Family TRYPETIDÆ.

***Tephritis murina* Doane.**

Tephritis murina DOANE, Journal New York Ent. Soc., p. 189, 1899.

Popof Island, Alaska: Seven specimens, collected July 9 to 14. The type locality of this species is Washington.

Family LONCHÆIDÆ.

***Paloptera jucunda* Loew.**

Paloptera jucunda LOEW, Berliner Ent. Zeitsch., p. 29, 1863.

Kukak Bay, July 4; Popof Island, Alaska, July 8 to 14: Eleven specimens. Originally described from Alaska. The U. S. National Museum contains specimens collected in Idaho and Colorado.

***Lonchæa albitarsis* Zetterstedt.**

Lonchæa albitarsis ZETTERSTEDT, Insecta Lappon., p. 754, 1840. Dipt. Scand., VI, p. 2351, 1847.

Sitka, Alaska: Two specimens, collected June 16. A European species not before reported from this Continent.

***Lonchæa hyalinipennis* Zetterstedt.**

Lonchæa hyalinipennis ZETTERSTEDT, Dipt. Scand., VI, p. 2350, 1847.

Yakutat, June 21; Virgin Bay, Alaska, June 26: Two specimens. This is also a European species, not before recorded from this Continent.

***Lonchæa deutschii* Zetterstedt.**

Lonchæa deutschii ZETTERSTEDT, Insecta Lappon., p. 753, 1840. Dipt. Scand., VI, p. 2348, 1847.

Sitka, Alaska: Two specimens, collected June 16. This species falls into the same category as the two preceding.

Family SAPROMYZIDÆ.

Sapromyza brachysoma Coquillett.

Sapromyza brachysoma COQUILLET, Canadian Entom., p. 278, 1898.

Muir Inlet, June 12; Sitka, Alaska, June 16: Twenty-seven specimens. Originally described from New Hampshire.

Sapromyza lupulina (Fabricius).

Musca lupulina FABRICIUS, Mantissa Insect., II, p. 344, 1787.

Sapromyza lupulina BECKER, Berliner Ent. Zeitsch., p. 213, 1895.

Juneau, Alaska: Two specimens, collected July 25. A European species, first recorded as occurring in this country by Walker about fifty-one years ago. It has been reported as occurring along the eastern part of this country from Nova Scotia to New Jersey. Specimens in the U. S. National Museum indicate that it ranges as far southward as North Carolina, and westward to Kansas and Colorado.

Lauxania cylindricornis (Fabricius).

Musca cylindricornis FABRICIUS, Entom. System., IV, p. 332, 1792.

Lauxania cylindricornis SCHINER, Fauna Austriaca, Dipt., II, p. 95, 1864.

Lowe Inlet, British Columbia, June 3; Muir Inlet, June 11; Sitka, June 16; Kukak Bay, July 4; Popof Island, Alaska, July 10 and 11: Eight specimens. This is also a European species, first reported from this country by the same writer and at the same time as the preceding species. It has been recorded as occurring along the Atlantic seaboard from Nova Scotia to Georgia.

Family PHYCODROMIDÆ.

Cœlopa frigida (Fallen).

Copromyza frigida FALLEN, Diptera Sueciæ, Hydromyz., p. 6, 1820.

Cœlopa frigida ZETTERSTEDT, Dipt. Scand., VI, p. 2472, 1847.

Kadiak, Alaska: A single specimen, collected July 20. A European species, reported as occurring in this country by Osten Sacken about twenty-two years ago. It has also been recorded from Bering Islands.

Cœlopa nitidula Zetterstedt.

Cœlopa nitidula ZETTERSTEDT, Dipt. Scand., VI, p. 2473, 1847.

Kadiak, Alaska: A single specimen, collected July 20. This is also a European species recorded from this country with the preceding species.

Family SEPSIDÆ.

Sepsis referens Walker.

Sepsis referens WALKER, List Dipt. Ins. Brit. Museum, IV, p. 999, 1849.

Lowe Inlet, British Columbia: A single specimen, collected June 3. Originally described from North America, without reference to any more definite locality.

Sepsis flavimana Meigen.

Sepsis flavimana MEIGEN, Syst. Besch. Eur. Zweif. Ins., v, p. 288, 1826.—
SCHINER, Fauna Austriaca, Dipt., II, p. 180, 1864.

Saldovia, July 21; Juneau, Alaska, July 25: Two specimens. A European species, not heretofore reported from this Continent.

Family PIOPHILIDÆ.

Piophila casei (Linné).

Musca casei LINNÉ, Fauna Suecica, p. 1850, 1761.

Piophila casei SCHINER, Fauna Austriaca, Dipt., II, p. 186, 1864.

Juneau, Alaska: Two specimens, collected July 25. A European species, first reported from this country by Dr. Loew about thirty-six years ago.

Prochyliza xanthostoma Walker.

Prochyliza xanthostoma WALKER, List Dipt. Ins. Brit. Museum, IV, p. 1045, 1849.

Saldovia, Alaska: A single specimen, collected July 21. Originally described from Albany River, British America, and has been recorded from New Jersey and the District of Columbia. Specimens in the U. S. National Museum indicate that it ranges southward to Georgia, and westward to Texas and Kansas.

Family EPHYDRIDÆ.

Hydrellia scapularis Loew.

Hydrellia scapularis LOEW, Monog. Dipt. N. Am., I, p. 153, 1862.

Lowe Inlet, British Columbia; Yakutat, June 21; Popof Island, Alaska, July 8 to 10: Six specimens. Originally described from the United States without any more definite locality being given. It has been recorded from New Jersey, and specimens in the U. S. National Museum indicate that it ranges westward through Illinois to California.

Pelomyia occidentalis Williston.

Pelomyia occidentalis WILLISTON, N. Amer. Fauna, no. 7, p. 258, 1893.

Saldovia, Alaska: Five specimens, collected July 21. Originally described from Monterey, Calif.

Parydra paullula Loew.

Parydra paullula LOEW, Monog. Dipt. N. Am., I, p. 167, 1862.

Popof Island, Alaska: A single specimen, collected July 10. No locality was mentioned in the original description, but the type specimen was evidently collected in some part of the United States.

Scatella setosa sp. nov.

Black, the halteres yellow; head and body opaque, densely bluish gray pruinose, cheeks at narrowest part about one-sixth as wide as the eye-height, a stout bristle near junction of each with the occiput and two on each side of the face; mesonotum bearing three pairs of dorsocentral bristles, the anterior pair in front of the suture, no bristles nor hairs between the two rows of dorsocentrals behind the suture, in front of the suture with a strong pair of acrostichal bristles, and in front of these are three or four pairs of shorter bristles; scutellum bearing a short lateral and a very long subapical pair of bristles; wings grayish brown, marked with five rather small whitish spots, one in the submarginal cell above the hind crossvein, one near the base and another beyond middle of the first posterior cell, finally one on either side of the hind crossvein; length 2.5 mm. A single specimen, collected July 21.

Habitat.—Saldovia, Alaska.

Type.—Cat. no. 5255, U. S. National Museum.

Scatella stagnalis (Fallen).

Ephydra stagnalis FALLEN, Dipt. Sueciæ, Hydromyzidæ, p. 5, 1823.

Scatella stagnalis SCHINER, Fauna Austriaca, Dipt., II, p. 266, 1864.

Yakutat, Alaska: A single specimen, collected June 21. A European species, reported as occurring in Greenland about fifty-five years ago. It has also been reported from New Jersey, and the specimens in the U. S. National Museum indicate that it occurs as far southward as Georgia and westward to Arizona.

Family DROSOPHILIDÆ.**Scaptomyza flaveola** (Meigen).

Drosophila flaveola MEIGEN, Sys. Besch. Eur. Zweif. Ins., VI, p. 66, 1830.

—SCHINER, Fauna Austriaca, Dipt., II, p. 279, 1864.

Sitka, Alaska: A single specimen, collected June 16. This is a European species, first reported from this country by the writer in 1895. It was recorded from the District of Columbia, and the National Museum also contains specimens from Connecticut and New Hampshire. The characters heretofore used for separating *Drosophila* from *Scap-*

toomyza have been rather vague and obscure, and in consequence the last-named genus has not been generally adopted. A recent study of this group has disclosed a well-marked difference in the disposition of the short, bristly hairs of the mesonotum; in *Scaptomyza* these hairs are sparse and are arranged in two or four nearly regular rows, while in *Drosophila* as restricted they are numerous and not arranged in two or four rows. This difference, taken in connection with the widely divergent habits of the larvæ—leaf-miners in *Scaptomyza*, scavengers in *Drosophila*—will justify the separation of these two forms into two distinct genera.

Family OSCINIDÆ.

Oscinis carbonaria Loew.

Oscinis carbonaria LOEW, Berliner Ent. Zeitsch., p. 42, 1869.

Metlakhtla, June 4; Popof Island, July 8 to 12; Juneau, Alaska, July 26: Seven specimens. Originally described from the District of Columbia, and has been reported to occur from New Jersey to Nebraska, and northward to Canada.

Chlorops sahlbergi Loew.

Chlorops sahlbergi LOEW, Berliner Ent. Zeitsch., p. 51, 1863.

Muir Inlet, June 12; Virgin Bay, June 26; Saldovia, Alaska, July 21: Five specimens. Originally described from Alaska.

Chlorops producta Loew.

Chlorops producta LOEW, Berliner Ent. Zeitsch., p. 52, 1863.

Sitka, Alaska: A single specimen, collected June 16. The type specimen also came from Sitka.

Chlorops scabra Coquillett.

Chlorops scabra COQUILLET, Journal New York Ent. Soc., p. 46, 1898.

Saldovia, Alaska: A single specimen, collected July 21. Originally described from Oswego, N. Y.

Family AGROMYZIDÆ.

Rhincæssa parvula Loew.

Rhincæssa parvula LOEW, Berliner Ent. Zeitsch., p. 45, 1869.

Kukak Bay, July 4; Saldovia, Alaska, July 21: Two specimens. Originally described from Rhode Island.

Agromyza neptis Loew.

Agromyza neptis LOEW, Berliner Ent. Zeitsch., p. 50, 1869.

Juneau, Alaska: Two specimens, collected July 25. Originally de-

scribed from the District of Columbia, and has been recorded as occurring from Massachusetts to Florida and Texas, and also from Porto Rico.

Agromyza lacteipennis Fallen.

Agromyza lacteipennis FALLEN, Diptera Sueciæ, Agromyzidæ, p. 4, 1823.—
SCHINER, Fauna Austriaca, Dipt., II, p. 300, 1864.

Saldovia, Alaska: A single specimen, collected July 21. A European species, not before reported from this Continent.

Phytomyza flavicornis Fallen.

Phytomyza flavicornis FALLEN, Diptera Sueciæ, Phytomyzidæ, p. 4, 1823.—
SCHINER, Fauna Austriaca, Dipt., II, p. 315, 1864.

Yakutat, Alaska: A single specimen, collected June 21. This is a European species, not before reported from this Continent. The U. S. National Museum contains specimens from Ohio and Illinois.

Phytomyza ilicicola Loew. *

Phytomyza ilicicola LOEW, Berliner Ent. Zeitsch., p. 290, 1872.
Phytomyza ilicis LOEW, Berliner Ent. Zeitsch., p. 54, 1863. (Nec Curtis.)

Muir Inlet, June 12; Orca, Alaska, June 27: Two specimens. Originally described from the District of Columbia. The U. S. National Museum contains specimens from Massachusetts, California, and Oregon.

Napomyza lateralis (Fallen).

Napomyza lateralis FALLEN, Diptera Sueciæ, Phytomyzidæ, p. 3, 1823.—
SCHINER, Fauna Austriaca, Dipt., II, p. 314, 1864.

Popof Island, Alaska: A single specimen, collected July 10. This is a European species, not before recorded from this Continent. The U. S. National Museum contains specimens collected in New Hampshire, Illinois, and Missouri.

Family BORBORIDÆ.

Borborus annulus Walker.

Borborus annulus WALKER, List Dipt. Ins. Brit. Museum, IV, p. 1129, 1849.

Popof Island, Alaska: A single specimen, collected July 10. Originally described from Nelson River and Albany River, British America.

Aptilotus politus (Williston).

Apterina politus WILLISTON, North Amer. Fauna, no. 7, p. 259, 1893.

Farragut Bay, Alaska: Two specimens, collected June 5. The type locality of this species is the Panamint Mountains, California.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES.

VOL. II, PP. 465-476.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

X.

ENTOMOLOGICAL RESULTS (4):
NEUROPTEROID INSECTS.

[PLATES XXVII-XXVIII.]

BY NATHAN BANKS.

THE Neuropteroid insects collected by Professor Kincaid on the Harriman Alaska Expedition represent thirty-four species. They may be tabulated as follows :

Pseudoneuroptera	11
Perlidae	9
Ephemeridae	2
Neuroptera	1
Hemerobiidae	1
Trichoptera	22
Phryganeidae	1
Limnephilidae	16
Leptoceridae	3
Rhyacophilidae	2
Total	34

It will thus be seen that the great majority of the species belong to two families, Perlidae and Limnephilidae. As regards the affinities of the fauna we can deal with only the described species, twenty-five in number. These may be tabulated as follows :

Known from Washington State	10
Known from Colorado	4
Known from Europe	2
Known from Northern United States	6
Known from British America	2
Known from Alaska only	8

Leaving out the species restricted to Alaska (some of which will doubtless be found on the West Coast), it will be seen that the fauna is very similar to that of the State of Washington.

The Perlidæ are represented chiefly by species of moderate size; the Trichoptera are represented by many species of large size. As a whole the collection is more brightly colored than those of more temperate latitudes.

PSEUDONEUROPTERA.

Family PERLIDÆ.

Chloroperla imbecilla Say.

Chloroperla imbecilla SAY, LeConte Ed. Compl. Writ., 1, p. 175, 1859.

Several specimens from Popof Island and Kukak Bay (July). Previously known from the Eastern States, Canada, and Washington.

Chloroperla pacifica Banks.

Chloroperla pacifica BANKS, Trans. Amer. Ent. Soc., p. 313, 1895.

Several specimens from Sitka (June) and Juneau (July). Described from Washington.

Chloroperla borealis Banks.

Chloroperla borealis BANKS, Trans. Amer. Ent. Soc., p. 313, 1895.

One specimen from Sitka (June). Described from Washington and Colorado.

Chloroperla decolorata Walker.

Chloroperla decolorata WALKER, Brit. Mus. Cat. Neur., p. 170, 1852.

Several from Popof Island and Kukak Bay (July). Previously known from British America and Canada.

Isopteryx cydippe Newman.

Isopteryx cydippe NEWMAN, Mag. Nat. Hist. (2), III, p. 88, 1839.

Four specimens from Sitka (June). Occurs in the northeastern States and Canada.

Nemoura cinctipes Banks.

Nemoura cinctipes BANKS, Trans. Amer. Ent. Soc., p. 21, 1897.

Four specimens: Sitka and Yakutat (June); Popof Island (July). Described from Washington.

Nemoura sp.

One specimen from Sitka (June). It is a small species, similar to *N. depressa* Banks, but apparently different.

Tæniopteryx sp.

Two specimens from Sitka (June). A rather large species with unmarked wings, except that the costal area is darker.

Leuctra sp.

Two specimens from Sitka (June); apparently like the eastern *L. ferruginca*, but the genitalia are different.

Family EPHEMERIDÆ.

Ephemerella grandis Eaton.

Ephemerella grandis EATON, Riv. Mon. Eph., p. 128, 1886.

Several examples from Popof Island (July). Described from Colorado.

Bætis sp.

Two adults and a sub-imago: Popof Island (July). It is pale brown, with yellowish legs and white setæ.

NEUROPTERA.

Family HEMEROBIIDÆ.

Hemerobius pacificus Banks.

Hemerobius pacificus BANKS, Trans. Amer. Ent. Soc., p. 24, 1897.

One specimen from Virgin Bay, Prince William Sound (June). Described from Washington.

TRICHOPTERA.

Family PHRYGANEIDÆ.

Neuronia lapponica Hagen.

Neuronia lapponica HAGEN, Verh. Zool.-bot. Ges. Wien., p. 852, 1864.

Two specimens, from Kukak Bay (July), of a pretty *Neuronia* which agrees well with this European species in every respect. Not before recorded from the American Continent.

Family LIMNEPHILIDÆ.

Limnephilus gravidus Hagen.

Limnephilus gravidus HAGEN, Syn. Neur. N. Amer., p. 257, 1861.

Two specimens from Virgin Bay (June). Described from North California; also occurs in Washington.

Limnephilus ornatus Banks.

Limnephilus ornatus BANKS, Trans. Amer. Ent. Soc., p. 27, 1897.

One specimen from Popof Island (July). Known from New Hampshire and Canada.

***Limnephilus sitchensis* Kolenati.** Pls. XXVII, fig. 8; XXVIII, fig. 15.

Limnephilus sitchensis KOLENATI, Gen. e Sp. Trich., II, p. 276, 1859.

Limnephilus pacificus BANKS, Trans. Amer. Ent. Soc., p. 207, 1898.

Many specimens from Kukak Bay, Popof Island, Unga and Unalaska (July). Described from Alaska. My *L. pacificus* is from Washington. At the time of its description I had not access to Kolenati's work.

***Limnephilus harrimani* sp. nov.**

Plate XXVII, figs. 1 and 2.

Face yellowish, black hair on sides and yellow in middle; vertex black, silvery near eyes, black hair above, posterior warts yellow, with black hair, ocelli rather small; palpi yellow; antennæ with basal joint brown, beyond yellowish, faintly annulate with brown. Prothorax with rather short yellow hair; rest of thorax black, silvery on middle, with mostly black hair, some yellowish on the sides near base of fore wings; legs yellowish, spines black; abdomen brown. Fore wings yellowish hyaline, largely infuscate with pale brown, sometimes broken up into faint pale spots, bases of the apical cells (except first) hyaline, apex of the thyridial area and base of the first subapical cell also hyaline, several large irregular dark brown spots in thyridial cell, area and subapicals; costal area pale; radius considerably bent at pterostigma, discal cell nearly one-third longer than its pedicel, first and fifth apicals fully their width on discal cell and thyridial area, fourth apical narrow at base. Hind wings hyaline, rather yellowish on tips, yellowish veins and gray fringe; fourth apical cell narrow at base, third broad and with a brown dot. Length 14 mm.; expanse 26 mm.

Two specimens from Kukak Bay (July), and Sitka (June).

Type.—Cat. no. 5259, U. S. National Museum.

***Limnephilus perjurus* Hagen.**

Plate XXVIII, fig. 14.

Limnephilus perjurus HAGEN, Syn. Neur. N. Amer., p. 258, 1861.

Two specimens from Popof Island (July). Described from Alaska.

***Limnephilus kincaidi* sp. nov.**

Plate XXVII, fig. 5.

Face black, with some yellow hair; vertex black, with black hair above and some yellowish behind; ocelli rather small; palpi pale; antennæ with basal joints black, rest yellowish. Prothorax with yellow hair; rest of thorax black, yellow patagia with yellow hair, yellow hair in middle; legs bright yellowish, usually black on femora except the tips, spines black; abdomen black. Fore wings rather dirty yellow-

ish, sometimes clearer beyond the anastomosis, veins mostly yellowish brown, hair black; radius considerably bent at the pterostigma, discal cell not much longer than its pedicel, first and fifth apical cells about their width on discal cell and thyridial area, fourth apical narrow at base; cubitals fractured at the posterior anastomosis. Hind wings hyaline, rather yellowish at the pterostigma, veins pale, fringe black, fourth apical cell plainly narrower at base than third. Length 13 mm.; expanse 25 mm.

Three specimens from St. George Island, Bering Sea (July).

Type.—Cat. no. 5260, U. S. National Museum.

Limnephilus nebulosus Kirby. Plate XXVIII, fig. 12.

Limnephilus nebulosus KIRBY, Faun. Bor. Amer., p. 253, 1837.

Four specimens, which apparently belong to this species, from Virgin Bay, Prince William Sound (June), and Saldovia and Kukak Bay (July). Described from British America.

Limnephilus sp.

Two specimens, from Popof Island and Kukak Bay (July), represent a small and probably undescribed species, but the material is not sufficient for study.

Asynarchus punctatissimus (Walker). Plate XXVII, fig. 6.

Hallesus punctatissimus WALKER, Brit. Mus. Cat. Neur., p. 17, 1852.

Four specimens from Popof Island and Farragut Bay (July). Occurs in Canada and Nova Scotia.

Asynarchus simplex sp. nov. Plate XXVII, fig. 3.

Head black, with black hair; palpi black; antennæ black, narrowly annulate with pale; ocelli of moderate size. Prothorax with long yellow hair, rest of thorax black, with black hairs in front of wings and yellowish near middle; legs pale yellowish, except the femora which are black, spines black; abdomen dark brown. Fore wings infuscated with pale brown, darker on pterostigma and along hind margin, veins brown, some faint pale spots beyond the anastomosis, hairs and fringe nearly black; radius considerably bent at pterostigma, the discal cell about one-third longer than its pedicel, first and fifth apical cells scarcely their width on discal cell and thyridial area, a brown dot in base of third apical, fourth as wide at base as third, the cubitals fractured at posterior anastomosis. Hind wings hyaline, with yellowish brown veins, pterostigma rather darker, fourth apical cell as wide as third at base. Length 14 mm.; expanse 27 mm.

Two specimens from St. Paul Island, Bering Sea.

Type.—Cat. no. 5261, U. S. National Museum.

Asynarchus fumosus sp. nov.

Plate XXVII, figs. 7, 9, 10.

Face dark in middle, pale on sides, with yellowish hair; vertex black, warts black, with mostly yellowish hair; ocelli small; palpi pale yellowish; antennæ brown, annulate beyond basal joints with yellowish. Prothorax with long yellow hair; thorax black, with mostly yellowish hair; legs yellowish, femora infuscate on bases, spines black; abdomen brown. Fore wings brown, shining; veins brown; rather yellowish in base of costal area; many scattered pale dots, most numerous just below the radius; a white mark near apex of thyridium, arculus white; several large whitish hyaline spots as follows: an oblique one in middle of the thyridial area and cell, one each in bases of first, second, fourth and fifth apical cells, a large one in apex of third apical, and a triangular one in apex of first and second subapicals (sometimes one or several of the discal marks are wanting); radius is bent at pterostigma, the discal cell is twice as long as its pedicel, the first apical is rather wide, at apex and extends for about its width on discal cell; the fourth is as wide as the third at base, the fifth extends about its width on thyridial area, the cubitals are fractured at posterior anastomosis. Hind wings hyaline, slightly infuscate on apex, a white dot in base of third apical cell; the fourth apical is broader at base than third. Length 15 mm.; expanse 29 mm.

Type.—Cat. no. 5262, U. S. National Museum.

Several specimens from Berg Bay (June); also occurs in Washington State. In one specimen the second apical sector fails to reach the margin in each hind wing.

Asynarchus flavicollis sp. nov.

Plate XXVIII, figs. 11 and 13.

Face yellowish, with yellow hair; vertex black, posterior warts yellow, with yellow hair; ocelli small; palpi yellow; antennæ yellowish, faintly annulate with brown. Prothorax yellow, with yellow hairs; rest of thorax black, the patagia and meso-scutellum pale; abdomen yellowish on base, brown at tip; legs clear pale yellowish, spurs reddish, spines black. Fore wings whitish hyaline, largely marked with brown, veins mostly yellowish, brown toward tips, the white spaces of wing with white hair, the brown spaces with brown hair; the brown marks are as follows: space between subcosta and radius, the radial sector and its fork narrowly margined, the third apical cell, the apical half of the fifth apical cell, basal half of the first subapical, all of second and third subapicals, middle of thyridial area, and all but tip of thyridial cell, and along the cubital veins; the first apical is about its width on discal cell, fourth as wide as third at

base, fifth about its width on thyridial area, upper branch of cubitus fractured at posterior anastomosis, radius bent at pterostigma. Hind wings whitish hyaline, more yellowish at tip, veins yellowish; fourth apical cell is as wide as third at base. Length 18 mm.; expanse 34 mm.

Two specimens from Yakutat (June).

Type.—Cat. no. 5263, U. S. National Museum.

Asynarchus alascensis sp. nov.

Plate XXVIII, fig. 16.

Face yellowish, with pale yellow hair; vertex black, with pale yellow hair; ocelli large, looking outwards; posterior warts yellow; palpi pale; antennæ yellowish on base, brownish beyond, narrowly annulate with brown, or brown throughout. Prothorax with tufts of long yellow hair; rest of thorax black, with some yellow hair; legs yellowish, femora more or less infuscate on bases, spines black; abdomen brown. Fore wings dirty yellowish-hyaline, sparingly clothed with yellow hair, black on the veins; thyridial cell, except base, and first subapical cell, except tip, whitish, with silvery white hair; veins mostly brown, that closing the thyridial area, a point on thyridium and the arculus white; radius considerably bent at the pterostigma; first apical cell fully its width on discal cell; fifth acute at base, scarcely on thyridial area; cubitals fractured at posterior anastomosis. Hind wings grayish hyaline, rather yellowish beyond anastomosis; discal cell only about twice as long as broad at tip, fourth apical about as broad as third at base. Length 14.5 mm.; expanse 29 mm.

Four specimens: Berg Bay and Virgin Bay (June); Kukak Bay (July).

Type.—Cat. no. 5264, U. S. National Museum.

In one specimen the silvery marks are scarcely visible.

Halesus (?) alascensis sp. nov.

Plate XXVIII, figs. 19 and 20.

Face yellow, with black hair on sides and yellowish in middle; vertex brown with yellow hair, ocelli small, posterior warts yellowish, black hair behind the eye; antennæ yellowish; palpi pale, slender. Prothorax yellow, with yellow hair, rest of thorax black, gray on middle, meso- and meta-scutellum yellow, mostly yellow hair; legs rather dirty yellowish, spines black; abdomen brown. Fore wings yellowish in anterior half, brown on posterior half, the division marked by a silvery white line above and a black line below, a black spot at base of the fourth apical cell, pterostigma darker than the nearby regions; veins yellowish; costal region is very broad, apical margin of wing almost concave, membrane finely rugulose and clothed with fine hairs,

radius much bent at pterostigma, discal cell much longer than pedicel, fourth apical narrower than third at base, the cubitals fractured at posterior anastomosis. Hind wings yellowish hyaline, scarcely infuscate on tips, a brown dot in base of third apical cell; fourth apical acute at base. Length 18 mm.; expanse 35 mm.

One specimen from Yakutat (June).

Type.—Cat. no. 5265, U. S. National Museum.

Apatania tripunctata sp. nov.

Plate XXVII, fig. 4.

Head black, with white and yellowish hairs; palpi and antennæ black. Thorax black, with short white hair; legs yellowish, femora black except the tips; abdomen black. Wings blackish, darkest beyond the anastomosis; veins black, with black hair; membrane with scattered yellowish hair, fringes black; three hyaline white spots; one on veinlet closing the thyridial area, one on thyridium, one at arculus; hind wings with a white mark at base of the fifth apical cell; in fore wing the first apical is about twice its width on discal cell fifth apical acute at base and not on thyridial area; cubitals fractured at the posterior anastomosis; discal cell one-half longer than its pedicel. Length 11 mm.; expanse 21 mm.

Several specimens from Yakutat (June).

Type.—Cat. no. 5266, U. S. National Museum.

Apatania sp.

One specimen of a small black species from Kukak Bay (July).

Family **LEPTOCERIDÆ**.

Molanna sp.

Two specimens of an ordinary-looking species from Popof Island and Kadiak (July).

Mystacides nigra (Linné).

Phryganea nigra LINNÉ, Syst. Nat. (12), p. 909, 1768.

Several specimens from Yakutat (June). Widely distributed in Europe and the northern parts of this country.

Heteropteron sp.

One specimen from Popof Island (July). Apparently different from *H. californicum*.

Family **RHYACOPHILIDÆ**.

Glossosoma alascensis sp. nov.

Plate XXVIII, figs. 17 and 18.

Black; antennæ yellowish on basal third (except basal joint); legs

brownish yellow, spurs brown, a few pale weak spines on middle and hind tibiae, in female the middle tibiae and first two joints of tarsi broadened and flattened. Wings infusate; veins black; hair mostly black, yellow in regions of pterostigma and arculus; fringes gray; veinlet closing thyridial area, a point on thyridium and the arculus are white; first apical cell is acute at base, but not pedicellate; in hind wings the fifth apical is long pedicellate. Male has a broad elongate plate on middle of base of the fifth ventral segment, and from each side at its base is a curved stout tooth, a spine on sixth and seventh segments. Length 8 mm.; expanse 14.5 mm.

Many specimens from Popof Island (July).

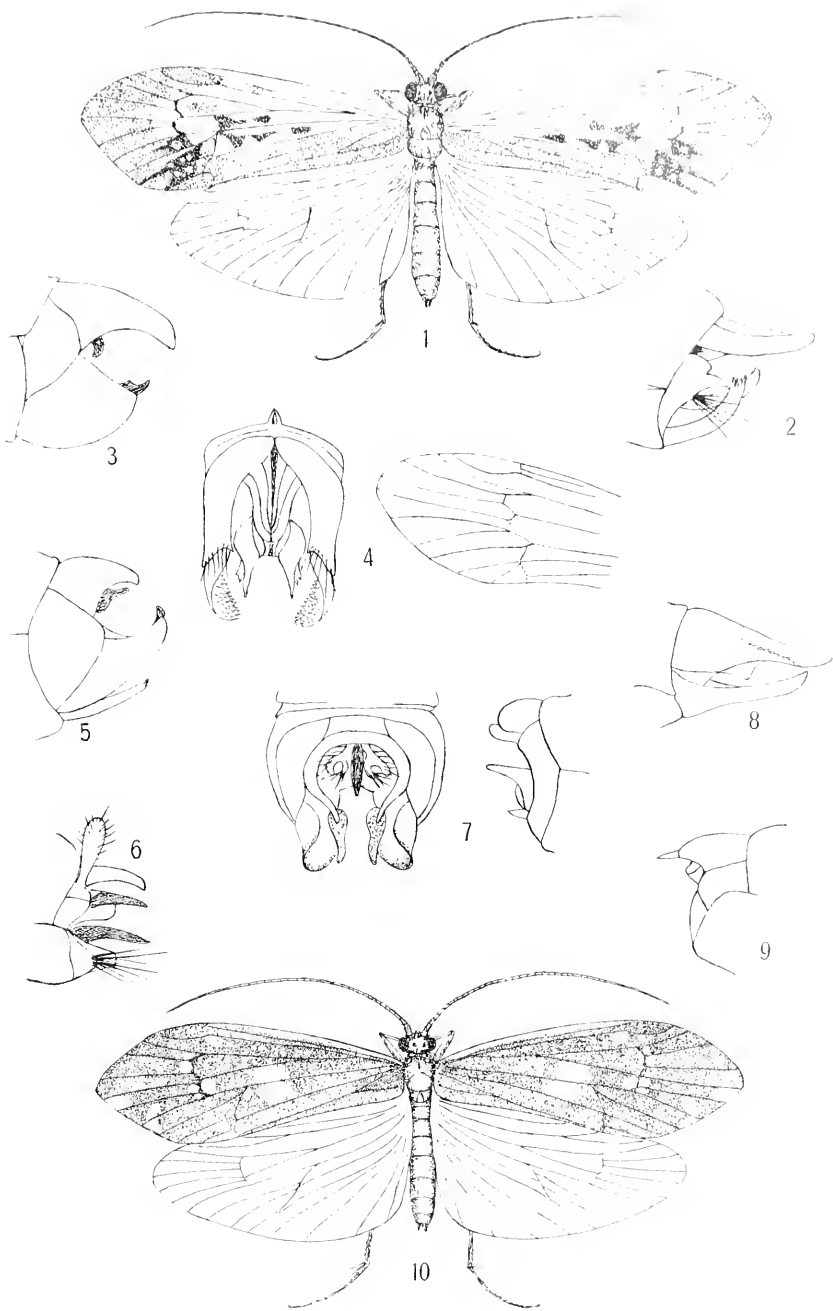
Type.—Cat. no. 5267, U. S. National Museum.

Glossosoma sp.

One specimen of a black species from Popof Island (July).

PLATE XXVII.

- FIG. 1. *Limnephilus harrimani*, insect.
2. *Limnephilus harrimani*, ♂ genitalia.
3. *Asynarchus simplex*, ♂ genitalia.
4. *Apatania tripunctata*, wing and ♂ genitalia.
5. *Limnephilus kincaidi*, ♂ genitalia.
6. *Asynarchus punctatissimus*, ♂ genitalia.
7. *Asynarchus fumosus*, ♂ genitalia.
8. *Limnephilus sitchensis*, ♀ genitalia.
9. *Asynarchus fumosus*, ♀ genitalia.
10. *Asynarchus fumosus*, insect.



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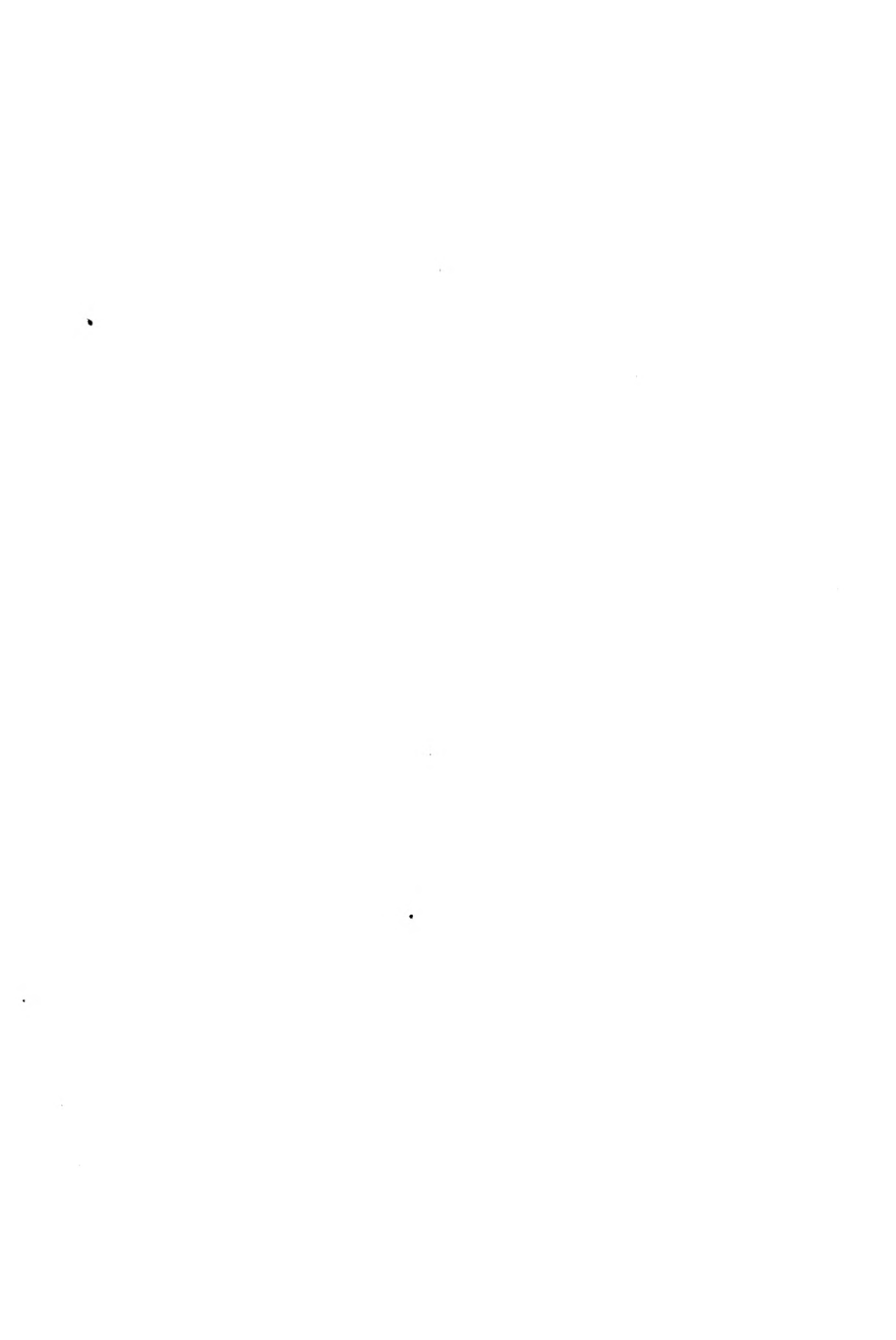
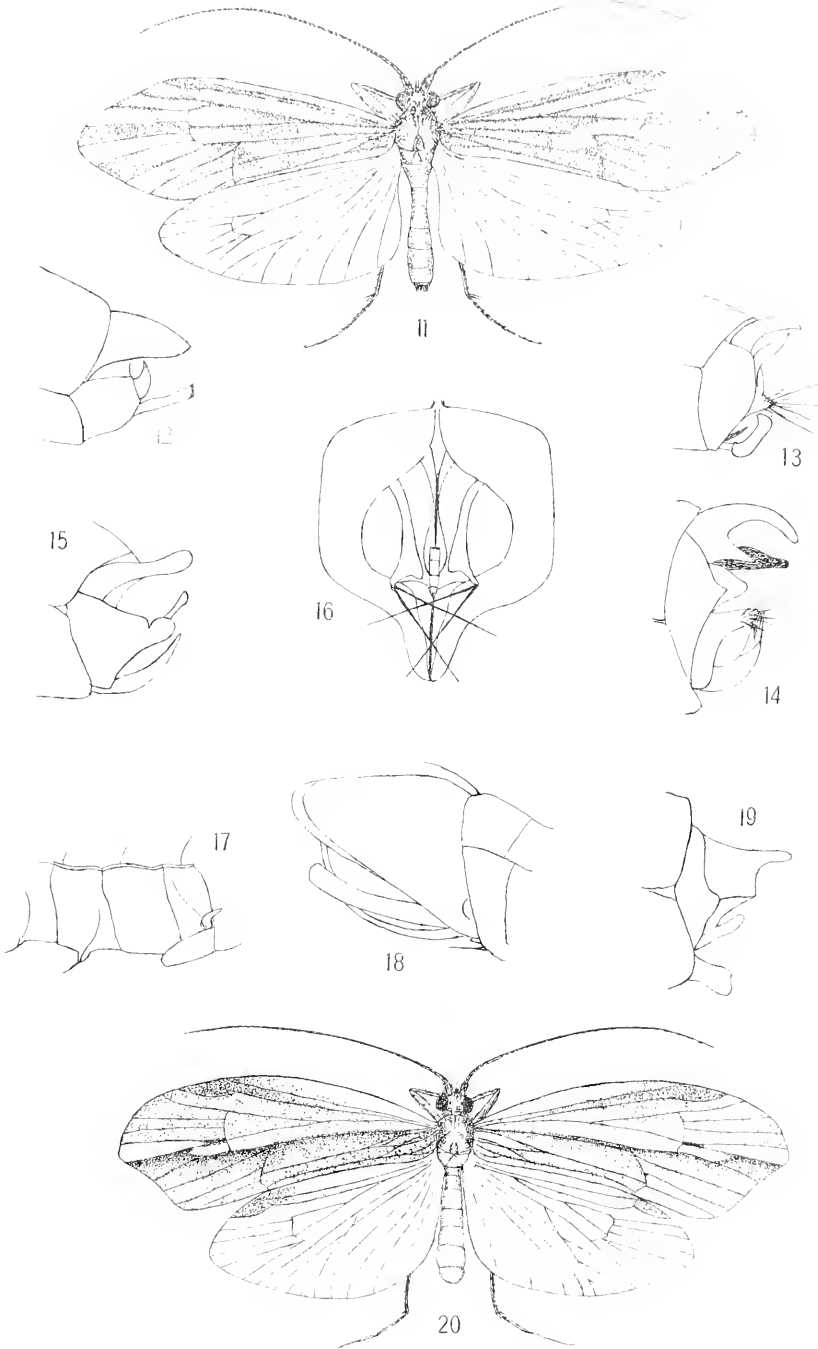


PLATE XXVIII.

- FIG. 11. *Asynarchus flavicollis*, insect.
12. *Limnephilus nebulosus*, ♂ genitalia.
13. *Asynarchus flavicollis*, ♂ genitalia.
14. *Limnephilus perjurus*, ♂ genitalia.
15. *Limnephilus silchensis*, ♂ genitalia.
16. *Asynarchus alascensis*, ♂ genitalia.
17. *Glossosoma alascensis*, venter.
18. *Glossosoma alascensis*, ♂ genitalia.
19. *Halesus alascensis*, ♂ genitalia.
20. *Halesus alascensis*, insect.



Alaska Neuropteroids

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 477-486.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XI.

ENTOMOLOGICAL RESULTS (5):

ARACHNIDA.

[PLATE XXIX.]

BY NATHAN BANKS.

THE spiders collected on the Harriman Expedition show considerable affinity to those of the State of Washington, but there are some, principally among the small Theridiidæ, that are peculiar to Alaska. Dr. Marx, in the Proceedings of the Entomological Society of Washington (Vol. II, p. 186), gave a list of Arctic spiders, including those known to him from Alaska, in which there were 62 species, many of them undescribed. In the list of 52 species given below are at least six not known to Marx. There are no remarkable forms in the collection. Of the five harvest-spiders collected, three are known from California and Washington, one recently described from the Commander Islands, and one which appears to be new. The one Pseudoscorpion is common in the coast regions of Oregon and Washington. Of the two mites, one is peculiar on account of its slenderness and armed hind legs.

Besides the 52 species recorded in the list, there are a few specimens of small Theridiidæ which can not be treated without more material, including the male sex.

ARANEIDA.

Family DRASSIDÆ.

Prosthesima niger Banks.

Prosthesima niger BANKS, Trans. Amer. Entom. Soc., p. 62, 1896.

Two specimens, one from Muir Glacier (June), and one from Metlakahla. Known from State of Washington.

Family CLUBIONIDÆ.

Clubiona pacifica Banks.

Clubiona pacifica BANKS, Trans. Amer. Entom. Soc., p. 65, 1896.

Two specimens, one adult from Juneau, and one young from Kukak Bay. Previously known from Washington.

Family AGALENIDÆ.

Agalena pacifica Banks.

Agalena pacifica BANKS, Journ. N. Y. Entom. Soc., p. 89, 1896.

Agalena curta MCCOOK, Amer. Spiders, III, pl. XXIX, figs. 2, 3.

A few specimens from Kadiak (July). Known from California and Washington.

Cybæus reticulatus Simon.

Cybæus reticulatus SIMON, C. R. Soc. Entom. Belg., p. LVI, 1886.

Many specimens from Sitka, Yakutat Bay, Kadiak, Popof Island, and Metlakahla. Previously known from Oregon and Washington.

Cybæus pusillus Simon.

Cybæus pusillus SIMON, C. R. Soc. Entom. Belg., p. LVII, 1886.

Two specimens from Berg Bay (June). Known from Washington.

Family THERIDIIDÆ.

Theridium sexpunctatum Emerton.

Theridium sexpunctatum EMERTON, Trans. Conn. Acad., vi, p. 12, 1882.

Theridium marxi KEYSERLING, Die Spinn. Amer. Therid., II, p. 231, 1886.

Several specimens from Sitka, Yakutat Bay, Berg Bay, and Kadiak (June and July). Known from New York, New Hampshire, and Washington.

Ceratinella sp.

Plate XXIX, fig. 5.

Cephalothorax, sternum and mandibles reddish; abdomen black; legs pale reddish except the patellæ, which are pale yellowish; no abdominal plate except a small piece at base of the spinnerets; P.M.E.

once and one-half their diameter apart, twice their diameter from the equal P.S.E.

One female from Yakutat: probably new, but better not named in absence of the male.

Cornicularia recurvata sp. nov.

Plate XXIX, fig. 9.

Cephalothorax red-brown, mandibles yellow-brown, sternum and abdomen black, legs pale yellowish. Head of male high, with a recurved horn in front, tipped with stiff, back-directed hairs; sternum broad, convex, blunt-pointed between the hind coxæ; legs slender, anterior tarsus nearly as long as the metatarsus, which is much shorter than the tibia; male palpus simple, tibia short, with a short, pointed process on outer tip, hook stout and short, bulb very large, terminating in a short process; no long stylet. Length 1.7 mm.

One male from the Muir Glacier; readily known by the large, recurved horn.

Type.—Cat. no. 5268, U. S. National Museum.

Cornicularia varipes sp. nov.

Plate XXIX, fig. 4.

Cephalothorax reddish, shining, margined with black; head blackish, with median and lateral black lines; mandibles red-brown; sternum reddish, scarcely rugulose, maxillæ brown; abdomen black; legs with femora and tibiæ reddish, the former at tip and the latter at base yellowish; metatarsi yellowish; tarsi brown; P.M.E. about their diameter apart and about the same distance from the equal P.S.E.; A.M.E. smaller, hardly their diameter apart, about their diameter from the larger A.S.E.; between the M.E. is a faint trace of a swelling, quadrangle of M.E., much higher than broad behind; abdomen about twice as long as wide, with short hairs. Length 2.6 mm.

One female from Popof Island. The colors of the legs will serve to separate it from the other species of the genus until the male is known.

Type.—Cat. no. 5269, U. S. National Museum

Cornicularia sp.

One female, similar to *C. communis* Emer., but different by shape of epigynum. Yakutat (June).

Lophocarenum sp.

One female from Muir Glacier.

Gonglydium alascensis sp. nov.

Plate XXIX, fig. 3.

Cephalothorax, legs and mandibles pale yellowish; eyes on black

spots; sternum and abdomen black, spinnerets pale. Posterior eye-row slightly procurved; P.M.E. their diameter apart, about as far from the equal P.S.E., which touch the A.S.E.; A.M.E. smaller, scarcely their diameter apart, and a little further from the larger A.S.E. Legs slender, tibia with two spines above, one near base, one near tip, one spine on patella; mandibles vertical, scarcely divergent, without teeth in front; abdomen one and two-thirds as long as broad; head of male not elevated; the epigynum, which is rather prominent from side view, shows a broad median septum with an oval cavity each side. Length 2.1 mm.

Three specimens from Berg Bay.

Type.—Cat. no. 5270, U. S. National Museum.

Gonglydium sp.

Two females of a pale species from the Muir Glacier; they may belong to some species of which the male only is known. The epigynum is an elliptical area with a nearly square cavity in posterior part; on middle of hind margin is a denticle projecting forward.

Gonglydium falsificum (Keys.).

Erigone falsificum KEYSERLING, Die Spinn. Amer. Therid., II, p. 259, 1886.

One female from the Muir Glacier agrees well with the description and figure of Keyserling. The male is unknown. Described from Alaska.

Erigone coloradensis Keys.

Erigone coloradensis KEYSERLING, Die Spinn. Amer. Therid., II, p. 168, 1886.

A few specimens from Kadiak and Yakutat (June). Known from Colorado and Washington.

Erigone simillima Keys.

Erigone simillima KEYSERLING, Die Spinn. Amer. Therid., II, p. 170, 1886.

Several from Popof Island, and Saldovia, Cook Inlet. Close to the preceding and probably but an extreme form of it. Described from Alaska.

Erigone famelica Keys.

Plate XXIX, figs. 7, 8.

Erigone famelica KEYSERLING, Die Spinn. Amer. Therid., II, p. 186, 1886.

A pair from Kadiak (July), and one from the Muir Glacier. The figure gives a different view of the palpus from that of Keyserling. Described from Alaska.

Pedanostethus riparius Keys.

Pedanostethus riparius KEYSERLING, Die Spinn. Amer. Therid., II, p. 265, 1886.

Several females from Berg Bay, Yakutat, the Muir Glacier, and Orca (June). Known from Washington and Lake Superior.

Linyphia pusilla Keys.

Linyphia pusilla KEYSERLING, Die Spinn. Amer. Therid., II, p. 55, 1886.

Many specimens from Sitka, Yakutat Bay, Kakiak and Metlakatla. Europe and northern United States.

Linyphia phrygiana Keys.

Linyphia phrygiana KEYSERLING, Die Spinn. Amer. Therid., II, p. 60, 1886.

One from Sitka (June). Europe and northern United States.

Linyphia reducta Keys.

Linyphia reducta KEYSERLING, Die Spinn. Amer. Therid., II, p. 73, 1886.

Two young females from Cook Inlet. Described from Washington.

Linyphia sitkænsis Keys.

Linyphia sitkænsis KEYSERLING, Die Spinn. Amer. Therid., II, p. 86, 1886.

One female from Yakutat. Described from Alaska.

Labulla altiocolata Keys.

Labulla altiocolata KEYSERLING, Die Spinn. Amer. Therid., II, p. 94, 1886.

One young specimen from Juneau. Described from Washington.

Lepthyphantes alascensis sp. nov.

Plate XXIX, fig. 6.

Cephalothorax, legs and mandibles pale yellowish; eyes on black spots; sternum blackish; abdomen black, a broad pale stripe on each upper side, spinnerets pale. Posterior eye-row slightly recurved, P.M.E. less than their diameter apart, scarcely farther from the nearly equal P.S.E., A.M.E. smaller, less than their diameter apart, much farther from the larger A.S.E., quadrangle of M.E. much higher than broad behind, S.E. touching. Mandibles long, vertical, plainly divergent, with three large teeth on front lower margin. Leg I longest, tibia I longer than metatarsus I, two spines above on all tibiae, one near base, one near tip; one spine on patella above. Abdomen rather high, one-fourth longer than broad; the epigynum extremely prominent, the finger projecting away from abdomen. Length 2.8 mm.

Several specimens from Yakutat.

Type.—Cat. no. 5271, U. S. National Museum.

Bathyphantes arctica Keys.

Bathyphantes arctica KEYSERLING, Die Spinn. Amer. Therid., II, p. 85, 1886.

A few specimens from Sitka, Berg Bay, and Kadiak (July). Described from Alaska; also known from Washington.

Bathyphantes sp.

One female of a pale species, with short legs, from Yakutat (June).

Family **DICTYNIDÆ**.**Amaurobius pictus** Simon.

Amaurobius pictus SIMON, Bull. Soc. Zool. France, p. 3 (sep.), 1884.

Two specimens from Cook Inlet and Fox Point (July). Known from California, Oregon, Washington, and British Columbia.

Family **EPEIRIDÆ**.**Epeira trifolium** Hentz.

Epeira trifolium HENTZ, Spid. U. S., p. 110, 1875.

Several specimens from Cook Inlet and Kadiak, June, July. Spread throughout the United States.

Epeira patagiata Emerton.

Epeira patagiata EMERTON, Trans. Conn. Acad., VI, p. 305, 1884.

Many specimens from Kadiak (June, July), Juneau, Kukak Bay (June), and Popof Island. Europe and northern United States.

Epeira displicata Hentz.

Epeira displicata HENTZ, Spid. U. S., p. 117, 1875.

A few specimens from Juneau and Kadiak (July). Entire United States.

Tetragnatha extensa Emerton.

Tetragnatha extensa EMERTON, Trans. Conn. Acad., VI, p. 333, 1884.

Many specimens from Kadiak (July), Fox Point (July), Sitka, and Metlakahla (June). Europe and northern United States.

Tetragnatha laboriosa Hentz.

Tetragnatha laboriosa HENTZ, Spid. U. S., p. 131, 1875.

Many specimens from Kukak Bay, Kadiak (July), Yakutat (June), Popof Island, Metlakahla (June), and Sitka. All over the United States.

Zilla californica Banks.

Zilla californica BANKS, Jour. N. Y. Entom. Soc., p. 90, 1896.

One male from Sitka (June). Known from California and Washington.

Family THOMISIDÆ.

Xysticus borealis Keys.

Xysticus borealis KEYSERLING, Verh. zool.-bot. Ges. Wien, p. 668, 1882.

A few specimens from Popof Island and Kadiak (July). Described from Alaska.

Misumena vatia Keys.

Misumena vatia KEYSERLING, Die Spinn. Amer. Later., p. 101, 1880.

One pair from Metlakahtla (June). Europe and the United States.

Tibellus oblongus Keys.

Tibellus oblongus KEYSERLING, Die Spinn. Amer. Later., p. 196, 1880.

A few specimens from Cook Inlet and Kukak Bay (June). Europe and the northern United States.

Family LYCOSIDÆ.

Lycosa albobastata Emerton.

Lycosa albobastata EMERTON, Trans. Conn. Acad., ix, p. 423, 1894.

Two specimens from Popof Island. Known from British Columbia.

Lycosa pratensis Emerton.

Lycosa pratensis EMERTON, Trans. Conn. Acad., vi, p. 483, 1885.

Several specimens from Cook Inlet and Orca (June). Known from the northern United States.

Lycosa quinaria Emerton.

Lycosa quinaria EMERTON, Trans. Conn. Acad., ix, p. 422, 1894.

One female from Popof Island appears to belong here. Described from British Columbia.

Lycosa sp.

One female from Kadiak (July) appears to be near *L. beani* Em., but does not agree very well.

Pardosa grœnlandica Thorell.

Pardosa grœnlandica THORELL, Proc. Bost. Soc. N. H., p. 498, 1875.—
EMERTON, Trans. Conn. Acad., ix, p. 423, 1894.

Several specimens from the Muir Glacier (June). Known from boreal America.

Pardosa glacialis Thorell.

Pardosa glacialis THORELL, Öfv. K. Vetensk., Akad. Förh., p. 159, 1872.—
EMERTON, Trans. Conn. Acad., ix, p. 424, 1894.

A few specimens from Popof Island. Known from boreal America.

Pardosa uncata Thorell.

Pardosa uncata THORELL, Bull. U. S. Geol. and Geog. Surv. Terr., III, no. 2, p. 508, 1877.—EMERTON, Trans. Conn. Acad., IX, p. 425, 1894.

Two specimens from Juneau and Metlakahtla. Known from New Hampshire, Colorado, and British Columbia.

Pirata sp.

One female of a large species from Berg Bay. It is probably new.

PHALANGIDA.**Sclerobunus brunneus** Banks.

Sclerobunus brunneus BANKS, Trans. Amer. Entom. Soc., p. 152, 1893.

Several specimens from Yakutat Bay, Juneau, Cook Inlet, Orca (June), and Kadiak (July). Known from Washington.

Phlegmacera occidentalis Banks.

Phlegmacera occidentalis BANKS, Psyche, p. 51, March, 1894.

♂ Several specimens, all very young, from Sitka (June), Berg Bay, Yakutat (June), and Popof Island. Known from Oregon and Washington.

Leptobunus borealis Banks.

Leptobunus borealis BANKS, Arachn. Commander Isl., p. 350, 1899.

One specimen from Popof Island. Described from the Commander Islands.

Liobunum exilipes (Wood).

Phalangium exilipes WOOD, Comm. Essex Inst., VI, p. 23, 1868.

Two specimens from Yakutat (June), Kadiak (July). Known from California, Nevada and Washington.

Mitopus dorsalis sp. nov.

Plate XXIX, fig. 2.

Gray: a darker median vase-mark, not reaching end of abdomen; through this there is a pale median line from the eye-tubercle backward; cephalothorax and sides of abdomen more or less mottled with pale, dark gray, and black; venter pale, dotted with gray, legs pale, indistinctly marked with brown at ends of joints, the tarsus on apical half blackish; palpi lineate with brown. Eye-tubercle near posterior margin of cephalothorax, quite high, with two rows of small teeth above; on middle of front margin of cephalothorax is a group of small teeth; rest of cephalothorax and dorsum of abdomen with many scattered denticles, those on the latter mostly in transverse rows; legs with many black denticles arranged in rows, no false articulations in meta-

tarsus I, nor in tibia II; palpi with rows of denticles, the patella and tibia on inner side swollen and there thickly clothed with short, erect spine-like hairs, claw not toothed; no supra-mandibular spine. Length 5 mm., femur II, 4 mm.

Two from Popof Island (one not adult and not fully marked from the mountain top).

Type.—Cat. no. 5272, U. S. National Museum.

PSEUDOSCORPIONIDA.

Ideobisium threveneti (Simon).

Obisium threveneti SIMON, Ann. Soc. Entom. France, p. 156, 1878.

Several examples from Cook Inlet, Lowe Inlet (June), Long Inlet, Popof Island, and Yakutat. Known from California, Oregon and Washington.

ACARINA.

Gamasus sp.

Several specimens from Kadiak on a *Necrophorus*, and from Sitka; none in an adult condition, and no males.

Holostaspis exilis sp. nov.

Plate XXIX, fig. 1.

♂. Pale yellowish, the legs still paler. Body about twice as long as broad, tapering each way, broadest before third legs, but slightly convex above, clothed with scattered long, simple hairs, more numerous at tip of body; each side at posterior third of the dorsal shield is a row of four or five round, reddish, impressed dots. Palpi slender; leg I slender, no claw nor sucker at tip; leg II with fourth joint thickened and with a large tooth below, and a small one above, the sixth joint with a small tooth at base and a long blunt spine at tip; legs III with a spur on hind tip of second joint, and one below near middle of third joint; leg IV with the second joint swollen on anterior face, and just before tip with a long slender process; bifid at tip. The peritreme runs directly to the stigmata which are above the third coxæ. The sternal plate is very narrow behind, so that the hind coxæ are not separated by half their width. Length 2 mm.

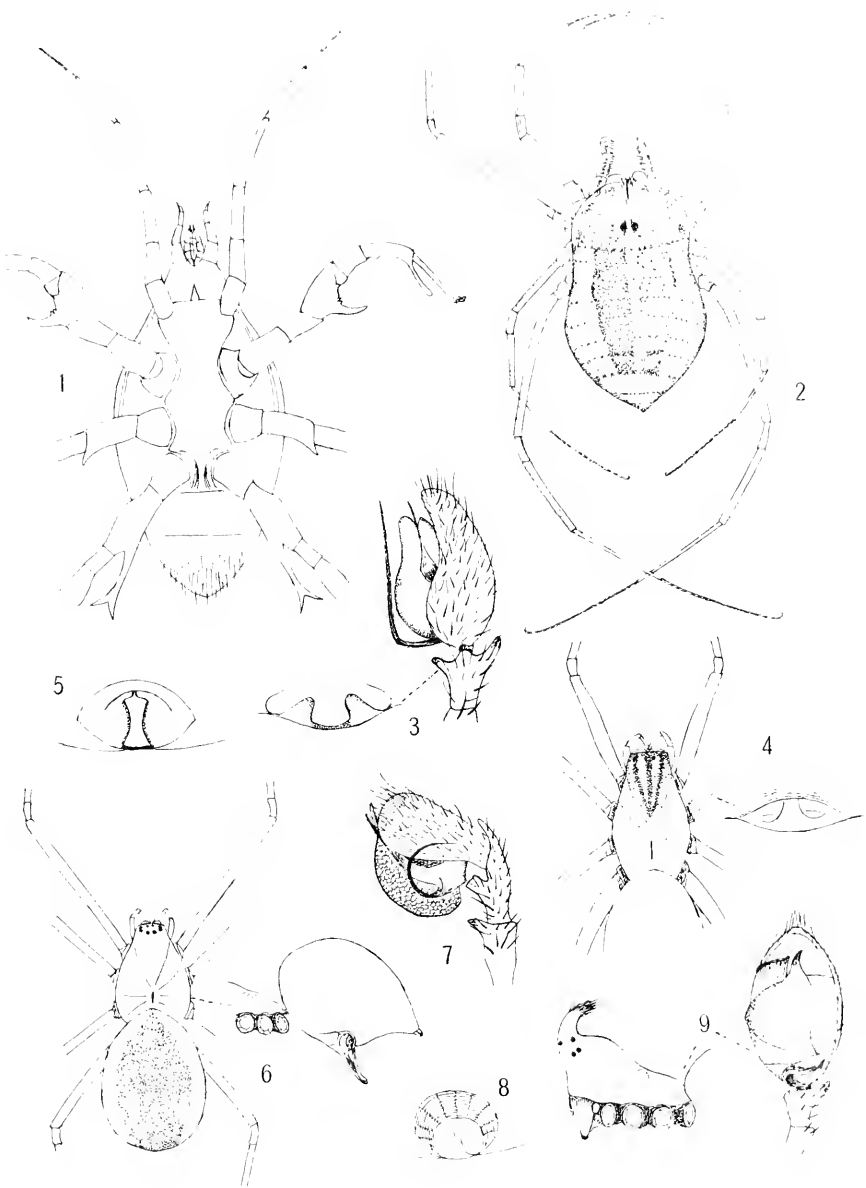
♀. What appears to be the female of this species is smaller, more reddish, the abdomen broadly rounded behind, the hind coxæ are more widely separated, yet much closer than third coxæ, the legs are unarmed; the dorsal shield shows a slight incision near middle of each side, indicating the division of the immature forms. Length 1.5 mm.

Several specimens from Yakutat, Berg Bay, Sitka, and Popof Island.

Type.—Cat. no. 5273, U. S. National Museum.

PLATE XXIX.

- FIG. 1. *Holostaspis exilis*. ♂
2. *Mitopus dorsalis*.
3. *Gonglydium alascensis*.
4. *Cornicularia varipes*. ♀
5. *Ceratinella* sp.
6. *Lepthyphantes alascensis*. ♀
7. *Erigone famelica*, palpus.
8. *Erigone famelica*, epigynum.
9. *Cornicularia recurvata*. ♂



Alaska Arachnids

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 487-501.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XII.

ENTOMOLOGICAL RESULTS (6):

LEPIDOPTERA.

BY HARRISON G. DYAR.

THE following species of Lepidoptera were collected by Professor Trevor Kincaid and other members of the Harriman Expedition, which visited various points on the coast and outlying islands of Alaska in the summer of 1899. In this connection the reader is referred to papers by Dr. Holland in the 'Entomological News,' Vol. XI, which treat of the Lepidoptera of the inland region.

Family PARNASSIIDÆ.

Parnassius smintheus Doubl. & Hew.

Parnassius smintheus, DOUBL. & HEW, Gen. Diurn. Lep., pl. 4, 1847.

Six specimens: Kadiak, July 4, 5; Kukak Bay, July 5.

Family PAPILIONIDÆ.

Papilio machaon Linn. var. *aliaska* Scudd.

Papilio machaon LINN. var. *aliaska* SCUDD., Pr. Bost. Soc. Nat. Hist., 12, 45, 1869.

One female: Fox Point.

Family NYMPHALIDÆ.

Brenthis myrina Cram.

Brenthis myrina CRAM., Pap. Exot. 2, 189, B. C., 1779.

Thirty-two examples of both sexes: Kukak Bay, July 5; Kadiak, July 20 (the latter somewhat worn).

Brenthis frigga Thunb. var. **saga** Staud.

Brenthis frigga THUNB., var. *saga* STAUD., Stett. Ent. Zeit., 350, 1861.

Five examples: Popof Island, July 12-15.

Brenthis pales Schiff. var. **alaskensis** Holl.

Brenthis pales SCHIFF. var. *alaskensis* HOLL., Ent. News, 11, 383, 1900.

One example: Mainland near Shumagin Islands (Mr. Palache).

Vanessa milberti Godt.

Vanessa milberti GODT., Enc. Meth., 9, 307, 1819.

Two examples: Fox Point.

Family AGAPETIDÆ.

Cænonympha kodiak Edw.

Cænonympha kodiak EDW., Trans. Am. Ent. Soc., 2, 375, 1869.

Seventeen examples: Kukak Bay, July 5; Kadiak, July 20.

The specimens vary considerably in color, some dark-gray, some partly ochraceous, and others with marked orange shading over disk of fore wings (var. *yukonensis* Holl.), scarcely distinguishable from *inornata* Edw. from Vancouver Island. The species is at best a local form of *C. typhon* Rott. of Europe.

Æneis semidea Say var. **nigra** Edw.

Æneis semidea SAY var. *nigra* EDW., Butt., 3, pl. 9, Chion., 1894.

One female: Kadiak, July 4.

This form, without a distinct band on hind wings (var. *nigra* Edw.), seems to be the prevailing one in Alaska. The U. S. National Museum has a male example from Davis Inlet (Turner).

Family PIERIDÆ.

Eurymus palæno Linn.

Eurymus palæno LINN., Syst. Nat., 2, 764, 1767.

Four examples, one a male: Kukak Bay, July 5; Kadiak, July 20.

Rather smaller than the European *palæno* and the male has the marginal band a little narrower, but the females have the band as broad or broader than European females, thus forming connecting links to the inland Alaska form which Dr. Holland calls *chippeewa* Edw. (Ent. News, XI, 418, 1900.)

***Pieris napi* Linn.**

Pieris napi LINN., Faun. Succ., 271, 1761.

Twenty-two examples.

Var. ***bryoniæ* Ochs.**

One female: Muir Inlet, June 11.

Var. ***hulda* Edw.**

Eighteen examples: Kadiak, July 20; Cook Inlet, July 21; Kukak Bay, July 5; Juneau, July 25; Popof Island, July 13; mainland near Shumagin Islands, July (Mr. Palache).

Var. ***acadica* Edw.?**

Three examples: Kukak Bay, July 5.

Rather smaller than the figure of *acadica* Edw. and the gray dusting of secondaries more extensive.

Family LYCÆNIDÆ.***Chrysophanus dorcas* Kirb.**

Chrysophanus dorcas KIRB., Faun. Bor. Am., 4, 229, pl. 4, 1837.

Thirteen examples: Kadiak, July 20; Cook Inlet, July 21.

The specimens vary enough to easily cover Edwards' description of *florus*, which is thus seen to be simply a synonym of *dorcas* Kirb.

Family HESPERIDÆ.***Pamphila palæmon* Pall.**

Pamphila palæmon PALL., Reise 1, 471, 1771.

Five examples: Kukak Bay, July 5.

Family ARCTIIDÆ.***Platarctia parthenos* Harr.**

Platarctia parthenos HARR., Agassiz, Lake Sup., 390, 1850.

Three examples: Kadiak, July 5; Popof Island, July 13.

All very red, the wings and thorax strongly tinged with red, the spots of fore wings large and yellowish.

***Platarctia subnebulosa* Dyar.**

Platarctia subnebulosa DYAR, Ent. News, 10, 130, 1899.

Two examples: Point Clarence, St. Paul Island.

Both females with the wings only partly expanded. One example is very red, the marks of fore wings reduced, leaving extensive yellow areas; the other has the normal markings, but blackish brown, not strongly reddened.

Nemeophila plantaginis Linn.

Nemeophila plantaginis LINN., Syst. Nat., 1, 501, 1758.

Twelve examples: Kadiak, July 1-20.

Var. **petrosa** Walk.

Nine examples.

Var. **modesta** Pack.

Three examples.

All the *petrosa* are males, all the *modesta* females, which is also the case with the specimens in the U. S. National Museum collection.

Family NOCTUIDÆ.

Noctua c-nigrum Linn.

Noctua c-nigrum LINN., Syst. Nat., 1, 576, 1758.

Eight examples: Popof Island, July 13-15; Kadiak, July 20.

Hadena basilinea Fab.

Hadena basilinea FAB., Mant. Ins., 2, 183, 1787.

One example: Sitka, June 16.

The example was submitted to Professor John B. Smith, who says:

A rubbed female not quite so reddish as in the normal examples; but, I believe it without question the same. It differs from the eastern *finitima* in the grayer, less contrasting maculation which is also less clearly written. From the normal European examples it seems to differ in being a little more powdery; but this may be due to the condition of the specimen.

Hadena pluviosa Walk.

Hadena pluviosa WALK., Cat. Brit. Mus. Lepid., 33, 725, 1865.

One example: Kukak Bay, July 4.

This example also was submitted to Professor Smith. He says:

One male in poor condition. This determination is open to considerable doubt, for the specimen is larger and darker than the Washington examples before me; but I find nothing else nearer, and do not feel justified in describing it as new.

Hadena vultuosa Grote.

Hadena vultuosa GROTE, Proc. Ac. Nat. Sci. Phil., 420, 1875.

Two examples; Sitka; Orca, June 27.

Hadena ducta Grote.

Hadena ducta GROTE, Bull. Geol. Surv., 4, 176, 1878.

Five examples: Popof Island, July 9-15; Pyramid Harbor.

***Hadena tenera* Smith.**

Professor Smith has prepared the following description of this new form :

Hadena tenera sp. nov.

Ground color of head, thorax and primaries a rusty, red brown. Collar a little darker, tipped with an indistinct, richer brown transverse line. Patagia somewhat smoky shaded. Dorsal tuftings distinct, rusty brown. Abdomen dull gray with distinct, rusty-brown dorsal tufts, and rusty, fine hair. Primaries with a narrow, black basal streak and a short black streak along the inner margin at the inner angle. Basal half line black, broken, geminate, included space more yellowish. Transverse anterior line geminate, black, even, inner portion partly lost; as a whole with a very even, not greatly marked outcurve. Transverse posterior line geminate on the costa, outer portion lost, inner narrow, black, lunulate, followed by a somewhat more yellow shading, only a little incurved below the cell. Subterminal line yellowish, somewhat diffuse, forming a small W on veins 3 and 4. A series of small, terminal lunules. Claviform moderate, concolorous, incompletely black margined, a black line extending from its tip to the transverse posterior line. Orbicular ovate, oblique, irregular, a little paler than the ground color. Reniform large broadly kidney-shaped, partly annulate in yellowish, inwardly margined with black scales. Secondaries whitish at base, shading to smoky, with an obscure, smoky, extra median line and a small discal spot. Beneath powdery reddish gray, with a powdery outer line and discal lunule; disc of primaries a little darker.

Expands 36 mm. = 1.44 inches.

Habitat.—Kukak Bay, Alaska, July 4, 1899.

One male in fair condition, save that the primaries are rubbed at the outer margin and have lost the fringes. The antennæ are distinctly serrate and the processes bristle tufted. The species is allied to and somewhat resembles a small *barusii*. The thoracic vestiture is more dense than usual and somewhat loose, perhaps as a defect.

Type.—Cat. no. 4844, U. S. National Museum.

***Hyppa rectilinea* Esp.**

Hyppa rectilinea ESP., Schmett. Abd. Nat., 1, 127, 1777.

Six examples: Kukak Bay, July 4.

Seems to correspond with the European species rather than with the eastern *xylinoides* Guen. or the western *indistincta* Smith.

***Pachnobia carnea* Thunb.**

Pachnobia carnea THUNB., Mus. Nat. Ac. Ups. Diss., 4, 56, 72, f. 1, 1788.

Thirty-eight examples: Popof Island, July 10-15; Kukak Bay, July 4; Unga Island, July 21.

The specimens vary in color from reddish to gray. An example was submitted to Professor Smith for determination.

Pachnobia alaskæ Grote.

Pachnobia alaskæ GROTE, Bull. Buff. Soc. Nat. Sci., 3, 84, 1876.

Five examples: Popof Island, July 12-13; St. Paul Island, August 7.

One specimen is a female and the wings are not expanded. Named by Professor Smith.

Caradrina punctivena Smith.

Caradrina punctivena SMITH, Trans. Am. Ent. Soc., 21, 77, 1894.

Three examples: Virgin Bay, June 25.

Professor Smith, on seeing the best specimen, remarked: "One very decent male. It is a little larger than the average specimens from Manitoba and British Columbia; but is otherwise practically the same. The nearest mate to it is an example from Laggan, British Columbia."

Ommatostola popofensis Smith.

As this proved an undescribed species, Professor Smith has made the following:

Ommatostola popofensis sp. nov.

Head, thorax and primaries dull luteous. Head a trifle deeper color, the clothing even. Thorax immaculate, vestiture dense, loose, neither collar nor patagia defined. Abdomen a paler shade of clay yellow, rather smoothly clothed, untufted. Primaries with a somewhat more reddish shade a little beyond the middle, enclosing and relieving the reniform. The latter is moderate in size, centrally constricted, upper portion not well defined; lower somewhat dilated, black filled, narrowly outlined in white. Transverse anterior line obsolete. Transverse posterior line traceable by the deeper shade and a few black scales on the veins. Subterminal line a little irregular, traceable by a narrow, very slightly darker preceding shade. Veins through terminal space black-marked; but irregularly so. Fringes dusky at tip. The orbicular spot is transversely oval, traceable with difficulty by a very slightly paler outline. Secondaries black, fringes yellow. Beneath pale luteous; primaries a little smoky on the disk, with a smoky outer line and obvious discal lunule; secondaries with a small discal dot.

Expands 35 mm. = 1.40 inches.

Habitat.—Popof Island, Alaska, July 15, 1899.

One female in good condition. The species is totally different in appearance from *litueneri*, yet seems to be fully congeneric with it. Its general appearance is hadeniform until the fine yet dense vestiture recalls some forms of *Leucania*.

Type.—Cat. no. 4843, U. S. National Museum.

Anarta lanuginosa Smith.

One example, which Professor Smith characterizes thus:

Anarta lanuginosa sp. nov.

Black and gray; primaries with a mossy green shade through the median space; secondaries straw yellow, with a broad black outer band and a black discal lunule. Head black with an admixture of white, especially prominent on the vertex. Collar gray tipped, above smoky blackish. Patagia gray edged, black vestiture of thoracic disc gray tipped posteriorly. Abdomen blackish, densely clothed with fine, yellow hair, through which the black ground appears smoky. Primaries with ornamentation well defined, the markings broken or incomplete. Basal space chiefly gray. Basal line black, single, curved toward the base. A curved black mark in the submedian interspace, above which are mossy scales. A black bar along the internal margin, beyond which are mossy scales to the transverse anterior line. This line single, broad, black, broken on the veins, only a little irregular, as a whole outwardly oblique. Transverse posterior line single, consisting of a series of black interspaceal lunules, a little drawn in below the cell. Subterminal space smoky or blackish on the costa, the dark shade narrowing abruptly and broken into black sagittate spots varying in size, which precede a very even, whitish subterminal line. Fringes black, tipped with white, cut with white on the veins, giving a neat, festooned appearance. Claviform moderate, incompletely outlined in black, filled with paler green and followed by a paler, mossy shading. Orbicular of moderate size, irregular, incompletely black margined, whitish, with a mossy overlay, the whitish shade extending along the median vein to the reniform. Reniform moderate in size, a little constricted, black margined, not sharply defined, whitish filled, with a smoky central shading. Secondaries with yellow fringes. Beneath pale yellow, with large black discal spots. Primaries with black subterminal band shading into a smoky terminal space. Secondaries with a broad marginal band; fringes yellow.

Expands 35 mm. = 1.40 inches.

Habitat.—Popof Island, Alaska, July 12, 1899.

This is the best marked species known to me, equalling *richardsoni* in size, with somewhat the same type of maculation. A single male in very good condition. The antennæ are distinctly serrated, the teeth furnished with tufts of bristles, so the member becomes brush-like.

Type.—Cat. no. 4845, U. S. National Museum.

Anarta etacta Smith.

One example, described by Professor Smith, at our request, as follows:

Anarta etacta sp. nov.

Head white with an admixture of smoky scales. Collar white inferiorly, then blackish, the tip gray. Patagia whitish, with a submarginal blackish line, edges gray. Thoracic disc smoky. Primaries dull gray, powdered with mossy green. The ordinary lines are white, marked by geminate blackish spots on the costa and edged with black

scales along their course. Basal line obvious, evenly bidentate. Transverse anterior line distinct, oblique, a little dentate on the veins to the submedian interspace, then with a long inward tooth on the internal vein, below which it curves outward to the inner margin. Transverse posterior line somewhat squarely exerted over the cell, then incurved so that it touches the lower edge of the reniform. Terminal space whitish with a mossy tinge, the subterminal line denticulate, defined only by the color contrast between terminal and subterminal spaces. A series of black terminal lunules. Fringes smoky, tipped with white, which is cut with smoky. Claviform moderate, outlined in pale mossy green. Orbicular round, of moderate size, annulate with white, which is edged with black, center of ground color. Reniform of good size, annulate with white, among which some green scales are intermixed; inwardly edged with black scales, center of ground color. A little heel extends backward from the reniform along the median vein for a short distance. Secondaries pale smoky, with blackish terminal lunules which are preceded by whitish. Fringes soiled whitish. Beneath smoky, secondaries a little paler, with a small discal spot.

Expands 36 mm. = 1.44 inches.

Habitat.—Kukak Bay, Alaska, July 4, 1899.

One female without antennæ, but otherwise in fair condition. The white markings on the dull gray ground are well defined and characteristic, the white terminal space adding to the contrast. It is probable that the amount of green powdering is variable and that, normally, there is more of it than is shown on the type.

Type.—Cat. no. 4845, U. S. National Museum.

Plusia hohenwarthi Hoch.

Plusia hohenwarthi HOCH., Act. Soc. Berol., 6, 337, 1785.

Two examples: Kukak Bay, July 4.

Plusia epsilon Ottol.

One example: Kadiak, July 20.

This was submitted to Dr. R. Ottolengui who sends us the following description:

Plusia epsilon sp. nov.

Head, thorax and primaries dull purplish with black shadows; thoracic edge of collar, patagia and tip of thoracic tuft of lighter shade. Transverse anterior line fairly straight, indistinct, purplish above the median vein, below the vein distinct, metallic golden, composed of two feeble outward curves, the upper longer than the lower, both bordered outwardly with black. The sign is metallic golden. Seen with the wings folded, that on the wing to the right represents the Greek character ϵ , while on the other wing, the sign being reversed, resembles the numeral 3. The sign touches the median vein at both extremities and, while apparently continuous with the transverse anterior line, really does not reach it. There is no dot, though this is an evanescent

character in some species. The subterminal line is geminate, waved, lighter at the outset, beginning with a hook on the costa and showing a few golden scales at the lower end, especially on the small tooth opposite the sign. The median space below the sign is the darkest part of the wing, the deepest black being immediately next to the sign. The subterminal line is black and shows distinctly against the paler shade between it and the fringes. It is sharply angulate and dentate. The two teeth at the center of the line are sharp, but near its anal angle there is no sharp tooth as in allied species, the angle being rounded. Fringes gray, cut with blackish. Orbicular indistinct, purplish, lined with black. Reniform upright, concolorous, outlined by faint metallic scales. Secondaries smoky yellowish basally with a wide darker outer border. Beneath, primaries smoky with yellowish discal spot, the white spots in costa and in fringes showing more distinctly than above. Secondaries much lighter.

Expanse 34 mm.

Habitat.—Alaska.

Type.—Cat. no. 5256, U. S. National Museum.

Hypena californica Behr.

Hypena californica BEHR., Trans. Am. Ent. Soc., 3, 23, 1870.

One example: Virgin Bay, Prince William Sound, June 25.

Professor Smith saw this specimen and said: "Does not differ in any notable particular from British Columbia examples. One ragged female."

Family GEOMETRIDÆ.

Mesoleuca variata Schiff.

Mesoleuca variata SCHIFF., Syst. verz. Wien. geg., 110, 1776.

Twelve specimens: Popof Island, July 12–15.

Determined by Rev. Dr. Hulst as a "small variety" of *Mesoleuca truncata* Hufn., but I cannot agree with this determination.

Mesoleuca lacustrata Guen.

Mesoleuca lacustrata GUEN., Phal., 2, 395, 1857.

One example: Yakutat, June 21.

Named by Dr. Hulst; but it is distinctly different from Eastern examples of this species.

Petrophora montanata Borkh.

Petrophora montanata BORKH., Nat. Eur. Schmett., 5, 397, 1794.

One example, large: Popof Island, July 10. Sixteen examples: Popof Island, July 9–15; Kukak Bay, July 4.

One of the latter examples was submitted to Dr. Hulst, who pronounced it a very light variety of the same species; I would determine the species as *munitata*, not *montanata*.

Petrophora nemorella Hulst.

Petrophora nemorella HULST, Trans. Amer. Ent. Soc., 23, 293, 1896.

Five examples: Yakutat, June 16; Popof Island, July 12-15; Kadiak, July 20; Saldovia, July 21. This will prove to be *munitata* also, I believe.

Petrophora borealis Hulst.

Petrophora borealis HULST, Trans. Am. Ent. Soc., 23, 292, 1896.

Nine examples: Berg Bay, June 10; Sitka, June 16; Yakutat, June 16; Virgin Bay, June 25; Kukak Bay, July 4. Some of the specimens are remarkably close to *P. ferrugata* L.

Petrophora munitata Hübn.

Petrophora munitata HÜBN., Schmett. Eur., 346, 1803.

Two examples: Yakutat, June 16, 21.

Determined by Dr. Hulst, but wrongly, I think. The specimens more nearly resemble the Siberian *P. quadrifasciaria* Cl.

Venusia cambricaria Curt.

Venusia cambricaria CURT., Brit. Ent., pl. 759, 1839.

One example: Sitka, June 16.

Euchœca albovittata Guen.

Euchœca albovittata GUEN., Phal., 2, 520, 1857.

One example: Sitka, June 16.

Hydriomene trifasciata Borkh.

Hydriomene trifasciata BORKH., Eur. Sch., 5, 308, 1794.

Four examples: Yakutat, June 16; Orca, June 21.

Tetracis hyperborea Hulst.

One example, which Dr. Hulst describes as follows:

Tetracis hyperborea sp. nov.

Expands 42 mm. Palpi bright ochre yellow; front ochre; summit and anterior part of thorax ochre yellow; thorax and abdomen rather light ochre, the latter somewhat fuscous stained; all wings light ochre more or less stained with fuscous; fore wings with basal line showing in three blackish spots, the largest costal, the next at middle of wing, the third at vein 1; just beyond the discal spot, which is very faint, is a broad blackish shading, nearly straight, and reaching across wing; an outer line of black spots on veins, these diffuse on their edges and running subparallel to outer margin to vein 2, then curved a little outwardly; a line of faint diffuse marginal spots; hind wings with outer line of black dots on the veins; discal spots present, blackish. Beneath as above, on fore wings the basal half more fuscous, discal spots

more distinct, middle band much less marked, outer line more distinct, the spots confluent; hind wings, discal spots very distinct, black; outer line of spots more distinct than above.

Virgin Bay, Prince William Sound, Alaska, June 25.

Type.—Cat. no. 4919, U. S. National Museum.

***Eustroma silaceata* Hübn.**

Eustroma silaceata HÜBN., Vög. & Schmett., 100, 1793.

One example: Kukak Bay, July 4.

Submitted to Dr. Hulst, who called it a very light form of *Eustroma atrocolorata* Grt. & Rob., but obviously incorrectly.

***Tephroclystis perfusca* Hulst.**

Tephroclystis perfusca HULST, Can. Ent., 30, 116, 1898.

Four examples: Popof Island, July 9–15.

Determined by Dr. Hulst as a varietal form of this species.

***Tephroclystis zygænidata* Pack.**

Tephroclystis zygænidata PACK., Mon. Geom., 51, 1876.

Four examples: Sitka, June 16; Yakutat, June 21.

This also is a varietal form, not the typical species, according to Dr. Hulst's determination.

***Tephroclystis miserulata* Grt.**

Tephroclystis miserulata GRT., Proc. Ent. Soc. Phil., 2, 32, 1863.

Two examples: Popof Island, July 15.

Again a varietal form of the Atlantic coast species, according to Dr. Hulst, who examined a specimen.

***Tephroclystis flebilis* Hulst.**

One example, which, being new, is described as follows by Dr. Hulst:

Tephroclystis flebilis sp. nov.

Expands 24 mm. Palpi front and antennæ dark fuscous; thorax fuscous in front, fuscous gray behind; abdomen gray, very light laterally; fore wings narrow, elongated, fuscous, darker, almost blackish fuscous narrowly along costa and broadly outwardly extending over marginal field; the black of costa broken as showing the beginning of cross lines, and broadened into a subquadrate spot within outer line; basal line scarcely evident; outer line broad, indeterminate, whitish; an outer scolloped dentate white line on outer field, parallel with margin; hind wings rather small, rounded, fuscous, the beginnings of dark cross lines showing along inner margin; marginal lines on all wings black, more or less broken. Beneath much as above, but with a rounded broad extra-discal line on hind wings.

Proc. Wash. Acad. Sci., December 1900.

Sitka, Alaska, June 16.

Type.—Cat. no. 4920, U. S. National Museum.

Eucymatoge grandis Hulst.

Eucymatoge grandis HULST, Trans. Am. Ent. Soc., 23, 273, 1896.

One example: Sitka, June 16.

Named by Dr. Hulst.

Rheumaptera lugubrata Staud.

Rheumaptera lugubrata STAUD., Cat. Lep. Eur., 189, 1871.

Twenty-four examples: Sitka, June 16; Kukak Bay, July 4.

Rheumaptera hastata Linn.

Rheumaptera hastata LINN., Syst Nat., 527, 1758.

Eighteen examples: Sitka, June 16; Metlakahtla, June 4; Yakutat, June 21; Kukak Bay, July 4; Kadiak, July; Popof Island, July 9-13; Fox Point, July 28.

Family PYRALIDÆ.

Pyrausta washingtonialis Grote.

Pyrausta washingtonialis GROTE, Bull. Geol. Surv., 6, 577, 1882.

Five examples: Sitka, June 16; Virgin Bay, June 25; Kukak Bay, July 4; Popof Island, July 13.

In some of the specimens the markings are nearly obliterated. We are indebted to Professor C. H. Fernald for the determination of a specimen.

Scoparia centuriella Schiff.

Scoparia centuriella SCHIFF., Wien. Verz., 319, 1776.

Nineteen examples: Popof Island, July 12 and 13.

Crambus labradoriensis Christ.

Crambus labradoriensis CHRIST., Ent. Zeit. Stett., 19, 314, 1856.

Four examples: Kukak Bay, July 1; Saldovia, July 21.

Crambus toparius Zell.

Crambus toparius ZELL., Ent. Zeit. Stett., 155, 1866.

Four examples: Sitka, June 16.

Crambus interminellus Walk.

Crambus interminellus WALK., Cat. Brit. Mus., 27, 156, 1863.

Four examples: Yakutat, June 21; Popof Island, July 12 and 13; Saldovia, July 21.

Determined by Professor Fernald. Hampson makes this a synonym of *trisectus* Walk.

Laodamia fusca Haw.

Laodamia fusca HAW., Lep. Brit., 493, 1829.

Eight examples: Juneau, June 25; Kukak Bay, July 1.

Family PTEROPHORIDÆ.

Platyptilia cosmodactyla Hübn.

Platyptilia cosmodactyla HÜBN., Samml. Eur. Schnett., 35-36, 1827.

Four examples: Sitka, June 16; Virgin Bay, June 25; Kadiak, July 20.

Determined by Professor Fernald.

Platyptilia petrodactyla Walk.

Platyptilia petrodactyla WALK., Cat. Brit. Mus., 30, 940, 1864.

Three examples: Popof Island, July 12, 13.

One specimen was submitted to Professor Fernald, but he was unable to recognize it. Another example, in somewhat better condition, seems referable here. The ground color of the wing is more ochreous than in Walsingham's figure, and the brown band is less oblique, being subparallel to the marginal band and approximate to it. There is a slight dot near base of fissure, one below end of costal stripe and one in center of cell; but the figure in general suggests this species, and it is stated that Walker's type is not in perfect condition.

Family SESIIDÆ.

Sesia culiciformis Linn.

Sesia culiciformis LINN., Syst. Nat., 493, 1758.

One example: Kukak Bay, July 1.

Sesia arctica Beut.

One example: Kadiak, July 20.

Determined as a new species and named as above by Mr. Wm. Beutenmüller, to whom it was submitted, and who favors us with the following description:

Sesia arctica Beutenmüller, sp. nov.

Male: Head, palpi and thorax entirely black. Abdomen black with a very narrow white band at the posterior edge of the second and fourth segments. Anal tuft black. Legs black with the hind tarsi dirty white. Fore wings transparent with black borders and a broad transverse mark. Hind wings transparent with a narrow black mar-

gin. Underside of fore wings washed with golden yellow, basally. Hind wings same as above. Expanse 20 mm.

Habitat.—Kadiak, Alaska, July 20, 1899.

Type (one male).—Cat. no. 5175, U. S. National Museum.

Somewhat allied to *Sesia rutilans* but has white bands on the abdomen instead of yellow ones as in that species. The palpi are wholly black, while in *rutilans* they are golden yellow and black.

A description of this species, without name, has been published by Mr. Beutenmüller.¹

Family TORTRICIDÆ.

Sciaphila argentana Clck.

Sciaphila argentana CLCK., Icones, 2, 14, 1759-64.

Four examples: Kukak Bay, July 4.

Sciaphila osseana Scop.

Sciaphila osseana SCOP., Ent. Carn., 238, 1763.

Eight examples: Kukak Bay, July 4; Kadiak, July 20.

Determined by Professor Fernald.

Sciaphila mœschleriana Wocke.

Sciaphila mœschleriana WOCKE, Stett. Ent. Zeit., 45, 1862.

Six examples: Popof Island, July 15.

Determined by Professor Fernald.

Sericoris bipartitana Clem.

Sericoris bipartitana CLEM., Proc. Ac. Nat. Sci. Phil., 346, 1860.

Five examples: Kukak Bay, July 4; Popof Island, July 10 to 12.

Phoxopteris kincaidiana Fern.

Ten examples: Metlakahtla, June 4; Sitka, June 16; Berg Bay, June 10; Muir Inlet, June 12.

Professor Fernald has kindly prepared the following description of this new form:

Phoxopteris kincaidiana sp. nov.

Expanse of wings 15 mm. Fore wings brownish white with a nearly triangular dark cinnamon brown dorsal spot extending from the base to the middle of the hind margin with the outer part oblique and ending in a rounded angle near the costal side of the cell. The outer and costal sides of the triangle are somewhat incurved. The oblique stripe from the middle of the costa extends about two thirds of the distance to the anal angle, then forms a right angle and extends to the apex, but is cut on its outer side beyond the end of the cell by two

¹ Can. Ent., 32, 208, 1900.

dark brown dashes and there is a dark brown dot near the angle of this stripe. The oblique stripe, a series of costal dots and three cross lines at the outer part of the wing, one of which is terminal, are dark cinnamon brown but much more indistinct than the dorsal spot. Fringe above the apex dark brown, elsewhere white at the base and pale fuscous beyond. Hind wing pale fuscous.

Described from one male in the collection of the National Museum, taken June 14, 1899, at Metlakahtla, Alaska, by Mr. T. Kincaid for whom I take pleasure in naming this insect.

Type.—Cat. no. 4967, U. S. National Museum.

Tortrix fumiferana Clem.

Tortrix fumiferana CLEM., Proc. Ent. Soc. Phil., 5, 139, 1865.

One example: Sitka, June 16.

Professor Fernald remarks that the specimen is too poor for him to be certain of the identification.

Carpocapsa pomonella Linn.

Carpocapsa pomonella LINN., Syst. Nat., 538, 1758.

One example: Orca, June 15. * (On shipboard.)

Named by Professor Fernald.

Family TINEIDÆ.

The collection in this family was small, and the condition of the specimens is such that it has not been thought desirable to make them the types of new species. The generic determinations have been made by Mr. August Busck.

Argyrestia sp.

Four examples: Sitka, June 16; Popof Island, July 13 to 15.

Monopis sp.

One example: Popof Island, July 13.

Plutella sp.

One example: Sitka, June 16.

This appears to agree essentially with the type of *duboisella* Beut.

Schreckensteinia sp.

Two examples: Sitka, June 16, Yakutat, June 21.

Zelleria sp.

One example: Farragut Bay, June 5.

Choreutis occidentella Dyar.

Choreutis occidentella DYAR, Can. Ent., 32, 86, 1900.

One example: Sitka, June 16.

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VOL. II, PP. 503-506.

DECEMBER 20, 1900.

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XIII.

ENTOMOLOGICAL RESULTS (7):

HETEROPTERA.

BY O. HEIDEMANN.

THE collection of Hemiptera-Heteroptera of the Harriman Alaska Expedition, made by Prof. T. Kincaid, although small, contains ten species of the family Capsidæ, two of Lygæidæ, one each of Aradidæ and Nabidæ, one of Gerridæ, and three of Corisidæ. These species are all well known except one of the family Aradidæ. It is interesting to note the wide geographical distribution of some of the European and East Siberian Hemiptera, namely, from Siberia over Bering Island to Alaska and into the American Continent.

Family CAPSIDÆ.

Megalocræa (Trigonotylus) ruficornis Fallen.

Megalocræa (Trigonotylus) ruficornis FALLEN, Hem. Suec., 1, 133, no. 8, 1829.—UHLER, Hayden, Mont. Surv., p. 409, 1872.—REUTER, Rev. Caps., p. 23, 1875.

Seven specimens, five males and two females, from Cook Inlet, Saldovia (July 21). Inhabits all Europe, East Siberia, United States, and Canada.

Miris sp. ?

A number of immature forms from Cook Inlet, but as no adult is among them the species can not be ascertained.

Leptopterna ferrugata Fallen.

Leptopterna ferrugata FALLEN, Hem. Suec., 129, 2, 1829.—REUTER, Rev. Caps., p. 14, 1875.

Three females (brachypterous) and one male (macropterous), the latter not quite mature, from Kadiak (July 20). A European species, also known from Siberia. It is most closely allied to the American species *Leptopterna amana* Uhler.

Mecomma (Leptomerocoris) gilvipes Stål.

Mecomma (Leptomerocoris) gilvipes STÅL, Stett. Ent. Zeit., p. 1870, 1858.—REUTER, Ofv. Finska Vet. Soc. Förh., XXI, p. 57, 1881. Gymn. Eur., III, pp. 355, 386, 1883.

Numerous specimens, males and females, from Popof Island (July 9), Karluk, Kadiak (July 20), Saldovia (July 21), Belkofsky, July 22. This species is originally described from Sitka, Alaska, and is also found in East Siberia. The female is always brachypterous. The species is distinguished from the other European form, *Mecomma ambulans* Fallen, by the more slender second joint of antennæ and by the whitish colored hemelytra of the female. Professor Ph. R. Uhler records the latter species also from British America.

Capsus ater Linné.

Capsus ater LINNÉ, Fauna Suec., p. 253, 1761.—Uhler's List, p. 18, 1886.

A single specimen, a male, from Kukak Bay, Alaska Peninsula (July 1). Found in all Europe, Siberia, and boreal America.

Irbisia (Leptomerocoris) sericans Stål.

Irbisia (Leptomerocoris) sericans STÅL, Stett. Ent. Zeit., XIX, p. 188, 1858.—REUTER, Ofv. Finska Vet. Soc. Förh., XIX, p. 57, 1876-79.

Series of macropterous and brachypterous forms, from Sitka, Virgin Bay, Kukak Bay, Karluk, Kadiak, Fox Point, Popof Island (June, July), Belkofsky, July 2. The insect is dimorphous. Males and females of both forms. Originally described from Sitka, Alaska. Found on Bering Island, also on Copper Island and Pribilof Islands (Barrett-Hamilton). The same species has been collected by Mr. E. A. Schwarz in Oregon, near Hood River. Other species of this genus extend down the Pacific coast as far as Lower California.

Lygus pabulinus Linné.

Lygus pabulinus LINNÉ, Fauna Suec., p. 253, 1761.—Uhler's List, p. 18, 1886.

Five specimens, male and female, and some immature ones, from Juneau. A European insect; occurs also in East Siberia and boreal America.

Lygus (Orthops) scutellatus Uhler.

Lygus (Orthops) scutellatus UHLER, Bull. U. S. Geol. Surv., 11, p. 420, 1877.
—DISTANT, Biol. Centr. Amer., Hem.-Heter., p. 274, 1884.

Two specimens, females, from Fox Point (July). Described from Colorado; found throughout the United States and Canada; also a variety in Mexico.

Lygus pratensis Linné.

Lygus pratensis LINNÉ, Syst. Nat. Ed., x, 59, 448, 1758.—FALLEN, Mon. Cim., p. 83, 1867.—Uhler's List, p. 18, 1886.

Two specimens, male and female, from Saldovia and Kukak Bay (July). The latter belongs to the variety *L. campestris* Fallen. A most variable insect, found in all Europe, Siberia, United States, and Canada.

Pæcilocythus unifasciatus Fabricius.

Pæcilocythus unifasciatus FABRICIUS, Ent. Syst., IV, 158, 178, 1794.—UHLER, List of the Hemiptera of Colorado, p. 38, 1895.

Three specimens, two females and one male, from Kukak Bay (July 1), Kadiak (July 20). Inhabits all Europe, Siberia, and boreal America.

Family LYGÆIDÆ.**Nysius grönlandicus** Zetterstedt.

Nysius grönlandicus ZETTERSTEDT, Ins. Lapp., pp. 262, 263, 1840.—STÅL, Enum., IV, p. 121, 1874.

Eight specimens, four females and four males, from Saldovia (July 21). This species is described from Greenland and has also been found at Ungava Bay, Hudson Bay Territory, by L. M. Turner (National Museum collection).

Scolopostethus thomsoni Reuter.

Scolopostethus thomsoni REUTER, Ann. Soc. Ent. France (5), IV, p. 562, 1874.—HORVATH, Rev. d'Entom., XII, p. 240, 1893.

A single specimen, male, from Sitka (June 16). It is a European species and the only one recorded as occurring also in boreal America. I have seen specimens from California (Argus Mountains), and from Colorado (National Museum collection). The genus is well represented also on this Continent: there have been found two other American species, *S. diffidens* Horv. and *S. atlanticus* Horv., and some not yet described.

Family ARADIDÆ.**Aradus** sp.?

One specimen, a male, from Saldovia (July 21). There seems to be no record of any *Aradus* found before in Alaska. The specimen

now taken by Professor Kincaid may likely be a new species. It belongs to the *Aradus betulæ* group, and is most closely allied to Say's species, *Aradus similis*, but differs in having the margins of abdomen more parallel, the prolongation of head more elongate, and the scutellum quite differently shaped. The sides are sinuated and the basal inner part of scutellum more transversely elevated. As there is but one specimen, a satisfactory description of a new species can not be given.

Family NABIDÆ.

Nabis flavo-marginatus Scholz var. **sibericus** Reuter.

Nabis flavo-marginatus var. *sibericus* REUTER, Ofv. Finska Vet. Soc. Förh., XIX, p. 60, 1877.

Three specimens, females, from Cook Inlet and Kadiak (July). The species is known from Europe, Siberia, and Greenland. *Nabis flavo-marginatus* Scholz is also found in Canada (St. John, New Brunswick).

Family GERRIDÆ.

Gerris rufoscutellatus Latreille.

Gerris rufoscutellatus LATREILLE, Gen. Crust. et Ins., III, p. 134, 1807.—Uhler's List, p. 26, 1886.

Two specimens from Metlakhtla (June 6). The insect is found in Europe, East Siberia, and boreal America.

Family CORISIDÆ.

Corisa germarii Fieber.

Corisa germarii FIEBER, Species Generis Corisa, II, p. 38, 1858.—Uhler's List, p. 29, 1886.

Nine specimens, four males and five females, from Popof Island. Inhabits Europe, North America, Alaska.

Corisa convexa Fieber.

Corisa convexa FIEBER, Species Generis Corisa, II, p. 37, 1858.—Uhler's List, p. 29, 1886.

Three females, from Popof Island and Berg Bay. Found also in North America and Labrador, near the coast line.

Corisa præusta Fieber.

Corisa præusta FIEBER, Species Generis Corisa, II, p. 28, 1858.—Uhler's List, p. 29, 1886.

Five specimens, one male, the others females, from Muir Glacier (pond on the west side, June 12), Popof Island (June 20), Berg Bay (June 10), Kadiak (July), Sitka. Previously found at Sitka.

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WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 507-510.

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XIV.

ENTOMOLOGICAL RESULTS (8):

THE SPHEGOIDEA AND VESPOIDEA.

BY TREVOR KINCAID.

THE collection upon which this report is based is a small one, including but nine species, but it is of considerable interest from the fact that but a single representative of the above groups has been recorded from Alaska, namely *Dolichocrabro wickhami* Ashmead,¹ which was collected by Mr. H. F. Wickham at Fort Wrangell. At the same time and place Mr. Wickham captured a Pemphredonid which Mr. Ashmead determined as *Pas-salæcus cuspidatus* Smith. In the collection of the U. S. National Museum there is also a Chrysid collected at Fort Yukon by Mr. L. M. Turner in 1877. This has been determined by Mr. Ashmead to be *Omalus sinuosus* Say. These three species, together with those listed below, bring the total number of known Alaska forms up to twelve. It is evident that the coastal regions of Alaska do not afford a favorable environment for either fossorial Hymenoptera or wasps.

¹Synopsis of the superfamily Sphegoidea, Can. Ent., xxxi, p. 216, 1899.

SPHEGOIDEA.

Family CRABRONIDÆ.

Ectemnius parvulus (Packard).

Crabro parvulus PACKARD, Proc. Ent. Soc. Phila., VI, p. 108, 1866.

One female and four males, Saldovia, July 21. Taken on the flowers of *Heracleum lanatum*. Recorded from Washington and eastward to Dakota.

Clytochrysus gracilissimus (Packard).

Crabro gracilissimus PACKARD, Proc. Ent. Soc. Phila., p. 78, 1866.

Eight females and ten males, Fox Point, Alaska, July 28. On flowers of *Heracleum*. Recorded from Washington and eastward to Dakota.

Thyreopus vicinus (Cresson).

Crabro vicinus CRESSON, Proc. Ent. Soc. Phila., IV, p. 479, 1865.

One female, Kukak Bay, Alaska, July 4. Recorded from Washington eastward to Nebraska.

Blepharipus ater (Cresson).

Crabro ater CRESSON, Proc. Ent. Soc. Phila., IV, p. 477, 1865.

One female and two males, Saldovia, Alaska, July 28. On flowers of *Heracleum*. Recorded from Washington and eastward to Maine.

Family PEMPHREDONIDÆ.

Mimesa propinqua sp. nov.

Male: Dorsal region of head closely and distinctly punctured, without any signs of striæ; cheeks with very faint punctures; clypeus and face with a silvery gray pile; head and thorax with long gray hair, most evident on the pleuræ and middle segment; clypeus obtusely bidentate; dorsulum with distinct separated punctures, striate behind; mesopleuræ very delicately striated, with no evident sign of punctures; middle segment coarsely rugose-reticulate, with a triangular smooth space at base, posterior surface depressed medially, the central area bounded by distinct but irregular ridges; sides with indistinct and rather irregular striæ. Color black; calcaria and tarsi testaceous. Length 7 mm.

Three males, Fox Point, Alaska, July 28.

Type.—Cat. no. 5314, U. S. National Museum.

This species is closely allied to *Mimesa mixta* Fox, which is recorded from California, Oregon, and Washington, but a comparison

with the types of the latter species in the collection of the American Entomological Society leads the writer to the conclusion that the northern form is distinct, since in *M. mixta* the antennæ and petiole are both shorter, the posterior face of the middle segment is not depressed and the smooth area at the base is lacking; also the front of the head is striato-punctate, which is not the case in the new form.

VESPOIDEA.

Family POMPILIDÆ.

Arachnospila septentrionalis sp. nov.

Female: Black; first and second segments of abdomen sanguineous except the extreme base of first segment and narrow apical margin of second, which are black; head broader than thorax, smooth, with indistinct, widely separated punctures; vertex and front sparsely clothed with long black hair, a greater abundance of the same on the cheeks; eyes separated from the mandibles by a narrow margin, converging but little above, the space between them equal to one and one-half times the length of the first joint of the flagellum; space between hind ocelli a little less than that between them and nearest eye-margin; clypeus very slightly emarginate, almost truncate, the lateral anterior angles rounded and the anterior border finely margined; antennæ slender, nearly as long as head and thorax, first joint of flagellum longer by one-fourth than the second; pronotum angulate behind; scutellum flatly convex in the center, declivous at the sides; middle segment strongly rounded out, smooth, with a faint trace of a medial groove; medial and posterior tibiæ and tarsi with numerous spines outwardly; anterior tibiæ and tarsi with a row of spines along outer margin; tarsi coarsely ciliated beneath; inner spur of hind tibiæ two-thirds the length of the first tarsal joint; claws with a sharp median tooth; abdomen elongate-ovate, as long as the head and thorax; wings fuliginous; third submarginal narrowed about one-fourth on upper margin, the third cubital nervure curved outwardly; second submarginal of nearly the same shape and slightly smaller than the third submarginal, the first cubital nervure curved toward the base of the wing; first recurrent nervure received a little beyond the middle of the second submarginal; second recurrent received before the middle of the third submarginal cell. Length 8.5 to 9 mm.

Two females, Kukak Bay, Alaska. Taken on the flowers of *Hera-
cleum lanatum*.

Type.—Cat. no. 5313, U. S. National Museum.

Family VESPIDÆ.

Vespa marginata Kirby.

Vespa marginata KIRBY, Faun. Bor. Am., iv, p. 265, 1837.

Two females and a worker, Kukak Bay, Alaska, July 3. Recorded from British Columbia.

Vespa borealis Kirby.

Vespa borealis KIRBY, Faun. Bor. Am., iv, p. 264, 1837.

Three females and three workers, Sitka, June 15; Virgin Bay, June. Recorded from British Columbia.

Family EUMENIDÆ.

Odynerus albophaleratus Saussure.

Odynerus albophaleratus SAUSSURE, Synop. Am. Wasps, Sol., p. 191, 1875.

Seven females and nine males, Kukak Bay, July 3; Saldovia, July 21; Fox Point, July 28. The species is widely distributed throughout the United States and is recorded from the Pacific coast as far north as Washington. The coloration varies considerably, and in most of the Alaska specimens the clypeus is either pure black or else a couple of small yellow spots are present on the anterior margin.

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WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 511-512.

DECEMBER 20, 1900.

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XV.

ENTOMOLOGICAL RESULTS (9):

ORTHOPTERA.

BY A. N. CAUPELL.

THE large collection of insects obtained during the Harriman Alaska Expedition by Professor Kincaid contained only a single species of Orthoptera, as follows:

Melanoplus borealis Fieber.

Melanoplus borealis FIEBER, Lotos, III, p. 120, 1853.—SCUDDER, Rev. Melanop., p. 270, 1897.

Professor Kincaid secured five adults, three males and two females, and nine nymphs, at Kukak Bay, Alaska Peninsula (July 3, 1899). They were all taken within a few feet of a small pool in a sphagnum swamp. This pool, which was about ten feet in diameter, was surrounded by a miscellaneous vegetation, in which the locusts lived. The specimens were captured by causing them to leap into the water, when they were easily secured. They were preserved in spirits. A large scope of country surrounding this spot was carefully gone over by the collector during the succeeding fortnight and many similar pools visited, but not another locust was seen. This would indicate that this species is quite local in its occurrence.

The nymphs, which are apparently in the last stage, usually have the outer surface of the posterior femora wholly black on the basal two-thirds, generally relieved by two oblique pale bands, and the inner surface marked by two oblong fuscous spots.

This species has been recorded from the Northern United States, Labrador, Greenland, and Norway.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES.

VOL. II, PP. 513-517.

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XVI.

ENTOMOLOGICAL RESULTS (10):

APHIDIDÆ.

BY THEO. PERGANDE.

THIS paper is based upon a small collection of plant lice obtained in Alaska by Professor Trevor Kincaid during the Harriman Expedition in 1899.

The material thus brought together comprises four species, one of them European, while the remaining three appear to be new; at least I failed to identify them with any of our described forms. It is greatly to be regretted that the migratory female was obtained with only two of them, that no colorational notes were made of the living insects before immersion in alcohol, and that no attempt was made to ascertain the name of the host plants on which they were feeding. The descriptions of the new species will therefore be rather defective and incomplete, though I hope they will enable future students to recognize them.

NECTAROPHORA CAUDATA sp. nov.

Winged viviparous female: general color apparently green or yellowish green. Antennæ black; the two basal joints dusky, their base and base of the third pale. Eyes brown. The head, a somewhat lunate spot at the posterior margin of the prothorax, the mesothoracic

lobes and sternal plate, posterior margin of the scutellum, two small roundish spots on the metathorax, a transverse row of three small linear spots on the first abdominal segment, a narrow, transverse band about the middle of the abdomen, a dorso-lateral row of three transverse spots in front of and two smaller spots between the nectaries of a brownish or dusky coloration. Legs brownish yellow, base of femora greenish yellow; both the femora and tibiæ change gradually to a darker brown towards the apex. Tarsi black. Nectaries and tail concolorous with the abdomen, with tip of nectaries blackish. The wings were very much mutilated, though the subcosta appears to have been greenish or greenish yellow at base and shading gradually to brownish yellow towards the stigma, which appears to have been greenish or yellowish green; veins black.

Length of body about 3.4 mm.; expanse of wings about 10 mm.; length of antennæ almost 4 mm.; of the nectaries nearly 0.4 mm.; and of the tail a little over 0.2 mm. The two basal joints of the antennæ, as usual, shortest, each of them slightly over 0.1 mm., the first one being slightly the longest; the third joint measures 0.8 mm. in length, the fourth nearly 0.7, the fifth a little over 0.5 mm., and the sixth with its spur 1.2 mm. in length. The hairs of the antennæ and abdomen are very short, simple and sparse, while those of the tibiæ are prominent and spine-like. The nectaries are slightly tapering and much shorter than usual in this genus, not reaching to the end of the body, while the tail is unusually broad and but slightly constricted beyond the middle.

Apterous female: General coloration similar to that of the winged form; eyes brown, antennæ black, the two basal joints pale, the third joint brownish. Legs and nectaries brownish yellow, base of femora greenish, apex of the tibiæ, of the nectaries and the tarsi black. There are no markings on the abdomen, except a dorso-lateral row of five or six minute, impressed, dusky dots each side in front of the nectaries.

Length, 3.6 to 4 mm. to the tip of the tail; antennæ rather short, barely reaching to nectaries and about 3 mm. in length. The third joint measures almost 0.7 mm., the fourth somewhat over 0.4 mm., the fifth 0.4 mm., and the sixth with its spur 0.8 mm. in length. There are from one to four small sensoria a little above the base of the third joint. The nectaries and tail are subequal in length, or with the tail, as in some specimens, distinctly longer than the nectaries; the tail measures about 0.4 mm. in length and is much broader than in the winged form.

The winged form of this species resembles, on account of the mark-

ings of its abdomen, *Nectarophora granaria* Kirby; it is, however, larger, with much shorter nectaries and much broader tail, while the apterous form, on account of the short nectaries comes near *Nectarophora fulvæ* Oestl., though it is considerably larger and differs besides in the conspicuously broad tail.

Taken at Juneau, Alaska.

Type.—Cat. no. 5274, U. S. National Museum.

NECTAROPHORA INSULARIS sp. nov.

Apterous female: General color evidently green. Eyes brown; antennæ black, the two basal joints, and the basal two-thirds or more of joints three and four pale. Legs pale, the coxæ brown, apex of tibiæ, the tarsi and the tip of nectaries dusky to black. The body is marked with a subdorsal row of nine small dusky spots, of which those on the prothorax and mesothorax are elongated; there are also two mediodorsal spots on the metathorax; four still smaller dorso-lateral spots in front of nectaries and four minute ventro-lateral spots. In some of the immature specimens the nectaries are almost black.

Length of body to tip of tail 3 to 3.4 mm., antennæ rather long, reaching to or beyond tip of tail and about 4 mm. in length. Length of nectaries 0.7 to 0.8 mm.; tail about 0.3 mm. Length of third antennal joint about 0.7 mm.; fourth joint 0.6 mm.; fifth joint 0.5 mm., and the sixth, with its spur, 2 to 3 mm. in length, the spur being much longer than joint three. The first joint is very stout and almost twice the length of the second; the third joint is provided with one to three small sensoria near its base. Nectaries slender, slightly tapering and curving outwards. Hairs of antennæ minute and simple, those of the tibiæ stout and spine-like, a few of them sometimes slightly thickened at the tip.

This species resembles somewhat *Nectarophora pisi* Kalt., but is much larger, the legs shorter and stouter, the nectaries shorter and the tail broader.

Obtained on St. Paul Island, Bering Sea.

Type.—Cat. no. 5275, U. S. National Museum.

NECTAROPHORA EPILOBII sp. nov.

Apterous female: Color apparently dark reddish or brownish. Eyes brown. Head, antennæ, nectaries, coxæ, terminal third of femora and tibiæ, the tarsi and anal lobes black, remaining parts of legs dark yellowish; tail yellow. There is a black or dusky band on the

prothorax and mesothorax, a longitudinal dusky mark each side of the mesothoracic band, transverse rows of minute black dots on the abdomen, and a large black spot at the base of the nectaries posteriorly.

Length of body, exclusive of the tail, 3 to 3.4 mm. Length of antennæ 3.5 mm.; nectaries 0.7 mm.; tail 0.6 mm. The third joint of the antennæ measures 1.2 mm.; the fourth joint 0.6 mm.; the fifth 0.5 mm., and the sixth, with its spur, 1.2 mm.

The third antennal joint is provided with a row of nine to ten prominent sensorial tubercles near its basal one-third. Nectaries stout and tapering; tail prominent, almost as long as nectaries, densely covered with sharp points and provided each side with five or six small notches, which give rise to a fine, long and curved hair. Hairs of antennæ and legs stout and spine-like, those of the body rather long, slender and simple.

In general appearance this species resembles very much *Nectarophora millefolii* Fab., but is larger and not so hairy as that species.

Found upon a species of *Epilobium* on Popof Island, Alaska.

Type.—Cat. no. 5276, U. S. National Museum.

CLADOBIUS POPULEUS Kalt.

Cladobius populeus KALT., Monog. d. Pflanzenl., 1, p. 116, 1843. (*Aphis*.)

While studying this handsome species and comparing it with the descriptions by Kaltenbach and Koch, I became convinced that it was identical with that described by these authors, notwithstanding both of them speak of the nectaries as being cylindrical, whereas, in fact, they are clavate. This error, or discrepancy was evidently due to the fact that the nectaries of this and probably some other species of this genus are rather more slender than usual and when being carried parallel to the sides of the abdomen, appears to be more or less distinctly cylindrical, whereas, in projecting obliquely from the sides of the body their clavate character becomes quite plain. In many of the species of this genus the nectaries are unusually robust and conspicuously clavate, while in others this character becomes less and less pronounced and may easily lead to errors.

Besides this oversight, Koch made evidently additional errors while drawing up his diagnosis of this genus, which, no doubt, was due to impaired eyesight. One of the most notable instances is his statement that joints four to six are of nearly equal length and that the, so-called, seventh joint is very small; in reality joints four, five, and the spur, or seventh joint, are, as stated by Kaltenbach, subequal in length,

whereas, as is usual in the higher groups of Aphidinae, the sixth joint is shorter than either of these joints, and, since our Alaska insect agrees in coloration and other important characters, excepting the nectaries, with Kaltenbach's description, I take it for granted that it belongs to the same species.

It may be of interest in this connection to point out that *Pterocomma pilosa* Buckton, belongs also to this genus and that his *Pterocomma* has to be dropped. In examining the type specimen of *Pterocomma pilosa*, which had been kindly loaned me by Dr. Buckton for study, I was surprised to find that the principal character, the peculiar shape of the wings, on which this genus was founded, does not exist, but that it was the result of poor preparation, by which a peculiar fold along the third discoidal vein was formed, which can be readily traced by gently focusing this part of the wing.

It is quite possible that his species may belong to the same species; at least, it appears to come very near to it.

Additional studies of other genera with more or less distinctly clavate nectaries have convinced me that the genus *Melanoxanthus* Buckton has also to be dropped and that it must be made a synonym of *Cladobius*. The clavate character of the nectaries in different species varies considerably, so that it frequently may happen that the clavate character of rather slender nectaries is overlooked, especially if they lay parallel with, or close to the abdomen. The general appearance, however, of these insects, their rather large size, strong pilosity of the body and its members and the minute, blunt tail, will not fail, even if the exact shape of the nectaries cannot be ascertained, to assign them to their proper position.

The synonymy of this genus will therefore read:

CLADOBIUS Koch.

Melanoxanthus Buckton.

Pterocomma Buckton.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 519-521.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XVII.

ENTOMOLOGICAL RESULTS (11):

FORMICIDÆ.

BY THEO. PERGANDE.

THE present paper is based upon a small collection of Alaska Formicidæ, made by Professor Trevor Kincaid while connected with the Harriman Expedition during the summer of 1899, and is especially interesting on account of the close relationship of most of the species to those of our northwestern States.

Subfamily CAMPONOTINI.

Formica neorufibarbis Em.

Formica neorufibarbis Em., Zool. Jahrb. Jena, p. 660, 1899.

The series representing this species are all workers, and were obtained in the following localities: Sitka, 1 specimen; Metlakahtla, 5 specimens; and Kadiak, 34 specimens. Those from the latter locality were found in a rotten log.

The species is quite variable as to coloration; the palest forms, from Metlakahtla, are absolutely identical with those found in Colorado, Dakota, and Oregon, while the darker specimens agree more or less closely with forms occurring in Colorado, Utah, and some of the far northwestern States.

Lasius niger L. subsp., *sitkænsis* subsp. nov.

Worker: Length about 4 mm. Head and abdomen dark brown, the posterior edge of the abdominal segments whitish or more or less

distinctly yellowish or greenish in a certain light, front of head as far as the eyes, the clypeus, cheeks, and under side of the head, sides of the thorax, the antennæ and legs, lighter or darker ferruginous; apex of the joints of the flagellum dark brown; mandibles red, their external edge and the teeth, as well as the eyes, black; palpi yellowish. Appressed pubescence yellowish and rather dense on the head and abdomen; erect hairs quite profuse, yellowish or brownish in certain lights; those of the clypeus, the under side, and end of the abdomen much the longest; there are but a few erect hairs on the scape, the femora and tibiæ. Punctuation of the head, thorax, and abdomen minute and dense, those of the mandibles rather coarse. Scale stout, its upper edge arcuated.

This ant, as far as I have been able to ascertain, does not agree with any of the various forms comprising the group *L. niger*, which have thus far been described, but appears to be nearest related to one of the forms of *Lasius subniger*, inhabiting Maine, though it is almost twice as large and much darker and with the eyes more elongated; the general appearance of this ant is very similar to that of *Lasius aliena*.

Twenty-five specimens, taken at Sitka during June.

Type.—Cat. no. 5277, U. S. National Museum.

Subfamily MYRMICINI.

Leptothorax yankee Em. var. *kincaidi* var. nov.

Female: Length about 4 mm. Head and thorax black, the abdomen dark brown, with the posterior edge of the segments brownish yellow; antennæ, mandibles, and legs yellowish red, the neck and paler parts of the nodes of a darker red; the flagellum grows gradually darker towards the end, with the last joint black; femora dark brown, their base and apex yellowish red; teeth of mandibles black. Head finely striated, the striæ most distinct in front of the eyes and between the frontal carinæ; the posterior half of the head is finely and rather densely rugose or reticulate, the clypeus is almost smooth and the mandibles striato-punctate; pronotum and mesonotum quite coarsely rugose, the metanotum, scutellum and upper surface of nodes finely, though rather indistinctly, striated; declivity of the metathorax transversely striated. Abdomen smooth. Erect hairs short, truncate and pale yellowish, those of the nodes and abdomen longest; there are also a few much finer, erect hairs on the femora.

The female resembles somewhat that of *L. yankee*, which, however, is somewhat smaller, the last antennal joint and metanotal spines

shorter, the hairs of the abdomen much finer and the erect hairs of the femora wanting.

Worker: Length about 3 mm. Head and teeth of mandibles black, the abdomen dark brown; antennæ, mandibles, thorax, legs and nodes reddish yellow; coloration of the last three or four joints of the antennæ and the femora as in the female, the upper surface of the thorax and nodes more or less decidedly reddish brown. Striation of the head more distinct than in the female, and the space between the striæ more or less distinctly reticulated, particularly so towards the sides. Pronotum and mesonotum and the nodes finely rugose; sculpturing of the metanotum slightly coarser. Abdomen smooth; all the hairs similar to those of the female.

The worker is very similar in appearance to those of *L. yankee*, though somewhat larger, more robust, the sculpturing coarser and the hairs stouter.

One female and twelve workers, taken at Metlakatla in June.

Type.—Cat. no. 5278, U. S. National Museum.

***Myrmica sabuleti* Meinert, var. *lobifrons* var. nov.**

Worker: Length about 3 mm. Color dark brown or black; mandibles, antennæ, legs, sides of the thorax and of the abdomen more or less distinctly yellowish brown, reddish brown, or almost black.

This variety is closely related to a form of *Myrmica sabuleti* inhabiting South Dakota, but is somewhat larger and much darker, with the sculpturing of the head and thorax coarser and the hairs stouter and shorter.

Type.—Cat. no. 5279, U. S. National Museum.

***Myrmica sulcinodoides* Em.**

Myrmica sulcinodoides Em., Zool. Jahrb. Jena, p. 313, 1894.

The palest specimens of this series agree exactly with those which I have seen from Hill City, South Dakota, while others are of a considerably darker shade.

Sixteen workers, collected at Sitka, June, 1899.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 523-537.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XVIII.

ENTOMOLOGICAL RESULTS (12) :

COLEOPTERA.

BY E. A. SCHWARZ.

THE Coleopterous fauna of Alaska is much better known than that of any of the other orders of insects of that territory, at least so far as the region along the southern and southeastern coasts is concerned, and Count C. G. von Mannerheim, in his often quoted series of papers,¹ enumerates and describes (in conjunction with Professor F. W. Mæklin) not less than 540 species. Subsequently to these early investigations by Russian explorers only a few additional species have been discovered in these regions. In 1894 the late Dr. John Hamilton² published a systematically arranged catalogue of the Coleoptera from Alaska which brings the total number of species to about 580. This includes, however, a small number of imperfectly known or not yet identified species described by the earlier authors. Owing to the large number of species already known from southern Alaska, and also to the difficulty in thoroughly exploring the Coleopterous

¹ Beitrag zur Käfer-fauna der Aleutischen Inseln, der Insel Sitka und Neu-Californiens. Bull. Soc. Imp. Nat. Moscow, vol. 16, 1843. Nachträge zur Käferfauna d. Aleut. Inseln und d. Insel Sitka, I-III, l. c. vol. 19, 1846, vol. 25, 1852; and vol. 26, 1853.

² Catalogue of the Coleoptera of Alaska, with the synonymy and distribution. Trans. Amer. Entom. Soc., vol. 21, 1894, pp. 1-38.

fauna in these boreal regions during the short period of two months, it was not to be expected that very extensive additions to the knowledge of Alaska Coleoptera would be made during the Harriman Alaska Expedition, when usually only one day or only a few hours were spent in collecting at each particular locality. Still the number of species (155) collected by Professor Kincaid under these unfavorable circumstances is surprisingly large and gives great credit to his industry and circumspection.

The bibliography and distribution of the described Alaska Coleoptera has been fully given by Dr. Hamilton, and since his paper (quoted above) is of such recent date and so readily accessible, it has been deemed advisable to give here simply the list of the species collected by the expedition.

Family CARABIDÆ.

Cychnus angusticollis Fischer.

Sitka, June 16, 4 specimens.

Cychnus angusticollis var. **velutinus** Mannerheim.

Sitka, June 16, 1 specimen; Yakutat, June 21, 3 specimens; Kadiak, July 20, 2 specimens; Saldovia, July 21, 3 specimens; Orca, June 27, 1 specimen.

Cychnus marginatus Fischer.

Sitka, June 16, 4 specimens; Kadiak, July 20, 1 specimen; Unalaska (no date). The specimen from Unalaska has the elytral striation more interrupted.

Carabus tædatus race **baccivorus** Fischer.

Kadiak, July 1 and July 20, 3 specimens; Yakutat, June 21, 1 specimen.

Nebria mannerheimii Fischer.

Sitka, June 16, 4 specimens; Muir Inlet, June 9, 13 specimens.

Nebria gregaria Fischer.

Sitka, June 16, 1 specimen; Yakutat, June 21, 1 specimen.

Nebria metallica Fischer.

Muir Inlet, June 9, 6 specimens.

Nebria kincaidi Schwarz sp. nov.

Elongate, apterous, shining, black, elytra metallic cupreous-green, mouth-parts and tarsi piceous, two spots between the eyes red. Head large, smooth, frontal impressions obsolete; antennæ long and slender, reaching beyond the middle of the elytra. Thorax small, wider than long (but much less so than in the allied species), sides moderately rounded in front, strongly sinuately narrowed toward the hind angles which are distinctly acute and slightly prominent posteriorly; lateral margin moderately wide and moderately reflexed; transverse and longitudinal impressions well-marked; along the side margin and within the basal impressions sparsely rugosely punctured. Elytra oblong-oval, humeri entirely obsolete; sides regularly arcuate; at their widest portion distinctly wider than the thorax; transversely and longitudinally more convex than in the allied species; surface rather deeply striate, striæ faintly punctulate, interstices slightly convex, third stria with three dorsal punctures, seventh interstice interrupted by two or three larger punctures. Prosternal process feebly lanceolate, horizontal, with distinct marginal line which is interrupted at the tip. Metepisterna short, about one-fourth longer than their width in front. Abdomen with the rows of ambulatorial setæ double. Length 11 mm.

Described from a single specimen collected at Farragut Bay, June 5, 1899.

Type.—Cat. no. 5258, U. S. National Museum.

On account of the obliteration of the elytral humeri this species belongs to group I of LeConte¹ and is allied to *N. ingens* and *N. ovipennis*, from either of which it is at once distinguished by its narrower and more convex form and the bright metallic color of the elytra.

Leistus ferruginous Mannerheim.

Sitka, June 16, 2 specimens; Yakutat, June 21, 1 specimen.

Bembidium complanulum Mannerheim.

Sitka, June 16, five specimens; Muir Inlet, June 12, 6 specimens; Kukak Bay, July 5, 1 specimen.

Bembidium incertum Mots. (*tetraglyptum* Mannerheim).

Popof Island, July 1, 1 specimen.

Bembidium bimaculatum Kirby.

Muir Inlet, June 12, 1 specimen.

Bembidium mutatum Harold & Gemminger.

Popof Island, July 1, 1 specimen. This is new to the fauna of Alaska. Specimens in the U. S. National Museum are from Mar-

¹Bull. U. S. Geol. and Geogr. Surv., VOL. III, no. 2, p. 474, 1878.

quette, Michigan; Veta Pass, Colorado; Banff, Alberta; New Hampshire (no definite locality), and Gros Ventre River, Wyoming.

Bembidium spectabile Mannerheim.

Sitka, June 16, 1 specimen.

Trechus chalybeus Mannerheim.

Kadiak, July 20, 1 specimen; Yakutat, June 21, 2 specimens; Popof Island, July 8, 1 specimen.

Patrobus septentrionis Dejean.

Kadiak, July 20, 1 specimen.

Patrobus aterrimus Dejean.

Sitka, June 16, 1 specimen.

Pterostichus amethystinus Dejean.

Sitka, June 16, 17 specimens; Yakutat, June 21, 1 specimen; Metlakatla, June 4, 4 specimens.

Pterostichus validus Dejean.

Sitka, June 16, 7 specimens.

Pterostichus castaneus Dejean.

Sitka, June 16, 11 specimens; Juneau, June (no date), 2 specimens; Farragut Bay, June 5, 3 specimens.

Pterostichus luczotii Dejean.

Muir Inlet, June 9, 21 specimens; Sitka, June 16, 2 specimens; Kukak Bay, July 5, 1 specimen; Yakutat, June 21, 2 specimens; Saldovia, July 21, 1 specimen; Popof Island, July 8, 1 specimen.

Pterostichus orinomum Leach.

Berg Bay, June 10, 1 specimen; Kadiak, July 19, 1 specimen; Point Gustavus, June 16, 1 specimen; Yakutat, June 21, 1 specimen.

Pterostichus riparius Dejean.

Yakutat, June 21, 2 specimens.

Pterostichus riparius Dejean var. ?

Muir Inlet, June 9, 1 specimen; possibly a distinct species. (Elytral striae deeper; color of upper side black.)

Amara (Lirus) eschscholtzii Chaudoir.

Saldovia, July 21, 21 specimens.

Amara hyperborea Dejean.

Popof Island, July 8, 1 specimen.

Amara erratica Sturm.

Sitka, June 16, 1 specimen.

Amara remotestriata Dejean.

Muir Inlet, June 9, 1 specimen.

Calathus ingratus Dejean.

Muir Inlet, June 9, 13 specimens; Popof Island, July 13, 1 specimen; "Alaska Peninsula opposite Shumagin Islands" (C. Palache, collector), 3 specimens.

Platynus erasus LeConte.

Farragut Bay, June 5, 1 specimen (broken).

Bradycellus cognatus Gyllh.

Saldovia, July 21, 7 specimens.

Tachycellus nigrinus Dejean.

Metlakahtla, June 4, 1 specimen.

Family DYTISCIDÆ.

Deronectes griseostriatus DeGeer.

Muir Inlet, June 9, 8 specimens.

Hydroporus signatus Mannerheim.

Muir Inlet, June 12, 1 specimen; Yakutat, June 21, 2 specimens; Popof Island, July 10, 1 specimen.

Hydroporus tristis Paykull.

Virgin Bay, June 26, 2 specimens; Kukak Bay, July 1, 2 specimens.

Hydroporus axillaris Aubé.

Popof Island, July 10, 2 specimens.

Ilybius quadrimaculatus Aubé.

Kukak Bay, July 9, 2 specimens.

Agabus hypomelas Mannerheim.

Saldovia, July 21, 1 specimen; Yakutat, June 21, 8 specimens; Orca, June 25, 1 specimen.

Agabus tristis Aubé.

Yakutat, June 21, 3 specimens; Popof Island, July 15 and 16, 3 specimens. Two from the latter locality have the upper side entirely black save a small spot on the front angles of the thorax.

Agabus semipunctatus Kirby.

Popof Island, July 16, 1 specimen.

Agabus scapularis Mannerheim.

Popof Island, July 5, 9, 10 and 16, 24 specimens.

Agabus lecontei Crotch.

Kukak Bay, July 1, 2 specimens; Popof Island, July 10, 2 specimens.

Rhantus binotatus Harris.

Fox Point, July 2, 1 specimen; Sitka, June 16, 1 specimen. Both specimens are females, and the determination is therefore not quite reliable.

Rhantus bistriatus Bergst.

Popof Island, July 13, 1 specimen. A single female but no doubt belonging to this species. Has not been reported before from Alaska.

Dytiscus dauricus Gebler.

Popof Island, July 11, a single female specimen with sulcate elytra.

Family GYRINIDÆ.

Gyrinus picipes Aubé.

Yakutat, July 21, 5 specimens; Kukak Bay, July 1, 1 specimen.

Family HYDROPHILIDÆ.

Helophorus auricollis Eschscholtz.

Popof Island, July 12, 1 specimen. Hitherto reported only from Unalaska.

Helophorus inquinatus Mannerheim.

Kukak Bay, July 1, 5 specimens.

Cercyon fimbriatus Mannerheim.

Kukak Bay, July 5, 3 specimens (black form).

Cercyon fulvipennis Mannerheim.

Farragut Bay, June 5, 1 specimen.

Cercyon lugubris Paykull.

Sitka, June 16, 1 specimen. This has not been recorded before from Alaska but there is no doubt that *Cybocephalus ? unicolor* Mots., described from the same locality (Bull. Moscou, 1845, vol. iv, p. 364) is to be referred to this cosmopolitan species.

Megasternum posticatum Mannerheim.

Farragut Bay, June 5, 1 specimen; Sitka, June 16, 1 specimen.

Family SILPHIDÆ.**Necrophorus pustulatus** Herschel.

Popof Island, July 15, 2 specimens.

Necrophorus vespilloides Herbst.

Kadiak, July 20, 1 specimen; Kukak Bay, July 1 and 5, 3 specimens.

Agyrtes longulus LeConte.

Sitka, June 16, 1 specimen; hitherto not recorded from Alaska. Known from northern California, Oregon and British Columbia (Masset, Queen Charlotte Island,).

Choleva egena Horn.

Popof Island, July 15, 2 specimens; Sitka, June 16, 1 specimen.

Anisotoma curvata Mannerheim.

Yakutat, June 21, 1 specimen; Saldovia, July 21, 1 specimen.

Agathidium concinnum Mannerheim.

Yakutat, June 21, 1 specimen.

Scydmaenus californicus Motschulsky.

Yakutat, June 21, 1 specimen. Recorded from Sitka and Queen Charlotte Island. The type locality, 'California,' is probably incorrect.

Family STAPHYLINIDÆ.**Homalota picipennis** Mannerheim.

Sitka, June 16, 2 specimens.

Homalota sp.

Yakutat, June 21, 2 specimens.

Homalota graminicola Grav.?

Saldovia, July 21, 1 specimen.

Homalota sp.

Sitka, June 16, 1 specimen.

Homalota sp.

Popof Island, July 10, 1 specimen.

Homalota fucicola Maeklin.

Popof Island, July 15, 1 specimen.

Proc. Wash. Acad. Sci., December 1900.

Calodera sp.

Popof Island, July 7, 1 specimen.

Aleochara sulcicollis Mannerheim.

Saldovia, July 21, 1 specimen.

Bolitochara notata Maeklin.

Yakutat, June 21, 1 specimen.

Amblopusa brevipipes Casey.

Kukak Bay, July 3, 1 specimen; Saldovia, July 21 and 28, 4 specimens.

Diaulota densissima Casey (*insolita* Casey).

Yakutat, June 21, 3 specimens.

Liparocephalus brevipennis Maeklin.

Yakutat, June 21, 2 specimens; Saldovia, July 21, 3 specimens; Virgin Bay, June 26, 1 specimen.

Liparocephalus cordicollis LeConte.

Taku Inlet, June 6, 1 specimen; Yakutat, June 21, 3 specimens.

Quedius capucinus Grav. var. **pediculus** Nord.

Sitka, June 16, 4 specimens; Saldovia, July 21, 1 specimen.

Quedius capucinus Grav. var. **marginalis** Maeklin.

Yakutat, June 21, 1 specimen.

Quedius lævigatus Gyllh. var. **plagiatus** Mannerheim.

Sitka, June 16, 2 specimens.

Creophilus maxillosus Linné.

Kukak Bay, July 1 and 5, 2 specimens.

Hadrotus crassus Mannerheim.

Kukak Bay, July 1, 1 specimen.

Philonthus siegwaldi Mannerheim.

Kukak Bay, July, 1 specimen; Yakutat, June 21, 1 specimen.

Cafius canescens Mannerheim.

Kukak Bay, July 5, 8 specimens; Popof Island, July 8, 10 specimens.

Baptolinus macrocephalus Nordman.

Yakutat, June 21, 11 specimens; Virgin Bay, June 26, 1 specimen; Sitka, June 16, 3 specimens; Farragut Bay, June 5, 2 specimens.

Stenus insularis Casey.

Virgin Bay, June 26, 1 specimen; Yakutat, June 21, 1 specimen; Saldovia, July 21, 1 specimen. Not before recorded from Alaska; originally described from Vancouver Island; occurs also in Oregon and at Lake Tahoe, California.

Stenus umbratilis Casey.

Metlakahtla, June 4, 2 specimens. Not previously recorded from Alaska; described from British Columbia.

Tachinus nigricornis Mannerheim.

Sitka, June 16, 1 ♂ specimen.

Tachinus sp.

Virgin Bay, June 26, 1 specimen. This is a female in poor condition but seems to indicate an undescribed species.

Mycetoporus lepidus Erichson.

Popof Island, July 12, 1 specimen. The specimen is a mere fragment, but if correctly determined, the species is an addition to the fauna of Alaska. It occurs on Lake Superior, in Michigan, in Florida, Colorado, northern California, British Columbia, and Alberta.

Oxytelus fuscipennis Mannerheim.

Popof Island, July 8, 9, 10 and 12, 8 specimens.

Amphichroum testaceum Mannerheim.

Lowe Inlet, June 3, 2 specimens; Metlakahtla, June 4, 1 specimen; Sitka, June 16, 2 specimens; Yakutat, June 21, 1 specimen.

Lathrimæum subcostatum Maeklin.

Yakutat, June 21, 1 specimen.

Olophrum convexum Maeklin.

Popof Island, July 13, 2 specimens.

Omalius foraminosum Maeklin.

Kukak Bay, July 5, 1 specimen.

Anthobium pothos Mannerheim.

Lowe Inlet, June 3, 1 specimen; Metlakahtla, June 4, 1 specimen; Sitka, June 16, 2 specimens; Yakutat, June 21, 4 specimens; Kukak Bay, July 5, 17 specimens.

Orobanus simulator LeConte.

Yakutat, 1 specimen. Not previously reported from Alaska; originally described from Mount Washington, New Hampshire, and

known to occur in the high mountains of Colorado and Utah, and also in Oregon and British Columbia.

Micrædus austinianus LeConte.

Muir Inlet, June 12, 25 specimens. The specimens are identical with typical specimens from Mount Washington, New Hampshire. This is the *Anthophagus laticollis*, var. *b* mentioned by Maeklin.

Family CRYPTOPHAGIDÆ.

Atomaria vespertina Maeklin.

Sitka, June 16, 1 specimen.

Family NITIDULIDÆ.

Epuræa linearis Maeklin.

Sitka, June 16, 18 specimens.

Epuræa truncatella Mannerheim.

Sitka, June 15, 1 ♀ specimen.

Epuræa planulata Erichson.

Sitka, June 16, 2 specimens.

Epuræa æstiva Linné.

Sitka, June 16, 1 specimen; Kukak Bay, July 1, 2 specimens.

Rhizophagus dimidiatus Mannerheim.

Sitka, June 16, 5 specimens; Yakutat, June 21, 1 specimen.

Family DERODONTIDÆ.

Peltastica tuberculata Mannerheim.

Sitka, June 16, 3 specimens.

Family DASCYLLIDÆ.

Cyphon variabilis Thunberg.

Saldovia, July 21, 3 specimens; Kukak Bay, July 1, 1 specimen.

Family ELATERIDÆ.

Cryptophypnus littoralis Eschscholtz.

Kukak Bay, July 1 and 5, 3 specimens.

Cryptophypnus hyperboreus Gyllenhal.

Muir Inlet, June 12, 1 specimen.

Cryptophypnus nocturnus Eschscholtz.

Sitka, June 16, 2 specimens; Saldovia, July 21, 1 specimen.

Hypnoidus musculus Eschscholtz.

Lowe Inlet, June 3, 1 specimen; Virgin Bay, June 26, 1 specimen; Popof Island, July 8 and 12, 2 specimens.

Elater nigrinus Paykull.

Sitka, June 16, 1 specimen.

Megapenthes stigmosus LeConte.

Fox Point, July 29, 3 specimens.

Athous ferruginosus Eschscholtz.

Saldivia, July 21, 4 specimens; Popof Island, July 7, 9, 10 and 13, 11 specimens; Kukak Bay, July 1 and 5, 2 specimens.

Corymbites resplendens Eschscholtz.

Yakutat, June 21, 1 specimen; Kadiak, July 5 and 20, 3 specimens.

Corymbites volitans Eschscholtz.

Sitka, June 16, 11 specimens.

Corymbites umbricola Eschscholtz.

Yakutat, June 21, 3 specimens.

Corymbites caricinus Germar.

Sitka, June 16, 1 specimen; Yakutat, June 21, 5 specimens; Kukak Bay, July 1 and 5, 8 specimens; Popof Island, July 7, 9 and 16, 6 specimens; Fox Point, July 27, 1 specimen.

Corymbites caricinus Germar var. ?

Kukak Bay, July 1 and 5, 7 specimens; Yakutat, June 21, 1 specimen.

Corymbites tarsalis Melsheimer.

Yakutat, June 21, 1 specimen.

Corymbites lobatus Eschscholtz.

Kukak Bay, July 1 and 5, 16 specimens.

Corymbites spectabilis Mannerheim.

Virgin Bay, June 26, 3 specimens; Kadiak, July 5, 1 specimen.

Corymbites sericeus Eschscholtz. ?

Port Clarence (B. E. Fernow), Yakutat, June 21, 1 specimen.

Sericosomus incongruus Lec.

Sitka, June 16, 1 specimen. Not previously reported from Alaska; occurs in New Hampshire (White Mountains), near Lake Superior, in the State of Washington (Tenino), and in Alberta (Banff).

Family BUPRESTIDÆ.

Melanophila appendiculata Fabr.

Fox Point, July 29, 1 specimen.

Family LAMPYRIDÆ.

Eros hamatus Mannerheim.

Yakutat, June 21, 6 specimens.

Eros lætus Mots.

Sitka, June 16. Not previously reported from Alaska; known to occur in Vancouver Island, Oregon, and northern California.

Podabrus scaber LeConte.

Yakutat, June 21, 1 specimen. Not previously recorded from Alaska; known to occur on Vancouver Island, in Oregon, British Columbia (Glacier Station) and on the Wahsatch Mountains of Utah (Alta).

Podabrus piniphilus Eschscholtz.

Lowe Inlet, June 3, 3 specimens; Farragut Bay, June 5, 1 specimen; Metlakahtla, June 6, 1 specimen; Sitka, June 16, 4 specimens; Yakutat, June 21, 2 specimens.

Podabrus sericatus Mannerheim.

Sitka, June 16, 1 specimen.

Silis pallida Mannerheim.

Sitka, June 16, 3 specimens.

Telephorus fraxini Say.

Popof Island, July 8 and 15, 5 specimens.

Telephorus divisus LeConte.

Farragut Bay, June 5, 2 specimens. Not previously known from Alaska; occurs in northern California, Oregon, Washington, Vancouver Island and Queen Charlotte Islands.

Family SCARABÆIDÆ.

Aphodius congregatus Mannerheim.

Virgin Bay, June 26, 1 specimen; Kadiak, July 5, 1 specimen (L. Cole, collector); Popof Island, July 16, 2 specimens; Saldovia, July 21, 1 specimen.

Family SPONDYLIDÆ.

Spondylis upiformis Mannerheim.

Sitka, June 16, 1 specimen.

Family CERAMBYCIDÆ.

Leptalia macilenta Mannerheim.

Popof Island, July 7, 8, 9 and 10, 28 specimens; Kukak Bay, July 1 and 15, 30 specimens; Virgin Bay, June 26, 1 specimen.

Pachyta monticola Randall.

Fox Point, July 29, 2 specimens.

Pachyta liturata Kirby.

Saldovia, July 21, 1 specimen.

Acmaeops pratensis Laich.

Saldovia, July 21, 1 specimen.

Family CHRYSOMELIDÆ.

Donacia femoralis Kirby.

Metlakahtla, June 4, 1 specimen; Sitka, June 16, 1 specimen; Kadiak, July 19, 1 specimen; Popof Island, July 10, 12, 13, 15, 4 specimens.

Syneta carinata Mannerheim.

Sitka, June 16, 8 specimens.

Chrysomela subsulcata Mannerheim.

Popof Island, July 13, 1 specimen. Hitherto recorded only from the Pribilof Islands in Bering Sea.

Family CÆDEMERIDÆ.

Ditylus quadricollis LeConte.

Yakutat, June 21, 1 specimen. Not previously known from Alaska; reported from middle California (Santa Cruz Mountains), Oregon (Astoria), Washington (Easton) and British Columbia (North Bend and Queen Charlotte Islands).

Family MORDELLIDÆ.

Anaspis sericea Mannerheim.

Saldovia, July 21, 2 specimens.

Anaspis rufa Say.

Saldovia, July 21, 1 specimen.

Family ANTHICIDÆ.

Anthicus nigrita Mannerheim.

Saldovia, July 21, 2 specimens.

Family CURCULIONIDÆ.

Sitones tibialis Herbst.

Kukak Bay, July 5, 1 specimen. This circumpolar species has not before been reported from Alaska; but it is common on Vancouver Island, in Washington, Oregon, Utah, Colorado, Canada, Michigan; also recorded from Bering Island.

Trichalophus constrictus LeConte.

Yakutat, June 21, 1 specimen.

Paraplinthus carinatus Bohman.

Sitka, June 16, 1 specimen; Yakutat, June 21, 1 specimen; Virgin Bay, June 26, 1 specimen; Kadiak, July 19, 1 specimen; Saldovia, July 29, 1 specimen.

Paraplinthus scrobiculatus Mannerheim.

Sitka, June 16, 1 specimen; Virgin Bay, June 26, 1 specimen.¹

Dorytomus longulus LeConte.

Popof Island, July 11, 12, 15, 5 specimens; Kukak Bay, July 5, 1 specimen; Saldovia, July 21, 2 specimens.

Dorytomus mannerheimi Gemminger (*vestitus* Mannerheim).

Yakutat, June 21, 6 specimens.

Trachodes ptinoides Germar.

Yakutat, June 21, 5 specimens; Kukak Bay, July 5, 5 specimens; Saldovia, July 21, 1 specimen.

Trachodes quadrituberculatus Mots.

Virgin Bay, June 26, 2 specimens; Yakutat, June 21, 1 specimen.

Orchestes rufipes LeConte.

Kukak Bay, July 5, 12 specimens. Not previously recorded from Alaska, but widely distributed in the northern States from Massachusetts to the Pacific Coast.

Family CALANDRIDÆ.

Rhyncholus brunneus Mannerheim.

Sitka, June 16, 6 specimens.

¹The distribution of this species is but imperfectly understood, but it does not seem to occur in British Columbia or farther south (cf. J. Faust: Notizen ueber Ruesselkaefer, Stett. Ent. Ztg., VOL. LIII, pp. 49, 50, 1892.

Family SCOLYTIDÆ.

Hylurgops rugipennis Mannerheim.

Farragut Bay, June 5, 1 specimen; Sitka, June 16, 3 specimens.

Dendroctonus obesus Mannerheim.

Sitka, June 16, 3 specimens. This is probably specifically different from *D. rufipennis* Kirby and confined to the northwestern region of North America. The precise distribution cannot be given at present.

Pityophthorus nitidulus Mannerheim.

Sitka, June 16, 1 specimen.

Dryocætus autographus Ratzeburg.

Sitka, June 16, 1 specimen; Yakutat, June 21, 10 specimens.

Xyloterus bivittatus Kirby.

Sitka, June 16, 4 specimens.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES.

VOL. II, PP. 539-540.

DECEMBER 20, 1900.

PAPERS FROM THE HARRIMAN ALASKA
EXPEDITION.

XIX.

ENTOMOLOGICAL RESULTS (13):

PSYLLIDÆ.

BY E. A. SCHWARZ.

ONLY a few specimens of this family were collected during the Harriman Alaska Expedition. Since most of them are more or less immature, and since no record of their food-plants has been preserved, it is not deemed advisable to describe them, although at least two of the species, and possibly also the third may be undescribed. Very little is known of the Psyllid fauna of the boreal regions of North America, but judging from the material preserved in the U. S. National Museum (mostly from Labrador, New Hampshire, Lake Superior, and the high mountains of Utah), it would seem that only four genera of this family occur in boreal North America, namely, *Livia*, *Aphalara*, *Psylla*, and *Trioza*, all of very wide distribution both in the Old World and New World, and all, with the exception of *Livia*, extending to the Tropics. No species has hitherto been recorded from Alaska.

Aphalara n. sp.

Fox Point, July (no date), 4 specimens; Popof Island, July 7 and 9, 2 specimens; Belkofsky, July 22, 1 specimen.

Aphalara n. sp.

Metlakahtla, June 4, 1 specimen; Fox Point, July (no date), 1 specimen; Popof Island, July 7 and 9, 2 specimens.

Psylla sp.

Fox Point, July (no date), 2 specimens; Popof Island, July 16, 1 specimen; Saldovia, July 21, 1 specimen. These specimens, all immature, may possibly belong to *Psylla arctica* Walker (*Aphalara arctica* Walker, List of the specimens of Homopterous Insects in the British Museum, part III, p. 931, 1851), described from St. Martin Falls, Albany River, Hudson Bay.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 541-604.

DECEMBER 28, 1900.

A CONTRIBUTION TO THE STUDY OF THE IN-
SECT FAUNA OF HUMAN EXCREMENT.

[WITH ESPECIAL REFERENCE TO THE SPREAD OF TYPHOID
FEVER BY FLIES.]

By L. O. HOWARD, PH.D.

[PLATES XXX, XXXI, FIGS. 17-38.]

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INTRODUCTORY.

In 1895 the writer became interested in the study of the common house fly (*Musca domestica*). Breeding-cage experiments described with some detail later on in this paper early convinced him that horse manure is the favorite food of this species. Even in the presence of kitchen garbage, cow dung, and human excrement, flies in confinement oviposited exclusively on horse manure. In the absence of the latter substance but in the presence of the others, he noted egg-laying on decaying fruit and on cow dung but the resultant larvæ failed to develop. He considered himself warranted in the statement that probably 95 percent of the flies found in cities come from the piles of horse manure everywhere so prevalent, especially in the vicinity of stables.

After the outbreak of the war with Spain, in the spring of 1898, a mild form of typhoid fever soon became prevalent in

concentration camps in different parts of the country. In many cases the fever was not recognized as typhoid at first but toward the close of the summer it was practically decided by very general blood tests that the fever which prevailed was not malarial but intestinal. The medical journals and the newspapers contained a number of communications from contract surgeons and others advancing the theory that flies were largely responsible for the spread of the disease, owing to the fact that in many of these camps the sinks or latrines were placed near the kitchens and dining tents and that the enormous quantity of excrement in the sinks was not properly cared for. One of the most forcible writers on this topic was Dr. H. A. Veeder, whose paper entitled 'Flies as Spreaders of Disease in Camps,' published in the *New York Medical Record* of September 17, 1898, brought together a series of instances and strong arguments in favor of his conclusion that flies are prolific conveyors of typhoid under improper camp conditions.

It should be stated at this point that the conditions which apparently brought about these results existed in violation of the distinct directions issued by the Surgeon-General of the Army, Dr. Geo. M. Sternberg,¹ in his Circular No. 1, published April 25, 1898. In this circular explicit directions were given to army surgeons regarding sinks which if explicitly followed would have prevented the spread of typhoid by flies. Two sentences may be quoted from this circular: "Sinks should be dug before a camp is occupied or as soon after as practicable. The surface of faecal matter should be covered with fresh earth or quick lime or ashes three times a day. * * * No doubt typhoid fever, camp diarrhea, and probably yellow fever are frequently communicated to soldiers in camp through the agency of flies which swarm about faecal matter and filth of all kinds deposited upon the ground or in shallow pits and directly convey infectious material attached to their feet or contained in their excreta to the food which is exposed while being prepared at the com-

¹ Dr. Sternberg had as early as 1885, in his prize essay on 'Disinfection and Personal Prophylaxis in Infectious Diseases,' published by the American Health Association, showed that he was fully alive to the necessity of isolating and disinfecting excrement.

mon kitchen or while being served in the mess tent." Thus the Surgeon-General not only gave sound instructions but stated his reasons for these instructions.

In the fall of 1899 I had an opportunity to examine an ideal camp in which the latrines were properly and regularly treated. This was the great camp at the Presidio, San Francisco, California. At the time, several thousands of soldiers were encamped at that place, either about to go to or having just returned from the Philippines. In company with Col. W. H. Forwood, U. S. A., the medical officer in charge of the Department of California, I made a thorough inspection of the camp and saw plainly that there was not the slightest opportunity for the transfer of faecal microorganisms by flies to the mess tables or the kitchens. During the summer of 1900, I was able to contrast this excellent condition of affairs with a large militia camp where the sinks were supposed to be looked after twice a day but during two days there was no effort to cover any of the faeces. The camp contained about 1,200 men, and flies were extremely numerous in and around the sinks. Eggs of *Musca domestica* were seen in large clusters on the faeces and in some instances the batches were two inches wide and half an inch in depth, resembling little patches of lime. Some of the sinks were in very dirty condition and had a very disagreeable odor.

This condition of affairs in army camps in 1898 was not confined to the United States. An epidemic occurred in the camp of the Eighth Cavalry at Puerto Principe, Cuba, in which 250 cases of the fever occurred. The disease was imported by the regiment into its Cuban camp, and Dr. Walter Reed, U. S. A., upon investigation reported to the Surgeon-General that the epidemic "was clearly not due to water infection, but was transferred from the infected stools of the patients to the food by means of flies, the conditions being especially favorable for this manner of dissemination. * * *"¹

The agency of flies in the transmission of Asiatic cholera was convincingly shown at an early date by the observations

¹ Sanitary Lessons of the War, by George M. Sternberg, Surgeon-General, U. S. A., read at meeting of the American Medical Association, at Columbus, Ohio, June 6 to 9, 1899.—Phila. Med. Jour., June 10 and 17, 1899.

of Tizzoni and Cattani, Sawtchanko, Simmonds, Uffelmann, Flugge and Macrae, while Celli had shown as early as 1888 that flies fed on the pure cultures of *Bacillus typhi abdominalis* were able to transmit virulent bacilli into their excrement. Dr. Geo. M. Kober, of Washington, D. C., in his lectures before the Medical College of Georgetown University, for some years had been insisting upon the agency of flies in the transmission of typhoid, and in the report of the Health Officer of the District of Columbia for the year ending June 30, 1895, referred to the probable transference of typhoid germs from box privies and other receptacles for typhoid stools to the food supply of the house by the agency of flies.

In the winter of 1898-'99 an admirable paper by Dr. Geo. H. F. Nuttall, entitled 'On the Role of Insects, Arachnids and Myriapods as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals; a Critical and Historical Study,' was published in Volume VIII of the Johns Hopkins Hospital Reports. In this volume the previously published literature of the subject was carefully reviewed and the agency of flies in the transmission of intestinal diseases was made reasonably apparent.

In all this literature, however, the expression used in connection with insects was simply the word 'flies.' It seemed as though it were intended by the writers to mean either that all flies were concerned, or that there was but one kind of fly—presumably the house fly. It did not seem to be realized that there are many species of flies which are attracted to intestinal discharges, nor did it seem to be realized that while certain of these species may visit and do visit food supplies in dining-rooms, kitchens or elsewhere, many others are not likely to be so attracted. It occurred to the writer, therefore, during the summer of 1898 that from the scientific point of view and possibly also from the practical point of view there was a distinct necessity for careful investigation of the insect fauna of human excrement, especially of the flies which breed in human fæces or are attracted to them. Such an investigation was therefore begun and carried on, the main work being done during the summer of 1899. The results are contained in the present paper.

Before stating the results and before generalizing upon them it should be stated that owing to the prevalence of typhoid in the army during the summer of 1898, already referred to, an army typhoid commission was appointed in August of that year, at the request of the Surgeon-General, consisting of Drs. Walter Reed, U. S. A., Victor M. Vaughan, U. S. V., and E. O. Shakespeare, U. S. V. Several times after the work of the commission was well advanced newspaper items appeared in various papers stating that its members had been convinced of the important agency of flies in the transmission of the disease. Its report has not yet been published, but one of the members of the commission, Dr. Vaughan, read a paper before the annual meeting of the American Medical Association at Atlantic City, New Jersey, June 6, 1900, which in addition to being one of the most important contributions to the study of enteric fevers published of late years, gives forcibly the views of at least one member of the commission on the fly question.

Dr. Vaughan's paper was entitled 'Conclusions Reached after a Study of Typhoid Fever among American Soldiers in 1898,' and comprised 53 categorical conclusions. The one relating to flies was as follows:

“ 27. *Flies undoubtedly served as carriers of the infection.*

“ My reasons for believing that flies were active in the dissemination of typhoid may be stated as follows:

“ *a.* Flies swarmed over infected fecal matter in the pits and then visited and fed upon the food prepared for the soldiers at the mess tents. In some instances where lime had recently been sprinkled over the contents of the pits, flies with their feet whitened with lime were seen walking over the food.

“ *b.* Officers whose mess tents were protected by means of screens suffered proportionately less from typhoid fever than did those whose tents were not so protected.

“ *c.* Typhoid fever gradually disappeared in the fall of 1898, with the approach of cold weather, and the consequent disabling of the fly.

“ It is possible for the fly to carry the typhoid bacillus in two ways. In the first place fecal matter containing the typhoid

germ may adhere to the fly and be mechanically transported. In the second place, it is possible that the typhoid bacillus may be carried in the digestive organs of the fly and may be deposited with its excrement."

There were also many important conclusions which bear upon the fly question. For example, it was shown that every regiment in the United States service in 1898 developed typhoid fever, nearly all of them within eight weeks after assembling in camps. It not only appeared in every regiment in the service, but it became epidemic both in small encampments of not more than one regiment and in the larger ones consisting of one or more corps. All encampments located in the northern as well as in the southern states exhibited typhoid in epidemic form. The miasmatic theory of the origin of typhoid fever and the pythogenic theory¹ were not supported by the investigations of the commission but the doctrine of the specific origin of fever was confirmed. The conclusion was reached that the fever is disseminated by the transference of the excretions of an infected individual to the alimentary canals of others and that a man infected with typhoid fever may scatter the infection in every latrine or regiment before the disease is recognized in himself while germs may be found in the excrement for a long time after the apparent complete recovery of the patient. Infected water was not an important factor in the spread of typhoid in the national encampments of 1898 but about one-fifth of the soldiers in the national encampments in the United States during that summer developed this disease, while more than 80 per cent. of the total deaths were caused by typhoid.

In the work carried on by the writer and under his supervision in the investigation of the insect fauna of human excrement which is here described, he was assisted by Messrs. D. W. Coquillett, E. A. Schwarz, W. H. Ashmead, F. C. Pratt, Nathan Banks, and Aug. Busck, of his office force. Mr. Coquillett is responsible for the determination of all of the species

¹This theory is founded upon the belief that the colon germ may undergo a ripening process by means of which its virulence is so increased and altered that it may be converted into the typhoid bacillus or at least may become the active agent in the causation of typhoid fever.

of Diptera mentioned; Mr. Schwarz named the Coleoptera, and Mr. Ashmead named the Hymenoptera. To Mr. Pratt more than to any one else is due the large amount of material studied. Undeterred by the extremely disagreeable nature of the investigation and with a rare enthusiasm, he devoted himself indefatigably to the work during the summer of 1899, making collections and conducting rearing experiments. In the autumn Mr. Pratt developed a severe case of typhoid fever and was confined in the hospital for more than six weeks. This fact may be coincidental but it is possible also that the fever may have been contracted as a result of his investigations. Messrs. Banks and Busck also collected a certain amount of interesting material, and Dr. A. D. Hopkins, while engaged on a special trip for this office to the West, collected additional material. The writer is greatly indebted to the following persons for collections of flies made in kitchens and dining rooms in different parts of the country, which collections are used as important checks in this paper in determining which species are most likely to carry bacteria from fæces to food: Professor W. B. Alwood, Agricultural Experiment Station, Blacksburg, Virginia; Professor H. A. Gossard, Agricultural Experiment Station, Lake City, Florida; Professor A. L. Quaintance, Experiment, Georgia; Professor H. A. Morgan, Agricultural Experiment Station, Baton Rouge, Louisiana; Dr. C. B. Davenport, University of Chicago, Chicago, Illinois; Professor H. B. Ward, University of Nebraska, Lincoln, Nebraska; Dr. R. H. Ward, Troy, New York; Alvin Davidson, Easton, Pennsylvania. The writer himself made similar collections at different points in California and at New Orleans, Louisiana, so that most sections of the country were represented.

GENERAL RESULTS OF THE INVESTIGATION.

In summing up the results of the work carried on by the writer the number of species of insects found breeding in or frequenting human excrement was very large. There were many coprophagous beetles—44 species in all—and many Hymenopterous parasites, all of the latter having probably lived in the larval condition in the larvæ of Diptera or Coleoptera

breeding in excrement. Neither the beetles nor the Hymenoptera, however, have any importance from the disease transfer standpoint. The Diptera alone were the insects of significance in this connection. Of Diptera there were studied in all 77 species, of which 36 were found to breed in human fæces, while the remaining 41 were captured upon such excrement. The following list indicates the exact species arranged under their proper families. The parenthetical remarks after each species should be estimated in the following order, from 'scarce' to 'extremely abundant': scarce, rather scarce, not abundant, moderately abundant, abundant, very abundant, extremely abundant.

REARED (USUALLY ALSO CAPTURED).

Family CHIRONOMIDÆ.

1. *Ceratopogon* sp. (scarce).

Family BIBIONIDÆ.

2. *Scatopse pulicaria* Loew (moderately abundant).

Family EMPIDIDÆ.

3. *Tachydromia* sp. (rather scarce).

Family DOLICHOPODIDÆ.

4. *Diaphorus leucostomus* Loew (scarce).
5. *Diaphorus sodalis* Loew (not abundant).

Family SARCOPHAGIDÆ.

6. *Lucilia cæsar* L. (abundantly captured; one reared).
7. *Sarcophaga sarraceniæ* Riley (abundant).
8. *Sarcophaga assidua* Walker (abundant).
9. *Sarcophaga trivialis* V. d. W. (abundant).
10. *Helicobia quadrisetosa* Coq. (very abundant).

Family MUSCIDÆ.

11. *Musca domestica* L. (abundant).
12. *Morellia micans* Macq. (abundant).
13. *Muscina stabulans* Fall. (abundant).
14. *Myospila meditabunda* Fabr. (abundant).

Family ANTHOMYIDÆ.

15. *Homalomyia brevis* Rondani (very abundant).
16. *Homalomyia canicularis* L. (moderately abundant).

17. *Homalomyia scalaris* Fabr. (scarce).
18. *Hydrotæa dentipes* Meig. (moderately abundant).
19. *Limnophora arcuata* Stein (moderately abundant).
20. *Ophyra leucostoma* Wied. (abundant).
21. *Phorbia cinerella* Fall. (abundant).
22. *Phorbia fusciceps* Zett. (moderately abundant).

Family ORTALIDÆ.

23. *Euxesta notata* Wied. (moderately abundant).

Family LONCHÆIDÆ.

24. *Lonchæa polita* Say (moderately abundant).

Family SEPSIDÆ.

25. *Sepsis violacea* Meig. (extremely abundant).
26. *Nemopoda minuta* Wied. (very abundant).

Family DROSOPHILIDÆ.

27. *Drosophila ampelophila* Loew (moderately abundant).

Family OSCINIDÆ.

28. *Oscinis trigramma* Loew (rather scarce).

Family AGROMYZIDÆ.

29. *Ceratomyza dorsalis* Loew (rather scarce).
30. *Desmometopa latipes* Meig. (rather scarce).

Family EPHYDRIDÆ.

31. *Scatella stagnalis* Fall. (scarce).

Family BORBORIDÆ.

32. *Limosina albipennis* Rond. (very abundant).
33. *Limosina fontinalis* Fall. (very abundant).
34. *Sphærocera pusilla* Meig. (abundant).
35. *Sphærocera subsultans* Fabr. (very abundant).

Family SCATOPHAGIDÆ.

36. *Scatophaga furcata* Say (very abundant).

CAPTURED (NOT REARED).

Family CHIRONOMIDÆ.

1. *Chironomus halteralis* Coq. (scarce).

Family TIPULIDÆ.

2. *Limnobia sciophila* O. S. (scarce).

Family EMPIDIDÆ.

3. *Rhamphomyia manca* Coq. (not abundant).

Family DOLICHOPODIDÆ.

4. *Neurigonia tenuis* Loew (scarce).

Family SARCOPHAGIDÆ.

5. *Chrysomyia macellaria* Fabr. (rather abundant).
 6. *Calliphora erythrocephala* Meig. (rather abundant).
 7. *Sarcophaga lambens* Wied. (rather scarce).
 8. *Sarcophaga plinthopyga* Wied. (rather scarce).
 9. *Cynomyia cadaverina* Desv. (rather scarce).
 10. *Phormia terrænovæ* Desv. (very abundant).

Family MUSCIDÆ.

11. *Muscina cæsia* Meig. (scarce).
 12. *Muscina tripunctata* V. d. W. (scarce).
 13. *Stomoxys calcitrans* L. (rather abundant).
 14. *Pseudopyrellia cornicina* Fabr. (abundant).
 15. *Pyrellia ochricornis* Wied. (rather scarce).

Family ANTHOMYIIDÆ.

16. *Hylemyia juvenalis* Stein (rather scarce).
 17. *Hydrotæa metatarsata* Stein (rather scarce).
 18. *Cœnosia pallipes* Stein (rather scarce).
 19. *Mydæa palposa* Walker (rather scarce).

Family ORTALIDÆ.

20. *Rivellia pallida* Loew (rather scarce).

Family SEPSIDÆ.

21. *Piophilæ casei* L. (rather scarce).

Family DROSOPHILIDÆ.

22. *Drosophila funebris* Meig. (scarce).
 23. *Drosophila busckii* Coq. (scarce).

Family OSCINIDÆ.

24. *Hippelates flavipes* Loew (rather scarce).
 25. *Oscinis carbonaria* Loew (moderately abundant).
 26. *Oscinis coxendix* Fitch (scarce).
 27. *Oscinis pallipes* Loew (rather scarce).
 28. *Elachiptera costata* Loew (moderately abundant).

Family EPHYDRIDÆ.

29. *Discocerina parva* Loew (rather scarce).
 30. *Hydrellia formosa* Loew (rather scarce).

Family BORBORIDÆ.

31. *Borborus equinus* Fall. (very abundant, undoubtedly breeds here also).
32. *Borborus geniculatus* Macq. (moderately abundant).
33. *Limosina crassimana* Hal. (abundant).

Family SYRPHIDÆ.

34. *Syrirta pipiens* L. (scarce).

Family PHORIDÆ.

35. *Phora femorata* Meig. (scarce).

Family SCATOPHAGIDÆ.

36. *Scatophaga stercoraria* L. (moderately abundant).
37. *Fucellia fucorum* Fall. (rather scarce).

Family MICROPEZIDÆ.

38. *Calobata fasciata* Fabr. (rather scarce).
39. *Calobata antennipes* Say (moderately abundant).

Family HELOMYZIDÆ.

40. *Leria pectinata* Loew (scarce).
41. *Tephrochlamys rufiventris* Meig. (scarce).

The details not only of our observations but of what was previously known concerning each species, together with some account of the habits of each genus and family will be given later. It should be stated here that this list, containing as it does only a record of actual observations, should by no means be considered as indicating definitely the habits of the species or their relative abundance under other conditions. Thus, some of the species here indicated as scarce in connection with excrement, may be very common under other conditions, which would indicate that their occurrence upon excrement was more or less accidental. Moreover, certain of the species which have been captured on excrement but not reared from it are nevertheless undoubtedly excrement breeders as will be proved by future observations. Thus, we have in several cases certain species which have been reared while congeneric species have simply been captured, as, for example, Nos. 7 and 8 of the captured species are congeneric with 7, 8 and 9 of the reared series; 11 and 12 of the captured series are congeneric with 13

of the reared series; 17 of the captured series is congeneric with 18 of the reared series; 22 and 23 of the captured series are congeneric with 27 of the reared series; 25, 26 and 27 of the captured series are congeneric with 28 of the reared series; 33 of the captured series is congeneric with 32 and 33 of the reared series, and is undoubtedly an excrement breeder, and the same may be said of 36 of the captured series which is congeneric with 36 of the reared.

From these data it will be noticed that the most abundant species reared were *Helicobia quadrisetosa*, *Sepsis violacea*, *Nemopoda minuta*, *Limosina albipennis*, *Limosina fontinalis*, *Sphaerocera subsultans* and *Scatophaga furcata*, while the most abundant forms captured on excrement were *Phormia terrænovæ* and *Borborus equinus*. It will also be noticed that among the reared forms there are ten others which are simply entered as 'abundant' and among the captured two others. With these facts in mind we are prepared to examine the results of the kitchen and dining room captures.

The results so far stated have a distinct entomological interest as regards the exact food habits of a large number of species, many of the observations being novel contributions to previous knowledge of these forms; but the practical bearing of the work is only brought out when we consider which of these forms are likely from their habits to actually convey disease germs from the excrement in which they have bred, or which they have frequented, to substances upon which people feed. Therefore collections of the Dipterous insects occurring in kitchens and pantries were made, with the assistance of correspondents and observers in different parts of the country, all through the summer of 1899 and also in the summer and autumn of 1900. Such collections were made in the states of Massachusetts, New York, Pennsylvania, District of Columbia, Virginia, Florida, Georgia, Louisiana, Nebraska, and California. Nearly all of the flies thus captured were caught upon sheets of the ordinary sticky fly-paper, which while ruining them as cabinet specimens, did not disfigure them beyond the point of specific recognition. The others were captured in the ordinary manner.

In all 23,087 flies were examined which had been caught in rooms in which food supplies are ordinarily exposed and which may safely be said to have been attracted by the presence of these food supplies. Of these 23,087 flies, 22,808 were *Musca domestica*, i. e., 98.8 percent of the whole number captured. The remainder, consisting of 1.2 percent of the whole, comprised various species, the most significant ones being *Homalomyia canicularis* (the species ordinarily called the 'little housefly') of which 81 specimens were captured; the stable fly (*Muscina stabulans*), 37 specimens; *Phora femorata*, 33; *Lucilia caesar*, 18; *Drosophila ampelophila*, 15; *Sarcophaga trivialis*, ten; *Calliphora erythrocephala*, seven. *Musca domestica* is, therefore, the species of great significance. *Homalomyia canicularis* is important. *Muscina stabulans* is of somewhat lesser importance. *Drosophila ampelophila*, as will be shown, is an important form, and had more of the captures been made in the autumn its numbers would probably have been greater, since beyond doubt it is an abundant species in houses after fruit has begun to make its appearance (say in August and September and on until winter time) in pantries and on dining room sideboards. The Calliphora and the Lucilia are of slight importance not only on account of their rarity in houses but because they are not true excrement insects. Other forms were taken but either their household occurrence was probably accidental or from their habits they have no significance in the disease-transfer function.

CONCLUSIONS.

It appears plainly that the most abundant species breeding in or attracted to human excrement do not occur in kitchens and dining rooms, but it is none the less obvious, as will be seen from the detailed consideration of *Musca domestica* which will be given further on, that while this species under ordinary city and town conditions as they exist at the present day, and more especially in such cities and towns or in such portions of cities as are well cared for and inhabited by a cleanly respectable population, may not be considered an imminent source of danger, it is, nevertheless, under other conditions a factor of the greatest importance in the spread of intestinal disease. In the account

which follows we have shown that the house fly prefers horse manure as a breeding place; we have shown, however, that in army camps where human excrement is left exposed it will and does breed in this substance in large numbers and may be attracted to it without necessary oviposition; we have shown that in towns where the box privy nuisance is still in existence the house fly is attracted to a certain extent to the excrement, and we have shown that it is so attracted in the filthy regions of a city where sanitary supervision is lax and where in low alleys and corners excrement is deposited by dirty people. I have seen excrement, deposited over night in an alleyway, in south Washington, swarming with flies in the bright sunlight of a June morning (temperature 92° F.) and within 30 feet of these deposits were the open doors and windows of the kitchens of two houses occupied by poor people, these two houses being only elements in a long row.

Now when we consider the prevalence of typhoid fever and that virulent typhoid bacilli may occur in the excrement of an individual for some time before the disease is recognized in him and that the same virulent germs may be found in the excrement for a long time after the apparent recovery of a patient, the wonder is not that typhoid is so prevalent but that it does not prevail to a much greater extent. Box privies should be abolished in every community. The depositing of excrement in the open within town or city limits should be considered a punishable misdemeanor in communities which have not already such regulations, and it should be enforced more rigorously in towns in which it is already a rule. Such offences are generally committed after dark and it is often difficult or even impossible to trace the offender; therefore, the regulation should be carried even further and require the first responsible person who notices the deposit to immediately inform the police so that it may be removed or covered up. Dead animals are so reported; but human excrement is much more dangerous. Boards of health in all communities should look after the proper treatment or disposal of horse manure, primarily in order to reduce the number of house flies to a minimum, and all regulations regarding the disposal of garbage and foul matter should be made more stringent and should be more stringently enforced.

INSECTS OTHER THAN FLIES WHICH WE HAVE FOUND ON
HUMAN EXCREMENT.

As already pointed out, the beetles breeding in or attracted to human excrement have comparatively little significance in the transfer of disease. They are distinctly outdoor species and are seldom found away from excrement. The same may practically be said of the Hymenopterous insects which we have found. The parasitic forms are parasites of the maggots of the Diptera breeding in such excrement and the other forms are attracted to it only while fresh and containing more or less moisture. They are seeking the foul-smelling moisture and nothing more. None of them are household insects.

*Insects collected on or found breeding in Human Excrement
during the summer of 1899.*

Coleoptera.

CARABIDÆ.

- Amara musculus Say (accidental).
Stenolophus conjunctus Say (accidental).

HYDROPHILIDÆ.

- Cercyon ocellatus Say.
Cercyon hæmorrhoidalis Fabr.

SILPHIDÆ.

- Silpha noveboracensis Forst.

STAPHYLINIDÆ.

- Homalota sp.
“ “
“ “
“ “
“ “
Aleochara bimaculata Grav. (predaceous).
“ nitida Grav. “
“ n. sp. “
Trichiusa robustula Cas.
Microglossa sp.
Hoplandria lateralis Melsh.
Quedius capucinus Grav. (predaceous).
Staphylinus maculosus Grav. “

- Philonthus hepaticus* Er. (predaceous).
 “ *brunneus* Grav. “
 “ *sordidus* Grav. “
Tachinus fumipennis Say.
Oxytelus pennsylvanicus Er.
 “ *insignitus* Grav.
 “ *nitidulus* Grav.
 “ *exiguus* Er.

- Platystethus americanus* Er.
Omalius repandum Fauv. (accidental).

HISTERIDÆ.

- Hister interruptus* Beauv. (predaceous)
 “ *abbreviatus* Fabr. “
Carcinops conjunctus Say “
Saprinus assimilis Payk. “

NITIDULIDÆ.

- Omosita colon* Linn.

SCARABÆIDÆ

- Canthon lævis* Drury.
Onthophagus hecate Panz.
 “ *pennsylvanicus* Harold.
Atænius cognatus Lec.
Aphodius granaricus Linn.
 “ *rubeolus* Beauv.
 “ *stercorosus* Mels.
Geotrypes blackburnii Fabr.
Trox asper Lec.
 “ *æqualis* Say
Anomala undulata Melsh. (accidental).

Hymenoptera.

BRACONIDÆ.

- Alysia rudibunda* Say.
Aphæreta muscæ Ashm.

FORMICIDÆ.

- Ponera pennsylvanica* Buckl.
Lasius neoniger Em.
Teleomorium cæspitum Linn.
Camponotus pennsylvanicus DeG.

ENCYRTIDÆ.

- Encyrtus* sp.

CYNIPIDÆ.

Kleidotoma bakeri Ashm.
 Hexaplasta sp.
 Solenaspis hyalinipennis Ashm.
 Psilodora erythroga Ashm.

APIDÆ.

Apis mellifica L. (accidental).
 Bombus pennsylvanicus Oliv. (accidental).
 Halictus disparilis Cr. (accidental).

Lepidoptera.

PAPILIONIDÆ.

Papilio troilus (accidental).

DETAILS CONCERNING THE EXCREMENT FLIES STUDIED.

In the following pages will be found a consideration of each species of fly captured or reared in the course of this work. They are arranged according to families in the systematic order followed in catalogues and monographic works on the order Diptera. A brief consideration of the habits of each family is given, and under the first species in each genus is presented a short statement of genus habits. Under each species is given, also briefly, some account of previous knowledge, and this is followed by a full record of the observations which have been made upon it in the course of this excrement fauna study.

No specific study of this nature seems to have been made previously. Some of the species treated here will be found mentioned in Mégnin's important work, 'La Faune des Cadavres,' and in Dr. M. G. Motter's important paper entitled 'A Contribution to the Study of the Fauna of the Grave' (Journal of the New York Entomological Society, Vol. VI, No. 4, pp. 201 to 231, 1898). Very careful studies of some of them have also been made by the Russian investigator, Professor J. Porchinski (usually spelled *Portschinski*) in his paper entitled 'Comparative Biology of the Necrophagous and Coprophagous Larvæ' (1885), known to the writer only through Baron Osten Sacken's paper entitled 'On Mr. Portschinski's Publications on

the Larvæ of Muscidae' (Berliner Entomolog. Zeitschrift, Bd. xxxi, 1887, heft I, pp. 17 to 28). Professor Porchinski's paper contains a series of important observations, and, according to Osten Sacken, "illustrates the wonderful power of adaptation of these larvæ to their environment, an adaptation which, in a certain measure, destroys the parallelism which we naturally expect to exist between the systematic characters of larva and imago. * * * Distantly related species, belonging to different genera, issue from larvæ almost undistinguishable from each other. Again, closely related and almost undistinguishable imagos, species of the same genus, differ in their oviposition (size and number of eggs), and their larvæ follow a different law of development (as to the degree of maturity the larva reaches within the body of the mother and the number of stages of development it passes through)."

Interesting generalizations might be made from the present studies, but such work is foreign to the immediate purpose of the investigation. In examining the specimens, however, it will be noticed that there are three predominant types of flies, namely the medium sized gray, somewhat striped flies of the *Musca domestica* type, the metallic greenbottle or bluebottle flies, and the small, dark brown or black flies of the Homalomyia type. Several species, for example, belonging to different families, so closely resemble *Musca domestica* that even a trained entomologist cannot distinguish them without a close study of structural characters. This fact accounts for a very general popular misunderstanding as to the specific habits of *Musca domestica*.

DETAILED CONSIDERATION OF THE DIPTERA STUDIED.

Family CHIRONOMIDÆ.

The insects of this family possess almost no importance from the standpoint of this article. They are small slender midges or gnats rather closely resembling mosquitoes and flying occasionally in enormous swarms. The larvæ are aquatic or are found on moist sappy places on tree trunks, or occur in the earth or in dung. The adults are not especially attracted to any one class of substances but frequent moist places.

Ceratopogon species.

The very minute biting flies of this genus, one or more species of which are known in the north woods as the 'punkie' or 'no-see-um,' the latter name on account of their excessive minuteness, are either aquatic in their larval habits, the larva being a very long slender delicate whitish creature, or they live in the sap of trees. This seems to be the only generalization which has been made by previous workers. In the course of the present investigation, however, specimens of the undescribed species under consideration issued June 17 from miscellaneous exposed faeces collected for breeding purposes and placed under cover on June 13, 1899. Another specimen was captured on exposed faeces at Travilah, Maryland, in June of the same year. It is probable that this species has little significance from the disease point of view but this breeding habit record is novel.

Chironomus halteralis Coq.

The little midges of the genus *Chironomus* breed in water, in the earth, or in dung. The European *C. stercorarius* is a dung feeder and bears out Porchinsky's generalization as to the presence of viviparity in coprophagous Diptera since it is the only Nemocerous fly which is viviparous. The present species, which has just been described by Mr. Coquillett, was captured at Washington, D. C., upon a fresh deposit of human excrement May 16, 1899. It is possible that this species will ultimately be found to breed in excrement.

Family TIPULIDÆ.

The insects of this family, commonly known as crane flies, are common and widespread in the larval state. They are generally found under the surface of the ground, particularly in rich or highly manured soils, in decomposing wood, or on the leaves of plants or in the water.

Limnobia sciophila O. S.

The larvæ of this genus are known to occur in decaying wood and in fungi. The present species is a western form, originally described by Osten Sacken from California. In the course of

this investigation it was captured in a privy in the Golden Gate Park, San Francisco, California, by Dr. A. D. Hopkins, but its occurrence there was probably accidental and the species probably has little or no bearing upon this work.

Family BIBIONIDÆ.

These insects, called by Comstock 'March flies,' are stout flies resembling the fungus gnats in some respects. Their larvæ vary in habits, some species feeding on decayed vegetable matter while others attack the roots of growing plants, especially grasses.

Scatopse pulicaria Loew.

The flies of this genus breed in decaying vegetable material, in sewers, and human excrement. The present species occurs both in Europe and in this country. In the present work specimens were bred June 17 and June 27 from miscellaneous exposed fæces collected June 13 and placed under cover, and other specimens were captured September 13, at Alexandria, Virginia, in a garden privy. Mr. Coquillett informs me that this species is common on our windows at certain seasons of the year; but it is not likely to be attracted to any other than foul or decaying matter.

Family EMPIDIDÆ.

The flies of this family, sometimes called 'dance flies,' are small or medium sized flies often seen in swarms in the woods flying up and down. The flies are predaceous and also frequent flowers. The larvæ live in decaying vegetable matter and may be carnivorous.

Tachydromia species.

This genus, of which between 15 and 20 species are known in this country, seems to be unknown in its early stages. We have not found the larva, but adults were reared June 27 from the same miscellaneous lot of exposed fæces collected June 13, 1899, and placed under cover.

Rhampomyia manca Coq.

The larvæ of one European species of this genus are found in the earth. The genus is well represented in the United

States, nearly 100 species being known. *R. manca* was captured at Washington on human fæces on the Potomac Flats.

Family DOLICHOPODIDÆ.

The flies of this family are small in size and are usually of metallic colors. The adults are predaceous like the Empididæ and the slender cylindrical larvæ live in the earth or in decomposing vegetable matter.

Diaphorus leucostomus Loew.

The metamorphoses of the insects of the genus *Diaphorus* are recorded by Schiner as unknown. The present species occurs in the District of Columbia and Maryland, and was reared in a single specimen on June 16 from the miscellaneous lot of fæces collected on June 13.

Diaphorus sodalis Loew.

This species, originally described from New York, was captured by Mr. Busck in a privy at Twining City, Maryland, and was both captured and bred by Mr. Pratt at Travilah, Maryland. The bred specimens issued from excrement deposited May 29 and exposed two days. The captured specimens were taken during the time of exposure and the bred specimens issued sometime during June (exact date unfortunately not noted).

Neurigona tenuis Loew.

The metamorphoses of the insects of this genus seem to be unknown in Europe. The present species is an American form and was captured May 16, 1899, on a fresh deposit at Washington, D. C.

Family SARCOPHAGIDÆ.

The name of this family implies that its species are flesh feeders, but as a matter of fact they are rather variable in their habits. The larvæ of some feed upon the bodies of dead animals, others live in dung, in decaying vegetable matter and in fruits, while others are practically parasitic on living insects, and one genus (*Sarcophila*) is a parasite of mammalia and even of human beings, depositing its young in the nostrils where

they cause great suffering and even death. Several species of this group are referred to in the literature of *Myiasis*.

Chrysomyia (Comptosyia) macellaria Fabr.

This insect, popularly known as the 'screw-worm fly,' is a famous species in the West. It is one of the most important of

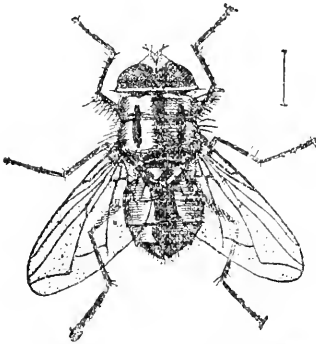


FIG. 17. *Comptosyia macellaria*—enlarged (original).

the insects which affect domestic animals and occurs throughout Central and South America, as well as in the United States. Its greatest damage to domestic animals is done in Texas. The fly lays its eggs on any spot where the skin has been injured, either from a scratch by a barbed-wire fence or the puncture of a thorn. A raw or slightly bloody surface attracts the flies which lay their eggs and the larvæ live in the flesh, making a large sore. The fly does not

confine its attacks to domestic animals, but also frequently attacks man. The most common of such cases is where the fly has laid its eggs in the nostrils of some person, usually some one who is troubled with offensive catarrh. The eggs hatch and the larvæ work their way through the upper nostrils and destroy the tissues. The soft palate is frequently entirely destroyed. Fatal cases in men are not rare. The remedy is to syringe out the nasal passages with dilute carbolic acid. It also feeds in the larval state on dead flesh. Its puparia were found by Dr. Motter in his investigations on Grave Fauna and the same observer reared this species from larvæ found feeding on an exposed human corpse.

In the present connection, the screw-worm fly has been, on several occasions, captured on human excrement, although it is not an especially common species near Washington. It has been captured on human excrement in Washington, D. C., and at Cabin John Bridge, Maryland, and was also taken at Snickers Gap, Virginia, in an out-of-door privy.

Lucilia caesar L.

This is another common and widespread form, abundant both in Europe and in North America, and possibly elsewhere. It is one of the shining green or bluish flies commonly found about dead animals and different kinds of excrement. Dr. Motter found its puparia on corpses in old graves and its larvæ feeding on an exposed corpse of a negro.

In the present investigation this species was taken at Washington, May 12, on human fæces exposed for six hours, and from fæces collected on that day, one adult was reared May 29. It was again captured on the 16th under similar conditions, and again, commonly under the same conditions, on June 6. It was captured, also under similar conditions, during the summer of 1899, at Twining City, Maryland, at Leesburg, Virginia, and at Cabin John Bridge, Maryland. In September, 1900, it was reared from animal and vegetable garbage at St. Elmo, Virginia.

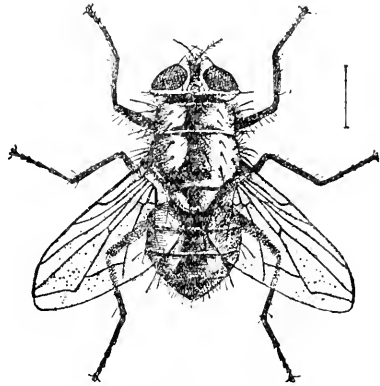


FIG. 18. *Lucilia caesar*—enlarged (original).

This species is not ordinarily found in houses, but may be driven in at the approach of a heavy storm, just as in the case of *Stomoxys calcitrans*, the biting fly. On May 17, 1899, for example, a heavy storm occurred about four P. M., and the next morning 28 specimens were found to have come into one of the rooms of my office. On June 1, at Travilah, Maryland, while Mr. Pratt was watching a fresh deposit, this species was common and flying quickly to and from the deposit. In one instance one settled on his cheek, much to his disgust.

In Europe, where this species is known as the greenbottle fly, it is apparently almost exclusively a carrion feeder. Porchinsky reared it from the dead bodies of sparrows and considered it a true carnivorous species, but larvæ hatching from eggs deposited on meat and subsequently transferred to cattle dung did not perish, but grew slowly.

Calliphora erythrocephala Meigen.

This is another widespread species common to Europe and North America. It is a large bluebottle fly of rather dull color,

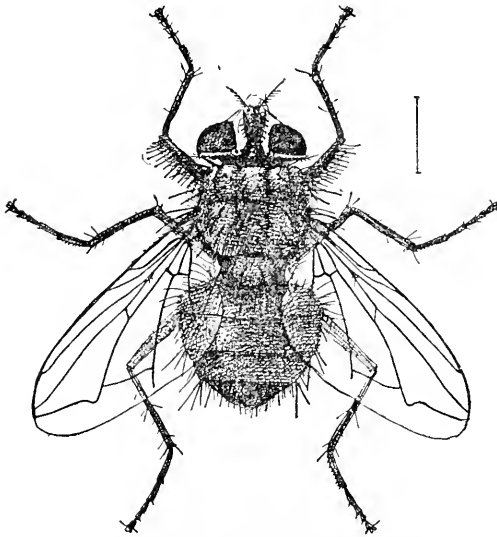


FIG. 19. *Calliphora erythrocephala*—enlarged (original).

with black spines on the thorax. It is the common 'blow-fly' of Europe and is the species treated by Lowne in his classic 'Anatomy of the Blow-fly.' Its larvæ are said by Porchinsky to be structurally indistinguishable from those of *Lucilia caesar* except in size. The fly lays its eggs on meat and dead animals. It has never been reared by us, although Riley records it in the first Report of the

United States Entomological Commission as destroying the Rocky Mountain locust or Western grasshopper. In our investigations it was captured upon fresh human feces, 24 hours old, May 13, May 16 and June 6, 1899. This fly is occasionally seen in houses, but such appearances should usually be considered accidental. In October, 1899, Mr. J. E. Benedict, living in the suburbs of Washington (Garrett Park), found thousands of these flies in his cellar where he was at work. No cows or horses are kept near the house. There is a chicken yard, however, on the premises and there is an outside privy 50 feet from the cellar, which is used by all the members of the family. It is possible that these thousands of flies had entered the cellar for hibernating purposes, although the weather was still warm. Where they bred is not known; but there had probably been a dead animal in the neighborhood.

Sarcophaga sarracenia Riley.

This fly, which superficially resembles the house fly, except that it is twice or three times as large, belongs to the group of flesh flies, as the generic name indicates, and was originally bred from the animal contents of the cups of the pitcher plants of the genus *Sarracenia* by Riley. Riley considered it a variety of *Sarcophaga carnaria*, the widespread common flesh fly which

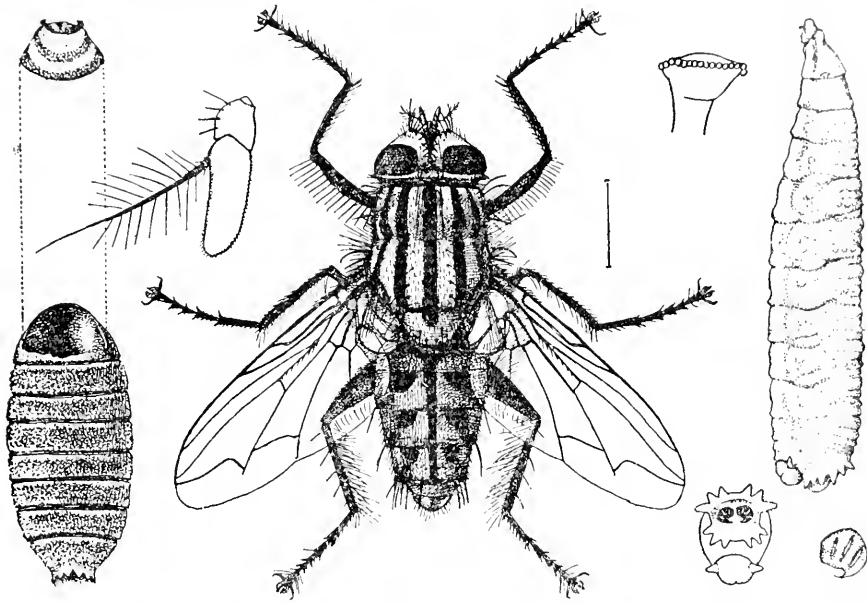


FIG. 20. *Sarcophaga sarracenia*: larva at right; adult in center; puparium at left—enlarged (original).

is a general scavenger in Europe and Australia, but its specific identity seems to be assured. This insect has been captured on and bred from human excrement on several occasions in the course of our work. It has occasionally been found in houses, though its presence there seems to be accidental. At Washington, it was captured on exposed faeces May 12 and issued on May 30 from faeces collected May 12. On July 2, at Piney Branch, D. C., an adult female of this species was observed to deposit eleven living larvæ upon faeces and then fly away. From this deposit, one adult issued on July 29. June 6, it was captured on a fresh deposit in south Washington, and adults is-

sued on June 17, in all 55 coming from this one deposit. From fæces collected June 13, adults of this species issued on June 26. From a child's fæces, exposed on July 7 in a back yard in northeast Washington, adults issued on July 21. From a similar deposit exposed July 9, in the same locality, adults of this species issued July 22. From a similar deposit exposed July 24, in the same locality, adults issued in numbers August 9 to 11, about thirty specimens being reared from a single deposit. The same species was also bred from excrement found in the latrines at the camp of the District militia at Leesburg, Virginia, June 19, 1899, and it was captured upon fæces at Marshall Hall, Maryland. It is a common, widespread and dangerous species.

Sarcophaga assidua Walker.

This species which seems to be restricted to the United States, or which, at all events, has not been reported from elsewhere, is a species which also resembles the house fly, having about the same size and being, therefore, considerably smaller than the last named species, *Sarcophaga sarraceniæ*. Nothing was definitely known of its breeding habits until the present investigations were begun. It was captured May 12, 1899, upon

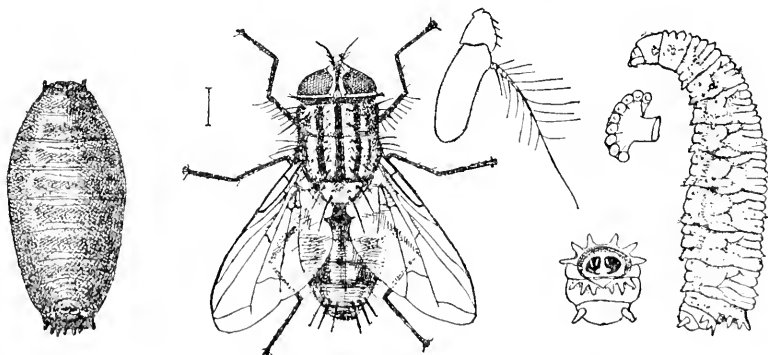


FIG. 21. *Sarcophaga assidua*: puparium at left; adult in middle, with enlarged antenna; larva with enlarged parts, at right—enlarged (original).

human fæces exposed six hours, and again on the same day upon older excrement. On July 3, a deposit was found at Piney Branch, Maryland, and was brought to my office and on July 25 a number of specimens of this species issued. On May 16,

several specimens were captured on a fresh deposit exposed only fifteen minutes on the grounds of the Department of Agriculture. It was also captured during the summer upon fæces of varying ages at Travilah, Maryland; Snickers Gap, Virginia; Cabin John Bridge, Maryland; Marshall Hall, Maryland, and at Leesburg, Virginia, the latter specimens at the militia camp previously mentioned. It was also bred from this material in the northeast Washington experiments, six specimens issuing July 18 to 26, from a child's fæces exposed in a back yard, July 9. September 9 it was reared from a deposit taken August 25 on the Potomac Flats and which was apparently about six days old when taken.

Sarcophaga lambens Wiedeman.

This fly, which is recorded from the West Indies and from Brazil, was taken from human excrement in Porto Rico by Mr. Busck in the spring of 1899.

Sarcophaga plinthopyga Wiedeman.

This species, which has been taken in Brazil, Dutch Guiana, West Indies and Nova Scotia, was also captured by Mr. Busck in Porto Rico in the spring of 1899.

Sarcophaga trivialis v. d. Wulp.

This species, originally described from Mexico, was captured on human excrement and bred from it at Travilah, Maryland; Washington, D. C., and at Snickers Gap, Virginia, in May, June and July, 1899, and was also captured during the summer at Cabin John Bridge, Maryland.

Cynomyia cadaverina Desv.

The flies of this genus live in the larval condition in foul animal matter and decaying flesh. The European *Cynomyia mortuorum* seems to be exclusively a carrion feeder, since larvæ transferred by Porchinsky from meat to cow dung and rotten fungi grew very slowly and finally perished. Several species are found in this country and the one under consideration was originally described from North or South Carolina. It has been captured at Washington, D. C., on exposed excrement.

Phormia terrænovæ Desv.

This species which is a medium-sized or rather small blue-bottle fly formerly placed in the genus *Lucilia*, would naturally be expected to undergo its metamorphoses in the excrement of mammalia or in decaying animal matter. It was originally described from Newfoundland, but is widespread in the United States. It has not been bred in the course of this work but seems to be abundantly attracted to human excrement, having been taken under many varying conditions at Washington, D. C., at Travilah, Maryland, and at Snickers Gap, Virginia. It was also captured about the deserted sinks at the D. C. Militia Camp at Leesburg, Virginia, in July, 1899.

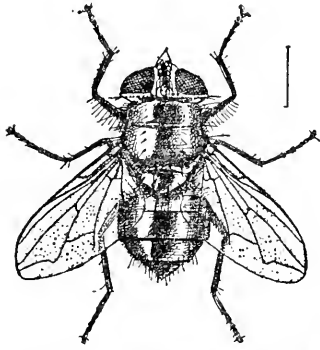


FIG. 22. *Phormia terrænovæ*
—enlarged (original).

Helicobia quadrisetosa Coq.

The insects of this genus apparently feed customarily upon dead animal matter. The genus was originally described from specimens reared from a snail, as the name indicates, but since that time specimens have been reared from several different kinds of dead insects. The species under consideration seems to have been one of the most abundant flies bred and captured from human excrement. In the experiments in the early summer of 1899 it was bred from excrement exposed six hours on the grounds of the U. S. Department of Agriculture on May 12, the first adults issuing May 24. It was also bred in July from a child's fæces exposed in the back yard of a house in northeast Washington. It was also bred the same month at Travilah, Maryland, by Mr. Pratt, and was both captured and bred at Snickers Gap, Virginia, and in the sinks at the District of Columbia Militia Camp at Leesburg, Virginia, by Mr. Pratt. It was also captured and bred during the same summer by Mr. Busck from privy excrement at Twining City, Maryland, and was captured also by Mr. Busck at Charlestown, West Virginia,

in a privy. The species has not been captured in houses. It is evidently a very rapid breeder, and Mr. Pratt's notes indicate that between June 1 and June 7, 1899, an entire generation developed, that is to say, from larvæ deposited June 1 the first adult fly issued early in the morning of June 7. It is only fair to say that the weather was very warm, the average temperature being estimated at 90° F. This fly is one of the first to be attracted in the summer time to freshly deposited excreta and its larvæ appear to be eagerly sought for by the Hymenopterous parasite *Alysia rudibunda* Say.

Another undescribed species of the genus *Helicobia* was captured upon excrement by Mr. Busck, in Porto Rico, in February, 1899.

Family MUSCIDÆ.

This family is a rather unsatisfactory complex of forms, systematically speaking, and comprises many flies of such varying habits that it is difficult to generalize concerning them.

Musca domestica Linn.

The house fly was first studied by the writer in 1895. Its breeding habits were specifically mentioned by Packard in

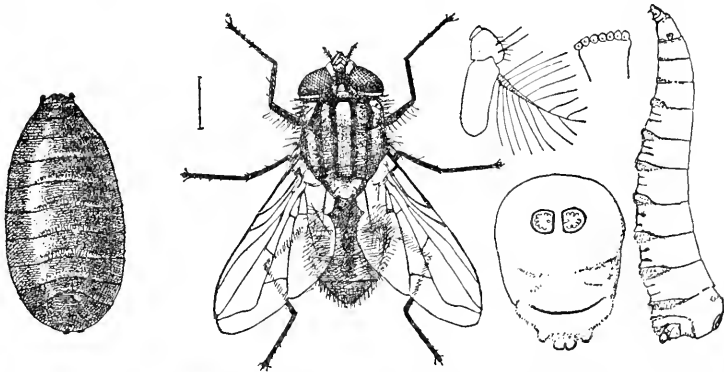


FIG. 23. *Musca domestica*: puparium at left; adult next, with enlarged antenna; larva and enlarged parts at right—enlarged (original).

1873, and by Taschenberg in 1880. Early accounts by De Geer (1752) showed that the larva lives in warm and humid dung, but the duration of the different stages was not mentioned.

Bouché (1834) stated that the larva lives in horse and fowl dung, but does not give the length of the larval stage. Packard (1873) showed that no one in this country had up to that time investigated the habits of the house fly, and that even in Europe little attention had been given to it. He bred a generation in fourteen days in horse manure, finding the duration of the egg state to be twenty-four hours, the larval state five to seven days, and the pupal state from five to seven days.

In the experiments made in my office in 1895 it was found unexpectedly that the house fly is a rather difficult insect to rear in confinement. Buzzing about everywhere and apparently living with ease under the most adverse conditions, it is nevertheless in the warm season, when confined to a small receptacle, not at all tenacious of life. The egg hatched in eight hours; the larvæ lived five days, and the pupæ five days; making the total time for the development of a generation ten days. This was at the end of June. About 120 eggs are laid by a single female, according to our observations; Porchinsky says 120 to 160.

These specimens were reared in horse manure. Subsequent experiments with cow manure were unsuccessful. We succeeded in getting only two flies to oviposit upon this substance, and although their eggs hatched, all of the larvæ died before attaining full growth. In the same way decayed fruit was tried. A single egg was laid upon a decaying blackberry, but this was the only one which could be obtained. These facts seem to indicate that horse manure is the preferred food of the adult fly, and that in all probability by far the greater number of the house flies in cities and towns come from horse manure.

Taschenberg (1880) gave a good popular account of the house fly, but gave the impression that the duration of a generation is much longer than we have indicated. He states that the female lays its eggs upon a great variety of substances, particularly on spoiled and moist foodstuffs, decaying meat, meat broth, cut melons, dead animals, in manure pits, on manure heaps, and even in cuspidors and open snuff-boxes. That the larvæ will successfully breed in such divers substances is, however, not stated by this author.

Down to the summer of 1899 we had been unable to breed a house fly from any other substance than horse manure. In the summer of 1898, while the concentration camp talk was in full blast, efforts were made to ascertain to what extent, even under abnormal circumstances, house flies would be attracted to or could be induced to breed in human excrement. Large earthen boxes were prepared with a gauze covering supported upon upright corner posts, making an enclosure with a cubic content of about twenty-seven feet. In these was placed freshly deposited excrement, and in it were liberated upon a number of occasions from one hundred to two hundred house flies. Not more than ten percent of the flies paid any attention to the excrement; about this percentage settled upon it and sucked up the moisture, flying away after a short interval. In not a single case was an egg deposited. This series of observations seemed very significant to the writer, and after they were concluded he was quite inclined to doubt the extensive breeding under any conditions of the house fly in human excrement. The erroneousness of this partly formed conclusion, however, was plainly shown the following summer, that of 1899. I had become convinced of the desirability of the most exact work upon this question, and elaborate observations were made, extending throughout the entire summer, the result being that it was shown beyond a doubt that the house fly may and does visit human excrement when fresh, and that it may and does oviposit in it, and that it may and does breed successfully in this substance. I am inclined to believe that what may be termed the psychological influence of confinement, even in so large an enclosure as the one used in the 1898 experiments, alarmed the flies, caused their early death, and prevented them from obeying their natural instincts and performing their natural functions. I recalled a similar effect upon the honey bee when enclosed in numbers under a gauze netting covering a large plant and containing perhaps fifty cubic feet of space. In that case also all of the bees died in a few hours. Therefore, in the summer of 1899 another line of experimentation was chosen. Human excrement was exposed under differing conditions in different parts of the surrounding country for a certain space of time and was then collected and

isolated, and the insects bred from it were all carefully mounted, preserved, and studied. At the same time the insects visiting the excrement in the field were noticed and many of them captured. As a result of such methods, the following facts concerning the house fly are recorded :

In the first place specimens of this species were collected in an outdoor privy at Falls Church, Virginia, in July, and a month later in a privy in Alexandria.

July 7, a child's fæces were exposed 48 hours in a woodshed, under cover, about six feet from a fly-infested kitchen in north-east Washington. Ten days later 22 specimens of *Musca domestica* were reared from this excrement, which in the meantime had been kept under cover. Certain other dipterous insects were also reared, which are referred to elsewhere.

On July 9, a large quantity of rather loose fæces of a child was exposed in the same way 48 hours in the same woodshed and afterward isolated. Nine days later two house flies issued, and others continued to issue during the next nine days until a total of 97 house flies and other dipterous insects had issued from the lot.

On July 24, child's fæces were exposed in the same way at the same place for three days, and 11 days later two house flies issued; 31 in all making their appearance during the following five days.

July 26, fæces of a child were exposed in a fly-infested kitchen for two hours, and were placed in a jar to breed. Ten days later ten house flies issued.

On June 7, a stool was found on the Department grounds, and when brought to the office insectary and placed upon one of the benches, house flies were attracted to it and walked all over it. They did not, however, deposit.

June 26, a similar experiment with a similar result.

June 24, a child's fæces were found on a floor in south Washington and were left exposed about four days. On the third day dipterous larvæ were seen crawling in it. July 1, pupæ were observed. July 3 and 4, four small specimens of *Musca domestica* issued.

July 2, specimens were captured upon fæces at Twining City, Maryland.

June 20, fæces taken in the latrines of the camp of the District of Columbia Militia at Leesburg, Virginia, were brought to Washington, and on the 1st of July two specimens of *Musca domestica* issued.

June 19, dried fæces collected in the same latrines were brought to Washington. June 27, one specimen of *Musca domestica* issued; June 28, three more; on July 1, one more. The troops had left the camp on June 16, and their sinks were left open, uncovered with lime, and dipterous insects bred freely.

June 20, another lot was collected in these sinks, and on July 7 one specimen of *M. domestica* issued.

In July one specimen was captured in a privy at Snickers Gap, Virginia, and one also in a privy at Marshall Hall, Maryland. Specimens were seen in privies at Leesburg, Virginia, and at the Bathing Beach, District of Columbia, in the latter part of May and the early part of June.

September 13, a few specimens of the house fly were captured on fæces in a privy, but no adults were reared.

July 24, 1900, a visit was made by Mr. Pratt to the summer camp of the District Militia at Gaithersburg, Maryland. The sinks were much better cared for than the previous year, but numbers of house flies were found about the sinks. Eggs of this species were seen in large clusters on fæces. In some instances the patches were two inches in diameter and looked like little patches of lime.

Morellia micans Macq.

This fly, which is a dark, shining, sometimes slightly bluish, species, about the size of the house fly, or perhaps averaging a little larger, seems to be an American species and is recorded by Osten Sacken from Baltimore. Its breeding habits seem not to have been previously known. This species was captured on human excrement at Washington, May 12, and began to issue from the same deposit on May 29, continuing to issue May 31, and June 1, 2, and 6, giving 17 days as a minimum duration for a generation. On June 4 a deposit which had been exposed for six days was placed in one of the breeding jars, and on June 8 specimens of this fly issued. A large number also issued on

June 14 from miscellaneous feces collected on the 13th. The same species was also captured and bred at Travilah, Maryland, and was captured at Snickers Gap, Virginia, on exposed feces,

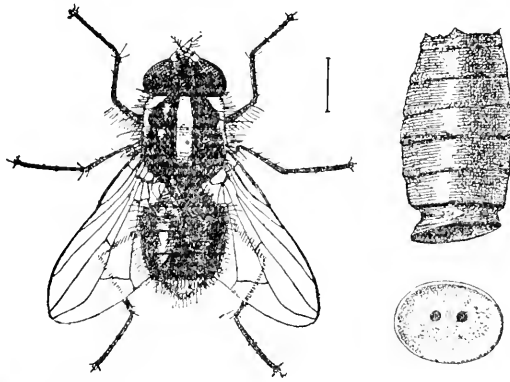


FIG. 24. *Morellia micans*: broken puparium at right—enlarged (original).

and at Leesburg, Virginia, in a privy. It seems, in fact, to be one of the most abundant of the true breeders in human excrement and one of the most specific. It apparently hibernates in larval and pupal states, entering the ground just below the excrement on which it has fed.

Muscina stabulans Fallen.

This fly is common throughout Europe and occurs also in North America. The larvæ usually feed upon decaying vegetable substances, fungi, etc., but it is recorded in Europe as feeding upon the larvæ of Lepidoptera and bees. Schiner also states that it breeds in cow dung, while Mègnin records its puparia as having been found upon the mummified bodies of children. In the course of the cotton worm investigation by this office it was found to prey upon the pupa of the cotton caterpillar. It was at first considered as a parasite, but Riley decided that it feeds on rotten chrysalids only. During the work of the Gypsy Moth Committee, the same species was reared from the pupa of the gypsy moth, possibly under similar conditions, *i. e.*, from pupæ which were already dead before the eggs of the fly were deposited. Gillette, in Bulletin 19 of the Colorado Agricultural Experiment Station, records the fact that

he found dying squash plants with the stems honeycombed below the ground by a white maggot. From these maggots he reared *Muscina stabulans*. Coquillett ('Insect Life,' VII, pp. 338, 339) determines this insect as *Cyrtonceura casia* and doubts the vegetable-feeding habit. In this case the eggs were probably to be found in the manure which was placed about the plants, or else the heavy manuring attracted the flies. In 1891 the fly was reared upon masses of the larvæ and pupa of the imported elm-leaf beetle which had congregated about the roots of trees upon the grounds of the U. S. Department of Agriculture (see Annual Report of Department of Agriculture for 1892, page 167). September 26, 1900, it was reared by Mr. Chittenden of this office from a rotten squash which had been infested with the pickle worm (*Margaronia nitidalis*). It thus seems to be an insect of somewhat variable habits, attracted, however, as a rule, to foul animal matter.

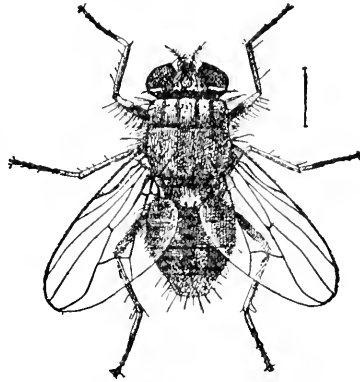


FIG. 25. *Muscina stabulans*—enlarged (original).

In May, 1899, it was captured at Washington upon human excreta exposed for six hours. This same thing occurred on six different exposures during this month. A typical case which may be described was that of observations on a mass of excrement found in an alleyway back of Tenth Street in southwest Washington, on June 6. It was a hot, summer day with a temperature of 92° F., and the small houses had kitchens practically opening on the alley. The writer and Mr. Pratt collected, that morning, on this excremental mass, *Muscina stabulans*, *Lucilia cæsar*, *Phormia terrænovæ*, *Calliphora erythrocephala*, *Limosina albipennis*, *Phorbia cinerella*, and seven specimens of *Musca domestica*, the common house fly. This is a typical case, illustrating the ready transfer of diseases of the alimentary tract to food in the poorer and dirtier parts of the city. Suppose, for example, that the excrement in question had

been deposited by a person in the early stages of typhoid fever, or with cholera. The flies in question might, any one of them, and especially the house flies and the species under immediate consideration, have flown ten or twenty feet or more to the adjoining kitchens and carried the germs direct to the food.

There were reared from this particular mass only *Sarcophaga sarraceniæ* and *Homalomyia brevis*. Fifty-five specimens of the former species made their appearance ten days later. The *Sarcophaga* is not a frequent visitor to houses, but the *Homalomyia* is frequently seen in human habitations.

On June 13 a miscellaneous lot of excreta in different stages was collected in south Washington and from these issued *Muscina stabulans* on June 23 and 29. This was the first time we had observed that the species breeds in this substance. In July additional specimens were captured in an outdoor privy near Washington in the District of Columbia, and at Twining City, Maryland. Under similar conditions other specimens were captured and adults were reared from the same material. In the fall series of observations of the same year, no specimens of this fly were captured or bred under such conditions.

The adult is shown in fig. 25, and the larva with anatomical details on Plate xxx, fig. 1.

Muscina cæsia Meig.

This species, found in Europe as well as in many different parts of the United States, was captured upon excrement at Washington, D. C.

Muscina tripunctata V. d. W.

This species, originally described from Mexico, was captured by Mr. Busck, on Culebra Island, Porto Rico, in February, 1899, on excrement.

Myospila meditabunda Fabr.

This is a dull-colored fly, about the size of the average common house fly, rather more sordid in its general appearance, but very difficult to distinguish from the house fly at a casual glance. It is common to Europe and North America and is a widespread

species on both Continents. The former doubt as to the identity of European and American specimens has recently been dispelled by Dr. Gary de N. Hough. It was known to Porchinsky in Russia as a dung feeder although the kind of dung is not mentioned by Osten Sacken in his abstract of the Russian writer's paper. It lays not more than 24 large eggs which hatch in 24 hours. The larval period is of brief duration.

It was reared at Washington in nine specimens on May 30 from human fæces deposited May 12, 1899, and eight additional specimens issued on June 2. It was formerly reared on May

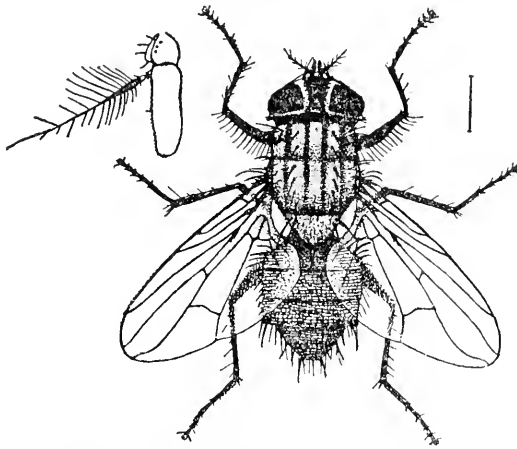


FIG. 26. *Myospila mediatubunda*: adult—enlarged (original).

27 from deposits which had been exposed earlier in the month. It also issued on June 5 from twelve-day-old fæces, additional specimens issuing on the 6th from the same deposit. The minimum duration of a generation is thus 12 days. It was captured upon excrement at Travilah, Maryland, July 5, and several times at Washington, District of Columbia, and at Twining City, Maryland, in June.

Stomoxys calcitrans Linn.

This fly, common to Europe and North America, has a very wide distribution and is a well-known biting fly; it was probably introduced into this country from Europe at an early date. The larvæ live in fresh horse manure and the flies live chiefly

on the blood of vertebrate animals, frequently causing much annoyance to horses and cattle. They resemble the common house fly very closely, so closely, in fact, as to deceive most people. They do not frequent houses except on the approach of a rain storm and late in the autumn, but they will bite human beings, and the proboscis is so strong and sharp that they even bite through thin clothing. The fact that they enter houses before storms gives rise to the common expression that, "Flies

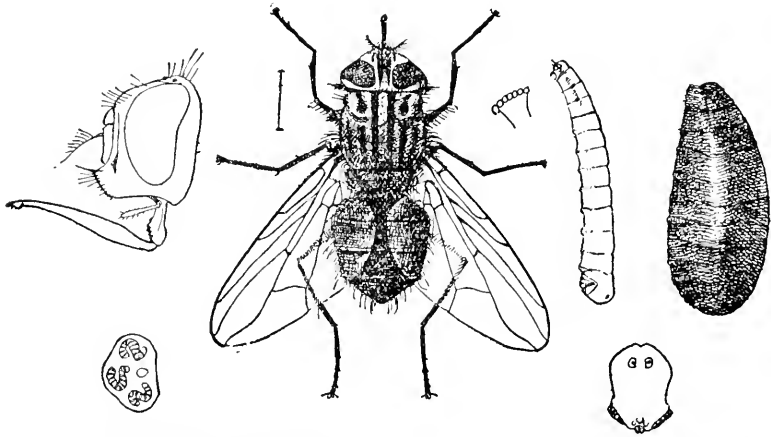


FIG. 27. *Stomoxys calcitrans*: adult, with enlarged side view of head at upper left; larva (two-thirds grown) at right; puparium at far right; anal segment of larva below, and enlarged anal spiracle of larva at lower left—enlarged (original).

begin to bite before a rain." From its biting and blood-sucking habits this insect has been suspected, in common with the true horse flies (all gadflies of the family Tabanidæ), of carrying the bacillus of anthrax, or 'malignant pustule,' and there is no reason why it should not transfer any blood-inhabiting micro-organism from domestic animals to man, or from one man to another. Packard (Proc. Bost. Soc. Nat. Hist., xvi, 145) found the pupa of this insect in horse dung and describes and figures it.

Our first experience with the breeding habits of this fly was in 1889, when studying the horn fly of cattle. August 20, 1889, four specimens of *Stomoxys calcitrans* were reared from horse manure collected at Washington, and on the 19th of the same month large numbers of adults were observed by Mr.

Marlatt, attracted to freshly dropped horse manure. January 20 and May 14, 1890, other specimens were reared from horse manure, the last lot of manure being collected on November 27, 1889, so that the insect hibernates in either the larval or pupal condition (probably the latter) in or just under old manure.

This species has not been bred from human excrement, but has been observed in out-of-door privies at Snickers Gap, Virginia, Alexandria, Virginia, and at Charlestown, West Virginia.

Pseudopyrellia cornicina Fabr.

The flies of this genus probably all resemble in their larval habits those of the genus *Pyrellia*, the larvæ of which live in foul animal matter. The present species is a shining, metallic fly. According to observations made by the writer in 1889, while studying the horn fly of cattle, it seems to be a very abundant feeder upon cow dung. In many fields in Virginia he found that almost every cow dropping of the previous day (this was in July) contained one or more clusters—one hundred or more in a cluster—of the elongated white eggs of this species, almost hidden from view, and evidently deposited after the dung had dried sufficiently to become somewhat hard on the top. The eggs had then been thrust into a crack

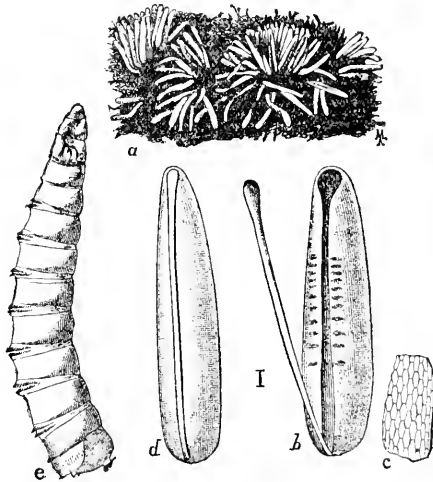


FIG. 28. *Pseudopyrellia cornicina*: a, egg mass in situ—natural size; b, egg showing method of hatching; c, sculpturing of egg; d, sound egg; e, full grown larva—all except a enlarged (from Annual Report U. S. Department of Agriculture, 1890).

and placed in little erect bunches near the surface. It was ascertained that a generation in midsummer averages from ten to fifteen days. About fifteen pounds of these cow droppings was brought to Washington and distributed in various standard breeding cages, and the numbers in which the adult flies issued from

the dung were almost inconceivable. Every morning for several days the breeding cages were apparently full of swarming masses of these flies. The species was at first identified as *Lucilia cæsar* L., and, as such, was mentioned on page 249 of Professor Riley's annual report as Entomologist in the Annual Report of the U. S. Department of Agriculture for 1890, and was figured on Plate VII of the same report. Eggs and larva are illustrated herewith, and the adult is shown at Plate XXXI, fig. 3.

In the course of the present work the adult fly has been captured upon human excrement at Snickers Gap, Virginia, but it has not been reared from this substance.

Pyrellia ochricornis Wied.

Flies of the true genus *Pyrellia*, as the names of two of the species (*cadaverina* L. and *cadaverum* Kirby) indicate, are found upon dead animals, although *P. serena* is said by Porchinski to be coprophagous. The species here mentioned is not known to occur in the United States. It was originally described from Brazil, and has also been reported from Cuba and Porto Rico, and was captured on human excrement at Culebra Island, Porto Rico, by Mr. Busck in February, 1899.

Family ANTHOMYIIDÆ.

This family comprises an assemblage of forms somewhat similar to the house fly but structurally distinct. They are difficult to separate. The larval habits are variable. Many of them attack vegetables, both healthy and diseased, as well as decaying vegetables, some are parasitic within living insects and others are found in excrement. Several forms are responsible for authentic cases of internal myiasis and have been taken into the alimentary canal with spoiled vegetables, retaining their vitality and in some cases issuing alive with the feces.

Homalomyia brevis Rondani.

This is one of the small, shining, black flies, found more or less often in houses and which, by non-entomologists, are frequently considered to be immature house flies. Three species of the genus *Homalomyia* have been reared or captured in the

course of this work. The genus is one of wide distribution and has several representatives in Europe. They breed in decaying vegetables and dung, and are said to differ in their larval forms strikingly from the other members of the family Anthomyiidae. The observations of Dr. Motter would seem to indicate that one of our American species feeds on human cadavers. The present species is not so common in houses as its congener, *Homalomyia canicularis*, which will be mentioned later, but

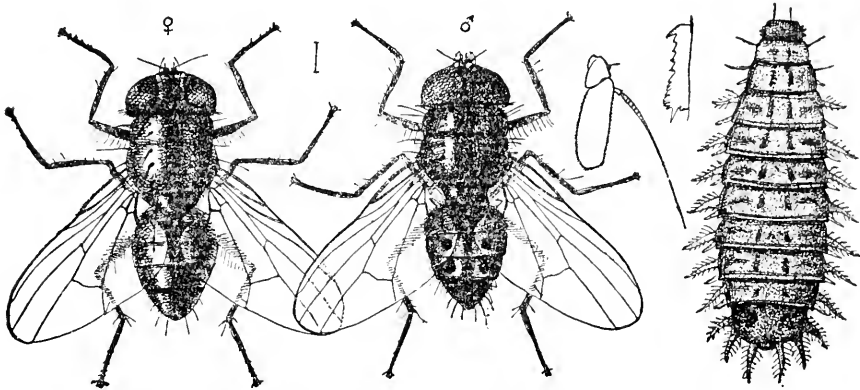


FIG. 29. *Homalomyia brevis*: female at left; male next, with enlarged antennæ; larva at right—enlarged (original).

this form was reared from human excrement and seems to be an abundant breeder in that substance. It was repeatedly bred in the experiments which have heretofore been mentioned, at Washington, namely: On May 30 it was reared from fresh fæces exposed May 12; on May 12 it was reared from an old deposit found on the grounds; on May 27 it issued from similar deposits, on June 2 from others; on June 22, after sixteen days it was reared in numbers from a deposit found fresh in south Washington; on June 8 it was reared from a deposit after 11 days. It was also reared in the northeast Washington experiments, and also bred from material gathered at Snickers Gap, Virginia, and at the militia camp at Leesburg, Virginia.

Homalomyia canicularis Linn.

This species, common to Europe and North America, is often found in houses, especially in the fall, and is the very small fly

with semi-transparent abdomen seen at such times on windows. This species is known in Germany as the little house fly ('Kleine Stubenfliege'). The larvæ are said by Schiner to live in decaying vegetable material. Heeger states that he reared it from larvæ found in the larvæ of *Epischnia canella*, a lepidopterous insect, and Roth found them in the nests of the common bumble-bee, *Bombus terrestris*. Hagen (Proc. Bost. Soc. N. H., xx, 107) reports a case in which a larva, presumably of this species, was found in the urethra of a patient. (Probably a case of pseudoparasitism.)

At Washington, one specimen issued on the 25th of May from human excreta gathered on the 12th of May, and the adult was also captured upon the same deposit before it was placed in the breeding cage. It was also reared on the 26th and 27th of June from miscellaneous material collected on the 13th. At Travilah, Maryland, it was captured upon exposed fæces June 15, 1899, and was also captured during the same month at Twining City, Maryland. Six specimens issued in January from excrement taken in a privy in Alexandria in October, 1899.

Homalomyia scalaris Fabr.

This species, also common to Europe and North America, is said to live, in Europe, in the larval state, in dry, human excrement. It was reared at Washington in a single instance on May 24 from fæces collected on the 12th.

Linnophora arcuata Stein.

The metamorphoses of the flies of this genus are not known. This species has been captured on excrement and bred from the same substance at Washington and at Travilah, Maryland, and was also captured upon excrement in Porto Rico by Mr. Buşck. From excrement deposited May 12 and exposed six hours adults issued June 16. On May 16 adults were almost immediately attracted to a fresh deposit. The adult is a small fly varying in color from grayish to nearly black.

Ophyra leucostoma Wied.

The larva of one European species of this genus, probably the species under consideration, is said by Schiner to live in

dung. *O. leucostoma* is found both in Europe and North America, and is recorded by Osten Sacken as common in the Atlantic States. It is a rather small, shining, metallic fly appearing like a small bluebottle fly. According to Bouché its

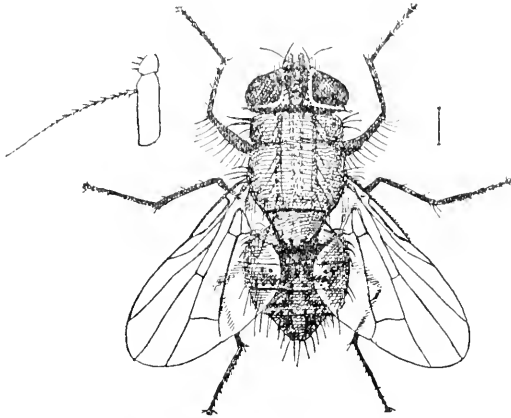


FIG. 30. *Limnophora arcuata*: adult—enlarged (original).

larvæ in Europe live in decaying vegetable material. It was reared June 30 from miscellaneous fæces collected during the early part of the month, many specimens being obtained in this way. It was also captured in the sinks at the District of Columbia Militia Camp at Leesburg, Virginia. It has not been caught in our series of fly-paper experiments, but on the evening of October 25, 1899, when the weather was warm and threatening, flies of this species swarmed in the second story of Mr. Pratt's house in southwest Washington.

Either this or a very closely allied species breeds in corpses in Europe, according to Mégnin, while this species was abundantly bred by Motter from the corpses of dogs in the course of his studies on the 'Fauna of the Grave.'

Phorbia cincrella Fall.

The present species is another small fly, common to Europe and North America, which the average person would be likely to take for a very small house fly. It has been captured and bred at Washington, District of Columbia, Leesburg, Virginia, and Snickers Gap, Virginia. It was first collected June 6 upon

exposed faeces in southwest Washington and was reared June 16 from miscellaneous faeces collected June 13. Numbers were reared from excrement brought from the District of Columbia Militia camp at Leesburg, Virginia, to Washington, and it was also captured in a privy near Washington.

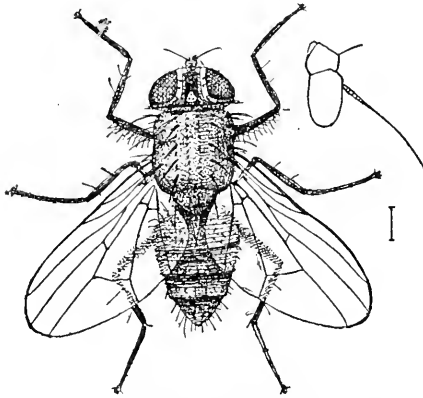


FIG. 31. *Phorbia cinerella*, with enlarged antenna at right—enlarged (original).

in June and also at Travilah, Maryland, by Mr. Pratt. It was also collected in a privy at Falls Church, Virginia, by Mr. Banks.

Hylemyia juvenalis Stein.

The larvæ of this genus are found in decaying vegetable material, in cow dung, and similar substances. The present species was captured upon human excrement at Marshall Hall, Maryland, September 17, 1899, by Mr. Pratt.

Hydrotæa dentipes Meig.

The larva of the flies of the genus *Hydrotæa* are found in cow dung and in decaying vegetables and according to Zetterstedt one European species has been found in human excrement. It is mentioned in works on internal myiasis. The present species is common to Europe and North America and is a small dark-colored fly superficially resembling the house fly. It was captured May 12, 1899, upon faeces exposed for six hours at Washington, District of Columbia, and again on deposits from three to six days old on the grounds of the U. S. Department of Agriculture. It was reared from a deposit col-

Phorbia fusciceps Zett.

This species, also common to Europe and North America, has been reared from pupæ of Lepidoptera and egg-cases of grasshoppers. It is also said to injure seed corn and beans in the ground. This species was reared at Wash-

ington, District of Columbia,

lected June 6 at Washington, District of Columbia, and was found by Mr. Pratt in a privy at Oxen Hill, Maryland.

Hydrotæa metatarsata Stein.

This species was captured upon a deposit at Travilah, Maryland, by Mr. Pratt.

Cynosia pallipes Stein.

The larvæ of this genus live in fungi, cow dung, and decaying vegetable material. The present species was captured in a door-yard privy in Alexandria, Virginia, September 13, 1899, by Mr. Pratt.

Mydæa palposa Walk.

This species was captured at Travilah, Maryland, in June, 1899, upon an old deposit.

Family ORTALIDÆ.

A group of flies with usually spotted or banded wings and frequently of metallic colors. The larvæ of one species occurs under the bark of pine and poplar and the larvæ of another work in the stalks of sugar cane and corn, either following damage by another insect or on healthy stalks.

Euxesta notata Wied.

This fly occurs throughout the eastern United States. It is a small shining species of somewhat coppery tinge, the wings bearing a brown spot at the tip. It has previously been reared from onions, cotton bolls, osage orange fruit and apples previously infested by Codling Moth; probably only follows work of other insects in such cases. It was reared in Washington, District of Columbia, June 8, 1899, from fæces exposed May 12 for six hours. It was also collected May 16 on a fresh deposit exposed for 15 minutes.

Rivellia pallida Loew.

The metamorphoses of the insects of this genus are recorded as unknown. *R. pallida*, originally described from the District of Columbia, was captured upon excrement at Rosslyn, Virginia, by Mr. Pratt.

Family LONCHÆIDÆ.

This is a group of flies not distantly related to the Ortalidæ, and formerly included in the Sapromyzidæ. The metamorphoses are not well known but the larvæ of one species has been found in Europe in the stalks of *Verbascum*.

Lonchæa polita Say.

The present species is an American form and is rather widely distributed. It was reared at Washington, District of Columbia, June 16, 1899, from excrement exposed six hours on May 12, so that it breeds in human fæces. It was also bred June 27 from miscellaneous fæces collected June 13, time of exposure not known, so that the duration of the early stages in this case is uncertain. A European species of this genus was found by Mégnin on the dead body of a child.

Family SEPSIDÆ.

This is a group of flies separated off from the old family Muscidæ, comprising small species the larvæ of many of which feed in decaying vegetable material.

Sepsis violacea Meig.

The little shining black rather slender flies of this genus are typical of the family in structure and habits. The metamorphoses are not fully understood, but the larvæ are known to breed in decaying vegetable matter. The species under consideration has a wide distribution in Europe, and is recorded by Mrs. Annie Trumbull Slosson from New Hampshire and by Dr. Jno. B. Smith from New Jersey. In the course of our excrement investigations it has been frequently found and has been both captured and reared in large series at Washington, District of Columbia, and at Travilah, Maryland, and has been captured upon human fæces at Twining City, Maryland, and at Snickers Gap, Virginia. It was taken on the 12th of May at Washington on fæces exposed six hours and was reared June 10th from the same deposit, making the duration of the early stages 29 days. It was also reared on the 20th of May from deposits collected on the 12th of May and exposed from three to six days, making a

minimum duration of the early stages in this case 23 days. From the same lot it was also reared on the 23d of May and was collected upon excrement on May 13 and May 16. A little later in the season, with warmer weather, it was reared, on June 10 after a period of immature existence of 14 days, and on the 23d of June was reared from a deposit of unknown age.

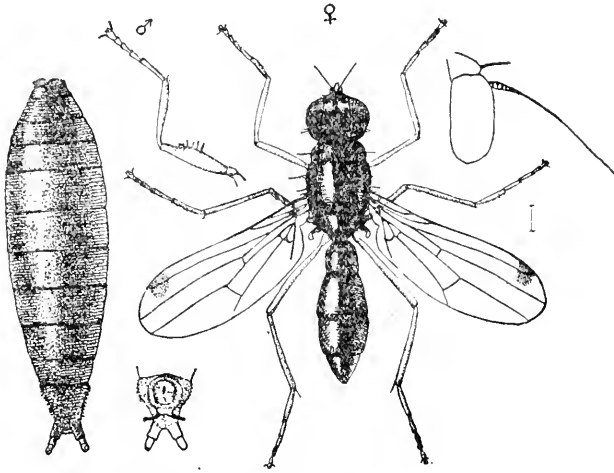


FIG. 32. *Sepsis violacea*: adult with enlarged antenna, at right; puparium at left—enlarged (original).

On September 11 it issued in swarms from a deposit collected August 18, and on the same day issued in great numbers from an old deposit collected on the Potomac Flats August 25. They also issued on this day in swarms from old excrement collected August 31.

Nemopoda minuta Wied.

The larvæ of one species of this genus (*N. cylindrica*, Desv.) has been found in Europe in human excrement. Therefore, the similar occurrence of the present species in this country was quite to be expected. *N. minuta* is an American species and was originally described from New York. It is superficially much like the preceding species but can at once be distinguished by the lack of the dusky spot near the tip of the wings. It has been taken in outdoor privies at Snickers Gap, Virginia (July

18), by Mr. Pratt, at Falls Church, Virginia, by Mr. Banks, and in the sinks at the District of Columbia militia camp at Lees-

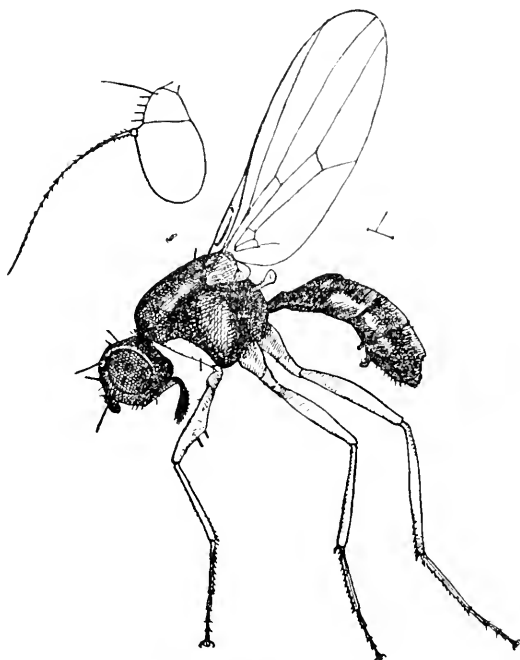


FIG. 33. *Nemopoda minuta*—enlarged (original).

burg, Virginia (July 19), by Mr. Pratt. It has been bred from human feces at Washington by both Messrs Pratt and Busck.

Piophilæ casei Linn.

The little shining black flies of the genus *Piophilæ* breed in cheese, ham fat and in other fatty or spoiled and decaying animal matter. The present species is the parent of the common cheese maggot or skipper and is one of the species occasionally referred to in cases of myiasis interna since the larvæ have been known to pass alive through the alimentary canal of human beings. The same insect sometimes does considerable damage to hams in western packing and curing establishments. It breeds commonly in human corpses, probably only or mainly on adipose tissue and Dr. Motter found its puparia abundantly in 12 of the graves which he examined in 1896-97. Each fe-

male lays about 30 eggs and the duration of a generation in this country is frequently as short as 18 days. In Germany the average duration of a generation is four to five weeks and there are two and three generations during the summer, the larvæ over-wintering in the puparium. The species is of cosmopolitan distribution.

In the course of the present investigation this species was captured upon human excrement at Travilah, Maryland.

This species is shown in its different stages on Plate xxx, at fig. 2.

Family DROSOPHILIDÆ.

The minute flies of this family, commonly known as fruit flies or pomace flies, are attracted to decaying vegetation, especially fruit, and are frequently found in houses in the autumn about dishes containing pears, peaches and grapes. They are attracted to fruit both for food and as places of oviposition since their larvæ live in decaying vegetable matter.

Drosophila ampelophila Loew.

This little pomace fly is the commonest species all over the United States and occurs also in the West Indies. It is also reported by Loew from South Europe. It does considerable damage to canned fruits and pickles, breeds in decaying apples and the refuse of cider mills and fermenting vats of grape pomace. It is a rather rapid breeder and a generation may be developed in 20 days or less. In the present series of observations it was captured upon human excrement at Charlestown, West Virginia, by Mr. Busck, and September 5, 1899, was reared from miscellaneous deposits collected at Washington, District of Columbia, August 31, so that it is a true excrement breeder. As this fly is as has just been stated in the remarks on the family Drosophilidæ frequently found in houses in the autumn about dishes containing fruit and as it also affects canned fruits, pickles, raspberry vinegar and similar substances, this discovery that it will and does breed in human excrement makes this species and the following very dangerous ones.

This species is shown in its different stages on Plate xxxi, at fig. 2.

Drosophila funcbris Meig.

This species is common to Europe and North America, and in habits resembles the preceding insect. We have bred it from rotten cherries from Massachusetts and it is recorded as breeding in the waste of pressed olives in Mauritius. It was captured upon human excrement at Travilah, Maryland, by Mr. Pratt.

Drosophila busckii Coq.

This insect was captured in a privy at Charlestown, West Virginia, by Mr. Busck. The same species was previously reared at this office from rotten potatoes and from burrows of *Chion cinctus*. It also occurs at Algonquin, Illinois.

Family OSCINIDÆ.

These are also small flies, usually either dark and shining or yellowish in color, the larvæ of which breed in the stems of grasses or are found in decaying vegetable material.

Hippelates flavipes Loew.

The metamorphoses of the very minute flies of this genus are unknown and its larval habits are unrecorded except in a single instance when *Hippelates convexus* was reared at this Department from the deserted burrow of a Lepidopterous larva in sugar cane from Florida. The flies themselves are very abundant, especially in the South, where they are found swarming about the eyes of animals and human beings, rendering life burdensome. Sores, ulcers and other open wounds have a great attraction for them and they are said by Hubbard to be responsible for the transmission of the disease known as 'pink-eye' occasionally prevalent, especially among school children, in Florida. The present species seems to be widely distributed in the Southern States, and has been captured on human excrement at Travilah, Maryland, at Leesburg, Snickers Gap and Rosslyn, Virginia. It is probably occasionally and perhaps often responsible for the carriage of putrefactive germs to open

wounds and is indirectly the cause of blood poisoning. This species is shown at Plate XXXI, fig. 1.

Oscinis carbonaria Loew.

The larvæ of the insects of this genus usually attack living plants not previously injured by insects, but a few species live in the deserted burrows of other insects. *O. carbonaria* was captured several times upon deposits at Washington (May 12, 13, 16 and 18) and at Snickers Gap, Virginia (July 18). It is an American species as in fact are all of the following species of this genus, *O. pallipes* occurring also in Cuba.

Oscinis coxendix Fitch.

This species, previously bred by Mr. Chittenden from the roots of *Ambrosia artemisiæfolia* at Washington, District of Columbia, was captured also at Washington on human fæces.

Oscinis pallipes Loew.

This species was captured September 17 on human excrement at Marshall Hall, Maryland.

Oscinis trigramma Loew.

This species was also captured on September 17 at Marshall Hall, Maryland, upon fæces and was bred September 5 from a deposit collected in Washington August 18 and which at that date was apparently about a week old.

Elachiptera costata Loew.

The larvæ of the insects of this genus attack living plants and decaying vegetation. Specimens have been reared at this office from plants of fall wheat received from F. M. Webster, at Lafayette, Ind. In the present series specimens were captured at Washington upon fresh excrement on May 12 and 13.

Family AGROMYZIDÆ.

This family is closely related to the Oscinidæ and it has practically the same habits. The larvæ of one genus prey upon living plant lice and scale insects but the others feed upon living

plants by forming burrows and mines in various parts of them but principally in the leaves.

Ceratomyza dorsalis Loew.

The transformations of one species of this genus are known in Europe and its larvæ mine the leaves of *Sonchus oleraceus*. *C. dorsalis* has been reared at this office from a puparium found in a mine in a leaf of timothy and similar rearings have been made by Mr. F. M. Webster. The previous statements as to breeding habits render the rearing of this species from human fæces something of a surprise, yet it was unquestionably reared on June 24, 1899, at Washington, from miscellaneous deposits collected in a low part of the city on June 13.

Desmomctopa latipes Meig.

This insect, which occurs both in Europe and North America, and which would hardly be expected to breed in human excreta was reared, September 6, 1899, from a miscellaneous lot of deposits collected in Washington August 18.

Family EPHYDRIDÆ.

This family includes a number of insects of curious structure and strange habits. The larvæ as a rule are aquatic or sub-aquatic and are found in waters strongly impregnated with salts. They occur near salt wells, are found in the strongly alkaline lakes of the Western States, some species breed in pools of water strongly impregnated with manure and one form is found breeding commonly in the pissoirs of European cities. *Brachydeutera argentata* Walker, a handsome little species belonging to this family, has been reared by the writer from larvæ found in a small pool, on the grounds of the Department of Agriculture, which was strongly impregnated with horse manure from an adjoining manure heap.

Discocerina parva Loew.

This species, found only in America and the breeding habits of which are not known, was captured at Travilah, Maryland, May 29, and June 1, 1899, on human fæces. It is a very small, black, dull-colored and somewhat hairy species.

Scatella stagnalis Fall.

The metamorphoses of the insects of this genus are not known. The flies are found in damp places and on water plants. The present species is common to Europe and North America and is boreal in its distribution. It is a small fly with mottled wings. Specimens were captured at Washington, May 16, upon a fresh deposit which had been exposed only fifteen minutes. Two specimens issued August 30, from a deposit of unknown age collected August 18. This record is a novel one.

Hydrellia formosa Loew.

This is an American species which was captured upon an old deposit upon the Potomac Flats near the water, as was quite to be expected since the flies of this genus are most commonly found upon the leaves of water plants.

Family BORBORIDÆ.

This is another group formerly placed in the old family Muscidae. The larvæ of very few species are known. These are found in dung and in decaying fungi. The little flies of this family, usually black in color, seem to be among the most abundant insects found in this country, not only upon human excreta but upon the dung of other mammalia. In the summer time they almost immediately swarm upon a fresh deposit. They occur very rarely, if at all, in houses.

Borborus equinus Fall.

Insects of this genus are known in Europe to breed in dung, including human fæces, and the flies are recorded by Schiner to be often found in great numbers on human excrement. The species are all rather small and dark-colored and are perhaps the most abundant of the excrement insects. One of the species of this genus (*B. venalicius*) was found abundantly in Cuba by Osten Sacken and as it is an African species it is considered probable that it was brought over in slave ships. *B. equinus*, like so many of the species which we consider in this connection, is common to both Europe and North America. It varies greatly in size, the largest specimens being five or six

times as large as the smallest ones. It was captured on human excrement at Washington, at Travilah, Maryland, and at Leesburg and Snickers Gap, Virginia, in April, May, June and July, 1899, and as early as the 25th of March, 1900, it was noticed by Mr. Pratt, on and around human fæces deposited near Chesterbrook, Fairfax County, Virginia. It was also seen about a dead horse. No other flies were seen at this time, probably on account of the cold weather following the 23d, which was warm, with a maximum temperature of 68° F. and a minimum temperature of 32° F. A wet snow followed on the 26th of March. The larva and puparium of this species were described by Haliday in the Entomological Magazine, III (1836), pp. 335-6. Eggs laid in the first week in October remained unchanged until the end of the month.

Borborus geniculatus Macq.

This is an European species, recognized here by Mr. Coquillett. Mrs. Slosson has captured it in New Hampshire on Mt.

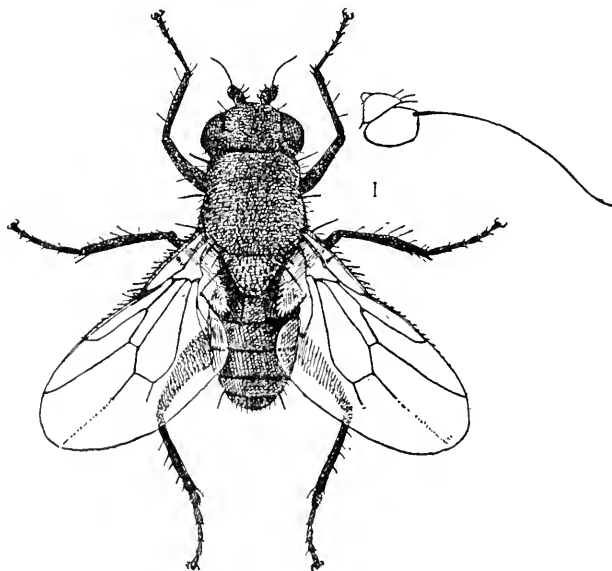


FIG. 34. *Limosina albipennis*, adult—enlarged (original).

Washington. It was captured upon excrement at Washington and at Travilah and Marshall Hall, Maryland, by Mr. Pratt,

and was taken in a privy at Charlestown, West Virginia, by Mr. Busck.

Limosina albipennis Rond.

The flies of this genus resemble somewhat the species of *Borborus*, but are smaller, and are distinguished by the imperfect venation. The European records show that the larvæ of some species are found in decaying cabbages and among confervæ and in fungi growing on willows. *L. albipennis*, illustrated herewith, has been captured abundantly upon human excrement in the course of this investigation at Washington, at Travilah and Cabin Johns Bridge, Maryland, at Snickers Gap, Rosslyn and Leesburg, Virginia, and has been taken in privies at Alexandria, Virginia, by Mr. Pratt, and at Charlestown, West Virginia, by Mr. Busck. Specimens were reared early in the summer from fæces collected on the 12th of May, and other specimens were reared from excrement taken from the sinks of the militia camp at Leesburg, Virginia, in July. September 13 it was captured on excrement in a privy at Alexandria, Virginia. It seems to be a very abundant species in such localities but has not been taken in houses.

Limosina crassimana Hal.

This species, common in Europe, is recognized here by Mr. Coquillett. It has been captured on both fresh and old excrement at Washington, District of Columbia, by Messrs. Pratt and Busck, at Travilah, Maryland, by Mr. Pratt, and in a privy at Charlestown, West Virginia, by Mr. Busck.

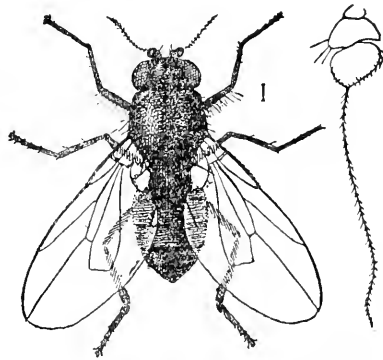


FIG. 35. *Limosina crassimana*, with enlarged antenna at right—enlarged (original).

Limosina fontinalis Fall.

This is another European species, recognized here by Mr. Coquillett, which has been captured at Travilah, Maryland, and

which was bred in Washington, on June 16, in large numbers from miscellaneous faeces of unknown age collected June 13. It was also bred from excrement taken from the sinks of the militia camp at Leesburg, Virginia, in July.

Sphæroccra pusilla Meig.

The insects of this genus resemble the foregoing both in structure and in habits. The larvæ are recorded in Europe as feeding in horse dung and cow dung, and one species according to Signoret has been found on scale-insects. The present species is European, recognized here by Mr. Coquillett. It was reared May 20 from fresh excrement collected May 12, giving a very short period of development.

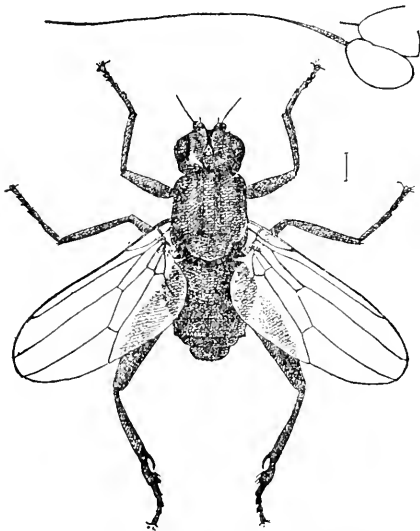


FIG. 36. *Sphæroccra subsultans*—enlarged (original).

Sphæroccra subsultans Fabr.

This is also a European species recognized here by Mr. Coquillett. It was reared with the foregoing species upon the 20th of May, from excrement deposited May 12. The same species swarmed upon a deposit during a storm which occurred on June 12. It was captured on other dates in May and in July at Washington by both Messrs. Pratt and Busck.

Family SYRPHIDÆ.

The species of this family, the majority of which are flower flies, are among the most numerous and best known flies. They abound in gardens in sunny weather. The larvæ are variable in habits, many being predatory, feeding upon soft bodied insects, while others live in foul water or in decaying vegetable

matter. Still others feed upon decaying animal matter, while others live in ants' nests. Still others are found in dung of various animals.

Syrilla pipiens Linn.

The larvæ of insects of this genus live in horse dung and cow dung in Europe. *S. pipiens* is found in Europe and North America, extending clear to the Pacific coast, and it is also found in Asia and Africa. It has been reported by Westwood as breeding in horse dung and by Scholtz in cow dung. The only specimen noted in the course of this investigation was taken in a privy at Newport, Oregon, by Dr. A. D. Hopkins.

Family PHORIDÆ.

The small flies of this family, which are brownish in color and hump-backed in shape, are occasionally found in houses. The larvæ feed on decaying vegetable and animal matter, such

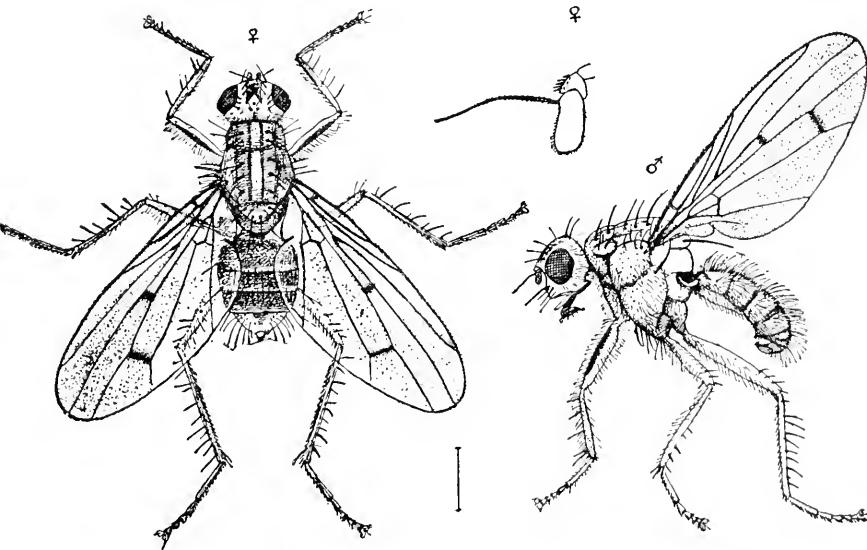


FIG. 37. *Scatophaga furcata*: male at right; female at left, with enlarged female antennæ above—enlarged (original).

as dead insects and snails, and are believed to be parasitic in other insects. Some forms have been found breeding in cadavers and have some medico-legal importance.

Phora femorata Meig.

A single specimen of a little *Phora*, which Mr. Coquillett thinks belongs to the European species *P. femorata*, was captured by Mr. Busck in a privy at Charlestown, West Virginia.

Family SCATOPHAGIDÆ.

The insects of this family, popularly known as dung flies, as the scientific name indicates, are attracted to and breed in dung of different mammals, in human excreta and also in decaying vegetable material. They are as a rule slender, rather light-colored, bristly flies.

Scatophaga furcata Say.

The flies of the typical genus *Scatophaga* are known in Europe to live in dung and in human excrement and are also found in water. The present species, *S. furcata*, well figured in the

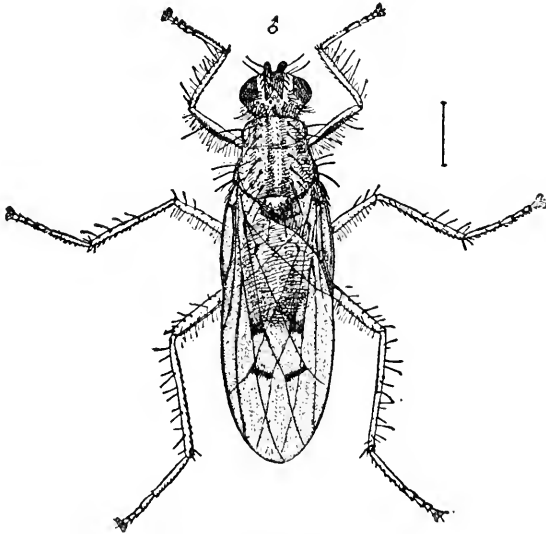


FIG. 38. *Scatophaga furcata*: male, with closed wings—enlarged (original).

accompanying illustrations, has been found all through the season on excrement at Washington and has been captured in a privy at Charlestown, West Virginia. It was not noticed during the early observations in the summer of 1899, although

more than 200 deposits were collected from May to October. On November 8, eight specimens were captured on a deposit in the field and very many were noticed upon fæces in a low part of Washington. November 10, with the thermometer at 65° (rather warm for this season of the year) very many more were noticed about fresh deposits, copulating and presumably ovipositing. Some of these deposits were placed in a breeding cage, and March 3, 1900, 12 adults issued.

Scatophaga stercoraria Linn.

This species, common to Europe and North America, was captured during the summer of 1899 on deposits at Travilah, Maryland, at Washington, District of Columbia, and in a privy at Charlestown, West Virginia.

Fucellia fucorum Fall.

Four specimens of this species were captured on excrement at Tybee Island, Georgia, in February, 1899, by Mr. Busck. Four other specimens were collected on Culebra Island, Porto Rico, in February by the same observer.

Family MICROPEZIDÆ.

These flies, somewhat related to the Sepsidæ, are little known and their metamorphoses do not appear to have been observed.

Calobata fasciata Fab.

Specimens of this species were collected upon human fæces by Mr. Busck in Porto Rico.

Calobata antennipes Say.

This species, reasonably common in the District of Columbia, is said by Mr. Burden, a Washington entomologist, to frequent human fæces in this vicinity.

Family HELOMYZIDÆ.

The flies of this family, which is not distantly related to the Scatophagidæ, occur in the larval condition in fungi and one species in Europe feeds upon truffles. These flies seem to prefer damp shady places and fly in the twilight.

Leria pectinata Loew.

The larvæ of the flies of this genus are known in Europe to occur in dung and in fungi, presumably decaying fungi. The flies lay their eggs in the excrement of dogs and other animals. The only observations upon this species made in the course of these investigations were by Dr. A. D. Hopkins, who collected specimens in a privy at Golden Gate Park, San Francisco.

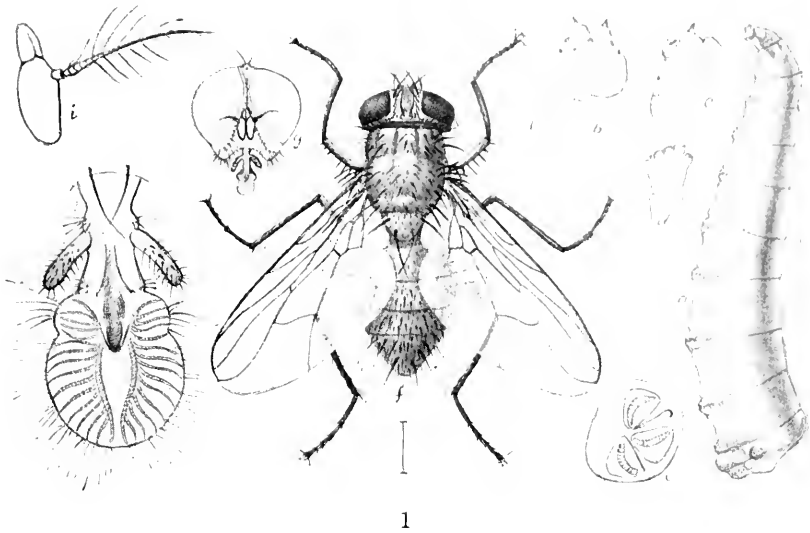
Tephrochlamys rufiventris Meig.

This species, common to Europe and North America, was taken in a privy at Newport, Oregon, also by Dr. Hopkins.

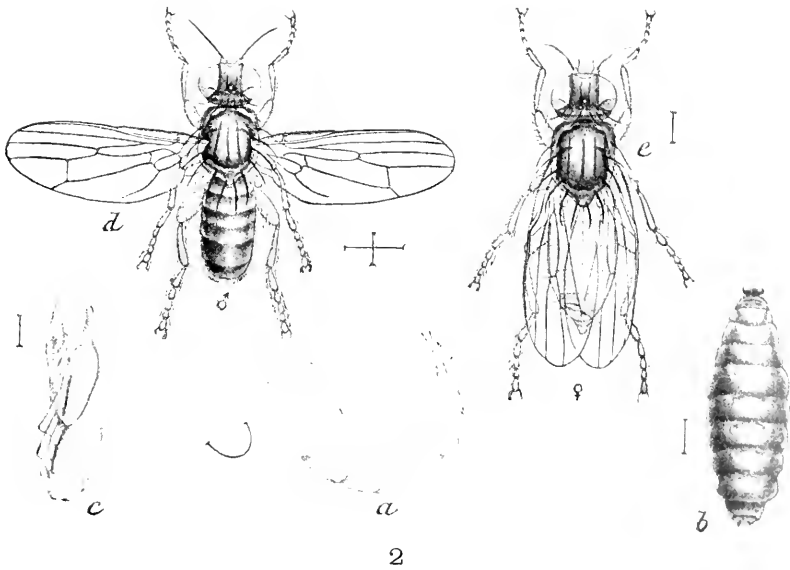
PLATE XXX.

[Enlarged.]

- FIG. 1. *Muscina stabulans*: *a*, full-grown larva; *b*, head of same from below; *c*, same from side; *d*, thoracic spiracles; *e*, anal spiracles; *f*, adult female; *g*, head of male from front; *h*, mouth parts of adult; *i*, antennæ. (From Annual Report U. S. Department of Agriculture, 1892.)
2. *Piophilila casei*: *a*, full-grown larva; *b*, puparium; *c*, pupa; *d*, adult with wings expanded; *e*, same with wings closed in resting position. (Author's illustration.)



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1. MUSCINA STABULANS

2. PIOPHILA CASEI

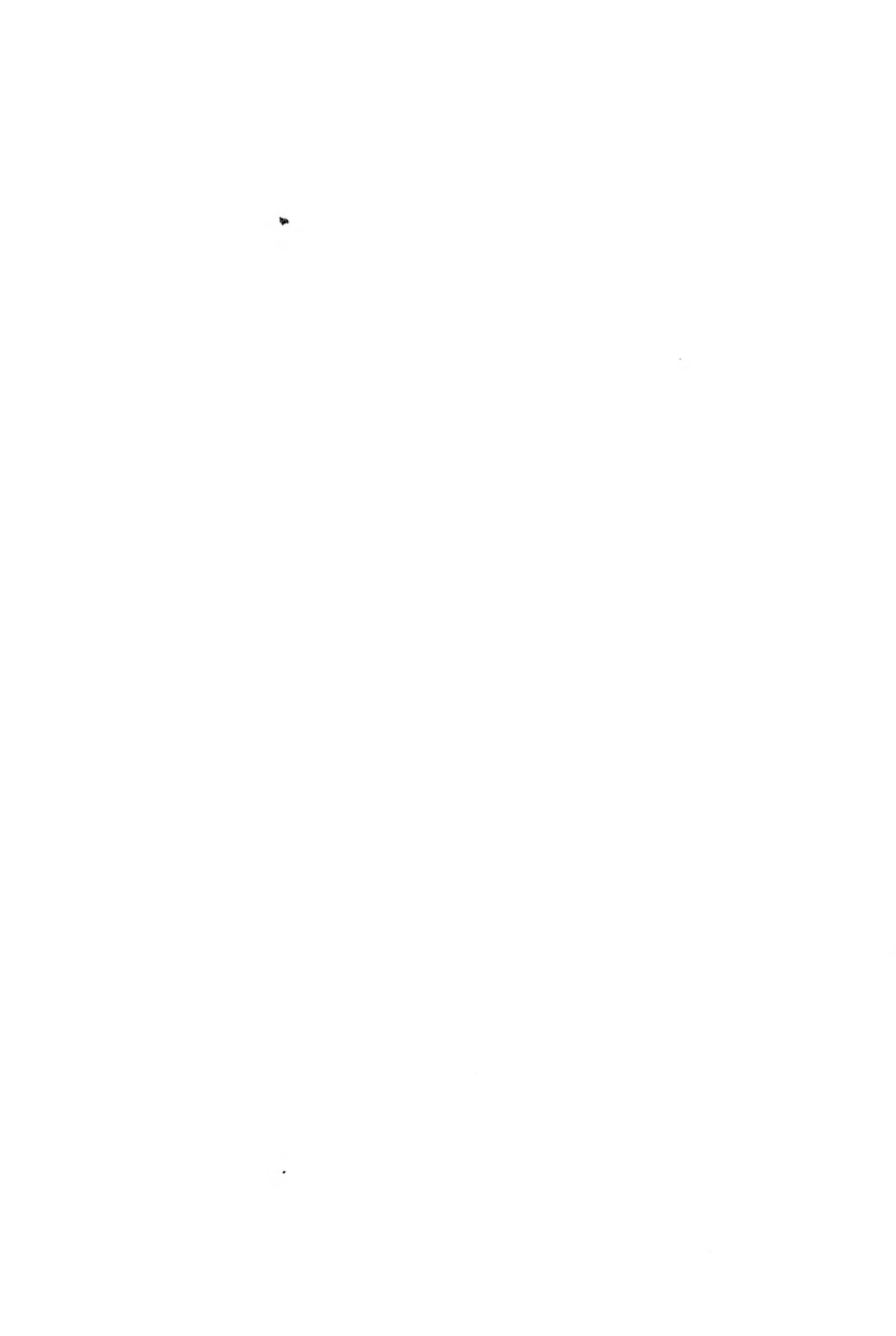
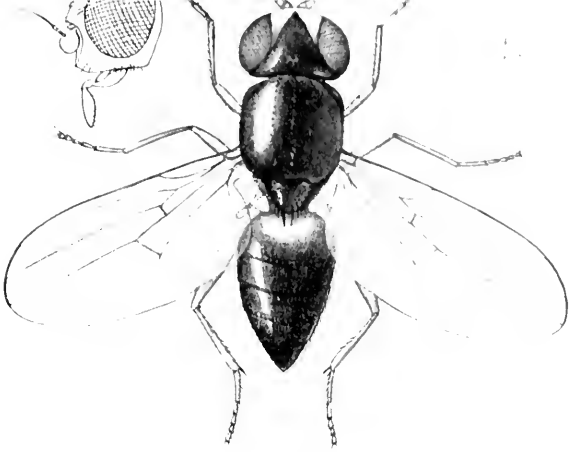


PLATE XXXI.

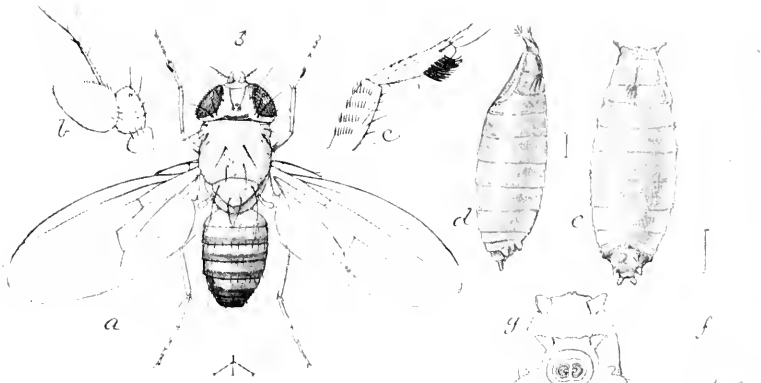
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- FIG. 1. *Hippelates flavipes*, with side view of head in upper left hand corner. (From *Insect Life*.)
2. *Drosophila ampelophaga*: *a*, adult; *b*, antenna of same; *c*, base of tibia and first tarsal joint of same; *d*, puparium, side view; *e*, puparium from above; *f*, full-grown larva; *g*, anal spiracles of same. (Author's illustration.)
 3. *Pseudopyrellia cornicina*: *a*, adult female; *b*, head of male from front; *c*, antenna. (From Annual Report U. S. Department of Agriculture, 1890.)

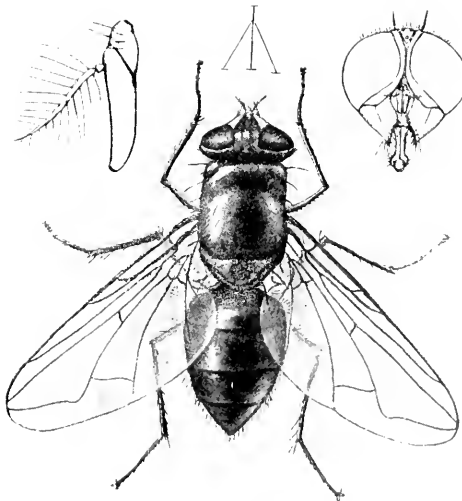
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1 HIPPELATES FLAVIPES

2. DROSOPHILA AMPELORACEA

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 605-629.

DECEMBER 28, 1900.

A THEATRICAL PERFORMANCE AT WALPI.¹

BY J. WALTER FEWKES.

[PLATES XXXII-XXXIV.]

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RELATION OF PRIMITIVE DRAMA AND CEREMONY.

DRAMA and ceremony spring from the same soil, the religious sentiment. In primal conditions of growth they have a common root, and later are so closely related that it is difficult to distinguish one from the other. Ceremony, the prescribed action, is dramatic or makes use of representations of mythological events and personages, both in its simplest and most complicated stages of evolution. These representations become more and more realistic, and finally part company with ceremony, becoming at last purely secular.

The drama is always a means of artistic expression. Among primitive men it is wholly dominated by the religious sentiment, by which is meant the sense of relation and fancied obligation of man to his supernatural conceptions called gods. This sentiment, the key to early pictorial art, is as has been shown elsewhere, also all potent in the drama.

¹The work on which this paper is based was done under the direction of the Bureau of American Ethnology, in the spring of 1900.

The dramatic performances of the Hopi Indians contain many elaborate theatrical representations which are practically ceremonies,¹ but there are many where a differentiation has taken place and the dramatic element has come to predominate over the ceremonial. It would certainly be incorrect to call the latter simply ceremonies, or regard them as pure religious rites.

The Hopi drama has advanced to a stage of growth in advance of that called primitive, but it has not wholly parted company from ceremony, and is still dominated by symbolism. It is in a condition which finds many parallels in the historical development of the drama among higher races.

There are several Hopi dramatic performances a consideration of which would give an idea of this stage in the development of the drama, but none are more characteristic than that of the Great Serpent, called *Palūlakōñti*, occurring annually in the March moon.

The first printed notice of this festival is a brief mention in Bourke's 'Snake Dance' (1884);² a more extended account was published in several newspapers about ten years later. The first systematic study was made by the late A. M. Stephen, whose notes were published in 1893.³

An elaborate festival, when most of the paraphernalia used is repainted and renovated, means much preparation. Several days are devoted to the manufacture and adornment of masks, serpent effigies, and other objects, and on the nights of these days there are rehearsals in the kivas, to which no one is admitted, except actors. The several acts are combined on the last night in a continuous performance lasting from 9 P. M. until midnight. This performance is witnessed by many spectators.

THE GREAT SERPENT DRAMA OF THE HOPI.

Throughout the performance at which I was present, two old men who may be called the kiva chiefs sat by the fireplace in

¹ The comparatively meager literature of the drama among American aborigines is ascribed to the fact that it is universally confounded with ceremonies.

² This festival has nothing to do with the celebrated Hopi snake dance, which contains dramatic elements of a different nature.

³ 'The Palūlakōñti: A Tusayan Ceremony.' *Journ. Amer. Folk Lore*, pp. 269-282, Pls. I, II, 1893.

the middle of the room and continually fed the flame with small twigs of greasewood, the sole method of lighting the room on that night. The heat was very great and the ventilation so poor that the atmosphere was stifling. The audience consisted mainly of women and children, who occupied one end of the room, the remainder being empty except while performances were being enacted. Every one was gladly welcomed to see the performance, and there were probably not a dozen persons on the mesa who did not attend. No one paid admission to this theater and no actor received a recompense; it was a festival for all to enjoy, as all contributed to its success. With the exception of one act, no women took any part as actors, and there were few men in the audience. The spectators assembled about 9 P. M., each clan seeking that kiva with which it had social affiliation.

First Act.

A voice was heard at the hatchway, as if some one were hooting outside, and a moment later a ball of meal, thrown into the room from without, landed on the floor by the fireplace. This was a signal that the first group of actors had arrived, and to this announcement the fire tenders responded, "*Yuñya ai,*" come in, an invitation which was repeated by several of the spectators. After considerable hesitation on the part of the visitors, and renewed cries to enter from those in the room, there was a movement above, and the hatchway was darkened by the form of a man descending. The fire tenders arose, and held their blankets about the fire to darken the room. Immediately there came down the ladder a procession of masked men bearing long poles upon which was rolled a cloth screen, while under their blankets certain objects were concealed. Filing to the unoccupied end of the kiva, they rapidly set up the objects they bore. When they were ready a signal was given, and the fire tenders, dropping their blankets, resumed their seats by the fireplace. On the floor before our astonished eyes we saw a miniature field of corn, made of small clay pedestals out of which projected corn sprouts a few inches high. Behind this field of corn hung a decorated cloth screen reaching from one

wall of the room to the other and from the floor almost to the rafters. On this screen were painted many strange devices, among which were pictures of human beings, male and female, and of birds, symbols of rain clouds, lightning, and falling rain. Prominent among the symbols was a row of six circular disks the borders of which were made of plaited corn husks, while the enclosed field of each was decorated with a symbolic picture of the sun. Men wearing grotesque masks¹ and ceremonial kilts stood on each side of this screen, one dressed as a woman and bearing in one hand a basket tray of meal and in the other an ear of corn. He wore a helmet with a coil of hair suspended on each side of the face, a bunch of feathers on the top, and a bang made of red horse hair hanging before the face. The helmet was painted black, and small crescents indicated the eyes and the mouth.

The act began with a song to which the masked men, except the last mentioned, danced. A hoarse roar made by a concealed actor blowing through an empty gourd² resounded from behind the screen, and immediately the circular disks swung open upward, and were seen to be flaps, hinged above, covering orifices through which simultaneously protruded six artificial heads of serpents, realistically painted. Each head had protuberant goggle eyes, and bore a curved horn and a fan-like crest of hawk feathers. A mouth with teeth was cut in one end, and from this orifice there hung a strip of leather, painted red, representing the tongue.

Slowly at first, but afterwards more rapidly, these effigies were thrust farther into view, each revealing a body four or five feet long, painted, like the head, black on the back and white on the belly. When they were fully extended the song grew louder, and the effigies moved back and forth, raising and depressing their heads in time, wagging them to one side or the other in unison. They seemed to bite ferociously at each other, and viciously darted at men standing near the screen. This remarkable play continued for some time, when suddenly

¹ Representing the Bear Kateinas.

² This gourd was decorated with the symbolic marks of the Great Plumed Snake.

the heads of the serpents bent down to the floor and swept across the imitation corn field, knocking over the clay pedestals, and the corn leaves which they supported. Then the effigies raised their heads and wagged them back and forth as before. It was observed that the largest effigy, or that in the middle, had several udders on each side of the belly, and that she apparently suckled the others. Meanwhile the roar emitted from behind the screen by a concealed man continued, and wild excitement seemed to prevail. Some of the spectators threw meal at the effigies, offering prayers, amid shouts from others. The masked man, representing a woman, stepped forward and presented the contents of the basket tray to the serpent effigies for food, after which he held his breasts to them as if to suckle¹ them.

Shortly after this the song diminished in volume, the effigies were slowly drawn back through the openings, the flaps on which the sun symbols were painted fell back in place, and after one final roar, made by the man behind the screen, the room was again silent. The overturned pedestals with their corn leaves were distributed among the spectators, and the two men by the fireplace again held up their blankets before the fire, while the screen was silently rolled up, and the actors with their paraphernalia departed.

The accompanying plate (pl. xxxii) represents the cloth screen tied in position to the roof of the kiva and the miniature corn field on the floor before it. The six openings in this screen, four of which are larger than the other two, are arranged in a row, and out of five of these openings protrude serpent effigies. The flaps which ordinarily cover these orifices are raised, with the exception of that at the extreme right, which hangs in place to show the sun symbol on its face and the tip of a serpent's head near one margin. The central effigy (*yuamú*, their mother), is knocking over the rows of clay pedestals which form the miniature corn field. The masked human figure standing at the left before the screen represents the mother of the clan gods or *Hahaiwüqti*, who is holding forward a basket tray of meal which she offers as food to the serpents. One of the performers may be obscurely seen behind the screen, blow-

¹This actor represented *Hahaiwüqti*, mother of Kacinas or clan ancients.

ing the gourd trumpet by which the 'roars' of the great serpents are imitated.

Prominent among the designs painted on this screen are three human figures. That of a man has two horns on the head like an *Alosaka*¹ and, as so often occurs in pictures or images on altars, the maidens have their hair arranged in disks one above each ear, as in the Hopi maid's coiffure of the present day. These maidens were called *Tubéboli manas*. The other designs represent birds, lightning, rain clouds, and falling rain. The first act was performed by men of the kiva which is situated in the middle of the Hano plaza², and the screen and snake effigies are owned by men of that pueblo. The screen was repainted on the day of the dramatization by the men who took part in the act. No actor tasted food on that day before the decoration of the screen was finished, and at the close of their work all vomited over the cliffs. This Hano screen, and the drama acted before it, resembles those which are occasionally used in the chief kiva of Walpi.

Second Act.

The second act, a buffalo dance, was one of the best on this eventful night. Several men wearing helmets representing buffalo heads, with lateral horns and shaggy sheep skins, and wool painted black, hanging down their backs, entered the room. They carried zigzag slats of wood, symbolic of lightning, and performed a characteristic dance to the beat of a drum. These buffalo personificators were accompanied by a masked man and boy representing eagles, who danced before them, uttering calls in imitation of birds.

The same buffalo dance, but more complicated, was celebrated earlier in the winter in the public plaza of Walpi, at which time the men were accompanied by girls dressed as buffalo maids who did not appear in the second act in the kivas. No representation of the eagles was seen in this public dance.

The buffalo maids bore disks decorated with sun emblems on their backs, and carried notched sticks representing 'sun lad-

¹One of the prominent 'gods' in Hopi worship.

²Called the *kisombi kiva*, plaza kiva.

ders'¹ in their hands. It is appropriate that this dance should be given by men from the Tanoan pueblo, Hano, as it was probably introduced by men of the same stock from the Rio Grande region, by whom this village was settled.

Third Act.

A new set of actors made their presence known at the entrance to the kiva soon after the departure of the buffaloes, but these were found, on entering, to be very unlike those who had preceded them. They brought no sun screens nor serpent effigies with them, but were clothed in ceremonial kilts, and wore masks shaped like helmets. They were called *Püükoñ* Kacinas, and were accompanied by two men, dressed like women, one representing their grandmother and the other their mother. The former personated *Kokyanwüqti*,² or Spider-Woman, and wore a closely-fitting mask with white crescentic eyes painted on a blackened face, and white hair made of raw cotton. She danced before the fire in the middle of the room, gracefully posturing her body and arms, while the others sang and danced to the beat of a drum. As the actors filed out of the room Spider-Woman distributed to the spectators seeds of corn, melon, and the like.³

Fourth Act.

After the audience had sat silent for about a quarter of an hour men were heard walking on the roof and strange cries came down the hatchway. Again the fire tenders called to the visitors to enter, and muffled responses, as of masked persons

¹ Ancient Hopi ladders were notched logs, some of which are still extant on the East Mesa. In the winter solstice ceremony at Hano there stand, back of the altars, notched slats of wood called 'sun ladders,' which are supposed to be efficacious in rites recalling the sun, or aiding an enfeebled sun to rise out of his 'home.' The prayer sticks carried by the buffalo maids are imitations of these 'sun ladders.'

² This part was taken by Nanahe, a Hopi who has for many years made his home at Zuni and returned to Walpi to be present at the dance.

³ The mother and grandmother of *Püükoñ* Kacinas naturally appear as representatives of the ancients of some clan with which this special form of the Kacina cult originated. *Haha'iwuqli*, who does not appear in this act, as in the first and fifth, is represented by *Kokyanwüqti*, probably the same supernatural, under a different name.

outside, were heard in reply. First came down the ladder a man wearing a shabby mask covered with vertical zigzag lines,¹ bearing a heavy bundle on his back. As he climbed down the ladder he pretended to slip on each rung, but ultimately landed on the floor without accident, and opened his bundle, which was found to contain a metate and meal grinding stone. He arranged these on the floor before the fireplace and took his seat at one side. A second man with a like bundle followed, and deposited his burden by the side of the other. Two masked girls² elaborately dressed in white ceremonial blankets followed, and knelt by the stones facing the fire, assuming the posture of girls when grinding corn.

After them entered the chorus, a procession of masked men who filed around the room and halted in line behind the kneeling girls. At a signal these last arrivals began to sing, and as they sang moved in a solemn dance. The girls rubbed the mealing stones back and forth over the metates, grinding the meal in time with the song, and the kneeling men clapped their hands, swaying their bodies in rhythm.

The last mentioned men held an animated conversation with the fire tenders, asserting that the girls were expert meal grinders, and from time to time crossed the room, putting pinches of the meal into the mouths of the fire tenders and spectators. This continued for some time, after which the girls rose and danced in the middle of the room, posturing their bodies and extending alternately their hands in which they carried corn ears. The chorus personated the Navajo *Aña Kalcina*, the girls were called the Navajo *Aña* maids and are supposed to be sisters of men in the chorus.

In order to understand better this act let us consider the nature of the Kalcina cult from which these personages were derived. These personages are called Kalcinas, of which there are many kinds among the Hopi, differing from each other in the symbolism of their masks and other paraphernalia. Their distinc-

¹ These men were called *Hehca Kalcinas*.

² These girls were called the *Tucal Aña Kalcina Manas*. On the day following, two girls representing the *Aña Kalcina Manas* performed the same act in the public plaza of Walpi.

tive names are totemistic, the same as those of clans now living at either Walpi or at some other place from which the Katcinas were derived. Katcinas are tutelary clan gods of the ancestral type and when personated appear as both males and females.

In many cases the Katcina is represented by no clan of the same totemistic name now living in the pueblo. This has been brought about in several ways, of which there may be mentioned: (1) The clan has become extinct, while its Katcina has survived; (2) A Katcina has been purchased or borrowed from neighboring people; (3) A Katcina mask has been invented by some imaginative person who has seen an object which he thinks fitting for a Katcina totem.

A study of a clan and the Katcina which bears the same name will be instructive in the determination of their relation.

There are several clans where this clan relation of the Katcina still retains its primitive totemistic character, and at least one where the names of both clan and Katcina are the same. For instance, the members of the *Tcakwaina* or *Asa* clans claim that the *Tcakwaina* Katcinas are their clan ancients, and when they personate these clan ancients they represent the following masked personages:¹

- | | | | |
|----|-----------------------------------|---------------------|---------------------|
| 1. | <i>Tcatcakwaina taamû</i> | <i>Tcakwainas</i> , | their uncle. |
| 2. | “ <i>tatakti</i> | “ | males (brothers). |
| 3. | “ <i>kokoiamû</i> | “ | their elder sister. |
| 4. | “ <i>mamantû</i> (<i>manas</i>) | “ | maids (sisters). |
| 5. | “ <i>yuamû</i> | “ | their mother. |

It will be noticed that all these ancestral personages belong to one and the same clan; the mother, brothers (*tatakti*), sisters (*manas*) and uncle, but that the father is unrepresented.

The most important fact, however, is that the name of the Katcina is the same as that of the clan, viz, *Tcakwaina*, and that men of this clan personate, in dramatic and ceremonial performances, supernaturals of the same name as the clan from which they claim to have descended. They do not introduce a personation of the *Tcakwaina* father because he is not of their clan, and hence in a sacerdotal sense cannot be a supernatural of their clan.

¹A good collection of pictures of these was made in 1900. These were drawn by a Hopi artist.

An analysis of other Katcinas shows that many of them are ancients of clans, or that each clan originally had distinctive divinized ancients in the Katcina cult. These gods are personated as brothers, sisters, uncle, mother, or grandmother, the paraphernalia being determined by the particular clan totem.

The relation of a Katcina to its clan can be traced in many other instances, but in others, and perhaps the majority, it is obscured by changes in nomenclature and sociologic development. Katcinas often no longer bear their ancient names but are called from some peculiarity of dress, prominent symbol of the mask, or peculiar cry emitted by them, which has no connection with the totems of their respective clans.

The *Aña Katcina* (brothers, men) and the *Aña Katcina manas* (sisters) belong to this group. Originally introduced by *Patki* (Raincloud clans) from settlements on the Little Colorado River, their name has no relation to the clans which brought them. In fact at Zuñi the dance of this Katcina is called the *Kokshi*, good dance, while the name of the same at Walpi is the *Aña* or long hair. We have also at the latter pueblos other names for the *Aña manas*, as *Soyal manas*, equally inapplicable, so far as their clan relation is concerned.

The popular names of Hopi gods, among which are included Katcinas or clan tutelary supernaturals, are commonly of exoteric origin and are oftentimes very numerous. Unfortunately the archaic name is often lost, although in a few cases it is the same as the popular. In a future article I hope to show that this is true of the nomenclature of the Sun God, the identity of which can be recognized by morphology in its symbolistic representation or resemblances in the masks.

Fifth Act.

As after former acts, we waited a few minutes only for the next, a fifth, which was somewhat similar in character to the first. A call at the hatchway, and an invitation from within to enter, led to the appearance of a procession of masked men, who came down the ladder bearing paraphernalia for their exhibition hidden under their arms or concealed in blankets. The fire tenders shielded the fire once more with blankets so that

the room was darkened, and in the obscure light the actors arranged their stage properties. When the blankets were dropped the light revealed on the floor before us an imitation field of corn, each hill of which was a clay pedestal with projecting corn leaves, and behind it, as a background, a wooden framework decorated with peripheral turkey¹ feathers and hung with two disks painted with sun emblems. Pine boughs were so arranged in the framework that they filled all vacant spaces and shielded performers in the rear of the room. Several naked men, called 'mudheads,' wearing on their heads close-fitting cloth bags, with attached knobs, stood before the framework, which was supported by two of their number. The exercises opened with 'roars' from behind the disks, and vigorous dancing by the 'mudheads' before the screen.

Soon the flaps of the sun disks swung open and from under them emerged the hideous heads of two snake effigies, larger than those of the first performance, but similarly constructed. These serpent heads were thrust forward until their serpentine bodies, extended several feet, came into view. Their heads darted back and forth, swaying first to one side, and then to the other, biting viciously now at the audience and then at each other, while deep roars imitating the voice of the serpent emerged from the rear of the room. With one stroke of the head the field of corn was swept over and the serpents twisted their bodies about each other.

One of the naked men, a 'mudhead' wearing the knobbed cloth bag, stepped forward and grasped one of the serpent effigies by the neck. He pretended to wrestle with the snake, and for a time was successful, but at last the man was overcome and sent sprawling on the floor. Then another advanced to the conflict, and he too was thrown down. A youthful 'mudhead' made a like attempt and mounted the effigy, riding on its neck as if on horseback. The whole act was a realistic representation of the struggle of man with the serpent. Ultimately the serpents contracted their bodies, drew back their heads behind the flaps, and the performance ended with a prolonged roar from behind the screen. In the darkness which followed, made by

¹ Sun shields commonly have eagle feathers inserted about their borders.

hanging blankets before the fire, the actors packed their paraphernalia, gathered their effigies and quietly left the room.

The accompanying plate (pl. xxxiii) represents this fifth act, or the struggle of the 'mudheads' with the serpent effigies. The framework which is supported by two men is decorated with zig-zag symbols representing lightning; the row of semicircular bodies on the crossbeam symbolizes the rain clouds, from which descend parallel marks, the falling rain. Each of these six semicircular rain-cloud symbols is of different color, yellow, green, red, and white, corresponding to the supposed colors of the cardinal points, and all have animal designs representing frogs and birds painted upon them. The manipulators of the serpent effigies are hidden from view by pine or cedar boughs inserted into a log on the floor, which is covered with figures of rings, symbolic of the earth. At the right of a median vertical line a serpent effigy is seen protruded through an opening, above which is a circular flap raised to a horizontal position. The serpent effigy on this side is searching for a youthful 'mudhead,' who has crawled below the disk. The left hand serpent is represented in conflict with an adult 'mudhead,' who has grasped it about the body and neck; the serpent appears to be biting at its opponent. We are looking at this strange contest from the raised spectators' floor of the kiva; the miniature cornfield which one of the serpents knocked down a short time before, has been removed, and the clay pedestals, which remained, are distributed among the spectators. The wierd effects of the light from the fireplace in the middle of the room have been brought out by the artist, Mrs. Gill, who has successfully drawn these screens from my kodak photographs and sketches.

Sixth Act.

There was yet another exhibition of serpent effigies in this continuous performance, and the actors were announced in much the same way as their predecessors. They appeared shortly after the departure of the Spider-Woman and her associates, and arranged their paraphernalia in the darkened room, holding up an additional blanket to conceal their preparations. When the blankets were dropped from before the fire, a miniature

field of corn was seen on the kiva floor, and back of it were two vases, surrounded, except on the side towards the fire, by a row of squatting 'mudheads.' A song immediately began, and suddenly the four lappets,¹ which covered the orifice of each vase, were turned back automatically, when out of the vases slowly emerged the heads of two artificial serpents drawing their bodies behind them (plate xxxiv). These effects were produced by hidden strings placed over the kiva rafters, and the images were made by this means to rise and fall, move backwards and forwards, or to approach each other. Their heads were drawn down to the floor, and swept over the miniature corn field, overturning it as in the first act, when a sun screen was also employed. They struggled with each other, winding their heads together, and performed various other gyrations at the wish of the manipulators.²

The performance was a very realistic one, for in the dim light of the room the strings were invisible, and the serpents seemed to voluntarily rise from the vases. At its close the effigies sank into the cavities of the vases, and the song ceased. Concealed by darkness the paraphernalia were wrapped in blankets, and the actors left the room, passing to another kiva, where the performance was repeated. The personators of this act were from the Teivato kiva of Walpi, and their chief was Paūtiwa.

While we were witnessing these six exhibitions in one room, simultaneously, shows were being enacted in the other eight kivas on the East Mesa. The six sets of actors, each with their paraphernalia, passed in turn from one room to another, in all of which spectators awaited their coming. Each of the performances was given nine times that night, and it may safely be said that all were witnessed by the five hundred people

¹These four semicircular flaps, symbols of rain clouds, were painted in four colors, yellow, green, red, and white. On the necks of the vases were parallel lines, symbols of falling rain, and on their sides were stars and tadpole decoration. Each vase was placed on a bed of cedar or pine boughs to make it more stable.

²The effects produced with these strings were effective, and the motions of the men who held the strings and manipulated the effigies were closely concealed. It is probable that some of the strings were attached to the rattles used by the chorus.

which comprise the population of the three pueblos, in one kiva or another.¹ It was midnight when this primitive theatre closed and the serpent effigies were disjointed and carried to hidden crypts in the houses, where they were luted in jars with clay not to see the light again until March of the next year.

ADDITIONAL ACTS SOMETIMES PERFORMED.

Although the sixth act closed the series of theatrical exhibitions in 1900, it by no means exhausts the dramatic resources of the Hopi in the presentation of their Great Serpent exhibition. This year (1900) was said by all to be one of abbreviating, in all winter ceremonies and dramatic performances, but in more elaborate exhibitions, in other years, instead of six we are told there are as many as nine acts in this continuous show, or one set of actors from each kiva on the mesa. Our account would be more comprehensive if it included short references to one or two of the important additional acts which occur in the more elaborate performances.²

Sometimes the screen performance is accompanied by an exhibition by a masked man, or men, who pretend to struggle with a snake effigy which they carry in their arms. This performance consists mainly in twisting these effigies about the body and neck of the performer, holding them aloft or even throwing them to the roof of the kiva, as elsewhere³ described in an account of the celebration in 1893.

The serpent effigies in this instance were manipulated by one arm of the actor, which is concealed in the body of the serpent, but a false arm is tied to the shoulder in place of the hidden arm, to deceive the spectators.

In some years marionettes representing Corn Maids are substituted for the two masked girls in the act of grinding corn, and

¹ On such occasions each clan assembles in a certain kiva, which is said to be the kiva of that clan.

² The sun screen and serpent effigies used by men of the Tacab kiva have been described in a former article (The Palülüköñti, *op. cit.*). This performance has many points of likeness to that of actors from the plaza kiva of Hano described in the first act.

³ *Op. cit.* The masked man who thus struggles with the serpent effigy represented *Calako*, a sun god, but figures of the same drawn by a Hopi artist were called *Macibol Katcina*.

these two figures are very skilfully manipulated by concealed actors. Although this representation was not introduced in 1900, it has often been described to me, and one of the Hopi men has drawn me a picture of the marionettes which is worth reproduction in a plate.

The figurines are brought into the darkened room wrapped in blankets, and are set up near the middle of the kiva in much the same way as the screens. The kneeling images, surrounded by a wooden framework, are manipulated by concealed men; when the song begins they are made to bend their bodies backward and forward in time, grinding the meal on miniature metates before them. The movements of girls in grinding meal are so cleverly imitated that the figurines moved by hidden strings at times raised their hands to their faces, which they rubbed with meal as the girls do when using the grinding stones in their rooms.

As this marionette performance was occurring, two bird effigies were made to walk back and forth along the upper horizontal bar of the framework, while bird calls issued from the rear of the room.

The substitution of marionettes for masked girls suggests an explanation of the use of idols among the Hopi. A supernatural being of the Hopi Olympus may be represented in ceremony or drama by a man wearing a mask, or by a graven image or picture, a symbol of the same. Sometimes one, sometimes the other method of personating the god is employed, and often both. In the latter method the image may be used on the altar, while the masked man appears in the public exhibition in the pueblo plaza. Neither idol nor masked personators are worshipped, but both are regarded as symbolic representations, in which possibly the gods may temporarily reside.

So in the use of marionettes to represent the Corn Maidens in the theatrical exhibition or personation by masked girls in the same rôle. They are symbolic representations of the mythic maidens whose beneficent gifts of corn and other seeds, in ancient times is a constant theme in Hopi legends.

The clan ancients or Katcinas, personated in the Great Serpent drama vary year by year, implying the theatrical nature

of the festival, but there are certain of these personations which invariably appear. In the 1893 exhibition, the only one previous to 1900 upon which we have reliable notes, there was one performance with a sun screen and serpent effigies which were manipulated by the men of the kiva under the snake rock. The symbols depicted on this screen differ somewhat from those on the screen employed in 1900, but the general character of the performance with it was the same. Briefly considered the acts given in 1893 were as follows:

ACT 1.—An exhibition with the sun screen and serpent effigies, by men of Tacab kiva, similar to Act 1 of 1900, but in which the actors personated *Puwik* (Duck), *Tacab* (Navajo), *Hahuiwüqti*, and others. A masked man (*Calako*) stood before the screen holding in his arms an effigy of a Great Snake with which he appeared to struggle, and for that reason was called the 'Struggling One.' The Serpent effigy carried was manipulated in such a way that the man and snake appeared to be engaged in a combat, much the same as in the fifth act of 1900, except that the serpent effigy was not thrown through openings closed by disks bearing sun symbols. The manipulator wore a false arm¹ hanging from one shoulder in place of his real arm, which was thrust within the body of the effigy, grasping a stick, the 'backbone' of the monster.

ACT 2.—Dance of masked men representing *Aña* Katcinas.

ACT 3.—Dance of masked men representing *Tacab* Katcinas.

ACT 4.—Dance of masked men representing clowns and two *Huhuyan* Katcinas.

ACT 5.—Dance of men personating women of the *Owaküllu* society, who threw their baskets to the spectators.

ACT 6.—Dance of men representing old women bearing willow wands.

ACT 7.—Dance of masked men representing Tanoan *Aña* Katcinas.

The god of death, *Masauüh*,² was personated in the 1893 exhibition and appeared in the plaza about 2 P. M., "dancing through Walpi with a hobbling movement, singing snatches of

¹ For figures of the 'false arm' see *op. cit.*, Pl. II.

² Two boys took this part in 1900.

a song. He was masked and wrapped in a rabbit-skin rug, and went to all the kivas, beating the entrances with a bush" (*Bigelovia graveolens*).

On the day following the night exhibitions in 1893 there were public dances of the *Tucab* and *Aña* Katcinas.

PARAPIERNALIA USED, THEIR CONSTRUCTION AND SYMBOLISM.

The effigies of *Palülüköñ* now used at the East Mesa are not very ancient, although there are one or two which show considerable antiquity. One of these older specimens has a body of buckskin, but the majority, and all the recent ones, are made of cotton cloth. The present screens are of the latter material, but these are commonly said to have replaced others of skin or native cloth. The Walpi men made two new serpent effigies in their kivas in 1900, and all the material of which they were manufactured was purchased from the neighboring trader at Keam's Canyon.

Each of the three pueblos, Hano, Sitcomovi, and Walpi, has several of these serpent effigies which are kept in the houses of the following clans:

Hano, *Sa* (Tobacco) clan; Sitcomovi, *Patki* (Raincloud) clan; Walpi, *Tcüa* (Snake) clan; *Paʼab* (Reed) clan.

In ancient times they were kept in stone enclosures outside the pueblos, but these receptacles have been abandoned of late, on account of the inroads of nomads.¹ The house of the ancient Plumed Snake of Hano is a small cave in the side of the mesa near the ruin Turkinobi, where several broken serpent heads and effigy ribs, or wooden hoops, can now be seen, although the entrance is walled up and rarely opened.

A knowledge of the mechanical construction of the serpent effigies may aid in an understanding of their manipulation. Their heads are either cut out of cottonwood or made of gourds, and are painted, and the protuberant goggle eyes are small buckskin bags tied to the top. Each head bears a medial horn curving forward, sometimes made with joints and at other times

¹It is said that the Oraibi or Middle Mesa pueblos still have extramural receptacles for the *Palülüköñ* effigies.

solid. A radiating crest of hawk feathers is tied vertically to the back of the head.

The teeth are cut in the gourd or wood of which the head is made and are painted red. The tongue is a leather strap, also painted red, and protrudes from the mouth a considerable distance. The top of the head is black, the bottom white, and these same colors continue along the sides of the body.

The body consists of a central stick, called a backbone, over which is extended a covering which is held in place by a series of hoops graduated in size from the neck to the end. The effigy is manipulated by means of the stick, held by a man behind the screen. The 'backbone' has a ferule cut in it a few inches back of the neck, and to this ferule are tied a quartz crystal called the heart, and a package which contains corn seeds of all colors, melon, squash, cotton and other seeds, and a black prayer stick. The body is made of a series of hoops called ribs, over which is stretched cotton cloth painted black above and white below, with a red streak at the dividing line, where there are also other markings and symbols.¹

The backbones of the two effigies which were made to rise out of the vases were short and stumpy, but they have a 'heart' similar to the longer ones, and an attached package of seeds.

The resemblances in symbolism between Hopi and Toltec figures of the Great Serpent are startling enough to indicate a like origin geographically, and legends are in accord with that belief. The Hopi serpent was brought, they say, from a place called Palatkwabi, a region in the south which may have extended as far as northern Mexico. The Toltecs, with whom the Great Serpent cult of Mexico is intimately associated, originated far north of their renowned pueblo, Tollan, and lived at a place called Tlapallan. The situation of the latter place is doubtful, but there is no doubt that it was in the north, and good authority for the belief that it was in southern Arizona or northern Mexico.

Geographically, Tlapallan and Palatkwabi were not far distant, possibly identical in their positions. The argument for the common origin of the Great Serpent cult in Tusayan and

¹ Like those on the kilts of the Snake priests.

among the Toltecs and the tribes to which they gave it, may be briefly stated as follows:

(1) There are similarities in objective symbolism on figures of the Great Serpent from Tusayan and Mexico. (2) Linguistic likenesses exist in the names of the regions from which the Hopi and Toltecs derived their variants of the cult.¹ (3) Legends of both point to regions of origin which are geographically adjacent or identical. (4) The worship of Quetzalcoatl was a form of sun worship, elements of which appear in the preceding description of the Great Serpent drama at Walpi.

RÉSUMÉ OF EVENTS IN PALÜLÜKOŃTI.

February 14. On this day corn was planted² in three kivas, the Moñ kiva, Tcivato kiva of Walpi, and the plaza kiva of Hano. This corn was daily watered and the kivas were heated so that the seeds might sprout.³ Children are not allowed to know that the corn is thus planted before the exhibition.

February 26. About two weeks after the corn seeds were planted the effigies of the Great Serpent were brought into the three kivas above mentioned, at nightfall, when rehearsals of the acts to be given later took place.

February 27. *Yuñya*. This day was devoted to the preparation of the paraphernalia, and at sundown there was a rehearsal of the Great Serpent acts, as also on the following day.

March 1. *Komoktotokya*. In addition to rehearsals in the kiva the following masked men representing *Wupamozv*, *Honau*, *Hehea*, *Mucaias*, *Wuyok*, *Soyanep*, and *Samozwüqtaka* Katcinas appeared in the plazas. They dressed and masked themselves at Walla (The Gap), and marched up the trail into Hano, where they gathered at the kiva hatches, and held an animated conversation with the chief of the kiva, who came to the hatchway for that purpose.

¹ The linguistic argument for the identity of Palatkwabi and Tlapallan, while not strong, is important; *palampú*, red, *obi*, locative; Tlapallan, place of the red land.

² The planting of corn seeds has given the name 'Corn planting' to *Palülüköñti*, just as the one of beans in a like way gave the name Bean planting to the *Powamú*, but these names characterize incidents not the true purpose of the festival.

³ The miniature cornfield was later made of these sprouts.

March 2. *Totokpi*. Many masked men were seen throughout the day in the three East Mesa pueblos. Early in the afternoon there were noticed in Hano three *Oe* Katcinas, each with a chevron mark on each cheek, and one *Wupamow* or Big High Sky god bearing a sun mask,¹ and held by a Mudhead priest by a rope tied about his loins. In Walpi shortly afterward, two small boys dressed and masked to represent *Masauühs* went from one kiva to another, standing on the hatch and beating the ladder with bundles of sticks.

Late in the afternoon the chief kiva of Hano sent the following delegation of masked men to all the kivas on the East Mesa: *Mucaias*, Buffalo; *Wupamow*, Big High Sky god (Sun); *Honau*, Bear; *Aholc*; *Ciloto*; *Tcanau*; *Wukokot*; many 'mudheads.' They went from one kiva entrance to another, holding conversations with the kiva chiefs and in various ways amusing the spectators.

About sundown the men of the two Walpi kivas carried their snake effigies to the main spring of the pueblo, the home of *Palülükooñ*, called Tawapa, Sun Spring, where they performed ceremonies, while the men of Hano took their serpent effigies to a spring called Moñwiva, sacred to their great snake. The six acts in the kivas were performed directly after the return of the men with the effigies from these springs.

During the festival all actors abstain from salt and meat and do not sleep with their wives, a tabu which is rigidly observed especially on the day preceding the exhibition in the kiva.

On several of the days of this festival there are foot races along the water courses in the valley, during which the naked racers kick small stone nodules in a sinistral circuit around the mesa. This was a prayer for streams full of water.

The events which occurred when the effigies were taken to the springs were wholly ceremonial, and not dramatic. During the day previous to this event all men of prominence, especially chiefs of clans, brought feathered strings to the kivas, and

¹The symbols of this mask resemble those of Tawa (sun) disks, and those of the masks of *Ahüla*, *Ahülani* and *Wüwüyomo*, showing that the latter are the same sun gods probably under different clan names.

tied them to the necks of the serpent effigies. One or more prayer sticks¹ were also made to be used at the springs.

The exercises at the springs, Tawapa and Moñwiva, were not witnessed by me in 1900, but they were probably the same as described in the account of this episode in 1893 (*op. cit.*) On that year, about 7:30 P. M., a procession went down to the spring carrying the effigies and trumpets by which the roars of the serpent are imitated. This procession was led by a man personating *Hahaiwuqti* and the kiva chief, "making a connecting trail from the south edge of the basin (Tawapa), along the east and north sides of the pool, and up as close to the west edge as the mud would permit. Those following with the serpent effigies, beginning at the east side of the pool, laid the effigies down close to the edge of the water, along the north side. The youths placed their gourd trumpets on the meal trail, upon which also were the serpent effigies. All then sat on the north side facing the south. The leader as he went down deposited the fire *pahos* * * * at the west side of the pool, setting them in a row fronting the east.

"The leader of the procession bore the *kopitcoki* cedar bark slow match. * * * It had been lighted at the kiva fire before the procession started, and the fire was smouldering in the bark. Momi (kiva chief) lit a pipe by this torch and gave it to the leader, who made the usual response, smoked a few puffs and passed it to the next man on his right. Momi then lit another pipe and passed it also to the leader and the two pipes passed down the two lines, in which they had arranged themselves when sitting, the elder in front, next the pool, the youths behind them. After all had smoked the leader prayed and each of the nine elders followed in succession. The ten youths did not pray, but each took his trumpet (gourd), and stepping one stride into the pool, stooped over, and placing the bulbous end to his mouth with the small orifice on the surface of the water, trumpeted three or four times. Each of the youths then dipped up a little water in his trumpet and poured it into a vase.

"The effigy bearers then dipped the tip of the serpents' heads

¹ Six *pahos* were made in the 1893 performance. One was tied to the backbone of each effigy. Five others were deposited at the spring, some at the edge of the water, others beneath it.

and the ends of the hawk-tail plumes in the pool, and the leader said a short prayer and started back up the trail."

Certainly the most remarkable of all the masked men who appeared that day were the two personifications of a being called *Tcanau Katcina*. They wore circular masks with feathers projecting from the periphery, and carried in their mouths realistic stuffed effigies of rattlesnakes, while over the eyes of the masks were attached carved wooden effigies of lizards.

Although these masks suggest the custom of the well-known snake dancers, they are not connected with the modern festival of the snake dance, nor with the snake clan, but with the Pakab clan by which they are said to have been introduced into the Walpi ferial calendar.

March 3. *Tihuni*. On the day after the acts in the kivas, there was a public dance of the *Aña Katcinas* in the Walpi plaza. During this dance grinding stones were placed in the middle of the open space by the Snake Rock, behind which two girls representing *Aña Katcinas manas* took their position, and a line of *Aña Katcinas* extended the whole length of the plaza. The latter served as chorus while the girls ground meal as in the kiva performance the night before.

In this exhibition or dance there were also two men personating *Hehea*, whose actions were identical with those of the same name in the kiva performance. They sat on the ground as the girls ground the meal and the chorus sang. The personators in this dance were from the chief kiva of Walpi, and the exhibition has the same meaning as that of the night before.

There also appeared in this public exhibition a masked personage called *Hopak* (eastern) *Katcina*, the signification of which is unknown to me.

CONCLUSIONS.

There are certain facts which justify calling the preceding performance a theatrical exhibition rather than a religious ceremony, among which the following may be mentioned.

Several very sacred objects invariably present in Hopi rites are conspicuous by their absence.

In every great Hopi ceremony one or more insignia of the

the religious fraternities participating in the rites are displayed. These objects, called *típonis*, were not seen in the festival of the Great Serpent. Every Hopi ceremony has an altar on which the *típonis* are conspicuous, but there is nothing which could be called an altar in this exhibition. It is customary in Hopi ceremonies to prepare feathered sticks called *pahos*, which are consecrated by song and deposited in shrines. The preparation of these symbols is quite inconspicuous in the drama considered. No medicine was made or medicine bowl employed, as is universally the case in true ceremonials.

The performers are not limited to any special religious fraternity and all men, women, and children except those specially tabu,¹ are permitted to witness the performances, a fact which likewise tells strongly in favor of their secular nature. The paraphernalia employed in the presentations are not ancient; thus the marionettes of the Corn Maids were manufactured by Totci, a Hopi of the Badger clan still living at Zuñi. Some of the sun screens employed are modern, that used in the first act being an old wagon sheet contributed for the ceremony by a young man of Hano three years ago. Two new serpent effigies were made the present year.²

The conclusion to which the above statements point is that the acts described are, in the main, theatrical and secular, performed for instruction or entertainment. Ceremonial proceedings, to be sure, pervade the whole, as they do all events in Hopi life, as birth, marriage, burial of the dead, pottery-making, house-building, rabbit hunts, planting, and harvesting. *A priori*, we should expect them in the Hopi drama, and certainly these studies show their existence.

The explanation of these theatrical performances must be sought in the symbolization of legendary events, part historical, part mythical. Since these performances deal with mythological subjects, the actors are personations of mythic or supernatural beings.

The effigies represent the Great Serpent, a supernatural per-

¹ Pregnant women are not allowed to witness the festival, and no woman should touch any part of the Great Serpent effigies.

² Broken and discarded portions of worn-out effigies are not thrown away, but are deposited in certain cave shrines, where they can now be seen.

sonage of importance in all their legends. This being is associated with the Hopi version of the flood, for it is said that in ancient times, while the ancestors of certain clans lived in the far south, at a place called Palatkwabi, this monster on one occasion rose through the middle of the pueblo plaza to the zenith, drawing after him a great flood, which submerged the land and obliged the Hopi to migrate, and to seek refuge in the north, their present home. At this time, which was long ago in their annals, the Serpent rose to the zenith and, calling out from the clouds, demanded the sacrifice of a boy and girl. To this demand the Hopi acceded with children of their chiefs, whom the monster took and sank back into the earth, leaving a black rock to mark the place of sacrifice.

When the two serpent effigies automatically rise from the two vases throwing back the semicircular flaps with rain-cloud symbols, it represents the event recorded in legends—the Hopi version of a flood.

The snake effigies knocking over the miniature field of corn symbolize floods, possibly wind, which the Great Serpent brings.

The effigies of the monsters emerge through orifices closed by disks, upon which sun symbols are depicted to show how floods which destroy the fields come from the sky, the realm of the sun.

The masked men, called 'mudheads,' are ancients which have come to have superhuman powers in causing corn to grow and mature. They struggle with the monsters who would destroy the farms of man. The acts in which they appear represent in a symbolic way the contest of early man with supernatural powers which set at naught the labors of the agriculturalist.

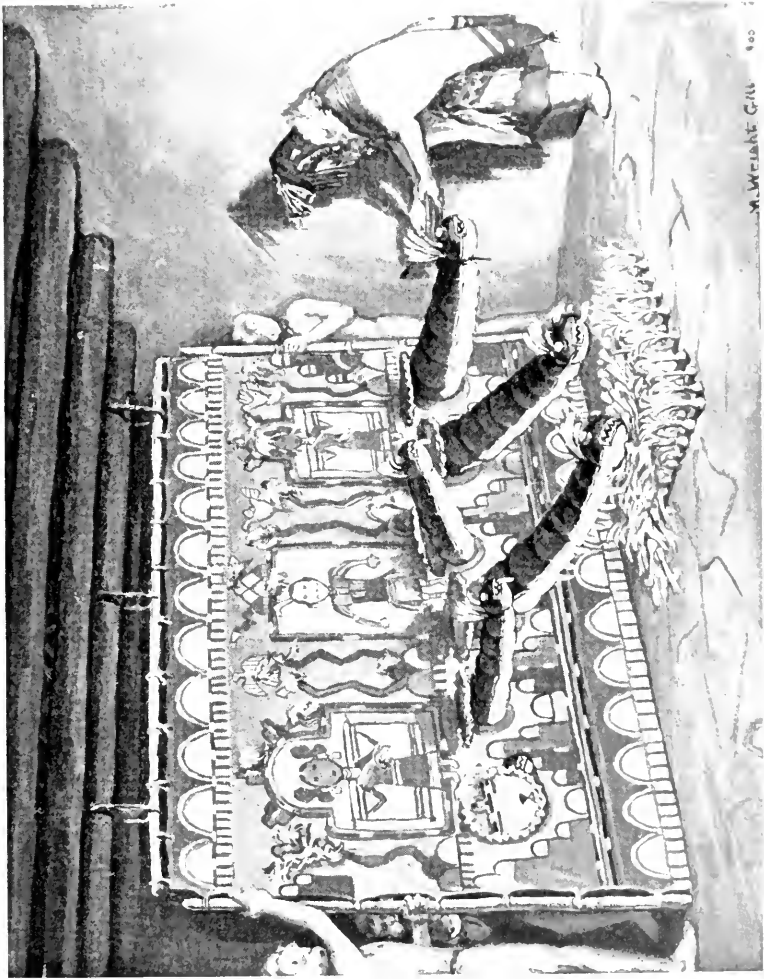
But nowhere is the dramatic element more prominent than in the representation of the conversion of corn into meal, when the personators of the Corn Maids, or effigies of the same, grind the meal in the kivas or public plazas, as is described in the preceding pages.

We have this exhibition in at least two forms, one by figurines, another by masked girls. Although the masks or maskettes, which these girls wear, vary slightly in symbols, there is

little doubt that they represent the Corn Maids who are likewise represented by the two figurines.

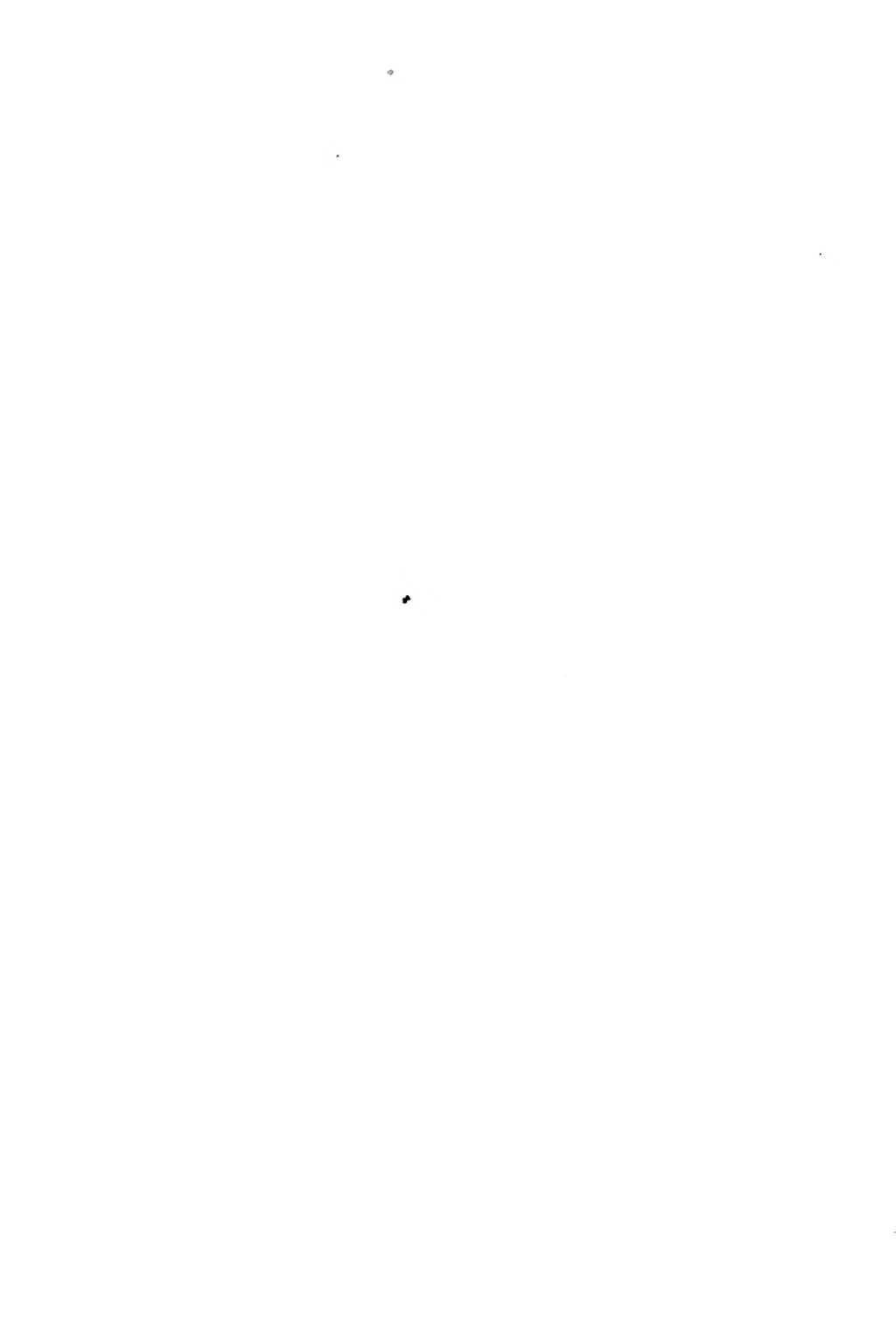
All these acts, given for the instruction or amusement of spectators, are symbolic dramatic representations of events in the cultural history or life of the Hopi, especially those recounted in the legends of their clans. They are rude mystery plays of a religious nature—developments from archaic ceremonies which have come to have a secular as well as religious use. While affording entertainment, which the Hopi greatly enjoy, they instruct the spectators in the mysteries of religion, as the Hopi regard this sentiment.

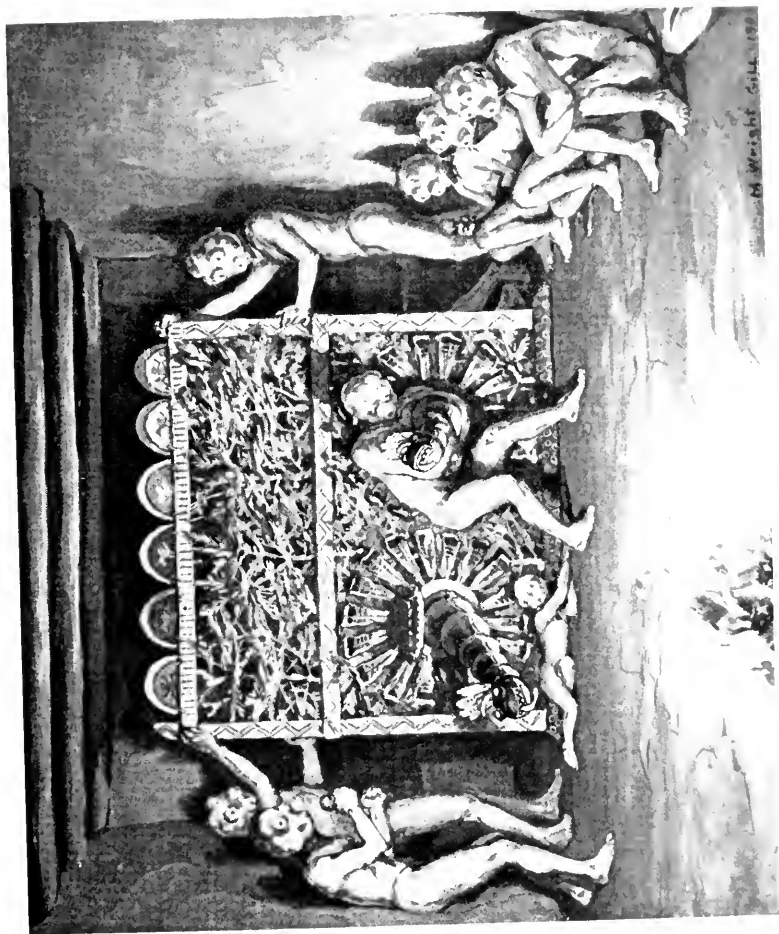
This theatrical performance is typical of an almost universal stage in the development of the drama among primitive people, which can likewise be detected in the early history of cultured races. The evolution of the drama is somewhat as follows: In the earliest stages the actors personated gods, and their performances were practically ceremonies. The actors, in time, were replaced by dummies, or idols were substituted for human actors. These inanimate objects or substitutes bore the same symbolic marks, and were regarded with the same reverence as the living actors. When the artistic power of expression was weak these idols were little more than rude images, stocks, or stones, but as it became stronger they became more life-like. The image representing the god in course of time usurped the place of the god in the mind of the worshipper, resulting in pure idolatry. In the Great Serpent exhibition, both men personating gods and symbolic images, pictures, and other representations are employed. The symbols are archaic and the performances with them are partly ceremonial, but so complex is their development along theatrical lines that they may be designated dramatizations.



M. WEINSTEIN G. 116 1900

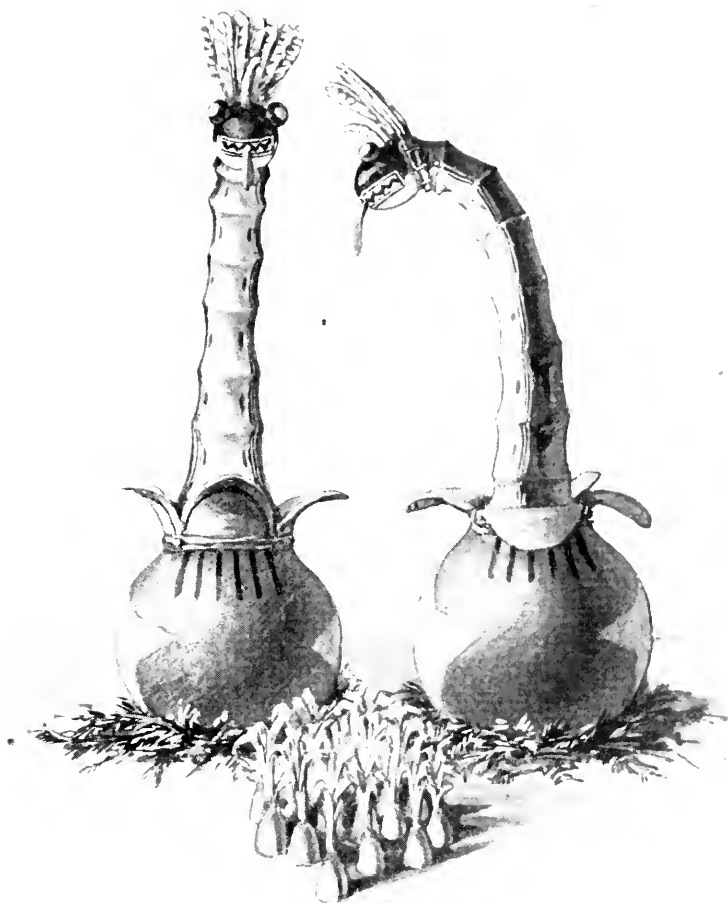
SERPENT SCREEN FIRST ACT





STRUGGLE OF SERPENTS WITH MUDHEADS FIFTH ACT

MUSEUM OF WASHINGTON



SERPENT EFFIGIES SIXTH ACT

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 631-649.

DECEMBER 28, 1900.

A COLLECTION OF SMALL MAMMALS FROM
MOUNT COFFEE, LIBERIA.

BY GERRIT S. MILLER, JR.

[FIGS. 39-43.]

IN 1897 Mr. R. P. Currie spent about fourteen weeks, February 1 to May 10, as the guest of the New York State Colonization Society, at Mount Coffee, Liberia, where he made extensive collections in the interest of the United States National Museum. Though principally occupied with entomology, he secured a collection of small mammals, which proves to be of particular interest. Only twenty-eight species are represented, but nine of these are additions to the known fauna of Liberia, and seven are new to science. That so large a proportion of forms new to the region should be included in the collection is especially remarkable, in view of the fact that Mount Coffee, situated on the St. Paul River, about twenty-five miles from Monrovia, is within the area covered by the explorations of Büttikofer, Sala, and Stampfli, who obtained no less than ninety species of mammals.¹

The country in which the Currie collection was made calls for no detailed description. Mount Coffee lies in a damp, densely forested region, and its elevation above sea level is only 400 or 500 feet.

A few of the specimens were obtained by Professor O. F. Cook, but when no collector's name is mentioned it is to be

¹ See Jentiuk, Notes from the Leyden Museum, x, pp. 1-58, 1888.

understood that they were taken by Mr. Currie, who is, in all cases, responsible for the native names and, unless the contrary is stated, for the measurements of the total length, tail vertebrae, and hind foot. I am much indebted to Mr. Wm. E. de Winton for aid in determining many of the rodents, and also for identification of most of the Cameroon material on which comparisons are based. Dr. F. A. Jentink has kindly compared a specimen of *Pipistrellus minusculus* with the type of *P. stanflii* in the Leyden Museum. This paper is published here by permission of the Secretary of the Smithsonian Institution.

FUNISCIURUS PYRRHOPUS LEUCOSTIGMA (Temminck).

1888. *Sciurus pyrrhopus* JENTINK, Notes from the Leyden Museum, x, p. 37.
 1890. *S[ciurus] pyrrhopus leucostigma* THOMAS, Proc. Zool. Soc. London, p. 447.

Native name, Buen-ben.

The seven specimens of this squirrel show practically no variation in color. A young individual, less than half grown, is duller than the adults, and the light stripes on its sides are paler. The skull of *Funisciurus pyrrhopus leucostigma* is smaller than that of *F. p. mystax* from the Benito River, Cameroon, the rostrum is less inflated in front of zygoma root, and the shaft of the articular process of the mandible is broader. Five adult males give the following measurements: Total length 348.6 (extremes 323-380); tail vertebrae 152 (124-175); hind foot with claw 45.7 (44.5-47); hind foot without claw 43.7 (43-44).

FUNISCIURUS POENSIS (A. Smith)?

1888. *Sciurus poensis* JENTINK, Notes from the Leyden Museum, x, p. 37.

One badly damaged skin with imperfect tail and no skull is the only representative of this animal in the collection. It was taken on March 3. As compared with three specimens of *F. poensis* from the Benito River, Cameroon, it differs in longer hind foot [38 (35.6) against 33.6 (31), 34 (31.4) and 34.6 (32), respectively] and more yellowish dorsal surface. The hairs of the back have the subterminal pale band a bright ochre yellow, while in the Cameroon specimen it is yellowish wood-brown. There is little probability that the Liberian animal is true *poensis*.

SCIURUS (HELIOSCIURUS) PUNCTATUS Temminck.

1888. *Sciurus punctatus* JENTINK, Notes from the Leyden Museum, x, p. 36.

Native name, Ten-deh.

An adult male was obtained on March 13. Measurements: total length 375; tail vertebrae 201; hind foot 45.7(40).

SCIURUS (HELIOSCIURUS) RUFOBRACTHIATUS
LIBERICUS subsp. nov.

1888. *Sciurus rufobrachiatus* JENTINK, Notes from the Leyden Museum, x, p. 36. Not of Waterhouse, 1842.

Native name, Bo-gongeh.

Type.—Adult male (skin and skull) no. 83834, U. S. National Museum. Collected at Mount Coffee, Liberia, Africa, March 22, 1897, by R. P. Currie. Original no. 16.

Characters.—Slightly larger than specimens of *Sciurus rufobrachiatus* from the Benito River, Cameroon; pelage less suffused with reddish, particularly on lower side of tail; skull decidedly larger, with heavier teeth and relatively larger, more elongate audital bullae.

Color.—Dorsal surface of head, body, and limbs black, irregularly suffused with tawny and everywhere thickly and uniformly speckled with yellowish white. The fur of the back is composed of long coarse hairs and fine soft underfur. The coarse hairs are about 25 mm. in length and black throughout except for two yellow bands, each 1–2 mm. in width, one placed about 7 mm. from base, the other about 10 mm. from tip. The more distal band is slightly the narrower. It alone gives the speckled appearance to the fur, as the lower band is concealed when the hairs lie in natural position. On the sides the specks are buff (Ridgway, Pl. v, No. 13), but on the back, shoulders and head they are distinctly tinged with orange, producing a faintly marked dorsal area. Underfur about 15 mm. long, slaty black, ringed subterminally with orange buff. This buff appears irregularly at the surface, giving rise to a faint tawny suffusion. Belly scantily haired, shading to gray anteriorly, and merging posteriorly with the ochraceous rufous of inner sides of hind legs. The inner surface of the front legs is like that of the hind limbs, and on both this color is sharply contrasted with the speckled black outer surface. Feet black, finely speckled with ochraceous. Tail black, finely speckled with buff on basal third, both above and below; the terminal two-thirds with ten faintly defined gray cross bars and a narrower gray margin above, and uniformly grizzled with gray below; pencil wholly black.

Skull.—The skull of *Sciurus rufobrachiatus libericus* is longer and relatively narrower than in the Benito River form of the species. The nasal branch of the maxillary is extended behind that of the



FIG. 39.—*a* *Sciurus rufobrachiatus libericus*;
b *S. rufobrachiatus rufobrachiatus*.

premaxillary so as nearly to reach rim of orbit (fig. 39). Audital bullæ larger than in specimens from Cameroon, their antero-posterior

diameter relatively as well as actually much greater.

Teeth.—The teeth are slightly heavier than in the Benito River animal, but not otherwise different.

Measurements.—External measurements of type: total length 515; tail vertebrae 295; hind foot 60 (57).¹

Cranial measurements of type: greatest length 57.4 (53)²; basal length 49 (44); basilar length 46 (42); palatal length 24 (22); diastema 12.4 (10.6); length of nasals 18 (16); zygomatic breadth 32.6 (31); greatest breadth of braincase 24 (24); mastoid breadth 26 (26); greatest diameter of audital bulla 13.6 (11.6); maxillary molar series (alveoli) 11.4 (10.4); mandible 33 (30); mandibular molar series (alveoli) 11.4 (11).

Specimens examined.—One, the only specimen of this squirrel obtained.

Remarks.—The Liberian form of *Sciurus rufobrachiatus* appears to be well differentiated from the Cameroon race, and, therefore, presumably from that occurring on Fernando Po, the type locality of the species.

ELIOMYS NAGTGLASII (Jentink).

1888. *Graphiurus nagtglasii* JENTINK, Notes from the Leyden Museum, x, p. 38 (Du Queah River, Liberia).

Native name, See-see.

An adult male was taken on March 12. Measurements: total length 258; total vertebrae 103; hind foot 30 (28).

MUS ALEXANDRINUS Geoffroy.

Native name, Tun-daw.

One specimen, March 18.

¹Three specimens from Benito River measure: total length 470, 490, and 500; tail vertebrae 230, 240, and 240; hind foot 54 (50), 55 (52) and 56 (52).

²Measurements in parenthesis are those of an adult skull of *Sciurus rufobrachiatus* from Benito River, Cameroon.

MUS RATTUS Linnaeus.

Four adult black rats are in the collection. They give the following measurements: total length 342.6 (323-354); tail vertebrae 187 (171-200); hind foot with claws 31.1 (28.4-33.5); hind foot without claws 29.8 (27-32.6).

MUS DEFUA sp. nov.

Native name, Deh-foua.

Type.—Adult male (skin and skull) no. S3837, U. S. National Museum. Collected at Mount Coffee, Liberia, Africa, May 13, 1897. Original no. 53.

Characters.—Nearest *Mus rutilans* Peters, but with larger feet and ears, and more closely annulated tail; color duller throughout, *the hairs of under surface plumbeous at base*; pale area behind ear obsolete or absent; skull more slender than that of *Mus rutilans*, the teeth larger and antorbital foramen much narrower.

Fur.—The fur is soft and dense though rather short. It is composed of the usual three elements, underfur, grooved bristles, and long terete hairs. The bristles and long hairs are inconspicuous and except on the rump, where the latter are somewhat noticeable, both might readily pass unnoticed. At middle of back the bristles and underfur are about 10 mm. in length and the terete hairs 5 mm. longer.

Color.—Dorsal surface russet, clear on forehead, occiput, and nape, elsewhere slightly dulled and varied by the yellowish tips and dark brown subterminal bands of the longer coarser hairs. Sides dull cinnamon in faint contrast with back. Cheeks and face concolor with sides, the former clear, the latter strongly tinged with brown. Ventral surface ecru-drab, slightly washed with Isabella color and irregularly darkened by the slate-gray bases of the hairs. Feet and ears scantily clothed with very short russet hairs.

Fect.—Sole naked to heel, the surface without reticulation; plantar tubercles six, all well developed; thumb very small, its claw blunt.

Tail.—The tail is slender and closely annulated, the rings uniform and distinctly outlined. They show no clearly defined traces of scales. At middle of tail there are 16 rings to the centimeter. Numerous fine, inconspicuous hairs spring from the spaces between the rings, their length about $1\frac{1}{2}$ times width of rings. Near tip of tail the rings become irregular and much narrower, and the hairs increase in length though without forming a pencil.¹

¹ In *Mus rutilans* there are only 11 rings to the centimeter at middle of tail, and they are distinctly divided by cross furrows. The hairs are slightly longer

Skull.—In size and general appearance the skull of *Mus defua* closely agrees with that of *Mus rutilans*. The rostrum, however, is narrower, and the dorsal profile of the nasals is much less distinctly bent downward near middle. Antorbital foramen barely more than half as wide as in *Mus rutilans*, its contraction especially noticeable below middle. The depression which extends forward on side of rostrum from antorbital foramen above root of incisor is smaller and less well defined than in *Mus rutilans*. On the lower side of the skull a few slight differences may be seen, some of which may prove to be mere individual variation. The incisive foramina are narrower than in *Mus rutilans* though of about the same length. The interpterygoid space on the contrary is wider in the Liberian animal. Audital bullæ like those of *Mus rutilans* but slightly smaller. Mandible with narrower angular process and shorter coronoid process than in *Mus rutilans*.

Teeth.—Though the toothrow is no longer, the individual teeth of *Mus defua* are broader and heavier than those of *M. rutilans*. Aside from their difference in general form, the maxillary teeth of *Mus defua* are peculiar in the greater disproportion between the central and lateral tubercles; the former are actually larger than in *Mus rutilans* while the latter are smaller and less definite in outline, particularly those on outer side. First molar with two well-developed tubercles on inner side, slightly larger than the corresponding ones in *Mus rutilans* and more posterior in situation. On the outer side there is a minute anterior tubercle smaller and further forward than in *Mus rutilans*, and a median tubercle of about the same size as in the latter. The posterior outer tubercle, small but well developed in *Mus rutilans* is here reduced to a mere trace on the outer side of the third median tubercle. The arrangement of the tubercles in the other maxillary teeth and in those of the mandible is essentially as in *Mus rutilans*.

Measurements.—External measurements of type: total length 310; tail vertebræ 187.5; hind foot 26.7 (25); ear from meatus 16; ear from crown 12; width of ear 12.

Cranial measurements of type: greatest length 32; basal length 27; basilar length 24.4; palatal length 13.6; palatal width between anterior molars 2.8; diastema 8.8; length of incisive foramen 6.4; combined width of incisive foramina 2.4; length of nasals 11.6; greatest combined breadth of nasals 3; zygomatic breadth 16.8; mastoid breadth 12; interorbital breadth 5.2; breadth of braincase above relatively to the width of the rings, and therefore actually much longer than in *Mus defua*.

roots of zygomata 13; depth of braincase at front of basioccipital S.S; fronto-palatal depth at posterior extremity of nasals 6.6; least depth of rostrum behind incisors 5.6; maxillary toothrow (alveoli) 6; breadth of first upper molar 1.8; mandible 18; mandibular toothrow (alveoli) 5.8.

Specimens examined.—One, the only specimen of *Mus defua* obtained.

Remarks.—*Mus defua* is so readily distinguished from *M. rutilans* that no special comparison is necessary. Its most obvious characters are the more closely annulated tail, plumbeous underfur of belly, and narrow antorbital foramen.

MUS ERYTHROLEUCUS Temminck.

Native name, Deh-foua.

The single specimen in the collection has been determined by Mr. Wm. E. de Winton. It was taken on March 30. Measurements: total length 204; tail vertebrae 96; hind foot 23.4 (22).

MUS TULLBERGI ROSTRATUS subsp. nov.

Native name, Deh-foua.

Type.—Adult male (skin and skull) no. 83836, U. S. National Museum. Collected at Mount Coffee, Liberia, May 7, 1897. Original no. 60.

Characters.—Slightly larger than *Mus tullbergi tullbergi*, but similar in color. Skull with heavier rostrum and mandible than in the typical subspecies.

Fur.—The fur is dense and soft, that on the middle of back about 9 mm. in length. It is composed almost exclusively of soft hairs of uniform length, though a few longer ones are interspersed, especially on flanks. There are no bristles.

Color.—As in true *Mus tullbergi* there are two color phases, characterized respectively by the predominance of red and brown. In the type (brown phase) the sides, cheeks, and flanks are yellowish wood-brown, slightly sprinkled with dark-tipped hairs. These hairs become more numerous on back, where they form a fairly well defined seal-brown dorsal area, faintly intermixed with color of sides. The seal-brown is clearest and darkest behind shoulders, between and in front of which it is much lightened by wood-brown. Face like back, but sprinkled with gray. Ventral surface dull white, sharply defined, the plumbeous bases of the hairs appearing irregularly at the surface. Feet

clothed with very short reddish hairs. Ears dark brown, sprinkled with almost microscopic hairs. Tail dark uniform brown throughout.

In the red phase the back and sides are russet, the former slightly duller near median line, but without trace of seal-brown. Forehead and face darker than back. Otherwise as in brown phase.

Feet.—The soles are entirely naked, and without reticulation. Plantar tubercles six, all well developed; thumb minute, its claw blunt.

Tail.—The tail is slender and moderately long, closely and distinctly annulated. At middle there are 17 rings to the centimeter. Each ring is divided by transverse furrows into scales slightly longer than broad. The scales are very conspicuous, and so arranged that those of contiguous rings form a noticeable quincunx. The few hairs that spring from the spaces between the rings are short and inconspicuous, in length scarcely exceeding width of rings. At tip the rings become crowded and indistinct, and the hairs slightly longer.

Skull.—The skull of *Mus tullbergi rostratus* is larger than that of the typical subspecies, the rostrum is proportionally larger and heavier, and the posterior portion of the mandible is deeper.

Teeth.—The teeth are as in the typical form.

Measurements.—External measurements of type: total length 266; tail vertebræ 145.6; hind foot 28.9 (27); ear from meatus 16.4; ear from crown 13; width of ear 11.6. Three topotypes average: total length 254 (240–266); tail vertebræ 136 (126–145); hind foot 27 (26–28.9); hind foot without claw 26 (25–27).

Cranial measurements of type: greatest length 33.4 (32);¹ basal length 28 (26.4); basilar length 26 (25.4); palatal length 14.6 (14); palatal width between anterior molars 3 (3); diastema 9.6 (9); length of incisive foramen 7 (6.4); combined width of incisive foramina 2 (2); length of nasals 12.2 (11.8); combined breadth of nasals 3 (3.6); zygomatic breadth 15 (14); mastoid breadth 12.2 (11); interorbital breadth 4.6 (5); breadth of braincase above roots of zygomata 12.6 (12); depth of braincase at front of basioccipital 8.8 (7.6); frontopalatal depth at posterior extremity of nasals 7 (6.4); least depth of rostrum behind incisors 5.6 (5); maxillary toothrow (alveoli) 5 (5); breadth of first upper molar 1.6 (1.6); mandible 18 (18); mandibular toothrow (alveoli) 5 (4.8).

Specimens examined.—Nine, all taken between April 1 and May 7. Four of these are in the brown phase.

¹ Measurements in parentheses are those of a much older skull of typical *M. ullbergi* from Benito River, Cameroon.

DASYMYS RUFULUS sp. nov.

Type.—Adult male (skin and skull) no. 83844, U. S. National Museum. Collected at Mount Coffee, Liberia, Africa, March 30, 1897.

Characters.—Plantar tubercles five as in *D. incomptus* and *D. bentleyæ*. Color much paler than in either of these, the dorsal area very slightly darker than sides and *suffused with red*. In size about equal to *D. bentleyæ*, but tail shorter, the proportions thus more nearly as in *D. incomptus*. Skull smaller than that of *D. incomptus*, the zygomatic width relatively less, the audital bullæ relatively smaller, and teeth, especially the incisors, less robust.

Fur.—The fur is fine but harsh, though without bristles. It consists of soft underfur and coarse somewhat iridescent hairs, the longer of which (about 20 mm. in length) are grooved, as may be seen on examination with a lens. Throughout the pelage the color zones on the individual hairs fade gradually into each other. On both back and belly the grooved hairs are light colored at base in contrast with the dark underfur through which they pass.

Color.—General color of dorsal surface wood-brown or clay color, finely though not conspicuously grizzled by darker and lighter hair tips, and dulled by appearance at surface of gray (Ridgway, pl. 11, no. 7) underfur. Throughout the dorsal area there is a distinct suffusion of red, somewhat variable according to light, but always noticeable on crown, shoulders, flanks, and about base of tail. The color of the back fades insensibly into dull grizzled ochraceous-buff on sides, and this into dull cream-buff on belly, where the dark bases of the hairs produce irregular and noticeable clouding. Muzzle and face hair-brown in rather marked contrast with crown and cheeks. Ears closely furred with short, dull brown hairs. Feet an indefinite hair brown. Tail dark brown above, faintly lighter below, but not bicolor.

Feet.—The feet are broad and strong, with toes of normal proportions. Soles with five tubercles, the hindermost of which is largest.

Tail.—The rather stout tail is distinctly and regularly annulated, the rings not obscured by hair. At middle there are ten rings to the centimeter. Each ring is divided into fairly well defined rectangular sections or scales *slightly broader than long*. In length the numerous fine hairs that spring from between the rings are about equal to width of two rings. At tip the rings become narrower and less definite and the hairs longer, but without forming a pencil.

Skull.—As compared with that of *D. incomptus* the skull of

Dasymys rufulus (fig. 40) differs chiefly in its smaller size, narrower rostrum, shorter broader interorbital region, narrower antorbital foramen, shorter nasals, and smaller auditory bullæ. Antorbital foramen

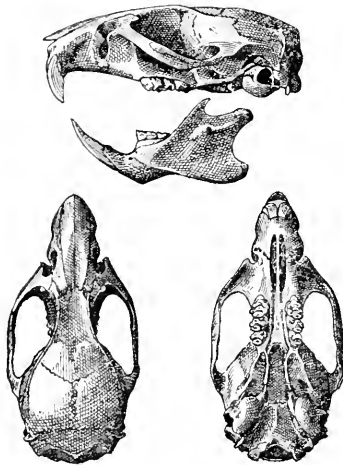


FIG. 40. *Dasymys rufulus*. Type.
Natural size.

narrower than in *D. incomptus*, the distance from its upper posterior margin to the elevation on side of rostrum marking root of incisor relatively much less. Plate forming outer wall of foramen relatively wider than in *D. incomptus*, its anterior border concave below, abruptly convex above, but this convexity never forming a pointed hook as in the only specimen of *D. incomptus* at hand. Posterior extremity of nasals in line with center of lacrymals, thus falling short of tips of nasal branches of premaxillaries by about 1.5 mm. In *D. incomptus* the nasals extend back to extremity of premaxillaries. Bony palate

very narrow, its width about equal to that of first upper molar. It is traversed by two deep longitudinal grooves. Pterygoids straight, slightly convergent posteriorly. Auditory bullæ relatively smaller and more globular than in *D. incomptus*. Mandible less robust than that of *D. incomptus*, the coronoid process shorter (rising scarcely above tip of articular process) and articular process much narrower.

Teeth.—The teeth are exactly as in *D. incomptus*, except that all are distinctly less robust. Anterior face of incisors paler orange than in *D. incomptus*.

Measurements.—External measurements of type: total length 302; tail vertebrae 151; hind foot 35 (32); ear from meatus 16.5; ear from crown 13; width of ear 17. Average of four specimens from the type locality: total length 306.5 (302–316); tail vertebrae 153 (151–156); hind foot 34 (33–35); hind foot without claw 30.4 (29–32).

Cranial measurements of type: greatest length 35 (37);¹ basal length 32 (34); basilar length 30 (32); palatal length 16.8 (18.4); palatal width between anterior molars 2.2 (2.4); diastema 10 (11.4);

¹ Measurements in parentheses are those of an adult *D. incomptus* from Port Natal (topotype of *D. guinzii*).

length of incisive foramen 7.4 (8.4); combined width of incisive foramina 2 (2.2); length of nasals 13 (14.4); combined breadth of nasals 4 (4); zygomatic breadth 17 (19); mastoid breadth 13.6 (13.8); interorbital breadth 4.6 (4.6); breadth of braincase above roots of zygomata 13.8 (14); depth of braincase at front of basioccipital 10.8 (10.6); frontopalatal depth at posterior extremity of nasals 9 (10); least depth of rostrum behind incisors 6.4 (6); maxillary toothrow (alveoli) 7.4 (8); breadth of first upper molar 2.2 (2.8); mandible 20.4 (22); mandibular toothrow (alveoli) 7 (8).²

Specimens examined.—Six, all from the type locality.

Remarks.—*Dasymys rufulus* differs so widely from the large, dark *D. incomptus* as to need no special comparison. It apparently more closely resembles *D. bentleyæ*, a species which I have not seen, though readily distinguishable by its shorter tail and smaller ears. In color *D. bentleyæ* is merely said to resemble Peters' plate of *Dasymys gueinzii*, a statement sufficiently vague to cover much specific variation. The plate, however, shows no trace of the red suffusion of the dorsal surface so conspicuous in *D. rufulus*.

LEGGADA MUSCULOIDES (Temminck).

1888. *Mus musculoides* JENTINK, Notes from the Leyden Museum, x, p. 44.

The collection contains two specimens, an adult female and a half-grown young. The former measures: total length 105; tail vertebræ 46; hind foot 13.8 (13); ear from meatus 9; ear from crown 7.4; width of ear 8.

ARVICANTHIS PULCHELLUS (Gray).

1888. *Mus barbarus* JENTINK, Notes from the Leyden Museum, x, p. 44.

Mr. Currie secured four individuals of this species, three adults and one young. The adults give the following average and extreme measurements: Total length 256 (244–268); tail vertebræ 129 (126–134); hind foot 28.1 (27–29); hind foot without claws 26.3 (25–28).

ARVICANTHIS PLANIFRONS sp. nov.

Type.—Adult male (skin and skull) no. 83814, U. S. National Museum. Collected at Mount Coffee, Liberia, Africa, April 26, 1897.

Characters.—Similar externally to *Arvicanthis univittatus* (Pe-

²Some of the cranial measurements of *D. bentleyæ* given in the original description are: basal length 31.5; greatest breadth 18; nasal length 13.8; interorbital breadth 4; palatal length 19.6; diastema 10.3; palatine foramina 8.1; length of upper molar series 6.5.

ters). Skull narrower than that of *A. univittatus*, the dorsal profile essentially straight from tip of nasals to middle of proencephalon.

Fur.—The fur is rather coarse and harsh, but without bristles or noticeable lengthened hairs. On middle of back it is about 8 mm. in length.

Color.—Face, cheeks, back, and sides uniform dull orange-rufous, slightly darkened by a uniform admixture of black-tipped hairs; these a little less noticeable on sides. A black line, 3 mm. wide, extends from nape to rump. Ventral surface buff (slightly yellower than Ridgway, pl. v, no. 13), fading to dirty white on throat, chin, lips, and inner side of front legs, and deepening to ochraceous in anal region and on inner side of hind legs. Hind feet thinly coated with short ochraceous hairs. Front feet dull brown. Tail and ears uniform dark brown.

Feet.—The feet present no characters of importance. Soles with five well-developed tubercles and apparently a rudimentary sixth. Palms 6-tuberculate. Thumb very small, its nail blunt.

Tail.—The tail is moderately long and rather thick, its annulation distinct. At middle there are 15 rings to the centimeter. The individual rings are somewhat irregular in outline at free border, but are not distinctly broken up into scales as in *Mus tullbergi*. From between the rings spring numerous black stiff hairs, the length of which is slightly greater than width of rings. Toward tip the rings become confused and crowded, but the hairs undergo no change.

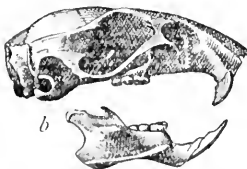
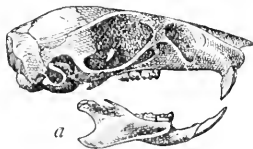


FIG. 41. *a* *Arvicanthis planifrons*; *b* *A. univittatus*. Slightly reduced.

Skull.—The skull of *Arvicanthis planifrons* (fig. 41) differs from that of *A. univittatus* in many important characters. In general it is more slender than the latter, though the ridges are equally well developed. The most striking peculiarities are to be found in the anterior half of the skull. The whole region in front of the interorbital constriction is reduced in both width and depth, and as this lessening most affects the region between anterior bases of zygomata a conspicuous change in the profile of the skull results. In *A. univittatus* the dorsal outline curves almost continuously (though it is nearly straight over front half of nasals) from front to back, the convexity slightly more abrupt at front of orbits and over mesencephalon. In *A. planifrons* it is essentially straight from anterior extremity of nasals to

middle of proencephalon. Ratio of depth of rostrum at posterior extremity of nasals to basilar length 36.8 in *A. univittatus*, 28 in *A. planifrons*. Antorbital foramen narrower than in *A. univittatus*, the difference similar to that between *Mus defua* and *M. rutilans*, though less. Plate of maxillary forming outer wall of antorbital foramen narrow, its anterior margin sloping gradually upward and backward, its width at middle 3 mm. In *A. univittatus* the anterior margin rises vertically to slightly above middle and then bends abruptly backward, forming a conspicuous angle. The width at middle is about 4 mm. Incisive foramina shorter and wider than in *A. univittatus*, the median septum *very widely expanded* at level above (dorsal to) palatal surface. Audital bullæ larger than in *A. univittatus*, but not essentially different in form. Mandible much more slender than that of *A. univittatus*, especially the posterior portion.

Teeth.—The teeth are broader than those of *A. univittatus*, but I can detect no difference in the enamel folds.

Measurements.—External measurements of type¹: total length 231; tail vertebræ 98; hind foot 30 (27.6); ear from meatus 14.8; ear from crown 10; width of ear 12.8.

Cranial measurements of type: greatest length 34 (33.6)²; basal length 28 (27.6); palatal length 14 (14.4); palatal width between anterior molars 3.8 (4.2); diastema 8.6 (8.4); length of incisive foramen 5.6 (6.4); combined width of incisive foramina 3.8 (2.4); length of nasals 13.6 (13); combined breadth of nasals 4.2 (4); zygomatic breadth 15 (16.6); mastoid breadth 11 (13); interorbital breadth 6.4 (6.4); breadth of braincase above roots of zygomatics 14 (15); depth of braincase at front of basioccipital 10 (9.6); fronto-palatal depth at posterior extremity of nasals 7 (9.2); least depth of rostrum behind incisors 5.4 (6); maxillary toothrow (alveoli) 5.8 (5.8); breadth of first upper molar 2 (2.4); mandible 17.6 (18.4); mandibular toothrow (alveoli) 5.4 (6).

Specimens examined.—Two, both from the type locality; one not fully adult.

Remarks.—The external similarity of this animal to *Arvicanthis univittatus* forms a striking contrast to the distinctness of its cranial characters. These are as marked in the immature individual as in the adult.

¹ Three specimens of *A. univittatus* from Benito River, Cameroon, average: total length 242; total vertebræ 105; hind foot 30 (28).

² Measurements in parenthesis are those of a somewhat older individual of *A. univittatus* from Benito River.

MALACOMYS sp.

A specimen less than half grown, and therefore too young for satisfactory determination, is the only representative of this species in the collection. It has six plantar tubercles, all well developed.

LOPHUROMYS SIKAPUSI (Temminck).

1888. *Lophuromys sikapusi* JENTINK, Notes from the Leyden Museum, x, p. 42.

Native name, Tō-sivē.

The two specimens of this mouse measure respectively: total length 187; tail vertebræ 70; hind foot 23.3 (21); and total length 204, tail vertebræ 68.7; hind foot 24 (22). Both are females.

CRICETOMYS GAMBIANUS Waterhouse.

1888. *Cricetomys gambianus* JENTINK, Notes from the Leyden Museum, x, p. 42.

Mr. Currie secured only one specimen.

HERPESTES GALERA (Erxleben).

1888. *Herpestes pluto* JENTINK, Notes from the Leyden Museum, x, p. 16.

Represented by a skull with imperfect dentition.

CROCIDURA SCHWEITZERI Peters.

1888. *Crocidura schweitzeri* JENTINK, Notes from the Leyden Museum, x, p. 46.

An adult male and an immature individual of the same sex were taken on April 16 and 18 respectively. They agree very closely with the characters given by Peters in the original description of the species. The measurements of the adult are as follows: total length 133; head and body 72.4; tail vertebræ 53; hind foot 15 (14); ear from meatus 8; ear from crown 5.

CROCIDURA STAMPFLII Jentink.

1888. *Crocidura stampflii* JENTINK, Notes from the Leyden Museum, x, p. 47.

Three specimens, taken April 23, May 3, and May 4 respectively. Their measurements are as follows: No. 83805, ♀ ad., total length 110; tail vertebræ 43; hind foot 13 (12); ear from meatus 7; ear from crown 4.5. No. 83806, ♂ ad., total length 120; tail vertebræ 47; hind foot 14.6 (12.1); ear from meatus 8.6; ear from crown 4. No. 83808, ♀ ad., total length 114; tail vertebræ 43; hind foot 13 (12).

MYOSOREX MURICAUDA sp. nov.

Native name, Dē-wā.

Type.—Adult male (in alcohol) no. 83809, U. S. National Museum. Collected at Mount Coffee, Liberia, Africa, April 5, 1897. Original no. 32.

Characters.—Slightly smaller and of more slender form than *Sorex araneus*; tail longer than head and body; unicuspid teeth $\frac{3-3}{2-2}$; color slaty brown above, smoky gray beneath.

Color.—After nearly three years' immersion in alcohol the type specimen is uniform slate-gray above, faintly tinged with sepia across shoulders and middle of back. Underparts whitish smoke-gray. The fur is everywhere plumbeous at base. Feet dull white.

Feet.—The feet are slender, scantily clothed with fine white hairs on dorsal surface, the soles and palms naked, each with six tubercles.

Tail.—Tail slender and distinctly four-sided. Its diameter near base is only 2 mm., a width that it maintains without perceptible diminution to within about 20 mm. of tip. It is without trace of scales or annulation, scantily clothed with almost microscopic hairs, and very inconspicuously sprinkled with minute bristles 2 to 3 millimeters in length, visible on close scrutiny only.

Skull.—The skull of *Myosorex muricauda* (fig. 42) is slender and lightly built, much like that of *Sorex araneus* though smaller and less robust. Under surface of basioccipital forming a distinct angle with that of basisphenoid, not continuous with it as in the Liberian species of *Crocidura*. Tympanic rings nearly circular and actually larger than in *Crocidura schweitzeri* or *Sorex araneus*.

Teeth.—Anterior upper incisor with large posterior cusp, the point of which is level with tips of smaller unicuspid teeth. First unicuspid nearly double the height of second and third, its alveolar length slightly greater than height at middle. Second and third unicuspids when viewed from side subequal and about one-half as large as first. Viewed from above (skull held upside down) the third appears much larger than the second, owing to the postero-internal expansion

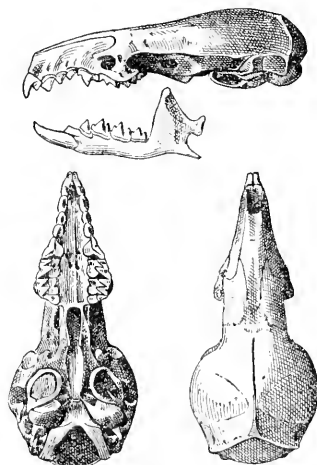


FIG. 42. *Myosorex muricauda*. Type. $\times 2$.

of its crown. The third unicuspid and large premolar are almost in contact. Large premolar well developed, its protocone minute. Cingulum cusp low, broad and ill defined. Posterior border of tooth deeply emarginate. First and second molars subequal in size, the second slightly narrower than first. Both are deeply emarginate posteriorly. Hypocone distinct but very small, about equal to protocone of large premolar. Lower incisor long and slender and although quite unworn barely turned upward at tip. The posterior border of its cingulum extends slightly behind middle of first unicuspid. Lower unicuspid essentially as in Dobson's figure of *Myosorex johnstoni* (Proc. Zool. Soc. London, 1887, p. 577).

Measurements.—External measurements of type: total length 120; head and body 58; tail 62; hind foot 12.4 (11.8); ear from meatus 8.5; ear from crown 5.

Cranial measurements of type: greatest length (exclusive of incisors) 18; palatal length 7.4; width of palate between middle molars 2.2; distance between outer edges of alveoli of second molars 5; breadth of braincase 8.4; mandible (without incisor) 9.8; maxillary tooththrow 8.4; mandibular tooththrow 7.8.

Specimen examined.—One, the type.

Remarks.—In its long tail *Myosorex muricauda* differs from all the previously known members of the genus except *M. sorella* Thomas. From this species as well as from the short-tailed forms it is distinguishable by the reduced number of upper unicuspid teeth.

EPOMOPHORUS FRANQUETI Tomes.

1888. *Epomophorus franqueti* JENTINK, Notes from the Leyden Museum, x, p. 50.

Native name, Soon.

One specimen of this bat was taken on March 1, 1897.

MEGALOGLOSSUS WOERMANNI Pagenstecher.

1888. *Megaloglossus woermanni* JENTINK, Notes from the Leyden Museum, x, p. 53.

Two specimens, adult male and female, February 23, 1897.

External measurements: head and body, ♂ 65, ♀ 68; tibia, ♂ 18, ♀ 16.4; foot, ♂ 10 (9), ♀ 11 (9); forearm, ♂ 42, ♀ 42; first digit, ♂ 56, ♀ 57; second digit, ♂ 30, ♀ 31; third digit, ♂ 75, ♀ 76; fourth digit, ♂ 59, ♀ 61; fifth digit, ♂ 56, ♀ 57; ear from meatus, ♀ 15.4, ♀ 14.6; ear from crown, ♂ 14, ♀ 14; width of ear, ♂ 11, ♀ 12.

Cranial measurements of adult female: greatest length 25.4; basal length 24; basilar length 22.4; palatal length 13.4; zygomatic breadth 13; interorbital breadth 4; breadth across postorbital processes 9.4; greatest breadth of braincase 11; mastoid breadth 9.4; upper tooth-row (exclusive of incisors) 9; mandible 20; mandibular toothrow (exclusive of incisors) 10.

HIPPOSIDEROS CAFFRA (Sundvall).

Five specimens, all males, March 27 to April 22, 1897. Although apparently representing a single species these specimens show remarkable variation in size. In two the forearm measures 52 mm., in two others 49, while in the fifth it barely reaches 42.

PIPISTRELLUS MINUSCULUS sp. nov.

Type.—Adult female (in alcohol) no. 84500 U. S. National Museum. Mount Coffee, Liberia, May, 1894. O. F. Cook, collector.

Characters.—Similar to *Pipistrellus stampflii* (Jentink), but smaller, the tail relatively longer and color "more reddish brown."

Ears.—The ears are rather short; laid forward they extend to extremity of muzzle. Anterior margin of conch abruptly convex at base, then slightly convex to narrowly rounded tip. Posterior border faintly concave to middle, then somewhat more strongly convex to deep notch separating antitragus from rest of ear. Antitragus small but sharply defined, subquadrate in outline, its height nearly equal to its width. Inner surface of conch with five or six ill-defined cross ridges.

Tragus blunt, slightly curved forward, broader above than at base.

Membranes.—The membranes are very thin and delicate. Wings from base of toes. Free border of uropatagium longer than calcar.

Feet.—The feet are short, scarcely one-half as long as tibiae. Calcar nearly double as long as foot, terminating in a distinct lobe, and noticeably keeled posteriorly.

Fur.—Fur short, that on middle of back about 5 mm. in length. It is closely confined to body, barely extending on membranes except as a thin sprinkling of scattered hairs.

Color.—Dorsal surface raw umber, slightly more yellowish posteriorly than anteriorly. Ventral surface yellowish wood-brown, in pubic region tinged with gray. The hairs are everywhere slaty black through basal half or more. Ears and membranes blackish brown,

the wings and uropatagium with a very narrow pale border along free edge.

Skull.—The skull of *Pipistrellus minusculus* (fig. 43b), which I am unable to compare with that of *P. stampflii*, is considerably smaller than that of the European *P. pipistrellus* (fig. 43a). The reduction in

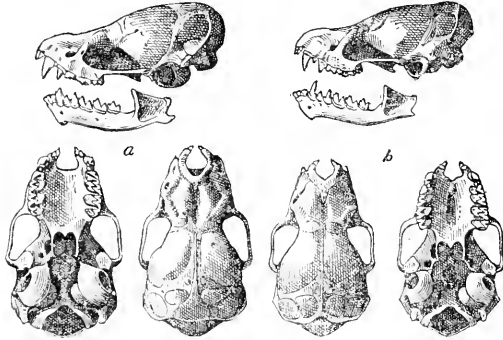


FIG. 43. a *Pipistrellus pipistrellus* ;
b *P. minusculus* $\times 2$.

size is chiefly due to shortening of the rostrum and flattening of the braincase, but, aside from the general difference in size and form, there are no very striking characters to distinguish the skull of the African animal. The premaxillaries in *P. minusculus* are more abruptly bent downward than in *P.*

pipistrellus, the anterior nares thus appearing to open more distinctly forward and less upward. Interpterygoid space *slightly broader than long*. Audital bullæ relatively smaller than in *P. pipistrellus* and space between them actually as well as relatively greater.

Teeth.—The teeth are essentially as in *P. pipistrellus*, though much smaller. Crown of middle upper, molar narrower and with more narrowly conical protocone. Hypocone of first and second molars minute but distinct. The mandibular teeth present no peculiarities.

Measurements.—External measurements of type: total length 70; tail vertebrae 31; tibia 9.4; foot 5.4; calcar 9; forearm 26.6; thumb 4.8; second digit 23; third digit 45; fourth digit 40; fifth digit 35; ear from meatus 8; ear from crown 7; width of ear 7; tragus 4.4.

Cranial measurements of type: greatest length 11; basal length 10; basilar length 8; median palatal length 4.6; lachrymal breadth 4.8; least interorbital breadth 3.2; zygomatic breadth 7; mastoid breadth 6.2; occipital depth 3.6; upper tooththrow (exclusive of incisors) 4; mandible 7.4; mandibular tooththrow (exclusive of incisors) 4.

Specimens examined.—Three, all from the type locality.

Remarks.—I should hesitate to separate this species from *Pipistrellus stampflii* had not Dr. Jentink made comparison of one of the Mount Coffee specimens with the type of the latter. After pointing out an

error in the original description of *P. stampflii* in which the length of forearm is recorded as 32 mm. instead of 27 mm., he continues (in letter under date of April 22, 1900): "your Liberian bat is still smaller [than *P. stampflii*], but its tail is longer. I think it is a new species, particularly as it is much browner-red colored than *stampflii*. As far as I can see the dentition is the same, though all the teeth appear to be smaller." The more important measurements of the type of *Pipistrellus stampflii* are: total length 62; tail vertebrae 24; forearm 27.

VESPERTILIO TENUIPENNIS (Peters).

1888. *Vesperus tenuipennis* JENTINK, Notes from the Leyden Museum, x, p. 54.

The collection includes an adult female of this bat collected by Professor Cook on the St. Paul River.

GALAGO DEMIDOFFII Fischer.

1888. *Galago demidoffii* JENTINK, Notes from the Leyden Museum, x, p. 14.

One very young individual.

CERCOPITHECUS sp.

A skull of some species of *Cercopithecus* was obtained by Mr. Currie.

PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 651-660.

DECEMBER 28, 1900.

FOSSIL LAND SHELLS OF THE JOHN DAY
REGION WITH NOTES ON RELATED
LIVING SPECIES

BY ROBERT E. C. STEARNS.

[PLATE XXXV.]

THE forms described below have previously been made known in Dr. Charles A. White's paper 'On the Marine Eocene, Fresh Water Miocene, and other Fossil Mollusca of Western North America.'¹ These forms were submitted to me for determination by Dr. White, and my conclusions are embodied in that part of his paper which bears the subtitle 'Fossil Mollusca from the John Day Group in Eastern Oregon.'

Fifteen years have passed since the publication of Dr. White's paper, and in the meantime the nomenclature has undergone so many important changes that a revision of the portion with which my name is associated has become necessary. In connection with this revision I have added notes and observations touching the distribution and variation of related living forms which occur in the greater general region wherein the John Day shells were found.

Before proceeding further with remarks of my own it may be well to quote from Dr. White, as to the character of the locality, and mention the sources from which these fossils were obtained.

In the year 1883 or about that time, Dr. White received from

¹ Bulletin U. S. Geological Survey, No. 18, Washington, 1885, pp. 10-19.

the late Professor Cope a small collection of fossil mollusks. Some two years later Professor Thomas Condon, of the University of Oregon, presented to the Geological Survey a small collection of shells which he obtained from the John Day group, at or near the locality from which Professor Cope obtained his specimens. Professor Condon's collection embraced the species which Professor Cope's contained, but no others. The exact locality as given on Professor Condon's label is 'the North Fork of John Day River, Oregon, at the angle of the big bend, longitude $119^{\circ} 40'$, latitude $44^{\circ} 50'$.' The shells were associated in the same layers with vertebrate remains.

Dr. White says of these collections: they "contain one, and perhaps two, species of *Unio* and four or five species of pulmonate gasteropods, which latter I refer to the Helicidæ; but no other invertebrate forms were found associated with them. The John Day deposit being of lacustrine origin one could not expect to find it containing the remains of an extensive molluscan fauna, as compared with the faunas of marine deposits; but these small collections do not embrace so wide a variety of forms as lacustrine faunas usually present. No gill-bearing nor palustral pulmonate gasteropods are found among them, and all bivalve mollusks, except the Uniones which have just been mentioned, are also absent. It is therefore quite apparent, from a zoological point of view, that these collections represent only a part, and probably only a small part, of the land and fresh water molluscan fauna which existed in and about the lake in which the John Day strata were deposited.

* * * * *

"It is so apparent, from the evidence furnished, that these fossil forms represent the living species ancestrally that one may reasonably make the same use of them, with reference to their genetic history, as if the continuity of that history were known by actual observation. These forms, whose genetic history and specific identity have so evidently been continued in unbroken lines from the John Day epoch to the present time, have endured remarkable vicissitudes of physical conditions as well as considerable geographical dispersion since Miocene time. Some of the changes which have taken place in that region since then are very remarkable.

"One of the greatest volcanic outflows which the earth has known, covering thousands of square miles with melted rock and forming the great mountains of the Cascade range, oc-

curred in and near that region since those mollusks lived upon the borders of the John Day Lake. The Glacial epoch has come and gone since then, and an immense subaerial erosion has taken place over the whole region, the extent of which one cannot comprehend without witnessing its results. Not a mammalian species or genus now exists indigenously upon the North American Continent that existed then, and all other vertebrate forms of continental life have materially changed; but living descendants of those land snails are thriving to-day in the same region and under the same specific forms that their remote ancestors bore."

From the interesting observations of Dr. White, the consideration of the Pulmonate forms of the Cope and Condon collections may properly follow.

Family HELICIDÆ.

Genus *Epiphragmophora* Doering 1875.

EPIPHRAGMOPHORA FIDELIS ANTECEDENS Stearns.

(Plate XXXV, figs. 1, 2, 3.)

Helix (Aglaia) fidelis GRAY (STEARNS) Bull. 18, U. S. Geol. Survey, p. 14, pl. III, figs. 1, 2, 3, 1885.

These fossil examples at once suggest the well-known and widely distributed living species *Helix fidelis* Gray,¹ of western North America. A careful comparison with the very large geographical suite of that species in the U. S. National Museum, which includes a great number of localities within its known area of distribution, verifies the suggestion. The only objection that I can anticipate as likely to be made, is, that the umbilicus in the most perfect of the specimens is closed; in the example referred to, there is some evidence of mechanical flattening, as if by external pressure, which would have the effect of pushing the reflexed edge of the lip in that part of the shell, over the umbilical cavity to some extent. Aside from this, a critical examination of the large series of recent shells in the National Museum collection, received from the Binney and Stearns collections and other sources, shows a marked range of variation in this feature. While in some specimens the umbilicus is widely open, in others it is so nearly covered that a slightly increased deposit of callus would so completely seal the umbilical opening as to make the shell imperforate. In the museum register the foregoing is numbered 13400.

¹Proc. Zool. Society London, July, 1834, p. 67.

Proc. Wash. Acad. Sci., December 1900.

E. fidelis exhibits very considerable variation in color and form. Some of the color varieties are quite showy, surpassing in this respect all other American Helices. This feature, however, need not be considered in connection with fossil examples. Variation in form and size has a more important bearing as will be seen by the following. Carinate, subcarinate, and dwarfed forms have been observed by various authors; these varietal aspects appear to be closely related to physiographic influences. The dwarfing which is seen in the specimens from the region of the Dalles of the Columbia River, and from Shasta County, California, indicate diminution in size as related to easterly distribution, while the tendency to angulation of the whorls seems to be coincident with distribution toward the south as exhibited in *E. fidelis infumata* of the Coast region as far south as Marin county, California, or nearly to the Bay of San Francisco. *E. fidelis subcarinata* of the Humboldt County forested region, is an intermediate and connecting link between *fidelis* proper, and the *infumata* aspect, not only in form but geographically also. It may be worth mentioning that the *fidelis* forms, unlike the other characteristic banded or markedly colored¹ West Coast snails, become darker, or shade conspicuously into *melanism* in their southerly distribution.

E. mormonum, which may be regarded in a general way as a higher mountain form, ranges from Shasta County to Tulare. Its zone of distribution is along the westerly slopes of the Sierra Nevada; it is, in my opinion, the hypsometric and easterly expression of the *fidelis* stock, the easterly and higher altitude branch of that form, extending to the south; it is said to approach the coast in Santa Barbara County, but how near to the sea, or at what altitude it has been detected in that direction, I do not know. The deflection of the Sierra Nevada range toward the southwest and the merging of its westerly flanks into the easterly outlying elevation of the coast ranges in this part of the State would furnish a highway for migration, as may be seen by a glance at the map. Binney² has shown that in its anatomical characters, the animal is quite different from the other *Ariontæ* (= Epiphragmophoræ), and more like *fidelis* and *fidelis-infumata*.

Fossilized shells of *mormonum* could not readily be separated from similar specimens of *fidelis* of the same size. The average size of *mormonum* is much less than the average of typical *fidelis*, approxi-

¹ That is to say, high colored when compared with the horn-colored eastern shells, and *townsendiana*, *columbiana*, etc., of the West Coast.

² W. G. Binney, Manual of American Land Shells; Bull. 28 U. S. Nat. Museum, pp. 121-123, 140, 141.

mating more nearly perhaps to *fidelis-minor* of the Dalles. While *fidelis* has its angulated aspect in the hirsute *infumata*, so *mormonum* exhibits, in the hirsute and carinated *hillebrandi* of Newcomb, parallel aspects of variation.

Turning from this digression to *E. fidelis*, an examination of forty-seven examples from the forested districts of Coos County, Oregon, which border on the ocean, shows *nine* that were prominently *elevated*, *five* conspicuously *depressed*, *three* pathologic in the ordinary sense (had been fractured and mended) and *one* extremely *flat*, *deepsutured* individual, in which each whorl commencing at the apex, was markedly immersed in the succeeding volution, resulting in extreme deepening of the suture, a very unusual abnormality and the only example in hundreds of *fidelis* that have passed under my scrutiny. These extremes of form, would in fossil shells, destitute of the assistance of color in determining relationship, be regarded as quite distinct, more especially if collected at different times by different persons, and at different, though not distant localities; they testify to the inadequacy of an isolated example, quite likely bleached and weather-worn, as is often the case, as a basis for specific distinction.

Genus *Polygyra* Say 1818.

POLYGYRA DALLI Stearns.

(Plate XXXV, figs. 4, 5, 6.)

Helix (*Monodon*¹) *Dallii* STEARNS (MS.) Bull. 18, U. S. Geol. Survey, pp. 14-15, pl. 111, figs. 4, 5, 6, 1885.

Following Binney's arrangement² the form described below would be placed in the generic group *Mesodon*, with the species *columbiana*, *devia*, *townsendiana*, etc., of the West Coast, and *albolabris*, *thyroides*, etc., of the eastern side of the continent.

In this revision I have been governed pretty much by Dr. Pilsbry's recent classification³ with which, in the main, I agree.

Shell elevated, subconical, base flattened-convex, imperforate, umbilical region depressed. Lip moderately thickened and reflected. Surface traversed by fine incremental lines and otherwise marked by minute pits (cicatrices?), as seen under a magnifier, implying a hir-

¹ Error for *Mesodon*.

² Bull. 28 U. S. National Museum, 1885, and previous publications of said author.

³ A classified catalogue, with localities, of the Land Shells of America north of Mexico. Philadelphia, April, 1898.

sute periostracum. Whorls six to six and a half, rounded and gradually increasing. Suture quite distinct. Aperture rounded lunate.

Of the three specimens submitted for examination the description is made from the most perfect. A measurement of these gives the following figures:

Altitude 0.63, 0.60, 0.52 inch; max. diameter 0.85, 0.85, 0.79 inch; apical angle about 95°. After a careful comparison with the living *Helices* of the West Coast, I find that while the above are larger than any examples of *P. columbiana* that I have seen, and differ from that form in the umbilical feature, and in having a less reflected lip, in other respects they exhibit many of the characters of the latter, as in the following particulars: General facies (size and umbilicus excepted); apical angle, when compared with elevated individuals of *P. columbiana*; number of whorls and convexity of the same; sutural definition; ratio of increase in size of whorls; basal convexity; and finally in shape of aperture.

P. dalli suggests an ancestral form, from which have proceeded such living representatives as are known by the specific titles *columbiana*, *devia*, etc., and relationship with *P. townsendiana*, its so-called variety *P. ptychophora*,¹ *P. thyroides*, an eastern form whose western range as reported to this date is Minnesota, and with *P. ptychophora* which has crossed the Cascade Mountains, and extends easterly to the Deer Lodge region of Montana.

All of the species named are rather of an eastern than a West Coast type. One aspect of *columbiana*, *labiosa*, has also been found in Deer Lodge Valley.

The wide gap between the western range of the eastern form, and the eastern distribution of the western species, may some time yield to the investigator connecting links, in the specific or varietal chain, indicating the lines of migration as well as descent. The Museum number of *P. dalli* is 13401.

Genus **Polygyrella** Binney 1863.

Subgenus **AMMONITELLA** Cooper 1869.

AMMONITELLA YATESI PRÆCURSOR Stearns.

(Plate XXXV, figs. 8, 9, 10, 11, 12.)

Gonostoma Yatesi COOPER (STEARNS) Bull. 18, U. S. Geol. Survey, p. 16, pl. 111, figs. 8, 9, 10, 11, 12, 1885.

The Cope-Condon collections contain four specimens (Mus. no.

¹The dental formula in these two species is nearly the same according to Binney; this character is, however, not a conclusive one.

13403) of this interesting and curious form. It is apparently the forerunner or ancestor of the living *A. yatesi* described by Dr. Cooper from specimens collected by Dr. L. G. Yates in the cave at Cave City, Calaveras County, California, in 1869.

As Dr. Cooper remarks "it would have been supposed to be a *Planorbis* if found near water and if the streams of that country had not been thoroughly searched by many collectors. It resembles *Planorbis* in the inverted spire and in the partial enclosure of each whorl in the next larger, so that the spire shows only a small portion of the whole shell."

The fossil examples are all imperfect, but taken together they show quite satisfactorily its specific and generic relations. I have compared them with a good series of specimens contained in the National Museum; though the fossil specimens are considerably larger than any of the recent ones, I am unable to detect any other difference. The geographical range of the living or recent *yatesi*, though quite restricted, is much greater than at first reported. It was supposed to be confined to the interior or immediate vicinity of the cave; subsequently Mr. Hemphill,¹ the well-known collector, found it "near Murphy's (in the same county), seven miles away from the cave, æstivating under stones or north hill-sides, while numbers of dead shells lay bleaching in the sunshine," etc. The late Mr. C. D. Voy also collected it elsewhere than at the cave. The restricted distribution of *A. yatesi* and the smaller size of the recent, compared with the fossil examples, suggest obsolescence, as well as a survival of the extraordinary physical changes of the John Day Epoch. The absence of other forms, which might prove connecting links with existing allied species, may be due to absolute obliteration through similar causes during the middle or later Tertiary periods, or even still later physical changes.

Family ENDODONTIDÆ Pilsbry.

Genus *Pyramidula* Fitzsinger 1883.

PYRAMIDULA PERSPECTIVA SIMILLIMA Stearns.

(Plate XXXV, fig. 7.)

Helix (Patula) perspectiva SAY (STEARNS) Bull. 18, U. S. Geol. Survey, p. 14, pl. 111, fig. 7, 1885.

The collections contained only one example of this form, and this

¹Zoe, Vol. III, p. 45. San Francisco, April, 1892.

in an imperfect condition. Upon careful comparison with the large series of living shells in the National collection, the specimen, though somewhat distorted by compression in the number and closeness of its whorls and general facies, points directly to *perspectiva* of Say (Museum no. 13402).

Dr. Pilsbry¹ gives the range of this species, geographically, "Minnesota to Texas, east to the Atlantic, but wanting from the Middle States east of the Alleghenies, and from New England to Canada."

P. striatella Anth., to which in a general way it bears a strong resemblance, has a widely diffused western distribution² "Ontario to Winnepeg, Manitoba, Montana, and Vancouver Island, south to New Mexico and Arizona, Kern River region, California"; while another form related closely to the foregoing, *cronkhitei* Newcomb, has been detected in Klamath Valley, Oregon, and occurs also in Nevada and California.

P. perspectiva simillima may be the ancestral aspect of these, which are represented farther to the east, by Dr. Pilsbry's "*P. striatella catskillensis* from Tannersville Valley, Catskill Mountains."

¹ In Classified Catalogue before quoted.

² Pilsbry's Catalogue, etc.

PLATE XXXV.

Epiphragmophora fidelis antecedens.

FIGS. 1, 2, 3. Lateral, vertical, and basal views of the same individual.

Polygyra dalli.

4, 5, 6. Lateral, vertical, and basal views of same individual.

Ammonitella yatesi praecursor.

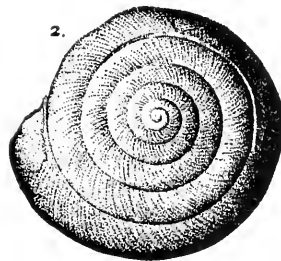
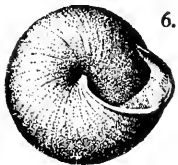
8 and 9. Lateral and vertical views of an imperfect example.

10, 11 and 12. Lateral, vertical, and basal views of another imperfect example.

Pyramidula perspectiva simillima.

7. Vertical view of an imperfect example.

Through the courtesy of the Director of the U. S. Geological Survey I have been able to present the figures above indicated.



PROCEEDINGS
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. II, PP. 661-676.

DECEMBER 28, 1900.

PRELIMINARY REVISION OF THE NORTH
AMERICAN RED FOXES.

BY C. HART MERRIAM.

[PLATES XXXVI-XXXVII.]

THE specimens necessary for a final revision of the North American Red Foxes do not exist in any museum. Nevertheless the collections of the U. S. Biological Survey and National Museum show that several well-marked forms have escaped description, and furnish material for a preliminary study of the group.

For many years it has been customary to refer all our red foxes, with the single exception of specimens from the far west, to *Vulpes fulvus* Desmarest; and some naturalists have considered this animal the same as *Vulpes vulpes* of northern Europe and Siberia. Outram Bangs, in a paper published in the Proceedings of the Biological Society of Washington in March 1897 (vol. XI, pp. 53-55), stated that the American species is quite distinct from the European and pointed out the characters by which either may be distinguished from the other; at the same time he described a new fox from Nova Scotia, which he named *Vulpes pennsylvanica vafra*.¹ A year later Mr. Bangs described another species, from Newfoundland, which he named *Vulpes deletrix*.²

Baird, in the Report of Stansbury's Expedition to Great Salt Lake, published in May or June 1852, described a cross-fox from Utah under the name *Vulpes macrourus*, to which

¹This name being preoccupied, Mr. Bangs renamed the form *rubricosa*. Science, NS., VII, pp. 271-272, Feb. 25, 1898.

²Proc. Biol. Soc. Wash., XII, pp. 36-38, March 24, 1898.

specimens from all parts of the far west have been usually referred. Additional specimens from the type locality are not at hand; hence I have been obliged to characterize the species from specimens collected in other parts of the Rocky Mountains—from Colorado and Wyoming. Comparison of the scanty material available from the Rocky Mountain region with corresponding specimens from the Great Plains, the Cascade Range in Oregon and Washington, and the High Sierra in California, has led me to recognize as distinct three additional species, heretofore confounded under *macrourus*.

Of the Alaska red foxes little is known and only one species has been described—the large Kadiak Island species, *Vulpes harrimani*, recently published by me in these Proceedings.¹ Two others from Alaska, one from British Columbia, and one from Labrador are here added to our fauna.

Mr. Bangs has kindly loaned me his types and other specimens from Labrador, Newfoundland, and Nova Scotia, thus enabling me to compare these forms directly with those from Alaska and the northern United States. Good skins with skulls are still needed from various parts of Alaska, the Rocky Mountain region, and the southern United States.

As a result of the present study, twelve species and subspecies are recognized. These, with their type localities, are:

<i>Vulpes fulvus</i> Desmarest	Virginia.
<i>macrourus</i> Baird	Wasatch Mountains, Utah.
<i>necator</i> sp. nov.	Southern High Sierra, Calif.
<i>cascadensis</i> sp. nov.	Mt. Adams, Washington.
<i>rubricosa</i> Bangs	Nova Scotia.
<i>rubricosa bangsi</i> subsp. nov.	Labrador.
<i>deletrix</i> Bangs	Newfoundland.
<i>alascensis</i> sp. nov.	Lower Yukon, Alaska.
<i>alascensis abietorum</i> subsp. nov.	Stuart Lake, British Columbia.
<i>kenaiensis</i> sp. nov.	Kenai Peninsula, Alaska.
<i>harrimani</i> Merriam	Kadiak Island, Alaska.
<i>regalis</i> sp. nov.	Elk River, Minn.

Of these, the last three (*regalis*, *harrimani*, and *kenaiensis*) are very large—probably double the bulk of the common eastern red fox; *abietorum* is only slightly smaller; *alascensis* is still slightly smaller and hardly larger than *deletrix*, *rubricosa*,

¹ Proc. Wash. Acad. Sci., 11, pp. 14-15, March 14, 1900.

and *bangsi*; then comes *macrourus*, and finally the smallest members of the group, *cascadensis*, *necator*, and *fulvus*.

In the large species (*regalis*, *harrimani*, and *kenaiensis*) the males are enormously larger than the females; in the smaller species the sexual disparity in size is much less pronounced.

VULPES FULVUS (Desmarest).

Pl. XXXVII, fig. 1.

Canis fulvus DESMAREST, Mammalogie, 1, pp. 203-204, 1820.

Type locality.—Virginia.

Range.—Northeastern United States.

Characters.—Size small; face small and sharp; tail terete and rather small; black of fore and hind feet extensive and reaching far up on legs.

Color.—Face rusty fulvous, profusely grizzled with whitish; upper parts bright golden fulvous, varying to fulvous, darkest along middle of back; hinder part of back slightly grizzled with whitish; chin, throat, and band down belly white; black of forefeet spreading over whole foot and reaching up broadly to elbow; black of hind feet reaching up in narrow band along outer side of thigh. Tail fulvous, profusely mixed with black hairs which are most abundant on distal half of under surface; a black spot near base of upper surface; tip white.

Compared with *Vulpes vulpes* of Sweden, *V. fulvus* is smaller; tail shorter and smaller; rusty of face paler and very much more profusely mixed with whitish [in *vulpes* the rusty is nearly pure]; black of fore and hind feet very much more extensive. In cranial characters the two are quite distinct, as shown under *V. alascensis*.

Skull.—Small; face and rostrum small and slender; bullæ smaller than in any other American species and sloping gradually (instead of rising abruptly) from basioccipital; basioccipital broad.

Teeth.—Rather small; premolars well spaced; upper carnassial with anterointernal cusp moderately developed but not projecting strongly from plane of inner side of tooth; 1st upper molar smaller than in any described species.

Measurements.—Average of 3 males from southern New England: total length 1034; tail vertebræ 394; hind foot 163.

VULPES MACROURUS Baird.

Pl. XXXVI, fig. 1.

Vulpes macrourus BAIRD, Rept. Stansbury's Expd. to Great Salt Lake, pp. 309-310, June 1852; Mammals N. Am., pp. 130-133, 1857.

Vulpes utah AUDUBON & BACHMAN, Proc. Acad. Nat. Sci. Phila., p. 114, July 1852.

Type locality.—[Wasatch Mts. bordering] Salt Lake Valley, Utah.

Range.—Mountains of Colorado, Utah, and Wyoming.

Characters.—Size and general appearance of *fulvus*, but *tail much longer*; hind feet larger; black of feet and legs much less extensive.

Color.¹—Nose dull brownish fulvous, grizzled with buffy; sides of face between nose and eyes dusky, grizzled with whitish; rest of face mixed buffy or buffy fulvous and whitish; back yellowish fulvous, darkest on median line, palest on sides of neck and flanks; outer sides of legs dark reddish fulvous; black of forefeet reaching up narrowly nearly to elbow; black of hind feet narrow and hardly reaching ankle. Tail grizzled grayish buff mixed with black hairs, the black hairs on upper side of base forming a broad blackish patch. Chin dusky; whitish of throat and breast darkened by underfur showing through.

Skull.—Similar to that of *fulvus*, but *bullæ much larger* and rising abruptly from basioccipital; basioccipital narrower; carnassials slightly larger; 1st upper molar decidedly larger.

Measurements.—A young ♂ from Wind River Mts., Wyoming: total length 1015; tail vertebræ 461; hind foot 172.

VULPES NECATOR sp. nov. High Sierra Fox.

Pl. XXXVI, fig. 2.

Type from Whitney Meadows near Mt. Whitney, High Sierra, Calif. (Altitude 9500 ft.) No. $\frac{30735}{42635}$, ♀ yg. ad., U. S. National Museum, Biological Survey Coll. Sept. 1, 1891, A. K. Fisher. Orig. no. 940.

Range.—Southern or High Sierra, California.

Characters.—A small fox of the *fulvus* group, resembling *fulvus* externally, but cranially most closely related to *macrourus*. Tail small as in *fulvus* (or smaller), differing widely from the big tail of *macrourus*.

Color.—Face dull fulvous, strongly grizzled with whitish; sides of nose dusky, grizzled with buffy; upperparts from back of head to base of tail dark dull rusty fulvous, becoming much paler on sides, where the whitish underfur shows through; black of forefeet reaching up on upper surface of foreleg to elbow; black of hind feet ending at or near tarsal joint, with only slight traces on outer side of leg; tail at base fulvous, becoming buffy whitish and profusely mixed with long black hairs; base with the usual black spot; tip white.

A male from Atwell's Mill, East Fork Kaweah River, Tulare Co., California (alt. 6300 ft.), collected the last of March, is in the black-

¹ From a male from Wind River Mts., Wyoming, August 28, 1893.

cross pelage: back grizzled black and whitish or buffy; sides buffy; feet, legs, and belly black; tail mainly black with tip white.

Skull.—Compared with *cascadensis*, its nearest geographical neighbor, the rostrum is more slender, the bullæ smaller, and in adult males the zygomata much more spreading. The carnassials both above and below are slightly larger and more swollen; the 1st and 2d upper molars and 2d lower molar are *decidedly larger*. Briefly, the rostrum is more delicate and slender, the molars (except the 3d lower) larger and heavier. The heel of the 2d upper molar is broader and less emarginate posteriorly. Compared with *macrourus* from the Rocky Mts., the resemblance is closer and the differences less marked: the rostrum is slightly narrower and more constricted laterally; the bullæ slightly smaller; the upper molars slightly larger (heel broader); 3d lower molar decidedly smaller.

Remarks.—Externally the High Sierra Fox in red pelage resembles the common red fox of the eastern United States (*fulvus*) much more closely than it does either *cascadensis* or *macrourus*. It differs from *fulvus* however in having the sides of the nose much darker (distinctly dusky); black of legs much restricted; fulvous of back duller and redder; ground color of tail buffy instead of fulvous.

Vulpes necator is apparently more closely related to its Rocky Mountain ally (*macrourus*), now separated by the full breadth of the Great Basin, than to its immediate neighbor of the northern Sierra (*cascadensis*) whose range it doubtless meets, as *cascadensis* has been found as far south as Mt. Raymond in Mariposa County, Calif.

Measurements.—Type specimen (♀): total length 930; tail vertebræ 345; hind foot 150. A ♂ from Atwell's Mill, on the west flank of the Sierra, measured: total length 1003; tail vertebræ 381; hind foot 171.

VULPES CASCADENSIS sp. nov.

Pl. XXXVI, fig. 3.

Type from Trout Lake, base of Mt. Adams, Cascade Range (near Columbia River), Washington. No. 92767, ♂ yg. ad., U. S. National Museum, Biological Survey Coll. March 3, 1898, P. Schmid. (Black-cross phase.)

Range.—Cascade Range in Oregon and Washington, and northern Sierra Nevada in California; northern limit unknown.

Characters.—A short-tailed, small-toothed mountain fox of the *fulvus* group, commonest in the 'black-cross' pelage; when in red pelage, *yellow* instead of fulvous (like a small edition of *regalis*). In

cranial and dental characters very close to *fulvus*; not very close to *macrourus*.

Color.—*Red phase*: General color of head and upperparts straw yellow; face from nose to eyes dull yellowish fulvous; rest of top of head and base of ears pale straw yellow; back golden yellowish-fulvous; tail very pale; black of ears and feet greatly restricted, that of fore and hind feet confined rather narrowly to upper surface, and mixed with pale fulvous.

Black-cross phase: Top of nose grizzled brownish, sides of nose and imperfect ring around eye dusky or blackish, grizzled with whitish; top of head yellowish white, the black underfur showing through; dorsal cross (back and shoulders) blackish, overlaid and nearly concealed by yellowish white or buffy; sides of neck, flanks, and post-scapular region golden yellow; distal two-thirds of ear black; forefeet black, grizzled above elbow with whitish and yellowish; hind feet and legs grizzled dusky and buffy, becoming nearly black on top of feet; chin, throat, and band down middle of belly black or blackish; inner sides of thighs washed with dusky. Tail black mixed with buffy and tipped with white [in some specimens nearly all black to white tip]. Specimens from Mt. Hood and Ft. Klamath, Oregon, are practically identical with those from Trout Lake, State of Washington.

Skull.—Similar to that of *fulvus* but bullæ larger; 1st upper molar (and usually upper carnassial) slightly larger. Compared with *macrourus* the carnassials, 1st upper molar (and usually the 2d also), and 2d lower molar are smaller. The premolars also are usually smaller, particularly the lower series.

Measurements.—Average of three males from Mt. Adams, Washington: total length 1070; tail vertebræ 412; hind foot 178.

VULPES RUBRICOSA Bangs. Nova Scotia Fox.

Pl. XXXVII, fig. 3.

Vulpes pennsylvanica vafra BANGS, Proc. Biol. Soc. Washington, vol. XI, pp. 53-55, March 16, 1897 (name preoccupied).

Vulpes pennsylvanica rubricosa BANGS, Science, NS., VII, 271-272, Feb. 25, 1898.

Type locality.—Digby, Nova Scotia.

Range.—Nova Scotia—limits unknown.

Characters.—Size rather large; color deepest and darkest of all the red foxes; tail large, very broad and bushy, and deep fulvous. Rostrum and teeth larger than in *fulvus*.

Color.—Upperparts deep rich and very dark fulvous; black of fore and hind feet reaching up a short distance on legs, but less extensive

than in *fulvus*; tail rich dark fulvous, with basal ring like back; rest of tail, except white tip, bountifully mixed with black hairs, most abundant below.

Skull.—Size essentially the same as *fulvus* of corresponding sex; similar to *fulvus* in general characters, but rostrum slightly more swollen; teeth larger. Premolars larger, more swollen, and less spaced; carnassials larger; 1st upper molar larger.

Measurements.—Type specimen (♀ old): total length 1077; tail vertebræ 401; hind foot 166 (from Bangs).

VULPES RUBRICOSA BANGSI subsp. nov.

Type from Lance au Loup, Labrador. No. 8880, ♀ (young of year), Bangs Coll. Oct. 2, 1899, Ernest Doane.

Range.—Labrador—limits unknown.

Characters.—Similar externally to *fulvus* but ears smaller; black of ears and feet more restricted. Skull as in *rubricosa* and *deletrix*.

Color.—Upperparts golden fulvous, as in *fulvus*; tail bountifully mixed with black hairs, as in *fulvus* and allied forms; black of ears restricted to apical half or less; black of fore and hind feet not reaching up on legs.

Skull.—Very close to *rubricosa*, from which it differs chiefly in greater narrowness, particularly of the zygomata and posterior part of palate, and in slightly larger teeth. The differences, however, do not appear to be constant or reliable—see remarks under *deletrix*.

Measurements.—(♂, not full grown, measured in flesh by collector): total length 964; tail vertebræ 378; hind foot 168; ear from notch 88.

VULPES DELETRIX Bangs.

Pl. XXXVII, fig. 2.

Vulpes deletrix BANGS, Proc. Biol. Soc. Washington, Vol. XII, pp. 36–38, Mar. 24, 1898.

Type locality.—Bay St. George, Newfoundland.

Range.—Newfoundland.

Characters.—Color very pale—light straw yellow, deepening in places to golden yellow or even buffy fulvous; black of feet restricted; tail pale buffy yellowish with usual admixture of black hairs, but without black basal spot. Hind feet and claws very large (about 160 in ♀).

Skull.—Very close to that of *rubricosa* but averaging narrower; zygomata less spreading in male; bullæ usually larger; teeth usually more swollen. Still, the resemblance is exceedingly close and I have been unable to find any positive character by which skulls of New-

foundland, Labrador, and Nova Scotia foxes may be certainly distinguished. Collectively they all differ from *fulvus* in slightly broader rostrum and decidedly larger teeth, as pointed out under *rubricosa*.

Measurements.—Type specimen (♀): total length 959; tail vertebræ 336; hind foot 161 (from Bangs).

VULPES ALASCENSIS sp. nov.

Type from Andreafski, Alaska. No. 21420 [old ♂], U. S. National Museum. Feb., 1880, E. W. Nelson. Orig. No. 180.

Range.—Northern Alaska—limits unknown.

Characters.—A large long-tailed red fox closely related to *V. vulpes* of Scandinavia and Siberia, and also to *rubricosa* and *bangsi* of Nova Scotia and Labrador. Color golden fulvous; *tail very long*; ears small; black of feet greatly restricted; pelage of neck and anterior part of back long and full, almost forming a ruff; pelage of posterior part of back and rump shorter and coarser.

Color.—Face and head grizzled fulvous and buffy, strongly rusty on top of nose and around eyes, paler on cheeks and forehead; upperparts fulvous or golden fulvous, much like Massachusetts specimens of *V. fulvus* but color deeper, particularly on top of neck and along dorsal line of back; rump and hind back grizzled; black of feet greatly restricted, that of forefeet not covering whole top of foot and not reaching above carpus; that of hind feet confined to median part of upper surface, spreading slightly over base of toes. Tail very long and bushy, fulvous like back, with the usual admixture of black hairs.

Skull.—Broad and relatively short, with broadly spreading zygomata, short and rather narrow rostrum (strongly constricted laterally on plane of 2d or between 2d and 3d premolars), and short upturned nose. Compared with its nearest geographical neighbors, *harrimani* and *kenaiensis*, the posterior part of the skull is much the same, while the anterior or facial part is greatly reduced (the rostrum being smaller, narrower, more constricted laterally), the nose more upturned, and the carnassial and molar tooth smaller. Compared with *kenaiensis* the carnassials, 1st upper molar, and 2d lower molar are decidedly smaller. Compared with *harrimani* the carnassials and molars are smaller and the anterointernal cusp of the upper carnassial is more anterior and less protruding laterally. Closely related to *rubricosa* and *bangsi*, with which it may intergrade; resembles *rubricosa* closely in size and proportions, but differs in having the rostrum slightly broader and more constricted laterally, the bullæ slightly larger (usually), the upper lateral series of teeth heavier [lower series essentially as in *rubricosa*].

Remarks.—The Alaska red fox is evidently a large form of the small narrow-faced *fulvus* group, to which *rubricosa* belongs. It differs widely from the large-faced group to which *harrimani*, *kenaiensis*, and *regalis* belong. It is closely related to the typical Old World *Vulpes vulpes* of Sweden and northern Siberia, and appears to serve as a connecting link between this species and the small-faced *fulvus* group of eastern North America. It may be distinguished from *vulpes*, with which it agrees in size, by the following characters: rostrum more swollen immediately in front of orbits, more constricted laterally, shorter and more upturned anteriorly; bullæ larger; basioccipital narrower; zygomata broader and more spreading; postorbital constriction less deep; incisive foramina shorter; anterointernal cusp of upper carnassial more prominent and forming a more decided angle with body of tooth; crowns of upper premolars usually longer anteroposteriorly. Compared with *V. abietorum* from Stuart Lake and Whitemud, the rostrum is much shorter and slightly broader; bullæ slightly smaller; upper carnassial (and usually lower also) more swollen. Compared with *V. fulvus* from the eastern United States, *alascensis* is larger; the fur of the neck and fore-back is longer and fuller, forming a sort of ruff; the tail very much longer and larger; ears smaller; face redder or more rusty, especially around eyes and over bridge of nose; black of feet greatly reduced, as already described.

VULPES ALASCENSIS ABIETORUM subsp. nov.

Type from Stuart Lake, British Columbia. Skull No. 71197 ♂ ad., U. S. National Museum, Biological Survey Coll. Winter of 1893–1894, A. C. Murray. ‘Silver fox.’

Range.—Interior of British Columbia and probably southeastern Alaska.

Characters.—External characters unknown. The skull is generally like that of *alascensis* but lighter, longer, and more slender. Skulls of adult males resemble those of *V. regalis* but may be distinguished by the much smaller teeth.

Skull.—Similar to *alascensis* but longer, more slender, and less massive; rostrum decidedly longer and narrower; bullæ usually larger; carnassials (particularly the upper ones), and usually the 1st upper molars also, more slender. Compared with *V. regalis*, with which the males agree closely in length, the posterior part of the skull is longer, the rostrum even more slender, and the sexual differences less marked; compared with skulls of the same sex of *regalis*, the males have smaller bullæ and decidedly smaller carnassials and molars;

the females slightly longer skulls and slightly smaller lower carnassials. Compared with *bangsi* from Labrador, the rostrum is decidedly longer, the carnassials and large upper molar smaller and less swollen.

VULPES KENAIENSIS sp. nov.

Pl. XXXVI, fig. 5.

Type from Kenai Peninsula, Alaska. No. 96145, ♂ old, U. S. National Museum, Biological Survey Coll. Collected in 1898 by Dall DeWeese.

Range.—Kenai Peninsula; limits of range unknown.

Characters.—Size large; external characters unknown; rostrum long and much more slender than in *harrimani*, but broader than in *regalis*. Skin not seen; pelage said to be softer and more valuable than the neighboring Kadiak animal (*harrimani*), which has very coarse fur.

Skull.—Largest of the known species; facial part large and long; muzzle very broad. Similar in general to *harrimani* but rostrum decidedly longer, less swollen over canines, lateral constriction absent, and nose less upturned; zygomata more spreading posteriorly; frontal broader interorbitally; premolars more spaced; upper carnassial and 1st upper molar huge; upper carnassial with anterointernal cusp weaker and set more anteriorly (not projecting so far into palate); 1st upper molar larger; 2d lower molar larger and more bellied on inner side; last lower molar often absent. *V. kenaiensis* resembles *regalis* from the northern plains in length of rostrum, breadth of zygomata, and large size and proportions of carnassial and molar teeth, but differs in having the rostrum less slender, zygomata more spreading posteriorly, and premolars very much larger and more swollen—in this respect even exceeding those of *harrimani*. Hence, while in some particulars the species is intermediate between *harrimani* and *regalis*, in others it departs materially from both.

Cranial measurements.—Type specimen (♂ ad): basal length 148; basilar length 145; palatal length 79; postpalatal length 68.5; zygomatic breadth 82.5; interorbital breadth 30.5; least breadth of rostrum on plane of 2d premolar (constriction absent) 27; length of crown of pm⁴ on outer side 15.5; length of m¹ on outer side 11; length of heel (transversely) from notch on outer side 13.

VULPES HARRIMANI Merriam.

Pl. XXXVI, fig. 6.

Vulpes harrimani MERRIAM, Proc. Wash. Acad. Sci., vol. II, pp. 14-15, March 14, 1900.

Type locality.—Kadiak Island, Alaska.

Range.—Kadiak Island, Alaska.

Characters.—Size large; tail enormous, constricted at base, largest on basal fourth and tapering thence to tip; pelage coarse, wolf-like on tail and posterior half of back; hairs of neck and shoulders greatly elongated, forming a conspicuous ruff; those of posterior half of back abruptly much shorter and conspicuously grizzled.

Color.—Nose to between eyes pale dull fulvous, grizzled with whitish; top of head from between eyes to nape buffy whitish, grizzled with yellowish fulvous; anterior half of back bright yellowish fulvous, the color extending down over sides and belly nearly to median line; posterior half of back coarsely grizzled buffy-whitish and dull fulvous, reddest along median line; underparts yellowish-fulvous except chin, throat, inguinal region, and a narrower strip on belly, which parts are grayish-buffy; ears black; fore and hind legs and feet dull pale fulvous, with an irregular black patch on dorsal surface of fore-foot, and a much smaller one on hind foot; tail grizzled grayish and yellowish fulvous, the fulvous most marked on median line of upper surface, the black-tipped hairs less abundant than in related species but sufficiently plentiful on basal fourth of dorsal surface to form an indistinct black patch or spot; tip inconspicuously white or buffy white.

Skull.—Large and massive with large, broad, and relatively short rostrum, conspicuously swollen over roots of canines; premolars large and crowded. Closely related to *V. kenaiensis* from which it differs as follows: rostrum shorter, much broader and more swollen over canines; nose more upturned; frontals narrower; frontal sulcus deeper; zygomata less spreading; upper carnassial usually heavier with anterointernal cusp more strongly developed and set out at greater angle from axis of tooth; 1st upper and 2d lower molar smaller. (These tooth characters are probably not constant.)

Compared with *regalis*, with which it agrees in general size, the rostrum and palate are broad and short [instead of long and slender], zygomata less spreading; upper carnassial thicker and heavier with anterointernal cusp strongly developed and projecting at right angle into palate; lower carnassial more swollen (broader, but shorter anteroposteriorly); 2d lower molar smaller, narrower, and more rectangular (less convex or bellied on inner side.)

Measurements.—Type specimen [a dry skin]: total length 1260; tail vertebrae [approximate] 450; tail to end of hairs 550; greatest diameter of tail, hairs laid naturally, 160; greatest diameter of tail, hairs spread, 250.

Cranial measurements.—Skull no. 98144, from Uyak Bay, Kadiak

Island: basal length 140; zygomatic breadth 77; palatal length 74.5; postpalatal length 65; breadth across postorbital processes 33; interorbital breadth 27.5; postorbital constriction 22.5; greatest breadth of rostrum over roots of canines 26.3; lateral series of teeth (from front of canine to back of last molar) 66.

VULPES REGALIS sp. nov. Northern Plains Fox.

Pl. XXXVI, fig. 4.

Type from Elk River, Sherburn Co., Minnesota. No. $\frac{31697}{43358}$, ♂ ad., U. S. National Museum, Biological Survey Coll. March 5, 1887, Vernon Bailey. Orig. No. 659.

Range.—Northern Plains from Dakota to Alberta; east to Manitoba and Minnesota; limits unknown.

Characters.—Size largest; ears very large and broad; tail very long but diameter less than in *rubricosa*; sexual difference in size great; color a beautiful golden yellow, becoming almost buffy-white on face and posterior part of back; legs abruptly dark fulvous; black of feet very pure but restricted in area.

Color.—Face, top of head, and base of ears pale straw yellow becoming pale fulvous around eyes; a darker area on each side of nose, reaching from whiskers nearly to eye; upperparts golden yellow or pale yellowish fulvous, becoming almost buffy-white posteriorly and grizzled on hinder part of back; fore and hind legs abruptly red or rusty fulvous, in striking contrast with yellow of body; forefeet intensely black, the black reaching up on front face of leg, narrowly, to halfway between wrist and elbow; hind feet intensely black on upper surface, the black narrowing posteriorly and ending at or near ankle; dark fulvous of outer side of thigh sometimes narrowly mixed with grizzled black and whitish. Tail with basal ring like back, without black hairs; rest of tail to white tip buffy, strongly intermixed with long black hairs, especially on underside.

Skull.—Skull large, long, and relatively massive, with long slender rostrum, broadly spreading zygomata, large inflated bullæ, and narrow slender premolars. Compared with *V. kenaiensis*, its nearest ally, it may be distinguished by more slender rostrum, and very much narrower and more spaced premolars. From *harrimani* it differs in slightly greater length; much longer and narrower rostrum and palate; more spreading zygomata; larger and more inflated bullæ; less prominent frontonasal sulcus; narrower and more spaced premolars; narrower upper carnassial, with anterointernal cusp weaker and less projecting over palate; upper molars decidedly larger; lower carnassial

more slender; 2d lower molar broader and more bellied on inner side.

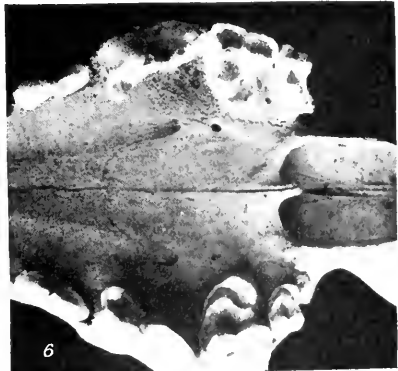
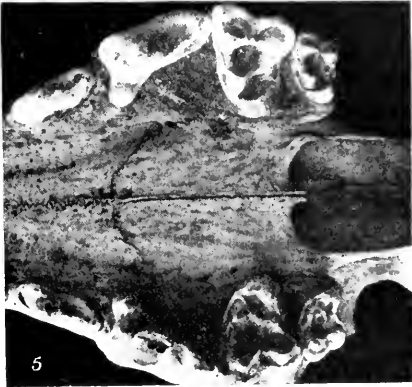
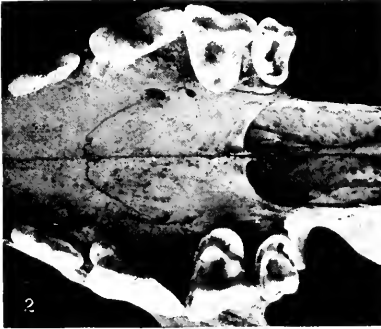
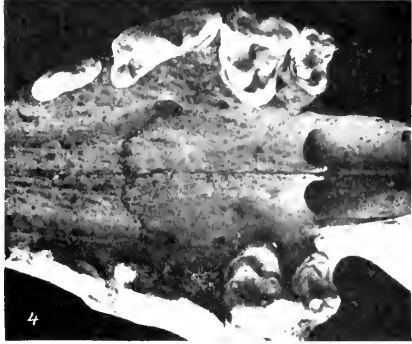
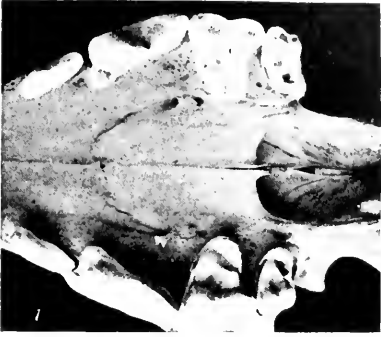
On account of the great disparity in size, skulls of *V. regalis* require no comparison with those of the same sex of the *fulvus* group; but females of *regalis* agree so closely in size with males of *fulvus* that care is necessary to distinguish them. *V. regalis* may be known by the size of the bullæ, which are larger, and the form of the postglenoid process, which is much broader at base, shorter, and less vertical.

Measurements.—Type specimen (♂ ad.): total length, in flesh, 1117; tail vertebræ from well made dry skin 420; hind foot in dry skin 170; ear from anterior base in dry skin 98. An adult ♀ from Carberry, Manitoba, measured in flesh: total length 1050; tail 392; hind foot (dry) 157.

PLATE XXXVI.

Carnassial and molar teeth of Red Foxes. All natural size.

- FIG. 1. *Vulpes macrourus*, ♂. Arkins, Colo., Nov. 29, 1894. No. 69982, U. S. Nat. Mus., Biological Survey Coll.
2. *Vulpes nescator*, ♂. Mt. Whitney, Calif., July 5, 1891. No. 41197, U. S. Nat. Mus., Biological Survey Coll.
3. *Vulpes cascadenis*, ♂. Trout Lake, Mt. Adams, State of Washington, Feb. 12, 1897. No. 82041, U. S. Nat. Mus., Biological Survey Coll.
4. *Vulpes regalis*, ♂. Elk River, Minn., March 5, 1887. No. 43558, U. S. Nat. Mus., Biological Survey Coll.
5. *Vulpes kenaiensis*, ♂. Kenai Peninsula, Alaska, 1898. No. 96145, U. S. Nat. Mus., Biological Survey Coll.
6. *Vulpes harrimani*, ♂. Uyak Bay, Kadiak Island, 1899. No. 98144, U. S. Nat. Mus., Biological Survey Coll.

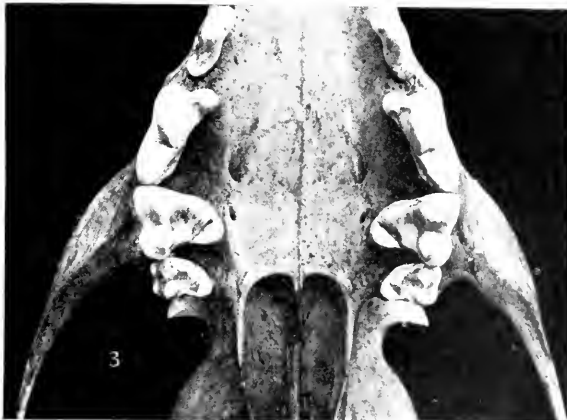
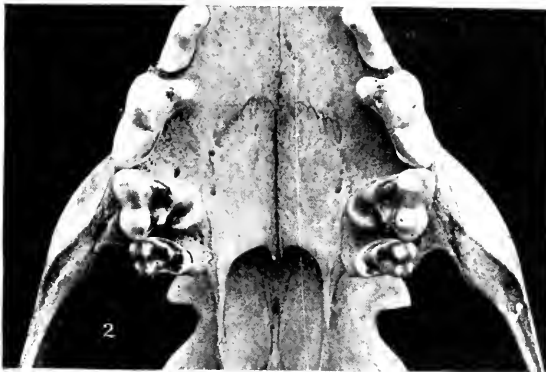


TEETH OF RED FOXES

PLATE XXXVII.

Carnassial and molar teeth of Red Foxes. All natural size.

- FIG. 1. *Vulpes fulvus*, ♂, yg. ad. Laurel, Maryland, Nov. 14, 1899. No. 101488, U. S. Nat. Mus.
2. *Vulpes deletrix*, ♀. Bay St. George, Newfoundland, April 24, 1897. No. 6967, Bangs Coll. Type.
3. *Vulpes rubricosa*, ♀ ad. Digby, Nova Scotia, Oct. 13, 1893. No. 116, Bangs Coll. Type.



TEETH OF RED FOXES

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