PROCEEDINGS

OF THE

Boston Society of Natural History.

VOL. XVII.

1874–1875.

BOSTON:
PRINTED FOR THE SOCIETY.
1875.

PUBLISHING COMMITTEE.

T. T. Bouvé.

Samuel L. Abbot.

Thomas M. Brewer.

A. S. Packard, Jr.

Edw. Burgess.

PRESS OF A. A. KINGMAN.
MUSEUM OF BOSTON SOCIETY OF NATURAL HISTORY,
BERKELEY STREET.

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PROCEEDINGS

OF THE

BOSTON SOCIETY OF NATURAL HISTORY.

TAKEN FROM THE SOCIETY'S RECORDS.

Annual Meeting. May 6, 1874.

Vice-President R. C. Greenleaf, Esq., in the chair. Forty-nine persons present.

Prof. Hyatt, Custodian, presented the following Report on the condition and operations of the Society for the year.

The most important, as well as the saddest event of the past year, was the decease of Prof. Agassiz.

The great influence which he had exerted, and the deep feelings which he had aroused by his life, were apparent in the respect and sorrow manifested by the entire community.

The unusual tribute of a Memorial Meeting was accorded to him by the Society, the proceedings being appropriately conducted by those among our members who had been intimate with him in the early days immediately after his arrival in this country.

When Prof. Agassiz came to New England he found a small but enthusiastic body of men, mostly members of this Society, who were devoted to the study of Natural History. These gentlemen were striving to awaken the minds of the community to the importance of the study of the Sciences, not only as the best means for developing the natural resources of the country, but for the attainment of a more advanced stage of culture than had yet been reached. This building, with its Library and Museum, and the present prosperous condition and importance of the Society, are witnessess of the untiring energy and success of their efforts.

The first work of these pioneers in the study of Natural History was to reduce to rule and order the fauna and flora of this comparatively unexplored territory. How successfully this was undertaken, and how completely it was carried out, may be judged by the works of Binney and Gould, Storer, Emerson, Harris, Hitchcock and others whose names adorn the Annals of this Society and the Survey of the State.

Prof. Agassiz had, however, learned by actual experience, that the exploration of a new fauna, when carried beyond the strict limit of the discovery and description of the more obvious forms, was liable to lead to the pernicious habit of species hunting. He had witnessed the last days of the wild scramble for new species, which had followed upon the introduction of the Linnean nomenclature in Europe, and its injurious effects upon the minds of his fellow students. He had also taken part in the reaction inaugurated by Oken, Goethe and Von Baer, in Germany, and Geoffrey St. Hilaire, Lamarck and Cuvier in France, and felt that in this country the same battle must be fought over again. With the strength and enthusiasm, which we know so well, he endeavored to open the eyes of naturalists to the impending danger, and tried by all the means in his power to turn the tide of future researches in a more fruitful direction. How much we owe to his labors in this field may be judged by the almost universal tendency of our naturalists toward embryological and anatomical studies. We have seen this in the production of such works as Prof. H. J. Clark's "Spongiæ Ciliatæ," Mr. J. A. Allen's "Laws of Geographical Distribution among Birds," Dr. A. S. Packard's "Embryology of Limulus" and "Guide to the Study of Insects," Prof. E. S. Morse's "Embryology of Brachiopods," and Alexander Agassiz's "Researches upon Echinoderms."

How widely his labors have extended, and how deeply they have affected the whole country in this respect cannot be estimated; it would take up the entire space allotted to this Report, if presented in detail. It suffices to say, however, that his students, bearing with them more or less of his desire for the philosophical study of Natural History, have spread over the whole country. They have founded Museums in Chicago, Rochester, New York and Salem, and have established a Natural History periodical, "The American Naturalist," and a State Survey, that of Kentucky, to which I hope we may soon be able to add Massachusetts.

The constant efforts which Prof. Agassiz put forth in order to place the pursuit of Natural History in a favorable light before the people, entitle him to the heartfelt thanks of all lovers of that branch of science. The almost universal derision with which the pursuit of Natural History was viewed in former times, has been changed to respect, principally through his efforts. His great social influence and persuasive eloquence was constantly employed in this work. He consistently taught his students that the future progress of science in this country must largely depend upon the good will of the people; and he created by his own efforts that popular respect for Natural History which we now find throughout the whole country.

Even with such a brief statement of facts it is possible to see that Prof. Agassiz's biographer can claim for him the honor of having been the author of two revolutions, one scientific and one popular — one in the mode of studying Zoology, and one in habits of thought of the people at large.

Doubtless these remarks will seem sadly deficient to those who would naturally expect a more extended notice of his social and scientific character. This has, however, received attention from the President, Mr. Geo. B. Emerson and Rev. R. C. Waterston, and I should only repeat what these gentlemen have already so well expressed, and will therefore turn to the usual record of the year's work.

My visit to Europe in pursuit of my own studies afforded an opportunity to fill out the Palæontological collection. A fair representation of the strata of Western Europe was needed in order that we should be able to compare the contained fossils in a general way with their synchronous representatives in North America. This met with the earnest approval of Mr. John Cummings, who generously furnished the necessary credit, and has given the collection to the Society.

By a lucky accident I was enabled to secure the collection of Oberfinanzrath Eser of Stuttgart, the printed catalogue of which lies upon the table.

This, next to the collection of Count Mandelsloh, was considered the best in Wurtemburg, with respect to the fossils of the tertiary and secondary periods, including also the triassic formations. It also possessed a fair representation of the fossils of the Carboniferous, and a small collection of Devonian and Silurian types. All of these fossils had been selected with great care, and Herr Eser had expended the leisure hours of nearly forty years of his life in accumulating them, during which time he made frequent and prolonged excursions to the most celebrated localities. He was in correspondence with the most eminent German Palæontologists, and the collections contain many originals and types described by such men as Hermann von Mayer, Oppel, Escher von der Linth, Heer and others. Besides suites of specimens with localities and names vouched for by these great authorities, the bulk of the collection possesses no little value derived from the careful determinations of Herr Eser himself, generally with the assistance of the authorities living near him, Prof. Quenstedt, Fraas and others.

The uniques which it contains, as might be anticipated from what I have said, are both remarkable and numerous. The locality of Unter and Oberer Kirchberg, which was first opened by Herr Eser, afforded many of these, named by Von Mayer and Heer. A collection from the eocene and cretaceous beds of Appenzell, Switzerland, is very fine. The Portland stone from the neighborhood of Ulm, contains many unique specimens described by Oppel, all the fossils found during the building of the extensive fortifications having been sent by the chief architect to Herr Eser. The most valuable single series in the collection consists of the two head pieces and detached bones of Belodon Campbelli, described and figured by Von Mayer, the only remains of this remarkable animal ever found. I would also call attention to the specimens of tertiary plants, which are of such delicacy that they are mounted like botanical specimens on paper. Herr Eser assured me that it took him six months to clean and mount them, and they have been identified by Heer, the great fossil botanist.

This purchase left me at liberty to enter into negotiations for a collection of fossils to fill out the Silurian portion, which was poorly represented in Herr Eser's collection, and this I hope may still be sent to us. It was also essential that some larger specimens should be added to the collection, and this the generosity of Mr. Cummings enabled me also to accomplish by the purchase of several Icthyosauri and Teleosauri, and a magnificent plate of the expanded crown of Pentacrinus Briareus. Besides these collections, the Palæontological Department has also been richly increased by the acquisition of the splendid suite of Devonian fossils collected near Ithaca, N. Y., by the late Prof. Wm. C. Cleveland, one of the most accomplished observers it has been my good fortune to know. These fossils unfortunately were still unnamed, but this has been in a great measure remedied by the kindness of Mr. Richard Rathbun, who has named for us a large proportion of them, and about all our Chemung specimens from other localities. The Society owes this collection partly to the donations of Mr. Bouvé and Mr. Cummings, and partly to purchase.

A considerable proportion of the year has been taken up with the alterations now going on in the building. By these alterations it is proposed to obtain the desirable results of arranging the collections according to their natural order. A visitor when entering the building, will be directed by a guide-book to find the different departments. Usually specimens are put in, like the plastering, to suit the inside of the building, and their natural affinities sacrificed more or less to every corner or inconvenient angle. We shall, undoubtedly, experience some difficulty in the arrangement of details in the separate collections, but we can rest assured that the natural sequence of forms, whether Mineralogical, Geological, or Zoological, will be as fully and better illustrated than it ever has been in any printed work embracing similar grounds, an achievement heretofore considered unattainable in Museums of the size of ours. I by no means desire to assume for myself the whole credit of this really extraordinary success; the peculiar construction of this building alone made it possible to adopt such a plan of arrangement, and reflects great credit upon the judgment and capacity of the gentlemen who superintended its erection. The President not only urged the adoption of the Plan of Organization which was announced in the Report of 1870–1871, but has ever since given it his most energetic support, and to his efforts the Society owes the great progress made at the present time.

The expense of these alterations necessarily came upon us all at one time, but it must be remembered that they will save the Society the expense of ultimately erecting a new building. The erection of an addition, which was contemplated, would necessarily involve not only a great outlay of capital in bricks and mortar, but a corresponding annual increase in our expenses for heating, lighting, and wages to employees, besides the accumulation of larger and costlier collections. These expenses would have at once disabled all attempts to render the Museum really useful and instructive to the public, and have obliged the officers and working members to give their whole time simply to the preservation of the constantly increasing collections.

The coöperation with the Institute of Technology, besides the usual use of specimens, has extended during this year to the delivery of a course of lectures by Prof. W. H. Niles, in this hall. The duplicate fossils have been worked over by Mr. Crosby, and prepared for use as a study collection, to be placed in the southwest room in the basement, which has been floored, and will be fitted partly with the cases of the Rogers collection, and partly with duplicate cases from our own building. The collections of Prof. Wm. B. Rogers and Henry D. Rogers, now in the Institute of Technology, will be placed in this room until such a time as they can be worked up, and a complete suite selected for deposit in the show-cases. Fortunately Prof. Rogers will be able to give us his assistance in this work, and we hope to be able with his aid to restore the labels which have been lost or damaged. Mr. Crosby has prepared numerous microscopical sections and preparations of sponges, and the work in this department is progressing favorably.

The unfortunate illness of Mr. Sprague has interrupted the progress of the work in the Entomological department, though he was at work for a month at the commencement of the year, and has frequently inspected the collections since, as has also Mr. Emerton, who reports them free of insects.

Work upon the Mollusca, though interrupted, is now being continued by Dr. Carpenter. He, with his assistant, visited Boston last summer, and, aided by Mr. Emerton, packed and unpacked specimens, arranging and cataloguing a large number of them. During the winter Dr. Carpenter has worked up ninety sets of duplicate bivalves and large shells, his assistant being now engaged upon the last tray. The whole of the land shells and fresh water univalves are yet to be arranged.

Dr. Thomas Dwight, chairman of the Committee on Comparative Anatomy, reports that the cases have been improved by the introduction of glass partitions, and the locks changed, but that considerable alteration in the cases is still necessary.

A prepared skeleton of a horse mackerel has been added to the collection, and some valuable exchanges have been negotiated.

Work upon the fishes has been begun by Mr. Putnam, Chairman of the Ichthyological Committee, and he is now engaged in arranging and classifying the Lake Erie collection.

The Reptiles remain in the same condition as in former years.

The Ornithological collection has been frequently inspected during the year by Mr. Emerton, and is entirely free from insects. The collection of Mammalia is represented by a few wretched looking skins, and it would be better for the reputation of the Society to close the room in which they are, if they cannot be added to or improved.

Considerable work has been done in the Botanical Department by Miss Carter, a young lady employed by Mr. Cummings to inspect and arrange the duplicates. Mr. Brigham, chairman of the Botanical Committee, has removed the collections in great part to the new work room designed for this department, and reports that they are all in excellent condition.

Work has also been done upon the Mineralogical collections by Mr. Bouvé, chairman of the Mineralogical Committee, in preparing them for removal and display in the new cases now making.

The Geological collections have been removed and stored in trays preparatory to a similar removal by the chairman of the Geological Committee.

I am happy in being able to state that work has been begun by a competent Microscopist, Dr. Henry Coleman, upon the revision and arrangement of our valuable Microscopical collection, and that there is some hope of his being able to continue his efforts until the collection is put in a safe and accessible condition.

During the last year five Corresponding and thirty-one Resident Members have been elected. Seventeen general meetings of the Society, eight of the Section of Entomology and seven of the Section of Microscopy have been held.

The plan of notifying each member by a postal card, of the general meetings, and of the papers to be read at each, was adopted during the autumn, and has been attended with great success, as has been shown by the greatly increased interest and fuller attendance at the meetings. The latter has averaged, since October 15, sixty-four; whereas the average during the last year was twenty-five. The greatest number of persons present at any one meeting was one hundred and twenty-four, the largest Society meeting ever held in this hall.

From various unavoidable causes, only one course of Lowell lectures has been given during the past season, a course of four in number by Dr. Thomas Dwight, Jr., on living animal tissues.

The disastrous effects of the great fire, together with other difficulties, prevented the continuance of the lectures to teachers, which had been so generously maintained by Mr. Cummings, but it is hoped that these may be resumed at no distant time.

PUBLICATIONS.

The Society has published since last May four Articles in the Memoirs: on the Fossil Myriapods from Nova Scotia, by Mr. S. H. Scudder; on Earthquakes in New England, by M. Albert Lancaster; on Embryology of Terebratulina, by Prof. E. S. Morse, and a list of the Birds of Western Mexico, by Mr. Geo. N. Lawrence.

Of the Proceedings two parts, concluding the fifteenth volume, and two parts of the sixteenth have been issued.

LIBRARY.

In the two last Annual Reports the need of the addition of a gallery to the back library has been urged; this want was supplied last June, and the Library is now arranged so as to preclude the necessity of extended changes for many years, although it is probable that a necessity for more shelf room will arise before the close of the present decade. The work of correcting the alcove catalogues has been accomplished; that on the card catalogue is still in progress.

The additions during the year number 1353, and may be classified as follows:—

	8vo.	*4to.*	*Fol.*	*Total.*
Volumes	246	75	2	323
Parts	652	177	4	833
Pamphlets	124	24		148
Maps and Charts				49
		Total		1353

Two additions of great value deserve especial mention, viz.: two collections of original paintings of Georgian Insects, by John Abbot. One of these collections, painted for Dr. Oemler of South Carolina, consists of nearly two hundred plates, illustrating Lepidoptera in different stages, and was purchased for the Society by the liberality of several members. The second collection, the gift of Dr. Asa Gray, is of about the same size, and represents, in the main, species different from those illustrated in the first collection, while both contain but very few of the insects figured in the great work of Smith and Abbot on the Lepidopterous Insects of Georgia.

Seventy-one volumes have been bound during the year; as usual, however, the amount of this work remaining to be done has increased.

We have received exchanges for the first time from seven Societies, viz.: —

Gesellschaft für Erdkunde	Berlin.
Botanisch Verein der Provinz Brandenburg	"
Physikalisch-medicinische Societät	Erlangen.
Sociedad Mexicana de Geografia y Estadistica	Mexico.
Société d'Emulation du Département de l'Allier	Moulins.
Dentsche Gesellschaft für Natur und Volkerkunde Ostasiens	Yokohama.
Imperial Botanical Garden	St. Petersburg.

For extensive series of earlier publications, we have to thank especially the

Academia real das Sciencias	Lisbon.
Literary and Philosophical Society	Liverpool.
Kongliga Svenska Vetenskaps Akademien	Stockholm.

During the year six hundred and seventy-four books have been taken from the Library by eighty-nine persons.

The Treasurer presented the following report.

Report of E. Pickering, Treasurer, on the Financial Affairs of the Society, for the year ending April 30th, 1874.

Receipts.			
Dividends and Interest			$6,944.39
Courtis Fund Income			709.91
Pratt Fund Income.			850.00
H. F. Wolcott Fund Income			464.00
Walker Fund Income			2,466.30
" Prize Fund Income			240.00
" Grand Prize Fund Income			94.00
" " " " Sale of Stock			728.00
Entomological Fund Income			75.00
Bulfinch Street Estate Fund Income			2,124.00
Admission Fees			100.00
Annual Assessments			1,385.00
Lowell Institute Subsidy for Lectures			138.76
Donations			580.00
Total			$16,899.36
Expenditures.			
Museum and Furniture		$3,423.81	
Repairs of Museum		864.02	
Cabinet		1,332.28	
Cleveland Collection of Fossils		300.00	
Library		527.76	
Abbot's Drawings of Lepidoptera		500.00	
Memoirs and Publications	$1,696.28		
Less receipts	562.87		
		1,133.41	
Lectures		141.11	
Gas		209.25	
Fuel		614.75	
Insurance		1,754.22	
Salaries		5,760.66	
A. S. Packard, Jr., Walker Prize		60.00	
A. Agassiz, Walker Grand Prize		1,000.00	
General Expenses		1,152.21	$18,773.48
Excess of Expenditures over Receipts			$1,874.12

E. Pickering, Treasurer,
Boston Society of Natural History.

Boston, May 1, 1874.

The Society then proceeded to the election of officers for the ensuing year.

Messrs. Mann and Brewer were requested to collect and count the ballots, and they announced that forty-four ballots had been cast, all for the nominees of the Nominating Committee reported at the previous meeting. The following gentlemen were therefore declared officers for 1874–75.

PRESIDENT,
THOMAS T. BOUVÉ.

VICE-PRESIDENTS,
SAMUEL H. SCUDDER, JOHN CUMMINGS.

CORRESPONDING SECRETARY,
SAMUEL L. ABBOT, M.D.

RECORDING SECRETARY,
EDWARD BURGESS.

TREASURER,
EDWARD PICKERING.

LIBRARIAN,
EDWARD BURGESS.

CUSTODIAN,
ALPHEUS HYATT.

COMMITTEES ON DEPARTMENTS.

Minerals.

Thomas T. Bouvé,
L. S. Burbank,
R. H. Richards.

Geology.

Wm. H. Niles,
T. Sterry Hunt,
L. S. Burbank.

Palæontology.

Thos. T. Bouvé,
N. S. Shaler,
W. H. Niles.

Botany.

John Cummings,
Charles J. Sprague,
J. Amory Lowell.

Microscopy.

Edwin Bicknell,
R. C. Greenleaf,
B. Joy Jeffries, M.D.

Comparative Anatomy.

Thomas Dwight, Jr., M.D.,
Jeffries Wyman, M.D.,
J. C. White, M.D.

Radiates, Crustaceans and Worms.

A. S. Packard, Jr., M.D.,
A. E. Verrill,
Alex. E. Agassiz.

Mollusks.

Edward S. Morse,
J. Henry Blake,
Levi L. Thaxter.

Insects.

S. H. Scudder,
Edward Burgess,
A. S. Packard, Jr., M.D.

Fishes and Reptiles.

F. W. Putnam,
S. Kneeland, M.D.,
Richard Bliss, Jr.

Birds.

Thomas M. Brewer, M.D.,
Samuel Cabot, M.D.,
J. A. Allen.

Mammals.

J. A. Allen,
J. H. Emerton,
J. B. S. Jackson, M.D.

The thanks of the Society were unanimously voted to the retiring Vice-President, Mr. Greenleaf, who had declined re-election.

The following Resolution, offered by Mr. G. Washington Warren, was unanimously adopted: —

" That this Society desires to place upon its records its high appreciation of the eminent services rendered by Dr. Charles T. Jackson, one of its Vice-Presidents, and of the high honor conferred upon the Society by his long association with it; and it would respectfully tender to his afflicted family its sincere condolence for the malady which has overtaken him, and has so abruptly terminated — for a season only it is greatly to be hoped — his scientific researches which have been of inestimable value to the public."

May 20, 1874.

The President in the Chair. Sixty persons present.

Prof. Jeffries Wyman read an account of the discovery of human remains in the fresh water shell-heaps of Florida, under circumstances which indicate that cannibalism was practiced by the early inhabitants living on the shores of the St. Johns River.

These remains were found scattered among the shells, and were broken up in the same manner as the bones of edible animals. In several instances considerable portions of the skeleton of a single individual were found, but spread out over a large surface and in a disorderly manner, showing that the bones could not have been deposited as in an ordinary burial. As there were no marks of teeth these bones could not be supposed to have been broken up, while lying on the surface, by wild animals, as bears and wolves, and subsequently covered over by the accumulation of rubbish. They were, besides, in the different instances broken up in a somewhat similar manner, the upper arm and thigh bones being fractured just below the heads and in the middle. The bones of the fore arm and leg were generally broken through the middle, and the ribs were broken into smaller pieces of nearly uniform length.

Prof. Wyman also gave an account of cannibalism as it existed in the two Americas at the time of the discovery of the country, as well as in later years, and gave the documentary evidence for his statements, the most complete and conclusive of which is derived from the relations of the Jesuits.

Mr. F. W. Putnam observed that in a few cases portions of human skeletons had been found in New England shell-heaps, and asked if Prof. Wyman believed that these were evidences of cannibalism in New England as well as Florida.

Prof. Wyman thought there was no sufficient evidence for such a belief, and he also stated that he had never known a case of burial in a shell-heap; but at Doctor's Island, Fla., he had found a portion of a skeleton apparently buried *under* a heap, as Mr. Putnam stated was the case with the skeleton found under the heap near Forest River at Marblehead.

The following paper was read: —

Genetic Relations of the Angulatidæ. By A. Hyatt.

According to Oppel, all three of the lower species of this group, and perhaps four, are identical. I have not, however, been able to satisfy myself that even *Amm. Moreanus* of D'Orbigny is not a separate species. The characteristics in which the forms differ from each other are precisely similar to those which distinguish *Ægoceras Boucaultianum* from its nearest ally, and this is considered worthy of a distinct name by Oppel.

Another difficulty in the way of joining all these species under one name is that they form a group precisely equivalent to the Discoceratidæ, or to the whole of the Falcifiri, so far as their involution and the general parallelism of their characteristics is concerned. They are simply a very highly accelerated series, in which there are as great differences between the extreme forms, as there is between the extreme forms of the Discoceratidæ or of many other groups, composed of more numerous forms with less abrupt modifications.

According to D'Orbigny his *Amm. catenatus*, of which we have a specimen from the neighborhood of Semur, occurs locally below

LOWER LIAS.	TUBERCULATUS-BED.		Ægoceras Boucaultianum
	BUCKLANDIBED	same	Ægoc. Leigneletii
	ANGULATUSBED.	Ægoc. Charmassei, thin variety Ægoc. Charmassei, stout variety Ægoc. angulatum	
	PLANORBISBED.	Ægoc. catenatum	
TRIAS.	TRIAS.	Ægoceras incultum	Psiloceras

Ægoceras Charmassei and *Leigneletii*, and according to Oppel, all these forms are in the "Angulatusbett," succeeded in the "Tuberculatusbett," by *Ægoceras Boucaultianum*. If there is really any such regularity of succession, and from the collection at Semur it would seem to be even more regular than Oppel supposed, it would accord admirably with what has been observed in other groups.

Not only does the involution greatly increase in each succeeding species, but the septa become more complicated in outline, and the adult characteristics of the pilæ[1] and form are repeated at earlier and earlier stages in each species. This may be seen by the following descriptions. The same law governs also the inheritance of the old age characteristics of the individual. Thus *Boucaultianus* has the old age characteristics sooner developed in its growth than any other form, and occurs latest in time, thus showing that the acceleration, or quicker reproduction of the characteristics, extends to the whole life, affecting even the period at which old age begins. The size increases in each successive form to *Leigneletii*, and then decreases considerably in *Boucaultianus*.

One specimen from Semur is labelled *Ammonites Boucaultianus*, but evidently belongs to *Leigneletii*. This shows that in extreme old age the abdomen becomes perfectly sharp and smooth; the pilæ are obsolescing, not reaching quite to the edge of the abdomen.

In Prof. Fraas' collection, associated with *P. planorbis* in the Planorbisbed, is a specimen of *Ægoceras angulatum* var. *catenatum*, and as this is the first appearance of *Ægoceras angulatum*, it is interesting to notice that it is less involute, more discoidal, and the whorl is more involute in aspect, or more like *P. planorbis* in its proportions than the members of the same group, which follow in the Angulatusbed.

It seems to me, therefore, that both by its geological position and characteristics it deserves to retain the separate appellation of *Ægoceras catenatum*. The developmental histories of both *catenatus* and *angulatus*, seem at first sight to contradict the supposition that they can be traced to *P. planorbis*, since the resemblances of the adults disappear and the differences become more and more prominent as the shells are traced backward to their younger stages of growth.

In the collection at Semur there are three specimens in the Planorbisbed under the name of *catenatus*. They are not large, but one exhibits obsolescing ribs and a smooth abdomen at the diameter of

[1] Pilæ is used as synonymous with ribs.

52 mm. D'Orbigny's types agree with this identification. One specimen from the lower part of the same zone with *Liassicus* is named *moreanus*, and may be said to agree with D'Orbigny's figure.[1] This is simply a variety identical with *colubratus* Zeit., growing to a larger size than *catenatus*.

At the diameter of 168 mm. in this specimen, the pilæ crossed the abdomen, showing that old age had set in. That this is sometimes an embryonic feature retained throughout life is shown by another specimen, which at the diameter of 21 mm. has the ribs continued over the abdomen. The typical *angulatus* form occurs as in Germany, in the true Angulatusbed, above the *catenatus* and *moreanus* varieties. The stout form of *Charmassei* occurs at Semur in the same bed, but the more compressed and more involute form which passes into *Leigneletii* occurs in the *Scipionianus* zone, and also in the *Bucklandi* zone. In the latter it is associated with a very thin form which seems to be a transition to *Boucaultianus*, and is identical with *Charmassei* D'Orbigny figured in Pl. 92, figs. 1, 2. One of these, 375 mm. in diameter, had the pilæ quite prominent on the abdomen.

The true *Boucaultianus* occurs above the Bucklandibed, associated with *Birchii*.

Amm. subangularis Oppel, in the Munich Museum, from Kaltenthal, has young like *planorbis*, but the pilæ in one specimen cross the abdomen. Another from Filder has smooth abdomen until it is an inch in diameter, then the pilæ cross the abdomen. One from Hammerkhar seems to pass through this stage, and finally becomes channelled, as in *angulatus*. In old age the abdomen continues smooth, and the shell resembles the old stage of *Caloceras Johnstoni*. This is hardly an intermediate form, and does not confirm the evidence brought forward by Prof. Quenstedt, which is founded upon the occurrence of similar abnormal forms, though the conclusions of that sagacious author are in the main correct. It seems to me, indeed, to be merely a reversionary form of *planorbis* or *Johnstoni*.

Waagen's name Ægoceras is retained for this group on account of the resemblance of the extreme young of *angulatus* to the figure which he gives of the type of his genus, *Ægoceras Buonarotti* of the Muschelchalk. He and Mojsisovics concur in describing the extreme young of *Amm. incultum* as similar to *planorbis*. If this is really so, and *Palmai* and *planorbis*, etc., are as nearly related as they appear to be by

[1] The original in the Jardin des Plantes is a fragment. It is like the figure, but shows that the interior whorls have been almost wholly restored.

descriptions and figures, we have the means of tracing both Ægoceras and Psiloceras to a common stock. Therefore Quenstedt after all is in the main correct, though the point of separation for the two stocks, one the parent of the Arietidæ, and the other of the Angulatidæ, must be sought in the Trias and not in the Lias. The resemblances between the form and characteristics of the full-grown *Amm. incultum* and the young of *Ægoceras angulatum* during the stage in which the pilæ stretch across the abdomen, and the channel is still undeveloped, are numerous and convincing in this respect.

Ægoceras angulatum Waagen.

Amm. angulatus Sch., Die Petref., p. 70.

Amm. catenatus Sow., De la Beche Traite de Geol., p. 407, f. 67.

" " D'Orb., Ter. Jurass., Ceph., pl. 94.

Amm. colubratus Ziet., tab. 3, fig. 1.

Amm. angulatus depressus Quen., Die Ceph., p. 75, pl. 4, fig. 2.

Nothwithstanding Oppel's reunion of this species with *Charmassei* and *Leigneletii* of D'Orbigny, I cannot regard them as anything more than closely allied species, since they differ in the young, as well as in the adult and old age. The young *appear* to be smooth for about one and a half whorls, then lateral tubercles appear. These spread upon the sides into folds, which on the early part of the fourth, or last of the third whorl, rapidly become true depressed pilæ, and then begin to be continued across the abdomen with a very decided forward bend in the geniculæ, and an acute angle on the abdomen. The furrowing or lineal depression which obliterates the angle of intersection of the pilæ on the abdomen, is developed on the last half of the fourth whorl.

On the early part of the fourth whorl the shell has already the abdominal lobe somewhat deeper than the superior laterals, and these again very much deeper than the inferior laterals. The cells broad and rather shallow, the superior laterals being a trifle shallower than the inferior laterals, as in the Arietidæ.

On the first quarter of the fifth volution the bases of the superior and inferior lateral cells and the tops of the superior lateral lobes, have become trifid, or unequally divided, whilst those of the inferior lateral lobes and auxiliary cells are equally divided. The abdominal lobes are shorter than the superior laterals, though the cells maintain their old proportions.

In the full adult condition the characteristics of the septa differ considerably from the Arietidæ, but approximate to those of Psiloceras.

The minor lobes are more numerous, deeper, and pointed than in the Arietidæ, the minor cells being quite leaf-like, the abdominal lobe considerably shallower than the superior laterals, the inferior laterals very short, and the auxiliary lobes quite numerous and bending posteriorly at a considerable angle. The seventh whorl increases in size with great rapidity, the abdomen becoming narrower, the channel shallower, the pilæ more depressed, losing their prominent, somewhat abrupt, genicular bend, and on the abdomen becoming depressed to a level with the siphonal line.

The involution of this whorl is about two-fifths, and that of the ninth a trifle over one-half. The peculiar flattening of the sides and form of the adult whorl, and the amount of involution, are close approximations to the adult characteristics of *Amm. Charmassei*, but the septa are different and the young more robust; the pilæ are developed earlier and more rapidly, and the abdominal channel also In some specimens, however, these last are not noticeable until quite a late period, the pilæ being continuous across the abdomen, as in *D. planicostum*, even on the sixth volution.

In the collections at the Stuttgart Museum are several very fine specimens of the old age of this species, and it is easy to distinguish it from *Charmassei*, by the narrowness of the whorls, and its more open umbilicus and discoidal aspect. One of the largest *angulatus* measures 495 mm., the last whorl 17 mm.; another measures 515 mm., and last whorl 18.5 mm.

In the Museum at Stuttgart, in the centre of a crushed specimen of the true *angulatus* from Kirchheim, the young was very clearly exposed. This had very smooth and round, though rather stout whorls. The pilæ appeared on the sides as faint folds, which are straight at first, then curve, reach the abdomen, and finally cross it with a forward inflection. These become very prominent and decided before the channel is formed, which finally cuts through the pilæ. This variety, however, is considerable, since in the adult of this specimen the channel is only partially developed, the pilæ being only about half cut through, though the specimen is about two and one-fourth inches in diameter. There is here a close likeness to some of the trias forms, but not to the true *Planorbis* which the young does not resemble at all.

In young specimens in Prof. Quenstedt's collection, and the Museum of Comparative Zoölogy, the same was observed. It often occurs also that after the character is developed, and the shell quite large, the pilæ again join, but this is not so frequent as has been supposed. They more often remain separated until old age.

The early occurrence of this form in the Planorbisbed is established by repeated observations on the part of Profs. Quenstedt and Fraas in Wurtemburg. The separation of the pilæ is not uncommon in other groups, especially in Perisphinctes. The original of *Amm. angulatus* Sow., which I saw in the British Museum, is only a malformed *communis.*

Ægoceras Charmassei Hyatt.

Amm. Charmassei D'Orb., Terr. Jurass., Ceph., p. 296, pl. 91, 92.

Besides the characteristics mentioned in the description of *Ægoceras angulatus* the following may be added. On the sixth volution, the extremely gibbous form of the young begins to change. The whorl increases more rapidly, the abdomen is narrower, and the pilæ as in preceding species, with this exception. On this volution, or perhaps on the fifth, they become bifurcated, or else have intermediate short pilæ interspersed between the longer ones. The septa have remarkably large abdominal lobes, shallower than the superior laterals, but with a much more ragged outline. The siphonal cell is extraordinary in this respect. It is very large, and marked with several lateral minor lobes and cells. The remaining lobes and cells are much more complicated than in *angulatus.*

On the sixth volution the form of the whorl changes exactly as in *angulatus.* The envelopment of this whorl equals one-half of the side of the sixth, whereas in *angulatus* the envelopment does not equal this until it reaches the ninth volution. The envelopment at the same age in this species, that is on the ninth whorl, covers full two-thirds of the side of the eighth whorl. There is a form in Prof. Fraas' collection from Möhringen answering to the young of *Charmassei,* as figured by D'Orbigny, pl. 91, and another from Filder, which is precisely intermediate in its characteristics between this and the smoother, flatter variety figured on pl. 92. The oldest specimens in the possession of the Museum of Stuttgart measured 53 mm., and the last whorl 23 mm. *A. angulatum* parts with its pilæ and grows smooth much earlier apparently than *A. Charmassei.* Probably this occurs at about the same age, but the superior size of *Charmassei* makes it seem older when the old age characteristics begin to appear.

Ægoceras Leigneletii Hyatt.

Amm. Leigneletii D'Orb., Terr. Jurass., Ceph., p. 298, pl. 92.

Amm. angulatus compressus Quen., Die Ceph., p. 75.

The same class off acts divides this species from *Charmassei* that we used to show the differences between the latter and *angulatus* — namely that the young differ as well as the old in some specimens.

The differences are very great between the fifth whorl (about) of *Leigneletii*, and the same age in *Charmassei*. The tubercles are more prominent on the edge of the abdomen, the pilæ more depressed on the sides, and their terminations tubercular on the edge of the abdomen, which instead of being a broad, rounded space, is a flattened zone. The reduction of the abdomen of course occurs in all species of this group, but in other species, except *Boucaultianus*, it is found only during the senile stage.

A specimen of Boucault's Collection, labelled *Amm. Charmassei*, is probably the young of this species. If so, the young shell differs from *Charmassei* in having laterally compressed whorls, like those of its own adult, much finer pilæ, not so prominent and near the abdomen, bifurcating very regularly. The smooth lateral zones found on the fifth volution are not indicated on the fourth whorl in this specimen, and it resembles at this time in the form of the whorl, the pilæ and the abdominal channel, a much older stage of growth which occurs in *Charmassei*.

Amm. angulatus compressus of Quenstedt may also in part belong to *Charmassei*, but the two specimens from Museum Stuttgart are apparently of this species only. The development in one of these specimens covers about two-thirds of the sides of the eighth whorl, and about the same age the pilæ again cross the narrow abdomen, obliterating the siphonal depression or bare tract, and introducing a series of crenulations instead. This is a return to the young condition, and indicates the first degradational or old age period. Of course it is not intended by this to deny that there are no young which closely approximate to the young of *Charmassei*. On the contrary some specimens are apparently identical in all respects, except the greater flatness and the earlier period at which the involution appears to be shown. In fact the species are connected by numerous transitional forms with *Charmassei*.

Ægoceras Boucaultianum Hyatt.

Amm. Boucaultianus D'Orb., Terr. Jurass., Ceph., p. 294, pl. 90.

This remarkable species differs from *Leigneletii* in about the same manner that that species differs from *Ægoceras Charmassei*, in other words, it is more involute than *Leigneletii* at the same age; on about the seventh or eighth whorl, at least three-fourths of the sides are hidden. The pilæ are not so coarse as in that species, and the abdominal channel is obliterated at an earlier age, and succeeded by the crenulations caused by the pilæ. The septa differ considerably The specimen examined was one of D'Orbigny's types. The same transitional forms which lead into *Leigneletii* also lead into other more compressed and more involute forms which are transitional to the true *Boucaultianus*. They differ from *Leigneletii* only in the suppression of the tuberculated pilæ, and a general tendency toward obsolescence of the pilæ on the sides.

Appendix to Communications on Reversions among Ammonites.

Proc., Vol. XIV, 1870, p. 22.

Microderoceras Birchii.

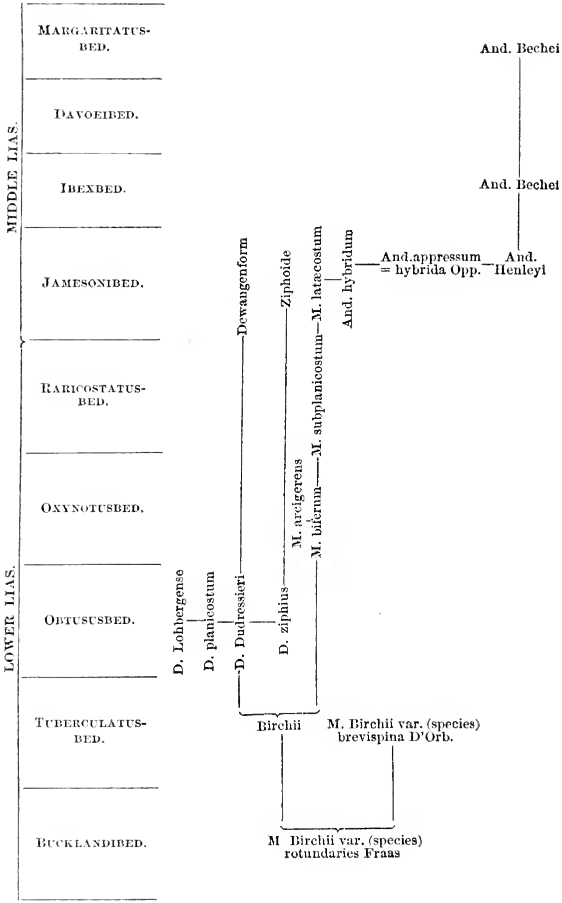
This occurs in the form named *Amm. rotundaries* by Fraas (MSS.) in the Arietenbank or Bucklandibed.

Microderoceras Hebertii.

This is not the Hebertii of Oppel, but a form intermediate between that figured by D'Orbigny under the name of *Amm. brevispina* and the typical *Birchii*. It is not found in the Middle, but in the Lower Lias Birchiibed at Semur. The confusion arises out of a false identification by Oppel from the supposed types in D'Orbigny's collection. The type is really a very rare form of *Birchii*, found only, so far as I know, in the Museums at Semur and Cambridge. The specimens in D'Orbigny's collection are forms of the single-spined group allied to *armatus*. They differ from the type described by D'Orbigny, and also from *Hebertii* of Oppel, which is identified in Germany, and appears in the Munich collection as a species allied to *Valdani*, with a keel, and all the characteristics of its group.

Microceras biferum.

The young of this species in some varieties is very similar to the young of *Birchii*, and confirms the views previously taken of their affinities.


MIDDLE LIAS.
LOWER LIAS.
MARGARITATUS-BED.
DAVOEIBED.
IBEXBED.
JAMESONIBED.
RARICOSTATUS-BED.
OXYNOTUSBED.
OBTUSUSBED.
TUBERCULATUS-BED.
BUCKLANDIBED.
And. Bechei
And. Bechei
And. Henleyi
And.appressum = hybrida Opp.
And. hybridum
M. latæcostum
M. subplanicostum
M. arcigerens
M. biferum
Ziphoide
D. ziphius
Dewangenform
D. Dudressieri
D. planicostum
D. Lohbergense
Birchii
M. Birchii var. (species) brevispina D'Orb.
M Birchii var. (species) rotundaries Fraas

Amm. polymorphus mixtus Quenst. is not a synonym of this species, and my remarks are erroneous in this respect. In Quenstedt's collection there are several specimens with the Turrilete deformity, supposed to be identical with *Turr. Valdani* and *Coynarti.* They are, however, members of this species, and not equivalent to *Turr. Coynarti*, though perhaps equivalent to *Turr. Valdani.*

Turr. Coynarti is evidently a deformed specimen of *planicosta* and *Turrilites Boblayei*, a deformed specimen of *carusense*, according to D'Orbigny's collection. I have found also similar deformities in several other species, so that it is an unquestionable deformity to which species of the Lower Lias are more or less susceptible, as previously noticed by Quenstedt.

Microceras latæcostum.

Besides the varieties *sinuosum* and *maculatum*, this should also include *crescens*. It cannot readily be separated, either by its form or any of its characteristics. The original of Sowerby has only one row of spines until quite large, when it acquires two.

Microceras arcigerens.

This is the English representative of *Microceras biferum*, and in some specimens is not separable from that species, while in others it is not separable from *latæcosta.*

The young of all, and the adult stages of some specimens, are like the young and adult stages of *biferum*, while the adult of other specimens have the peculiar form and pilæ of *latæcosta.*

Deroceras Dudressieri.

In Quenstedt's collection are several remarkable forms of this species. One begins to show old age, or rather in that case a premature decay of parts begins to take place when the shell is only two inches in diameter. The tubercles and folds begin to show signs of decay in a perfectly normal way, even at this early age. Another specimen from Dewangen (Der Jura, p. 125) has young, with enormously large, truncated spinous casts, as in *armatum.* There are other young of this species which are identified as *planicosta* Sow.[1]

Deroceras ziphius.

Amm. armatus sparsinodus Quenstedt.

Quenstedt's magnificent series confirms the views previously printed.

[1] See also Der Jura, p. 97, *Capricornus nudus.*

Deroceras ziphoides.

Amm. ziphoides Quenst., Der Jura, p. 130, pl. 15, fig. 11.

This is really only a form of *ziphius* in the Lias, which has an accelerated mode of development, and has partly skipped the planicostan character of the abdomen. The pilæ still cross the abdomen, but have lost their broad planicostan aspect.

Deroceras planicostum.

Sowerby's specimens are mixed with *latæcosta* and *Dudressieri.* These hardly afford the means of determining whether *planicosta* deserves a separate name from *Dudressieri,* but after a careful examination I doubt whether the form of *planicosta* can be separated from the young of *Dudressieri.* It will be observed that *planicosta* is a small species, and in many undoubtedly planicostan varieties the characteristic spines of *Dudressieri* are assumed after the specimen attains an unusually large size, so that it becomes impossible to separate them from the young of *Dudressieri.* Several of Sowerby's specimens are unquestionably forms of this species.

There are, however, some extreme forms of *planicosta* laterally very flat and very narrow on the abdomen, for which it may be found convenient to reserve a separate appellation.

My remarks with regard to the affinity of this species with species of the Arietidæ should be more definite. They can apply only to certain parallel or reversionary characteristics which are common to both Arietidæ and Microceras, and not attributable to any direct genetic connection.

Deroceras confusum.

This should be *Ammonites Lohbergensis* Emerson. *Deroceras confusum* Quenst. is very distinct. The figures of Quenst. are not exactly correct. Fig. 8. pl. 72 of "Der Jura" has a hardly perceptible keel connecting some of the abdominal ridges of the original specimen, but absent between others. The whorl is quite round in the young, then acquires the form given in Fig. 8, and then that delineated in Fig. 10. There are, however, still very faint signs of a keel which is entirely lost between the oldest ridges.

Amm. subplanicosta Oppel.

This remarkable form, as seen in the Munich Collection, has young like *biferum,* and in other respects resembles that species, but begins to acquire the planicostan or latæcostan pilæ at a very early age, and in some specimens probably remains similar to *latæcosta* throughout life. There can be but little doubt that it is a latæcostan-like variety of *M. biferum.*

Deroceras desinodum.

This species is not a member of this series at all, but genetically allied with the armatus series.

Androgynoceras hybridum.

This species is very commonly confused with the other forms of Androgynoceras and Liparoceras by all German authors. It is, however, quite readily distinguished by the large size which it attains before acquiring the peculiar tuberculated lateral and divided abdominal pilæ of the group to which it belongs. Sowerby's collection shows that his *Henleyi* was identical with this species, and not with the species which now universally goes by that name.

Androgynoceras appressum.

This is quite a distinct form, but is equal to *Amm. striatus evolutus* Quenst., and to a part of *Amm. hybrida* Oppel, and appears to lead into a peculiar keeled form, also part of *Amm. hybrida* Oppel.

This form becomes almost smooth in the young, and thus resembles *Amm. polymorphus lineatus*, which both Quenstedt and Oppel consider connected with it. I think the resemblance is caused merely by a mode of development which has the same relation to the mode of development in *And. appressum* that the mode of development in *Bechii* has to *Henlyi*. That is, the young are smooth for a long time in both, and both skip the latæcostan stage, but the adults differ in the subsequently developed characteristics of the adult abdomen.

Liparoceras indecisum.

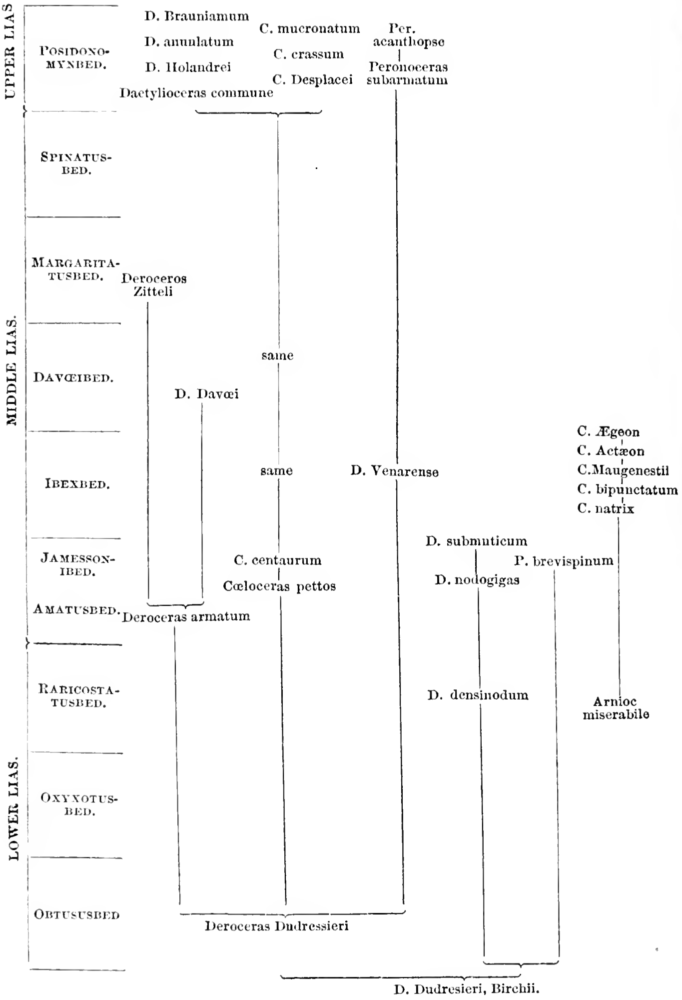
This form has two varieties, one in the collection of the Museum of Comparative Zoölogy, which in the young approximates quite closely to the young of *And. hybrida*, and one form in the Munich collection, which is intermediate between the normal forms and the true *Henleyi*; that is, the young have the latæcostan abdomen for a much more limited time.

Liparoceras Henleyi.

This is undoubtedly, as Oppel states, only a form of *Bechei*, but if we join this and *Bechei* under one name, we must also, according to the same rule, join all the forms from *Microceras latæcosta* to *Bechii* inclusive under one specific name, with numerous varieties.

Liparoceras Bechei.

This occurs in Lias γ with *Henleyi* and *appressum*, but the extreme forms are mostly found in Lias α. Sowerby's original is the form usually identified as *Bechei*, with smooth young.


UPPER LIAS
MIDDLE LIAS.
LOWER LIAS.
Posidonomyabed.
Spinatus-bed.
Margaritatusbed.
Davœibed.
Ibexbed.
Jamessonibed.
Amatusbed.
Raricostatusbed.
Oxynotus-bed.
Obtususbed
D. Brauniamum
D. annulatum
D. Holandrei
Dactylioceras commune
C. mucronatum
C. crassum
C. Desplacei
Per. acanthopse
Peronoceras subarmatum
Deroceros Zitteli
same
D. Davœi
same
D. Venarense
C. Ægeon
C. Actæon
C.Maugenestil
C. bipunctatum
C. natrix
D. submuticum
P. brevispinum
D. nodogigas
C. centaurum
Cœloceras pettos
Deroceras armatum
D. densinodum
Arnioc miserabile
Deroceras Dudressieri
D. Dudresieri, Birchii.

Appendix to Communication on "The Non Reversionary Series of the Liparoceratidæ," etc.

(Proceedings, Jan. 17th, 1872.)

Deroceras armatum.

I have noted that a well preserved specimen of this species occurs in Prof. Fraas' collection from the Raricostatusbed of the Lower Lias.

Deroceras alternum.

This may be a broad whorled variety of *Deroceras Zitteli* (sp. Oppel), and *Deroceras minatum* Hyatt, Bull. Mus. Comp. Zool., No. 5, p. 94, is probably the typical variety of the same species figured by Oppel in the Mittheilungen, pl. 42.

Both of these forms probably came from the Margaritatusbed, though the latter is labeled Upper Lias, Plateau de Larzac.

D. alternum approximates to Oppel's species in possessing a large abdominal cell, but the lateral cells and lobes are quite different. These differences are not important, however, and *alternum* appears the same as Oppel's species; but whether *minatum* is or not cannot be decided on account of the label referred to above.

Deroceras Davœi.

The *Amm. planarmatus* of Quenstedt appears to be a form of this species. A specimen in the Museum of Stuttgart is much stouter than the ordinary form of *Davœi*, but is more nearly allied to that species than the fragment figured and described by Quenstedt. This has no spines and the pilæ are split into several upon the abdomen according to Quenstedt's description, though the figure shows that they are merely the abdominal remnants of pilæ whose lateral portions have been obliterated. This, the absence of tubercles and the fold-like character of the pilæ, appear to indicate an old age form of *Davœi*. I say this with great doubt, because the septa are slightly different, and I have not seen Quenstedt's original specimen.

Deroceras muticum.

This description includes a broad form, which is the *Deroceras Venarense* (Opp. Spec. Mittheil., pl. 42), and a compressed variety which is named *Amm. muticus* by Boncault. The specimens are from Venarey, and doubtless are merely varieties of Venarensis, but they agree quite closely with D'Orbigny's figure of *Amm. muticus*. Unfortunately the original specimen was not found in D'Orbigny's collection, and I think it would be more consistent with prudence to adopt Quenstedt's and Oppel's conclusion, that *Amm. muticus* D'Orb.

is equal to *Amm. armatus densinodus* Quenst., and give both the above described varieties the name of *Deroceras Venarense.*

Deroceras nodogigas.

This species really belongs to the series of which *Amm. muticus* D'Orb. (*Armatus densinodus* Quenst.) is the first member, and not to this genus at all.

Platypleuroceras brevispina.

This is the *Natrix rotundus* of Quenstedt. Sowerby's original is really a variety of *latæcosta*, as well as the accompanying figure on the same plate, but it seems best to accept Oppel's solution of the difficulty, and cut the knot by applying the name to the *Natrix rotundus* form. *Natrix oblongus* is entirely distinct in every respect. In Prof. Fraas' collection there are two young specimens, undoubtedly belonging to this species from Lias β Balingen.

Amm. natrix oblongus Quenst.

A careful examination of the young in Quenstedt's collection shows them to be very distinct from the young of the preceding. This resembles *Birchii* until a late period, while *Natrix oblongus*, on the other hand, is similar in the younger stages to the adult of *Deroceras densinodum*; the aspect and closeness of the pilæ and truncated spines, the form of the whorls and abdomen are precisely similar. Finally, Quenstedt himself has remarked the similarity of the septa in the adults of both forms. Here, as in many of the neighboring forms, it is very interesting to observe the reversions caused by the reappearance of the planicostan aspect of the abdomen in the adults, accompanied by the loss of the armatoid tubercles. This mode of development unites *desinodum*, *nodogigas* and this species, into one genetic series. The name which should then be adopted is that given by Oppel, *Amm. submuticus.*

Cycloceras natrix.

This species is only separable from *Cycloceras bipunctatum* by the greater stoutness of the whorls and greater rotundity of the abdomen; whether it should be separated from *Natrix rotundus* or not, my material does not permit me to determine.

Cycloceras bipunctatum.

In the collections of Fraas, Quenstedt, and especially in one made by Baron Schwartz, which I saw at Tübingen, it is easy to observe that the old of *bipunctatus* becomes smooth, and possesses the same form as the so-called *Cycl. Masseanum.* A specimen in the collection of Museum of Stuttgart is eleven and a half centimetres in diameter, but still not so smooth or so advanced in senility as D'Orbigny's figure of a much smaller individual. The young are identical in their characteristics with the more flattened varieties of *Arnioceras miserabile*, which have the pilæ bent forward and of linear aspect.

Amm. maugenestii D'Orb.

This species, as exhibited in Prof. Fraas' collection, shows a young form which at 35 mm. in diameter is precisely similar to the adult of *bipunctatus* at the diameter of 8 to 12 mm. with two rows of spines. The abdomen is also elevated at this early age, though it afterwards flattens slightly, and assumes the planicostan pilæ in some specimens. When 9 mm. in diameter, the specimen referred to above loses its tubercles and begins to become narrower across the abdomen, and at the diameter of 11 to 12 mm. the senile features exactly reproduce the characteristics of the spineless or Masseanus form.

In D'Orbigny's collection it may be seen that there is no real line to be drawn between *Maugenestii* and *bipunctatus* (*Valdani* D'Orb). The single row of spines described by D'Orbigny is confined to a limited number of specimens; the larger number of specimens have two rows of spines. The extreme *Valdani* or *bipunctatus* form is usually thinner, and the septa somewhat different.

Cycloceras Masseanum.

That this is merely the old age of the preceding species, and not a form by itself with adult characteristics, is shown by all the collections I have seen, especially by that of Dr. Schwartz, who first drew my attention to this fact.

Cycloceras Ægæon.

This form is very closely connected to the preceding or Actæon variety of *Maugenestii* by a series of forms in which the old or Masseanus stage is inherited at earlier and earlier periods, until it finally invades the young stages of development. In other words, *C. Ægæon* is the old age type of its series, having no stage corresponding to the adult, but only to the old age of the preceding species.

Peronoceras acanthopsis.

This is evidently only a variety of *subarmatum*, with a broad abdomen.

Peronoceras subarmatum.

As pointed out by Quenstedt, this is identical with the flattened forms named by him *Amm. Bollensis*, and occurring in Lias ε.

Cœloceras pettos.

There are two distinct varieties with numerous intermediate forms. One has large pilæ in the young, and the earlier stages are inseparable from those of *C. centaurus*; the other has smaller and finer pilæ. The development is often distinct when the adults exhibit no perceptible differences. On the other hand, a very broad abdomened typical variety, or a very narrow adult shell, may be produced from young that are precisely similar. In Quenstedt's collection the broad variety is found in the Davœibed, somewhat above the other.

C. pettos and *centaurus*, according to Fraas' and Quenstedt's collection, are found together in the same bed where alone *centaurus* appears in Quenstedt's diagram. This, and numerous intermediate forms, show that they are merely varieties of the same species though it is convenient to retain their separate names.

Cœloceras Desplacei.

The *Amm. acanthus* D'Orb. is a form of this species which has no tubercles on the cast, very slight ones on the shell, and pilæ very regularly divided. A very fine specimen in D'Orbigny's collection shows the old age. The spines become obsolete, and subsequently they lose their divided pilæ and stretch across the abdomen in parallel lines. At the same time, also, the size of the whorl decreases, the abdomen losing in breadth until the sides are only gibbous near the dorsal line, and then converge rapidly outwards. The breadth of the dorsum also decreases so that a decided tendency to return to a cylindrical smooth form of the whorl is manifested in old age.

Cœloceras crassum.

In D'Orbigny's collection a fine specimen of this form reaches a larger size than any I have seen, nearly 9 mm. In this, also, the tubercles are lost in old age, pilæ become single on the abdomen, and the involution becomes less, as described above for *C. Desplacei.* The *Amm. crassus* of Quenstedt occurs in Lias ε and ζ, and in Fraas' collection there are representatives of this species which have no tubercles; they are from Metzingen.

Cœloceras mucronatum.

This is merely a compressed form of *C. crassum.*

Dactylioceras commune.

This species occurs in the compressed specimens of Lias "ε" of Quenstedt, and in Lias "ζ," as shown by Quenstedt's and Fraas' collections, in company with Holandrei. See also Quenstedt's remarks on *Amm. communis* and *crassus* in "Der Jura," p. 251.

Dactylioceras annulatum.

A form allied to this species appears in Fraas' collection under the name of *Amm. annulatus triplicatus* Quenst., in the Macrocephalibed. This form is precisely intermediate between the true *annulatum* and the *Amm. athleta* of the upper formations, and as stated by him it is not the same as the *annulatus* of the Upper Lias, though very closely allied to it. It is also distinct from *athleta*, and other allied forms of the same group, in which the adults acquire the spines and peculiar outlines of the abdomen and septa of the *athleta* group.

June 3, 1874.

Prof. Hyatt in the chair. Thirty-one persons present.

The following paper was read: —

NOTES ON THE NATURAL HISTORY OF PORTIONS OF DAKOTA AND MONTANA TERRITORIES, BEING THE SUBSTANCE OF A REPORT TO THE SECRETARY OF WAR ON THE COLLECTIONS MADE BY THE NORTH PACIFIC RAILROAD EXPEDITION OF 1873, GEN. D. S. STANLEY, COMMANDER. BY J. A. ALLEN, NATURALIST OF THE EXPEDITION.

I. INTRODUCTORY.

The route taken by the Expedition may be briefly indicated as follows: — Starting from Fort Rice, on the Missouri River (a point a little to the north of the geographical centre of Dakota), our course was thence nearly due west to the Yellowstone River, in Montana Territory, which we struck a few miles above the mouth of Glendive Creek. Crossing the Yellowstone at this point, (where a temporary post was established, called Camp Thorne), we followed up its left bank to Pompey's Pillar, a distance of one hundred and ninety miles. We kept mainly to the bottom lands, but the high bluffs being cut by the river at frequent intervals, we were forced occasionally to the adjoining highlands. Leaving the Yellowstone at Pompey's Pillar, we crossed over to the Musselshell, which we struck near the 109th meridian. From this point the Expedition descended the valley of the Musselshell, as far as the "Big Bend," — a distance of about seventy miles — where we left it, and by a southeasterly course reached the Yellowstone again at the mouth of Little Porcupine Creek. Thence down the Yellowstone, and eastward to Fort Abraham Lincoln, on the Missouri, our course was essentially the same as that pursued on our way out. The route of the Expedition hence lay wholly between the 46th and 47th parallels, sweeping somewhat sinuously from one to the other, and extended from near the 100th meridian to the 109th.

The whole extent of country traversed is thus, in respect to its fauna, wholly beyond the western boundary of the so-called "Eastern Province" of North America, and is comprised within the excessively arid belt of the western plains. But throughout this wide area, the country, either in respect to its general features or its productions, is by no means everywhere alike. The eastern border receives much more rain than the western, and the vegetation is proportionally more abundant and varied, with, of course, corresponding differences in the fauna. Geologically the region is wholly embraced within what has been termed the Lignite Tertiary Formation, but includes limited outcroppings of the Upper Cretaceous. It hence embraces considerable areas deeply scored by erosion, forming the well-known "Bad Lands" of the Upper Missouri district. A broad belt of these Bad Lands extends along the Little Missouri, and they occur at intervals all along the Yellowstone and its principal tributaries. They form the favorite haunts of several species of animals and plants not found generally dispersed over the plains.

From the Missouri River westward, nearly to the Little Missouri, the country gives evidence of considerable fertility, being covered with a good growth of grass, which the present year remained quite green till our return in September. Along the streams occur scattered clumps of timber, composed chiefly of box-elder, elm and cottonwood, with here and there groves of oak, the latter being confined chiefly to the coulées, or dry ravines, that extend back from the larger streams. Passing this semi-fertile district we arrive at the Little Missouri belt of Bad Lands, twenty to thirty miles in breadth. Beyond these we again meet with comparatively fertile grassy prairies, which extend to the divide west of Inman's Fork of the Little Missouri, or for a distance of some thirty miles. On reaching this divide (that of the Little Missouri and Yellowstone) we find indications of a more arid climate, the vegetation becoming more scanty, the grass shorter and thinner, and cacti and sage brush begin to be for the first time common, and even at times the predominating plants. Thence to the Yellowstone the country becomes still more and more barren, and is deeply cut by erosion, belts of "Bad Lands" bordering the Yellowstone and its tributaries, and rendering an approach to them with wagons a very difficult undertaking. The valley of the Yellowstone indicates a great degree of aridity of climate and soil, but the overflowed portions generally afford an abundance of good grass, interspersed, however, with large areas occupied almost exclusively with luxuriant growths of either *Opuntia missouriensis*, grease wood (*Obione vulgaris*), or sage brush (*Artemisia canescens*). The several terraces of the river are even more barren than the bottom-lands, though occasionally affording fine grass, while the plateaus on either side, but especially to the westward, are often nearly destitute of grass, the vegetation consisting mainly of cacti and low depauperate forms of *Artemisia*, and their few characteristic associates. The divide between the Yellowstone and Musselshell, at the point where we crossed it, is also quite similar, a more barren country than that bordering the Musselshell from the 109th meridian to the Big Bend, or than that between the two Porcupine Creeks, being hard to find anywhere east of the Rocky Mountains.

From Camp Thorne, or the "Yellowstone Crossing," nearly to Tongue River, there is very little timber in the valley of the Yellowstone, frequently not a single tree occurring for miles. Quite large forests begin to appear a little below the mouth of Tongue River, extending up that tributary as far as can be seen from the bluff opposite its mouth, and almost uninterruptedly along the Yellowstone thence to Pompey's Pillar, forming an almost continuous belt of varying width. The trees are almost exclusively cottonwood, and are many of them of large size. They sometimes form thick forests, half a mile to a mile in breadth, but more frequently grow in more or less detached belts and clumps, being confined to the old beds of the river or its affluents. In the valley of the Musselshell the cottonwood belt is almost uninterrupted, and is much wider in proportion to the size of the river than that along the Yellowstone, frequently attaining a width of one-half to three-fourths of a mile. The bluffs on the east side of the Musselshell, as far as the Great Bend, as well as the bluffs on both sides of the Yellowstone above the Porcupine Creeks, and much of the region between the Mussellshell and Yellowstone, from the Big Porcupine to Pompey's Pillar, is sparsely covered with pines, which attain the height of thirty to eighty feet, and give the country, when seen at a distance, the appearance of being quite thickly wooded. The distribution of the pines serves to mark the extent of the tertiary sandstones, the pines abruptly disappearing with the appearance of the cretaceous clays and marls.

With these preliminary remarks descriptive of the general character of the country, we proceed to give in detail such observations as our rapid journey of nearly one thousand miles in less than one hundred days, including detentions, enabled us to make respecting the vertebrate fauna of the district through which we passed. Although we moved quite too rapidly to allow of a very satisfactory examination of the country traversed, or to admit of the formation of very large collections, it is believed that but few species escaped notice, while of the greater part specimens were either preserved or examined.

In this connection it gives me great pleasure to acknowledge my indebtedness to my valuable assistant, Mr. C. W. Bennett, for important aid in my work, and for many facts recorded in the following pages. Mr. S. H. Scudder has kindly prepared the report on the butterflies, and Dr. Geo. Vasey, botanist of the Department of Agriculture, has prepared the report on the plants, with which I have incorporated a few remarks on the relative abundance and range of some of the more prominent species. The report on the fishes is unavoidably delayed.

II. Report on the Mammals.

Although the region now under consideration is so barren, and has hitherto been so little frequented by white men, considerable changes in the relative abundance of the larger mammals have already been effected by human agency. The buffalo that once swarmed over these plains has wholly disappeared east of the Yellowstone, as far up at least as the Tongue River, and with his decline have nearly disappeared the coyote and the wolf. The elk and the black-tailed deer were formerly abundant along all the principal streams, but neither now occurs in any numbers except on the Musselshell, and on the Yellowstone above the mouth of Powder River. The mountain sheep, or bighorn, still occurs sparingly in the Bad Lands bordering the Little Missouri and Yellowstone Rivers. The pronghorn is the only one of the herbivores that is still generally distributed, being now the most numerous of the larger mammals. A very fatal disease, however, visited them the past summer (1873), sweeping away thousands inhabiting the region between the Little Missouri and Yellowstone divide and the Missouri River, in fact nearly dépopulating the district; so that many years must elapse before they will again be as abundant here as formerly.

With perhaps one or two exceptions, none of the smaller mammals can be considered as abundant. The prairie dog is much less numerous than further south, and the striped gopher is far from abundant, though these are among the most numerously represented species. Along the Yellowstone, however, the *Dipodomys Ordii* may be fairly regarded as abundant.

FELIDÆ.

1. **Lynx rufus** Raf.[1] Bay Lynx. Wild Cat.

Indications of their occurrence were noticed along the Yellowstone and Musselshell Rivers, and a young one was shot near our camp on the Big Porcupine.

CANIDÆ.

2. **Canis lupus** var. **occidentalis** All. Gray Wolf.

Rare east of the Little Missouri, but frequent indications of their presence were noticed as we approached the Yellowstone, and from the mouth of the Big Horn up the Yellowstone and over to the Musselshell and back, they were heard in considerable numbers about camp nearly every night. They are rare now, however, throughout this whole region, in comparison with their former abundance. Dr. Hayden, writing in 1863, says, "Countless numbers are seen in the valley of the Yellowstone, and along the Missouri above Fort Union, and woe to any poor buffalo, elk or deer, which may have been so unfortunate as to have been wounded by the hunter, or to be in the decline of life." [2] They, however, no longer occur in such large numbers on the Lower Yellowstone.[3]

[1] The authorities adopted here are those of the first author who used both the generic and specific names in their present connection. In the case of varietal names, the same practice is followed. The authority is hence regarded, as the writer has always regarded it, as a part of the name, and not as a property label.

[2] Trans. Am. Phil. Soc., Vol. XII, p. 141.

[3] In writing of the varieties of color presented by our wolves in 1869 (See Bull. Mus. Comp. Zool., Vol. I, p. 156), I overlooked the following important remarks on this subject by Dr F. V. Hayden:— He says, "This animal varies so much in color that the traders on the Upper Missouri suppose there are four or five species. I have seen them differing in color from an almost snowy whiteness to a dark brown or black, and was at first inclined to attribute this difference to age and sex, but Mr. Zephyr, an intelligent trader, informed me that he had noticed the same variations of color in all ages." Trans. Am. Phil. Soc., Vol. XII, p. 141.

3. Canis latrans Say. Coyote. Prairie Wolf.

Not common east of the Yellowstone. In the valley of the Yellowstone and westward, they were heard in considerable numbers every night, and were occasionally seen while we were on the march, particularly in the Musselshell district. None were heard on our way out till we reached the Yellowstone, but from the Yellowstone "Crossing" westward they were at times quite numerous. The wolves, including the coyote and the gray wolf, have been nearly exterminated over the region most frequented by hunters, by the use of strychnine. The hunters have pursued them till too few of them are left to make " wolfing " profitable. They now say, " There are now no wolves here," they have become so much scarcer than they formerly were.

4. Vulpes vulgaris var. **macroura** All. Western Fox.

Quite common along the Yellowstone, and thence westward to the Musselshell.

5. Vulpes velox Aud. and Bach. Kit Fox. Swift.

Quite frequent.

MUSTELIDÆ.

6. Mephitis mephitica Bd. Common Skunk.

But two or three individuals were met with on the whole trip. Apparently not very numerous.

7. Taxidea americana Waterh. American Badger.

Apparently more or less common, though but very few were seen.

URSIDÆ.

8. Ursus arctos var. **horribilis** All. Grizzly Bear.

Very scarce. Less than half a dozen were reported or seen by the whole Expedition collectively, during the whole trip, and only one old one and two cubs were killed. Even very few signs of them were noticed.

PROCYONIDÆ.

9. Procyon lotor Storr. Raccoon.

Saw tracks in the mud along the Yellowstone that were unmistakably those of the raccoon, but none of the animals were either taken or observed.

BOVIDÆ.

10. Bos americanus Gray. American Bison. "Buffalo."

Recent signs of the buffalo were first met with in the valley of the Yellowstone, near the mouth of the Rosebud — tracks of single old bulls that had passed down to the river for water within a period of a few weeks. Above this point considerable numbers seemed to have frequented the river valley during the early part of the season (1873), and tracks but a few days old were frequent for the last ten miles before reaching Pompey's Pillar. The first buffalo *seen* was observed about twelve miles west of Pompey's Pillar. Eight miles further west, on the divide between the Yellowstone and the Musselshell, we found large herds had grazed but a day or two before our arrival, and fresh tracks of cows and calves, as well as of bulls, were abundant. From this point to the Yellowstone we were frequently in sight of quite large bands, and quite a number of individuals were killed. They moved off rapidly, however, as we approached, and at no time were more than a few hundreds in sight at once. We found later that the valley of the Musselshell and its adjoining prairies had been the recent feeding ground of large herds, immense numbers having evidently spent the early part of the season there. They seemed not, however, to have visited the valley in large numbers before for many years, as all the trails and other signs had most evidently been made within the few weeks immediately preceding our arrival. Traces of ancient trails remained, but they were few and insignificant as compared with those of the present year. The herds seemed to have occupied the whole valley as far as we followed it (from the 109th meridian to the Big Bend), as well as the plains on either side. Considerable bands had also ranged over the divide between the Musselshell and Yellowstone, particularly along the two Porcupine Creeks. Gen. Custer met with small herds still further to the eastward, and the main expedition came in sight of a few near the mouth of Custer's Creek, where several were killed by the scouts. On our return we found that during our absence small bands had visited the valley of the Yellowstone itself as far down as Powder River, while quite large herds had recently passed up Custer's Creek.

Occasional skeletons and buffalo chips in a good state of preservation occur eastward nearly to the Missouri, but the only very recent signs observed this year east of the Yellowstone were the tracks of a few old straggling bulls a few miles east of the river. The last buffalo killed near Fort Rice was taken in 1869, when three were killed from a herd of ten old bulls that had strayed far to the eastward of the main herds. It is but two or three years, however, since they ranged one hundred to two hundred miles east of the Yellowstone in the latitude of Fort Rice.

11. Ovis montana Cuv. Bighorn. Rocky Mountain Sheep. Not common. First met with in the Bad Lands, near the head of Glendive Creek, and seen occasionally in the Bad Lands that border the Yellowstone. Not more than six or eight were secured by the hunters and scouts altogether, though their fresh tracks were quite abundant at a few localities.

ANTILOCAPRIDÆ.

12. Antilocapra americana Ord. Pronghorn. "Antelope." Generally distributed, and more or less common. Most frequent, however, between the Missouri and Little Missouri Rivers.

During the summer of 1873 a fatal epidemic raged among the prong-horns over nearly the whole area between the Yellowstone and Missouri Rivers, destroying apparently three-fourths to nine-tenths of them. The greatest fatality seems to have occurred in July, judging from the size of the fawns found dead, and hence not long after we crossed this portion of the country. From the head of Heart River to the Missouri we found their carcasses, on our return, thickly scattered along our line of march, including those of both sexes and all ages, fawns being often found lying within a few yards of their dams. On our way out antelopes were almost constantly in sight, but on our return they were only rarely met with, ten dead ones being seen to each living one. The epidemic seems not to have extended beyond the Yellowstone, where they seemed more numerous on our return than on our way out, and where no dead ones were observed.

The previous year they are reported to have ranged over this section of the country, in autumn, in very large numbers, bands of two or three hundred being sometimes met with by the Yellowstone Expedition of 1872, on its return eastward. Four were captured by the men as the frightened animals attempted to run through the train.

Epidemics similar to that affecting the prong-horns, are well known to occasionally affect deer, rabbits and field mice. A few years since (about 1869) the jackass rabbits of Salt Lake Valley, Utah, were nearly exterminated by a fatal disease, their dead bodies being found scattered over the plains in great numbers. From being so common that some of the farmers were accustomed to shoot them to feed to their hogs, they became so scarce that but two or three could be obtained in a whole day's hunt, and sometimes none would be met with. From frontiersmen and hunters I have learned of deer being similarly swept away and almost exterminated over quite large areas.

The field mice, especially the *Arvicolæ*, it is well known are periodically excessively abundant, and again very scarce, and this variation in their numbers is probably due to a similar cause.

CERVIDÆ.

13. Cervus canadensis Erxl. Elk. Wapiti.

Quite numerous along the Musselshell, and also on the Yellowstone above Powder River, and occasional near all the larger wooded streams.[1]

14. Cervus macrotis Say. Mule Deer. "Black-tailed Deer."

More or less frequent along all the wooded streams, and quite common on the Yellowstone and Musselshell Rivers.

VESPERTILIONIDÆ.

15. Lasiurus noveboracensis Gray. Red Bat.

Apparently not very unfrequent along the more heavily timbered portions of the Yellowstone and Musselshell Rivers. Often seen flying about camp after nightfall.

16. Scotophilus fuscus H. All. Brown Bat.

One specimen was taken on the Yellowstone, near the mouth of the Little Porcupine. Probably more or less frequent.

[1] A yearling buck was killed on the Musselshell, which had a very singular malformation of the left antler. It is essentially a double antler, and is attached to the skull by a base three inches long by an inch in diameter. The antler divides into two main parts or beams about three inches from the head, each beam sending out a branch from near its base. There is no trace of a bur or enlargement at the usual point, the bony portion passing higher than usual, and blending insensibly with the horn proper. The anterior beam is fifteen inches long, and inclines a little backward; it sends out a branch seven inches long from near the base of its anterior face, which in turn is also bifurcate at the end. The posterior beam is seventeen inches long, being a little larger than the anterior, and parallel with it. Near the base a branch four inches long arises from its posterior face, which grows in a horizontal direction, curving inwards, and nearly clasping the base of the right antler. The right antler is of the usual size and form of that of a buck of this age.

17. Scotophilus noctivagans H. All. Silvery-haired Bat.

One specimen was taken at our camp of August 29, on the Big Porcupine.

18. Vespertilio subulatus Say. Little Brown Bat.

A specimen was taken at the mouth of the Little Porcupine, Sept. 1. A small bat of probably this species was more or less frequent at most of our camps along the Yellowstone and Musselshell Rivers.

MURIDÆ.

19. Mus musculus Linn. House Mouse.

A specimen was taken in our camp at Fort A. Lincoln, where the species was already becoming common, although the post had been established but one year.

20. Hesperomys leucopus var. **sonoriensis** Coues, Ms. White-footed Mouse.

A specimen was taken at the Big Bend of the Musselshell, and another on Heart River, and it undoubtedly occurs with greater or less frequency along all the principal streams.

21. Neotoma cinerea Bd. Mountain Rat.

More or less frequent along the timbered portions of the streams.

22. Arvicola riparius Ord. Meadow Mouse.

A specimen was collected near the head of Heart River by Dr. W. J. Hoffman, and by him kindly presented to the collection. Signs of their presence were observed at various localities, but no other specimens were obtained.

SACCOMYIDÆ.

23. Dipodomys Ordii Woodh. Jumping Rat.

The most abundant mammal met with in the valley of the Yellowstone; much less common on the Great Porcupine Creek and in the valley of the Musselshell. It seems to prefer the dryest situations, burrowing beneath the cacti and in bunches of sage brush everywhere. Rarely seen abroad, but occasionally surprised and killed by the teamsters and soldiers, the collection being indebted to the kindness of Dr. Hoffman for several specimens thus obtained. These animals form little paths or "run ways" leading in various directions from their burrows, not unlike those made by muskrats.

24. Perognathus flavus Baird. Pouched Mouse.

Apparently common. First met with at the Big Muddy, and afterwards along the Yellowstone and Musselshell.

GEOMYIDÆ.

25. Thomomys rufescens Maxim. Fort Union Gopher.

The little mounds of earth thrown up by some species of *Thomomys* were frequent in the moister parts of the prairies east of the Yellowstone, but were more rare along the Yellowstone, and still less frequent along the Musselshell. The only specimen obtained was taken on the Yellowstone, near Camp Thorne.

CASTORIDÆ.

26. Castor fiber Linn. Beaver.

Sparsely distributed along all the principal streams. Along the Yellowstone indications of their presence were seen at only a few points.

SCIURIDÆ.

27. Sciurus hudsonius Pall. Red Squirrel.

One or two were seen on the Musselshell, among the pines that cover the sandstone ridges.

28. Tamias quadrivittatus var. **pallidus** All. Missouri Striped Squirrel.

Rather frequent from the Little Missouri westward, especially in the bad lands along the Yellowstone and the sandstone bluffs of the Musselshell. Nowhere, however, very abundant.

29. Spermophilus tridecem-lineatus var. **pallidus** All. Striped Gopher.

Generally distributed, but much more numerous on the prairies east of the Yellowstone than in the Yellowstone valley, or west of it.

30. Cynomys ludovicianus Bd. Prairie Dog.

More or less generally distributed throughout the region traversed, but nowhere very numerous, and sometimes not seen for days together.

HYSTRICIDÆ.

31. Erethizon dorsatus var. **epizanthus** All. Porcupine.

Rather rare. Two specimens were killed near the Heart River, and indications of their presence were seen elsewhere.

III. Report on the Birds.

Notwithstanding the almost entire absence of timber, and the generally arid nature of the country, the birds are comparatively numerous, but belong mainly to a few species. The greater part are of course prairie species, but more woodland birds occur than would naturally be looked for in a region so destitute of trees. Every tree and every clump of shrubbery, however isolated, forms the home of one or more pairs of tree-nesting species, while the continuous though narrow belts of trees, and their accompanying undergrowths, are far more populous with bird-life than similar patches of timber are in the better wooded parts of the country. The prairies, particularly those east of the Yellowstone, abound in birds, a few species, almost universally distributed, being exceedingly numerous in individuals. These are, more especially, two species of *Plectrophanes* (*P. ornatus* and *P. Maccowni*), the lark bunting (*Calamospiza bicolor*), and the meadow lark (*Sturnella ludoviciana* var. *neglecta*). The horned lark (*Eremophila alpestris*), the grass finch (*Poœcetes gramineus*), Baird's bunting (*Centronyx Bairdii*), the Missouri skylark (*Neocorys Spraguei*), the yellow-winged and clay-colored sparrows (*Coturniculus passerinus* and *Spizella pallida*), the cow bird (*Molothrus pecoris*), the night hawk (*Chordeiles popetue* var. *Henryi*), the Carolina dove (*Zenædura carolinensis*) and the upland plover (*Actiturus Bartramius*), make up the chief part of the rest. Of the woodland birds, the three by far most abundant species are the Arkansas flycatcher (*Tyrannus verticalis*), the king bird (*Tyrannus carolinensis*) and the red-headed woodpecker (*Melanerpes erythrocephalus*). The cat bird (*Mimus carolinensis*), the brown thrush (*Harporhynchus rufus*), the yellow warbler (*Dendrœca æstiva*), the Arctic towhee (*Pipilo maculatus* var. *arcticus*), and the common wren (*Troglodytes ædon*) are next in abundance, and are pretty sure to be met with wherever there are a few trees and thickets of underbrush. The Arkansas flycatcher probably nearly outnumbers all the other woodland species together, excepting the king bird, which is almost equally abundant. Isolated trees, though miles away from the nearest clump of timber, are sure to be inhabited by one or more pairs of these birds. Thickets of low willows and rose bushes, however isolated, are almost equally certain to form the home of one or more pairs of cat birds, or brown thrushes, or black-headed grosbeaks (*Goniaphea melanocephala*), and sometimes of each of these.

A clearer idea of the association and relative abundance of the species at particular localities may be obtained from the following abstracts from my note-book, than can be gained from the general list.

At Forts Rice and Lincoln, on the Missouri River, where about two weeks were spent in June, a greater variety of species occur than at any point that we visited further west, owing, of course, to the much greater extent of forest occurring here. At Fort Rice, in the wooded bottom-lands of the Missouri, birds were extremely numerous, twenty or twenty-five species being common, and some of them abundant, as indicated in the subjoined list. During the early part of the day, and also toward evening, they filled the air with song, so many singing at once that the song of any particular individual could scarcely be distinguished. At this time but few of the species had commenced nesting. The forest growth of these bottom-lands consists of large, rather scattered trees of oak, ash, willow and cottonwood, with a dense undergrowth of rose, willow and *Symphoricarpus*, at times so dense as to be almost impenetrable. The following birds were observed at this locality during the third week of June:—

Turdus migratorius. Not common.
Turdus fuscescens. Abundant.
Harporhynchus rufus. Frequent.
Mimus carolinensis. Very abundant.
Icteria virens. Very abundant.
Dendrœca æstiva. Very abundant.
Mniotilta varia. Not common.
Geothlypis trichas. Abundant.
Troglodytes ædon. Common.
Seiurus aurocapillus. Abundant.
Setophaga ruticilla. Common.
Hirundo lunifrons. Abundant.
Vireo olivaceus. Common.
Vireo gilvus. Common.
Chrysomitris tristis. Common.
Spizella socialis. Common.
Spizella pallida. Common.
Chondestes grammaca. Common.
Cyanospiza amœna. Common.
Goniaphea melanocephala. Not common.

Pipilo maculatus var. *arcticus*. Abundant.
Quiscalus purpureus. Abundant.
Molothrus pecoris. Abundant.
Icterus Bullocki. Not numerous.
Corvus americanus. Abundant.
Tyrannus carolinensis. Abundant.
Tyrannus verticalis. Abundant.
Empidonax minimus. Common.
Chordeiles popetue var. *Henryi*. Abundant.
Chætura pelasgia. Common.
Colaptes auratus. Not common.
Melanerpes erythrocephalus. Abundant.
Picus pubescens var. *Gairdneri*. Not common.
Falco sparverius. Common.
Zenædura carolinensis. Abundant.

Other woodland species were occasionally observed, but the above named were characteristically common. The following species were generally numerous on the adjoining prairies:—

Eremophila alpestris. Rather common.
Plectrophanes ornatus. Abundant.
Plectrophanes Maccowni. Common.
Poœcetes gramineus. Frequent.
Coturniculus passerinus. Common.
Sturnella ludoviciana var. *neglecta*. Common.
Pediœcetes phasianellus var. *columbianus*. Frequent.
Ægialitis vociferus. Frequent.
Actiturus Bartramius. Abundant.
Numenius longirostris. Occasional.

After leaving the Missouri, we of course found no large areas of forest. Along Heart River, which in places is well bordered with trees, we found nearly the same kinds of birds as at Fort Rice, and equally numerous in proportion to the more limited amount of timber. At the Big Muddy we were detained several days by high water, which afforded me an opportunity of becoming quite familiar with the birds found in the vicinity of our camp. The trees were limited to here and there a few low scraggy box elders and elms scattered along the creek, a few hundred yards to half a mile or more apart. The banks of the stream were clothed with a thick growth of rose bushes, mixed with a few willows and a species each of *Sympho-*

ricarpus and *Viburnum*, which, with the scattered trees already mentioned, formed the only resort available for the tree- and bush-nesting birds. Yet in the three or four days spent here (June 28th to July 1st) about forty species were noticed within the limited area of our rambles, twelve or fifteen of which may be regarded as tree- or bush-nesting species. But generally only a few pairs of each species were met with, the prairie species being the only ones really numerous. As indicating the general character of the bird fauna of this almost treeless region, I subjoin a list of the species met with, and remarks on their relative numbers, giving first the arboreal species and then the truly prairie forms, or those not materially influenced in their distribution by the presence or absence of trees.

Mimus carolinensis. Two or three pairs seen.
Harporhynchus rufus. A single pair observed.
Dendrœca æstiva. A few pairs noticed.
Troglodytes ædon. One pair seen.
Spizella pallida. Only once or twice observed.
Euspiza americana. Several seen.
Goniaphea melanocephala. Several pairs seen.
Tyrannus verticalis. Quite numerous.
Tyrannus carolinensis. One pair seen.
Sayornis Sayus. One pair seen.
Coccygus americanus. One seen.
Zenædura carolinensis. A few pairs seen.
Buteo sp. Seen once or twice.

The following list is composed mainly of prairie species, but includes also several swallows and hawks that cannot properly be included among those of the preceding list: —

Neocorys Spraguei. Common.
Eremophila alpestris. Common.
Hirundo horreorum. Only a few seen.
Petrochelidon lunifrons. Quite frequent.
Cotyle serripennis. One small colony found.
Plectrophanes ornatus. Very abundant.
Plectrophanes Maccowni. Abundant.
Calamospiza bicolor. Abundant.
Poœcetes gramineus. Common.
Centronyx Bairdii. Common.
Coturniculus passerinus. Common.

Chondestes grammaca. Common.
Dolichonyx oryzivorus. Only one seen.
Molothrus pecoris. Common.
Agelæus phœniceus. One small colony.
Xanthocephalus icterocephalus. A few pairs, with the preceding.
Scolecophagus cyanocephalus. Occasional.
Sturnella ludoviciana var. *neglecta.* Common.
Chordeiles popetue var. *Henryi.* Common.
Speotyto cunicularia var. *hypogæa.* One pair seen.
Circus cyaneus var. *hudsonius.* One pair seen.
Archibuteo ferrugineus. Several seen.
Falco communis var. *anatum.* A single pair seen.
Pediœcetes phasianellus var. *columbianus.* Not frequent.
Ægialitis vociferus. Occasional.
Actiturus Bartramius. Common.
Ardea herodias. A single one seen.
Anas boschas. One pair seen.

Along the Yellowstone and Musselshell are found nearly all the species observed at Fort Rice, but generally more sparingly represented, and with the addition of *Sialia arctica*, *Salpinctes obsoletus*, *Centrocercus urophasianus* and *Ægialitis montanus.* A few others not yet mentioned were also occasionally met with, as shown by the following general list, in which one hundred and eighteen species are enumerated.

TURDIDÆ.

1. **Turdus migratorius** Linn. Robin.

Nowhere very numerous. It was rather frequent in June near Fort A. Lincoln, and a few were observed at Fort Rice, and along the Heart River. It was not again met with till we reached the valley of the Yellowstone, where a few pairs were seen at distant intervals. Along the Musselshell they were observed in considerable numbers wherever there were plenty of small fruits, as gooseberries, currants, bullberries (*Shepherdia argentea*), and wild cherries (*Prunus virginiana*).

2. **Turdus fuscescens** Stephens. Wilson's Thrush. Veery.

Common in the timbered bottom lands of the Missouri at Fort Rice, but not elsewhere met with. One nest was found by Mr. Bennett containing eggs *thickly speckled with very small dots of olive.*

Other nests were found with the eggs uniform green, as usual. Song and habits same as at the East.

3. **Oreoscoptes montanus** Bd. Sage Thrush.

Not common. Met with only along the Musselshell, and on the divide between the Musselshell and Yellowstone. Seen only at distant intervals, either singly or two or three together, and very difficult to approach. Frequents the sage brush and grease wood, often far away from streams or timber.

4. **Mimus carolinensis** Gray. Cat Bird.

One of the most common and generally distributed woodland species met with, occurring along the streams everywhere, even where the thickets of rosebushes and *Symphoricarpus* shrubs, with here and there an occasional clump of small willows and isolated scraggy box elders, were the only forms of arborescent vegetation.

5. **Harporhynchus rufus** Cab. Brown Thrush.

More or less common everywhere in the thickets along the streams from the Missouri to the Musselshell. Far less numerous, however, than the preceding species (*Mimus carolinensis*).

SAXICOLIDÆ.

6. **Sialia arctica** Sw. Arctic Blue Bird.

First met with at the crossing of the Yellowstone. Rather frequent along the Musselshell, and seen at Pompey's Pillar, and at a few other points on the Yellowstone. Much more numerous along the pine ridges than among the cottonwoods near the streams.

PARIDÆ.

7. **Parus atricapillus** var. **septentrionalis** All. Chickadee.

Frequent along the Yellowstone and Musselshell Rivers, and noticed in September along Heart River.

SITTIDÆ.

8. **Sitta carolinensis** var. **aculeata** All. White-bellied Nuthatch.

Observed at rare intervals, both on the Yellowstone and Musselshell Rivers.

TROGLODYTIDÆ.

9. **Salpinctes obsoletus** Cab. Rock Wren.

First met with about some rocky buttes near the Big Muddy (near Camp No. 12); common in the Little Missouri Bad Lands, and more or less frequent throughout the Bad Lands of the Yellowstone, and thence westward to the Musselshell.

10. **Troglodytes ædon** var. **Parkmanni** Cs. Common Wren.

Abundant along all the streams wherever there is timber.

ALAUDIDÆ.

11. **Eremophila alpestris** var. **leucolæma** Cs. Horned Lark.

Occasional in the breeding season throughout the region traversed by the Expedition, but nowhere very common, being far less numerous than at the same season on the plains of Kansas and Colorado. More numerous in September, when they were often seen in considerable flocks.

As on the plains generally, the form here met with is the variety with very pale colors, (var. *leucolæma* of Coues), having the yellow which forms so prominent a feature of the markings about the head and on the throat in the eastern form, either of the faintest tint of yellowish white, or quite obsolete.

MOTACILLIDÆ.

12. **Anthus ludovicianus** Licht. Titlark.

First seen September 6, when a small flock was met with on the Yellowstone, near the mouth of Powder River. Two weeks later they were quite common, occurring near Heart River in small flocks, associating with *Plectrophanes Maccowni* and *P. ornatus*.

13. **Neocorys Spraguei** Scl. Missouri Sky-lark.

First observed along the Heart River, about fifty miles west of Fort Rice; more or less common thence to the Yellowstone; and it was noticed once or twice on the plains beyond the Yellowstone. Ranges at least from the Yellowstone to the Missouri, and probably eastward to the Red River. Most numerous on the moist grassy prairies from the Big Muddy westward to the Little Missouri. Probably more rare on the drier plains beyond the Yellowstone, over which it doubtless ranges sparingly to the base of the Rocky Mountains. Audubon, who first described this species, met with it in considerable abundance about Fort Union, near the mouth of the Yellowstone, in the summer of 1843. It was next taken on the Saskatchewan by Capt. Blackiston, and by Capt. J. P. McCown at Fort Randall, D. T., where Dr. Coues feels sure also of having seen it.[1] Dr. Coues also reports it as abundant on the prairies of the northern border of Dakota, where he obtained it in large numbers the past summer. Though it so long eluded observation after its discovery by Audubon, it seems to be a tolerably abundant species over a considerable area.

Audubon speaks of the resemblance of its habits to those of the European Sky-lark, and of the difficulty of obtaining specimens. In common with others, I sought for the bird at first on the ground, striving to locate it by its notes, which were finally found to originate from a point over our heads, so high in the air that the bird was almost invisible. Their notes resemble the syllables *jingle, jingle, jingle, jingle*, rapidly repeated, beginning loud and high, and decreasing rapidly in strength and loudness, and are remarkable for their clear metallic ring, their song reminding one of the jingling sound of a light chain when slowly let fall into a coil. They appear to sing only while on the wing, remaining often one-fourth to half an hour hovering over nearly the same spot, and so high as to be seen with great difficulty. They descend almost vertically, and with a rapidity so great that the eye can scarcely follow them, until within one or two hundred feet of the ground, when they scale off obliquely, and often finally alight at a considerable distance from the point over which they commenced to descend. When on the ground they run rapidly through the grass, and are thus difficult to find, as in attempting to flush them one never knows which way or where to look for them. When mounting to sing they rise rapidly in a wide spiral, with a bounding, very undulatory flight, and are thus soon out of reach.

The nest, as described by Audubon, is placed on the ground and very neatly formed of fine dry grass. The only one found by me was arched over, and being placed in a tuft of rank grass was most thoroughly concealed. The bird would seem to be a close sitter, as in this case the female remained on the nest till I actually stepped over it, she brushing against my feet as she flew off. The eggs, five in

[1] Am. Nat., Vol. VII, Nov., 1873, p. 697.

number, were rather long and pointed, being .90 of an inch in length by .60 in diameter. The ground color is a dull grayish white, thickly and quite uniformly covered with small blotches of purplish brown, giving to the eggs a decidedly dark purplish tint. In color the eggs thus somewhat resemble those of *Anthus ludovicianus*.

This species appears to migrate southward early in September, as very few were seen between the Yellowstone and the Missouri on our homeward march. Being necessarily migratory, and probably passing quite far southward, it seems strange that a bird so numerous should not have been before this met with during its migrations.

SYLVICOLIDÆ.

14. **Mniotilta varia** Vieill. Black-and-White Creeper.

A few were seen near Fort Rice, June 10th to 20th, and several specimens were taken.

15. **Dendrœca æstiva** Baird. Yellow Warbler.

Abundant along the Missouri and Heart Rivers, and frequent on the Musselshell and Yellowstone. Very generally distributed, being found also along all the streams wherever wooded. One of the most numerously represented of the woodland species.

16. **Seiurus aurocapillus** Swain. Golden-crowned Wagtail.

Abundant in the thickets and timbered bottom-lands in the vicinity of Forts Rice and A. Lincoln, and observed on Heart River, but not elsewhere on the trip.

17. **Seiurus ?noveboracensis** Nutt. Water Wagtail.

A water thrush, probably *S. noveboracensis*, was seen by Mr. Bennett at the Big Bend of the Musselshell.

18. **Geothlypis trichas** Cab. Maryland Yellowthroat.

More or less common along all the wooded streams, from the Missouri to the Musselshell, and quite abundant at favorable localities.

19. **Geothlypis philadelphia** var. **Macgillivrayi** All. Mourning Warbler.

Seen a few times along the Musselshell.

20. **Icteria virens** Baird. Yellow-breasted Chat.

Common in the woodlands along the Missouri, and observed at rare intervals on the Yellowstone and Musselshell; also seen on Heart River and the Little Missouri.

21. Setophaga ruticilla Sw. Redstart.

Quite common along the Missouri at Fort Rice in June, where it was apparently breeding. Not met with elsewhere.

A bird supposed to be *Dendrœca Auduboni*, was seen on two or three occasions (on Davis Creek, and near the mouth of the Big Horn River), but it eluding capture, it was not positively identified.

HIRUNDINIDÆ.

22. Hirundo horreorum Bart. Barn Swallow.

Occasional pairs met with throughout the district traversed, but it was nowhere common. Found it nesting under projecting rocks, against which the nest was plastered. Dr. Hayden has also reported its nesting "on the vertical sides of the bluffs along the Missouri,"[1] this being its normal mode of nesting doubtless everywhere prior to the occupation of this continent by the whites.

23. Tachycineta bicolor Cab. White-bellied Swallow.

Common at one locality on the Musselshell, but not seen elsewhere.

24. Tachycineta thalassina Cab. Violet-green Swallow.

First seen near the mouth of Tongue river, and frequently on the Yellowstone for some distance above this point.

25. Petrochelidon lunifrons Cab. Cliff Swallow.

Rather common. The most numerous and the most generally distributed of the Hirundines. A peculiar deviation from its usual mode of nesting, which was observed at some sandstone bluffs near the Yellowstone Crossing, seems worthy of note. The sandstone had weathered in such a manner as to leave the face of the bluff full of rounded cavities a few inches in diameter. Here a large colony of these swallows, instead of affixing their nests against the smooth face of the cliff, as they usually do, built them in these weatherworn holes. A few nests were built in the ordinary way, but most of them were formed by adding a neck to the holes already existing in the rocks! Some of them looked like nests imbedded in the cliff, with only the neck of the retort-shaped structure projecting. On another occasion I had an opportunity to note the breeding of this species in holes in banks, in the same manner as, and in company with, a large colony of sand martins.[2] At Fort Rice a colony had taken possession

[1] Trans. Am. Phil. Soc., XII, p. 161.

[2] Bull. Mus. Comp. Zool., Vol. III, p. 125.

of a bridge over a small creek for the location of their nests, attaching them to the sleepers of the bridge. The bridge was crossed almost constantly by heavy teams, which caused it to vibrate quite forcibly, yet the birds continued their work of nest building without interruption or apparent fear.

26. **Cotyle riparia** Boie. Bank Swallow. Sand Martin.

A colony seen breeding in the banks of the Great Porcupine Creek; young unfledged August 10th. Another large colony was met with on the banks of the Yellowstone, near the mouth of Custer's Creek. Here full-fledged young were obtained August 1st.

27. **Cotyle serripennis** Bon. Rough-winged Sand Martin.

A colony found breeding in a sand bluff near our crossing of the Big Muddy. A considerable number of nests, examined July 1st, all contained newly hatched young. This species was not positively identified as occurring elsewhere on the trip.

28. **Progne subis** Baird. Purple Martin.

More or less frequent along the Yellowstone, from the mouth of Tongue River to Pompey's Pillar, August 1st to 15th.

AMPELIDÆ.

29. **Ampelis cedrorum** Baird. Cedar Bird.

Seen at a few points on the Yellowstone, and quite common along the Musselshell, in consequence, doubtless, of the abundance here of choke cherries, buffalo berries and other small fruits.

VIREONIDÆ.

30. **Vireo olivaceus** Vieill. Red-eyed Vireo.

Common wherever there is timber, from the Missouri to the Musselshell.

31. **Vireo gilvus** Bon. Warbling Vireo.

Common, and generally distributed, occurring wherever there is timber.

LANIIDÆ.

32. **Collurio ludovicianus** var. **excubitoroides** Coues. Logger-head Shrike.

A few pairs were met with, widely scattered throughout the whole district traversed by the Expedition.

FRINGILLIDÆ.

33. Loxia americana Bon. Red Crossbill.

Quite frequent from the mouth of the Big Horn to Pompey's Pillar, and also on the Musselshell, in the vicinity of the pine covered bluffs, and ravines.

34. Chrysomitris tristis Bon. Yellow Bird. Goldfinch.

Observed at frequent intervals from the Missouri to the Yellowstone. Quite common along the better timbered portions of the larger creeks and rivers, particularly along the Musselshell and Yellowstone Rivers.

35. Plectrophanes ornatus Towns. Chestnut-collared Bunting.

Abundant from Fort Rice, on the Missouri River, to the Yellowstone. Rarely observed beyond the Yellowstone, only two or three individuals being seen during our whole march up the Yellowstone and across to the Musselshell and back. Seen about June 1st as far eastward as the James River. They are generally most abundant in the moister prairies, and in the vicinity of the streams. Everywhere between the Missouri and the Yellowstone one of the most abundant species of the plains.

The twelve sets of eggs collected present a very considerable amount of variation in form, size and color. The ground color is usually a clear grayish white, in one set varying to reddish. The markings are usually fine streaks and blotches of purplish brown or black, sometimes very few, at other times covering the greater part of the surface. In size and form they vary from $.74 \times .56$ of an inch to $.85 \times .60$.

In plumage the males of this species vary greatly. Generally the black of the lower parts is greatly obscured by the ashy edgings of the feathers, but in others these parts are pure intense black, while in still others they are more or less strongly tinged with bright rufous. One specimen (Orig. No. 60; S. I. No. 65, 116) has the feathers of the breast and middle of the abdomen broadly edged with bright rufous, representing typically the *P. melanomus*, which, as I have already shown,[1] and as is now generally admitted,[2] is merely a high state of plumage of *P. ornatus*. In the less brightly colored males the lesser wing coverts are brown; but as the general colors become

[1] Bull. Mus. Comp. Zool., III, 136.

[2] Coues, Key to N. Amer. Birds; Baird, Brewer and Ridgway, Hist. Birds North Amer.

heightened, these coverts become black, with the outer row tipped with white. One of the females also shows the rufous color strongly on the lower parts, which are almost as black as in some of the paler males. Another female is quite black below, but shows no red. Both have the nuchal collar strongly marked.

36. Plectrophanes Maccowni Bd. McCown's Bunting.

Seen in considerable abundance from the Missouri to the Yellowstone, but hardly so numerous nor so uniformly distributed as the *P. ornatus*. Sometimes very few were seen for twenty or thirty miles, and again they outnumbered any other species over a considerable area. Both this and *P. ornatus* seem to locate more or less in colonies, being here and there very numerous, and then almost entirely absent for miles.

In ascending the Yellowstone, about August 1st, this species, as well as *P. ornatus*, was very rarely seen; but a month later, on our way back, we began to meet with them in small flocks, which increased in size and number as the season advanced. A few small parties were seen on the Musselshell, and in crossing the divide between the Musselshell and the Yellowstone; but on again reaching the valley of the Yellowstone at the mouth of the Little Porcupine, we found them in flocks of hundreds, and even in some cases of thousands, of individuals. At the Yellowstone Crossing (Camp Thorne), where hardly one was seen in July, in September the prairies were alive with the immense flocks that had assembled from more or less distant points. Mixed with them were many *Eremophila alpestris* and a few *P. ornatus*, and occasionally a little party of *Anthus ludovicianus*. They were also frequent thence eastward to the Missouri River.

Three nests of this species were found, two of which contained five eggs each, and the other three. The nests were of course placed on the ground, and were formed of dry grass. The eggs are olive, or dull yellowish white, sparingly marked with small streaks and blotches of brown. The ground color varies from a dull soiled bluish white to cream color. Average size .80 by .60 of an inch. These are apparently the first really authentic eggs of this species known.

The plumage of this species is quite variable, even in the breeding season, the black of the breast in the males being sometimes pure and intense, and sometimes nearly concealed by the ashy edgings of the feathers, and the general colors vary in intensity in a corresponding degree. The females sometimes wholly lack the chestnut on the wing-coverts, while in some it is nearly as bright as in average males.

37. Passerculus savanna var. **anthinus** Coues. Savanna Sparrow.

A single specimen was shot at Camp 56, on the Great Porcupine Creek, August 29th, where a few others were seen.

38. Poœcetes gramineus Baird. Grass Finch.

One of the most common and uniformly distributed species met with; particularly numerous in the valleys of the Yellowstone and the Musselshell.

39. Coturniculus passerinus var. **perpallidus** Ridgway. Yellow-winged Sparrow.

Common at intervals from the Missouri to the Musselshell, but apparently much more numerous over the comparatively moist prairies east of the Yellowstone than beyond it.

40. Centronyx Bairdii Baird. Baird's Sparrow.

Rather frequent in the moist hollows from the Missouri westward to the Little Missouri. Found by Audubon about Fort Union, and Dr. Elliott Coues reports it as abundant in Northern Dakota, west of the Pembina Mountains.[1] A single nest (the only one thus far known) was found by the writer July 1st, near Heart River, containing four eggs. The nest was a substantial structure of dry grass placed on the ground. The eggs are quite spherical, and of large size for the size of the bird, measuring .82 of an inch by .65. The color is pale grayish white, irregularly and quite thickly marked with specks and blotches of reddish brown, varying to dark umber.

41. Spizella socialis Bon. Chipping Sparrow.

More or less common along the wooded bottom-lands of the streams from the Missouri to the Musselshell; quite abundant also in August and September in the piny districts of the Yellowstone and Musselshell. They were chiefly young birds, which, with *Chondestes grammaca*, often formed considerable flocks.

42. Spizella pusilla Bon. Field Sparrow.

Frequent along Davis Creek, in the Bad Lands of the Little Missouri, but not observed elsewhere. No specimens were taken.

43. Spizella pallida Bon. Clay-colored Sparrow.

Common in the thickets bordering the streams from the Missouri nearly to the Yellowstone. In the valley of the Yellowstone, and to the westward, it seemed to be wholly replaced by the *S. Breweri*; at

[1]Am. Nat., Vol. VII, Nov., 1873, p. 697.

least no specimens of the true *pallida* type were taken, while the other form was abundant, the sage brush plains seeming to be its favorite haunts.

43*a*. **Spizella pallida** var. **Breweri** Coues. Brewer's Sparrow.

A common inhabitant of the sage brush everywhere; especially numerous in the valleys of the Yellowstone and Musselshell.

44. **Chondestes grammaca** Bon. Lark Finch.

One of the most abundant and generally diffused species, frequenting the edges of the wooded bottom-lands and the bushy ravines, but also found occasionally quite far out on the prairies.

45. **Calamospiza bicolor** Bon. Lark Bunting.

Very abundant at localities from near the Missouri to the valley of the Musselshell. Prefers wet prairies and bottom-lands near streams, where scores of pairs were sometimes found inhabiting a small area. I have often seen six or eight males hovering and singing in the air at once. Observed it first about fifty miles west of Fort Rice; saw it in the valley of the Yellowstone the first week in August, in considerable flocks, consisting mainly of young birds; but it disappeared entirely about the end of the month, being one of the earliest species to migrate.

In this species the colors are much less intense here than on the plains of Middle Kansas and Colorado, the black being more obscured by brownish edgings to the feathers, and more frequently mixed with brownish patches. This region probably forms nearly the northern limit of its distribution, it doubtless not extending its range much to the northward of the Upper Missouri.

The eggs of this species are very variable in respect to size, form and depth of color. Some twenty sets were collected, varying in color from pale bluish white to quite deep blue. The average dimensions may be given as .90 by .73 of an inch, the variation ranging from .80 to .95 of an inch in length, and .63 to .75 of an inch in diameter. The considerable variation in form is indicated by the following extremes of proportions: .80 × .73, .95 × .65, and .86 × .63. The nest varies from a very slight to a quite bulky and substantial structure.

This species proves to be one of the favorite foster-parents of the cow bird (*Molothrus pecoris*). In a series of eighteen nests, five, or nearly one-third, contained eggs of the cow bird, two even containing two each, and one had three; while out of twenty-nine nests of other ground-nesting prairie birds, collected at the same time and over the same area, *not one* contained an egg of the cow bird!

46. Euspiza americana Bon. Black-throated Bunting.

Occasional along the bushy ravines from Fort Rice westward to the Bad Lands of the Little Missouri.

47. Goniaphea melanocephala Bowd. Black-headed Grosbeak.

Observed at frequent intervals along the wooded portions of the streams from the Missouri to the Yellowstone.

48. Cyanospiza amœna Baird. Western Indigo Bird. Lazuli Finch.

Quite abundant on the Missouri at Fort Rice, and met with occasionally thence westward throughout our journey.

49. Pipilo maculatus var. **arcticus** Coues. Arctic Towhee.

A common inhabitant of the wooded bottom-lands everywhere. Heard a few whose songs were undistinguishable from the songs of *P. erythrophthalmus*. A single individual seen on Davis Creek could not be distinguished in appearance, though but three or four yards distant, from the true *P. erythrophthalmus*.

ICTERIDÆ.

50. Dolichonyx oryzivorus Sw. Bobolink.

A few were seen at distant intervals about midway between the Missouri and Yellowstone,— not more than half a dozen in all,—and none were met with elsewhere. Dr. Hayden reports it as common about Fort Pierre, but states that he "never observed it high up towards the sources of the Missouri."[1]

51. Molothrus pecoris Swain. Cow Bird.

Abundant and very generally diffused. Its eggs occurred in nearly one-third of the nests of the lark bunting we found, in one instance three, and in several instances two, being found in the same nest. They thus form no inconsiderable check upon the increase of this bird; but in no instance were their eggs found in the nests of the other prairie birds.

52. Agelæus phœniceus Vieill. Red-winged Blackbird.

Met with only at distant intervals, and nowhere in considerable numbers. Not observed either on the Musselshell or the Yellowstone.

[1] Trans. Am. Phil. Soc., XII, p. 169.

53. Xanthocephalus icterocephalus Baird. Yellow-headed Blackbird.

Seen but three or four times on the whole journey. A small colony found breeding near the point where we crossed the Big Muddy, and a single small flock seen near the head of the Great Porcupine Creek. A small flock seen once also on Heart River.

54. Sturnella ludoviciana var. **neglecta** All. Meadow Lark.

One of the most abundant birds of the plains, occurring everywhere. No other bird, perhaps, is so uniformly met with.

The following are some of the variations in the size and color of the eggs of this species: Extremes, 1.25 $\times$ .81 inches, and 1.02 $\times$ .81 inches. Two eggs of the same set varied as follows: 1.20 $\times$ .90; 1.02 $\times$ .80. The markings vary from pale diffused rufous blotches to sharply defined small dark purplish brown or black specks. One set of eggs presents an almost exact likeness in size, shape and color to the eggs of the whippoorwill.

55. Icterus spurius Bon. Orchard Oriole.

A few pairs seen near the "Second Crossing" of Heart River, July 5th, were the only ones met with.

56. Icterus Bullocki Bon. Bullock's Oriole.

More or less frequent along all the wooded portions of the streams. Observed at Fort Rice and on the Heart River; collected on Beaver Creek, on the Yellowstone at the Crossing, and at the Big Bend of the Musselshell. Dr. W. J. Hoffman, U. S. A., informs me that it is common at the Grand River Agency and at Fort Randall. Dr. Hayden says this species "seldom passes above Fort Pierre," but that "it occurs occasionally along the Lower Missouri." He speaks of having met with but one specimen in all his explorations. On the other hand, he gives *I. Baltimore* as "abundant throughout the wooded portion of the Missouri country," and as "more common on the numerous islands in the river, from the mouth to Fort Union," [1] while not a single specimen was seen by us west of the Missouri.

57. Scolecophagus cyanocephalus Cab. Brewer's Blackbird.

Common along all the timbered portions of the streams everywhere. In September seen in immense flocks along the Yellowstone and Heart Rivers. I observed large flocks in Dakota, as far east even as the James River.

[1] Trans. Am. Phil. Soc., XII, p. 170.

58. Quiscalus purpureus Licht. Crow Blackbird. Purple Grakle.

Abundant on the Missouri at Fort Rice, common along Heart River, and on the Yellowstone as far up as we ascended. Very abundant about the mouth of Tongue River.

CORVIDÆ.

59. Corvus corax Linn. Raven.

More or less common from the Missouri to the Musselshell, being seen almost daily, but nowhere very numerous. Seen on the divide, between the two Porcupine Creeks, far out on the naked barren ridges in the Bad Lands.

60. Corvus americanus Aud. Common Crow.

Common wherever there is timber. Contrary to what is usually supposed, we found the ravens quite common where the crows were very abundant. Quite large flocks of crows and small parties of ravens were frequently in sight along the Yellowstone at the same time, there being apparently no hostility nor antipathy between them. We robbed a raven's nest July 5th, near the Heart River, within hearing of a large flock of crows that had assembled a few hundred yards distant in the timber, to celebrate, apparently, some great occasion.

61. Pica caudata var. **hudsonica** All. Magpie.

Not common. A few seen at distant intervals throughout the journey.

TYRANNIDÆ.

62. Tyrannus carolinensis Bd. King Bird. Bee Martin.

Very common along all the wooded portions of the streams. One of the most common of the woodland birds. Seen frequently after the breeding season far out among the sage brush on the plains. Departs for the south during the last week in August.

63. Tyrannus verticalis Say. Arkansas Flycatcher.

Exceedingly abundant wherever there is timber, far outnumbering even so common a bird as the *T. carolinensis*, and more numerous than any other of the tree-nesting species. After the breeding season seen far away from the timber among the sage brush. This, like the preceding species, disappeared about the end of August.

64. Sayornis Sayus Bd. Say's Flycatcher.

During the breeding season only solitary pairs were seen, usually at intervals of several days, generally in the Bad Lands, or about rocky buttes. Found two or three nests, but they all contained young birds. The nests were placed under projecting ledges of rock, in broken or precipitous places. Later in the season the species was more frequently observed, sometimes in small parties of four or five together.

65. **Contopus virens** var. **Richardsoni** All. Richardson's Pewee.

Seen at various points along the Yellowstone and Musselshell.

66. **Empidonax minimus** Baird. Least Flycatcher.

Common in the timbered bottom-lands of the Missouri at Fort Rice, frequenting the more open parts of the woodland, where fires had killed the underbrush. A few were seen also on Heart River, but neither this nor any other species of *Empidonax* was met with elsewhere during the whole journey.

CAPRIMULGIDÆ.

67. **Antrostomus Nuttalli** Cass. Nuttall's Whippoorwill.

A few individuals seen in the pine ridges and ravines along the Musselshell.

68. **Chordeiles popetue** var. **Henryi** All. Western Nighthawk.

Everywhere quite common.

CYPSELIDÆ.

69. **Chætura pelasgia** Steph. Swift.

Common along the Missouri at Fort Rice; seen elsewhere only on the Yellowstone, near the mouth of Tongue River, where the hollow trees of the heavy cottonwood forests doubtless afford them the necessary breeding sites.

ALCEDINIDÆ.

70. **Ceryle alcyon** Boie. Kingfisher.

Two or three individuals, observed on the Musselshell, were all that were seen during the whole journey. Their absence is readily explained by the turbid state of the streams, in which it would be impossible for them to discover their finny prey, however abundant it might be.

CUCULIDÆ.

71. **Coccygus americanus** Bon. Yellow-billed Cuckoo.

This species was several times observed along Heart River and either this or *C. erythropthalmus* in the valley of the Yellowstone. Dr. Hayden speaks of having both species in his Nebraska collections.[1]

PICIDÆ.

72. **Picus villosus** var. **Harrisi** All. Hairy Woodpecker.

Occasional in the forests of the Yellowstone and Musselshell.

73. **Picus pubescens** var. **Gairdneri** Coues. Downy Woodpecker.

More or less frequent along the more heavily wooded portions of the streams, from the Missouri to the Musselshell.

74. **Sphyrapicus varius** var. **nuchalis** All. Yellow-bellied Woodpecker.

Seen only on the Musselshell, where several specimens were taken.

75. **Melanerpes erythrocephalus** Swain. Red-headed Woodpecker.

Abundant everywhere from the Missouri to the Musselshell, far outnumbering all the other *Picidæ* together.

76. **Colaptes "auratus."** Yellow-shafted Flicker.

Obtained in the vicinity of Fort Rice, and seen occasionally westward to the Musselshell.

77. **Colaptes "mexicanus."** Red-shafted Flicker.

The most prevalent form of *Colaptes*, but by no means numerous, and very hard to approach. On the Great Porcupine Creek I shot a series of specimens that present a very interesting gradation from the "*mexicanus*" to the "*auratus*" type. Throughout this region the two forms associate together, and a considerable portion of them present an interesting combination of the characters of the two forms.

A female collected at Fort Rice is scarcely different from the usual form of *C.* "*auratus*." A young male, collected on the Big Knife River, also scarcely differs from the ordinary style of *C.* "*auratus*." Other specimens, collected along the Yellowstone and Musselshell Rivers, more or less strongly resemble the *C.* "*mexicanus*," one of them typically representing that form, while of the rest each presents a different and intermediate stage between the two types.

[1] Trans. Am. Phil. Soc., XII, p. 155.

STRIGIDÆ.

78. **Bubo virginianus** Bon. Great Horned Owl.
Occasional.

79. **Otus vulgaris** var. **Wilsonianus** All. Long-eared Owl.
Occasional. Two specimens obtained.

80. **Brachyotus palustris** Bon. Short-eared Owl.
Apparently the most common of the Owls. Seen a few times far out on the prairies, many miles from timber.

81. **Syrnium nebulosum** Gray. Barred Owl.
Met with on the Missouri at Fort Rice, and on the Yellowstone and Musselshell.

82. **Speotyto cunicularia** var. **hypogæa** Coues. Burrowing Owl.
Not numerous; met with at intervals, in the prairie-dog towns, from the Little Missouri westward.

FALCONIDÆ.

83. **Circus cyaneus** var. **hudsonius** All. Marsh Hawk.
Rare in the breeding season; more common in August and September.

84. **Accipiter Cooperi** Bon. Cooper's Hawk.
One was taken August 8th, near the mouth of the Little Porcupine, and a few others were seen later in the season. Rare.

85. **Falco communis** var. **anatum** Ridg. Duck Hawk.
Seen but once or twice, near the Great Bend of the Musselshell.

86. **Falco columbarius** Linn. Pigeon Hawk.
Seen at distant intervals on the Yellowstone and Heart Rivers, in September.

87. **Falco sparverius** Linn. Sparrow Hawk.
Very abundant along the timbered portion of the streams everywhere. Ten times more numerous than all the other *Falconidæ* together.

88. **Buteo borealis** Vieill. Red-tailed Hawk.
Occasional along the more heavily timbered portions of the bottom-lands.

89. **Buteo Swainsoni** Bon. Swainson's Hawk.
More or less common, doubtless, where there is timber. Obtained an adult male on Heart River, June 25th.

90. Archibuteo ferrugineus Gray. Western Rough-legged Hawk.

Next to *Falco sparverius*, the most common species of the *Falconidæ*; yet it was seen only at distant intervals. Several nests were found containing young. The nest is often a very large, bulky structure, sometimes three or four feet in diameter, built of coarse sticks, mixed with the ribs of antelopes and buffalos. It is placed on the ground or rocks, usually near the summit of isolated buttes. The same nest is apparently occupied for a series of years and annually repaired.

91. Aquila chrysaëtos Linn. Golden Eagle.

Occasional. A young one was captured by some soldiers of the 7th Cavalry on Heart River.

92. Haliaëtus leucocephalus Savig. White-headed Eagle. Bald Eagle.

Seen only at rare intervals along the Yellowstone and Musselshell Rivers.

CATHARTIDÆ.

93. Cathartes aura Ill. Turkey Buzzard.

Seen at intervals all the way from the Missouri to the Yellowstone, rarely more than two or three together, and generally singly. Quite a number, however, finally assembled around Camp Thorne, attracted, doubtless, by the offal from the beeves slaughtered for the support of the garrison stationed there during the absence of the main expedition up the Yellowstone.

COLUMBIDÆ.

94. Zenædura carolinensis Bon. Carolina Dove.

Abundant everywhere, particularly near the streams. A few nests met with, which were invariably placed on the ground.

TETRAONIDÆ.

95. Centrocercus urophasianus Sab. Sage Cock. Cock-of-the-plains.

More or less common along the Yellowstone and Musselshell Rivers, but large flocks met with only a few times. None seen east of the Little Missouri.

96. Pediœcetes phasianellus var. **columbianus** Coues. Sharp-tailed Grouse.

Occasional in the vicinity of all the larger streams from the Missouri to the Musselshell, but nowhere very numerous. Young hatched the last week in June.

CHARADRIIDÆ.

97. Ægialitis vociferus Cass. Killdee Plover.

Single pairs met with at intervals throughout our journey. Far less numerous than on the plains of Kansas, Colorado, and Southern Wyoming. Sometimes none were seen for several days.

98. Ægialitis montanus Cass. Mountain Plover.

Met with at widely distant intervals. Seen more frequently on the plains bordering the Yellowstone and Musselshell than elsewhere. Two or three small flocks were met with in September, but generally they were seen only in single pairs at intervals of several days.

RECURVIROSTRIDÆ.

99. Recurvirostra americana Gmel. Avoset.

Three or four pairs were seen about a rain-water pool on the divide between the Yellowstone and Musselshell (near Camp 46), August 18th — the only time the species was met with on the whole journey.

SCOLOPACIDÆ.

100. Tringa ? Bairdii Coues. Baird's Sandpiper.

A few individuals were seen along the Musselshell, which were supposed to be of this species, but no specimens were taken. It was also seen a few times in September along the Yellowstone.

101. Totanus solitarius Wils. Solitary Sandpiper.

Observed frequently along the Musselshell and Yellowstone Rivers. First seen July 28th, on a little creek not far from Camp Thorne.

102. Totanus melanoleuca Gm. Greater Tattler.

Occasional along the Musselshell, and seen a few times on the Yellowstone and Heart Rivers in September.

103. Tringoides macularius Gray. Spotted Sandpiper.

Not common. Seen at unfrequent intervals from the Missouri to the Musselshell.

104. Actiturus Bartramius Bon. Bartram's Plover. Upland Plover.

Very common on the prairies east of the Yellowstone, and seen at frequent intervals throughout our journey. Outnumbers all the other *Grallæ* together. Nests found with fresh eggs from June 14th to July 15th.

105. Numenius longirostris Wilson. Long-billed Curlew.

A few pairs met with at quite distant intervals from the Missouri to the Musselshell.

ARDEIDÆ.

106. Ardea herodias Linn. Blue Heron.

A single specimen seen on Heart River — the only representative of the family seen on the journey.

GRUIDÆ.

107. Grus canadensis Temm. Brown Crane.

A large flock seen at the crossing of the Little Missouri, September 15th, circling over our camp high in the air; the only time that the species was observed.

RALLIDÆ.

108. Rallus virginianus Linn. Virginia Rail.

Met with once or twice in June near the Heart River.

109. Fulica americana Gmel. Coot.

Not common.

ANATIDÆ.

110. Branta canadensis Scop. Canada Goose.

Quite frequent along the Yellowstone and Musselshell. Breeds.

111. Anas boschas Linn. Mallard.

Not common. Seen on Beaver Creek and Heart River in September.

112. Querquedula carolinensis Steph. Green-winged Teal.

A few pairs met with at distant intervals during the breeding season, and a few small flocks seen in September mixed with *Q. discors.*

113. Quequedula discors Steph. Blue-winged Teal.

Met with occasionally in the breeding season, and a few small flocks seen in September.

114. Spatula clypeata Boie. Shoveller. Spoon-billed Duck. Two or three shot near the head of Heart River in September. No others observed.

115. Aix sponsa Boie. Wood Duck.
More or less frequent on the Missouri, near Forts A. Lincoln and Rice, but not met with elsewhere.

116. Mergus cucullatus Linn. Hooded Merganser.
Met with near the head of Heart River about July 1st, and also in September, but not seen elsewhere.

PELECANIDÆ.

117. Pelecanus trachyrhynchus Lath. White Pelican.
One specimen obtained at Camp Thorne, September 12th. Said to be common on the Missouri in June, a few miles below Fort Rice.

PODICIPIDÆ.

118. Podiceps auritus var. **californicus** Coues. Eared Grebe.

A single specimen was obtained on the Yellowstone, near the mouth of Tongue River, September 2d, and four or five others were seen on the Great Porcupine Creek.

IV. Report on the Reptiles.

Reptilian life is extremely scarce throughout the region traversed by the Expedition, there being but two species very numerously represented, or very generally dispersed. These are the *Caudisona confluenta* and the *Phrynosoma Douglassi.* The first not only outnumbers all the other Ophidians, but all the other reptiles, excluding the *Phrynosoma Douglassi*, which may possibly exceed in numbers the *Caudisona confluenta.*

The *Aspidonectes spinifer*, which is more or less frequent in the large streams, is apparently almost the sole representative of the Testudinata, as *Phrynosoma Douglassi* is also almost the only representative of the Lacertilia.

TESTUDINATA.

1. Chrysemys oregonensis Agass.
A few individuals were seen near Fort Rice, and in the vicinity of Heart River, near pools of water in the prairies.

2. Aspidonectes spinifer Agass.

Frequent in both the Musselshell and Yellowstone Rivers, and also seen in some of the smaller streams.

LACERTILIA.

3. Sceloporus consobrinus B. & G.

A single specimen was taken on the Yellowstone, near Camp Thorne, and a few others were seen. Apparently quite rare.

4. Phrynosoma Douglassi Wagl.

Occasional throughout the region traversed, but very common only at a few looalities.

OPHIDIA.

5. Caudisona confluenta (Say).

Common, especially in the Bad Lands of the Little Missouri and along the Yellowstone. This species many times outnumbers all the other Ophidians together. Several hundred were killed by the different members of the Expedition, but notwithstanding its abundance the only casualty resulting from it was one horse bitten. On the Expedition of 1872 they were found in much greater abundance than on the present one. It was estimated that on the Expedition of 1872 not less than *two thousand* were killed, and yet not a man nor an animal was bitten by them. This shows how little danger there really is from them, even when numerous. Man is a far more fatal enemy to the snake than the snake is to man. I was surprised to find how late in the season they are found abroad, as we met with them quite frequently after several severe frosts had occurred. During July two pairs were found *in coitu*, indicating the season at which they pair.

6. Bascanion flaviventris B. & G.

Two specimens were taken in the valley of the Yellowstone, near Camp Thorne, and only two or three others were seen.

7. Pityophis bellona B. & G.

A single specimen taken at the mouth of Custer's Creek, Sept. 1st, was the only one seen.

8. Heterodon nasicus B. & G.

A specimen was taken near the head of Heart River, and another in the valley of the Yellowstone; one or two others were observed.

9. Eutænia proxima B. & G.

Not common. Less than half a dozen representatives of the genus *Eutænia* seen on the whole trip.

V. Report on the Batrachians.

As would be anticipated from the great aridity of the climate, the Batrachians are very sparsely represented in the district traversed by the Expedition. The *Rana halecina* is by far the most common species, but is yet comparatively scarce, and, with *Bufo columbiensis*, forms the only representative of the class that can be regarded as at all frequent.

ANURA.

1. Bufo columbiensis B. & G.

Occasional, but far from common.

2. Spea bombifrons Cope.

A single specimen, collected by Mr. Bennet at Camp Thorne, was the only one seen.

3. Rana halecina Kalm.

Rather frequent along the streams, and quite generally dispersed.

URODELA.

4. Amblystoma mavortium Baird.

A specimen was obtained at Fort A. Lincoln, and it was once or twice seen in the valley of the Yellowstone. This was the only representative of the tailed batrachians seen.

VI. Report on the Plants.

For the identification of the species of the following list of plants I am indebted to Dr. Geo. Vasey, Botanist of the Department of Agriculture, to whom the collection was referred for determination. I have added a few species from my notes that were not contained in the collection, which are distinguished by the names being enclosed in brackets. The collection was begun at Fort Rice, about June 12th, and was continued throughout the journey, or till about September 15th. Many of the species collected were confined to the vicinity of the large streams, as were nearly all the species of *Ranunculaceæ* met with, while others were as exclusively inhabitants of the dryest portions of the Plains. The difference between the flora of the vicinity of Fort Rice and that of the divide between the Yellowstone and Musselshell Rivers is very great. The general features of the country through which we passed, and of its flora, have already been given in the Introduction; but a few additional remarks may be added here. As compared with the flora of Northern Kansas, situated seven or eight degrees further south, the contrast is very great, while the general features of the landscape, aside from the flora, of the region east of the Yellowstone, and especially east of the Little Missouri, are not essentially different from those of the prairies of Middle Kansas. Gently rolling grassy prairies characterize both regions, but while in Kansas the landscape, during early summer, is everywhere varied with differently tinted patches of bright color, from the abundance of the flowers, and from those of the same species growing together in masses, in central Dakota we miss entirely this effect, the flowers being not only far less numerous in species, but those of a given species are so few as rarely to give their own tint to extended portions of the landscape. Such social species, for instance, as the *Malvastrum coccineum*, which on the Kansas prairies sometimes covers acres with its bright flowers, almost to the exclusion of other species, occurs here apparently only as a straggler, a few individuals in a place, of small size, and never forming masses of color sufficient to particularly attract the attention. The same is true of many other species; the absence of this marked grouping of the brightly colored species, resulting evidently from their paucity of representatives, being here as much a floral characteristic of these northern prairies as the presence of this grouping is on the prairies of Kansas. Further remarks on the distribution of particular species are incorporated with the list.

RANUNCULACEÆ.

1. **Clematis ligusticifolia** Nutt. Collected on the Yellowstone at the mouth of Big Porcupine Creek, August 8th. Noticed in considerable abundance at other localities along the Yellowstone and its tributaries.

1*a*. **Clematis ligusticifolia** var. β. Collected with the preceding.

2. **Anemone patens** var. **Nuttalliana** Gray. Wooded bottom-lands of the Missouri at Fort Rice, June 15th. Abundant.

3. **Anemone Pennsylvanica** Linn. Abundant at Fort Rice, with the preceding.

4. **Thalictrum Fendleri** Eng. In moist wooded bottom-lands at Fort Rice. Common.

5. **Ranunculus aquatilis** var. **heterophyllus** D. C. Crossing of the Big Muddy, July 1st.

CRUCIFERÆ.

6. **Erysimum Arkansanum** Nutt. Crossing of the Big Muddy, July 1st. A common prairie species from the Missouri to the Yellowstone.

7. **Erysimum asperum** var. **inconspicuum** S. Watson. Crossing of the Big Muddy, July 1st.

8. **Vesicaria Ludoviciana** D. C. Prairies, west of Fort Rice, June 22d.

9. **Physaria didymocarpa** Gray. Valley of the Little Missouri, at the mouth of Davis Creek, July 10th.

10. **Lepidium Virginicum** L. Valley of the Little Missouri, July 10th.

CAPPARIDACEÆ.

11. **Polanisia uniglandulosa** D. C. Shell Point, Yellowstone River, July 16th. Abundant in sandy places.

12. **Cleome integrifolia** Nutt. Valley of the Musselshell August 20th. Common.

CARYOPHYLLACEÆ.

13. **Cerastium arvense** Linn. Valley of the Musselshell.

14. **Paronychia sessiliflora** Nutt. Near the Big Muddy, July 3d.

MALVACEÆ.

15. **Malvastrum coccineum** Gray. Sparingly on the prairies from Fort Rice to the Yellowstone, June 18th, and later. Also found in blossom in the bottom lands of the Yellowstone, August 8th, where the growth of this and other plants had been retarded by the spring overflow of the river.

LINACEÆ.

16. **Linum sulcatum** Riddell. Crossing of the Big Muddy, July 1st. Seen also on Heart River, but not common.

17. **Linum perenne** L. Abundant on the dry plains and prairies everywhere, varying greatly in size and appearance at different localities.

ANACARDIACEÆ.

18. **Rhus toxicodendron** Linn. Along the Missouri at Fort Rice, and also on Heart River.

VITACEÆ.

19. **Vitis cordifolia** Michx. Heart River, June 24th. Also on the Yellowstone, a short distance below Pompey's Pillar.

20. **Ampelopsis quinquefolia** Michx. Heart River, June 24th.

CELASTRACEÆ.

21. **Celastrus scandens** L. Heart River, June 24th.

ACERACEÆ.

22. **Negundo aceroides** Mœnch. One of the most common trees along all the streams from the Missouri to the Musselshell. This and the cottonwood (*Populus monolifera*) constitute the only trees met with at many localities.

POLYGALACEÆ.

23. **Polygala alba** Nutt. Common on the moister prairies, from Fort Rice westward.

LEGUMINOSÆ.

24. **Lupinus pusillus** Pursh. Common on the prairies between the Missouri and Little Missouri Rivers.

25. **Psoralea floribunda** Nutt. Yellowstone Valley, at mouth of Little Porcupine Creek, August 7th.

26. **Psoralea lanceolata** Pursh. Moist bottom-land of the Missouri, at Fort Rice, June 15th.

27. **Psoralea argophylla** Pursh. Great Bend of Heart River, July 24th.

28. **Psoralea esculenta** Pursh. Near Fort Rice, June 20th.

29. **Hosackia Purshiana** Benth. Prairies west of Little Missouri, July 11th.

30. **Petalostemon candida** Michx. Common on the prairies from the Missouri to the Yellowstone.

31. **Petalostemon violaceum** Michx. With the preceding, and equally common.

32. **Lathyrus ochroleucus** Hook. Fort Rice, June 15th.

33. **Lathyrus linearis** Nutt. Bottom-lands of the Missouri at Fort Rice, June 15th. Abundant.

34. **Vicia Americana** Muhl. Fort Rice, June 16th. Common.

34*a*. **Vicia Americana** Muhl., var. Valley of the Little Missouri, at mouth of Davis Creek, July 10th.

35. **Astragalus lotiflorus** Hook. Near Heart River, July 7th.

36. Astragalus Nuttallianus D. C. Near Heart River, July 7th.

37. Astragalus racemosus Pursh. Heart River Crossing, June 26th.

38. Astragalus Plattensis Nutt. Fort Rice, June 13th.

39. Astragalus adsurgens Pall. Heart River Crossing, June 26th.

40. Astragalus aboriginum Rich. Heart River Crossing, June 26th.

41. Astragalus bisulcatus Gray. Head of Heart River, July 8th.

42. Oxytropis Lamberti Pursh. Fort Rice, June 13th.

43. Glycyrrhiza lepidota Nutt. Mouth of Little Porcupine Creek, August 4th.

44. Amorpha fruticosa Linn. Heart River Crossing, June 26th. A rather common shrub along the streams.

45. [Amorpha canescens Nutt.] Common on the prairies.

46. Amorpha microphylla Pursh. Heart River Crossing, June 26th. Common only at a few localities.

ROSACEÆ.

47. Prunus Virginiana Linn. Fort Rice, June 15th. A common shrub along all the streams, from the Missouri to the Musselshell, and on the tributaries of the Little Missouri and Heart Rivers, but not frequent on the Yellowstone, between Glendive Creek and Pompey's Pillar.

48. Prunus pumila Linn. Near the Great Bend of Heart River, June 24th.

49. Potentilla arguta Pursh. Crossing of the Big Muddy, June 30th.

50. Potentilla Pennsylvanica Linn., var. Head of Heart River, July 8th.

51. Potentilla anserina Linn. Bad Route Creek, near the Yellowstone, July 28th.

52. Potentilla gracilis Dougl., var. Head of Heart River, July 8th.

53. Potentilla fruticosa Linn. Heart River Crossing, June 25th.

54. Rosa blanda Ait. Prairies west of Fort Rice, June 22d. Abundant on the prairies almost everywhere, thence westward to the

Yellowstone. Varies in height from a few inches to three feet, according to locality.

55. [**Cratægus coccinea** Linn.] Occasional along the banks of the streams.

56. **Amelanchier Canadensis** T. and G. Heart River Crossing, June 25th. Widely dispersed, but not common anywhere.

ONAGRACEÆ.

57. **Epilobium paniculatum** Nutt. Bad Route Creek, July 28th.

58. **Gaura coccinea** Nutt. Heart River, July 6th.

59. **Œnothera biennis** Linn. Bad Route Creek, July 28th

59*a*. **Œnothera biennis** Linn., var. Head of Heart River, July 8th.

60. **Œnothera albicaulis** Nutt. Head of Heart River, July 28th.

61. **Œnothera serrulata** Nutt. Second Crossing of Heart River, July 6th.

62. **Œnothera pinnatifida** Nutt. Great Bend of Heart River, June 23d.

63. **Œnothera cæspitosa** Nutt. Near Fort Rice, June 20th.

LOASACEÆ.

64. **Mentzelia nuda** Linn. Shell Point, Yellowstone River, July 16th.

CACTACEÆ.

65. [**Opuntia Missouriense** D. C.] Common at Fort Rice, and increasing in abundance westward. In the Yellowstone Valley, and between the Yellowstone and Musselshell Rivers, it often nearly covers the ground for long distances.

66. [**Opuntia fragilis** Nutt.] More or less common on the prairies west of Fort Rice, but increases in abundance westward, in places nearly covering the ground, and though smaller, is far more troublesome to animals in traveling than the preceding species.

67. [**Mamillaria vivipara** Nutt.] Common throughout the region traversed.

GROSSULACEÆ.

68. **Ribes aureum** Pursh. Occurs sparingly along the streams everywhere, from the Missouri to the Musselshell; most abundant in the valley of the Musselshell.

69. **Ribes rotundifolium** Michx. Abundant in the valley of the Musselshell, and occurs sparingly along the streams elsewhere.

70. [**Ribes hirtellum** Michx.] Dry rocky places, head of Heart River to the Musselshell.

CUCURBITACEÆ.

71. [**Echinocystis lobata** T. & G.] Near Fort Rice, June 20th.

SAXIFRAGACEÆ.

72. **Heuchera hispida** Pursh. Near Fort Rice, June 20th.

UMBELIFERÆ.

73. **Sanicula Marylandica** Linn. Shell Point, Yellowstone River, July 16th.

74. **Peucedanum nudicaule** Nutt. Fort Rice, June 15th.

75. **Musenium divaricatum** Nutt. Crossing of the Big Muddy, June 30th.

76. **Sium angustifolium** Linn. Yellowstone River, near Shell Point, July 25th.

CORNACEÆ.

77. **Cornus stolonifera** Michx. Fort Rice, June 15th.

CAPRIFOLIACEÆ.

78. **Symphoricarpus occidentalis** R. Br. Abundant near all the streams, and in the moist ravines everywhere.

RUBIACEÆ.

79. **Galium boreale** Linn. Near Fort Rice, June 22d. Common in the bottom-lands of the Musselshell and other streams.

COMPOSITÆ.

80. **Liatris punctata** Hook. Yellowstone, fifteen miles below the Big Horn River, August 11th. A common species over a wide area.

81. **Aster oblongifolius** Nutt. Near Pompey's Pillar, August 13th.

82. **Aster multiflorus** Ait. Valley of the Musselshell, August 19th.

83. **Aster lævis** Linn. Near Pompey's Pillar, August 14th.

84. **Aster tenuifolius** Linn. Near Pompey's Pillar, August 14th.

85. **Aster falcatus** Lindl. Valley of the Musselshell, August 24th.

86. **Macærantha tanacetifolia** Nees. Valley of the Yellowstone, twenty-seven miles above Tongue River, August 6th.

87. **Macærantha canescens** Gray. Valley of the Yellowstone, near the mouth of Tongue River, August 6th.

88. **Erigeron pumilum** Nutt. Fort Rice, June 13th.

89. **Erigeron Canadense** Linn. Valley of the Musselshell, August 21st.

90. **Solidago rigida** Linn. Valley of Musselshell, August 21st.

91. **Solidago nemoralis** Ait. Bottom-lands of the Musselshell River, August 21st.

92. **Solidago gigantea** Ait. Bottom-lands of the Musselshell River, August 21st. Abundant.

93. **Lynosyris graveolens** T. & G. Valley of the Musselshell, August 21st. An abundant species over a wide area.

94. **Lynosyris graveolens** T. & G., var. Near Shell Point, Yellowstone River, July 27th.

95. **Lynosyris viscidiflora** Hook. Musselshell River, August 21st.

96. **Grindelia squarrosa** Duval. Valley of the Yellowstone August 1st.

97. **Aplopappus Nuttalli** D. C. Head of Heart River, July 8th.

98. **Aplopappus spinulosus** D. C. Beaver Creek, July 13th.

99. **Chrysopsis villosa** Nutt. Yellowstone, near mouth of Custer's Creek, August 1st.

100. **Iva axillaris** Pursh. Crossing of Big Muddy, June 30th.

101. **Iva ciliata** Wild. Yellowstone, near mouth of Big Horn River, August 11th.

102. **Xanthium strumarium** Linn. Yellowstone, near the mouth of the Little Porcupine Creek, August 7th.

103. **Echinacea angustifolia** D. C. Abundant on the prairies between the Missouri and Yellowstone.

104. **Lepachys columnaris** Raf. Bad Route Creek, July 28th.

105. **Helianthus pumilis** Nutt. Divide between the Musselshell and Yellowstone, west of Pompey's Pillar, August 18th.

106. **Helianthus lenticularis** Dougl. Musselshell and Yellowstone divide, August 18th.

107. **Helianthus petiolaris** Gray. Near Pompey's Pillar, August 16th.

108. **Helianthus Maximiliani** Schrœd. Valley of the Musselshell, August 20th.

109. **Coreopsis tinctoria** Nutt. Found only at one small locality, a few acres in extent, on a moist prairie near Beaver Creek, July 13th.

110. **Dysodia chrysanthemoides** Lag. Shell Point, Yellowstone River, July 21st.

111. **Gallardia aristata** Pursh. Near Fort Rice, June 20th.

112. **Hymenopappus tenuifolius** Pursh. Second Crossing of Heart River, July 6th.

113. **Actinella acaulis** Nutt. Near Heart River, June 26th.

114. **Actinella Richardsoni** Nutt. Head of Heart River July 8th.

115. **Achillea millefolium** Linn. Crossing of the Big, Muddy, June 30th. Occurs sparingly from the Missouri to the Musselshell.

116. **Artemisia dracunculoides** Pursh. Valley of the Musselshell, August 21st.

117. **Artemisia Canadensis** Michx. Custer's Creek, September 6th. Abundant in the valley of the Yellowstone and in the bad lands.

118. **Artemisia Ludoviciana** Nutt., var. Musselshell Valley, August 21st. Abundant throughout the bad lands, and in the valleys of the Musselshell and Yellowstone.

119. **Antennaria dioica** Gært. Heart River, June 24th.

120. **Senecio lugens** Rich., var. Fort Rice, June 13th.

121. **Senecio canus** Hook. Crossing of Big Muddy, July 1st.

122. **Senecio aureus** Linn. Near Fort Rice, June 20th.

123. **Arnica angustifolia** Vohl. Fort Rice, June 13th.

124. **Circium undulatum** Spreng. Bad Route Creek, July 28th.

125. **Circium Virginianum** Michx., var. Valley of the Musselshell, August 24th.

126. **Lygodesmia juncea** Don. Shell Point, Yellowstone River, July 22d.

127. Troximon cuspidatum Pursh. Near Fort Rice, June 20th.

128. Macrorhynchus glaucus Eaton. Near Fort Rice, June 20th.

129. Mulgedium pulchellum Nutt. Near Shell Point, Yellowstone River, July 24.

CAMPANULACEÆ.

130. Campanula rotundifolia Linn. Near Fort Rice, July 24th. Occasional westward, on the prairies.

PLANTAGINACEÆ.

131. Plantago pusilla Nutt. Crossing of Big Muddy Creek, June 30th.

132. Plantago Patagonica Jacq., var. Crossing of the Big Muddy, June 30th. Very abundant and widely dispersed.

PRIMULACEÆ.

133. Androsace septentrionalis Linn. Prairies between Little Missouri and Yellowstone, July 12th.

134. Lysimachia ciliata Linn. Little Missouri, at mouth of Davis Creek, July 10th.

OROBANCHACEÆ.

135. Aphyllon fasciculatum T. & G. Prairies near Heart River, June 24th. Rather common.

136. Phelipæa Ludoviciana Don. Valley of the Yellowstone, July 22d. Common in sandy bottom-lands.

SCROPHULARIACEÆ.

137. Penstemon grandiflorus Nutt. Common on the prairies, between the Missouri and Yellowstone.

138. Penstemon albidus Nutt. Fort Rice, June 13th. Common.

139. Penstemon gracilis Nutt. Crossing of the Big Muddy, June 30th.

140. Penstemon cæruleus Nutt. Near Fort Rice, June 20th.

141. Penstemon cristatus Nutt. Head of Heart River, July 8th.

142. Castilleja sessiliflora Pursh. Bad Boute Creek, July 28th.

143. Orthocarpus luteus Nutt. Bad Route Creek, July 28th.

VERBENACEÆ.

144. Verbena bracteosa Michx. Generally abundant in the prairie dog towns, especially along the Yellowstone.

LABIATÆ.

145. Lycopus sinuatus Linn. Bad Route Creek, July 28th.

146. Hedeoma Drummondi Benth. Little Missouri, at the mouth of Davis Creek, July 10th.

147. Hedeoma hispida Pursh. Little Missouri, at the mouth of Davis Creek, July 10th.

148. Monarda fistulosa Linn. Little Missouri, at the mouth of Davis Creek, July 10th, and the Musselshell Valley, August 21st. This and the above-named species of *Hedeoma* are common at favorable localities, from the Missouri to the Musselshell.

BORAGINACEÆ.

149. Echinospermum Redowski Lehm. Fort Rice, June 15th.

150. Eritrichium glomeratum D. C. Near the Great Bend of Heart River (June 26th), and near the head of Davis Creek (July 9th).

151. Lithospermum canescens Lehm. Fort Rice, June 20th.

152. Lithospermum longiflorum Spreng. Fort Rice, June 13th.

POLEMONIACEÆ.

153. Phlox Douglassi Hooker. Prairies west of Fort Rice, June 22d. Very abundant, in places nearly covering the ground.

154. Collomia linearis Nutt. Crossing of the Big Muddy, June 30th. Common.

CONVOLVULACEÆ.

155. Calystegia sepium R. Br. Valley of the Yellowstone, near the mouth of the Big Horn, August 12th.

SOLANACEÆ.

156. Physalis pubescens Linn. Heart River Crossing (June 26th) and the Yellowstone, opposite Shell Point (July 25th). Seen at only two or three localities, in sandy places, near streams.

157. Solanum triflorum Nutt. Valley of the Yellowstone, at numerous localities. Very much eaten by the *Doryphora 10-lineata* Say, with which it was almost always infested.

158. Solanum rostratum Dunal. Crossing of the Big Muddy, June 30th.

APOCYNACEÆ.

159. Apocynum androsæmifolium Linn. Fort Rice, June 15th.

160. Apocynum cannabinum Linn. Crossing of the Big Muddy, July 1st.

ASCLEPIADACEÆ.

161. Acerates viridiflora Ell. Near the Great Bend of Heart River, June 23d. Common on the prairies.

162. Acerates lanuginosa Descainse. Near the Great Bend of Heart River, June 23d.

NYCTAGINACEÆ.

163. Oxybaphus angustifolius Torr. Heart River, June 26th.

164. Oxybaphus nyctagineus Sweet. Heart River, June 26th.

165. Abronia cycloptera Gray. Near Shell Point, Yellowstone River, July 19th.

166. Abronia fragrans Nutt. Near Shell Point, Yellowstone River, July 19th.

CHENOPODIACEÆ.

167. **Obione argentea** Moq. Abundant in the bad lands of the Yellowstone and Musselshell.

168. **Obione canescens** Moq. Fort Rice (June 15th), and thence increasing in abundance westward to the Musselshell.

169. **Obione confertifolia** Torr. Yellowstone, above Tongue River, August 6th.

170. **Endolepis Suckleyi** Torr. Yellowstone Valley, and westward. Common.

171. **Monolepis Nuttalliana** Moq. Fort Rice, June 13th.

172. **Suœda diffusa** S. Wat. Valley of Yellowstone. Common.

173. **Eurotia lanata** Moq. Crossing of the Big Muddy, June 30th.

POLYGONACEÆ.

174. **Rumex salicifolius** Weinm. Crossing of the Big Muddy, June 28th. Frequent along the smaller streams.

175. **Polygonum amphibium** Linn. Head of Davis Creek, July 9th. Streams, common.

176. **Polygonum aviculare** Linn. Valley of the Yellowstone, near the mouth of Big Horn River, August 11th.

177. **Polygonum ramosissimum** Michx. Bad lands of the Yellowstone, August 11th.

178. **Eriogonum annuum** Nutt. Shell Point, Yellowstone River, July 21st.

179. **Eriogonum cernuum** Nutt. Shell Point, Yellowstone River, July 21st.

180. **Eriogonum brevicaule** Nutt. Valley of the Yellowstone, near the mouth of the Big Horn, August 12th.

181. **Eriogonum flavum** Nutt. Prairies, forty miles west of Fort Rice, June 22d.

182. **Eriogonum multiceps** Nees. Andrew's Creek, July 10th; head of Davis Creek, July 12th.

ELÆAGNACEÆ.

183. **Shepherdia argentea** Nutt. Abundant along the Missouri at Fort Rice, and common on Heart River and on the Yellowstone. Very abundant in the valley of the Musselshell, and loaded with fruit — the only place where it was seen with fruit.

SANTALACEÆ.

184. Comandra pallida D. C. Near the Great Bend of Heart River, June 24th. Met with but a few times.

EUPHORBIACEÆ.

185. Euphorbia dyctiosperma Fisch. & Moq. Near crossing of the Little Missouri, July 11th.

186. Euphorbia marginata Pursh. Abundant in the valley of the Yellowstone at the mouth of Custer's Creek, and thence up the Yellowstone to Pompey's Pillar. Confined mainly to the bottom-land of the Yellowstone, and not seen below Custer's Creek.

187. Euphorbia montana Engl. Near the crossing of the Little Missouri, July 11th.

188. Euphorbia polygonifolia Linn. Shell Point, Yellowstone River, July 19th.

189. Euphorbia serpens H. B. K. Shell Point, Yellowstone River, July 19th.

URTICACEÆ.

190. Ulmus fulva Michx. Common along Heart River, and other small streams between the Missouri and the Yellowstone.

191. Humulus Lupulus Linn. Occasional along the wooded parts of all the streams.

CUPULIFERÆ.

192. [**? Quercus macrocarpa** Michx.] A species of Quercus, probably *Q. macrocarpa*, occurs abundantly at a few localities on Heart River, thickly clothing the dry ravines, or coulées, that extend back from the river, where they form sometimes almost the only tree occurring at these localities. It was not noticed west of the Little Missouri.

SALICACEÆ.

193. Salix nigra Marsh. Common along the streams.

194. Salix longifolia Muhl. Common along the streams.

195. Populus monolifera Ait. Abundant along all the streams, at some localities constituting the only timber met with. Along the Yellowstone, above Tongue River, and also on the Musselshell. it forms quite thick forests, occupying a considerable portion of the bottom-lands of these streams.

CONIFERÆ.

196. [? **Pinus Engelmanni** Torr.] Occurs abundantly along the Yellowstone bluffs, above the Great Porcupine Creek, and along the bluffs of the Musselshell. It also occupies much of the broken country between the Yellowstone and Musselshell, above the Porcupine Creeks, the country as far as the eye can see seeming quite well-wooded; generally of small size and quite thinly scattered.

197. Juniperus Sabina var. **procumbens** Pursh. Great Bend of Heart River, June 24th. Common on the tops of the buttes east of the Yellowstone.

LILIACEÆ.

198. Lilium Philadelphicum Linn. Great Bend of Heart River, June 24th.

199. Smilacina stellata Desf. Fort Rice, June 15th.

200. Polygonatum giganteum Dietrich. Fort Rice, June 15th.

201. Calochortus Nuttalli T. & G. Grassy hillsides, near the Crossing of the Little Missouri, July 11th. Not common, and seen at only a few localities.

202. Allium reticulatum Nutt. Fort Rice, June 13th. Very abundant throughout the prairies east of the Little Missouri; perhaps with other species.

203. Zygadenus glaucus Nutt. Near Fort Rice, June 20th.

204. Yucca angustifolia Nutt. Common, especially between the Missouri and Little Missouri Rivers.

IRIDACEÆ.

205. Sisyrinchium Burmudiana Linn. Common in the moist prairies east of the Yellowstone.

COMMELYNACEÆ.

206. Tradescantia Virginica L. Common in the moist prairies east of the Little Missouri.

SMILACEÆ.

207. Smilax herbacea Linn. Fort Rice, June 15th.

207*a*. Smilax herbacea Linn., var. **pulvurulenta** Michx. Near the Great Bend of Heart River, June 24th.

CYPERACEÆ.

208. Scirpus validus Vahl. Crossing of the Big Muddy, June 30th.

209. Carex longirostris Torr. Fort Rice, June 15th.

GRAMINACEÆ.

210. Calamagrostis longifolius Hook. Valley of the Musselshell, August 21st.

211. Stipa viridula Trin. Near Great Bend of Heart River, June 23d.

212. Stipa spartea Trin. Near Great Bend of Heart River, June 23d.

213. Spartina cyanosuroides Willd. Valley of the Yellowstone, near the mouth of the Big Horn, August 12th.

214. Bouteloua curtipendula Gray. Bad Route Creek, July 28th.

215. Bouteloua oligostachya Torr. Bad Route Creek, July 28th.

216. Kœleria cristata Pers.

217. Poa seratina Ehrhart. Fort Rice, June 15th.

218. Poa tenuifolia Nutt. Fort Rice, June 15th.

219. Triticum repens Linn. Valley of the Musselshell, August 21st.

220. Hordeum jubatum Linn.

221. Elymus condensatus Presl. Valley of the Musselshell, August 21st.

EQUISETACEÆ.

222. Equisetum arvense Linn. Fort Rice, June 15th.

FILICES.

223. Woodsia Oregona D. C. Eaton. Near crossing of the Little Missouri, July 11th. Very rare; met with but a few times.

MUSCI.

224. **Hypnum filicinum** Linn. Near Shell Point, Yellowstone River.

VII. Report on the Butterflies collected by Mr. J. A. Allen on the Yellowstone Expedition of 1873. By Samuel H. Scudder.

The twenty-eight butterflies mentioned below were brought home by the Yellowstone Expedition, sent out under the charge of Gen. D. S. Stanley, by the Secretary of War. They were collected by Mr. J. A. Allen, zoologist and botanist of the expedition, and were taken at four different localities, from Heart River (about 1800 feet above the sea) to the mouth of Cedar Creek on the Yellowstone (about 2200 feet above the sea), between June 26 and July 20. The localities were the following: —

1. Heart River Crossing, Dakotah Terr., about fifty miles west of the Missouri River, June 26. The collections were almost wholly made in the valley of the river, near or among timber. More than half of the specimens brought home, and nearly three-fourths of the species were taken at this place. The butterflies *not* found here were: —*Min. silvestris*, *Arg. nevadensis*, *Char. Ismeria*, *Chrys. Sirius*, *Chrys. Helloides*, *Amar. Zolicaon*, the two species of Erynnis and *Atryt. Logan*. There was a large proportion of Nymphales and Urbicolæ, three-fourths of the butterflies belonging to these two families.

2. "Camp No. 8," at the crossing of Big Muddy Creek, about twenty miles northwest of the Heart River Crossing. There was very little timber here, and most, if not all, of the butterflies were taken in the open country, and represent, says Mr. Allen, the usual species of the prairie. The butterflies taken there were: — *Cœn. Galactina*, *Arg. nevadensis*, *Lyc. Anna*, *Chrys. Helloides*, *Hesp. tessellata* and *Ocytes Uncas*.

3. Near the head of Heart River, about one hundred miles west of the two previous localities, July 8. The butterflies were also taken on the prairie, and consisted of *Bas. Dissippe*, *Van. cardui*, *Arg. nevadensis*, and *Chrys. Helloides*.

4. Shell Point, Yellowstone River, at the mouth of Cedar Creek, ten miles above the mouth of Glendive Creek, — landmarks which will doubtless be given on the next good map of this region. The

butterflies were obtained July 18 and 20, among the sage brush of the river valley, and consisted of *Min. silvestris*, *Bas. Weidemeyeri*, *Char. Ismeria*, *Lyc. Anna*, *Col. Philodice*, *Amar. Zolicaon*, the two species of Erynnis, and *Atryt. Logan*.

NYMPHALES.

1. **Satyrus Ridingsii** Edw. A single male, rubbed, but not torn, was taken in the river valley, at Heart River Crossing, June 26.

2. **Minois silvestris** (Edw.). Sixteen specimens (11♂, 5♀) were taken on the banks of the Yellowstone River, in the sage brush, July 18 and 20. About half the males were in fair condition; the other half were rather rubbed and frayed; most of the females were pretty fresh, but two of them were a good deal torn. Probably the butterfly appears early in July.

3. **Cœnonympha Galactina** (Boisd.) Morr. This species was taken at Heart River Crossing, in the river valley, June 26, and on the open prairie, at the crossing of the Big Muddy, June 28. The males (six) were fresh or very nearly fresh; and the females (fourteen) were all fresh, though some were a little torn, perhaps in capture. The butterfly probably appears toward the end of the month.

4. **Basilarchia Disippe** (God.) Scudd. This butterfly was only taken on Heart River; a male, fresh and very dark, like Floridan specimens, was taken at the crossing in the river valley, June 26; and a female, very badly rubbed, and of the ordinary color of northern specimens, near the head of the river, on the prairie, July 8.

5. **Basilarchia Weidemeyeri** (Edw.) Grote. Three specimens of this beautiful insect were taken; two males, one of them perfect, the other pretty fresh, were found near timber at Heart River Crossing, in the river valley, June 26; the third, a female and ragged, was taken in the sage brush of the river valley, near the encampments on the Yellowstone, July 18. Its periods resemble, therefore, those of *B. Arthemis*.

6. **Vanessa cardui** (Linn.) Ochs. Two males were taken, one fresh, the other very badly frayed; the former on the banks of the Yellowstone, July 18; the latter at Heart River Crossing, June 26; the latter had probably hibernated, and the former was an early individual of the first brood.

7. **Argynnis nevadensis** Edw. Two males and a female of this butterfly, fresh, were taken on the open prairie at the crossing of

the Big Muddy, June 28. On July 8, at the head of Heart River, also on the prairie, thirteen males were taken, most of them in a tolerably fresh condition.

8. Argynnis Edwardsii Reak. Four males of this species, either fresh or very nearly fresh, were taken June 26, at Heart River Crossing, near the timber in the valley of the river. The seasons of these two species are therefore nearly identical.

9. Phyciodes Tharos (Drury) Kirb. About thirty specimens of this butterfly were taken at Heart River Crossing, June 26, the two sexes in nearly equal numbers; fresh, passable and badly bruised individuals were divided about equally among males and females.

10. Charidryas Ismeria (Boisd.-LeC.) Scudd. Only taken on the Yellowstone, among the sage brush in the valley, July 18; six males and two females were captured; a single male in pretty good condition, the others, as well as the females, dull, rubbed and frayed. Probably, therefore, it appears in June.

RURALES.

11. Lycæides Anna (Edw.). This butterfly was found in considerable abundance, and in nearly all the localities in which collections were made, viz.: at Heart River Crossing, the banks of the Yellowstone, and at the crossing of the Big Muddy, from June 26 to July 18. At the earliest date, twenty-one males were taken, of which six were fresh and bright, twelve tolerably fresh, and three badly rubbed; while of the six females taken at the same time, four were perfectly, and two tolerably, fresh. Two days later, one fresh and one rubbed male and two rather fresh females were taken; while the single female captured July 18 was badly rubbed and torn. The butterfly probably made its appearance this year at or shortly after the middle of June.

12. Agriades Minnehaha nov. sp. Upper surface of male dark violet; the outer margin dark brown, extending more broadly on the front than on the hind wings; upper surface of male rather dark brown, the basal half dusted, not very conspicuously, with blue scales; both sexes have a small black bar crossing the cell of all the wings, larger in the female than in the male; outer margin edged with black, followed interiorly on the hind wings by a line of white scales, upon which are seated small, blackish, interspaceal spots, surmounted, in the female, by small, dull orange, triangular spots. Under surface ashy gray, slightly darker in the male than in the female, the outer border edged with black. Fore wings with a rather large, black discal bar, edged narrowly with white, and midway between this and the outer border a row of small black spots, the upper ones round, the lower oval, all narrowly encircled with white, and arranged in a curve which bends most strongly in the interspaces beyond the cell; there are also two faint rows of transverse, dusky submarginal spots, the inner midway between the border and the outermost portion of the row of black spots. On the hind wings the discal spot is scarcely, if at all, darker than the ground, and distinguishable only by being narrowly encircled with whitish; in the middle of the cell is a small blackish spot, and above it another, both encircled with whitish; beyond is a sinuate series of spots encircled with white, the upper and lower spots black or blackish, the others seldom darker than the ground, and thus indistinct; there is one in each interspace, transverse oval in shape, those in the interspaces beyond the cell lying half way between the discal spot and the border. There is a marginal series of small, round, dark brown spots, often dotted, especially away from the centre, with metallic spots, surrounded with yellowish brown, which above, and especially in the female, deepens into dull orange; these spots are again surmounted by very slight, dark brown lunules, bearing pretty large triangular spots of grayish white, pointing toward, and almost reaching, the extra-mesial row of spots. Expanse ♂ 26 mm.; ♀ 24–26 mm.

This butterfly does not seem to have been described, but it accords best with the description of *Lyc. Maricopa* Reak., from California.

One pretty fresh male, another rubbed male, one fresh and one rubbed, dull female were taken at Heart River Crossing, June 26.

13. Chrysophanus Helloides (Boisd.) Edw. One pretty fresh female was taken at the crossing of the Big Muddy, on the open prairie, June 28.

14. Chrysophanus Sirius Edw. A single male, badly torn and rubbed, was taken on the Yellowstone River, among the sage brush in the valley, July 20.

PAPILIONIDES.

15. Colias Philodice God. At Heart River Crossing, near timber in the river bottom, June 26, ten males were taken, mostly in good condition, though two of them were poor. Later, July 18 and

20, a large number of males and a single female were taken on the banks of the Yellowstone River, among the sage brush; of these, most of the specimens taken on the 18th were pretty fresh; but some males were somewhat or considerably rubbed; of those taken on the 20th, only one specimen was fair, the others being very badly rubbed; some of these were very small, one measuring but thirty-seven millimetres in alar expanse.

16. Colias Eurytheme Boisd. This species was taken only at Heart River Crossing, near timber in the river bottom, June 26. Three pretty good males and two good females were captured, besides three females, rather badly worn.

17. Synchloe Protodice (Boisd.-LeC.) Scudd. Two females only were taken, both fresh; one at Heart River Crossing, June 26; the other on the Yellowstone, July 18.

18. Amaryssus Polyxenes (Fabr.) Scudd. A single female, badly torn and worn, was taken at Heart River Crossing, June 26.

19. Amaryssus Zolicaon (Boisd.). A single male, fresh in color, but a little torn, was taken on the Yellowstone, July 18.

URBICOLÆ.

20. Epargyreus Tityrus (Fabr.) Scudd. A single female, torn (perhaps in capture) but pretty fresh, was taken at Heart River Crossing, June 26.

21. Thorybes Pylades Scudd. A single fresh male was taken at Heart River Crossing, June 26.

22. Erynnis Persius Scudd. A single, rather rubbed male, apparently belonging to this species, though differing somewhat from eastern examples in the abdominal appendages, was taken on the Yellowstone, July 18.

23. Erynnis Lucilius (Lintn.) Scudd. A single male, not very fresh, was taken with the preceding species. It does not differ from the eastern type, even in the abdominal appendages.

24. Hesperia tessellata Scudd. Three fresh males were taken at Heart River Crossing, June 26; but three worn specimens, a male and two females, their fringes all gone, were taken at the crossing of the Big Muddy, only two days later.

25. Oarisma Hylax (Edw.). Three pretty fresh males were taken at Heart River Crossing, June 26.

26. A single male butterfly was taken at Heart River Crossing, June 26, which resembles very closely *Amblyscirtes vialis* in the form and neuration of the wings, in the structure of the legs and antennæ, and even in the coloration and markings of the wings, so far as these could be made out from a somewhat rubbed individual; but there is a perfectly distinct indication of a discal dash of raised scales, the sexual mark of the fore wings in so many Astyci, which is altogether wanting in Amblyscirtes. I await the reception of further material before describing this interesting form.

27. Ocytes Uncas (Edw.). One pair, both fresh, were taken at Heart River Crossing, near timber in the valley of the river, June 26. At the crossing of the Big Muddy, on the open prairie, two females, one of them fresh, the other somewhat less so, were taken June 28.

28. Atrytone Logan (Edw.) Scudd. A torn and rubbed male and a pretty fresh female were taken on the banks of the Yellowstone, among sage brush on the river bottom, July 18.

June 24, 1874.

Vice-President S. H. Scudder in the chair. Thirty-two persons present.

Mr. Charles Stodder exhibited, with the microscope, a slide showing some of the contents of a mastodon's stomach. The material from which the slide was prepared, received through the kindness of Mr. Morehouse, was obtained in Wayland, N. Y., and he had sent it to Dr. J. G. Hunt, of Philadelphia, for determination and preparation. Respecting this material Dr. Hunt reports as follows: —

The remains, both of cryptogams and flowering species were in abundance. Stems and leaves of mosses, wonderfully distinct in structure, so much so that I could draw every cell. I even readily detected confervoid filaments, with cells arranged in linear series, resembling species now found in our waters. Numerous small black bodies, probably spores of the mosses, were found in abundance. Not a fragment of sphagnum was seen in the deposit. I found, however, one fragment of a water plant, possibly a rush, an inch long, every cell of which was as distinct as though growing but yesterday. Pieces of woody tissue and of bark of herbaceous plants, spiral vessels, etc., were abundant. Carapaces of Entomostraca were present, but no trace of coniferous plants could be detected. It hence appears that the animal ate his last meal from the tender mosses and boughs of flowering plants growing on the banks of the streams and margins of the swamps, rather than fed on submerged plants; and it is probable, moreover, that the pines and cedars, and their allies, formed no part of the mastodon's diet.

Mr. Stodder also showed some botanical slides prepared by Dr. Hunt, all of which were presented to the collection.

The following papers were presented: —

Description of a New Species of North American Serpent. By S. W. Garman.

Genus HELICOPS Wagler.

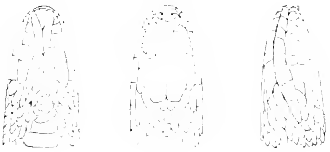
Generic Characters. Plates of the top of the head 8, 9; rostral not higher than wide; nasals grooved; form of loral varying in different species, sometimes absent; preoculars 1, sometimes 2; postoculars 2, sometimes 3; temporals 4–12; upper labials 8, sometimes 9; lower 9–11; scales carinate, in 19–25 rows; anal divided; subcaudals in two rows.

Teeth smooth, the posterior two of the upper jaw longer, and separated from the others.

Helicops Alleni.

Specific Characters. Body subcylindrical, retaining its size in the middle and tapering abruptly near the extremities; head not larger than the neck; nasal plates single, in contact between prefrontal and rostral; one prefrontal; loral and anteorbital present; three postorbitals, not in contact with the temporals; two or more rows of carinate scales on the tail; color in longitudinal bands.

Description. Body of moderate size, subcylindrical, tapering in the anterior and posterior fifths; head subconical, depressed, continuous with the body; eyes medium, circular, distant from the end of the snout, and from each other, about one-fourth of the length of the head; mouth inferior, deeply cleft, outline sharply curved in its



posterior third; tail smaller than the body, tapering abruptly in the anterior third, posterior two-thirds slender.

Rostral shield very small, five-angled; prefrontal one small, rhomboid, posterior angle rounded, transverse diameter the greater; postfrontals six-sided, the smaller next the loral, rounded angle backward; vertical moderate, six-angled, narrower forward; superciliaries shorter than the vertical, five-sided, narrow, wider above the postorbitals; occipitals large, separated in front by the angle of the vertical, extending around the orbitals to the sixth labial; postorbitals three, the lower, small and four-sided, rests on the fourth and fifth labials, the middle, larger and five-sided, upon the sixth, the upper is largest and four-sided; one anterior, narrow, rests on the third labial, extends to the anterior lateral angle of the vertical; one loral, small, four-sided, smaller next the frontal; nasals single, nearly elliptical, bearing the minute circular nostril nearer the prefrontal, grooved from the nostril to the lower posterior angle; upper labials eight, third and fourth entering into the orbit, sixth and seventh larger; lower eleven, fifth and sixth larger; five shields between labials and occipitals.

Scales of the body in nineteen rows, smooth, hexagonal, those in the vertebral rows twice as long as wide, in the exterior wider than long, those of the tail strongly keeled in the two vertebral rows, slightly in the next two; abdominals 128; anal bifid; subcaudals 58 pairs.

Color in longitudinal bands; the vertebral dark brown, five scales and two half-scales in width, extending over the head to the upper portions of rostral and labials; the first laterals of yellowish brown, from the occiput, two half-scales wide; the second of dark brown, two scales and two halves; the exterior of brownish yellow, two scales and a half. The darker lateral edges of all the scales give the appearance of narrow stripes. Abdominals, subcaudals, lower part of head, upper labials, and rostral dull yellow or straw color. Without spots.

It is likely that in life the dark bands were purplish or bluish, and the light flesh-colored.

Total length, .65 mm.; head, .023 mm.; tail, .14 mm. Of the maxillary teeth the posterior two are much the larger.

The specimen described is No. 2255 of the alcoholic collection in the Museum of Comparative Zoology. It was collected near Jacksonville, Florida, by the zoologist, Mr. J. A. Allen, to whom the species is dedicated.

The generic characters are as given by Prof. G. Jan (Arch. per la Zool., Vol. III, p. 245).

In the body and head this beautiful animal resembles the North American species of the genus Calopisma; it is sufficiently evident, however, from the peculiar structure of the tail, with its carinated scales, that this species belongs to Helicops. The possession of characters belonging to both genera suggests a position for this as a leading species of its genus.

Note on Aptenodytes patagonica Forst. By A. Hyatt.

During a recent hurried visit to the British Museum, I made some observations upon the specimens of this species, which may be worthy the attention of the Society. The validity of Dr. G. R. Gray's distinctions have been almost universally doubted, but they seem to me very well founded, though not very fully stated in his description of *Aptenodytes Forsteri.*[1] This form is represented by a fine suite of specimens in the British Museum, exhibiting the young as well as the adults. Some of the young equaling in size a full-grown *Aptenodytes Pennantii*, have no orange patch on the throat, and the dark area extends over the head and down the back of the neck, interrupted in front by a spot of gray immediately under the beak. This spot is separated from the gray of the neck and breast by a narrower dark line. One specimen larger than any full-grown specimen of *Aptenodytes Pennantii* which I have seen, possessed the area or collar extending around the neck, as in the adults, but the color still remained grayish, as in the young.

[1]Annals and Mag. Nat. Hist., Vol. XIII.

The thanks of the Society were voted to Messrs. Matthew Bartlett and C. E. Aiken for donations to the Museum.

October 7, 1874.

The President in the chair. One hundred and fourteen persons present.

After the usual reading of the records the meeting was opened by the following remarks from President Bouvé, in relation to the death of the late President of the Society, Professor Jeffries Wyman.

After our usual summer vacation we meet together with more than accustomed emotion: for, mixed with the joy of greeting one another after separation, there is a consciousness of irreparable loss that weighs heavily upon our spirits, a recognition that there have gone away from us a force and a virtue which have so long been a help and an inspiration, that we cannot but feel a sense of loss such as no words of mine can adequately express. Sad indeed is it for us and for all, that such nobleness of nature, such wealth of acquired knowledge, such purity and simplicity of life, as were manifested in Jeffries Wyman, should pass from the world; for rare, too rare, are to be found examples of such exalted character and attainments.

To our Society Prof. Wyman was a great benefactor; not in the sense of a donor especially, but in the higher sense of one imparting to it such honorable fame as enhanced greatly respect for it, both at home and abroad. To him also was the Society mainly indebted for the interest shown in our work by the late Dr. Walker, and which led directly to its large endowment with the means of success.

But pleasant as it would be for me, as a personal friend, to dwell upon the transcendent virtues of one whom I have always regarded with the highest respect and most affectionate esteem, I feel it would be unbecoming to further occupy your time in view of those present, who have come here with their tributes of love to the memory of our dear departed friend. I therefore close by inviting others to address you first calling upon Prof. Gray, who, from his great regard for Prof. Wyman, has kindly prepared a notice of his life and work to read on this occasion.

ADDRESS OF PROFESSOR A. GRAY.

When we think of the associate and friend whose death this Society now deplores, and remember how modest and retiring he was, how averse to laudation and reticent of words, we feel it becoming to speak of him, now that he is gone, with much of the reserve which would be imposed upon us if he were living. Yet his own perfect truthfulness and nice sense of justice, and the benefit to be derived from the contemplation of such a character by way of example, may be our warrant for reasonable freedom in the expression of our judgments and our sentiments, taking care to avoid all exaggeration.

Appropriate and sincere eulogies and expressions of loss, both official and personal, have, however, already been pronounced or published; and among them one from the governors of that institution to which, together with our own Society, most of Professor Wyman's official life and services were devoted,—which appears to me to delineate in the few-est words the truest outlines of his character. In it the President and Fellows of Harvard University "recall with affectionate respect and admiration the sagacity, patience and rectitude which characterized all his scientific work, his clearness, accuracy and conciseness as a writer and teacher, and the industry and zeal with which he labored upon the two admirable collections which remain as monuments of his rare knowledge, method and skill. They commend to the young men of the University this signal example of a character modest, tranquil, dignified and independent, and of a life simple, contented and honored."

What more can be or need be said? It is left for me, in compliance with your invitation, Mr. President, to say something of what he was to us, and has done for us, and to put upon record, for the use of those who come after us, some account of his uneventful life, some notice, however imperfect, of his work and his writings. I could not do this without the help of friends who knew him well in early life, and of some of you who are much more conversant than I am with most of his researches. Such aid, promptly rendered, has been thankfully accepted and freely used.

Our associate's father, Dr. Rufus Wyman, — born in Woburn, graduated at Harvard College in 1799, and in the latter part of his life Physician to the McLean Asylum for the Insane, — was a man of marked ability and ingenuity. Called to the charge of this earliest institution of the kind in New England at its beginning, he organized the plan of treatment and devised the excellent mechanical arrangements which have since been developed, and introduced into other establishments of the kind. His mother was Ann Morill, daughter of James Morill, a Boston merchant. This name is continued, and is familiar to us, in that of our associate's elder brother.

Jeffries Wyman, the third son, derived his baptismal name from the distinguished Dr. John Jeffries, of Boston, under whom his father studied medicine. He was born on the 11th of August, 1814, at Chelmsford, a township of a few hundred inhabitants in Middlesex Co., Mass., not far from the present city of Lowell. As his father took up his residence at the McLean Asylum in 1818, when Jeffries was only four years old, he received the rudiments of his education at Charlestown, in a private school; but afterwards went to the Academy at Chelmsford, and, in 1826, to Phillips Exeter Academy, where, under the instruction of Dr. Abbot, he was prepared for college. He entered Harvard College in 1829, the year in which Josiah Quincy took the presidency, and was graduated in 1833, in a class of fifty-six, six of whom became professors in the University. He was not remarkable for general scholarship, but was fond of chemistry, and his preference for anatomical studies was already developed. Some of his class-mates remember the interest which was excited among them by a skeleton which he made of a mammoth bull-frog from Fresh Pond, probably one which is still preserved in his museum of comparative anatomy. His skill and taste in drawing, which he turned to such excellent account in his investigations and in the lecture room, as well as his habit of close observation of natural objects met with in his strolls, were manifested even in boyhood.

An attack of pneumonia during his senior year in college caused much anxiety, and perhaps laid the foundation of the pulmonary affection which burdened and finally shortened his life. To recover from the effects of the attack, and to guard against its return, he made in the winter of 1833–34, the first of those pilgrimages to the coast of the Southern States, which in later years were so often repeated. Returning with strength renewed in the course of the following spring, he began the study of medicine under Dr. John C. Dalton, who had succeeded to his father's practice at Chelmsford, but who soon removed to the adjacent and thriving town of Lowell. Here, and with his father at the McLean Asylum, and at the Medical College in Boston, he passed two years of profitable study. At the commencement of the third year he was elected house-student in the Medical Department, at the Massachusetts General Hospital, — then under the charge of Doctors James Jackson, John Ware and Walter Channing — a responsible position, not only most advantageous for the study of disease, but well adapted to sharpen a young man's power of observation.

In 1837, after receiving the degree of Doctor of Medicine, he cast about among the larger country towns for a field in which to practice his profession. Fortunately for science he found no opening to his mind; so he took an office in Boston, on Washington Street, and accepted the honorable, but far from lucrative post of Demonstrator of Anatomy under Dr. John C. Warren, the Hersey Professor. His means were very slender, and his life abstemious to the verge of privation; for he was unwilling to burden his father, who, indeed, had done all he could in providing for the education of two sons. It may be interesting to know that, to eke out his subsistence, he became at this time a member of the Boston Fire Department, under an appointment of Samuel A. Eliot, Mayor, dated Sept. 1, 1838. He was assigned to Engine No. 18. The rule was that the first-comer to the engine-house should bear the lantern, and be absolved from other work. Wyman lived near by, and his promptitude generally saved him from all severer labor than that of enlightening his company.

The turning point in his life, *i. e.*, an opportunity which he could seize of devoting it to science, came when Mr. John A. Lowell offered him the curatorship of the Lowell Institute, just brought into operation, and a course of lectures in it. He delivered his course of twelve lectures upon Comparative Anatomy and Physiology in the winter of 1840–41; and with the money earned by this first essay in instructing others, he went to Europe to seek further instruction for himself. He reached Paris in May, 1841, and gave his time at once to Human Anatomy at the School of Medicine, and Comparative Anatomy and Natural History at the Garden of Plants, attending the lectures of Flourens, Majendie, and Longet on Physiology, and of de Blainville, Isidore St. Hilaire, Valenciennes, Dumeril, and Milne-Edwards on Zoology and Comparative Anatomy. In the summer, when the lectures were over, he made a pedestrian journey along the banks of the Loire, and another along the Rhine, returning through Belgium, and by steamer to London. There, while engaged in the study of the Hunterian collections at the Royal College of Surgeons, he received information of the alarming illness of his father; he immediately turned his face homeward, but on reaching Halifax he learned that his father was no more.

He resumed his residence in Boston, and devoted himself mainly to scientific work, under circumstances of no small discouragement. But in 1843 the means of a modest professional livelihood came to him in the offer of the chair of Anatomy and Physiology in the medical department of Hampden-Sidney College, established at Richmond, Virginia. One advantage of this position was that it did not interrupt his residence in Boston except for the winter and spring; and during these months the milder climate of Richmond was even then desirable. He discharged the duties of the chair most acceptably for five sessions, until, in 1847, he was appointed to succeed Dr. Warren as Hersey Professor of Anatomy in Harvard College, the Parkman professorship in the Medical School in Boston being filled by the present incumbent, Dr. Holmes. Thus commenced Prof. Wyman's most useful and honorable connection as a teacher with the University, of which the President and Fellows speak in the terms I have already recited. He began his work in Holden Chapel, the upper floor being the lecture-room, the lower containing the dissecting room and the anatomical museum of the College, with which he combined his own collections and preparations, which from that time forward increased rapidly in number and value under his industrious and skillful hands. At length Boylston Hall was built for the anatomical and the chemical departments, and the museum, lecture and working-rooms were established commodiously in their present quarters; and Prof. Wyman's department assumed the rank and the importance which it deserved. Both human and comparative anatomy were taught to special pupils, some of whom have proved themselves worthy of their honored master, while the annual courses of lectures and lessons on Anatomy, Physiology, and for a time the principles of Zoology, imparted highly valued instruction to undergraduates and others.

In the formation and perfecting of his museum — the first of the kind in the country, arranged upon a plan both physiological and morphological — no pains and labors were spared, and long and arduous journeys and voyages were made to contribute to its riches. In the summer of 1819, — having replenished his frugal means with the proceeds of a second course of lectures before the Lowell Institute (viz., upon Comparative Physiology, a good condensed short-hand report of which was published at the time),— he accompanied Capt. Atwood of Provincetown, in a small sloop, upon a fishing voyage high up the coast of Labrador; in the winter of 1852, going to Florida for his health, he began his fruitful series of explorations and collections in that interesting district. In 1854, accompanied by his wife, he travelled extensively in Europe, and visited all the museums within his reach. In the spring of 1856, with his pupils, Green and Bancroft, as companions and assistants, he sailed to Surinam, penetrated far into the interior in canoes, made important researches upon the ground, and enriched his museum with some of its most interesting collections. These came near being too dearly bought, as he and his companions took the fever of the country, from which he suffered severely, and recovered slowly. Again, in 1858–9, accepting the thoughtful and generous invitation of Capt. J. M. Forbes, he made a voyage to the La Plata, ascended the Uraguay and the Parana in a small iron steamer which Capt. Forbes brought upon the deck of his vessel; then, with his friend George Augustus Peabody as a companion, he crossed the pampas to Mendosa, and the Cordilleras to Santiago and Valparaiso, whence he came home by way of the Peruvian coast and the Isthmus.

By such expeditions many of the choice materials of his museum and of his researches were gathered, at his own expense, to be carefully prepared and elaborated by his own unaided hands. A vast neighboring museum is a splendid example of what munificence, called forth by personal enthusiasm, may accomplish. In Dr. Wyman's we have an example of what one man may do unaided, with feeble health and feebler means, by persistent and well-directed industry, without eclât, and almost without observation. While we duly honor those who of their abundance cast their gifts into the treasury of science, let us not — now that he can not be pained by our praise — forget to honor one who in silence and penury cast in more than they all.

Of penury in a literal sense we may not speak; for although Prof. Wyman's salary, derived from the Hersey endowment, was slender indeed, he adapted his wants to his means, foregoing neither his independence nor his scientific work; and I suppose no one ever heard him complain. In 1856 came unexpected and honorable aid from two old friends of his father who appreciated the son, and wished him to go on with his scientific work without distraction. One of them, the late Dr. William J. Walker, sent him ten thousand dollars outright; the other, the late Thomas Lee, who had helped in his early education, supplemented the endowment of the Hersey professorship with an equal sum, stipulating that the income thereof should be paid to Prof. Wyman during life, whether he held the chair or not. Seldom, if ever, has a moderate sum produced a greater benefit.

Throughout the later years of Prof. Wyman's life a new museum has claimed his interest and care, and is indebted to him for much of its value and promise. In 1866, when failing strength demanded a respite from oral teaching, and required him to pass most of the season for it in a milder climate, he was named by the late George Peabody one of the seven trustees of the Museum and Professorship of American Archæology and Ethnology, which this philanthropist proceeded to found in Harvard University; and his associates called upon him to take charge of the establishment. For this he was peculiarly fitted by all his previous studies, and by his predilection for ethnological inquiries. These had already engaged his attention, and to this class of subjects he was thereafter mainly devoted,—with what sagacity, consummate skill, untiring diligence and success, his seven annual Reports—the last published just before he died,—his elaborate memoir on shell-heaps, now printing, and especially the Archæological Museum in Boylston Hall, abundantly testify. If this museum be a worthy memorial of the founder's liberality and foresight, it is no less a monument of Wyman's rare ability and devotion. Whenever the enduring building which is to receive it shall be erected, surely the name of its first curator and organizer should be inscribed, along with that of the founder, over its portal.

Of Prof. Wyman's domestic life, let it here suffice to record, that in Dec., 1850, he married Adeline Wheelwright, who died in June, 1855, leaving two daughters; that in August, 1861, he married Anna Williams Whitney, who died in February, 1864, shortly after the birth of an only and a surviving son.

Of his later days, of the slow, yet all too rapid progress of fatal pulmonary disease, it is needless to protract the story. Winter after winter, as he exchanged our bleak climate for that of Florida, we could only hope that he might return. Spring after spring he came back to us invigorated, thanks to the bland air and the open life in boat and tent, which acted like a charm; — thanks, too, to the watchful care of his attached friend, Mr. Peabody, his constant companion in Florida life. One winter was passed in Europe, partly in reference to the Archæological Museum, partly in hope of better health; but no benefit was received. The past winter in Florida produced the usual amelioration, and the amount of work which Dr. Wyman undertook and accomplished last summer might have tasked a robust man. There were important accessions to the archæological collections, upon which much labor, very trying to ordinary patience, had to be expended. And in the last interview I had with him, he told me that he had gone through his own museum of comparative anatomy, which had somewhat suffered in consequence of the alterations in Boylston Hall, and had put the whole into perfect order. It was late in August when he left Cambridge for his usual visit to the White Mountain region, by which he avoided the autumnal catarrh; and there, at Bethlehem, New Hampshire, on the 4th of September, a severe hemorrhage from the lungs suddenly closed his valuable life.

Let us turn to his relations with this Society. He entered it in October, 1837, just thirty-seven years ago, and shortly after he had taken his degree of Doctor in Medicine. He was Recording Secretary from 1839 to 1841; Curator of Ichthyology and Herpetology from 1841 to 1847, of Herpetology from 1847 to 1855, of Comparative Anatomy from 1855 to 1874. While in these later years his duties may have been almost nominal, it should be remembered that in the earlier days a curator not only took charge of his portion of the Museum, but in a great degree created it. Then for fourteen years, from 1856 to 1870, he was the President of this Society, as assiduous in all its duties as he was wise in council; and he resigned the chair which he so long adorned and dignified only when the increasing delicacy of his health, to which night-exposure was prejudicial, made it unsafe for him any longer to undertake its duties. The record shows that he has made here one hundred and five scientific communications,[1] several of them very important papers, every one of some positive value; for you all know that Prof. Wyman never spoke or wrote except to a direct purpose, and because there was something which it was worth while to communicate. He bore his part also in the American Academy of Arts and Sciences, of which he was a Fellow from the year 1843, and for many years a Councillor. To it he made a good number of communications; among them one of the longest and ablest of his memoirs.

Then he was from the first a member of the Faculty of the Museum of Comparative Zoology, where his services and his advice were highly valued. He was chosen President of the American Association for the Advancement of Science for the year 1857, but did not assume the duties of the office.

Some notice — brief and cursory though it must be — of such portion of Dr. Wyman's scientific work as is recorded in his published papers, should form a part of this account of his life.

[1] The Royal Society's Catalogue of Scientific Papers enumerates sixty-four by Prof. Wyman alone, and four in conjunction with others.

His earliest publication, so far as we know, was an article in the Boston Medical and Surgical Journal, in 1837, signed only with the initials of his name. It is upon "The indistinctness of images formed from oblique rays of light," and the cause of it. The handling of the subject is as characteristic as that of any later paper. In January, 1841, we find his first recorded communication to this Society, "On the Cranium of a Seal." The first to the American Academy is the account of his dissection of the electrical organs of a new species of Torpedo, in 1843, part of a paper by his friend Dr. Storer, published in "Silliman's Journal." In the course of that year, eleven communications were made to our Society, besides the Annual Address, which he delivered on the 17th of May. The most important of these was the memoir, by Dr. Savage and himself, on the Black Orang or Chimpanzee of Africa, *Troglodytes niger*, published in full in the Journal of this Society, the anatomical part by Prof. Wyman. Two other papers of that early year, on the Anatomy of two Mollusca, *Tebennophorus carolinensis* and *Glandina truncata*, published in the fourth volume of the Society's Journal, each with a copper plate, are noteworthy, as showing that he possessed from the first that happy faculty of clear, terse, and closely relevant exposition, and that skill and neatness of illustration with his pencil, which characterize all his work, both of research and instruction.

Another paper of that year, "On the microscopic structure of the teeth of the *Lepidostei*, and their analogies with those of the *Labyrinthodonts*," read to this Society in August, and published in Silliman's Journal in October, 1843, was important and timely. In it he demonstrated that the labyrinthine structure of the teeth, considered at the time to be peculiar to certain sauroid reptiles, equally belonged to the gar-fishes, and consequently that many fossil teeth which had been referred by the evidence of this character alone to a group of reptiles founded upon this peculiarity, might as well belong to ancient sauroid fishes.

Although not of any importance now to remember, I may here mention his report to this Society on the *Hydrarchos Sillimani* of Koch, a factitious Saurian of huge length, successfully exhibited in New York and elsewhere under high auspices, and I think also in Germany, but which Dr. Wyman exposed at sight, showing that it was made up of an indefinite number of various cetaceous vertebræ, belonging to many individuals, which (as was afterward ascertained) were collected from several localities.

But the memoir by which Prof. Wyman assured his position among the higher comparative anatomists was that, communicated to and published by this Society in the summer of 1847, in which the Gorilla was first named and introduced to the scientific world, and the distinctive structure and affinities of the animal so thoroughly made out from the study of the skeleton, that there was, as the great English Anatomist remarked, "very little left to add, and nothing to correct." In this memoir the "Description of the habits of *Troglodytes Gorilla*," is by Dr. Thomas S. Savage, to whom, along with Dr. Wilson, "belongs the credit of the discovery"; the Osteology of the same and the introductory history are by Dr. Wyman. Indeed, nearly all since made known of the Gorilla's structure, and of the affinities soundly deduced therefrom, has come from our associate's subsequent papers, founded on additional crania brought to him in 1849, by Dr. George A. Perkins of Salem; on a nearly entire male skeleton of unusual size, received in 1852, from the Rev. William Walker, and now in Wyman's museum; and on a large collection of skins and skeletons placed at his disposal in 1859, by Du Chaillu, along with a young Gorilla in spirits, which he dissected. It is in the account of this dissection that Prof. Wyman brings out the curious fact that the skull of the young Gorilla and Chimpanzee bears closer resemblance to the adult than to the infantile human cranium.

In Prof. Wyman's library, bound up with a quarto copy of the Memoir by Dr. Savage and himself, is a terse but complete history of this subject, in his neat and clear handwriting, and with copies of the letters of Dr. Savage, Prof. Owen, Mr. Walker, and M. du Chaillu.

In the introductory part of the Memoir, Prof. Wyman states that "the specific name, *Gorilla*, has been adopted, a term used by Hanno in describing the wild men found on the coast of Africa, probably one of the species of the Orang." The name, *Troglodytes Gorilla*, is no doubt to be cited as of Savage and Wyman, and it was happily chosen by Prof. Wyman, after consultation with his friend, the late Dr. A. A. Gould, for the reason just stated. But it is interesting to see, in the correspondence before me, how strenuously each of the joint authors deferred to the other the honor of nomenclature. Dr. Savage from first to last insists, in repeated and emphatic terms, that the scientific name shall be given by Dr. Wyman as the scientific describer, and that he could not himself honestly appropriate it. Prof. Wyman, in his MSS. account, after mentioning what his portion of the Memoir was, and that "the determination of the differential characters on which the establishment of the species rests was prepared by me," briefly and characteristically adds: "In view of this last fact, Dr. Savage thought, as will be seen in letter, that the species should stand in my name; but this I declined."

This Memoir was read before this Society on the 18th of August, 1847, and was published before the close of the year. But it had not, as it appears, come to Prof. Owen's knowledge when the latter presented to the London Zoological Society, on the 22d of February, 1848, a memoir founded on three skulls of the same species, just received from Africa through Capt. Wagstaff. When Prof. Owen received the earlier Memoir, he wrote to compliment Prof. Wyman upon it, substituted in a supplementary note the specific name imposed by Savage and Wyman, and reprinted in an appendix the osteological characters set forth by the latter. "It does not appear, however (adds Dr. Wyman), either in the Proceedings or the Transactions of the [Zoological] Society, at what time our Memoir was published, nor that we had anticipated him in our description."

It is safe to assert that in this and the subsidiary papers of Dr. Wyman, may be found the substance of all that has since been brought forward, bearing upon the osteological resemblances and differences between men and apes. After summing up the evidence, he concludes: —

"The organization of the anthropoid Quadrumana justifies the naturalist in placing them at the head of the brute creation, and placing them in a position in which they, of all the animal series, shall be nearest to man. Any anatomist, however, who will take the trouble to compare the skeletons of the Negro and Orang, cannot fail to be struck at sight with the wide gap which separates them. The difference between the cranium, the pelvis, and the conformation of the upper extremities in the Negro and Caucasian, sinks into comparative insignificance when compared with the vast difference which exists between the conformation of the same parts in the Negro and the Orang. Yet it cannot be denied, however wide the separation, that the Negro and Orang do afford the points where man and the brute, when the totality of their organization is considered, most nearly approach each other."

Selecting now for further comment only some of the more noticeable contributions to science, we should not pass by his investigations of the anatomy of the Blind Fish of the Mammoth Cave. The series began, in that prolific year, 1843, with a paper published in "Silliman's Journal," and closed with an article in the same Journal in 1854. Although Dr. Tellkamph had preceded him in ascertaining the existence of rudimentary eyes and the special development of the fifth pair of nerves, yet for the whole details of the subject, and the minute anatomy, we are indebted to Prof. Wyman. Many of the details, however, as well as the admirable drawings illustrating them, remained unpublished until 1872, when he placed them at Mr. Putnam's disposal, and they were brought out in his elaborate article in the "American Naturalist." Here the extraordinary development of tactile sense, taking the place of vision, and perfectly adapting the animal to its subterranean life, is completely demonstrated.

If Prof. Wyman's first piece of anatomical work was the preparation of a skeleton of a bull-frog, in his undergraduate days, his most elaborate memoir is that on the anatomy of the nervous system of the same animal (*Rana pipiens*), published in the "Smithsonian Contributions," in 1852 (51 pages, royal 4to, with 2 plates).

Anything like an analysis of this capital investigation and exposition would much overpass our limits. For, although the special task he assigns to himself is the description of the nervous system of a single Batrachian, chiefly of its peripheral portion, and of the changes undergone during metamorphosis, he is led on to the consideration of several abstruse or controverted questions; — such, for instance, as the attempts that have been made to homologize the nervous system of Articulates with that of Vertebrates, upon which he has some acute criticism; — the theories that have been propounded respecting the functions of the cerebellum and its relation to locomotion, which he tests in a characteristic way by a direct appeal to facts; — the supposition of Cuvier that the special enlargements of the spinal cord are in proportion to the force of the respective limbs supplied therefrom; which he controverts decisively by similar appeal, an extract from which I beg leave to append in a note.[1]

[1] "If by force is meant the muscular energy and development of the limbs, this statement does not appear to be sustained in the present instance, nor in many other instances brought to notice by comparative anatomy. In man the brachial enlargement is always larger than the crural, though the legs are so much more powerfully developed than the arms, and the same is true of the greater number of mammals. In frogs there is a still greater disproportion between legs and arms yet there is not a corresponding difference in the size of the bulgings. They cannot, therefore, be said to be in proportion to the muscular force only of the limbs, but correspond far more nearly to the acuteness of the sense of touch, which in man and mammals is more delicate in the hands and arms than in the legs and feet. In bats, it is true that the muscular force of the arms is greater than that of the legs, and that the brachial far surpasses the crural enlargement; but, at the same time, the sense of touch in the membranes of the wings is exalted to a most extraordinary degree. In birds the posterior bulging is almost universally the largest, though this condition is in part dependent upon the presence of the rhomboidal sinus. In these animals, while the muscular energy of the wings is the most developed, the sensibility of the feet is the more acute."

So, in describing the structure of the optic nerves in the frog, and the development of the eye and optic lobes, he proceeds to remark, that —

"The instances of *Proteus* and *Amblyopsis* naturally suggest the questions, whether one and the same part may not combine functions wholly different in different animals, and whether the same may not hold true with regard to the cerebral organs which is known to obtain with regard to the skeleton, the teeth, the tongue, and the nose, that identical or homologous parts in different animals may perform functions wholly distinct. If the doctrine here suggested can be admitted (and if this were the place facts could be cited in support of it), may we not find in it an explanation of many inconsistences which now exist between the results of comparative anatomy and of physiology?"

Then, in his chapter on the philosophical anatomy of the cranial nerves and skull, after showing that there are but three pairs of cranio-spinal nerves, he takes up the controverted question as to the number of vertebræ which compose the skull, and supports the opinion that they also are only three in a characteristic manner.[1]

Of this whole memoir it is thought that, notwithstanding the great advance which has been made in comparative anatomy during the twenty-five years which have elapsed since

[1] "The conclusions which have been drawn from the statements made above are as follows: that in frogs the *vagus* comprises the glosso-pharyngeal and accessory nerves; that the *trigeminus* comprises the facial, the abducens, and in the salamanders the patheticus and portions of the motor communis; that other evidence sustains the hypothesis, that the whole of the motor communis is a dependence of the trigeminus; if to these we add the *hypoglossus* (which in frogs is exceptionally a spinal nerve), we shall have three pairs of cranial nerves, each having all the characters of a common spinal nerve, namely, motor and sensitive

it was published, its importance to the student has not at all diminished.

Next to this in extent and value may be ranked Prof. Wyman's paper on the development of the common skate of our waters (*Raia Batis*), communicated to the American Academy in 1864, and published among its Memoirs. It gives an account of the peculiar egg-case of the Selachians, and of the several stages of the development of the embryo skate, expressed in the concise and clear language — as little technical as possible, — for which he was distinguished, and leading up to not a few problems in comparative anatomy, morphology, or systematic zoology, — problems which Prof. Wyman never evaded when they came directly in his way, and seldom handled without making some real contribution to their elucidation. For instance, in describing the external branchial fringes of the young skate, he notes the agreement in this character with the Batrachians; and in studying the seven branchial fissures of the embryo, he is brought into contact with the view of Huxley, that the formation of the external ear is by involution of the integument. After confirming the contrary observations of Reichert, on the embryo pig, he concludes that "the first of the seven branchial fissures of the embryo skate is converted into the spinacle, which is the homologue of the Eustachian tube and the outer ear-canal." After a full discussion of the homology of the

roots and a ganglion; that there are no nerves to indicate a fourth vertebra, unless the special sense nerves are considered; if these are admitted as indications, then we must presuppose either two pairs of nerves to each vertebra, or the existence of six vertebræ, which is a larger number than can be accounted for on an osteological basis. The functions and mode of development of the special sense nerves we have taken as affording sufficient grounds for considering them as of a peculiar order, and not to be classified with common spinal nerves."

upper jaw in sharks and skates, under the light afforded by his investigation of the embryo skate, he suggests that the cartilage which extends from the olfactory fossæ towards the pectoral fin is the probable homologue of a maxillary bone, and that in the lobe, the homologue of an intermaxillary; that, if so, the skates and proteiform reptiles agree in having the nostrils open in front of the dental arch; that while in all Batrachians the nasal groove becomes closed, in the skate it remains permanently open; and finally that this view, if confirmed, "will add another feature which justifies Owen, Agassiz and others, in dissenting from Cuvier so far as to give the Selachians a place in the zoological series higher than that of the bony fishes. But at the same time, it will give corroborative proof of the correctness of Cuvier's view, that 'the rudiments of the maxillaries, and intermaxillaries, ... are evident in the skeleton.'"

In attempting these analyses, I am drifting into a fault which Prof. Wyman never committed, that of being too long. So I must leave many of his papers unmentioned, and barely refer to two or three others which cannot be passed over. The most noteworthy of the shorter papers, however, are upon less technical or more generally interesting topics, so that we have need only to be reminded of them. Among them are his "Observations on the Development of the Surinam Toad," and the same of "*Anableps Gronovii*," and the paper "On some unusual Modes of Gestation." The importance of these papers lies, not in being accounts of some of the most striking curiosities of the animal world, but in the sagacity and quickness with which he discerned, and the clearness with which he taught, the lessons to be learned from them. Any good zoologist, with the same excellent opportunities, would have worked out all the details of the development of the Surinam toads in the skin of the back of their mother, and would equally have noted the morphological significance of the branchiæ and tail, that are never to know any thing of the element they are adapted for; but Dr. Wyman remarks upon the development of the limbs independently of the vertebral axis, as showing that, whatever view be taken of their homology, they are something superadded to it, and not evolved from it; he notes how the *whole* yelk-mass is moulded into a spiral intestine; and that the embryo at the end of incubation forms a larger and heavier mass than existed in the egg when it commenced, — showing that there was an absorption of material furnished by the dermal sac of the mother, — "a solitary instance among Batrachians, if not among Reptiles generally, in which the embryo is nourished at the expense of materials derived from the parent." From this he is led (in the later paper above mentioned), to infer the probability that the developed larvæ of *Hylodes lineatus*, — carried about inland upon the back of their mother, and destitute of limbs adapted to terrestrial locomotion, — may depend upon a secretion from the body for needful sustenance — an interesting and rudimentary foreshadowing of mammalian life, of which he discerned the bearings.

His "Description of a Double Fœtus" (in the "Boston Medical and Surgical Journal, March, 1866), gives him the opportunity of briefly recording some of the results of his studies of the development of double monsters, and to bring out his view, that "the force, whatever it be, which regulates the symmetrical distribution of matter in a normal or abnormal embryo, has its analogy, if anywhere, in those known as polar forces"; that "studying the subject in the most general manner, there are striking resemblances between the distribution of matter capable of assuming a polar condition, and free to move around a magnet, and the distribution of matter around the nervous axis of an embryo." That this is not one of those vague conceptions by which many speculators set about to explain that of which they know little by means of that of which they know less, but that he had striking parallelisms to adduce, the close of this striking paper shows.

The subject of fore and hind symmetry, thus brought directly under notice, had been broached by Dr. Wyman several years before. He returned to it the year following, in his very important morphological paper, "On Symmetry and Homology in Limbs," read to this Society in June, 1867, and published in the Proceedings of that date. It is interesting to observe with what caution and restraint he handled this doctrine of "reversed repetitions," which has since been freely developed by one of his pupils who has a special predilection for speculative morphology, Prof. Burt Wilder.

Prof. Wyman's "Notes on the Cells of the Bee," in the "Proceedings of the American Academy" for January, 1866, is a characteristic specimen of his way of coming directly down to the facts, and making them tell their own story. I could not recapitulate his results much more briefly than he records them in his paper. I need not recall to you how neatly he made this investigation, and represented some of the results, filling the comb with plaster-of-paris and then cutting it across midway, so that the observations might be made and the cells measured just where they are most nearly perfect; and then printing impressions of the comb upon the wood-block, he reproduces on the pages of his article the exact outlines of the cells, with all their irregularities and imperfections. But I cannot refrain from citing a porticn of his remarks at the close: —

"Here, as is so often the case elsewhere in nature, the type-form is an ideal one; and with this real forms seldom or never coincide. . . . . An assertion, like that of Lord Brougham, that there is in the cell of the bee 'perfect agreement' between theory and observation, in view of the analogies of nature is more likely to be wrong than right; and his assertion in the case before us is certainly wrong. Much error would have been avoided if those who have discussed the structure of the bee's cell had adopted the plan followed by Mr. Darwin, and studied the habits of the cell-making insects comparatively, beginning with the cells of the humble-bee, following with those of wasps and hornets, then with those of the Mexican bees (*Melipona*), and finally with those of the common hive-bee. In this way, while they would have found that there is a constant approach to the perfect form, they would at the same time have been prepared for the fact, that even in the cell of the hive-bee perfection is not reached. The isolated study of anything in natural history is a fruitful source of error."

Let me add to this important aphorism its fellow, which I have from him, but know not if he ever printed it. "*No single experiment in physiology is worth anything.*"

The spirit of these aphorisms directed all his work. It is well exemplified in his experimental researches — the last which I can here refer to, upon —"The formation of Infusoria in boiled solutions of organic matter, enclosed in hermetically sealed vessels and supplied with pure air," and its supplement, "Observations and Experiments on living organisms in heated water," published in the American Journal of Science and Arts, the first in the year 1862, the other in 1867. Milne-Edwards could not have known the man, when he questioned the accuracy of the first series because they do not agree with those of Pasteur, and thought the difference in the results depended upon a defective mode of conducting the experiments. As Dr. Wyman remarks in a note to the second series, "the recent experiments of Dr. Child of Oxford, and those reported in this communication, are sufficient answer to the criticisms of M. Edwards." Then as to his thoroughness: — most persons would have rested on the results of his thirty-three well-devised experiments, proving "that the boiled solutions of organic matter made use of exposed only to air which has passed through tubes heated to redness, became the seat of infusorial life;" but all would not have concluded that, after all, they "throw but little light on the immediate source from which the organisms have been derived," nor would many have closed an impartial summary of the opposing views in this judicial way: —

"If, on the one hand, it is urged that all organisms, in so far as the early history of them is known, are derived from ova, and therefore from analogy we must ascribe a similar origin to these minute beings the early history of which we do not know, it may be urged with equal force, on the other hand, that all ova and spores, in so far as we know anything about them, are destroyed by prolonged boiling; therefore from analogy we are equally bound to infer that Vibrios, Bacterians, etc., could not have been derived from ova, since these would all have been destroyed by the conditions to which they have been subjected. The argument from analogy is as strong in the one case as in the other."

Returning to the subject again a few years later, with a critical series of twenty experiments, each of three, five, ten, fifteen, or even twenty flasks, used by way of checks and comparisons,—a rigorous experimenter would have been satisfied when he had proved that sealed solutions subjected to a heat of at least 212° for from *one* to *four* hours, became the seat of infusorial life, at least of such as Vibrios, Bacterians and Monads, while all infusoria having the faculty of locomotion were shown by a special series of experiments to lose this at a temperature of 120°, or at most 134° Fahr. But Prof. Wyman carried the boiling up to *five* hours, and in these flasks no infusoria of any kind appeared. The question of abiogenesis stands to-day very much where Prof. Wyman left it seven years ago.

I must omit all notice of the ethnological work which has occupied his later years, merely referring to the seven Annual Reports of the Trustees of the Peabody Museum of American Archæology and Ethnology, of which he was curator. The last of these, issued just before the writer's death, contains the principal results of his investigation of the human remains he collected in the shell-heaps of East Florida, and convincing evidence of the cannibalism of those who made them. A fuller memoir, embodying all his observations of the last six winters upon the Florida shell-mounds, was sent to the printer just before he died.

The thought that fills our minds upon a survey even so incomplete as this is: How much he did, how well he did it all, and how simply and quietly! We knew that our associate, though never hurried, was never idle, and that his great repose of manner covered a sustained energy; but I suspect that none of us, without searching out and collecting his published papers, had adequately estimated their number and their value. There is nothing forth-putting about them, nothing adventitious, never even a phrase to herald a matter which he deemed important.

His work as a teacher was of the same quality. He was one of the best lecturers I ever heard, although, and partly because, he was the most unpretending. You never thought of the speaker, nor of the gifts and acquisitions which such clear exposition were calling forth, — only of what he was simply telling and showing you. Then to those who, like his pupils and friends, were in personal contact with him, there was the added charm of a most serene and sweet temper. He was truthful and conscientious to the very core. His perfect freedom, in lectures as well as in writing, and no less so in daily conversation, from all exaggeration, false perspective, and factitious adornment, was the natural expression of his innate modesty and refined taste, and also of his reverence for the exact truth.

It has been a pleasure to learn, from former college students, who hardly ever saw him except in the lecture-room, that he gave to them much the same impression of his gifts and graces, and sterling worth, that he gave us who knew him intimately — so transparent was he, and natural.

With all his quick sense of justice, and no lack of occasion for controversy, it seemed to cost him no effort to avoid it altogether. He made no enemies, and was surrounded by troops of life-long friends. When he first went abroad, in 1841, he was told by some near friends, who recognized his promise, that a chair of Natural History in his alma mater would soon have to be filled, and that he should be presented as a candidate. In the winter following, the present incumbent, responding to an invitation to visit Boston, which he had never seen, and to consider if he would be a candidate, then first heard of Wyman's name and of his friends' expectations or hopes; whereupon he dismissed the subject from his mind. Probably he felt more surprise than did Dr. Wyman when notified, a few months afterwards, of the choice of the Corporation. The exigencies of the Botanic Garden probably overbore other considerations. I doubt if Dr. Wyman ever had an envious feeling. Certain it is that no one welcomed the new professor with truer cordiality, or proved himself a more constant friend.

In these days it is sure to be asked how an anatomist, physiologist, and morphologist like Prof. Wyman regarded the most remarkable scientific movement of his time, the revival and apparent prevalence of doctrines of evolution. As might be expected, he was neither an advocate nor an opponent. He was not one of those persons who quickly make up their minds, and announce their opinions, with a confidence inversely proportionate to their knowledge. He could consider long, and hold his judgment in suspense. How well he could do this appears from an early, and so far as I know, his only published presentation of the topic, in a short review of Owen's "Monograph of the Aye-Aye" (in Am. Journ. Science, Sept., 1863) — the paper in which Prof. Owen's acceptance of evolution, but not of natural selection, was promulgated. Dr. Wyman compares Owen's view with that of Darwin (to whom he had already communicated interesting and novel illustrations of the play of natural selection); and he adds some acute remarks upon a rather earlier speculation by Mr. Agassiz, in which the latter suggests that the species of animals might have been created as eggs rather than as adults. He states the case between the two general views with perfect impartiality, and the bent of his own mind is barely discernable. In due time he satisfied himself as to which of them was the more probable, or, in any case, the more fertile hypothesis. As to this, I may venture to take the liberty to repeat the substance of a conversation which I had with him sometime after the death of the lamented Agassiz, and not long before his own. I report the substance only, not the words.

Agassiz repeated to me, he said, a remark made to him by Humboldt, to the effect that Cuvier made a great mistake, and missed a great opportunity, when he took the side he did in the famous controversy with Geoffroy St. Hilaire; he should have accepted the doctrines of morphology, and brought his vast knowledge of comparative anatomy and zoology, and his unequalled powers, to their illustration. Had he done so, instead of gaining by his superior knowledge some temporary and doubtful victories in a lost cause, his prëeminence for all our time would have been assured and complete. I thought, continued Wyman, that there was a parallel case before me, — that if Agassiz had brought his vast stores of knowledge in zoology, embryology, and palæontology, his genius for morphology, and all his quickness of apprehension and fertility in illustration, to the elucidation and support of the doctrine of the progressive development of species, science in our day would have gained much, some grave misunderstandings been earlier rectified, and the permanent fame of Agassiz been placed on a broader and higher basis even than it is now.

Upon one point Wyman was clear from the beginning. He did not wait until evolutionary doctrines were about to prevail, before he judged them to be essentially philosophical and healthful, "in accordance with the order of Nature, as commonly manifested in her works," and that they need not disturb the foundations of natural theology.

Perhaps none of us can be trusted to judge of such a question impartially, upon the bare merits of the case; but Wyman's judgment was as free from bias as that of any one I ever knew. Not at all, however, in this case from indifference or unconcern. He was not only, philosophically, a convinced theist, in all hours and under all "variations of mood and tense," but personally a devout man, an habitual and reverent attendant upon Christian worship and ministrations.

Those of us who attended his funeral must have felt the appropriateness for the occasion of the words which were there read from the Psalmist: —

"The Heavens declare the glory of God, and the firmament showeth his handy-work. . . . . O Lord, how manifold are thy works! In wisdom hast thou made them all; the earth is full of thy riches; so is this great and wide sea, wherein are things creeping innumerable, both great and small beasts. Thou sendest forth thy spirit, they are created, and thou renewest the face of the earth."

These are the works which our associate loved to investigate, and this the spirit in which he contemplated them. Not less apposite were the Beatitudes that followed: —

Blessed are the meek; blessed are the peace-makers; blessed are the merciful; blessed are the pure in heart.

Those who knew him best, best know how well he exemplified them.

Mr. F. W. Putnam offered the following Resolutions, which were seconded by Dr. Storer, and unanimously adopted.

Resolved: — That in the death of JEFFRIES WYMAN the Boston Society of Natural History mourns the loss of a most honored member and efficient officer; one who was untiring in his labors for the Society during his long and active connection with it as Curator, Secretary and President; and that, in his death, Science has lost a most thorough and careful investigator, and the cause of education and truth a most devoted and conscientious disciple.

Resolved: — That as members of a Society who gave to Professor Wyman the highest honor and position we could bestow, we acknowledge our indebtedness to him for the thoughtfulness and care with which he guided our labors for so many years, and, while filled with sorrow at our own loss, we ask the privilege, by transmission of these resolutions, of extending our sympathy to his bereaved family in their great trial.

The following letter from Prof. Rogers was read: —

NEWPORT, Oct. 6, 1874.

TO PRES. BOUVÉ,

My dear friend: — I regret that it will not be in my power to attend the meeting of the Natural History Society tomorrow evening, as I should greatly desire to unite with you in an affectionate tribute to the memory of Prof. Wyman, whose long services as President of the Society, and whose peculiar excellences as a student of nature must ever claim our regard and admiration.

From my first acquaintance with him, while engaged in the delicate microscopic dissections with which he illustrated the work of the late Dr. Amos Binney on Land-shells, until within a few years past, I have had frequent opportunities of marking his scientific progress; and although but little acquainted with the inquiries to which he chiefly devoted himself, I have understood enough of his labors to appreciate his singular patience and accuracy as an observer, his ingenuity in devising experiments, and the caution and conscientiousness with which he was accustomed to report the results of his investigations.

These qualities, early recognized by his scientific co-workers abroad as well as at home, placed him in the front rank of the promoters of the biological sciences. To these intellectual gifts was added a modesty and self-forgetfulness which, while they were unfavorable to the more popular recognition of his merits, have rendered his example preëminently worthy of imitation by all honest seekers after truth. Yours faithfully,

William B Rogers.

Out of respect to Dr. Wyman's memory, it was voted to adjourn without the transaction of any business but the imperative election of members.

Prof. Oswald Heer was elected an Honorary Member, and Messrs. Geo. W. Bond, Jonathan Brown, Jr., E. S. Cassino, W. G. Corthell, R. W. Greenleaf, M. L. Ham, J. S. Hayes, C. E. Hobbs, Wayland Hoyt, Dan'l T. Huckins, John Orne, Jr., R. Rathburn, and E. A. Thompson, were elected Resident Members.

October 21, 1874.

The President in the chair. Fifty-four persons present.

The Secretary read a note by Mr. Charles Stodder, on the locality of the Bermuda Tripoli, accompanied by a communication on the same subject by Prof. Christopher Johnston of Baltimore.

In "Science Gossip," London, for May, 1874, is a note signed "F. K.," in reply to a correspondent, who had inquired for the locality of the celebrated "Bermuda Tripoli," so rich in peculiar forms of Diatomaceæ, described by Ehrenberg and the late Prof. J. W. Bailey. "F. K." says that "Mr. Geo. Norman of Hull, England, found that it came from Nottingham, Maryland."

As the Nottingham earth came from our corresponding member, Prof. Christopher Johnston of Baltimore — and that it was possible that Nottingham was the original locality, was well known in this country independent of Mr. Norman — I applied to Prof. Johnston for the authentic history of that deposit; to which he replied by the paper herewith appended. Mr. Norman's paper is in the "Quarterly Journal of Microscopical Science," January, 1861. In that paper he does not say that the Bermuda came from Nottingham, as "F. K." represents, but only suggests the possibility of the case, as American diatomists had before him. Since Dr. Johnston's paper was written, Dr. Josiah Curtis has visited that part of Maryland, and discovered numerous other localities of the diatomaceous earth, containing the same forms as the Bermuda and Nottingham deposits.

About the Rediscovery of the "Bermuda Tripoli," near Nottingham, on the Patuxent, Prince George's County, Maryland. By Christopher Johnston, M.D.

In 1854 I had the great pleasure of being a correspondent of Prof. J. W. Bailey of West Point, and during the year received from that distinguished gentleman valuable guidance, and also specimens of diatomaceous material, among others a very small portion of a buff-colored dust, labelled "Bermuda Tripoli." From this I prepared a single slide, now in my possession, containing very beautiful forms, chiefly *Heliopelta*, *Corcinodiscus*, *Craspedodiscus*, *Aulacodiscus Crux*, and *Eupodiscus Rodgersii*.

At a later period I was in correspondence with my friend J. Sullivant, Esq., of Columbus, and while making some exchanges, I asked for "a good boiling of Bermuda Tripoli"; to which request Mr. S. replied, June, 1859, "I would send you a quantity if I had it. I have nothing but a slide, and I have been long struck with its resemblance to the Richmond earth. . . . . In a letter just received from Mr. Geo. Norman, he says 'what a pity the locality of Bermuda Tripoli and its beautiful fossils has been lost;' and then adds 'that himself and Dr. Arnott had come to the separate and independent conclusion that they *never came from Bermuda at all*, but from Bermuda or James River in Virginia.' I have very little doubt of it, for there is a place called 'Bermuda Hundreds' on the James River. From the frequent intercourse between Baltimore and Richmond, you have an opportunity of following this up. I trust you will."

Early in 1860 I sent my "Bermuda" slide to Columbus, where the beauty of the diatoms was much appreciated, and Bermuda Hundreds again the subject of remark, as appears by a letter from Mr. Sullivant, dated March 25, 1860.

I had resolved to visit Bermuda Hundreds for the purpose of making an exploration, when, about the first of April, my valued friend P. T. Tyson, Esq., State Geologist for Maryland, sent me a number of small parcels of "Tripoli," which he had procured in different parts of the State. One of these earths marked *Nottingham*, attracted my particular attention, for I had the extreme pleasure to find in it the diatomaceous forms familiar on my Bermuda Tripoli slide, besides a host of others, and I at once was satisfied that the lost Bermuda Tripoli was before me, and its locality discovered.

I at once communicated my dicovery to Mr. Tyson, who was much gratified at being the means of leading to so interesting a development; and as he was about to visit Boston as member of the American Association for the Advancement of Science, which was to have its sitting in May, my friend offered to take a short note which I hastily prepared, together with some of the "new Bermuda earth," and lay both before the Academy. Mr. Tyson kept his promise.

In the next month I received a note from that eminent physician, Dr. Silas Durkee of Boston, of date June 9, 1860, making me acquainted with Charles Stodder, Esq., an associate of the Boston Natural History Society, and conveying a valuable and detailed catalogue of "the genera and species" of Diatomaceæ found by Mr. Stodder in the Nottingham earth.

I had hardly convinced myself of the identity of the "Bermuda Tripoli" and the Nottingham earth, than I thought of my friend Mr. J. Sullivant, to whom I dispatched a parcel of the earth in question; and in his reply, dated June 4, 1860, he says "I trust you have rediscovered the equivalent of the Bermuda Tripoli."

Although I had identified the "Bermuda Tripoli" in the Nottingham earth, I could not abandon all hope of tracing the former to Bermuda Hundreds, on the James. Accordingly, in the summer of 1860, I made a pilgrimage to the latter place, situated upon the right bank of the river, above City Point, about one hundred miles nearly due south of Nottingham, and since made remarkable by a historic amphoric inclusion, but my visit was without other fruit than a surprise to the inhabitants, who failed to appreciate any zeal, but who, nevertheless very kindly aided my search.

About this time my friend Mr. Wm. S. Sullivant of Columbus, sent a portion of the Nottingham earth with which I furnished him to Mr. G. Norman of Hull, as I find in a letter of date January 12, 1861, from Dr. J. M. Dempsey, of Charterhouse Square, with this reference: "In the last 'Quarterly Journal of Microscopical Science,' there is a short paper by Mr. Norman of Hull, describing the fossil forms of Diatomaceæ, contained in a deposit forwarded to him by Messrs. Sullivant and Wormley, Columbus, Ohio, described or discovered by you at Nottingham, Maryland."

The letter also contained a request for some of the earth, with which I complied at once, forwarding by the same conveyance a parcel to Mr. G. Norman of Hull, and to my almost namesake, the venerable Christopher Johnson, Esq., of Lancaster, and included under the cover of each several other Maryland deposits. For these, Mr. Johnson wrote in acknowledgement a very kind letter, bearing date March 15, 1861, and Mr. Norman's reply soon followed, his letter being dated April 12, 1861.

From this time until the present, Mr. Tyson and myself have supplied quantities of the Nottingham earth to very many correspondents; and upon looking over my own slide of the new Bermuda, nothing gives me so much satisfaction as the knowledge that I have, by the very probable discovery of the "Bermuda" locality, contributed so much to the pleasure of other microscopists.

In reply to a question by the President, Mr. R. C. Greenleaf said that the diatomaceous forms contained in the Bermuda Tripoli were the same as those found in the Richmond earth.

Dr. T. S. Hunt spoke of the geological age of these deposits, and said that no infusorial earths are as yet known to occur in Bermuda.

Prof. W. H. Niles stated that Tyson's Reports on the Geology of Maryland contain very good reports on the various Maryland localities of infusorial earth.

Mr. S. H. Scudder presented, on behalf of Miss Flint of Charlestown, several nests of trap-door spiders found in Mentone, France, together with specimens of the insects themselves.

Cylindrical holes in the earth, serving as nests, are made by but a single family of spiders, commonly known as Tarantulas, and are of four types: a simple tube, without covering; a simple tube with a silken lid, either thin, like a wafer, or thick, like a cork; a simple tube with two lids, always wafer-like, one at the summit and another part way down the tube, the latter resting against the side of the tube, when not in use; and a branched tube, which is a modification of the third type, made by constructing an upwardly receding branch to the tube, behind the point where the inner lid falls when not in use; in this case the inmate, finding resistance useless against the encroachments of an enemy which has effected an entrance to the tube, retreats up the branch and allows the lid to fall and conceal the opening, baffling the efforts of the intruder, who vainly searches the bottom of the tube for his victim.

Nests of the simplest type are found in our own State, while simple tubes with cork-like lids are made by a large Californian spider.

Prof. A. Hyatt gave an account of his recent studies of the larvæ of some forms of Ascidia.

The larva of *Cynthia* is not unlike a very young tadpole in external outline, having an egg-shaped body, with a tail of considerable length, and this tail surrounded by a continuous fin of extremely transparent membrane. This fin had been described by Prof. E. S. Morse, and certain marks in it described and figured as rays. Such rays as had been described certainly were present, but a closer examination of several hundred larvæ of *Cynthia carnea* seemed to show that no differences existed between the rays and the adjoining parts of the same membrane. The appearance of rays was due entirely to permanent folds, which occur when the animal is seen in its usual position from either side, but which may be considerably altered in form, number and position, by varying the position of the animal. A technical point like this seems to be of but slight importance, but since this fin has been compared by a late author with the fin of a fish, it becomes at once of great interest to ascertain the exact nature of the rays, and whether they are really supports extending from the tail, similar to those of the fins of fishes. The entire fin is evidently an extended fold of the body membrane, of such extreme tenuity and transparency that only the edge can be faintly traced by the aid of the microscope when straightened out upon a glass slide, and it is very doubtful whether any rays exist which may be in any sense compared with those of a fish's fin.

November 4, 1874.

Vice-President Scudder in the chair. Forty persons present.

The following papers were read:—

DESCRIPTIONS OF NEW NOCTUIDÆ. BY H. K. MORRISON.

Acronycta increta nov. sp.

Expanse 30–31 mm. Length of body 12 mm.

This is an intermediate form, between *hamamelis* Guen. and *dissecta* G. & R. The latter is distinguished by its smaller size (26–27 mm.), comparatively smooth squamation, and white thorax and median space. *Hamamelis* is the largest (40 mm.). Its color is uniform dark gray, the markings are confused and interrupted, and the squamation rough, coarse, and raised up. In size *increta* is between the two just mentioned; its scales are large and raised up in ridges to form the ordinary lines, and the markings are more or less broken, but in a less degree than in *hamamelis*.

In *increta* the reniform spot is almost linear, its sides being parallel, and only slightly curved. The median shade is nearly straight, except at the costa. In *hamamelis* the reniform is a full lunule, and the median shade is broadly outwardly curved, touching the reniform.

In the former the coloration is more diversified than in the latter. The interior line is black and well defined; the median space is lighter, approaching *dissecta*, and the whole wing is more or less suffused with olivaceous green, giving it a different color from the plain gray of the larger species. Posterior wings and under surface much as in *hamamelis*.

Hab. New York. Several specimens received from Messrs. Fred. Tepper and E. L. Graef.

Types in the collections of the Buffalo Society of Natural Sciences, and H. K. Morrison.

Acronycta aspera nov. sp.

Expanse 46 mm. Length of body 18 mm.

The eyes are naked. The collar rounded. The thorax is provided with a small prothoracic tuft. The abdomen has a slight tuft at the base. The markings are jagged and rough. The ground color is uniform bluish-gray. The half-line is present. The exterior line is simple, oblique and uneven; to it is attached a black shade line, representing the claviform spot. The ordinary spots are concolorous and encircled with black. Orbicular spot very small; the reniform of the usual size. The median shade is present, at first oblique, and parallel with the interior line to the base of the reniform, then turning at right angles, and continuing parallel to the exterior line to the inner margin. The exterior line is denticulate, of the usual form. The subterminal line is very prominent, inwardly jagged, each tooth filled with black. A series of triangular dots at the base of the fringe. Posterior wings gray, with a discal dot and median line. Beneath gray, the anterior wings darker, both wings with discal dots and a broad, common, median line.

Hab. Adirondack Mts., N. Y. Received from Mr. F. C. Bowditch.

This species is apparently allied to *subochrea* Grote, but differs principally by the absence of any ochreous color.

DEMAS Steph.

Eyes naked. Head drawn in. Palpi short and hanging. Tongue weak. Antennæ in the male pectinated, in the female setiform. Thorax thickly haired, and with a small prothoracic and a strong metathoracic tuft. Abdomen with strong hairy tufts. Tibiæ unarmed.

Demas diversicolor nov. sp.

Expanse 32 mm. Length of body 17 mm.

Front, collar, and thorax, light gray. The metathoracic tuft tipped with black. The abdominal tufts black. The anterior wings are divided into two distinct fields (the exterior light and the interior dark) by a black, slightly oblique line, extending across the median space, from the inception of the exterior line to its termination on the inner margin. The portion of the median space within this line is black-brown. The basal space is green, most distinctly so beneath the median nervure. Half-line present. Interior line distinct, geminate, and to it are attached the orbicular and claviform spots. It is notched on the costa, then joining the orbicular spot, and below the latter forming one outward lobe to the inner margin. Orbicular spot elliptical, strongly contrasting, whitish, with an internal green shade spot; it opens into a basal, costal, greenish white shade. The lower part of the basal space is less green, and contains a large, deep brown spot situated in the lobe of the interior line. Claviform spot concolorous, with its upper line alone distinct; extending, as well as the orbicular, to the median shade, which is seen as a thick black line parallel to the border of the dark space. The outer half of the wing is clearly whitish in the median space, shading into light green in the subterminal and terminal spaces. Reniform spot barely perceptible. The lines sub-obsolete. The exterior line is most clear opposite to the cell; there it is dentate, of the usual shape, and followed by dark points on the nervules. The subterminal line is white, irregular, forming two blunt, Hadena-like teeth on the second and third median nervules. The upper portion of the subterminal space slightly darker. A longitudinal black dash on the first median nervule in the terminal space. A series of fine black lunules at the base of the fringe, which is dark, intercepted with ochreous, and with a continuous central dark line. Posterior wings whitish, with a discal dot, a twice angulated median line, and a diffuse blackish terminal shade. Fringe concolorous. Beneath, the anterior wings are dark, lighter along the inner margin and in the terminal space. The reniform spot and the exterior and subterminal lines are faintly reproduced. Posterior wings whitish, with a discal dot and exterior line.

Hab. New York. From my collection. Massachusetts, Sept. 16, 1874. (Mr. Roland Thaxter.)

This species can be easily identified by its strongly contrasting markings and colors, which resemble in their disposition those of the only other and closely allied species of this genus, the European *Demas Coryli.*

Copipanolis vernalis nov. sp.

Expanse 37 mm. Length of body 16 mm.

Antennæ pectinate above, serrate beneath. Eyes naked, with lashes. Tongue present, but weak. Palpi short and hanging. The hairy clothing of the front protuberant between the eyes. Collar rounded, and with the thorax uniform dark gray. A peculiar, close-lying, metallic bronze patch of hair behind the collar, and another, somewhat longer, but similar, on the metathorax. Abdomen untufted.

Beneath, the thorax and legs are thickly clothed, and the anterior tibiæ are armed with a strong claw. All the tarsi hairy, concealing the short spines. Anterior wings uniform dark gray; half-line distinct, followed on the costa by whitish scales. The ordinary spots obscure, slightly edged with black, but principally indicated by the whitish scales which fill them. Claviform spot also present beneath the orbicular, and marked in the same manner. Interior and exterior lines obsolete. The subterminal line represented by an interrupted series of blackish spots. A faint whitish subapical shade. A dark line at the base of the concolorous fringe. Posterior wings translucent, grayish fuscous, with a discal dot and a black line at the base of the conspicuous white fringe. Beneath the anterior wings are gray, with the costa and a terminal border cinereous. Posterior wings cinereous. A very distinct black discal dot, and faint traces of a median line. An interrupted black line at the base of the concolorous fringe. Base of both wings slightly tinged with yellow.

Hab. Massachusetts.

One specimen taken on April 8, by Mr. Roland Thaxter. Easily recognized by the strong generic characters, and by the metallic thoracic markings. These latter have not before, to my knowledge, been noticed in any Noctuid. They resemble those found on *Tolype velleda* Stoll. *C. vernalis* differs from *cubilis* Grote, in the presence of the metallic spots, and in the antennæ, which in the latter are strongly bipectinate.

Pleonectopoda fimbriaris Guen.

Expanse 30 mm. Length of body 13 mm.

Eyes naked, furnished with hairy lashes. Antennæ strongly bipectinate, each pectination clothed with interlacing hair. Front rounded, without a navel-shaped knob. Tongue present, but short. Head drawn in. Palpi nearly horizontal, only reaching to about the middle of the eyes; the first two joints black, shaggily haired, the third yellow, short and round. The thorax stout, rounded, and untufted, of the color of the anterior wings, with the addition of a few scattered whitish yellow hairs. Abdomen untufted, reaching to the exterior margin of the posterior wings; above alternately banded with black and yellow. The anterior tibiæ are armed on the outside and at the junction with the tarsi with a long spine (not a curved claw, as in *Copipanolis*). On the inside there is a row of shorter spines, also terminating in a longer one at the tarsi, resembling that on the outside, but considerably smaller. Middle and posterior tibiæ strongly spinose. Color of the anterior wings variable in the female,—different shades of clay or brick red. All of the eight males examined were much worn, and almost colorless. There is a narrow black shade along the costa in the median space. Beneath this shade, above the reniform spot, and to the inception of the exterior line, there is a more or less distinct whitish cinereous shade. A black spot on the median nervure at its base. Orbicular spot reduced to a simple black spot, occasionally white-centred. The median shade is present as a diffused blackish band, forming a regular outward curve, its two extremities being at a nearly equal distance from the base. Reniform spot narrow and subquadrangular, yellow and very distinct, with an indistinct black central shade, which culminates in a black spot at the junction of the median nervure and fourth median nervule. Beyond the reniform the median space is black to the exterior line, which consists of clear white dots on the nervules, most evident on the lower subcostal and upper median branches. Subterminal line a blackish undefined shade. A series of terminal dots. Posterior wings in the female fuscous, in the male lighter; in both sexes there is an interrupted black line at the base of the fringe. Beneath, the wings are without bands or spots, the anterior grayish fuscous, tinged with reddish along the costal margin; the posterior whitish.

Hab. Tuckernuck Island, near Nantucket. (Mr. Edward Burgess.)

Quickly identified by the pectinated antennæ, the uniform reddish hue only interrupted by the conspicuous yellow reniform spot, and the cinerous and blackish markings above and beyond it.

This species had not, until now, been rediscovered since its description by Guenée from a single male specimen; the reception after the above description was written of males in perfect condition, has enabled me to make the identification.

Eurois astricta nov. sp.

Expanse 60 mm. Length of body 25 mm.

A very large, stout form. Eyes naked, unlashed. The head somewhat sunken. The antennæ of the female showing fine, short bristles. The collar and thorax are smoothly and closely haired, the former rounded, and not separated from, or elevated above, the latter. The abdomen very stout, cylindrical and heavy, slightly exceeding the posterior wings; untufted. All the tibiæ spinose. The anterior wings are gray, strongly suffused with brown, the subterminal and terminal spaces darker. The half-line present. The median lines are geminate, with broad pale included bands. The interior nearly perpendicular, its inner component line diffused, clearly defining the basal space, its outer line narrow, dark brown, and continuous, forming a dent beneath the submedian nervure. The median space is shaded with brown, particularly in the neighborhood of the spots. The ordinary spots are all very large, annulated with black and filled with cinereous, which is overspread with dull gray. The reniform spot has traces of an internal annulus, and is of the normal shape. Orbicular spot very long, extending below the median nervure. In one female the reniform spot is normally formed above, and outwardly, but inwardly it is joined to the orbicular. Outer portion of the claviform spot alone apparent; in the abnormal specimen before mentioned it joins above the annulus of the orbicular spot. Median shade rounded, dark brown and diffuse; it appears above and below the united spots. The exterior line is of the usual form, its inner component line fine and denticulate, the outer, broad and continuous, defining the dark subterminal space. The subterminal line is faint and irregular, preceded by a series of very conspicuous, black, cuneiform markings, those opposite the cell the largest. A series of triangular dots at the base of the fringe. Posterior wings dark grayish fuscous, with a discal dot, and an indistinct line. A black interrupted line at the base of the white contrasting fringe. Beneath more or less distinct gray; the discal dots, median line, and a terminal black shade band common to both wings are present. The costa of both wings tinged with dull carneous.

Hab. New Hampshire, in August.

I am indebted to Mr. Holmes Hinckley for one of his two specimens of this fine species, as well as for other interesting material. It resembles *Mamestra purpurissata* Grote, but is much larger, and also differs in its strong generic characters.

Polia perquiritata nov. sp.

Expanse 42 mm. Length of body 17 mm.

Eyes naked, with hairy lashes. Male antennæ pyramidal-toothed, with fine hairy clothing, and with a tuft at the base. Collar hollowed out. Thorax having a low fore and hind tuft; mixed black and white, the hind tuft entirely black. The collar and tegulæ are edged with black. Abdomen untufted. Coloration of the anterior wings plain black, white, and gray; all the markings very prominent and contrasting. A short, black, basal. longitudinal, submedian branch. Basal space black. Half and interior lines double, each enclosing broad white bands, the latter strongly outwardly lobed, particularly between the median and submedian nervures. To this lobe the small black claviform spot is attached. Median space overspread with gray; the median shade blackish and diffused. Reniform and orbicular spots white, broadly encircled with black; the former lunulate, the latter nearly round. The exterior line of the usual shape, acutely inwardly dentate between the nervules, followed by its lighter component line; the space between them clear white. The subterminal line a blackish diffused shade, preceded by a series of clear black subcuneiform spots. Those opposite to the cell and below the median nervure the most prominent. A series of conspicuous triangular spots at the base of the fringe. The latter is black, cut with white opposite to the triangular spots. Posterior wings gray, having a distinct discal dot and median band. An interrupted black line at the base of the fringe, and a darker subterminal shade band. Beneath gray. On the anterior wings the ordinary spots, the exterior line, and the cuneiform spots are reproduced in black, somewhat less distinctly than above. The posteriors with a very distinct discal dot and median band.

Hab. White Mountains, N. H.

Taken at the camp of the Entomological Club, a short distance below the Half Way House, July 6, 1874.

A very distinct species. Allied to *Polia leucoscelis* Grote, from Wisconsin, from which it can be separated by the absence of a connecting line between the exterior and interior lines, and also of the cuneiform subterminal markings. It differs, besides, in other minor particulars.

Polia speciosa nov. sp.

Expanse 45 mm. Length of body 20 mm.

Eyes naked, lashed. Basal antennal tufts. Collar and thorax gray, the former rounded, with a central black line; the latter smooth, with only a short metathoracic tuft, tipped with black. Abdomen smooth, untufted. On the anterior wings the median space is of a dark, bluish olivaceous gray. A bifid, black, basal streak, its lower branch short and thick, the upper fine, extending along the subcostal nervure to the interior line. Half-line present. A very distinct, thick, black dash beneath the submedian nervure; between the dashes the basal space is whitish. Interior line double, lobed between the nervures, the lobe beneath the submedian elongated. The lines which compose the claviform spot thick and black. The ordinary spots disconcolorous, edged with black, with olivaceous centres and very distinct, yellowish-white annuli. Reniform spot large, irregular, forming a right angle on the submedian nervure, above rounded, and on the outside deeply excavated. Median shade dark, extending obliquely, close to the reniform spot, to the exterior line, then turning and continuing parallel to the latter to the inner margin. Exterior line incompletely geminate, denticulate above, subparallel to the exterior margin. Terminal and subterminal spaces of a slightly bluish, olivaceous cinereous. Subterminal line white, preceded between the median branches by four very conspicuous, black, cuneiform marks, and followed by more or less distinct, olivaceous spots. Upper portion of the subterminal space olivaceous, contrasting with the subterminal line. A series of black, triangular spots at the base of the fringe, which is dark, cut with light. Posterior wings fuscous, a black line at the base of the yellow fringe. Beneath, the anterior wings are dark gray, the reniform spot and the upper portion of the exterior line reproduced in black. Costa and terminal space light gray. Posterior wings whitish with a distinct discal dot. Traces of a median and terminal shade line.

Hab. Cambridge, Mass., July 17. From my collection.

Very strongly marked, but the colors are not so clear and unmixed as in the previously described species. The peculiar shape and color of the reniform spot, the submedian dash and the subterminal cuneiform spots are prominent markings, and will distinguish it.

Polia confragosa nov. sp.

Expanse 44 mm. Length of body 20 mm.

The eyes are naked, with strong lashes. The antennæ are shortly bipectinate. The collar is cut out and produced in front. A furrowed, prothoracic tuft. The metathoracic tuft is not present on this specimen, but it may have been accidentally destroyed. Abdomen tufted. On the anterior wings the markings are very distinct and contrasting, as is usual in this genus. The colors are black, white, gray, and ochreous. The half-line distinct. A short basal streak, accompanied by a broad blackish shade. The basal space is white, more or less diffused into ochreous, an ochreous shade extends along the inner margin. The interior line is very oblique, geminate, its inner line fine, the outer one black and distinct, forming a long tooth on the submedian nervure, the point of which connects with the exterior line. The median space is gray, broad above, much narrowed below. The ordinary spots are large, disconcolorous and very conspicuous, the orbicular is rounded, slightly ochreous, having a central gray spot; the reniform is much excavated outwardly, white, with an inferior ochreous portion limited by the central indistinct gray shade; the claviform is very large, concolorous, outlined in black, its lower bounding line straight, extending to the exterior line. The median shade extends from the base of the reniform spot closely parallel to the exterior line, to the inner margin. Distinct black shade lines follow the reniform spot to the exterior line. Latter very distinct, parallel with the outer margin, above acutely outwardly dentate, below forming only two inward indentations to meet the two lines which connect it with the interior line. The outer component line is very much diffused, being rather a shade than a line. The teeth of the exterior line are followed by short black lines on the nervules. The subterminal and terminal spaces are in general whitish, but they are much suffused with ochreous, particularly along the subterminal line, and beyond the claviform spot. The subterminal line is whitish, indistinct, preceded by an interrupted series of cuneiform markings, four of which, two near the costa and two between the second and fourth median nervules, are large and well-defined; followed by a grayish shade (intermixed with ochreous) which centres in two black blotches, one at the inner angle and one at the first median branch, each of these blotches containing cuneiform markings. A series of triangular dots at the base of the fringe, which is gray with a central whitish line. The posterior wings are grayish fuscous, with a dot and black median line. There is also a very distinct ochreous terminal band. A black line at the base of the fringe, which is gray, tipped with white outwardly. Beneath gray, tinged with ochreous, bearing distinct discal dots, a conspicuous, broad, denticulate, common median line, and a more obscure common subterminal shade.

Hab. Quebec, Canada. The only specimen I have seen was captured by Prof. F. X. Belanger, and is in his collection.

It is unnecessary to repeat the characters of this handsome insect; it is so vividly colored that it will be recognized at sight. It is a typical species, possessing all the markings of the Noctuidæ in their normal form.

Mamestra passa nov. sp.

Expanse 35 mm. Length of body 16 mm.

Eyes hairy. The third joint of the palpi short, and tipped with white. Collar produced in front, but in a much less degree than in *Cucullia*; it is dark, with a central black line, above the line conspicuously capped with white. Villosity of the thorax intermixed white, gray and cinereous. Tegulæ with a black line. Abdomen untufted. On the anterior wings the median and terminal spaces are olivaceous gray; the basal space shows a lighter shade of the same color, and the subterminal space is whitish cinereous, contrasting. A distinct, longitudinal basal streak; beneath this and between it and the interior line, a dark, oblique shade. Interior line widely removed from the base, double, with a pale included shade, and strongly outwardly lobate between the nervures. Attached to it in the usual place is the black-edged, concolorous claviform spot. Ordinary spots very large, contrasting, whitish or reddish cinereous, with included olivaceous shades; orbicular open above; reniform indistinctly limited outwardly, followed by a pale reddish shade, which extends to the exterior line. This latter is subobsolete above, defined mainly by the contrast in color between the subterminal and median spaces; below the median nervure it is distinct, black, strongly drawn in and approaching closely the claviform spot. Pale carneous cinereous shades prevail over a portion of the upper part of the subterminal space; below, this space is very clearly whitish, particularly at the inner angle, where it forms a distinct blotch. Subterminal line whitish, distinct, preceded by narrow blackish shades, and by a very conspicuous triangular black mark, just above the inner angle. Beyond the line the terminal space is of an olivaceous, partly yellowish-gray, with the nervules distinctly black. A clear black spot between the third and fourth median branches. Fringe dark, intersected with light at the termination of the nervules. Posterior wings uniform fuscous, without lines or spots. Fringe whitish. Beneath, the anterior wings are uniform fuscous, the posterior whitish, sprinkled with dark atoms, and with a median line and discal dot.

Hab. California. From my collection.

Allied to *M. cuneata* Grote, from California, and to *M. vicina*, from the Eastern States, but sufficiently distinct from both. It is also apparently allied to *Dianthœcia leucogramma* Grote, unknown to me. *M. passa* differs in several particulars from the description of that species, but it is so short that I cannot be fully satisfied.

Mamestra impolita nov. sp.

Expanse 35 mm. Length of body 13 mm.

Eyes hairy. Male antennæ with fine hairy clothing. Collar gray, with a median line. Abdomen strongly tufted. In this species the lines and spots are arranged as in *chenopodii* Albin, but the markings are more broken, and the squamation is rough and uneven.

The ground color is white, almost totally obscured, except in the ordinary spots and on the subterminal space, by black or gray shades. The nervules, and a portion of the basal space, are tinged with glaucous. Half-line present. The interior line irregular, simple, obsolete below the claviform spot. The latter round, large, whitish, outlined in black. Above, is situated the white, oblique orbicular spot, containing a central gray shade. The submedian nervure is plainly blackish. Median shade blackish, suffused and irregular, lost in the dark median space. Reniform spot white, containing a central gray shade, well-sized, unsymmetrical, its defining line broken. The exterior line is black, simple, continuous, dentate, much drawn in below the reniform spot, and forming a particularly deep lobe above the submedian nervure. Subterminal space more or less distinctly whitish below the costa, this color culminating in a very conspicuous white spot, filling the median lobe of the exterior line. The terminal line is whitish, distinct, but somewhat broken, forming two short, but evident teeth on the second and third median nervules. The line cuts and divides into two portions, the black shades which extend over the terminal and latter part of the subterminal spaces. The usual subapical white dots, and a similar series at the base of the fringe. Posterior wings dark fuscous, becoming lighter and partially translucent at the base; a faint discal dot. The fringes are whitish. Beneath very uniform in coloration; the anterior wings dark gray; whitish scales line the costa; the posterior wings are whitish, with a distinct discal dot; a common line extends over both wings.

Hab. Quebec, Canada.

Kindly lent me for identification by my friend Prof. F. X. Belanger, of the Université Laval.

The dark, almost black coloration of the anterior wings contrasting with the four white spots in their central portion is characteristic of the species. Of these spots, two, the orbicular and claviform, are comparatively small and well-defined; the remaining two, the reniform and the spot in the lobe of the exterior line, are large and irregular.

Mamestra illabefacta nov. sp.

Expanse 35 mm. Length of body 16 mm.

Eyes hairy. Male antennæ setiform. Collar showing a central, and a terminal transverse dark line, the latter edged with whitish. Tegulæ edged with black. Thorax in both specimens before me somewhat defaced, but there are evidently low prothoracic and metathoracic tufts. The examination of perfect specimens will show the actual size of this structure. Abdomen smooth above, with only a slight basal tuft. Its coloration yellowish, with reddish lateral and anal tufts; beneath, the abdomen is red. Posterior tibiæ provided with short yellow tufts. General color of the anterior wings light grayish cinereous. On the costal region brown spots extend over the reniform spot. Terminal space dark gray. All the lines and spots are present, the former double; the half-line indistinct, the space between its two component lines whitish, forming a spot on the costa. Interior line distinct, outwardly lobed between the nervules; its outer component line clear and fine, the inner ill-defined and broad. Claviform spot conspicuous, concolorous; orbicular oblique, elliptical, with a central blackish shade spot; reniform large, clearly outlined in black, constricted outwardly; within it is tinted with brown, and also contains a blackish shade, which in the lower portion of the spot deepens in color, forming a round black spot. Median space shaded with brown above and on each side of the reniform spot. The median shade forms a narrow shade line extending, parallel to the exterior line, to the base of the reniform spot, where it turns obliquely, touching the orbicular spot, and after that the costa. The black spots which terminate the ordinary lines on the costa, alternate with the gray ground color. The inner component line of the exterior line is most distinct, and forms short, sharp, outwardly projecting angles on the nervules. Beyond the outer line the subterminal space is darker gray, becoming light as it approaches the subterminal line. On the costa, however, this shade increases in depth as it proceeds, and contrasts strongly for a short distance with the white line following the brown subterminal. Terminal space dark gray, almost blackish. A fine white line at the base of the fringe, connected with others crossing the gray fringe at the base of the nervules. Posterior wings having a more or less distinct, yellowish tinge, and with a blackish terminal border and discal lunule. Nervules black. Fringe whitish. Beneath both wings are yellowish, with a partly interrupted exterior line, and black discal dots. The costæ of both are purplish gray, and the wings are more or less covered with blackish atoms.

Hab. Beverly, Mass. June 26, 1869, Edward Burgess. Types in my collection, and in that of the Buffalo Society of Natural Sciences.

Allied to *M. chenopodii* Albin. Easily distinguished by the clearly defined lines and spots, gray ground color, dark terminal space and yellowish posterior wings. In this species the abdomen is only very slightly tufted, and the marking of the subterminal line is absent.

M. illabefacta is apparently closely allied to *M. lilacina* Harvey, which was published after this description was written. But Mr. Grote, who has typical specimens of both species, informs me that they are distinct from one another.

Mamestra olivacea nov. sp.

Expanse 26 mm. Length of body 11 mm.

A small, robust species, with coarse and rough villosity. Eyes hairy. Palpi gray. Collar olivaceous gray, with a distinct black terminal line. Thoracic tufts short and thick. Tegulæ large and well separated, white, with a terminal black line. Abdomen tufted. On the anterior wings the median space is gray, strongly suffused with green; the basal space is of a lighter gray, also more or less green. The terminal and subterminal spaces white, with green patches at the inner angle and costa, and also along the outer margin. A black basal dash. The lines simple and black. Half-line present, Interior line outwardly curved, most clear opposite to the claviform spot, which is large, concolorous, and outlined in black. Median shade curved, black, and diffused, passing between the ordinary spots to the base of the reniform; from this point it extends, closely adjacent to the exterior line, to the inner margin. The spots are very distinct, of normal shape, whitish (the reniform most clearly so), with greenish central shades. The exterior line is very evident, continuous, non-dentate, and but little drawn in below the cell. The subterminal line obsolete. After it the greenish shades prevail in the terminal space, and the nervules are then plainly marked with black, particularly the fourth median branch. Fringe dark, indistinctly cut with light. Posterior wings whitish at the base, with a very broad, dark fuscous, terminal band, and large discal dots. Beneath gray. the posterior wings whitish in the basal and median spaces. A common line, and very black discal dots, especially on the posterior wings; on the anterior a series of light dots at the base of the fringe.

Hab. New York; New Hampshire.

Two specimens taken in the Adirondack Region by Mr. F. C. Bowditch; and one taken at Gilmanton, N. H., August 18, 1874, by Mr. Holmes Hinckley, who has kindly lent it to me for determination. Separated from the other species of Mamestra except *M. laudabilis* Guen., by the green coloration; from this species, however, it is very different in size as well as markings.

Dianthœcia modesta nov. sp.

Expanse 28 mm. Length of body 14 mm.

Eyes hairy. Thorax and collar smooth, concolorous. Female abdomen elongate, with a rather short, projecting ovipositor. A short, radiating lateral tuft on each side of the abdomen near the tip. On the anterior wings the basal, terminal, and one-half the median space, uniform, cinereous gray. The outer half of the median space beyond the median shade, and the subterminal space, blackish gray. The ordinary spots indistinct, the lines conspicuous. The half-line present. The interior line slightly oblique, undulating, and geminate, its outer component line the best expressed. The space between the lines concolorous. The claviform spot absent. The orbicular very small, with a fine, external black annulus, and a central dot. The median shade is rounded, bounding the central dark space, and reaching the inner margin at nearly the same point as the exterior line. The latter is geminate, with an included pale shade; above it is rounded and projects outwardly beyond the cell; below, it extends obliquely to the inner margin. Reniform spot indistinct, with a minute white dot at its base. Above, the subterminal space is blackish, and contrasted strongly with the pale terminal space; below it is lighter and not so well-defined. Subterminal line blackish, irregular. Terminal space cinereous gray. Fringe concolorous. Posterior wings even, dark fuscous, with a faint discal dot. Fringe whitish. Beneath, a common exterior line and discal dots. Posterior wings lighter, with scattered dark atoms.

Hab. Cambridge, Mass. Taken on June 8, 1872. From my collection.

The pale and dark cinereous contrasting coloration, the distinct, even and geminate lines, and the clear white dot at the base of the reniform, will distinguish this species.

D. modesta does not belong to the typical section of the genus, but is related to *Dianthœcia meditata* Grote, which resembles our species in its small size and modest tints.

Hadena vulgivaga nov. sp.

Expanse 30 mm. Length of body 13 mm.

Allied to *Hadena rurea* Fabr.

Eyes naked. The front with a slight tuft between the eyes. The collar is smooth, distinctly lobed, and with a black, terminal line. The thorax concolorous, with short, but evident, prothoracic and metathoracic tufts. Abdomen showing short, even, dorsal tufts, and a large anal one enclosing the genitalia. The lateral tufts not prominent. The anterior wings are dull gray, slightly tinged with yellow-brown. The terminal, and upper part of the basal and median spaces, of a darker shade of the same color. The lines are all present, but somewhat confused. An obscure basal streak beneath the median nervure, and a similar one, slightly beyond the first, and not touching the base, below the submedian. The interior line is oblique, removed from the base, and thus narrowing the median space, blackish, and preceded by a clearer line of the ground color. To it are attached the orbicular and claviform spots, the former rounded, the latter obtusely triangular; both are concolorous, and faintly annulated with black. The median and subcostal nervures are tinged with dull black in the median space. Reniform spot normally formed, with a dark, internal shade line; in one specimen this spot is of the ground color, and therefore lighter and slightly contrasting with the median space; in the other white, and very conspicuous. Exterior line shortly denticulate, drawn in below the reniform spot, limiting the dark median space. The wide subterminal space is of the ground color, containing beyond the exterior line a double series of faint black and white spots on the nervules. The subterminal line is concolorous, preceded by an undulating, dark, diffused shade, which sets it off. The terminal space is very narrow, black, and having a purple reflection; in one specimen it is slightly frosted with whitish scales. A series of light dots at the base of the dark fringe. Posterior wings uniform dark fuscous, fringe lighter. Beneath, the anterior wings are dark gray, the costa and terminal space light. Posterior wings with a discal dot, and a median and subterminal line.

Hab. Nebraska; New York.

The two specimens before me of this species are variable. The one from Nebraska, received through the kindness of Mr. G. M. Dodge, I consider the typical form; in it the reniform spot is concolorous, and the white frosting of the terminal space is absent.

In the other, from the Adirondack Mts., N. Y., collected by Mr. F. C. Bowditch, the reniform is whitish and evident. I do *not* propose a new name for this form in case it should prove to be distinct.

Segetia fidicularia nov. sp.

Expanse 30 mm. Length of body 12 mm.

Eyes naked. The antennæ are filiform. The front, collar and thorax concolorous, rounded, and with smoothly stroked villosity. The anterior wings are of a clear, light, uniform gray. The lines are widely geminate, blackish, confused and irregular, as is usual in this genus. The interior line is strongly marked on the costa, oblique, and forming a dent beneath the submedian. Orbicular spot reduced to a round, clearly defined dot, and the claviform to a similar dot on the interior line. Reniform spot of ordinary size, shaded with ferruginous, subquadrate, and containing at each corner a clear, white, punctiform dot, the one at the lower outermost corner geminate. The median shade extends from the costa obliquely to the base of the reniform spot, then perpendicularly to the inner margin. Component lines of the geminate exterior line separated by a wide concolorous space; they are both acutely dentate, drawn in beneath the reniform spot, and produced on the submedian nervure in a sharp tooth. The inner line is the most distinct. Subterminal line faint, preceded by irregular, well-defined ferruginous shades, most evident in the centre of the wings. A series of black dots at the base of the concolorous fringe. The posterior wings are semi-translucent, with discal dot and dark tinted nervules. Anterior wings beneath dark gray. A black spot on the costa marks the point of inception of the exterior line. Posterior wings as above, the dot slightly more distinct and also darker terminal shadings.

Hab. Adirondack Region, N. Y. A single specimen in the collection of my friend Mr. F. C. Bowditch, of the Harvard Law School.

Distinguished from the three known species of the genus, as well as from M. Guenée's unidentified ones, by the clear gray anterior wings and thorax, and the peculiar disposition of the white spots in the reniform spot.

Segetia fabrefacta nov. sp.

Expanse 30–32 mm. Length of body 15–16 mm.

Eyes naked, without lashes. Palpi black, edged with whitish, closely scaled, erect, reaching above the eyes; the third joint long and cylindrical. Antennæ simple in both sexes; collar, thorax and anterior wings closely scaled, and of a peculiar dull yellow, like the color of brick when only partially burnt. Collar orbicular, with a central, fine, very distinct, black rounded line on each side; behind the collar a flat, rounded, closely scaled plate (corresponding to the crest in many species), also with a black central line. Abdomen with a very short tuft on the first segment. Anterior wings with the spots and lines indistinct and slightly marked. Interior and exterior lines blackish, geminate, their component lines equally well marked, and separated by a wider interval than usual. The ordinary spots indistinctly marked in black. Reniform spot set out and encircled by irregular patches of white atoms, which extend towards the base of the wings along the median nervure. A double row of black dots on the nervules beyond the exterior line. Exterior line irregular, clearly defined outwardly, shaded inwardly; in one specimen this inner shade is uniform, and finally lost in the ground color. In the other, it forms cuneiform markings which are also clearly defined inwardly. Clear white dots on the median branches, just beyond the sub-terminal line. All the nervules are surrounded near their termination by fine dust-like white atoms, similar to those near the reniform spot. Each nervule with a clear white dot at its end, at the base of the fringe. Fringe concolorous. Posterior wings transparent, slightly nacreous, with a black terminal band. Anterior wings beneath gray, yellowish on the costa, and whitish along the inner margin. The nervules are distinctly marked with black, until they reach a subterminal light band; which is followed by a narrow gray band interrupted by them; beyond, the terminal space is again light. Posterior wings beneath yellowish white, with scattered gray atoms, and a dull terminal band more conspicuous near the costa.

One specimen taken at Tuckernuck Island, near Nantucket, and now in the collection of A. R. Grote. Another taken at Brooklyn, N. Y., in my possession.

I have referred this species to *Segetia* Boisd., with some hesitation, as I have not the two rare European species of the genus to compare with. Our species agrees very well with the generic characters as given by Lederer. It can be recognized by the smooth, close, thoracic squamation, and the distinct black lines of the collar and thoracic plate. The clouded white scales which surround the reniform spot, and the white dots at the base of the fringe and on the nervules, are also of service in its identification.

Orthosia minuscula nov. sp.

Expanse 30 mm. Length of body 12 mm.

♀. Eyes naked, with lashes. Antennæ filiform. Thorax and abdomen robust, the latter untufted. Basal, median, and subterminal spaces of the anterior wings, grayish-brown, the costal region with more or less distinct, clear red shades and markings, particularly around and between the ordinary spots. Half-line double, distinct. Interior line simple, oblique; opposite the orbicular spot thickened, forming a quadrangular black patch, bordering the spot; below the submedian it joins a broad, black, oblique shade, connecting the interior and exterior lines; at its point of junction with the shade the former line turns at nearly a right angle, reaching the inner margin at the same distance from the base as is its point of inception on the costa. Ordinary spots cinereous and distinct; the orbicular is open above; the reniform contains a red central line. Median space darker between the spots, and nearly black adjacent to them. Above, the reniform spot is cinereous, and beyond it reddish shades predominate. The exterior line has its inception above the anterior portion of the reniform spot, curving completely around it, and joining the submedian connecting line directly beneath the spot. It is black, and followed by a faint cinereous shade. The subterminal space is darker costally, and contrasts strongly with the light cinereous, terminal space. Faint black dots are present at the base of the fringe. There are four small, ante-apical, costal, cinereous dots. Posterior wings uniform, dark grayish fuscous, with white fringes. Beneath, the colors are not distinctive, grayish. The hind wings lighter, with median band and discal dot.

Hab. Tuckernuck Island, near Nantucket. Mr. Edward Burgess.

A very clearly defined species. It is unnecessary to repeat its characters, which are evident. Unfortunately the thorax and collar of the specimen are badly rubbed, and perhaps the discovery of better specimens will show that this species should be referred to a different genus.

Orthosia baliola nov. sp.

Expanse 27 mm. Length of body 14 mm.

Eyes naked, with weak lashes. Palpi horizontally projecting. Thorax untufted, concolorous. Abdomen smooth, conical and untufted. Anterior wings with the basal, subterminal and terminal spaces, and the costal and lower portions of the median space brownish-cinereous, having the nervules tinged with carneous. The central portion of the median space deep brown. The claviform and orbicular spots obsolete. The interior line brown, undulating, and slightly oblique. The median shade absent. The exterior line of the usual shape, brown, dentate, its origin lost in the costal shade, as is that of the interior line. Below, the exterior line bounds the discal dark brown patch; beneath this, it is abruptly drawn in, and then continued straight to the inner margin. The reniform spot is the most noticable feature of the wings. It is wedge-shaped, clear white, ill-defined and widened above, and containing there a shade concolorous and connected with the costa; below it is contracted, and clearly contrasts with the discal patch into which it extends. Paler costal subapical dots. The subterminal line is brown, thick and broadly undulating. Fringe concolorous. Posterior wings gray, tinged with carneous. Beneath, the anterior wings are uniform gray, with traces of the exterior line. The posteriors are whitish, suffused with carneous, with discal dot, and a broad median line.

Hab. Massachusetts, August 7th. Mr. Roland Thaxter.

The shape and the clear white color of the reniform spot will at once separate this species from others of the genus. It is about the size and shape of *O. euroa* G. & R., but is very different from it in marking.

Orthosia Belangeri nov. sp.

Expanse 40 mm. Length of body 19 mm.

Male antennæ setiform. Front, collar and thorax rounded, untufted and concolorous, covered with fine and spreading hair. Abdomen also untufted. The anterior wings are dull deep ochreous, evenly overspread with brown scales. The interior line is deep brown, thrice outwardly lobed. The claviform and orbicular spots are obsolete. The reniform is nearly so above; below, it is represented by a large, conspicuous black spot on the median nervure. The median shade is very distinct, bright reddish-brown, strongly outwardly arcuate, touching the reniform spot; below this it is adjacent and nearly parallel to the exterior line. The latter is evident above, blackish, simple and denticulate; below, it is nearly obsolete. Beyond the exterior line the ground color deepens in tint, becoming purple-gray, especially in the upper part of the subterminal and terminal spaces; the nervules are tinged with blackish. The subterminal line is of the ground color, distinct and undulating. Three costal subapical light dots. The fringe is dark, with a light line at the base. The posterior wings are dark grayish-fuscous, with an indistinct median line and discal dot. The fringe is yellow at the base, then a central dark line, and outwardly whitish. Beneath ochreous, more or less shaded with reddish-brown. Discal dots. A very conspicuous, black, common line, and a dusky, common, subterminal shade.

Hab. Quebec, Canada.

This species bears some resemblance to Mr. Grote's description of *O. infumata*, but differs very considerably from it. I dedicate it to Prof. F. X. Belanger, to whom I am greatly obliged for loans of material.

PERIGRAPHA Lederer.

Eyes hairy. The front without a projecting knob. The antennæ pectinate in both sexes, but the pectinations in the female are shorter. The collar is cut out. The thorax bears behind the collar a sharp-edged, longitudinal crest, and also has an angular projection on each side. There is no metathoracic tuft. The abdomen is smooth, except that the first segment is provided with a short, thick, hairy tuft. In the female there is a projecting ovipositor. The tibiæ are unarmed. The apices of the anterior wings are rectangular. All the marking clear and distinct.

Perigrapha semiaperta Morr., Can. Ent., Vol. VI, p. 105, 1874.

I have already shown in the Canadian Entomologist that *P. Normani* Grote, was erroneously referred to Perigrapha. The present species agrees precisely with Lederer's definition of the genus except in the extruded female ovipositor; but this alone is hardly sufficient to render necessary a generic separation. The ordinary spots and lines in this species are remarkably conspicuous; for a detailed description of it see the original paper.

Tæniocampa modifica nov. sp.

Expanse 35 mm. Length of body 17 mm.

The eyes are hairy. The female antennæ simple, with a clothing of fine scattered hair. The male antennæ more evidently setiform. The palpi, front, collar and thorax, clothed with a dense, erect, villosity. The abdomen and thorax untufted. The female ovipositor extruded. The anterior wings are gray, overspread with blackish atoms. The costa is distinctly edged with carneous, as in *Panopoda*. The interior and exterior lines are alone distinct; they are blackish, accompanied by pale, even, conspicuous shades. The former is oblique, the latter is rounded, parallel with the exterior margin, and nearer to it than usual, thus narrowing the terminal and subterminal spaces. The ordinary spots are distinct, filled with black and surrounded by pale annuli; the orbicular small and round; the reniform of usual size, narrow and upright. The subterminal line is light, faint, containing a series of interrupted blackish dots. The fringe concolorous, with a yellow line at its base. The posterior wings uniform dark fuscous, with a discal dot. The base of the fringe is yellow; it is separated from the outer whitish portion by a dark central line. Beneath, the anterior wings are dark gray, tinged outwardly with yellow and carneous. The posteriors are whitish, with scattered black atoms. A very distinct discal dot and an angulated median line.

Hab. Massachusetts.

A male from my collection captured July 16, 1874. A female from the collection of Mr. F. C. Bowditch, kindly lent me for determination. The markings in this species are very simple but evident, so that its identification will be easy.

Glæa sericea nov. sp.

Expanse 39 mm. Length of body 17 mm.

Thorax and palpi as usual in this genus. The eyes naked, with hairy lashes. The abdomen much flattened, and distinctly edged with red laterally and anally. The anterior wings are rounded at their apices, thus differing from *apiata* Grote; in color they are of a uniform silky brown on a cinereous ground. The lines and spots distinct. The half-line present; to it is attached a concolorous, claviform, white-edged spot. This spot seems to be nearly always present in this genus, although not mentioned in Mr. Grote's descriptions. I have noticed it in *inulta*, *apiata* and *viatica*. All the nervules are prominently light and contrasting. The lower portion of the basal and median spaces is diffused with dull blackish, as in *apiata*. The interior line is very oblique, even, and accompanied by a light shade line. The ordinary spots are large, concolorous, and with pale annuli. Reniform spot attenuate below, and not constricted outwardly. The median shade is diffused and blackish, passing between the spots. The exterior line is shaped as in *apiata*, followed by a light line. The subterminal line light, preceded by a dark shade. A series of faint black dots at the base of the concolorous fringe. The posterior wings are uniform fuscous, with a faint discal dot. The fringe light, tinged with carneous. Beneath, the costa and exterior margin of the anterior wings are carneous; the rest of the wing dark gray. The posterior wings are lighter, uniformly diffused with carneous. Both wings possess discal dots and a broad, common, blackish median line.

Hab. Boston, Mass. From my collection.

This species is allied to *apiata*, but the spots are pale instead of encircled with red; the apices of the anterior wings are rounded, and the ground color is quite different.

Glæa pastillicans nov. sp.

Expanse 42 mm. Length of body 19 mm.

This species is very different from the seven known species of the genus. The palpi, front and collar, are as usual; but behind the latter there is a low, sharp-edged, longitudinal tuft. The abdomen is flattened. The thorax, as well as the anterior wings, is of a smooth, uniform, purple-brown. The costa and internal margin are deep red. The half-line present, followed by a black dot, the representative of the spot found in the other species. The interior line is arcuate, black, and slightly irregular. The ordinary spots are concolorous, of nearly equal size, of the same shape, and with red annuli; the reniform with a distinct, punctiform, black spot at its base. The median shade is obsolete. The exterior line is indistinct, except near the costa. From its point of inception it extends obliquely to a point midway between the reniform spot and the subterminal line, and then continues subparallel with that line to the inner margin. Subterminal line reddish, preceded by a narrow blackish shade. A series of black dots at the base of the concolorous fringe. The posterior wings are dark, gray-black, without reddish admixture. The fringe concolorous. Beneath, on the anterior wings, the costa and inner margin are red as above; the central portion of the wing is blackish. The outer border, together with the posteriors, are purple-red, with discal dot and a common black line.

Hab. New Hampshire, Sept. 13, 1874.

A single specimen, in perfect preservation, generously given me by my friend Mr. C. P. Whitney.

Scopelosoma napæa nov. sp.

Expanse 30 mm. Length of body 14 mm.

The eyes are naked, very strongly lashed. The collar is slightly produced in front. There is a longitudinal tuft behind the collar. The abdomen is flattened. The anterior wings are narrow. The ground color of the thorax and anterior wings is light gray. All the markings are very distinct. The usual lines are geminate. The interior line is slightly oblique, strongly lobate, and both its component lines are equally well expressed. Orbicular spot concolorous, indistinct, with a double blackish annulus. The median shade is black, thick, very distinct, and somewhat undulate, followed by cupreous stains, one beneath the median nervule being very evident. Reniform spot large, very conspicuous, black, surrounded by a narrow white, and then a black annulus. The exterior line is black, angular, its inner line the most distinct. The subterminal line is light gray, irregular, preceded by a notable darkening of the subterminal space.

A series of black dots at the base of the concolorous fringe. The posterior wings are uniform dark gray, with a lighter gray fringe. Beneath, the anterior wings are of a much darker gray than the posterior. The discal dots and traces of the median line are present on both wings.

Hab. Massachusetts. From my collection.

Pyrophila glabella nov. sp.

Expanse 35 mm. Length of body 16 mm.

Three forms have been recently described as distinct in this genus, *inornata* Grote, *conspersa* Riley, and *Agrotis repressus* Grote, but they have turned out to be identical with our common *pyramidoides* Guen., and *tragopoginis* Linn. The first two are well marked varieties of *pyramidoides*: the last simply a redescription, under an erroneous generic reference, of American specimens of *tragopoginis*, a well known European species. *P. glabella* is an intermediate form between the two species mentioned above, but I cannot consider it other than a very well defined species. The following are its characters. The third palpal joint noticeably shorter than in *pyramidoides*. The anterior wings are of a dull gray; uniform over the basal and median spaces, but becoming blackish before the subterminal line, and there strongly contrasting with the light gray terminal space. The subterminal line is nearly perpendicular, and slightly jagged. The interior line is faintly seen, although nearly overspread by the ground color. The exterior line is very distinct, black, followed by a lighter shade line. From its inception on the costa above the reniform spot, it is boldly and evenly outwardly projected, and then drawn in beneath the spot. The orbicular spot is a black dot with a broad light gray annulus. The reniform is also light gray, with a black spot at each end. The posterior wings are gray, becoming deeper towards the margin. At the base of the light fringe there is a dark line, preceded by a narrow, light gray, terminal band. The abdomen is gray, unicolorous, and conical; beneath, light gray, the markings obsolete.

Hab. Nebraska.

Received from my friend Mr. G. M. Dodge, to whom I am indebted for much interesting material.

Xanthoptera nigrocaput nov. sp.

Expanse 25 mm. Length of body 13 mm.

The palpi are yellow, tipped with black. The head and collar are deep black. The tegulæ, thorax and abdomen, yellow. The ground color of the anterior wings yellow. A broad, basal, black band, enlarged on the costa, extends obliquely to the inner margin. Beyond this band the wing is yellow, until a median, broad, slightly arcuated band, corresponding to the median shade. The exterior line is also black, narrower than the other two, arcuated on the costa. It is followed by a narrow, partially obliterated line of the ground color. Beyond, the terminal and subterminal spaces and the fringe are black. The posterior wings are fuscous, tinged with yellow, crossed by three very broad, diffused gray bands, separated by the ground color. Beneath, the anterior wings are yellow at the base; the terminal and subterminal spaces are gray. The median space is occupied by two broad, diffused, gray bands. The posterior wings are lighter in color, but are banded as above. The anterior femora are blackish. The middle legs are yellow, but have the ends of the tibiæ distinctly black. The abdomen has a yellow anal tuft.

Hab. Texas? From my collection.

Larger, and quite distinct from the species described by Guenée, and from *X. fax* Grote. *E. coccineifascia* and *rosaba*, figured very poorly by Mr. Grote in the "Transactions of the American Entomological Society," Vol. x, pl. I, figs. 88 and 89, are erroneously placed in this genus by him; they should be referred to *Prothymia* Hb. *E. rosaba* is closely allied to the European *œnea* Hb., and strictly congeneric with it.

Our species of the two genera will now stand as follows:—

XANTHOPTERA Guen. (1852).

Xanthoptera nigrofimbria Guen., Noct., II, p. 241 (1852).
" *nigrocaput* Morr. (1874).
" *semiflava* Guen., *id.*
" *semicrocea* Guen., *id.*
" *fax* Grote, Trans. Amer. Ent. Soc., IV, p. 295 (1873).

PROTHYMIA Hubn. (1816).

Prothymia coccineifascia Grote, Tr. Am. Ent. Soc., IV, p. 294 (1873).
" *rosaba* Grote, *id.*, p. 295 (1873).

Eustrotia obaurata nov. sp.

Expanse 19 mm. Length of body 7 mm.

This is a very small, slight-bodied species, quite distinct from *E. muscosula* Guen. and its allies. The ground color is pure white, with the entire median space blackish gray. The basal space is unmarked, except by a black costal border. On the blackish median space are scattered metallic scales, more frequent in the neighborhood of the ordinary spots. These last are of the usual shape, but are formed of raised patches of black scales. The median lines are black, the interior oblique, the exterior outwardly curved around the reniform, drawn in below the cell and prominently produced on the submedian nervure. The terminal and subterminal spaces are white. The subterminal line is broad, gray, and lobate. The fringe and terminal line are also gray, but even ; the latter is composed of united spots. The posterior wings are whitish, with a broad, much diffused gray terminal border and discal dot. Beneath, the anterior wings are black, white at the base; the posterior wings white, with discal dot.

Hab. Massachusetts.

The markings of this little species are very well defined, the black reniform and orbicular spots, overspread with bluish metallic scales, are very characteristic.

PTEROSCIA nov. genus.

Eyes naked. Antennæ of male with short, dense, hairy clothing; of female, filiform, with a single lateral row of fine, separated hairs. Palpi erect, reaching slightly above the eyes, the third joint of usual length, the other two clothed with rather long, coarse hair. Front rounded, untufted, clothed with coarse, unevenly spread hair. Thorax rounded, without an angular projection in the sides, and with a very low fore and hind tuft (in one of my specimens this is scarcely perceptible). Abdomen conical, untufted, just reaching the exterior margin of the hind wings. Both wings with even margins, and broad in proportion to their length. The fourth median veinlet of the posterior (vein five of the German entomologists) not so strong as the rest, and arising some distance from them. The tibiæ are armed with the usual spurs, and strongly spined, particularly the middle and posterior pairs. All the femora with hairy tufts on their under side.

In this genus the imagines are of medium size, with the body rather slight in proportion to the spread of the wings, and with the habitus of the *Ophiusidæ*. The coloration is dull, and the markings are obscured. It is allied to the European *Eccrita* Lederer, and *Toxocampa* Guen.; from the former it differs by the spined anterior tibiæ, the hairy femora, and the broad anterior wings; and from the latter by its spinose tibiæ.

Pteroscia atrata nov. sp.

Expanse 40 mm. Length of body 15 mm.

Palpi, front, collar and thorax, black. The edge of the palpi, the collar, and the tuft behind the collar, ferruginous gray. Anterior wings shining black, with scattered lighter scales. The markings are deeper black, and show but faintly. Interior line scarcely distinguishable, preceded by a line of lighter scales. The ordinary spots are of medium size, and filled with scattered lighter scales; in shape the orbicular is round, the reniform lunate. The exterior line is black, quite distinct, strongly dentate, and deeply drawn in between the nervules; followed by a line of whitish scales, which culminate on each nervule in a white spot. A series of light spots at the base of the fringe, which is dark, and in addition a number of distinct ante-apical white dots. Posterior wings uniform, dark grayish fuscous. A discal lunule. A black line at the base of the fringe, which is yellowish white, with a central darker line. Wings beneath dark grayish fuscous. Secondaries lighter. Nervules tinged with yellowish. The anterior have the ante-apical dots present, and the costal and terminal spaces covered with light scales. The posterior wings show a median band and discal dot.

Hab. Mt. Washington, N. H. Two specimens taken at night near the Half Way House, July 5th and 7th, 1874.

A striking form, apparently confined to the mountain fauna.

The new species described below are from a fine collection of Noctuidæ sent me for study by Prof. C. V. Riley, State Entomologist of Missouri, and I cheerfully acknowledge my obligation to him for this and many other kind offices.

The new genus characterized is peculiarly interesting, on account of its abnormal palpal structure, which is the more striking as the insect is small and slender bodied.

Mamestra incincta nov. sp.

Expanse 28–30 mm. Length of body 13–14 mm.

Eyes hairy. Male antennæ shortly bipectinate. A slight prothoracic furrowed tuft. The abdomen is untufted. The thorax and anterior wings are light gray, somewhat yellowish; in one fresh specimen, with a slight purple reflection. The median lines are black, simple and denticulate, the one preceded, the other followed by a lighter shade line. The half-line present. The interior line oblique, forming two particularly prominent teeth, one on the costa, the other on the submedian nervure. The orbicular spot is nearly obsolete, sometimes seen as a blackish spot. Reniform spot narrow and subrectangular, filled with black. The median shade is blackish, diffused, passing obliquely from the costa across the reniform, then parallel with the exterior line. The latter is drawn in below the cell; its teeth connect with a series of more or less distinct spots on the nervules. The subterminal line is light, preceded by a dark, diffuse shade; in one specimen this shade is condensed into a series of black spots. The nervules towards their termination are sometimes marked with black. A yellow line at the base of the concolorous fringe. The posterior wings are white at the base, with a diffused, gray, terminal border. The fringe is yellow. Beneath the anterior are gray; on the costa the exterior line is seen. The posteriors are whitish, evenly sprinkled with gray atoms, with a distinct discal dot and traces of the median line. The base of the fringe yellow.

Hab. Illinois. Prof. C. V. Riley.

Described from three specimens which vary among themselves, but which are evidently referable to the same type.

Homohadena retroversa nov. sp.

This form differs very much from the typical *badistriga* Grote, and with my present material I can hardly doubt that it is specifically distinct.

Size and coloration of *H. badistriga*, but both wings are narrower, and the posterior more angular and less rounded. The basal streak is obsolete. The median lines have their origin in irregular spots on the costa. The interior line is only slightly curved, and not strongly outwardly projected on the costa. The ordinary spots are visible, small, black-centred, with broad white annuli. The broad streak found in *badistriga* extending from the interior line to the exterior margin, is here reduced to a fine black line, present only just before and after the exterior line. The latter is not evenly outwardly projected beyond the reniform spot, but follows its outlines closely, being slightly depressed immediately after it, strongly drawn in below it, and then connected with the interior line by a short, intense black streak; below this dash the line extends obliquely outwards, not straight to the inner margin, as in the allied species. The black dashes on the nervules in the terminal space are obsolete in *retroversa*. The posterior wings are as in *badistriga*, except that the median line is absent. The posterior wings, beneath, have the median line more even, and farther removed from the exterior margin. A broad, black, terminal band.

Hab. Central Missouri. Prof. C. V. Riley.

Prof. Riley has kindly given me one of the typical specimens of this striking species.

Hadena rasilis nov. sp.

Expanse 23 mm.

Eyes naked. Tibiæ unarmed. Palpi closely scaled, the two first joints blackish, the terminal one light. Thoracic villosity smooth, the usual tufts short and close lying, concolorous with the anterior wings. The latter are of a smooth, ferruginous brown, with numerous fine white atoms on the nervules. The ordinary lines are white, fine, even and continuous. The half-line present. The interior line oblique, curved inwardly near the costa, and followed by a narrow dark line. The median and terminal spaces are slightly darker than the basal and subterminal ones. Orbicular spot reduced to a fine black dot, ringed with white. Reniform spot of medium size, white, narrow and sublunulate, containing in each end a black spot. The exterior line is less oblique than the interior; touching the upper extremity of the reniform spot, it forms a complete semicircle, returning to, and touching the lower extremity; from this point it proceeds straight to the inner margin. The reniform spot and the curve of the exterior line form a perfect circle, the most conspicuous feature of the species. Subterminal line whitish, indistinct, becoming obliterated before the inner margin. Fringe dark, and comparatively long. Posterior wings semi-hyaline, with the nervules blackish, and a dark, diffused, terminal band. Beneath, on the anterior wings, the median space is gray; the rest of the wing is light, with numerous gray atoms. Posterior wings light; gray atoms obscure the costal and terminal regions. The discal dot is present. A diffused median band extends over both wings.

Hab. St. Louis. From my collection; received through the kindness of Mr. C. V. Riley, State Entomologist.

The uniform coloration, the fine white lines, and the peculiar disposition of the reniform spot and exterior line will serve to identify the species.

Tæniocampa earina nov. sp.

Expanse 39 mm. Length of body 18 mm.

Eyes hairy. Antennæ serrate, with a hairy tuft at each joint. Palpi, and the villosity of the front, collar, and thorax, gray, ornamented as in the common *alia* Guen. Abdomen of the same color, untufted. Wings slightly more elongate than in *alia*. Anterior wings uniform gray, with scattered yellow atoms, particularly on the basal and terminal spaces, but without brown or reddish admixture. Veins very prominent, but not disconcolorous. The ordinary lines black. Half-line present. The interior line extends obliquely from the costa to the submedian fold, where it connects with a black, curved, longitudinal branch from the base. At this point the claviform spot is indicated as a blackish shade attached to the line; below, the interior line extends directly to the inner margin. Median shade indistinct and suffused. Ordinary spots large, whitish, and contrasting, with central gray shades. Orbicular spot circular, resting on the median vein. Reniform spot slightly excavated on each side, its base touching the simple, blackish, exterior line. The latter is of the usual shape, formed of internervular lunules. The subterminal line is faint, whitish, preceded by very faint, black, cuneiform marks. A row of black spots at the base of the fringe. Posterior wings light grayish fuscous, with a mèdian band and discal dots. Wings beneath with a common line. The anteriors have the costal portions of the median and basal spaces covered with long close-lying hair. Posteriors with discal dot.

Hab. California.

Prof. C. V. Riley, of St. Louis, kindly presented me with this species, with permission to describe if found to be new. It can be easily determined by the cuneiform, subterminal series of spots, and the whitish orbicular and reniform spots.

M. Guenèe has published in the "Species Genéral" (Vol.v, pp. 355 and 356) two species of Tæniocampa, which have not yet been identified, founded on unpublished drawings of Abbot's.

It seems to me that to recognize these species, *styracis* and *hibisci*, and others of various genera described by M. Guenèe in the same way, will establish a precedent which will cause much confusion. I simply raise the question for discussion, leaving it to be decided by others.

Tæniocampa confluens nov. sp.

Expanse 34 mm. Length of body 13 mm.

Eyes hairy. Thoracic villosity as usual in the genus. The anterior wings are brownish-cinereous, the brown tint more apparent near the spots; otherwise uniformly diffused over the wings. The interior line is obsolete, only represented by a faint shade on the costa. The median shade is dark, diffused, and present above and below the spots. These latter are large, concolorous, with pale annuli, and united together, forming an irregular dumb-bell shaped spot. Base of the reniform spot blackish. The exterior line is faint, cinereous, containing black spots on the nervules, most evident opposite the cell. The subterminal line is irregular, of the same color, most clearly indicated above, where it is preceded by a costal dark shade. A series of black spots at the base of the concolorous fringe. The posterior wings are brownish-fuscous, tinged with dull gray outwardly, and with a black line at the base of the fringe. Beneath, the wings are unicolorous, whitish, with a faint carneous tinge. The discal dots, and traces on the costa of the median lines as black points, are seen on both wings.

Hab. St. Louis, Mo. Prof. C. V. Riley.

This species, quickly recognized by the united spots, a character possessed by none of our identified *Tæniocampæ* was determined as *T. populeti* by Dr. Staudinger, but it is certainly distinct from this European moth.

It is closer to M. Guenèe's *T. hibisci*, founded on one of Abbot's unpublished drawings, but it differs in several particulars from his short description.

Tæniocampa intractata nov. sp.

Expanse 30 mm. Length of body 14 mm.

Form rather slight. The male antennæ clothed with fine hairy bristles. The first two joints of the palpi erect, the third horizontal, comparatively long, naked and rounded at the tip. The thorax and abdomen untufted, clothed as in *T. stabilis*. The coloration and markings are similar to those of this species, although the former is of a slightly darker yellowish-gray. There is a distinct black spot at the base, beneath the median nervure. Interior line indistinct, whitish, with two plain black spots, one before the orbicular spots, the other beneath the median nervure. The ordinary spots are very large, concolorous, with pale annuli, and shaped as in *stabilis*. They differ in their closeness to each other, in one specimen being almost contiguous. Exterior line faint, drawn in below, and touching the base of the reniform spot. There is a distinct black spot below the fourth median branch. All the lines are pale, with darker accompanying shades. The subterminal is light, more irregular than in *stabilis*, and preceded by a darker shade. The posterior wings are whitish at the base with a broad, diffused, terminal band. Beneath, whitish, with discal dots and traces of a median common line.

Hab. Missouri. Prof. C. V. Riley.

This species, although resembling *stabilis* in its style of ornamentation, belongs to quite a different section of the genus. It is separated from the typical *Tæniocampæ* by the peculiar structure of the palpi and the more slender form.

THAUMATOPSIS nov. gen.

I erect this genus for a very peculiar Noctuid allied to *Doryodes* and *Sudariphora*, but more closely approaching the former. The following are its characters: Form slight. Habitus and markings resembling *Crambus*. Ocelli present. The head wide, with the front slightly rounded. The male antennæ are clothed with long slender pectinations, as in *Doryodes*. The palpi are exceedingly long (5 mm.), horizontal and closely scaled. The first joint of normal length; the second comparatively thick, very long, and slightly compressed; the third slender, long and needle-shaped. The eyes are naked. The thorax is weak, rounded, with scaly clothing. The abdomen is slender, long, and untufted. The legs are long, having the tibiæ non-spinose and closely scaled.

The anterior wings are narrow, with subrectangular apices. The posterior are comparatively broad, with all the angles rounded.

Thaumatopsis longipalpus nov. sp.

Expanse 32 mm. Length of body 19 mm. (including palpi).

Thorax and anterior wings with the ground color as in the common *Doryodes acutaria* H. S. Along the costa the anterior wings are ochreous to the exterior line. The median nervure from the base to the divarication of the first median nervule is covered by a clear white streak, as in *acutaria*. Above the nervule, from the median space to the apex, there extends a black shade, at first distinct and definite, contrasting with the white streak, but afterward becoming diffuse. Below the median nervure, from the base to the middle of the median space, there is a similar black shade, which limits above an ochreous streak extending to the exterior line. The ordinary spots and all the lines are obsolete, except the exterior line; this is, however, represented only by a series of black dots on the nervules. The latter are more or less distinctly tinged with blackish. The posterior wings are light gray, unicolorous. Beneath, both wings are uniform gray.

Hab. St. Louis, Mo. Prof. C. V. Riley.

The only specimen I have examined of this interesting species is unfortunately in indifferent condition, although all the parts are present. The wings are a little rubbed, and perhaps the specific description will have to be amended when fresh material is discovered.

I give below a preliminary list, with short descriptions, of some new species of *Agrotis*, which will be fully illustrated and compared with allied forms in my forthcoming paper on that genus.

Agrotis saxigena nov. sp.

Expanse 40 mm.

Allied to *sigmoides* Guen. It differs in the large, oblique, einereous orbicular spot, the distinct, reddish-stained reniform spot, the more cinereous coloration of the wings, and the fine basal dash. The collar is also concolorous.

Hab. White Mountains, N. H.

Agrotis claviformis nov. sp.

Expanse 33 mm.

Also allied to *sigmoides* Guen.

The wings are ornamented by different shades of brown. Claviform spot brown, very distinct. The basal and anterior portion of the median space light, and contrasting with the rounded, deep brown median shade. Orbicular spot concolorous, reniform stained with red. Beyond, the wings gradually become lighter to the subterminal line. The anterior wings pointed at the apex. The posterior wings rounded, fuscous, with median and subterminal dark lines.

Hab. Massachusetts.

Agrotis decolor nov. sp.

Expanse 30–37 mm.

Allied to *geniculata* Grote. The spots and lines are all present, and of normal form. The space between the orbicular and reniform spots, black. The basal and median spaces cinereous. The species can at once be separated from all others by the subterminal and terminal wings, which are uniform dull black, and by the whitish posterior spaces, with a broad, even, black marginal band.

Hab. New York; Massachusetts; Maine.

Agrotis gladiaria nov. sp.

Expanse 34 mm.

Closely allied to *pitychrous* Grote, but the antennæ in this species are strongly pectinate; claviform spot large, encircled with black; exterior line absent. A series of cuneiform dashes before the subterminal line.

Hab. Massachusetts.

Agrotis stigmosa nov. sp.

Expanse 36 mm.

Allied to *volubilis* Harvey, and *gravis* Grote. The anterior wings are uniform gray, and the brownish shades of *volubilis* are entirely absent. Claviform spot and basal streak united; space between the normal ordinary spots blackish; no cuneiform black markings in the terminal space.

Hab. Massachusetts; New York.

Agrotis plagigera nov. sp.

Expanse 33 mm.

This species is allied to 4-*dentata* Grote, but the whitish streaks of the terminal space are absent. The exterior line is preceded by cuneiform dashes. Costa and median nervure whitish. Spots large, whitish and contrasting. Hind wings gray in both sexes.

Hab. Colorado.

Agrotis bochus nov. sp.

Expanse 32 mm.

Coloration and markings of the anterior wings very similar to *herilis* Grote, but the interior line is perpendicular instead of outwardly oblique. The male posterior wings are white, thus differing very strongly from the dark fuscous wings of *herilis*.

Hab. Nebraska.

Agrotis permunda nov. sp.

Expanse 37 mm.

This species resembles closely *repentis* G. & R., but the anterior wings are uniform dark gray, without any alternation of color. The median lines are simple, black and dentate. The ordinary spots are obsolete. The posterior wings are gray at the base, and with a broad, blackish-gray, terminal border.

Hab. Massachusetts; Canada.

Agrotis tenuicula nov. sp.

Expanse 33 mm.

Habitus and markings of *Agr. conflua* Tr., from which it differs in the uniform gray color of the posterior wings, the presence of two distinct cuneiform markings before the subterminal line and below the costa, and in the size of the subterminal space, which is much wider than in *conflua*.

Hab. New York.

Agrotis cinereomacula nov. sp.

Expanse 43 mm. Length of body 18 mm.

Allied to the European *agricola*. Anterior wings uniform gray, shaded faintly with brown; the terminal space dark gray. All the lines are distinct, geminate and denticulate. Claviform spot absent. Reniform and orbicular spots very conspicuous, disconcolorous and cinereous; the former filled below with black. Posterior wings partially translucent, with a discal dot. The abdomen is flattened.

Hab. St. Louis, Mo. (Prof. C. V. Riley.)

Agrotis simplicius nov. sp.

Expanse 32 mm.

Allied to *annexa* Tr. The anterior wings uniform ash color. All the lines obliterate. Orbicular spot absent; reniform spot black, surrounded by an incomplete white annulus, preceded by a narrow, distinct, black streak. Claviform spot present, black. Posterior wings whitish.

Hab. Texas.

Agrotis intrita nov. sp.

Expanse 34 mm.

Allied to *phyllophora* Grote. The anterior wings are reddish brown. The median lines are geminate, uniform and distinct. The ordinary spots are lighter than the ground color, and slightly contrast.

Hab. California.

Agrotis perpura nov. sp.

Expanse 45 mm.

Closely allied to *cinereomacula*, and its western representative. The ground color is light gray, without reddish or brown admixture. The space between the ordinary spots is filled with black. The median lines are geminate, continued as in the allied species, but the terminal space is concolorous, and not darker than the ground color.

Hab. California.

Agrotis incivis Guen.

Expanse 38 mm.

Allied to *lubricans* Guen. The collar deep black, as in that species. The wings are uniform light gray, with scattered black atoms, with the exception of the terminal space and fringe, which are reddish. The ordinary spot distinct, concolorous, tinged with red. The reniform spot has an irregular, black, central shade. The lines are obsolete. The posterior wings are transparent, iridescent, with a narrow, suffused, terminal gray border.

Hab. California; Missouri; Florida.

Agrotis monochromatea nov. sp.

Expanse 32 mm.

Male antennæ very strongly bipectinate. Collar, thorax and anterior wings uniform reddish-brown. All the lines and spots obsolete, except the two median lines, which are dark, broad, outwardly curved, and subparallel. Posterior wings brownish-fuscous, with yellow fringes.

Hab. Massachusetts.

Agrotis redimacula nov. sp.

Expanse 34 mm.

Allied to *tessellata* Harr. Ground color cinereous, suffused with black. A large, thick, basal, black dash. The ordinary spots and another costal spot at the base, clear cinereous, contrasting. Claviform spot small.

Hab. Colorado (T. L. Mead); Albany, N. Y. (J. A. Lintner); Massachusetts.

Agrotis rufipectus nov. sp.

Expanse 39 mm.

Collar dark brown, disconcolorous. Breast red. Anterior wings and thorax light violaceous gray. The markings indistinct, the lines simple, the spots annulate, concolorous. A black dot in the basal space. Interior line oblique, undulate. The subterminal line faint, preceded by a more or less distinct, blackish, diffused shade. Beneath, the anterior wings are tinged on the costa with carneous.

Hab. New York. (T. L. Mead.)

Kindly sent to me by Mr. A. R. Grote, for determination.

Agrotis scropulana nov. sp.

Expanse 33 mm.

The basal, subterminal and terminal spaces bluish-cinereous, shaded with brown. The median space rich deep brown. Claviform spot elongate, yellowish. The ordinary spots cinereous, with brown central shades. A thick, brown, basal dash. Collar yellow. Posterior wings fuscous, with yellow fringes.

Hab. The alpine region of Mt. Washington.

Agrotis opipara nov. sp.

Expanse 37 mm.

Allied to *scropulana*. Wing without any brown admixture, cinereous, with heavy black markings. The spots have black central shades. The claviform very thick, black, and conspicuous. The interior line is nearly perpendicular, differing from the inwardly curved line of *scropulana*.

Hab. The same localities as *A. scropulana*.

Agrotis unimacula nov. sp.

Expanse 50 mm.

One representative of the European *augur* Fabr., with which it has hitherto been considered identical. It differs in its large size, darker color, distinct, purple reflection, and in the absence of the ordinary spots; the only trace of the latter being a small, distinct, black spot corresponding to the reniform spot.

Hab. Atlantic States.

Agrotis exsertistigma nov. sp.

Expanse 37 mm.

This species resembles the eastern *alternata* Grote, but it can be separated by the following characters. Orbicular spot open above, not sub-quadrate, as in *alternata*. The median space is suffused with black. Claviform spot distinct and disconcolorous. The exterior line is drawn in below the cell; and lastly, the collar is black above, whitish and contrasting below.

Hab. California.

Agrotis Rileyana nov. sp.

Expanse 33 mm.

Coloration of *repentis* G. & R., to which it has a superficial resemblance. The antennæ are bipectinate. The lines disposed as in *repentis*. Orbicular spot reduced to a black dot, adjacent to the interior line. The space between the spots is unusually large, as the reniform spot is removed nearly to the exterior line. It is very large, black, and of the usual shape. Posterior wings whitish.

Hab. St. Louis, Mo.

Kindly presented to me by Prof. C. V. Riley, to whom I dedicate the species.

Agrotis manifestolabes nov. sp.

Expanse 37 mm.

Male antennæ slightly pectinate. Anterior wings and thorax uniform reddish-brown. The ordinary lines shaped as in *balanitis* Grote (from Colorado), and accompanied by pale shades. The spots whitish, distinct, strongly contrasting. The orbicular small, round. The reniform large, filled with black inferiorly. Posterior wings brownish fuscous.

Hab. Massachusetts, in the early spring.

Note on Metamorphism and Pseudomorphism, with reference to the Statements of Prof. T. Sterry Hunt at the Meeting of this Society of the 4th of March last. By James D. Dana.

In the paper by Mr. Hunt, reviewing Dr. Genth's memoir on the Corundum of North Carolina, the author makes statements respecting my views on metamorphism and pseudomorphism, which do not accord with my understanding of them, and I therefore present to the Society this note on the subject.

Mr. Hunt regards the so-called pseudomorphs among mineral silicates as examples for the most part of replacement and "envelopment." This word envelopment was taken from Delesse's paper on pseudomorphism. It means, as used by Delesse, simply mixtures produced by the crystallizing together of minerals. This author, knowing that such mixtures might be mistaken for pseudomorphs, commences his work — published in 1859 — with a chapter on "Envelopment," or such mixtures, in order to clear the way for the treatment of true pseudomorphs. He then takes up the subject of pseudomorphs, and, after remarks on a number of the cases, gives a long table, in which occur, on pages 55, 56, 67, the following pseudomorphs of silicates after silicates.

Mica, *after* Orthoclase and Tourmaline.
Orthoclase, *after* Laumontite, Prehnite, Analcite.
Ice Spar (var. of Orthoclase) *after* Leucite.
Gieseckite and Liebenerite, *after* Nephelite.
Tourmaline, *after* Orthoclase.
Steatite or Talc, *after* Pyroxene, Amphibole, Epidote, Couzeranite, Mica, Topaz, Pectolite, Analcite, Mesole.
Serpentine, *after* Amphibole, Chrysolite, Garnet.
Chlorite, *after* Garnet, Scapolite (Couzeranite), Axinite.
Pectolite, *after* Analcite.
Prehnite, *after* Laumontite, Leonhardite, Analcite, Natrolite, Scolecite.
Analcite, *after* Laumontite.
Thomsonite, *after* Nephelite.
Scolecite, *after* Apophyllite.

The table shows that Delesse does not class the above cases of pseudomorphism among cases of envelopment; he, like all other writers on pseudomorphism, makes them true pseudomorphs. Even serpentine after hornblende and chrysolite, gieseckite after nephelite, and mica after tourmaline, are included. The very same views are repeated by him in the successive numbers of the Geological Annual, published by himself and Mr. Lapparent. In the number published in 1872, he mentions, on page 243, the pseudomorph, *talc after enstatite*. He has another theory for the formation of *beds* of serpentine and steatite; but he has not put into that category, in any statement I have seen, distinct pseudomorphous crystals consisting of serpentine or steatite.

Naumann, the eminent mineralogist, crystallographer and geologist, commended Delesse's judicious chapter on "envelopment." Thereupon, Mr. Hunt has claimed that Naumann adopts his own view of the envelopment theory. In fact, Naumann's Mineralogy contains throughout the ordinary views on pseudomorphism, and many examples are given. Moreover, in the *Jahrbuch für Mineralogie und Paleontologie*, for November, 1872, he has a letter correcting in strong language the statement of his views on pseudomorphism, made by Mr. Hunt in his American Association Address. Naumann's letter closes with the remark that "only an incomprehensible misunderstanding can account for his statement, which has already been sufficiently refuted by Mr. Dana in the American Journal of Science for February and August of 1872."

Mr. Hunt says, in his notice of Dr. Genth's paper, that "the advocates of the doctrine of transmutation [by which he means pseudomorphism as it is held by most writers] have not hesitated to assert, upon this supposed evidence [that of 'examples of replacement and envelopment'] the conversion of almost every mineral species into some other, and to extend this view to rock-masses, declaring that the great part of all the so-called metamorphic or crystalline rocks are the results of an epigenic process; a doctrine that has been embodied in the doctrine of Prof. Dana, that 'regional metamorphism is pseudomorphism on a broad scale.'" And he adds, "while the advocates of this doctrine maintain that a mass of granite or diorite may be converted into serpentine or limestone, and that a limestone may be changed into granite or gneiss, which may in its turn, become serpentine, it is evident that it makes little difference what mineral species is taken for the starting point."

Now the above, whether regarded as referring to my views, or to those of other writers on pseudomorphism, needs profound modification to make it just and true. As to that "dictum" of mine (a clause in a sentence of a book notice, published in the "Journal of Science," Vol. xxv, p. 445, 1858), I told him, in my review of his Address, in

1872, that it did not express the opinions on metamorphism which I had held for the past twelve years; and I referred him to the chapter on metamorphism in my Manual of Geology, a copy of which I gave him in 1862, that he might read, and so become aware of the grossness of the misrepresentation. And yet he repeats it in 1874, without a qualifying remark.

So again, as to the statement that "the advocates of this doctrine maintain that a mass of granite or diorite may be converted into serpentine or limestone, and that a limestone may be changed into granite or gneiss, which may in its turn become serpentine:" I assured him, in letters addressed to him in the autumn of 1871, in my notice of his Address (Am. Jour. Sci., III, 86, 1872), and in the Sequel to it (Am. Jour. Sci.. IV, 97) that I had never held such views; and, further, that the idea of such "transmutations" had never occurred to me until found in that Address, in his charge against "Gustaf Rose, Haidinger, Blum, Volger, Rammelsberg, Dana, Bischof, and many others." And yet he repeats it without qualifying remark.

I have also demonstrated, from the writings of Gustaf Rose and others, that they have never expressed the extravagant view attributed to them; and the same could be shown for all writers on the subject, excepting Bischof and one or two others. Bischof's statement about the change of limestone to granite I had overlooked until Mr. Hunt's remark called my attention to the subject.

Mr. Hunt, in an article in Volume IV of the "Journal of Science" (1872), endeavored to substantiate the charge that *I had virtually sustained the metamorphism of granite or gneiss to limestone*, by saying that I state in my mineralogy,

First, that calcite is sometimes found pseudomorphous after quartz; and,

Secondly, that calcite is found pseudomorphous after feldspar.

Then he made these two alleged statements about isolated pseudomorphs of calcite after quartz and feldspar (leaving the mica of granite wholly out of consideration) proof that I virtually believed in the change of granite or gneiss to limestone! The truth is, that I have no such statement in my Mineralogy as that calcite is ever found pseudomorphous after quartz; and the pseudomorph of calcite after feldspar is spoken of as an example, not of the alteration of the feldspar, but of its replacement or removal. Such is the whole demonstration; such its scientific character.

It is a most dissatisfying use of a man's writings thus to make him a believer in what he never did believe, and never knew that any one was ignorant or audacious enough to have suggested.

On the Skates (Rajæ) of the Eastern Coast of the United States. By S. W. Garman.

All of the sharks, skates, and rays possess the spiracle at some period of their existence, but in the adults of some it is difficult to discover, if not quite obsolete. This is an opening through which the water may pass from the upper surface of the head into the mouth cavity. It is placed between the eye and the cartilage (hyomandibular) joining the jaws to the scull. In front of it is a strong, flat, crescent-shaped cartilage, attached at one end to the hyomandibular, reaching out toward the skull, and having a strong muscle, the contraction of which forces the inner end backward, at the same time turning the upper edge in such manner as to close the opening. Only among those species whose habits confine them closely to the bottom is the spiracle found in its perfection. The sting rays (*Trygon*, *Pteroplatea*, *Rhinoptera*, *Myliobatis*) have, proceeding from the upper edge of the cartilage, a valvular fold, which is turned inward so as to open for an inward, and be closed for an outward, current. These are broad, flat-bodied creatures, with all their protective armor or weapons on the dorsal surface, with eyes so situated as to allow them little or no chance to see downward, and with teeth flat and pavement-like, for crushing the crustacea, molluscs, etc., on which they feed. Unfitted by their structure for darting through the water at all depths and gaining a living as do the round-bodied sharks, they spend their lives creeping over the sand and mud, finding with their noses such prey as is hardly able to make an effort to escape.

The majority of the sharks allow the water to pass freely through the mouth and out of the gill-openings; they, however, live in midwater, and can do so without experiencing the least inconvenience; but were these bottom feeders to do the same, keeping the sediment stirred up as they do in their search for food, they would continually bring coarse, harsh, gritty material in contact with the delicate branchial membranes. Instead of this, on any enlargement of the mouth cavity, the purer water is taken from above the body through the spiracle to pass out through the branchial aperture. A valve-like fold which hangs across the mouth from the base of the upper teeth, effectually prevents the water filling the interior from passing out through the mouth-opening when feeding, and the structure of the gill-openings prevents an inward flow through them, so that but one course is open for the current.

Passing to the skates we find the spiracle deprived of the reflexed valve, but in other respects it exists as before; here the water may pass either way. The principal use of the cartilage and muscle is to close the aperture at the will of the animal, as on occasion of the head being thrust into sand. Further along, among the flattened Selachians, as long as their main dependence is on the sense of smell in seeking food — the olfactories retaining their great development, as compared with the eyes — so long the spiracles are well developed; but as soon as we approach creatures more dependent on the eyes, as the sharks, the spiracle begins to disappear, until amongst those having nictitating membranes, whose eyes have comparatively great freedom of movement, and who are no longer dependent on the nose, it is found to be nearly or quite obsolete, as in *Carcharias* and *Zygæna.*

The development of the spiracle is in direct proportion to the development of the organs of smell, and in inverse proportion to that of the organs of sight.

The credit of the discovery of the functions of the claspers is due to Professor Louis Agassiz. At the meeting of the American Academy, held in Cambridge, during the winter of 1872–73, he showed conclusively, by means of dissections and drawings, that they were intromittent organs. His preparations were made some years previous, but he had not before, to my knowledge, published the facts. The dissections exhibited before the Academy were made to show the muscles by which the claspers were erected, turned and carried forward, their ends expanded and turned outward, and the manner in which the grooves on their sides were brought over the openings of the spermatic ducts so as to lead the fluid into the oviducts of the female.

As the Professor remarked at the time, Aristotle's comparison of the sharks with dogs, as to the manner of copulation, is well supported by the facts. During the past summer it was with great pleasure that I observed a fact that adds a little emphasis to his discovery. The hint which led to the establishment of the fact that the virgin females of the sharks have the oviduct closed by a membrane, that they possess a hymen corresponding to that of the mammals, was taken from a dissection of a young *Mustelus canis*, made by a couple of lady pupils of the Anderson School of Natural History. Repeated observations confirmed the fact in different genera (*Mustelus*, *Odontaspis*, *Carcharias*, *Zygæna*). Mr. Paulus Roetter, artist in the Museum of Comparative Zoology, kindly made an excellent series of drawings, including the young and adult, male and female, of all the species we were able to obtain; these are soon to be published in a joint paper with Prof. Putnam. The extremities of the oviducts of the adult fertilized female of our *Mustelus* present quite a different appearance from those of the young. In the virgin they are closed, or with a minute pore-like opening, and extend along the dorsal side of the cloaca to a point opposite the middle of the vent; in the adult, after fertilization, they are open, as if an inch or more had been cut off the end, and the intestine opens into the cloaca between their openings and the external. In those specimens of *Mustelus* under observation, the ovary on one side only was developed, the other being abortive. Amongst those species having round claspers which taper to a point, the minute opening into the ducts of the young female is usually a round pore; in those having flat ones with rounded ends the pore becomes a short horizontal slit. Those species which have claspers with harsh, sharp edges and hooks, have the posterior portion of the ducts and cloaca very thick and leathery.

On each side of the vent, extending back upon the ventrals, adult females of the *Rajæ* have close-set patches of shagreen-like scales, which serve as a protection from the claspers of the male. These seem most prominent in those about to deposit the eggs. They are not found in the males. Upon the adult males there are near the outer border of the pectorals two or more rows of long pointed hooks, directed toward the base of the tail; these are capable of erection, and when retracted are hidden in the grooves beneath them. Heretofore the nature and use of these hooks has not been clearly ascertained.

On consideration of the structure and motions of the skate, one is driven to the conclusion that their purpose is to aid in coupling; that it is with them that the male is enabled to hold and turn the female, so that their ventral surfaces shall be together. If the males, with their eyes on the dorsal side, were without these hooks, and obliged to turn themselves over, the females, unimpeded in their flight, would easily elude them, but if the female be turned over she is, by means of these hooks, at once detained and placed in a favorable position.

On p. 173, it is necessary, through accidental transposition of matter, to make the following important correction, namely, to substitute for the first six lines the following:

That the cavity upon the ventrals, containing the muscular gland, fills so readily with the sperm when the claspers are erected, and that its contents are expelled, upon contraction of the muscles around it, with such certainty to their ends, when restored to their normal position, are evidences that it acts as a forcing or squirting apparatus.

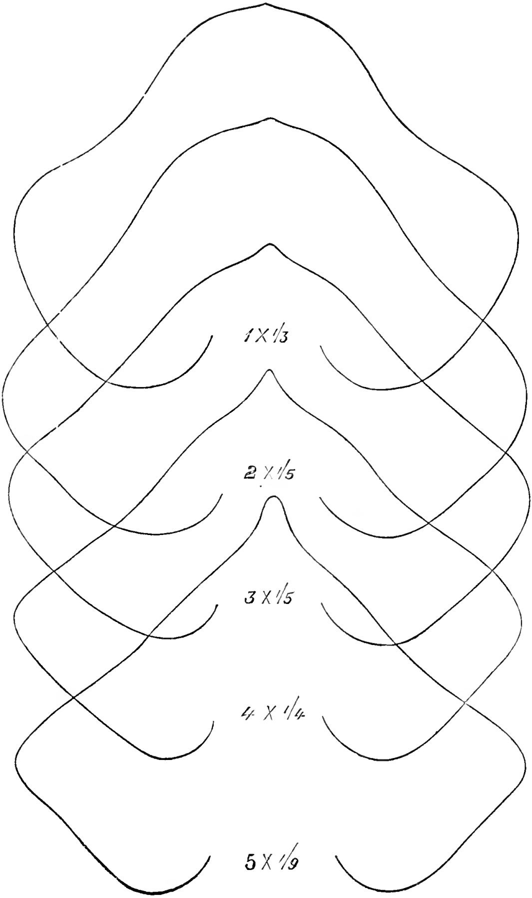
and extent of this organ in these finless animals, suggests that it serves an important purpose, as it may act by its mere presence as a pad or cushion to soften the effect of hard knocks upon the more tender organs it envelopes.

It is found necessary, from the confusion existing in the literature, to redescribe each species of our representatives of the genus *Raja*. The grand collection in the Museum of Comparative Zoology affords the means of doing this with some degree of readiness. In certain respects, all of our skates agree in the general shape of the body, the armature on the dorsal surface, and the position of the eyes, spiracles, mouth, nostrils, and gill-openings. There are other particulars in which they differ to a greater or less extent, as in size and outlines, in shape and size of claspers, in the number, shape and size of teeth, in the number and distribution of the spines, etc. It is hardly worth the while to dwell on the characters possessed in common, but rather on those by which we may be able to distinguish the different species. All remarks are to be understood as applying to full grown specimens unless otherwise specified.

The species *erinacea* and *ocellata* differ in size; the former attains a length of from sixteen to twenty inches, the latter, including the variety which is the smaller, varies in length from two to three feet or more. In *erinacea* the rows of teeth vary from forty-six to fifty-four, in the numerous specimens at hand; in *ocellata* the lowest number to be found is eighty, the highest one hundred and ten. The specimens having the lower number are young ones, about the size of the adult of *erinacea*. For the variety, *diaphana*, the average number of rows is about ten less than for the species. The claspers in the smaller species when at rest have the hook fitting closely in a crotch of about the same length; in the larger the hook is some distance above the crotch, which is undeveloped. Females of *erinacea* have the outlines of the males of *ocellata*; the males of the former have more of an indentation on the anterior margin of the pectoral. Young of *ocellata*, of the size of the adults of the smaller species, have spines in the median dorsal row, and on the head and shoulder girdle, much as in *radiata*. *Radiata* differs from both of the preceding in outline, in dentition, in its stout bucklers, and in the structure of the claspers. In outline it is less acute anteriorly than *eglanteria*. Its rostral cartilage is broad and strong at the head, and, keeping its strong proportions, tapers somewhat abruptly; that of *eglanteria* becomes slender, and, having its sides nearly parallel, tapers gradually to a point. *Eglanteria* has a greater number of rows of teeth than *radiata*. While *radiata* has bucklers, *eglanteria* has laterally compressed, much hooked spines in nearly the same positions. On the outer extremity of the shoulder girdle, where the former has a small buckler in front and a large one behind, the latter has a single large spine in the middle.

The one has the clasper broad, flattened, rounded at the end like a spatula; the other rounded and terminating in a point. One has the caudal fins separate, but without a space between them; the other has an interspace with spines between them. In *radiata* the spots are as in the preceding species; in *eglanteria* they are more or less confluent, forming lines, bands or bars. *Lævis* has the snout more produced, and the lateral angles sharper than either of the others. Its rostral cartilage is quite different in shape. It is long, comparatively wide, flattened above and below, and has its sides parallel. It tapers on the upper and lower surfaces in such a way as to form a chisel or shovel instead of a point, as in all of the other species. It is much the largest of the skates and has the largest teeth, but in the smallest number of rows. The spines on the sides of the tail are immediately above the membranous expansion; they are directed horizontally, and are either straight or hook forward. In *eglanteria* these spines are directed outward and upward, and hook backward; in *radiata* they are separated from the membrane by a band of shagreen. From uniform brown the colors of *lævis* vary to clouded or spotted.

It will be noticed that under the measurement of each species four numbers are given; the first is the length from the snout to the end of the tail; the second, to a line joining the widest portions of the pectorals; the third, to a line joining the posterior extremities of the


1 X 1/3
2 X 1/5
3 X 1/5
4 X 1/4
5 X 1/9

pectorals; and the fourth is the width across the widest portion. For *ocellata* the lowest number of rows of teeth found is given; for the others an average of all the counts. The variation from this average is indicated in the description. In the accompanying wood-cut comparative outline figures are given of the several species of our coast.

SYNOPSIS.

Rajæ with the outline anterior to the spiracles[1]

rounded, not forming an angle;		
	rows of teeth $\frac{50}{48}$	1. *erinacea.*
	rows of teeth $\frac{80}{78}\frac{+}{+}$	2. *ocellata.*
	without ocellæ.	2*a*. var. *diaphana*
forming an angle		
obtuse;		
	rows of teeth $\frac{40}{38}$	3. *radiata.*
acute;		
	rows of teeth $\frac{50}{48}$	4. *eglanteria.*
much produced, blunt;		
	rows of teeth $\frac{32}{30}$	5. *lævis.*

1. Raja erinacea.

Raja eglanteria Lesueur, Jour. Ac. Nat. Sci., Vol. IV, pt. I, p. 103, 1824.

Raja erinacea Mitchill, Am. Jour. Sci., Vol. IX, p. 290, pl. 6, ♂, 1825. — DeKay, New York Fauna, pt. III, p. 372, pl. 78, fig. 246, 1842. — Storer, Synopsis of the Fishes of North America, p. 259, 1846.

Raja eglanteria Storer, Synopsis of the Fishes of North America, p. 260, 1846. — Dumeril, Elasmobranchs, Tom. I, pt. II, p. 532, 1870.—Gunther, Cat. Fish. Brit. Mus., Vol. VIII. p. 462, 1870.

This is the smallest and most common of our skates. In shape it is rhomboid, with all the angles rounded. With the exception of a small portion of the anterior, opposite the spiracles, the outline of the pectoral is convex; the indentation in this place is less marked in the females than in the males. There is a slight rounded projection at the end of the muzzle. The spines are largest on the anterior extensions of the pectorals, where they are close-set, strong, laterally compressed, and hooked backward. Smaller ones are scattered over the head, above the spiracles, above and in front of the eyes, on the

[1] See wood-cut, preceding page.

ones, so disposed as to leave a space between them on the dorsum. This space is, to a greater or less extent, occupied by scales in the young. A triangular patch of small scales is found on the shoulder-girdle. The inner and posterior portions of the pectorals are nearly or quite free from spines in the males; near the exterior angles, arranged in lines parallel to the outer border, they have a couple of rows of large erectile hooks, pointing toward the ventrals, which, when at rest, lie in channels below the surface. On each side of the vent the adult females have groups of small scales which seem to be more noticeable about the time of laying the eggs. The teeth are small, in about fifty rows in the upper jaw and forty-eight in the lower; the central ones are sharp in the males; all are blunt in the females. The jaws are much curved. A membranous expansion extends down each side of the tail. The caudal fins are not separated to the base, and are rough, with small scales; a narrow membrane extends from the posterior to the end of the tail. The hook in the claspers fits neatly in a crotch of equal height. The prongs of the crotch are of about the same length; the inner is on the stem.

Color light brown, with rounded spots of darker; lower surface white. Those specimens coming from the southward have the spots most distinct. Specimens from the north are larger. The males are smaller than the females. Size of female, from Nahant: L. 20, 6, 10. W. 12. Teeth $\frac{50}{48}$. Size of male, from mouth of Connecticut River: L. $16\frac{1}{2}$, $4\frac{1}{3}$, $7\frac{3}{4}$. W. $9\frac{1}{2}$. Teeth $\frac{50}{50}$.

2. Raja ocellata.

Raja ocellata Mitchill, Trans. Lit. and Phil. Soc., N. Y., Vol. I, p. 477, 1815. — Storer, Report on the Fishes of Mass., p. 191, 1839. — Duméril, Elasmobranchs, Tom. I, pt. II, p. 539, 1870.

Var. *diaphana*.

Raja diaphana DeKay, N. Y. Fauna, pt. III, p. 366, pl. 67, fig. 218, 1842. — Storer, Synopsis Fish. North America, p. 258, 1846. — Storer, Hist. Fish. Mass., p. 264, 1867.

The appearance of both sexes of this species, the second in size of our skates, is quite similar to that of the female of the preceding. On the anterior margin of the pectoral of the male the indentation is less marked, and the change from the large spines of the anterior extension of the pectoral to the smaller ones on its outer border less abrupt than in *erinacea*. With the exception of additional rows down the back and along the sides of the tail, the distribution of the spines is about the same. Young examples have strong buckler-like spines above the eyes and spiracles, on the girdle, and down the median line.

Most adults have traces of the median row of spines, either on the back or on the tail near the caudal fins. The adult males have two or more rows of large hooks toward, and parallel with, the outer margin of the pectoral. The females have the small scales around the vent. In the claspers the hook is some distance from the end of the cartilage which forms the crotch in *erinacea*, but which in this species is undeveloped. There is a membrane along the side of the tail. The caudal fins are not separate to the base. They are rounded in outline and rough with small spines; the posterior is at a little distance from the end of the tail. The jaws are curved. The teeth are sharp in the males, more blunt in the other sex; the number of rows in the majority of our specimens was $\frac{90}{88}$, or very near it; the lowest counted was 80, and one specimen had 110.

Color light brown, with rounded spots of darker. A translucent space on each side of the rostrum is nearly white. Near the posterior angle of the pectoral there is a large ocellus three-fourths of an inch in diametre. This is white, in alcoholic specimens, with a dark spot in the centre, and a darker border. Much nearer the angle there is a smaller one, of about a third of the size, which lacks the spot in the centre. Just forward of their junction, between the pectorals and ventrals, there is a third, about half as large as the first. Some specimens have only one ocellus; others two.

Size of a male from Nahant, Mass.: L. 32, 10, 16. W. 21. Teeth $\frac{80}{78}$. Size of a female from Nahant, Mass.: L. $32\frac{1}{2}$, $10\frac{1}{4}$, $16\frac{1}{2}$. W. $21\frac{1}{2}$. Teeth $\frac{84}{82}$.

The variety *diaphana* differs principally in size, being smaller, and in markings, being without ocellæ.

3. Raja radiata.

Raja radiata Donovan, Hist. Brit. Fish., v, pl. 114, 1820.—Storer, Report on the Fishes of Mass., p. 201, 1839. — Müller and Henle, Plagiostomen, p. 137, 1841.

Raja americana DeKay, N. Y. Fauna, pt. III, p. 368, pl. 66, fig. 215, 1842.— Storer, Synopsis Fish. North Amer., p. 260, 1846.

Raja lævis Storer, Hist. Fish. Mass., p. 266 (description) 1867.

Raja radiata Duméril, Elasmobranchs, Tom. I, pt. II, p. 531, 1870. — Gunther, Cat. Fish. Brit. Mus., Vol. VIII, p. 460, 1870.

This animal has been described so often by European naturalists that no attempt is made to give a complete synonymy. The anterior outlines of the pectorals are slightly sinuous, and form a blunt angle at the end of the muzzle; their exterior and posterior angles are rounded. In addition to the spines found on the pectorals, head, back and sides of the tail, as in the others, this skate is marked by the possession of bucklers. These are large, strong spines, with broad bases, differing from those on the pectorals by their great size and solidity. They are distributed as follows: one or two in front of each eye; one on each side, between the eye and the spiracle; one just back of each spiracle; a pair on the shoulder, the smaller in front; and fourteen or more forming a dorsal row, beginning just back of the head and extending to the caudals. The spines scattered over the pectorals have stellate bases instead of the broad and shield-like ones of the bucklers. The medium sized spines on the anterior margin of the pectoral diminish in size toward the outer angle. There is a row, more or less irregular, of spines on each side of the tail, separated from the membrane by a band of shagreen; these are of about the size of those opposite the cheeks. This species has two or more rows of the peculiar hooks on the pectorals of the male.

The color in the specimens from which the description is taken is nearly uniform brown.

The teeth are nearly round on the base, and have a long, sharp point rising from the middle and hooking backward in the male; those of the female are more blunt. The claspers are large and stout, flattened, widened, and rounded toward their extremities.

Size of male from Nahant: L. 21, $6\frac{1}{2}$, $10\frac{3}{4}$. W. 15. Teeth $\frac{38}{36}$. Size of female from Nahant: L. 22, $6\frac{3}{4}$, $12\frac{1}{2}$. W. $15\frac{1}{2}$. Teeth $\frac{40}{38}$.

One of the specimens is, in all respects, a female, but possesses small undeveloped claspers; it has but one caudal, the posterior. The females have more spines than the other sex, and are larger.

4. Raja eglanteria.

Raja eglanteria (Bosc. Mss.) Lacépède, Hist. d'Poiss., Tom. II, p. 103 et 109, 1800.

Raja diaphana Mitch., Trans. Lit. and Phil. Soc., N. Y., Vol. I, p. 478, 1815.

Raja desmarestia Lesueur, Journ. Ac. Nat. Sci., Vol. IV, p. 100, pl. 4 (♂ juv.), 1824.

Raja chautenay Lesueur, Journ. Ac. Nat. Sci., Vol. IV, p. 106 (fig. ♀, adult), 1824.

Raja desmarestia M. et H., Plagiostomen, p. 154, 1841.

Raja ocellata DeKay, New York Fauna, pt. III, p. 369, pl. 65, fig. 212, 1842.

Raja desmarestia DeKay, New York Fauna, pt. III, p. 372, 1842. — Storer, Synopsis of the Fishes of North America, p. 259, 1846.

Raja chautenay Storer, Synopsis of the Fishes of North America, p. 260, 1846.

Raja desmarestia Duméril, Elasmobranchs, Tom. I, pt. II, p. 551, 1870.

The outlines of the anterior border of the pectorals are more sinuous than in *radiata*, and form a sharper angle at the end of the snout. The rostral cartilage is long, narrow, slender, and rounded on the lower side, or subtriangular. It tapers gradually, and is pointed at the end. The scales are very small; many of them are only perceptible to the touch; all are very sharp. They are most numerous on the anterior portion of the pectoral, over the head, on the rostrum, on the middle of the back, and on the tail between the rows of larger scales. There are larger spines around the eyes and spiracles, on the middle of the rostrum, in a median dorsal row from the head to the second caudal, and in two lateral rows on the tail. The rows on the side of the tail are at a little distance from the membrane. The spines in these rows are directed outward and upward; they are very sharp, and have the points turned toward the end of the tail.

Larger and smaller spines alternate in the rows. In the middle of each shoulder there is one large spine. A single spine stands between the caudal fins; the tail extends a short distance beyond the posterior.

The claspers are wide, deeply split, and pointed. Color brown, with bands, bars, lines, blotches and spots of darker in the middle of the pectoral. On each side of the rostrum there is a large, translucent space, which in some specimens is quite white.

Size of a male, from Penikese Island: L. $22\frac{1}{2}$, $6\frac{5}{8}$, $14\frac{1}{2}$. W. $13\frac{1}{2}$. Teeth $\frac{50}{48}$.

We have no adult female.

5. Raja lævis.

Raja lævis Mitch., Amer. Month. Mag., Vol. II, p. 327, 1817.

Raja batis Storer, Report Fish. Mass., p. 193, 1839.

Raja lævis DeKay, New York Fauna, pt. III, p. 370, 1842.

Raja ocellata Storer, Synopsis Fish. N. Amer., p. 258, 1846.

Raja lævis Storer, Synopsis Fish. N. Amer., p. 259, 1846.

This is the largest species of skate on this coast; on account of its great size it is called the Barndoor Skate by the fishermen. The angles in the outline of *lævis* are more acute than in either of the preceding. Its muzzle is much produced. The rostral cartilage is long, wide, and flattened on the upper and under surfaces; its sides are about parallel; near the end it tapers above and below in such a way as to form a shovel or chisel. The spines of the rostrum are worn smooth, both on the upper and under sides of the snout, as if it was used as a spade in the mud and sand. The spines of the entire body are very few and small. There are some above the eyes and spiracles, on the snout, along the anterior borders of the pectorals, and on the back. Those on the back are often so small as to be perceived only by rubbing the finger over the skin. A median dorsal row extends from the posterior portion of the back to the second caudal fin. These are larger, laterally compressed, and slightly hooked. Two lateral rows extend along the sides of the tail, immediately above the membrane; these are either straight or hook forward; their points are directed horizontally.

The caudals are separated by an interspace with spines. The tail extends some distance beyond the posterior fin. On this extension there is usually a false or membranous fin; it possesses no rays, and is wholly unlike the caudals in structure. It is this membrane that has led naturalists to describe the species as having three caudals.

Lævis is subject to great variations in color. Examples from the same locality present marked differences in this respect. Commonly it is brown, clouded, marbled, or spotted with lighter; occasionally the spots are ringed with darker. A couple of specimens in this collection have kidney-shaped marks near the shoulders. The hooks on the pectorals of the male are common to all the species of the genus inhabiting our waters.

Size of a male from Massachusetts Bay: L. 42, 14, $23\frac{1}{2}$. W. 32. Teeth $\frac{32}{30}$; width of tooth bearing surface on the jaw $3\frac{3}{8}$ inches.

The spines on a female from the same locality were much more numerous. Size, L. $47\frac{1}{2}$, $15\frac{3}{4}$, 25. W. $34\frac{1}{2}$. Teeth $\frac{31}{30}$, more blunt than those of the male.

Mr. L. S. Burbank described and exhibited specimens from a granitic vein in Athol, Mass., which he had recently discovered.

This vein is of the same general character as that of the noted beryl locality of South Royalston. It is, however, of much greater extent, and furnishes crystals and masses of mica of much larger size. Some of the mica crystals exceed a foot in diameter, and are of a quality suitable for use in the arts. Only a small excavation has yet been made, but the abundance of the mica indicates that the mine may prove to be very valuable. A few crystals of beryl have been found which are similar to those of South Royalston, and if the mine should be extensively worked it will undoubtedly yield many fine crystals of beryl.

The Custodian announced the bequest of the late Mr. F. P. Atkinson of his collection of birds, eggs, and insects to the Society.

Section of Microscopy. November 11, 1874.

Mr. Bicknell in the chair. Twelve persons present.

Mr. Stodder read an account of a preliminary examination of mud from oyster beds in the harbor of Charleston, S. C., collected by Prof. John McCrady.

Preliminary examination with the microscope shows that it contains Diatoms, but only in a small proportion of the mass, which is made up almost entirely of apparent organic matter in a state of decomposition, with some sand. I have found in it many pollen grains of Coniferæ and one *Polythalamia*. The Diatoms, so far, are two or three species of *Pleurosigma*, one of *Nitzchia*, one of *Amphora*, two or more of *Navicula* — some of each containing the endochrome, and many of the *Navicula* in particular looking fresh and living — two specimens indeed were alive and moving freely. There was one example of *Biddulphia Baileyi* W. S. (= *Zygoceros mobilensis* Bailey), with endochrome, showing that this was its native locality. The shells of this species have usually been found in deeper water in the Gulf and Gulf Stream. There are a few *Melosira* (*Orthosira* W. S.), but the most abundant form is *Tryblionella punctata* W. S., very small, and all empty shells. As yet I have found none of the circular and angular forms so frequent in the waters of Charleston harbor, where the forms before mentioned are also plenty.

November 18, 1874.

Vice-President S. H. Scudder in the chair. Sixty-eight persons present.

The following papers were presented:—

COAL SEAM NO. 6, OHIO GEOLOGY. BY COL. C. WHITTLESEY.

According to the Report of 1870, which contains the latest information yet published on the general structure of the coal-bearing strata of Northeastern Ohio, *Coal Seam No. 6* is the most persistent of the series. It is represented as having been traced through the counties of Holmes, Tuscarawas, Coshocton, Carroll, and Columbiana, covering nearly all that part of the Ohio coal field north of the Pan Handle railway. On page 15 a general view of the physical structure of this district may be found in the following paragraph.

"We have learned that instead of one symmetrical basin with a tolerably uniform dip to the southeast, our coal measures form several troughs, in a general way parallel with the axis of the great one, of which they are parts."

In subsequent parts of the Report this discovery is dwelt upon at length, as a prominent feature of the survey, particularly as accounting for the frequent disappearance and reappearance of Seam No. 6.

Investigations previous to the Survey of 1869, tended to show that the regularity of the coal bearing strata of Northeastern Ohio had been over-rated. It had become evident that coal beds could not safely be identified at points widely asunder, by means of their fossils or their associated strata. As soon as it was found that profiles made in different parts of the field did not show the *same number* of seams, it was evident that all the beds could not be persistent. It had been settled that with all the seams, sometimes within very short distances, there were radical changes of the associated rocks. The coal seams also change rapidly in appearance, thickness, and quality.

These perplexing facts are presumed to have been harmonized by adopting a *theory of undulations*. On this hypothesis, if it is true, there must be as many instances of *counter* or *reverse* dip, as there are waves in the strata. If the troughs are a part of the folds of the Alleghany flexures, dying out westwardly, the axes of both the synclinals and anticlinals must be in general parallel with the crests of the system in Pennsylvania.

In the language of the Report, " From Nashville, Holmes Co., to the valley of the Kilbuck, the dip is eastward, and *somewhat rapid*. From thence to the east line of Holmes County, the strata *rise*, then dip again *eastwardly* into the valley of the Tuscarawas. From Dover (on the Tuscarawas) to, and beyond the Tunnel, and to Carrollton, the dip is *westwardly*, while from Hanover summit it is *eastward* to the State line." No instance, local or general, is given in the Report on the northeastern counties, of the precise direction, or the rate of dip per mile. The process is very simple, being one of plain geometry, and might easily have been applied. It would have been far more satisfactory in the form of figures, than it is in such expressions as "somewhat rapid." Elevations are given, but no application of them in fixing the planes of dip.

The quotation I have made embraces a summary of the supposed discovery, which is dwelt upon at more length on pages 16 and 483. Such a line of elevation exists on the Ohio River, but whether it is due to a corrugation of the Alleghany system, or to deposition, is an open question. This line comes up from Burning Spring, in West Virginia, crossing the river above Marietta, and extends northerly through Noble County into Muskingum. Beyond this to the north I find no traces of it.

I propose to test the correctness of these conclusions of the Report by utilizing its levels, together with such as I have taken or procured during the past thirty-five years, applying the common mode of triangulations, both local and general. By the use of a map of large scale, these can easily be carried forward over the entire region, each connected with the others. Small errors are unavoidable, but they cannot seriously impair a protracted series of calculations.

The inclination of a coal seam in *one direction* goes very little towards fixing its *true inclination* in space. Local triangles determine the local irregularities; those of longer sides eliminate the local irregularities. Some of the results here reproduced were made public in 1856, and others in 1869, with maps, in the Memoirs of this Society. No more important question can arise, connected with the geology of this region. It involves a correct determination of the number of coal seams, and their depth beneath the surface. It is capable in theory of three solutions.

First.— The beds may be regular and continuous, dipping from the margin of the field on the north and west, towards the central line of the basin beyond the Ohio River, south and east. In this event their number along the central line, if the series shall be pierced by borings or by shafts, should be *the same* as at the out-crop.

Secondly. — The beds may not be persistent in any direction, but may thin out, both on their line of bearing and of dip; and in this case the number of beds must be different at different parts.

Thirdly.—There might be undulations of regular beds like those in my first hypothesis, which shall be persistent and parallel, which is the theory of the Report. This I shall endeavor to show is an error.

To make the demonstration complete there should be a map, and correct physical sections, commencing at a central line near the middle of the basin, about midway between Steubenville and Pittsburg, in West Virginia and Pennsylvania, and radiating from thence to the west and north, at points on the border of the field. The Survey has not yet furnished topographical materials to do this. To bring those that are available into as compact a form as possible, I will assume for the purpose of demonstration, Coal Seam No. 6 as a persistent horizon, in accordance with the Report.

If this seam is regular the others must be the same, forming parts of a system; for if there are undulations resulting from the Alleghany up-lifts, they occurred *after* the deposition. If the proofs of such disturbances are wanting, the fact of irregularities being admitted, we must look for a solution in the direction of unequal and *irregular deposition* during the formation of the series.

The mode of this deposition I consider to have been generally in disturbed waters, on a shelving shore, — not necessarily a basin, — where the beds did not reach downwards continuously to the centre or deepest water. They were laid up along the sloping sides — coal, limestone, sandstone and shales — by currents that were sometimes strong, and at others sluggish, their dip more rapid than that of the floor. The areas over which these changes occurred were often not extensive.

To bring all the observations in favor of merely local *uniformity of deposition* together, would make this article altogether too lengthy, and therefore I confine myself at present principally to physical or topographical geology.

The floor of the series in Ohio has a very irregular surface, and therefore Coal Seam No. 1, as it is called, furnishes a very uncertain horizon to reckon from. It (No. 1) is often interrupted, and when it is again taken up, after a break of continuity, cannot be regarded as a geological equivalent. The limestone beds, like the coal, show along their line of bearing, and of dip, the same disappearances. Their identity often rests upon fossils alone, of which the specimens are few. In such circumstances, in cases of doubt, especially where the beds are not conformable, the most sure solution lies in the use of the spirit level, and geometry. It often happens that the vertical distance between coal seams is less than the unavoidable errors of the barometer, and therefore in Ohio I have never used it. The local undulations in large mines are often twenty and twenty-five feet, and the extreme ones forty to fifty feet.

Opposite the Ohio division of this coal field in West Virginia, the central line of the basin lies fifteen to twenty miles beyond the Ohio River, its general direction being about northeast, and, though not always straight, is roughly parallel to the valley.

The bottom of the basin here is probably boat-shaped (its thickness unknown), the central line being vertically in the plane of the keel, crossing the river near the great bend below Pittsburg, east of the Ohio line, and pointing in the direction of the forks of the Alleghany at Franklin, Pa. Here the keel rises into the prow. Easterly of it, the dip changes from southerly to westerly, in a region which H. D. Rogers has shown to be peculiarly irregular. The three tests I propose to apply are as follows: —

First. — To take several points on the reputed out-crop of No. 6, as given in the Report, and draw lines from them converging to a point on or near the central line of the basin, in Washington County, Pennsylvania. The points are six in number, covering a section of the coal field of about 90° in arc from west to north; all of which lines must cut the supposed undulations. All the elevations of Seam No. 6, on and near these radial lines, will be given. If there are swells and reverse inclinations in the strata, it must appear on these lines.

Secondly. — To give a net work of triangulations for dip covering the same territory. If there are reverse planes it is impossible they should escape observation among so many lines and levels.

Thirdly. — Taking Seam No. 6 as a persistent stratum, as it is represented to be in the Report, to refer to it all beds of coal and limestone below it. If it shall appear that no other bed is persistent, the presumption is that this is not an exception.

I begin with the outcrop of No. 6 in Coshocton County, O., which is nearly west of the assumed central point, and number the radii around to the north in succession. The figures for elevation, where they are taken from my notes, are generally marked (W.), especially where these differ from those of the Report, which are marked (N.). If they are without either of these letters, they are from the Report, or agree with mine.

Radial No. 1.

Coshocton County, west part, head of Simmon's Creek; course east; elevation of No. 6, 487′ to 500′ above Lake Erie (Whittlesey); in the west part of the county 477′ (Newberry); mean 489′ A.; thence to Coshocton eight miles east, 248′ (N.); to New Comerstown, twelve miles, 292′ (N.); descent in 20 miles, 197′, or at the rate of about 10′ per mile.

Coshocton is situated at the south end of the valley of Kilbuck, which lies nearly north and south, and in which there is reported to be a synclinal. The next synclinal is located in the valley of the Tuscarawas, about thirty miles to the east, and lies also north and south. This radial is therefore at right angles to the intermediate anticlinal, if it exists, and the elevations of No. 6 across the end of it are as follows (Report, p. 43), reckoning from west to east: Coshocton, 248′; New Comerstown, 293′; Lock 17, 295′; Port Washington, 260′; Uhricksville, 275′. These figures show no more differences than are to be found in many large mines, and represent a stratum substantially *level*, in this direction. This is accounted for in triangle No. 2, which will be given below, by the fact that the general direction of this line is on the bearing of the beds. According to my memoranda, however, the Uhricksville mines are materially higher than is represented by the Report.

Radial No. 2: Course south, 77° east.

Nashville, Holmes County, 688′; to near Millersburg, $11\frac{1}{2}$ miles, 583′; to New Castle, on the Tuscarawas, 19 miles, 352′ (W.); descent in $30\frac{1}{2}$ miles, 336′; about $11\frac{1}{2}$ feet per mile.

Radial No. 3: Course south, 70° east.

Fredericksburg, Wayne County, 600′; to Dundee, Tuscarawas Co., 12 miles, 558′ (N.); Zoar, 11 miles, 462′ (N.); 487′ (W.); Perches' Mill, valley of Connoten, 7 miles, about 400′ (W.); descent in 30 miles, 200 feet, equal to $6\frac{6}{10}$ feet per mile.

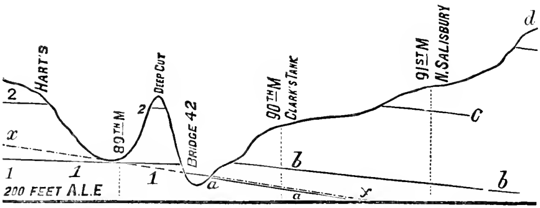
Radial No. 4: Course south, 54° east.

Osnaburg, Stark Co., 574′ (N.); to valley of Sandy, 11 miles, 540′ (W.); descent 34 feet.

Radial No. 5: Course south, 43° east.

In the only instance of a reverse dip on this line, the rise is no greater than occurs locally in several mines, or 32 feet.

New Chambersburg, Columbiana Co., 629′ (W.); Lynchburg, 6 miles, 540′ to 560′ (W.); 1 mile beyond Hanover Station, 592′ (W.); Salineville, 7 miles, 283′ (W.); Irondale, 6 miles, 330′ (W.); Ohio River, 5 miles above Steubenville, 12 miles, 125′? (Briggs). On this line I conceive that Seam No. 6, at New Chambersburg and Hanover, is not the same as the "Big Seam" at Salineville, called also No. 6, and am quite confident that the "Big Seam" at Irondale and Hammond's Station is not the same as the Salineville bed. As to the latter, the accompanying diagram and levels explain the situation.



a–a — Creek vein.
b–b — Hammondsville "Strip vein."
c— Reputed place of the "Rogers vein."
d— Reputed place of the Nisely Big Seam and No. 6.
1 1 1—Salineville "Big Seam," and No. 6.
2 2 — Salineville "Strip vein."
x x — Railroad grade, 182 to 233 ft. A.

In the space of four miles, represented by this profile, decided changes have taken place in the geological structure. At Salineville there are two workable beds of coal, and two thin ones not wrought, making four. One is about 80′ above the Strip vein, and the other 36′ below the great seam, alias No. 6. At Hammondsville there are *six*, and as the two groups are traced together some of the seams disappear. When the profiles are brought together and compared at Bridge 42, the Salineville strip (2) is further than usual above No. 1

by ten or fifteen feet, which is nothing unusual. All the way from Linton, eight or nine miles distant, coming towards Bridge 42, the Strip and Creek veins continue to be visible close together, and conformable. It is not certain that the Rogers and the Nisely beds do continue thus far, but at Irondale, two miles below, they are respectively 250′ and 330′ A. If *c* exists there, it corresponds in stratification most nearly with No. 2, at Hart's. No. 1, or the Salineville Big Seam, may be the same as *a*, or as *b*, or it may be neither. Even in this short space some of the beds thin out and disappear. At Hart's there is a bare bluff rising from the railroad track up to an old opening 50 feet above, and no intermediate seam of coal is visible. As yet no bed has been found, or sought for, below No. 1, at this place. To force No. 2, on the north, down to *a* or *b*, or to bring No. 1 up to connect with *d*, on the south, and call both of them No. 6, are equally wild conclusions.

It may be conjectured that the bed 1, 1, 1, at Bridge 42, represents one of the beds near the track at Clark's, *a* or *b*. The latter beds are so near together, and are so nearly on a level, that farther examination is necessary to connect them with certainty. If 1, 1, 1, corresponds with either *aa* or *bb*, it would follow that 2, 2, and the Rogers seam are the same. In that case the Nisely great seam, 100 feet higher or more, may exist on the hills, near the top, in a thinner condition, and be represented by the upper thin seam at the Empire mine, near Salineville, three miles northwest. Should this prove to be true, there is an approach to harmony in the groups; but if the Salineville "Great Seam" is No. 6, the Strip is No. 7, and the Nisely seam No. 8.

Radial No. 6: Course south, 32° east.

Near Franklin, Columbiana Co., 530′ (W.): New Lisbon, 5 miles, 515′; mouth of Yellow Creek, 15 miles, 253′ (N.); descent in 20 miles, 267′.

In the "Whan Seam," next below No. 6, there is at New Lisbon a local dip to the *northeast* of 13′ per mile. If this represents the side of a general undulation, its axis must lie in the direction of northwest and southeast, at right angles to the Alleghany uplifts, and therefore not due to them.

From Rochester (553′) to Lynchburg (560′) and Hanover 549′, moving easterly, No. 6 is substantially level, as it should be, in the direction of the strike. The limestone, only a few feet beneath it, passing beneath the summit 631′, extending easterly to the waters of Little Beaver, around Dungannon, five miles farther, is on that line, substantially level, or 540′ A. From there to New Lisbon, five miles, a little north of east, No. 6 is reported to be 515′ (N.), but without the limestone. At Arter's mine, five miles northwest of New Lisbon, it is 530′ (W.). Over this space, about twelve miles by five, the only inclination yet detected is to the south.

At fifteen miles south, near Irondale, the presumed No. 6 is at an elevation of 330′, rising to the northwest at the rate of 50′ per mile. No general undulation of the beds in a north and south direction could produce these results.

If there is an axis of elevation between Hanover and Salineville, it must bear northeast and southwest. The Sandy Creek valley group, if it rises, rises over this axis, and must be visible in the ravines at the head of the west fork of Little Beaver, in Franklin township. Two miles along the track from the summit, where the railroad grade is 542′, the Salineville " Strip seam " is found at 447′ A., rising rapidly to the west.

The Salineville No. 6, if it exists there, is 40′ to 50′ lower. At the nearest point of the Sandy group, eight miles northwest, the arrangement of beds is entirely different, and therefore I infer that the two groups are independent. I have shown that the Irondale group and the Salineville group cannot be matched.

In the eastern part of Columbiana County, near the State line at Achor, No. 6 is reported to be 430′ A., while at the Arter mine, about fifteen miles north, 20° west, it is 530′. This difference in that direction, instead of being evidence that the strata dip to the east, shows only that Achor lies below the line of bearing, which is north of east, and the bed should be lower at that point, on the theory of regularity.

Returning to Coshocton County, at the southwest, I have constructed a series of triangles in different beds of the series; carrying them forward consecutively to the north and east, over the same ground as the radial, to the State line in Mahoning County; many of which were published prior to the present survey.

In this investigation I use the additional elevations given in the Report, although in several instances they are not correct. Observations with a barometer carried in the field are not reliable to identify strata which lie vertically so near each other, or which have so large local irregularities of level. Coal seams Nos. 5 and 6, over a large tract, are only 25′ to 30′ apart, and in one mine of No. 6 the variation of the floor is 25′. Unavoidable errors of the barometer exceed this.

Close topographical work and exact physical profiles are indispensable in such a region, to give confidence in the results. In those which I give there are admitted sources of error, when viewed as strictly mathematical determinations. The bearings and distances are taken from maps; and the elevations are frequently taken only to the mouth or entry of the mines, and are not the average of the seam. Within the perimeter of the triangles the beds are waving and warped surfaces, with domes and valleys, but having a surface which approximates to a plane, some parts above and others below, with a plus or minus difference of 15′ to 20′. But admitting these defects, which might have been measurably cured by the Survey, it cannot be that such errors are very large, or are *all in one direction*. It will appear that among hundreds of elevations, after extending a series of triangles over the field, locally and generally, the results show *no instance of a bed of coal dipping to the west or northwest.*

TRIANGULATIONS.

No. 1. Coal Seam No. 1.

Warsaw, northwest part of Coshocton Co., Darling's bank, 348′ (W.); Cameron's bank, three miles north of Millersburg, Holmes Co., 365′; and Union Company's sump, near Massillon, Stark Co., 340′ (W.); length of three sides, eighty-one miles.

These figures represent the floor of the series, which is over this space, nearly level, as I showed in 1869. The inclination is very slight, only two feet per mile, and its direction is south 55° east.

No. 2. Coal Seam No. 6.

Nashville, Holmes Co., 688′ (N.); Dundee, Tuscarawas Co., 558′ (N.); Coshocton, Coshocton Co., 248′ (N.); length of sides, sixty-nine miles; bearing of the strata north 64° east, dip south 26° east; rate 22′ per mile, neglecting fractions.

If No. 6 is persistent, it dips beneath the barren measures, and the Pittsburg seam on the southeast, in Guernsey and Harrison Counties. If an undulation exists in those counties it has not affected the Pittsburg seam. It is, however, far from conformable to the floor of the series beneath it. Because Patterson's mine at Dundee, 558′ A., eighteen miles north, 75° east of Sanders, and other mines in the valley of Kilbuck, near Millersburg, 522′ and 532′ A., are 25′ to 36′ higher, an undulation has been assumed to extend beneath two counties. The course is near the line of bearing, and the difference of level is no greater than it is in single mines.

No. 3. Coal Seam No. 6. Local.

Zoar, Tuscarawas Co , 462′ (N.), 487′ (W.); Perches' Mill, valley of the Connoten, 405′ (W.); and Canonsburg, Carroll Co., about 450′ (W.); length of sides, twenty-four miles. Locally the strike of the bed is here north 80° east; the dip southerly, at the rate of 14½ feet per mile. It passes beneath the barren measures, according to Prof. Read, at the head of the valley of the Connoten, near New Market.

No. 4. Coal Seam No. 6.

Tunnel near Mineral Point, Tuscarawas Co., 495′ (N.); Dundee, northwest part of same county, 558′ (N.); New Philadelphia, same county, 405′ (W.). Sum of sides, thirty-seven miles; dip south 32° east, 16½ feet per mile. New Philadelphia is three miles from Dover, towards which a dip to the west is given, and a general *rise* to the east. The actual rise is to the north as it should be, the strike being, locally, east and west.

No. 5. Blue Limerock No. 1. Local.

Short lines between Bethlehem, Stark Co., Bolivar and Sandyville; dip south 72° east; rate per mile, twenty-five feet and a fraction.

No. 6. Coal Seam No. 6. Local.

Sandy Valley, Malvern, Waynesboro, and Pekin, Stark Co., east of Tunnel; dip south 43° east, 36′ per mile.

No. 7. Coal Seam No. 1. Local.

Valley of Newman's Creek, near Massillon, Stark Co.; dip south 71° east, $15\frac{6}{10}$ feet per mile. Here from the sump to the highest parts of the same mine it is frequently forty feet.

No. 8. Coal Seam No. 1.

Tallmadge and Clinton, Summit Co., and Massillon, Stark Co.; dip south 23½ feet east, nine feet and a fraction per mile, representing the floor of the series.

No. 9. Coal Seam No. 1.

Massillon, Tallmadge, and Briar Hill, near Youngstown, Mahoning County; length of sides one hundred and twelve miles; dip 53° east, $8\frac{1}{2}'$ per mile; very flat, representing the base of the series.

No. 10. Coal Seam No. 1.

Tallmadge, 517′ (W.); Brookfield, Trumbull Co., on the State line near Sharon, Pa., 426′ (W.); Briar Hill, Mahoning Co., out-crop, 342′ (W.). Sum of the sides ninety-nine miles; dip south 12° east, $20\frac{6}{10}'$ per mile. The mean of all the mines at Coal Hill, Tallmadge, is 505′. The above represents the old Newberry opening at the north end of the hill.

No. 11. Coal Seam No. 1. Local.

Mahoning County, valley of the Mahoning River, Briar Hill, 342′ (W.); Mt. Nebo, 222′ (W.); and Ewing's boring on Meander Creek, 305′ (W.). Sum of the sides twenty-seven miles; dip south 22° east, 14′ per mile. This bed is very irregular in the Youngstown region. It lies in local troughs and basins that connect with each other, without any apparent system. From the sump to the out-crop of some of the mines, there is frequently a rise of 50′. I have not always been able to get the elevation of the sump.

No. 12. Coal Seam No. 1. Local.

Mt. Nebo, Briar Hill, and Porter's old bank on Meander Creek, 332′ (sump); dip south 37° east, 13′ per mile; length of sides twenty-five miles, between the Meander and the Mahoning Rivers.

No. 13. Coal Seam No. 1. Local.

Mt. Nebo, Mineral Ridge, 377′, and Ewing's, dip south 18° east; $16\frac{6}{10}'$ per mile.

No. 14. Coal Seam No. 6. Local.

New Chambersburg, Columbiana Co., 629′ (W.); Rochester, in valley of Sandy, 560′; near Hanover Station, 549′ (W.); sides fourteen miles; dip south 10° east, 30′ per mile. A little more than a mile southeasterly of Hanover Station the bed rises to 592′, and tapers out in that direction.

No. 15. Limestone, next below No. 6.

Hanover Station, Columbiana Co., 540′ (W.); on old canal at Section 25, near Dungannon, Hanover township, 540′ (W.); on

Cleveland and Pittsburg Railroad, south side, Section 14, Franklin township, 477′ (W.); sides fourteen miles; dip south 20° east, 16′ per mile.

Passing over the summit from Franklin to Salineville, 6 miles, about southeast, the "Big Seam" (No. 6) is at the Station 283′ A., or 257′ below the coal near Hanover Station. Forty to fifty feet above it is the "Strip Vein" (No. 7), in which I have three local triangles, with sides of three-fourths of a mile to a mile and a quarter. The dip varies from north 70° to north 82° east, and is very rapid, being from 80′ to 100′ per mile. Proceeding westward it is much less. Here is a local rise of 40′ to the north, in less than forty rods, where the bed is cut out entirely. If this is due to a wrinkle of the strata, caused by dynamical forces, connected with the Pennsylvania uplifts, the local bearing, instead of being nearly north and south, should be northeast and southwest. On the Big Sandy, thirteen miles distant to the north, the bearing is nearly east and west, and consequently not parallel with either the Salineville local trough, or that of the Alleghanies.

I have already noticed the supposed rise of Salineville No. 6, to meet the Irondale No. 6, or "Nisely Big Seam." The former has been traced from Salineville in that direction three miles, or half way, and found to be 223′ A. A mile farther on, at Clark's tank on the Railroad, are beds Nos. 3 and 4 of the Reports, only 18′ to 20′ apart, on the *same level* with the Salineville No. 6.

As the Nisely Great Seam is about 200′ above the "Strip Vein" of Hammondsville, at Clark's tank it should be about 425′ A. Two miles farther on, in a southeast direction down the valley of Yellow Creek, it is 330′ or 107′ *higher* than at Bridge 42.

To account for this requires a rapid reverse dip to the northwest, between Salineville and Irondale, of which the levels show no evidence beyond the common local undulations. From Hammond's Station to the Ohio the elevations are numerous in both No. 6 and No. 4 seams; both of them descending in that direction, but not strictly conformable.

No. 16. Coal Seam No. 6. Local.

Hammond's Station. Mean of three planes, dip south 50° east, 57 feet per mile. Seam No. 4, or "Strip Vein," mean of three planes, south 8° east, 63 feet per mile; not conformable.

In this seam is a sag of 30 feet in one-fourth of a mile, the axis of which is nearly northwest and southeast; evidently local, like that at Salineville. A heavy bed of limestone, capping the hills, lies in conformity to the Nisely seam (No. 6), its elevation ranging along the valley to the southeast as follows: 696′, 658′, 648′ and 550′.

It is but a short distance down the Ohio from Yellow Creek to the Pittsburg seam, as it appears in the hills around Steubenville. I add a few more calculations for dip, made in this seam, which is the most regular of any in Ohio. It crops out through Jefferson and Harrison Counties to the north and west. If from the base of the series as high as No. 6, the beds have been disturbed since their deposition, this seam (No. 8 of the Reports) must have partaken of the same movements.

No. 17. Coal Seam No. 8.

This is the first seam above the barren ground. At New Cumberland, West Virginia, eight miles above Steubenville, the first seam below the barren measures, is, according to Mr. Briggs of the Virginia Survey (1840), 262 feet A. At Rush Creek, thirteen miles below Steubenville, in a shaft, it is 133 feet below lake level, showing a descent of 395 feet in 21 miles, or between 18 and 19 feet per mile. Here the barren measures are 543 feet thick. Using Rainey's mine, between Rush Creek and Martinsburg, as one point, Ball & Co.'s mine, on MacMahon's Creek, west of Bellaire, as another, and the mouth of Weegee Creek, on the Ohio, as a third, the dip of the Pittsburg seam is south 37° east, 23′ per mile. Using Bellaire, Ball & Co.'s mine, and mouth of Pipe Creek, it is south 45° east, 53′ per mile.

From thence it passes under the highlands to the northwest, coming out in the valley of Wills Creek, west of Barnesville, very much changed in all respects, and difficult of identification. Professor Andrews finds there no conspicuous barren ground. The limestone beds, from fifty to seventy feet thick, overlying the Pittsburg seam as far down the Ohio as Wheeling, have become thin and unimportant. His profile thence to Zanesville, shows several more seams of coal than does the Report on the Northeastern district. But near Hopedale, in Harrison Co., on the highlands between Connoten and the waters of the Ohio, Prof. Read has found the overlying limestone in its usual force. In passing from one county to another southwesterly, it loses its excessive thickness, and is identified with great difficulty.

The value of the elevations I have given in the nature of profiles, along six converging lines, from the outcrop to the centre of the field, would appear to much better advantage on a map. A plan is still more necessary to exhibit clearly the results of the triangulations I have already given. In the absence of maps and profiles I recapitulate in a tabular form the inclination of the strata, both as to the direction and the rate per mile, over the first geological district. Running the eye down the column of dip, it will be seen at a glance that there is no instance of a plunge of the beds to the west yet discovered, in a region where at least four general undulations are reported, the axes of which are supposed to be north and south.

RESUMÉ OF THE TRIANGULATIONS.

NO. OF TRIANGLE.	COUNTIES.	TOTAL LENGTH OF SIDES, MILES.	DIRECTION OF PLUNGE OF STRATA.	RATE OF DIP PER MILE IN FEET.
1	Coshocton and Holmes.	81	S. 55° E.	2
2	"	69	S. 26° E.	22
3	Tuscawaras.	24	N. 80° E.	14½
4	"	37	S. 32° E.	15½
5	"	Local.	S. 72° E.	25
6	Stark.	"	S. 43° E.	86
7	"	"	S. 71° E.	15½
8	Summit.	"	S. 23½° E.	9
9	Summit, Stark and Mahoning.	112	S. 53° E.	8½
10	Summit, Mahon'g and Trumbull.	99	S. 12° E.	20½
11	Mahoning.	27	S. 22° E.	14
12	"	25	S. 37° E.	13
13	"	Local.	S. 18° E.	16½
14	Columbiana.	"	S. 10° E.	30
15	"	"	S. 20° E.	16
16	"	"	S. 50° E.	57
16*a*	"	"	N. 70° to 80° E.	80 to 100
17	Jefferson.	"	S. 37° E.	23
17*a*	Belmont.	"	S. 45° E.	53

The second main anticlinal of the Report is located under Carroll County. Near its west line, at Canonsburg, No. 6 is about 450′ A., but not very well determined. Five miles nearly west, at New Cumberland, its elevation is given in the Report at 447′. On the east line of the county, at Dianon, two miles west of Salineville, No. 6 of the Report is 407′ (W.), being distant from Canonsburg nineteen miles; course north 60° east. This line passses through Carrollton, the elevation of which has not transpired. Near New Market, thirteen miles south of Carrollton, where it dips beneath the surface, it is about 400′ A., and at Rochester, fifteen miles nearly north, 560′.

Joining these points, if this seam exists at Carrollton, and is regular, it should be at an elevation not far from 460′. Judging from the indications on the west, north, east and south sides of the county, if No. 6 extends through to Yellow Creek, it is *nearly level*, inclining slightly to the east of south, in consonance with the results in adjacent counties. If it rises between the valley of Connoten and that of Yellow Creek, either in the form of a ridge or a crown, the proofs are yet to be made public.

On the west it is nearly level, inclining slightly to the south. At Salineville, on the east, the Big Seam rises to the west at the rapid rate of 80′ to the mile, in places 100′, which would soon carry it above the highest hills. In the present state of information, the Salineville bed No. 6 cannot be connected with either the No. 6 of Sandy valley or of Tuscarawas valley. A thorough exploration would probably disclose a disappearance by thinning out, and the appearance of the Salineville group at a higher geological level.

I have already shown that the Salineville No. 6 does not connect with that of Irondale. New Lisbon, in the valley of Little Beaver, is fifteen miles north of Irondale, where No. 6 is 515′ A. (N.). If this is the same bed as at Hanover, 560′ A., it is nearly on the line of bearing, and its elevation at New Lisbon is what it should be.

If I am right, such a misconception of the geological structure of an important coal field is fundamental, and neither the number or extent of the seams are to be relied upon. The coal beds are as regular and persistent as any of the strata, but cannot be assumed to be more so.

The teachings of the accompanying table are very significant, showing that in ten (10) sections extending from the western part of Pennsylvania around to the valley of the Muskingum, where my first radial is situated, there are, as to the beds of coal and limestone, none that are continuous. If there were space to compare the strata of shale, sandstone and iron ore of the same section, this difference would be equally evident. In this universal want of identity among the beds we are required to consider No. 6 as an exception.

At the mouth of Yellow Creek there are visible in the same profile *seven* beds of coal above low water mark. The lowest one, not numbered in the Report, is thin, and is probably local. Next above it is the " Creek vein," entitled No. 3 in the general profiles. The "Groff seam," No. 6 of the local profile, or No. 7 of the general section, has above it another seam, which should be No. 8, and is two seams

ENUMERATION OF COAL SEAMS AND BEDS OF LIMESTONE IN VARIOUS PARTS OF THE COAL FIELD OF NORTHERN OHIO, REFERRED TO SEAM No. 6.

LOCALITY.	NUMBER OF COAL SEAMS.			NUMBER OF LIMESTONE BEDS.			Vertical Space, No. 1 to No. 6, Coal Seams.	Thickness of Lower Barren Measures.	REMARKS.
	Be ow No. 6.	Above No. 6 to Barren Measures.	Total.	Below No. 6.	Above No. 6 to Barren Measures.	Total.			
Mercer and Beaver Counties, Western Penn.	12	1	14	3	1	4	600	370	Rogers' Final Report.
Columbiana and Mahoning Co's., on the Pa. line.	7	2	10	4	2	6	520		Ohio Reports.
Line of C. & P. R. R. Ravenna to New Chambersburg, O.	4			3			720 (W.)		
Massillon, Stark Co., to Zoar, Tuscawaras Co.	6	2	9	2			374 (N.) 310 (W.)		
Yellow Creek, Jefferson County.	5 (N.)	2 (N.) 5 (W.)	8 (N.)	2	5	7	310 No. 2 to No. 6 (N.)	500	
Valley of Kilbuck, Holmes County.	7	2	10	2	2	4	323 (N.)		Beds not the same on different sides of the valley.
Valley of Black Cr'k, Holmes County.	4			2	2	4	250		
Fredericksburg, Wayne County.	2			1			373		
Simmon's Creek, Coshocton County.	4			2			200		
Muskingum County.	4	9	14	2	2		211	140	Prof. E. B. Andrews.

above the so-called "Mahoning Sandstone." If I am correct in the profile at Bridge 42, there are four more beds in the lower series below Salineville No. 6, making eleven in all, with a strong probability that another should be added at Steubenville. If the Creek vein is properly No. 3, No. 1 of the same profile, or the block coal, if it exists so near the centre of the basin, should be found within one hundred and sixty to two hundred feet below the channel of the Ohio.

It has been assumed that the "Mahoning sandstone" of the Pennsylvania Reports is a reliable guide rock in Ohio. Its position, according to Prof. H. D. Rogers (Final Report, pp. 477 and 493), is at the base of the "lower barren measures." On the Ohio side of the State line it has always *one* seam of coal (No. 7) above it, and at the mouth of Yellow Creek, on the Ohio River, it has *two*. The furnace coal of Steubenville has not been shown to be identical with the upper seam at Yellow Creek, and if not there are *three* seams in the "barren measures"; seams that are not thin and valueless, but of workable coal. From the furnace seam at Steubenville as far as Wheeling, the real barren measures, where the true Mahoning should be, are something over 500′ in thickness.

Comparing the numerous profiles in Ohio with each other, the sandstone between Nos. 6 and 7 is no more heavy or irregular than three other beds of this rock which are found beneath it, on or near beds Nos. 3, 4 and 5. The profiles show it to be every where a changeable rock, replaced by shale frequently within distances of a mile. This changeable feature of all the beds of the series, is particularly dwelt upon by Prof. Rogers when treating of the country between the Alleghany River and the Ohio line.

The Mahoning sandstone of the Pennsylvania and Virginia Reports belongs to the lower part of the lower barren group. That of Ohio is placed between seams No. 6 and 7, and is often wanting. In some places there is a bed of coal above No. 7, before the barren ground is reached, making every where one, and often two seams of coal in the barren measures, if this classification is correct.

Between the passage of the Pittsburg seam beneath the hills northwest of the Ohio, and its reappearance in the valley of Wills Creek, between Barnesville and Cambridge, the thickness of the barren measures has contracted from 500 to 140 feet, the seams of coal not being much farther apart from the bottom of the series to the top, than they are in the productive measures. The limestone group overlying the Pittsburg seam, forty to sixty feet thick, has also disappeared, or so nearly disappeared that it does not exceed in thickness many of the lesser beds. In a region subject to such numerous and rapid changes, questions of structure cannot be settled by superficial examination. In the southeastern district, where the explorations have been made with a patient attention to details, and where the profiles are very numerous, this diversity of structure is made perfectly manifest.

The profiles on page 242 show from seven to eleven seams of coal between the Putnam Hill limestone and the Pomeroy coal, which is regarded as the equivalent of the Pittsburg. Adding three for lower beds, there are ten to fourteen in all. Of the many sections made in all parts of the Ohio coal field, it is doubtful if two can be found which are more than five miles apart, that will match each other in all respects. If there is any rule of structure in the Ohio series, it is a rule of want of persistence, such as Prof. H. D. Rogers recognized in western Pennsylvania. Can these results be accounted for by assuming the existence of regular waves, folds and undulations, due to mechanical disturbances after the deposition of the coal?

On a Newly-discovered Lead Vein in Newburyport, Mass.

By Prof. Robert H. Richards.

In the early part of the month of August, 1874, I was shown a specimen of galena, which purported to come from near Newburyport. The specimen was much weathered on its surface, but nevertheless I was able to recognize galena, gray copper (tetrahedrite), and pyrite. The galena was rather fine in texture and columnar in structure; altogether the ore reminded me very much of the rich silver ores of Georgetown, Colorado, which are often composed of identically the same minerals.

A day or two after, (August 8,) I accompanied Dr. E. J. Kelly to the locality whence the specimen was taken, which is about two miles southwest of Newburyport, in the town of Newbury. In a barn near by there was a pile of the ore containing about four tons. This ore was composed of the same minerals as the previously mentioned specimen. The rich piece of tetrahedrite, whose analysis is given further on, was selected from this pile. The owner of the land informed us that the pit had been dug during the spring to the depth of six feet, and that further sinking was rendered impossible by water.

It was now necessary to prove a vein in position in the rock and to remove all question of "salting." The earth which had been thrown back into the pit was removed, and then after digging a short time in the harder undisturbed debris of the drift deposit two pieces of galena were found, placed end to end, both of them dipping about 45° N. W., with a strike of about N. 80° E. They weighed respectively about 50 lbs. and 200 lbs. They were composed of the minerals previously described; on the north side of each specimen was a thickness of about seven inches of galena and on the south side about three inches in thickness of mixed gray copper, galena, and pyrite. We learned from the farmer who owned the land that he had found all the ore which we had seen in the barn in much the same condition of direction and arrangement.

Three specimens were assayed, with the following results: — No. 1 was a coarse grained galena, very rich in lead and yielded $63.13 of silver per ton of 2240 lbs. No. 2 was a specimen of fine grained galena which was broken from the above-mentioned 200 lbs. mass, and seemed to represent the standard ore of the mine. This gave 50 per cent. of lead and $84.26 in silver per ton. No. 3 was a pure piece of gray copper (taken from the barn) containing a little quartz and galena, and yielded $1,422 of silver per ton, also $145.12 of gold per ton, and 27 per cent. of copper. The gold was very roughly determined.

Subsequently the pit was sunk to the depth of about sixteen feet, but the ore and all of its accompanying signs had long since disappeared. But upon consideration it seemed, since the drift of the glacial epoch moved from the N. W., and the indications pointed to a northeasterly strike for the vein, that if a trench were cut down to the solid rock, in a northwesterly direction, that it must cut across the vein and expose it. Prof. J. M. Ordway of the Massachusetts Institute of Technology entirely corroborated this view of the matter. Accordingly a trench was recommended to be made ten to thirty feet, or even fifty feet, long in a northwesterly direction. Recent developments have proved that if the trench had been made as recommended, it would have struck the vein at about thirty feet from the first pit, thus proving that the specimens at first found were brought there by the action of the drift.

The above directions were not followed, but instead, pits were dug in various places, and the amount of float ore taken up in these explorations would seem to be sufficient, in lack of any other evidence, to prove the vicinity of a thick and perhaps very extensive lead deposit. In one of these pits, on October 10th or thereabouts, the vein was found, the lead being only about one inch in thickness. At this time a party consisting of Prof. Ordway, Mr. J. W. Revere, and myself made a trip to the mine, where we found the exposed vein to consist of a streak of lead one inch in thickness, lying against the south wall of the crevice, which was elsewhere filled with gangue to a thickness of seven feet, but no effort had been made to reach the north wall. This error was pointed out and within a few days we heard that a streak of lead ten inches thick had been found against the north wall of the vein.

The gangue which fills up the intermediate portion of the crevice is of a green color and is probably quartz and serpentine, or, as Mr. Burbank has suggested, quartz, feldspar and epidote. Its composition has not yet been ascertained. The rock which lies on either side of the vein differs from the country gneiss; it is crystalline and free from mica, being perhaps a trap rock; it is however much decomposed and rusty on the surface and contains occasionally specks and cavities filled with galena. On the north side there is probably not over five feet of this rock, if there is any of it between the vein and the gneiss, but on the south side the decomposed galena bearing-rock extends to a thickness of eighty or one hundred feet, before the gneiss is reached.

About the 1st of November another pit was sunk in the direction of the vein to the west of the pit just mentioned, and the galena was there found three and a half feet in thickness. The opening of the vein on this enlarged spot shows the thickness the vein may be expected to occasionally assume. The mass as now visible is about one foot thick at the eastern side of the pit; it widens immediately to three feet and a half in thickness and then, at the western end, narrows again to about two and a half feet. I think it highly probable that it widens as it goes downward, but I have no means of knowing. The southern face however dips to the south while the vein seems to dip steeply to the north. Word has just been received that another opening from one hundred to one hundred and fifty feet to the west has exposed the vein again, where the thickness is said to be one foot. A specimen of galena has also just been received at the Institute of Technology purporting to come from an opening, situated upon the Merrimac river, about two miles distant from this vein. With a view of ascertaining the value of the mass which is now lying in the ground three and a half feet in thickness, Mr. Kelly caused a hole to be drilled through it horizontally, and the dust, which was all saved, was assayed for silver, gold, and lead. This therefore, is the fairest valuation of the ore that has as yet been made. The results were :

Lead, 52 per ct. at 6 cts. per lb.	$69.84 per ton of 2,240 lbs.
Silver, .1736 per ct. at $1.29 per oz.	72.87
Gold, .0017 per ct. at $20.60 per oz.	11.43
	$154.14

This gives the gross value of the ore per ton of 2,240 lbs. Probably eight or ten per cent will be lost in the working. Another valuation of the ore was made upon a larger scale. A lump one foot thick, weighing about 500 lbs., was broken into three pieces, one of which, weighing one hundred and forty-five lbs., was treated. This, when crushed and sorted, yielded ninety-two lbs. of smelting ore, *i.e.*, a tolerably pure galena, which yielded 30 lbs. crude ingot lead, or 746 lbs. to the ton of 2,240 lbs.

This 30 lbs. yielded as follows:—

23 lbs. refined lead.
436.32 grains silver.
4.19 " gold.

From this it appears that a ton of picked ore contains, in condition to be actually extracted and put in the market, as follows: —

560 lbs. lead at 6 cts. per lb.	$33.60
22 oz. silver at $1.30 per oz.	28.60
101.8 grains gold at $20.60 per oz.	4.37
	$66.57

A ton of the crude ingot lead, as produced by smelting, contains

1710 lbs. lead at 6 cts. per lb.	$102.60
74 oz. silver at $1.30 per oz.	96.20
341. grains gold at $20.60 per oz.	14.63
	$212.43

The deposit seems to be a true fissure vein, and will therefore probably last in depth, undergoing the usual pinching out and thickening up again, after the manner of veins. No certain prophecy, however, can be made in a district the veins of which have not been tested. I have acted in consultation with Prof. Ordway in all matters connected with this subject, while the assays and tests were made by Mr. William Foster and by myself. Since writing the above, the sinking of the shaft has opened out the galena streak to a width of six feet.

NOTE. A day or two before this paper went to the printer I made a visit to the mine. The east shaft had been sunk twenty-two feet. The lead streak, which lies upon the north wall of the vein, had widened to about six feet in this shaft, and shows a little copper pyrites and tetrahedrite, and also a considerable proportion of siderite (carbonate of iron). The copper pyrites may prove to be argentiferous and auriferous as in Colorado; this however has not yet been investigated. The west shaft, which lies some one hundred and fifty or two hundred feet from the east shaft, had been sunk about twelve feet. The lead streak in this shaft is about seven inches thick and well defined. The two walls of the vein have not yet been found in the west shaft, and the south wall is still wanting in the east shaft. An estimated quantity of one hundred tons of ore of good smelting quality is now lying in the shaft house.

A quantity of float ore, weighing a little over four tons, was sent to Messrs. Edward Balbach & Sons of Newark, N. J., who returned the products from the ore and valued the sample at thirty-eight per cent. lead, $56.76 of silver, and $4.85 of gold per ton of two thousand lbs. This float ore sample may, I think, prove to be a little poorer in lead than the average of the mine.

Prof. A. Hyatt gave an account of his recent investigations of the Hollow-fibred Horny Sponges. This communication, of which but a brief abstract is here given, will appear in full in the Memoirs (Vol. II, pt. IV), illustrated with a plate. In this paper the following groups and species of Keratose sponges are characterized.

Suborder APLYSINÆ Hyatt.

Genus DENDROSPONGIA Hyatt.

Aplysina (pars) Schmidt.

This is a new form from Florida, characterized by the large size of the fibres and their open irregular net work. It includes but one species, *D. crassa*. The types are in the Museum of Comparative Zoology, and in the Society's Museum.

Genus VERONGIA Bowerbank.

Luffaria Duch. et Mich.

The type is *Verongia fistularis* Bow.

Genus Aplysina Nardo.

Evenor ? Duch. et Mich. *Aplysina* (pars) Schm.

A number of new species from Florida are described in this genus, which is distinguished by the regularity of the net-work of the flattened fibres, and their tendency to unite and form hexagonal cells, remotely resembling those of some corals (Porites).

Aplysina aurea Hyatt.

Gamboge yellow when living, form fistulose. Skeleton remarkably delicate, more irregular than is usual.

Aplysina prætexta Hyatt.

This has a peculiar flattened form, with notable differences between the under and upper sides, and very long cells in the skeleton.

Aplysina gigantea Hyatt.

This has the form of an open cone, or goblet-shape, without a pedicle, and the cells much more regular in size, and angular in shape, and may be selected as the type of the genus.

Aplysina cellulosa Hyatt.

Spongia cellulosa Esper.

This well known form will serve for a comparison since it possesses in a remarkable degree the generic characteristics.

Aplysina ærophoba Nardo.

Identified with Schmidt's type.

Dr. T. M. Brewer called attention to four skins of herons obtained by purchase.

These represented two forms which embody one of the puzzling questions of our ornithology. The birds in the blue and brown plumage had been originally described as *A. rufescens* or *A. rufa*, and the white birds as a distinct species, *A. Pealii*. Mr. Audubon was led, by his investigations in Florida, to the conclusion that the white birds are only the young or immature form of the *A. rufa*. To demonstrate this he caused some of the young birds to be kept in confinement. One of these lived to be three years old, but died still in the white plumage. Dr. Gambel of Philadelphia, a young and promising ornithologist, whose early death was one of the greatest of losses to science, followed with other investigations. He found the brown and blue birds having young in like plumage, and the white birds having white young and naturally concluded that the two forms are distinct species, and in the IXth volume of the P. R. R. Report the *A. Pealii* is restored to the rank of a good species.

But now the Smithsonian Institution is in receipt of some interesting investigations made by Mr. N. B. Moore, which point to a different solution, which is, that the two forms belong to one and the same species, and that these differences are indicative of neither age nor sex. Like our common *Strix asio*, which whether in the red or the brown plumage, is ever the same species without reference to age or sex, so the *A. rufa* and *A. Pealii* are one and the same bird, breeding together in either plumage and having young birds in various plumage, irrespective of that of their parents. Mr. Moore's observations have enabled him to supply another indirect evidence of the correctness of this supposition. He has found that where herons are feeding together in the same water, individuals of different species do not molest or interfere with the movements of one another. But, as sure as a bird of its own family approaches too near it is at once attacked and driven to a more respectful distance. Tried by this test, the white and the blue birds are of the same species, as they invariably quarrel in this manner if too nearly approached.

Section of Entomology. November 25, 1874.

Mr. J. H. Emerton in the chair. Twelve persons present.

The following paper was presented: —

Remarks on the Old Genus Callidryas.
By Samuel H. Scudder.

At the conclusion of his admirable monograph of the Callidryades,[1] Mr. A. G. Butler attempts to divide the species into groups, and with a great degree of success. He places, however, all the old world forms in a single genus, retaining for it the name Catopsilia (with *P. crocale* Cramer as type), and placing Murtia of Hübner as a synonyme. It will be a matter of surprise, however, if a further

[1] Lep. exot, parts iii–xviii.

examination does not prove that this old world group will need still further subdivision, and that *P. Pyranthe* Linn. can stand as the type of Murtia, with its comparatively shorter antennæ and differently formed wings, and slightly differing neuration.

Three species are given by Butler as found within the limits of the United States: —

1. **Phœbis Agarithe,** which he quotes from Texas. The other localities given by him are Brazil, Santa Martha, Caraccas, Yucatan, Nicaragua, Panama, Venezuela and Hayti. Dr. Palmer has recently brought home a fine pair of this species from Key West, the ♀ closely resembling Butler's figure; but the ♂ much larger, as large as Butler's figure of *P. rorata* ♂, from which, however, it differs conspicuously in the extent of the sexual mealy border of the fore wings. There are two males from Texas in the Museum of Comparative Zoology, one of the large and one of the small size, which do not otherwise differ. This is probably the insect catalogued by Mr. Edwards in his Synopsis as *Callidryas Argante.*

2. **Callidryas Eubule,** which he gives from St. John's Bluff and from "N. America," only. This is doubtless the *Callidryas Eubule* of Edwards' Synopsis. I can scarcely understand the figure of the male given by Butler. The mealy border of the fore wings is represented as a comparatively narrow band of nearly equal width, terminating below at the submedian nervure, and forming a couple of short oval patches next the margin of the costal border I have never seen such an insect, and although the extent of this belt unquestionably varies considerably in *C. Eubule,* I can hardly help supposing that Mr. Butler has overlooked its true limits in the specimen he figures, or else that it was partially obliterated. Specimens collected by Dr. Palmer at Jacksonville, St. John's River, Florida (very near St. John's Bluff, at the mouth of the river), agree in general with those from the northernmost point at which the species has been taken abundantly (Long Island, N. Y.), in having a slender extension of this band along the inner border nearly to its middle, narrowing as it passes toward the base; in all the subcostal interspaces the patches (always separated from each other by the nervures) often extend almost to their very base, leaving but a narrow, free space between the patches and the nervures; this is especially the case in those interspaces which open upon the costal margin; in the lowest subcostal interspace (that lying between the two inferior subcostal nervules, or what the English entomologists call the discoidal ner-

vules), the patch almost invariably extends half-way to the cell, sometimes close up to it.

The under side of this species, both in specimens from the south and from the north, and especially in males, is often almost wholly devoid of markings, excepting the spots at the tip of the cell in both wings; and generally the species bears so close a resemblance to *C. Drya* that it seems probable that these two are identical. If they are distinct, as given by Butler, the specimen from Guatemala, upon which I based my remark on the distribution of Eubule in my Systematic Revision, may belong to Drya.

3. **Callidryas sennæ,** which he also gives from Texas. Other localities given by Butler are Rio Janeiro, Para, Bahia, Columbia, Santa Martha, Venezuela, Trinidad, Honduras, west coast of Mexico, Jamaica, Hayti, Polochic Valley and San Lorenzo. This is doubtless the *C. Marcellina* of Edwards' list, although the reference to Boisduval and LeConte's plate should have been given to the previous species. Females of this species (which occurs also in Cuba, having been given as the female of *C. Orbis* by Poey) were taken by Dr. Palmer on the Florida Keys in some numbers; but I doubt if it occurs in Northern Florida, unless it be along the western coast of the peninsula.

In addition to these, Edwards gives in his Synopsis, *Metura Cipris* (*Callidryas Cypris*), a species we have not seen, from New Mexico. Butler's only localities are Brazil and Peru. I have also in my collection from Texas a single female of *Callidryas Philea*, the pale form, so common in this and allied genera, without any trace of the deep red color, so striking on Butler's plate. The localities given by Butler are Rio Janeiro, Bahia, Amazons, Bogota, Polochic Valley, Santa Martha, Mexico and Honduras. We have therefore five species in the United States.

I take this opportunity of adding a species to those described by Butler.

Aphrissa Butleri nov. sp.

Upper surface uniform pale buff, the outer half of the costal margin of the fore wings and the outer margin, as far as the lower median nervure, very narrowly bordered with blackish brown, broadest, but still very narrow, at the apex. The sexual mealy border of the wings is of a silvery hoary appearance. On the fore wings it occupies nearly half the upper surface, its interior border passing from the middle of the uppermost subcostal nervule to the middle of the inner border, by a gentle, rather regular curve, which follows the outer border of the cell; besides, there is a small roundish patch at the extremity of the cell itself, separated from the part outside by the nervures. On the hind wings it is of less extent, its interior border passing in a broad sinuous curve from the tip of the costal nervure to the middle of the lower median interspace, where it terminates abruptly; the band is broadest beyond the cell, reaching two-thirds the distance from the outer border to its outer extremity; the fringe is concolorous, but its basal half is black below the middle subcostal nervure. Beneath, both wings are uniform, immaculate, very pale silvery buff. Expanse of wings 70 mm.

I have not seen the female. Tehuantepec.

This butterfly is undoubtedly most nearly allied to *A. Neleis* (Boisd.) Butl., but differs from it in the coloration of both surfaces, the black edging of the fore wings and the secondary mealy patch of scales in the cell of the same wings.

December 2, 1874.

Prof. N. S. Shaler in the chair. One hundred and fourteen persons present.

The following paper was read:—

List of a Collection of Texan Noctuidæ, with Descriptions of the New Species. By H. K. Morrison.

The collection on which this paper is founded was made in the vicinity of Waco, Texas, by Mr. Belfrage, and is now in the possession of the Peabody Academy of Science, at Salem.

The opportunity of determining it we owe to Dr. A. S. Packard, Jr., and we only hope we shall succeed in working it up as well as he has the *Geometridæ* from the same locality.

We have thought best to publish a list of all the species, as some of them have not been before recorded from Texas; the generic position of others has been changed, and finally, they are all provided with the date of capture, which is usually lacking in similar collections. There are comparatively few new species, as material from the same collector has already been examined by Mr. Grote, but those that do occur are interesting additions to our fauna. The following is a list of the species.

Leptina dormitans Guen. Sept. 5.

Charadra dispulsa Morr. (1)[1] Aug. 28.

Bryophila percara Morr. (2) Three specimens, May 2 and Sept. 4 and 20.

Agrotis subgothica Haw. Var. *tricosa* Lintn. This Texan specimen of *tricosa* approaches more closely to the true *subgothica* than northern specimens of that variety.

Agrotis Morrisoniana Riley. (3) Oct. 24.

Agrotis malefida Guen. Two specimens, June 26. This species has hitherto been unidentified; it agrees perfectly with M. Guenée's concise description, and as he remarks, forms the connecting link between the species allied to *puta*, and *annexa*.

Agrotis annexa Treits. Five specimens, Sept. 1 to 15, and Jan. 12. Common in Texas, as in all the Southern States.

Agrotis suffusa Linn. Two specimens, Sept. 20.

Agrotis saucia Hübn. Three specimens, March 13, May 26, and June 22. *Agrotis Ortonii* Pack., from the Upper Amazon, is identical with this species, which is distributed over both North and South America, as well as Europe.

Agrotis simplaria Morr. Two specimens, Oct. 13. This species will be fully illustrated in our paper on the genus *Agrotis*. The name was printed *simplicius* in the original description; this error was overlooked, and is now corrected.

Agrotis clandestina Harr. May 9. The ground color is much lighter than in northern specimens.

Mamestra confusa Hübn. March 5.

Mamestra innexa Grote. (4) Three specimens, Sept. 11 and 21.

Mamestra laudabilis Guen. Two specimens, Oct. 13 and Sept. 29.

Mamestra teligera Morr. (5) Two specimens, Oct. 13 and 24.

Hadena miselioides Guen. Three specimens, April 30, June 25, and Oct. 5. One was of the variety in which the reniform spot is white and contrasting; this form is also found in the Northern States.

[1] The numbers in parentheses refer to the new species, described in the concluding portion of the paper.

Hadena flava Grote. Aug. 24. This species has been recorded from British Columbia and Colorado. Its specific characters are very strong, but the specimen obtained from Belfrage, although agreeing in most of them with the type, differs in the obsolescence of the abdominal tufts, and in several details of coloration. The fact that the species has occurred in a locality between Columbia and Texas, leads us to believe that this form is simply a variety of it.

Hadena relicina Morr. (6) Oct. 13.

Hadena rasilis Morr. Two specimens, Aug. 24 and Oct. 5.

Prodenia commelinæ Sm. Abb. Four specimens, Aug. 25 and Sept. 20.

Laphygma frugiperda Sm. Abb.

Var. *fulvosa* Riley. Aug. 25.

Var. *obscura* Riley. Five specimens, June 15 and 17, and Aug. 25, This variety differs extremely from the typical form, and would be taken to be distinct had not Prof. Riley succeeded in breeding it from the same larvæ.

Segetia xanthoides Guen. Six specimens, May 3 to 24.

Segetia orbica Morr. (7) Two specimens, July 28 and Sept. 24.

Heliophila unipuncta Haw. Sept. 20.

Heliophila phragmitidicola Guen. Six specimens, March 21, April 26 and 27, July 17, and Sept. 20. In addition to these specimens there occurred four others, which we refer to this species with hesitation. They expand only 29 mm.; the collar lacks the black transverse line of the typical form; the ground color is clear and whitish, not becoming suffused with reddish or dark ochreous before the terminal space. We propose the name *texana* for this variety. It was taken Sept. 20 and Oct. 13.

Heliophila rubripennis Grote. Three specimens, Aug. 24 and Sept. 2.

Heliophila Harveyi Grote. Three specimens, April 20 and May 1.

Platysenta atriciliata Grote. Four specimens, Aug. 26 and Sept. 20.

Caradrina disticha Morr. (8) Sept. 25.

Cucullia asteroides Guen. April 12.

Tornos robiginosus Morr. (9) Four specimens, June 6, July 15 and Aug. 8.

Heliothis phlogophagus G. & R. May 12.

Heliothis tertia Grote (*Tamila*). Four specimens, Sept. 14 and 29. We had this species in manuscript, but fortunately received Mr. Grote's description in time to prevent the publication of a synonyme.

Lygranthœcia saturata Grote. Sept. 10.

Tricopis chrysellus Grote. Three specimens, Sept. 14 to 24.

Tarache aprica Hübn. Three specimens, July 12 and Sept. 9 and 11. All these specimens were very variable; in one which approached the var. *biplaga* Guen., the anterior wings were black, with the exception of a basal and two costal white spots; in another the ground color was white, the black portion being restricted to the terminal and subterminal spaces.

Tarache delecta Walk. (*Acontia metallica* Grote). Four specimens, May 5 and 7. Also very variable, but all its forms can be separated from *aprica* by the metathoracic metallic tuft and the black and white banded abdomen.

Tarache cretata G. & R. Three specimens, Aug. 1 and 16, and Sept. 5.

Tarache tenuicula Morr. (10) Three specimens, Oct. 3, and 5.

Tarache candefacta Hübn. Eleven specimens, April 20 to May 11, June 1, July 12, and Sept. 11. They do not differ from our specimens of the same species.

Telesilla cinereola Guen. Three specimens, Sept. 9, 11, and 20.

Chamyris cerintha Treits. Aug. 16. The single specimen of the species was very small, expanding only 25 mm., but the markings were very distinct and well defined.

Thalpochares concinnimacula Guen.

Plusia ou Guen. (11) Five specimens, May 9 to 13, and June 10.

Plusiodonta compressipalpis Guen. Three specimens, June 22, July 12 and Sept. 20.

Agnomonia anilis Drury. Two specimens, Sept. 6.

Panopoda carneicosta Guen. Two specimens, July 12 and Aug. 24.

Remigia latipes Guen., var. *texana*. (12) Four specimens in September.

Drasteria erechtea Cram. Eighteen specimens. Occurred abundantly in March, April, May, September and October.

Bolina jucunda Hübn. Six specimens, in Aug. and Sept.

Bolina fasciolaris Hübn. (13) Five specimens, in May and October.

Bolina pallescens G. & R. Aug. 19.

Syneda deducta Morr. (14) July 17.

Syneda pavitensis Morr. (15) Two specimens, Sept. 7 and 17.

Pseudanthracia coracias Guen.

1. **Charadra dispulsa** nov. sp.

Expanse 37 mm. Length of body 15 mm.

This species is closely related to the two northern species of the genus, *deridens* Guen. and *propinquilinea* Grote, and it can be most readily identified by a comparative description. From the former species it is separated by the absence of a black streak connecting the median lines, the large concolorous ordinary spots which are not black centred, and the outwardly oblique course of the exterior line after leaving the submedian fold; from the latter it differs in the large concolorous orbicular and reniform spots, with their faint, partially interrupted annuli, and the slightly undulating, regularly arcuate interior line not marked by any prominent outward teeth; from both species it can be distinguished by the palpi, which exceed the head considerably in length, and have the terminal joint comparatively well developed. In *dispulsa* there is a darkening of the median space between the spots caused by the thickening of the median shade; the fringe shows a central dark line, and is not chequered with black and white; the abdomen is untufted. We think this species will be easily determined by these characters, together with its locality.

Hab. Waco, Texas.

2. **Bryophila percara** nov. sp.

Expanse 22 mm. Length of body 9 mm.

Eyes naked; tibiæ unarmed and closely scaled; abdomen smooth and untufted. The clothing of the head and thorax close and scaly. The palpi dark, the third joint light and contrasting. The anterior wings triangular, with the apices rounded, and a shallow indentation below them on the external margin; markings black and well defined; general coloration ochreous, almost entirely obscuring the white ground color, which only appears in the neighborhood of the spots and lines; a black point on the costa is the only trace of the half-line; a black shade at the base of the wing, from which proceeds a thick, clavate, longitudinal dash; the course of the interior line is oblique, faintly indicated by a series of spots, the largest on the costa and inner margin; the median shade twice outwardly dentate, very distinct above, obsolete below; the portion of the wing from this shade to the exterior line above the median nervure is black, with the exception of a large, irregular, costal spot of the prevailing color; the exterior line is black, continued and dentate, depressed opposite the cell, then produced, and afterward extends obliquely to the inner margin; just below the costa, and above the inner margin it is thickened, forming blackish spots; beyond this line there is a large, triangular, blackish spot resting on the margin; the subterminal line whitish, indistinct; an interrupted black line at the base of the short fringe. Posterior wings light gray, with a suffuse discal dot and a distinct median black line; fringe concolorous. Beneath whitish; on the anterior wings the markings of the upper surface are partially reproduced; on the posterior the median line is black and very distinct, and there is a blackish suffused spot on the costa.

Hab. Waco, Texas.

Allied to the European *perla* and *muralis*, but our species is a smaller, more compact form, approaching in size and markings the larger species of *Tarache*.

3. **Agrotis Morrisoniana** Riley.

This species will be described at length by Prof. Riley, who has bred it for several years, and is acquainted with its larval and pupal stages. In the Texan specimen the antennæ are strongly pectinate; the orbicular spot is small and distinct; the reniform spot is of the normal size; all the nervures and their branches are accompanied by contrasting light shades; the terminal line is preceded by a series of black cuneiform markings; posterior wings whitish, with a distinct discal dot and faint terminal band.

4. **Mamestra innexa** (Grote). *Perigrapha innexa* Grote. Bull. Buff. Soc. Nat. Sc., Vol. II, p. 123.

We are unable to understand why Mr. Grote places this species in *Perigrapha*, when it does not possess any of the generic characters (except the hairy eyes) laid down by Lederer; the antennæ are not pectinate, the collar is neither cut out, nor preceded by a longitudinal prothoracic crest, and there are no angular projections on the sides of the thorax.

M. innexa is closely related to *Dianthœcia meditata*, also described by Mr. Grote. These species agree in size, in the disposition of the markings, the villosity of the palpi and front, the rounded collar, the almost total absence of the usual prothoracic tuft, the presence of a thick spreading metathoracic tuft, the sharp apices of the pterygodes (a very unusual character in the higher Noctuidæ), the low tuft on the first segment of the abdomen, and the single pencil-like dorsal tuft on its middle; they only differ in the presence of a short, extruded ovipositor in the female of *meditata*. *Mamestra* and *Dianthœcia* differ in the long, pointed abdomen and extruded ovipositor of the latter; these characters have been considered decisive by European entomologists, but the discovery of *modesta*, *meditata*, *teligera*, and other species, with stout abdomens and short ovipositors, seem to destroy their validity, and the fact that *meditata* and *innexa* are so near each other, and yet technically separated by the difference in the length of the ovipositor, also tends to show that this character is at most only of subgeneric value.

Mamestra niveiguttata Grote, belongs undoubtedly to the section *Dianthœcia*; the abdomen of the female being pointed, and furnished with a long projecting ovipositor.

5. Mamestra teligera nov. sp.

Expanse 30 mm. Length of body 14 mm.

Eyes hairy. The collar and thorax gray, the former with a very distinct, black, central line, the latter having a low metathoracic tuft, and with the apices of the pterygodes sharp and well defined. The abdomen of the female with a short, projecting ovipositor and dorsal tufts. The ground color of the anterior wings gray; a very distinct basal dash, above which the basal space is whitish; the half-line is indistinct; the median lines are distinct and geminate, accompanied by pale shades; the interior line lobed between the nervures; to the largest lobe the conspicuous, black-edged claviform spot is attached, and extends nearly to the exterior line; the latter is shaped as usual, inwardly dentate between the nervules; the ordinary spots are of the normal form, filled with light gray, which contrasts with the ground color; the subterminal line whitish, interrupted, forming an irregular white spot at the internal angle, and preceded by faint, black, cuneiform markings. Posterior wings whitish at the base, with a discal dot, a faint median line and a broad diffuse terminal border. Beneath the anterior wings are dark gray, the posterior whitish, both with discal dots and a common black median line.

Hab. Waco, Texas.

Allied to *Dianthœcia capsularis*, which we have not identified, but differing from M. Guenée's description and plate by the presence of a distinct basal dash, by the central portion of the median space not being suffused with black, and by the presence of abdominal tufts.

6. **Hadena relicina** nov. sp.

Expanse 40 mm. Length of body 22 mm.

Eyes naked. The antennæ of the male with fine hairy clothing. The palpi and front as usual in this genus. The collar and pterygodes black, the former with a distinct, transverse black line; behind the collar a low longitudinally furrowed tuft. The abdomen with short tufts on the first three segments. Ground color of the anterior wings light gray, variegated with darker gray and black; a distinct basal dash, and beneath the submedian nervure another similar dash; the median lines black, single, and strongly dentate; the interior line forming two conspicuous teeth on the costa, the lower one touching the orbicular spot; to the lobe between the median and submedian nervures the strongly marked black-lined claviform spot is attached, and extends to the exterior line; beneath the submedian nervure the lines are again connected by a long, sharp tooth; the exterior line is incepted on the costa above the reniform spot; below, its teeth are short and regular, but it forms one very sharp inward indentation, reaching the reniform spot; the ordinary spots concolorous, with black annuli, the orbicular oblique, the reniform upright, with its annulus outwardly obsolete; the terminal portions of the nervules tinged with black; the subterminal line whitish, very jagged, marked chiefly by the contrast between the light subterminal and the dark terminal spaces; a series of black triangular dots at the base of the fringe, which is dark, intersected with light. The posterior wings white, with a very faint terminal border, and a black line at the base of the concolorous fringe. Beneath whitish, the anterior wings with a discal dot and median line.

Hab. Waco, Texas.

This beautiful and distinct species belongs to the section *Xylophasia*, and is related to *H. lignicolor*, but the markings are more acute, and the ground color is gray, without brown or ochreous admixture.

7. **Segetia orbica** nov. sp.

Expanse 23 mm. Length of body 11 mm.

Generic characters precisely as in *S. xanthoides*, from the same locality. The coloration of the thorax and front uniform dull brown. The anterior wings shorter and more distinctly triangular than in the allied species, with the colors brownish and much less vivid; the median lines are evident, black and finely dentate, followed by indistinct whitish shade lines; the subterminal line irregular, preceded by a deepening of the ground color; the orbicular spot absent, the reniform large, round, and pure white, forming the most prominent feature of the ornamentation. Posterior wings uniform dark fuscous, with light fringes. Beneath gray, suffused with ochreous, and with numerous scattered black atoms; on the anterior wings the exterior line is visible on the costa; the posteriors have a clear, black, discal dot, and a regular, finely dentate, median line.

Hab. Waco, Texas.

The contrasting white reniform spot will always separate this species from the rest of the genus.

8. **Caradrina disticha** nov. sp.

Expanse 27 mm. Length of body 14 mm.

Eyes naked. Palpi ochreous, the third joint short. Front and thorax smooth, concolorous and untufted. Abdomen untufted, in the female with a short projecting ovipositor. Anterior wings light gray, sprinkled with numerous black atoms to the median shade, which is perfectly straight, oblique, inwardly clearly defined, and followed by a dark, blackish-gray ground color, which contrasts very strongly with the preceding light gray region; this continues as far as the exterior line, beyond which the ground color lessens in depth, returning to the original light gray color; interior line dark gray, geminate, and even, forming a single inward indentation below the median nervure; orbicular and claviform spots obsolete; the reniform large, subquadrate, light ochreous gray, contrasting with the dark ground color; exterior line even, broadly undulate, geminate, dark gray, enclosing a pale shade line; two conspicuous, clear black, cuneiform, subapical markings, one much larger than the other; below them a black spot; the terminal space darker gray. Posterior wings gray at the base, melting into uniform black; all markings absent. Beneath dark gray, with innumerable scattered black atoms; the usual discal dots are present on the posterior wings.

Hab. Waco, Texas.

The ornamentation in this species is so simple and defined that it will hardly be possible to mistake it.

TORNOS nov. genus.

We found this genus for a slender built geometriform insect, which we place near *Adipsophanes* and *Crambodes* on account of the comparatively short, stout, erect, trifidiform palpi. Eyes naked. Ocelli present. The antennæ in the male strongly bipectinate, in the female with the segments well separated, each terminated by a short spur or projecting edge of fine hair. Front broad, rounded. Thorax weak, rounded, and untufted; the clothing scaly. Abdomen long, in the male conical, in the female cylindrical; in both sexes the dorsal tufts are absent, but short lateral tufts are present, more distinct in the female than the male. The legs are long, smoothly scaled and slender. The wings are elongate, the angles rounded, and the markings common to both pairs, as in *Pangrapta*.

9. **Tornos robiginosus** nov. sp.

♀. Expanse 25 to 28 mm. Length of body 10 to 11 mm.

The basal and central portions of both wings pale yellowish, with a brown tinge; beyond, a broad, blackish, contrasting terminal band. On the light region of the anterior wings the markings are nearly obsolete, except the large, distinct, reniform spot, formed of black raised scales; the orbicular is seen as a faint, dark spot; the median shade is more or less distinct, diffuse, extending around the reniform, and subparallel with the faint, interrupted, exterior line; the brown tinge is more evident along the border of the black terminal band. On the posterior wings the markings are similar, but darker and more diffuse. Beneath still darker, with the markings above reproduced, the discal dots distinct.

Described from two specimens which vary considerably, but seem to belong to the same species.

♂. Expanse 23 to 25 mm. Length of body 10 to 11 mm.

Both wings uniform dark, slightly brownish gray, the terminal black border barely perceptible, the reniform distinct, as in the female, all the other spots and lines obsolete. Beneath uniform, of the same color as above, the discal dots not so distinct as in the female.

Described from two specimens which agree perfectly with each other.

Hab. Waco, Texas.

Notwithstanding the great difference between the sexes, we can not consider them other than belonging to the same species.

10. **Tarache tenuicula** nov. sp.

Expanse 16 mm. Length of body 8 mm.

This species is closely allied to *erastroides* Guen., and intermediate between it and *candefacta* Hb. The head and thorax white; the metathoracic tuft tinged slightly with metallic blue, thus approaching *delecta* Walk. The anterior wings are perceptibly narrower than in *erastroides*, having the basal space and the subcostal part of the median space white; a black dot at the base; dark spots, sometimes connected together by bluish-gray shades, mark the inception of the median lines on the costa; the interior line is usually continuous below, bounding the dark outer portion of the wings, but in one specimen the dark part only extends to the median shade; in all the specimens we have there is a distinct black spot on the median nervure in addition to a black dot which appears in the place of the orbicular spot; the reniform spot is situated on the border of the dark space, is concolorous and surrounded by a dark annulus; the median shade is ill-defined, interrupted by the costal white space, and followed by a bluish-gray shade, which extends to the indistinct exterior line; the subterminal line whitish, irregular, preceded by more or less distinct black spots; the subterminal and terminal spaces are dark brown; there are also some traces of this color after the interior line. A series of black points at the base of the fringe; the latter is white, shaded with bluish-gray. The posterior wings whitish, translucent, with a suffused terminal blackish border. Beneath, the anterior wings are blackish, with the basal and part of the median space ochreous; the posteriors are whitish with the costa ochreous, and with a dark terminal border as above.

Hab. Waco, Texas.

The smallest species known to us. From *candefacta* it can be separated by the color and the form of the markings, and from *erastroides* by the shape of the wings.

11. Plusia ou Guen. (*Plusia fratella* Grote, Bull. Buff. Soc. Nat. Sc., Vol. II, p. 161.)

This species has hitherto been unidentified by American authors; the Texan specimens agree very well with M. Guenée's description. Our specimens from Nebraska, Missouri and Texas, show but slight variation except in size, the smallest specimens being about 29 mm., and the largest 35 mm.

Mr. Grote's *fratella*, expanding 30 mm., came from the same locality as our Texan specimens; we think it merely a redescription of *P. ou.*

12. Remigia latipes Guen., var. *texana* nov. var.

This form differs materially from M. Guenée's description, but the species is so variable and so widely spread that we do not dare to consider it specifically distinct. Compared with *latipes* the interior line does not terminate on the inner margin in a black spot; there is no additional spot beneath the reniform; the median lines are not parallel, and are accompanied by lighter shade lines. The four specimens taken exhibit no variation among themselves.

13. Bolina fasciolaris Hübn. (*Aedia nigrescens* G. & R.) Proc. Ent. Soc. Phil., Vol. VI, p. 21, pl. 3, fig. 5.)

It will be noticed that M. Guenée gives two descriptions of this species, referring in both cases to figures 443 and 444 of Hübner's "Zutræge." We think it probable that he intended only one species, although in one instance the name is spelled *fascicularis*. The species is very widely distributed, occurring in Brazil, Central America, Mexico, and the Antilles, as well as Texas, and everywhere appears to be common. We have seen specimens ourselves from Guatemala and Mexico. The Texan specimens are very variable; in several of them the basal space is black instead of gray, and the subterminal line also varies in distinctness. Grote and Robinson's figure represents the typical form from that locality.

14. Syneda deducta nov. sp.

Expanse 30 mm. Length of body 16 mm.

Palpi long, thin, and falcate, forming a peak above the head; the third joint is not visibly separated from the second. Thorax and abdomen untufted, smooth and concolorous. Ground color of the anterior wings gray; in the basal space a broad black band, obsolete at the costa and bounded outwardly by the interior line; the exterior line limits the anterior gray portion of the wings; it is black, depressed opposite the cell, then forming an outward, rounded projection, below which it is strongly drawn in; it then extends in a gentle outward curve to the inner margin; this latter portion of the line is preceded by an olivaceous brown shade, which reaches the reniform spot; the latter is black-encircled, filled by a bluish shade, which extends along the costa and descends beyond the exterior line as a bluish line; beyond the reniform the extradiscal spot (contained in the lobe of the exterior line) is light gray and contrasting; the subterminal space is dark, marked only by the bluish line before mentioned; the subterminal line is irregular and well defined, followed by a narrow yellow-brown shade; terminal space gray. Posterior wings gray, with a black terminal border, attenuate towards the anal angle. This border contains a large, central, yellow lunule; fringe white. Beneath white. On the anterior wings an oblique, black, median band, filling the place which is occupied by the reniform spot above, and a broad, terminal border; posterior wings marked as above, with the addition of discal dots and the absence of any ochreous tinge.

Hab. Waco, Texas.

Related to *Syneda graphica* Hübn., but differing in the course of the median lines on the anterior wings, and the absence of either black or yellow markings on the basal and median portions of the posterior wings.

15. Syneda pavitensis nov. sp.

Expanse 34 mm. Length of body 17 mm.

Palpi with the second joint as in *graphica* Hübn., but the third joint is long, needle-shaped, and held horizontally. Thorax and abdomen as in *deducta*. Ground color of the anterior wings uniform dull olivaceous gray; all the markings faint and diffuse; geminate, blackish spots on the costa mark the inception of the ordinary lines; half-line present; interior line, orbicular spot and median shade, obsolete; the reniform present as a diffuse, dull blackish spot; exterior line subobsolete, differing in distinctness in the two specimens before us; subterminal line light gray, irregular; a faint, scalloped black line at the base of the concolorous fringe. Posterior wings precisely as in *deducta*, with a black, terminal border, a yellow lunule and white fringes. Beneath as in *deducta*.

Hab. Waco, Texas.

We would consider this species the female, or merely a variety of *deducta*, notwithstanding the great variation in the color of the anterior wings, were it not for the structural differences seen in the palpi; these could hardly be either sexual or varietal.

The species of *Bolina* and *Syneda* need a careful revision by some one who is acquainted with those described by Dr. Behr, from the Pacific coast. After examining the species found in the Eastern and Southern States, we are inclined to think the characters of the latter genus insufficient, and that it would be more proper to consider it merely a section of the former.

Prof. E. S. Morse gave a further account of his investigations respecting the homologies of the bones of the tarsus in birds and reptiles. His more recent studies fully confirm his conclusions in respect to the *intermedium*, as announced in a former special paper on the "Tarsus and Carpus in Birds," published in the Annals of the Lyceum of Natural History (Vol. x, 1872).

Prof. N. S. Shaler presented a paper on "The Antiquity of the Caverns and Cavern Life of the Caves of the Ohio Valley." This paper, illustrated with a lithographic plate, will be published in the Memoirs of the Society, forming No. 5 of pt. iii, Vol. II.

Mr. F. W. Putnam exhibited a number of living specimens of fishes and cray fishes which he had collected in the waters of the Mammoth Cave during the month of November while connected, as Ichthyologist, with the Kentucky State Geological Survey, under Prof. Shaler.

They consisted of *Amblyopsis spelæus*, *Typhlichthys subterraneus*, *Chologaster Agassizii*, *Cambarus pellucidus*, and *Cambarus Bartonii*. Of these the Amblyopsis and Typhlichthys are without external eyes and colorless, and are commonly known as the big and little blind fishes, while the Chologaster has eyes, and is of a beautiful brownish tint. *Cambarus pellucidus* is blind, and generally colorless, but three of the specimens exhibited were of a light drab color. The other species of cray fish, the *Cambarus Bartonii*, is provided with dark eyes, and is generally found in the cave of the same mottled brown color as the individuals living in the Green River, as in the case of the larger specimen shown; but a smaller individual was also exhibited that was of the same light color as the darker specimens of *C. pellucidus*. These specimens, with many others, were all obtained in various parts of the river which runs through the lower passages of the cave, and in the same waters were collected five other specimens of fishes that had evidently entered the cave from the Green River, as they were of the same species, and in every way identical with specimens collected outside. They were of the following kinds: two *Amiurus catus*, one *Uranidea* (sp.?), one each of two species of Cyprinoids. These outside forms were all in good condition, and, apparently, had thrived as well in the darkness of the cave as had their kin in the river without. Their colors were not in the least faded, and their eyes were as perfect as ever, so far as could be noticed externally, and from keeping them alive in the light for several days.

Mr. Putnam alluded briefly to the other forms of animal and vegetable life in the caves of Kentucky, and specially mentioned a cave on the opposite side of the Green River, several miles below the Mammoth Cave, where blind fishes and blind cray fishes were obtained very near the entrance by himself, and previously by others, so near the entrance that artificial light was not required in order to see the specimens.

He then went on to review the facts he had presented, and to consider their bearing on the question of the origin of life in the subterranean streams, confining himself particularly to the fishes. The two blind fishes are found throughout the whole of the subterranean streams of the great region of the southwest occupied by the subcarboniferous limestone, and are not known from any other place. The *Chologaster Agassizii* belongs to the same family with the blind fishes; and the only other known specimen, in addition to those he obtained in the Mammoth Cave, was the type of the species which he had described in 1872,[1] from a young individual obtained with a specimen of Typhlichthys from a well in Lebanon, Tenn.; while the only other representative of the genus, so far as known, was the species mentioned by Agassiz from the rice ditches near the coast of South Carolina, under the name of *C. cornutus*. These four species are all that are known of the family, and the affinities of the group he considered were not yet satisfactorily determined, though in common with other ichthyologists he had formerly considered the family as allied to the Cyprinodontes. Thus, it would be seen, in the case of the blind fishes and the Chologaster, we had a family which had blind and colorless representatives living in utter darkness, and also, in another instance, if not in daylight, at least with the unobstructed opportunity to go into it if they wished; in the total darkness of the Mammoth Cave were found, with the colorless blind fishes, others of the same family which were provided with eyes, and were of a dark color. The same was also true with the two species of cray fish found in the cave.

The peculiar geographical distribution of the family must also be considered, one species being found in South Carolina, under very different conditions from the three others in the subterranean streams of the southwest; and this fact also must be taken into consideration, if the endeavor is made to account for the origin of the cave species.

[1] See Putnam, Amer. Nat., VI, p. 22, pl. I, Jan., 1872, and Rep. Peabody Acad. Sci., 1871. Both articles are reproduced in "Life in the Mammoth Cave," 1872.

The peculiar and marked characters of the family left no doubt as to all four of the species belonging to it; for the smooth body, caused by the deeply imbedded and small circular scales, the shape of the body, and the blunt, flattened head, the position of the fins, and the absence of the ventral fins in Typhlichthys and Chologaster, the large air bladder slightly divided longitudinally, the single ovary, the peculiar shape of the liver, the marked character of the general structure of the intestinal canal with its external termination in front of the pectoral fins, and the agreement of all in the development and shape of the lobes of the brain, were all characters that could not mislead in bringing the three genera into a most natural and well-defined group, whatever its allies may be.

Mr. Putnam then alluded to the habits of the three species of the family (*Heteropygii*) found in the cave, and showed that what had been stated regarding the habits of the blind fishes, which, from being surface swimmers, had been considered as better adapted for life in the subterranean waters than would otherwise be the case, no longer held good now that we know the habits of the Chologaster are just the contrary; as they seldom leave the bottom of the stream, and yet evidently thrive as well as their white cousins at the surface of the same waters. Then, as regards color, and its supposed absence in the cave, he thought that the specimens on the table were evidence that much had been said on that subject without a full knowledge of the facts; for the specimens proved, beyond question, that light is not necessary for the production or maintenance of color. Darkness did not bring about atrophy of the eyes, if the specimens exhibited were any test, for here we had fishes with eyes which had (for all we know to the contrary) been in the cave as long as those species without them, and were as essentially subterranean forms, so far as our present knowledge goes; for we have no right to assume that the five specimens of Chologaster obtained were any later inhabitants of the cave than the blind fishes, until at least one specimen of the former had been collected in the outer waters of the vicinity of the caves; and he had carefully seined the Green River and many of its tributaries without finding it.

He also called attention to the fact that if the theory of development of the blind fishes from the Chologaster was maintained, it was not only necessary to account for the atrophy of the visual organs, the development of the tactile organs with which the blind fishes were provided, and the loss of coloration which characterized them;

but that great internal changes had also to be accounted for, inasmuch as Chologaster had a much longer intestine, with an additional turn, than either Typhlichthys or Amblyopsis, and had a stomach provided with two pairs of pyloric appendages, while the other genera had but one pair, and had the single ovary placed behind the stomach in the posterior part of the abdominal cavity, whereas in the other two genera it was situated at the side of the stomach, and in the forward part of the cavity. With such marked differences as these to be taken into consideration, he thought it would be rather hasty for any one to assume that one genus was developed, in the ordinary acceptance of the term, from the other; and that with all the facts we now have, it was assuming more than the facts warrant, to accept as truths any of the arguments that have been brought forward so far as they relate to the origin of the blind fishes; and he thought that there were as many, if not more, facts in favor of their having been a very early form of life that had been continued, than one of late development; and if it could be shown geologically that marine life had once had access to the first formed of these caves in any way, he thought that many of the facts would be as well understood on the basis of the continuance of types from past time, as upon that of their late evolution.

Remarks on two New Genera of Ammonites, Agassiceras and Oxynoticeras. By Prof. A. Hyatt.[1]

Family ARIETIDÆ.

AGASSICERAS.

The young are quite immature and remarkable for the prolonged existence of the goniatitic form which is generally confined to the earliest stage of growth in the Ammonites. The living chambers are quite short, the abdomen keeled but not channeled. This genus would not be placed in the group of Arietidæ by many authors. A comparison of the adult with the perfect young of *A. obtusus*, which I saw in the

[1] I am now publishing so many of these fugitive papers that I feel called upon, in advance of a more formal Memoir now in manuscript, which is to appear in the Bulletin of the Museum of Comparative Zoology at Cambridge, to thank my many friends in Europe, to whom I have been indebted for much information and the free use of collections. To mention any one by name would be unjust to others, and I therefore defer more formal acknowledgement until the appearance of the Memoir referred to.

British Museum, shows, however, that both have similar forms and short living chambers. The septal sutures of *Agassiceras Scipionianum* are also strictly Arietian in outline and proportion, and the septa, form and external characteristics of *Agass. lævigatum* are so similar to the young of *Cor. kridion* and *rotiforme* in some varieties that it becomes difficult to separate them.

Agassiceras lævigatum Hyatt.

Amm. lævigatus Sow., Min. Conch., pl. 570, f. 3.

Amm. lævigatus Opp., Der Jura., p. 81.

This species has an exceedingly immature or embryonic form. It seems to complete its growth in five whorls. The mouth has a simple pointed rostrum, the lips slightly flaring with a broad shallow constriction between the edge and the main body of the shell, very similar to Oppel's type of *Amm. planorbis*, which, by the bye, is not correctly figured by him.[1]

Variety *a* is smooth during four whorls at least and flatter and thinner than the other varieties, and the umbilicus is therefore not so deep. These pass by insensible gradations into the next.

Variety *b* is smooth only during the first three or three and a half whorls, and then the sides are broken by a series of immature folds like those of variety *plicatum* of *Psiloceras planorbe*. The younger whorls are generally wider than in either of the other varieties and the umbilicus therefore deeper. These fade insensibly into those of the next variety.

Variety *c* has the pilæ much more distinct but the period at which they are developed is the same as in the preceding variety. Another peculiarity of this variety is the tendency of the pilæ to cross the abdomen, forming slightly prominent ridges. This, like all other characteristics, is found to a greater or less degree in the other varieties.

Variety *d* is founded on the presence of a faintly defined siphonal line. This includes members of the other varieties, regardless of the time at which the pilæ are developed, their greater or less prominence, and the breadth or thinness of the whorls. This variety also fades off into all the rest in respect to its distinctive peculiarity, the difference being wholly one of degree.

The young have at first the abrupt umbilical edges, common also to the young of other species; these give considerable depth to the

[1] Oppel's figure gives the lateral curves in an exaggerated form, and the indented collar too deep.

young umbilicus. The umbilical edges become reduced in course of growth, and also, as explained before, by the comparative reduction of the rate of growth of the transverse diameter of the whorl; but this only endures for a time, and the fourth whorl again increases fast enough to be somewhat broader than the third. The aspect of the umbilicus when the fourth whorl is completed is thus altered from deep to shallow, just as it changes at much earlier stages in other species, after the earlier goniatitic proportions are outgrown.

The pilæ are introduced generally after the second stage of growth begins and but very rarely before the reduction in the comparative breadth of the whorl begins. The septa are also immature on the fourth whorl, but the abdominal lobe is considerably deeper than the superior laterals. The other lobes are pointed and the cells serrated. This species, according to Oppel, appears in the bed immediately above the Bucklandi bed and in the Museum of Stuttgart is a specimen in the Geometricus bed from Degerloch. In England, however, it is usually found associated with *Deroceras planicosta*, and at Semur with *Ægoc. angulatum*. They also have short living chambers and septa which do not permit of their being joined with *Psil. planorbe*. The Museum at Semur and the Museum of Comp. Zoology afford ample materials for tracing the connection between this species and *striaries*, there being many intermediate forms closely connecting the two.

The constant identification of this species with *Psiloceras planorbe* is a mistake very naturally made by those who are ignorant of its precise geological position, as I was at the time of the description of the variety *planilaterale*. They seem, however, to have but little in common, except the general aspect of the shell.

Agassiceras striaries Hyatt.

Amm. striaries Quenst., Der Jura., p. 70, pl. 8, fig. 5.

Psiloceras planilaterale Hyatt, Bull. Mus. Comp. Zool., No. 5, p. 73.

Loc. Semur. Coll. Boucault.

Sides of the whorls in some adult specimens flattened but in others decidedly gibbous; they may be either plicated or smooth. Abdomen very broad, depressed, convex, smooth or very lightly ridged where the thickened lip of the rostrum marks the limit of the annual growth of the shell. The position of the siphon is often indicated by a raised line. The young are smooth for the first three whorls, the plications beginning to appear on the fourth whorl.

Remarks. The observations were made upon five specimens which were labelled *Amm. planorbis* by M. Boucault, but they differ from that species in the smaller size and greater proportional bulk of the whorls, the breadth and depressed convex form of the abdomen, and the raised siphonal line. Several specimens of this species in the collection at Stuttgart from Balingen showed living chambers, as pointed out to me by Prof. Fraas, always shorter than in *P. planorbe*, and the septa distinct. The peculiar folds appearing in some shells, and the form and aspect of the whorls like those of the young *Scipionianus*, show that their affinities lie in the same direction as those of *Scipionianus*. Occurs in the Geometricus bed. The originals of Prof. Quenstedt's descriptions from Pforen fully sustained the above, and a fine suite of these at Semur exhibits several forms passing into the young forms of *Scipionianus.*

Agassiceras Scipionianum Hyatt.

Amm. Scipionianus D'Orb., Terr. Jurass., p. 207, pl. 51, f. 7–8.

This species varies exceedingly; some of the young occasionally show a crenulated keel; they may also be either smooth or pilated on the sides, with all the intermediate differences. The abdomens are keeled and occasionally though very slightly channeled. The form of the whorl from the young up may be either very gibbous or comparatively flat. In the young forms the pilæ vary from those comparatively thin and depressed to prominent well-defined ones, with or without tubercles; they may also be either very numerous or few in number, and be very distinct or mere thick awkward looking folds. It has been commonly supposed that the affinities of this fossil were with the Margaritatus group but nothing could well be more erroneous. Its development is altogether peculiar and different and its septa are very distinctly Arietian.

When old age begins the tubercles are suppressed, the sides become flatter, the geniculæ bend less abruptly and curve slightly forward, the pilæ reaching to the edge of the channels, these last being indicated by shallow longitudinal furrows raised above the level of the abdomen; the keel still remaining very prominent and sharp. The envelopment even at this age does not exceed one third of the breadth of the whorl. This old age period just before the pilæ become obsolete is very similar to the adult of *Asteroceras Collenotii.*

The young of this species has the rotund gibbous volutions so characteristic of *lævigatus* and *striaries.* The sides are at first divergent, but they become nearly parallel on the latter part of the second whorl; the dorsal side also broadens and the umbilical shoulders become more abrupt. On the third volution the sides are entirely parallel, the dorsum and abdomen of the same breadth and the latter elevated into an obtuse ridge. This ridge on the fourth whorl becomes a true keel unaccompanied by slight channels, though there are traces of their formation. The quicker increase of the abdomino-dorsal diameter of the whorl after this period speedily elevates the abdomen and renders the transverse diameter of the shell considerably less on the latter part of the fourth volution, destroying even the faint traces of the channels mentioned above. On the fifth volution the sides become slightly convergent, and increase very slowly this convergence on the sixth volution.

The pilæ appear on the early part of the third whorl, as thick, widely separated folds, but rapidly grow into true pilæ. The geniculæ may become tuberculated on the fifth volution or they may remain permanently without tubercles; there is however great variation with regard to their prominence and their number.

The duration of the different stages of growth is also varied, in some specimens the abdomen remaining flattened through the keel-forming stage until they reach the first quarter of the fifth volution. In one specimen the pilæ are reversed in position, bending posteriorly, but subsequently, begin slowly to change to a natural position on the fifth volution. Quite a number of the specimens from Semur have the pilæ but very slightly or not at all developed. None of them seem to reach beyond four and a half volutions, and their small size may possibly be due to the same cause as the absence of the pilæ. In some specimens the involution may begin to cover up the geniculæ of the latter part of the fourth whorl, and in others this process may be delayed for one or more volutions.

On the early part of the fourth volution the abdominal lobe is considerably longer than the superior lateral lobes, which in turn are shorter than the inferior laterals. The inferior lateral cells are slightly deeper than the superior laterals. On the latter part of the same volution the abdominal lobe has increased in length and the superior lateral cells are shallower; the inferior lateral cells become deeper proportionally and the lateral lobes are nearly equal in length, the inferior laterals still remaining, however, slightly the longest. The minor lobes are very minute and remain so, the sutures having a comparatively even outline for that reason. In some specimens the lengthening of the abdominal lobe continues until the superior lateral cells are almost obliterated; in others the lobes and cells may remain with about the same proportions as in the stage of development last described. There are two specimens in the Geometricus bed (Stuttgart Museum), but they do not show the young or give any better clue to the true development. There are three casts in the Stuttgart Museum from the Pentacrinus bed near Krumenacher, which appear to be the young of this same species, and one of them with the shell on shows all the peculiar marks of *Agassiceras striaries*, while another is so broad on the abdomen, and the broad, fold-like pilæ are so high, that it looks remotely like the young of *Cor. Sauzeanum*. The three are identified as young of *Coroniceras Sauzeanum*, but the young of this species is very distinct in septa and all its characteristics. In the Collection at Semur is a specimen which, until a late period of its growth, maintains the aspect of *striaries* and then develops the keel and perfect form of *Scipionianus*. The *Scipionis* of Reynés is a form which at an early age becomes smooth like the old stage of *Scipionianus*.

Family OXYNOTIDÆ.

I have thought it essential here to designate the group below as distinct from the Arietidæ because of its great difference in development, in adult characteristics, and especially in old age. The young are similar to the group of certain aberrant forms of that family, as noticed below, but the adult, instead of the solid keel of the Arietidæ, possesses a hollow keel. In the old, however, this keel entirely disappears, leaving the abdomen rounded and almost flattened, a transformation entirely distinct from that which occurs in the old of any of the Arietidœ. Here, as elsewhere, however, a single characteristic unites the two; the sutures are similar in both families. The similarities of the young are such as occur commonly between what are supposed to be very widely separated adults in many other distinct families or groups.

OXYNOTICERAS.

This group, which has heretofore not been treated of in a connected form, so far as I know, is perhaps one of the most interesting. Baron Schwartz, to whom I am indebted for being made aware of the importance of the hollow character of the keel among the Ammonites, was, at the time of my visit at Tübingen, searching for specimens of *O. oxynotum* in which the structure of the keel could be studied. It was my good fortune to find several specimens in the collections at Stuttgart and Semur which showed the essentially hollow interior of the keel. One of these, in the collection at Semur, exhibited the hollow, but I found it filled with layers evidently of organic origin. The black layer was also present. This would appear to be an intermediate stage between the solid and hollow keeled groups of Ammonites, but it may be only a specific character. That it is not due to age may be proved by the examination of young specimens in which also the same solid filling may be observed.

In *O. Guibalianum, Guibalii*, and *Lotharingum* the hollow keel was also observed. The late stage of growth at which it appears and the comparatively early stage at which it disappears, as well as the completeness of its obsolescence, are very marked in *O. Guibalii* and especially in *O. Lotharingum*. The young of *O. oxynotum* and *O. Guibalianum* and *Guibalii* are very similar in many of their varieties to those of *Agassiceras striaries* and in *O. oxynotum* this is so marked that it becomes almost identity. The young of *O. Lotharingum*, however, never show these striaries-like forms, but begin at a very early stage to resemble the adult of *O. Guibalianum* in all its characteristics. These facts appear to justify the conclusion that we have in this family either the first appearance, or at least one independent source, of the hollow-keeled group springing up in a genus whose origin is traceable by inference from the developmental characteristics to the Arietian species *Agassiceras striaries*. The resemblances of the senile stage to its own young in the form and characteristics of the last whorl are very remarkable. The length of time during which the adult stage maintains the peculiar sharpness of the whorl and the keel in the individual is greatest in *O. oxynotum*, less in *O. Guibalianum*, still less in *O. Guibalii*, and least in *O. Lotharingum*.

This also would be the natural order of the arrangement of the species if placed by the evidence afforded by their development and adult characteristics. *O. Guibalianum* is in every way most nearly allied to *O. oxynotum*. There are some varieties, especially among the German forms in Prof. Fraas' collection, which have much sharper abdomens than the true *Guibalianum* and approximate very closely to the stouter varieties of *oxynotum*.

On the other hand, the duration of the striaries-like stage in *O. Guibalianum*, the septa of the adult, which are simpler or more Arietian in outline than in *oxynotum*, and the essentially hollow keel, seem to indicate a separate though common origin from *Agassiceras striaries*. The specimen *O. Guibalianum* in the Stuttgart Museum, in which the hollow keel was observed, had an outer shell remarkably thickened, but the interior evidently hollow, while in the French specimens at Semur the shell was of the usual thickness. The former may possibly indicate a transition to *O. oxynotum*. *O. Guibalii*, however, by the resemblances of the young to the adult of *O. Guibalianum*, or in other words by the younger period at which the adult characteristics of the species are inherited, is apparently a direct derivative from *O. Guibalianum*. The same reasons would also apply to *O. Lotharingum*, in which the young lose the striaries-like stage almost entirely and repeat only the adult form and characteristics of *O. Guibalianum*. The shorter and shorter duration of the adult stages and the continually earlier period at which the senile stage of decline makes its appearance in each successive species probably indicate a similar relationship. The evidence of the descent of these three species from each other would be complete if they did not all make their appearance on the same level, in the Birchii or Obtusus bed at Semur. As the case now stands, therefore, no relation of succession in time can be affirmed. The relations of the different species would seem rather to be represented by divergent lines connecting *O. oxynotum* with *O. Guibalianum* through a series of intermediate forms, and then *O. Guibalianum* with *Guibalii* and *Lotharingum*, but all on the same geological level.

Oxynoticeras oxynotum Hyatt.

Amm. oxynotus Quenst., Petrfk. 98, pl. 5, f. 11.

This species presents us, in the course of its development, with some curious and interesting metamorphoses. The young are round and smooth and may continue to retain this smoothness and the rotundity of the abdomen until the specimen is fully an inch in diameter. The sides, however, become flatter and slight folds and striations become visible. The resemblance to *Agassiceras striaries* is so decided in these specimens that if found independently, no one would hesitate to place them in the same genus as a closely allied species. The septa even agree very closely, as may be seen in Prof. Fraas' collection, which presents a very fine series of these exceptional varieties. The keel does not appear until much later in these striaries-like forms than in the normal forms, but in all varieties the Arietian characteristics of the septa are apparent. The keel on its first appearance seems to be solid, though I could not determine this with absolute precision. If this could have been determined, the evidence that this species is a descendant of *Agassiceras striaries* would have been complete. Besides this variety, there is another evidently normal and healthy which resembles in every respect the young of *Amaltheus margaritatus*, having even the crenulated abdomen. This leads into a variety quite common but not so evidently the result of normal or healthy causes. This has a blunter abdomen, which is deeply crenulated as in *Phylloceras Boblayei*, and otherwise resembles it in form though distinct in the septa. The involution, however, is irregular, decreasing with age, instead of preserving the normal mode of increase, though the specimens rarely exceed an inch in diameter. The normal or true *oxynotus* variety prevails in the majority of specimens, and in these the resemblance of the young to *striaries* is very much obscured by the early development of the laterally flattened adult form, the sharp keel and specifically characteristic sutures.

The examination of old and young forms at Semur enables me to state that in extreme old age, when the shell is about 335 mm. in diameter, the form changes. The keel becomes very broad, a depressed zone make its appearance on the sides near the umbilicus, and the involution becomes so much less that I have compared the aspect of the umbilicus to that of *Amm. Romani*. Here also the structure of the keel in one specimen was plainly visible. Externally the outer shell enveloped the cavity of the keel, internally the nacreous layer formed a convex floor, but the space between, instead of being hollow as in *Oxynoticeras Guibalianum* was filled by layers thickest in the centre and gradually fading off to either side, their attenuated lateral extensions forming a third layer between the outer shell and the nacreous lining. The dark colored layer, which is considered as important by Baron Schwartz, is also present, lying just above the nacreous lining and a little on one side.

Besides these forms there is at Semur, identified as a form of *Lotharingus* by Reynés a variety of this species which attains the large size of 393 mm. Even at this size the characteristic form of the adult is maintained, though the involution is perceptibly less, the umbilicus being quite open. *Oxynotus* is the only species of this group which attains as great a size in its normal variety without losing the keel, and therefore I think this form is also a variety of this species. *Amm. oxynotus-numismalis* Quenst. (Der Jura, p. 119) is probably a form of this series, and, as supposed by him, is probably identical with *Amm. Buvigneri* D'Orb. D'Orbigny's original is altered by compression and this defect is represented in his drawing as natural. The original in the Coll. of the Jardin des Plantes has one side more compressed by pressure than the other, showing that the concave zone near the abdomen did not probably exist in the living shell. The abdomen also has a decided keel, which is not represented in the plate.

Oxynoticeras Guibalianum Hyatt.

Amm. Guibalianus D'Orb., Ter. Jurass., Ceph., p. 259, pl. 73.

Amm. Guibalii Reynés' Plates (pars).

Amm. Guibalianus Reynés' Plates (pars).

The examination of German specimens leads me to the conclusion that this species was closely allied to *Oxynoticeras oxynotum* in development and in septa, but the matter still remained doubtful until I reached Semur. Here the splendid suite of specimens of this species enabled me to solve all difficulties. Here also I was enabled to compare it with specimens of the true *Collenotii* D'Orb., the originals of which are in the Museum of Comp. Zool. at Cambridge.

They have not the slightest claims to be considered identical. Oppel, who has identified many species, was probably led astray by the miscellaneous collection of supposed types in D'Orbigny's Collection. Reynés has divided this species into three forms, not very readily distinguishable by their adult characteristics, but quite distinct when their development and old age are studied. His principal observations on *Lotharingus Guibalii* and *Guibalianus* were made in the Museum at Semur. I, however, am obliged to refer his *Guibalii* to *Guibalianus* D'Orb., because of their close resemblance in development and old age, and in order to avoid the use of a new name I distinguish the next species, his *Guibalianus*, as *Guibalii*. In this also I am justified by the types in the Semur Collection, in many of which these names are interchanged. The true *Guibalianus* D'Orb., as may be seen by comparison of the original specimen and the Semur collection, has more abrupt umbilical shoulders, a more open umbilicus, is less involved, and retains the keel and typical form of the whorls until a later stage of growth than any of the group except *O. oxynotum*. The shell sometimes attains the size of 235 mm. before any marked change of form is observable, and in one specimen reached the size of 410 mm. before the keel disappeared. Finally, however, the keel begins to disappear and eventually all traces of it vanish in the almost flattened abdomen. The form, however, seldom changes as completely as in *O. Guibalii*. The length of the ribs, whether long, or alternately long and short, seems to be a characteristic of great variability, and I have not been able to make it of any use in distinguishing the species.

Oxynoticeras Guibalii Hyatt.

Amm. Guibalii Reynés' Plates (pars).

Amm. Guibalianus Reynés' Plates (pars).

The keel of this species may begin to disappear even at the size of 100 mm. In one specimen in the Semur collection this is accompanied by a singular and marked lateral deflection of the hollow keel, and at the size of 170 or 180 mm. it has wholly disappeared. The outer whorl then has a very broad, gibbous abdomen, the sides remaining convergent and rounded.

Oxynoticeras Lotharingum Hyatt.

Amm. Lotharingus Reynés' Plates.

In this species at the size of 100 mm. the keel has almost disappeared and the ribs in several instances cross the abdomen. The abdomen becomes rounded but the involution did not appear to decrease perceptibly in the specimens examined. The umbilicus is smaller in the adult, the whorls stouter in proportion and the characteristic form and aspect of *O. Guibalianus* is found only in the young. The extreme young stages have no hollow keel; it is a characteristic of the later periods of growth and of the adult, and then disappears in the oldest stage. This is perhaps the most interesting instance I have yet discovered of the polarity of the senile and young stages of the life of the individual. The resemblances which exist between them in other characteristics are intensified by the disappearance in old age of this important structure.

Prof. R. H. Richards exhibited some photographs of large masses of copper, found at Isle Royal, Lake Michigan, which bear hammer marks made by the prehistoric inhabitants of that region.

The thanks of the Society were voted to Prof. H. A. Parker and Mr. D. B. Fay for donations to the Museum.

December 16, 1874.

The President in the chair. Forty-five persons present.

Mr. Ernest Ingersoll, of the United States Geological Survey, gave an interesting account of the domestic life of the Ute Indians, who occupy the western half of Colorado. After referring briefly to the traditions current among them respecting the origin of their tribe, he spoke of their recent rapid decrease in numbers through the ravages of the small pox. They still, however, maintain a tribal existence and a certain degree of organization. He then described their ways of living and domestic customs, referring to their burial rites and marriage contracts, and gave such information as he had been able to obtain respecting their religious ideas.

The following papers were read: —

Abstract of a Memoir on the "Biological Relations of the Jurassic Ammonites." By Prof. A. Hyatt.

The speaker traced the history of the evolution of the order of Ammonoids, showing that the characteristics of the first three stages of the embryo were inherited from a very early period. These were first, the sac-like shell of the embryo containing the equally sac-like beginning of the siphon,— prosiphon as it has since been called by M. Munier-Chalmas; second, the beginning of the true shell or apex, with its nautilus-like septum, and peculiar nautilus-like umbilicus; third, the depressed and goniatite-like continuation of the form of the shell with its accompanying goniatitic septa.

These of course represent only their most advanced stage in the Ammonites proper of the Jura and Trias; they are, when first observed in the Silurian and Devonian, exceedingly variable in the length of the periods and other important characteristics even between the varieties of different species. They become invariable in the young as embryonic characteristics only after the lapse of time represented by the Silurian, Devonian, and Carboniferous periods. This variability in the same species in the Silurian shows how recently they were inherited, and their invariability in every individual of the Jurassic shows the result of the long ages of inheritance through which the group has passed between that period and the Silurian epoch.

He then showed that in each subordinate group there were certain invariably occurring forms precisely similar to those found in other groups often widely removed in time and very distinct in the structure of the parts. These are apt to occur with a certain fixity of succession which enables the observer to predict with considerable certainty the general characteristics of the succeeding forms of any given group after he has thoroughly studied the development and succession of a few of the lowest. They correspond to what naturalists are in the habit of calling parallel forms, often also representative forms. These forms begin in every group with which I am acquainted with a certain low or open-whorled form and evolve, in course of time and by inheritance, more and more involved whorls, or else the whorls are modified in the characteristics which usually accompany the normal increase of the involution, namely, by the increasing thinness of the shell laterally, flattening of the sides which become more and more convergent outwardly, and the tendency of the abdomen to become narrower. This and the origin of most of the groups from certain single ancestral species of the discoidal or open-whorled forms show conclusively that these forms arise independently in each group.

But it must be noticed that they can be only thus limited in each group or series of groups which are genetically connected. The range of forms comprehend every imaginable modification of the original inherited or stock form of the third stage among Ammonites. This is tubular or coniform and has an inherited tendency to grow by increasing the abdominal more than the dorsal side, thus revolving upon itself. Therefore while the choice or selection of the original forms by which a series starts into being is practically unlimited except by the possibilities of the typical discoidal form of the embryo and young, the subsequent development in each series becomes more and more limited according to the size of the group. The same law of inheritance which renders the embryonic form of the third stage fixed or invariable in each individual of the true Ammonites of the Jura, subsequently accomplishes the same purpose, to a less degree and with greater fluctuation, for the later developed forms and characteristics of each separate series or group, obliging them to evolve, if they progress at all, a certain succession of forms which have been described above.

It will be noticed that I use the word progress in a special sense as applicable to a certain class of parallel forms and not to those with which we shall presently deal, the old-age forms, which though equally perfect in the phenomena of parallelism, cannot be attributable to growth. The former are the mechanical results of the growth or increase in size of the shell of the common embryonic form of the third and succeeding stages of the young, while the latter result from the natural but inevitable loss of growth-force in the adult shell and its parts.

This growth seems to me to be due to the favorable nature of the physical surroundings, primarily producing characteristic changes which become perpetuated and increased by inheritance within the group. We can recognize this in the constantly increasing size of the shell, complication and development of the new parts, as has been shown by Prof. Cope in his "Method of Creation of Organic Types." Though he does not attribute so much to the influence of the physical surroundings as has been done here, the results of my investigations are, as they have been heretofore, very similar to his.

The law or general expression for the mode of inheritance by which this is accomplished is the same for all characteristics, whether of form or structure ; namely, that of acceleration. By this I mean the constant tendency of every individual to inherit the characteristics of its parents at earlier periods than those in which they have appeared in the parents themselves. I know of no exception to this law, whether the characteristics are due to a healthy adult condition or to old age ; whether they precede or succeed the supposed period of reproduction. This I have already treated of fully in previous publications, and need only refer to the old age parallel forms, presently to be treated of, in order to make it clear to every zoologist that senile characteristics must be inherited or these series of senile parallel forms could have no existence.

This constant tendency to reproduce the ancestral characteristics at earlier and earlier stages accounts for the reduction of the principal characteristics of the Nautiloids and Goniatites to an embryonic condition in the young of the Jurassic Ammonites.

It also accounts for the inheritance of the more and more involved form in each of the subordinate series. This becomes apparent when the parallel forms of any series are traced from the primary discoidal or open umbilicated through the intermediate forms to the most completely involved.

We find in all cases the more discoidal or primary with all its characteristics, whatever they may be, repeated at earlier stages in each species, until at last in some of the most involved, all perceptible traces of its existence are lost. Then and only then can the series be said to die a natural death. When this form appears I have never found another. The reason for this is that in all cases the disappearance of the primary or ancestral form and characteristics of the series is due to the encroachments of the inherited old age characteristics. When these, which are essentially degradational, begin to be inherited in a race, the adult characteristics begin to be confined to younger periods of growth and finally disappear altogether, the shell showing certain old age or inherited senile characteristics from the beginning of the fourth stage. Everywhere this mode of inheritance by acceleration occurs, everywhere it seems to govern the succession of the forms. I have not, however, been able yet to trace the precise connection between all the roots of the secondary series. If this could be completely done, which I fear is impossible at present, no doubt some similar relations would be found.

Besides those parallel forms which may be called progressive, there are others in the same groups which may be shown to be due to the inheritance of the old age of these same parallel forms, and, by comparison with similar forms prematurely produced in the different species by disease or local influences, they may be attributed to similar causes, namely, the action of unfavorable surroundings. It is no exaggeration to say that in many instances the small, dwarfed forms produced by disease are very similar to the normal and large old age forms of the same series. This resemblance extends sometimes even to the mode of development. Disease thus produces directly an effect similar to the normal action of the laws of inheritance through a greater or less period of time under the influence of physical surroundings.

The word surroundings is now used instead of environment, for the reason that environment covers the whole ground of physical causes which may have either a remote or immediate effect upon the life of the species.

The environment, or the sum of the physical influences, however favorable it may seem to be, is, as is well known to all physiologists, perpetually inimical to the prolonged existence of life, and brings about in the individual the retrograde metamorphoses known as old age, and leads to death by the disuse, atrophy and decay of the functions and organs.

These changes in the individual are in precise correspondence with those taking place in a group, and, as has been shown, these characteristics are acted upon in their transmission from individual to individual, during the decline of the group, by the same law of inheritance as are the progressive characteristics during its rise. Thus it becomes possible to compare the life of the individual with the life of the group to which it belongs, the period of growth and development to the period of the progressive evolution of new forms, and the period of old age with its retrograde metamorphoses to the period of decline during which retrogressive forms are evolved. This comparison and the facts noted above enable us to attribute the parallel modifications of forms, whether occurring during the progressive or declining period in the existence of a group, to the direct influence of the environment.

Besides these characteristic forms and structural parts which are parallel, there are many others in each group not classified under the head of similarities but under that of differences, in so far as they distinguish the groups from each other. These may be often followed back to varieties of one species, showing that certain varieties have given rise to the groups. These varieties are few as compared with the whole number of varieties traceable in these original ancestral species.

Thus it seems clear, that these varieties must have had certain advantageous peculiarities enabling them to survive the climatic or geological changes, which destroyed the weaker descendants of the same stock, and that these peculiarities rendered them capable of perpetuating their race until they arose into a group or series of genetically connected forms.

Unless the Darwinian law of natural selection, or the survival of the fittest, does apply to the perpetuation of these structural differences which distinguish groups from each other I am entirely at loss in my attempts to account for them. I here carefully guard against attributing the origin of these differences to the law of natural selection, but limit its action strictly to the modification of the structural differences which tend to appear first in the varieties and then by inheritance in larger and larger groups and at earlier and earlier stages in the life of the individual.

It may also be shown by Cope's law of the origination of differences by growth that the origin of these differences probably lies in some law of growth under the influence of the physical surroundings, supply and kind of food, climate, etc. Thus they may be said to be due to growth modified and directed by the Darwinian law of natural selection, both of these being directly subject to the influence of the environment, or the sum of all the physical influences brought to bear upon the organization.

This conclusion, it will be noticed, is strictly in accordance with the general tendency of zoological opinions at the present time and almost identical with the results taught by Herbert Spencer in his works on biology, although I was not aware of this until after they were written. Many of the facts supporting the positions assumed have already been published in various scattered papers, but these will be united and accompanied by others since discovered in the partially completed memoir of which this is an abstract.

Preliminary Report on the Cretaceous Lamellibranchs collected in the vicinity of Pernambuco, Brazil, on the Morgan Expedition of 1870. Ch. Fred. Hartt in charge. By Richard Rathbun, Assistant in the Museum of the Boston Soc. of Nat. History.

After partially completing his explorations on the lower Amazonas during the Morgan Expedition of 1870,[1] Prof. Hartt directed two members of his party, Messrs. O. A. Derby and D. B. Wilmot, to explore various portions of the coast, between the mouth of the Amazonas and the city of Pernambuco. In the neighborhood of the latter place were found several outcrops of fossiliferous rocks, which have since proved to be of cretaceous age. Quite extensive collections of the contained fossils were made and sent to this country, and last year the mollusca were offered me for study.

The localities from which the specimens were obtained are three exposures, situated at and near the mouth of the Rio Maria Farinha, and all included within a radius of two or three miles. The Rio Maria Farinha is but a small stream, which, in the latter part of its course, flows nearly due east, and enters the ocean at a point about eighteen miles north of Pernambuco, and a few miles south of the island of Itamaracá, lying just off the coast. On the north side of the river, at its mouth, is an elevated point called Nova Cruz, which rises in a cliff about twenty-five feet in height and is composed mostly of beds of colored clays. In the upper part of this cliff appears a single layer, about three feet in thickness, of a grayish, fossiliferous limestone, with clay immediately above and below it. The entire cliff is

[1] For a brief account of this Expedition, see "Preliminary Report of the Morgan Expeditions, 1870-71," by Ch. Fred. Hartt. Bulletin of the Cornell University, (Science), Vol. I, No. 1, 1874.

capped with a bed of unconsolidated tertiary sand, and both the clays and the limestone composing it are probably of cretaceous age.

Following up the river along the north side for about a mile, we come upon a rather heavy bed of hard, whitish limestone, outcropping from the plain near the bank of the river, and containing cretaceous fossils, mostly lamellibranchs. It is covered with tertiary deposits. This stone is extensively burned for lime and may be designated the Maria Farinha bed. On the south side of the river, about midway between its mouth and Maria Farinha, and a short distance from its bank, is a slight exposure of fossiliferous cretaceous limestone, resembling the limestone bed in the cliff at Pt. Nova Cruz. Only the upper portion of a single layer projects from the tertiary plain. To this bed has been given the name São José.

As far as could be ascertained, the beds at São José and Pt. Nova Cruz are horizontal, while the Maria Farinha bed has a slight dip to the west, only observable in large exposures of the rock; but the relative horizon of the beds of the three exposures could not be determined, as the surface is everywhere covered with loose materials.

A careful comparison of the fossils obtained from them has shown, however, that although none of the species, so far as known, occur in all three beds, yet some are common to both the Pt. Nova Cruz and São José localities, while others are found in the Maria Farinha and either the São José or Pt. Nova Cruz beds. The character of the rock in the three exposures is also quite similar, all uniting to prove the close relationship of the beds, which may belong near the Sergipian and Cotinguiban groups of Prof. Hartt. The beds at Pt. Nova Cruz and São José seem to be more nearly related to one another, than do either of these to the one at Maria Farinha. The limestone containing the fossils is somewhat porous, and, being constantly exposed to the weather, the shells have been entirely removed by the percolation of water, thus leaving only the moulds of the exterior and interior, some of which are very perfect.

Lamellibranchs are by far the most abundant fossils in all three localities. At Point Nova Cruz and São José, gasteropods and cephalopods are quite common, the latter often of considerable size, but in a poor state of preservation. Some few fish and crustacean remains, together with a single echinoid and fragments of a small coral, were also found. On the island of Itamaracá, three or four miles above the mouth of the Rio Maria Farinha, there is exposed a bed of soft drab-colored limestone, containing fish remains and a few obscure moulds of lamellibranchs.

As I have not as yet had time to finish the study of all the mollusca collected on the Rio Maria Farinha, descriptions of only the larger and more prominent forms among the lamellibranchs have been given in this paper. In a future and more complete report I hope to furnish figures of all the forms here described.

Though disliking to increase the already large number of names among the cretaceous mollusca, I have found it necessary to designate and name as new all but two of the forms herein described. They have been carefully compared with the collections in the Museum of Comparative Zoology at Cambridge, with those of the Boston Society of Natural History, and also with the literature on the subject contained in the libraries of both the above-named institutions.

I am greatly indebted to Mr. Alex. Agassiz, for kindly allowing me free use of the collection of Palæontology and the library in the Museum at Cambridge; and also to Count L. F. de Pourtalés and Mr. O. H. St. John of Cambridge, who aided me much in my comparisons. To Prof. A. Hyatt, of the Boston Soc. of Nat. History, I am under many obligations for aid and advice in the preparation of this short paper. It is due Mr. O. A. Derby of Cornell University, to whom the first right of the collection belonged, to state here, that he had already done some work upon it before I received it. He had carefully prepared most of the specimens and separated many of the species. The account of the localities is, of course, taken entirely from his notes.

Family OSTREIDÆ.

Gryphæa (sp.?)

There are numerous internal moulds of a small oyster, belonging to this genus, but no external moulds perfect enough to show the true specific characters of the form were obtained. The thickening within the beak varies greatly, sometimes almost entirely filling up that portion of the shell. The exterior surface seems to have been marked simply with small, irregular, concentric lines. From the cretaceous bed at São José, Prov. of Pernambuco, Brazil.

Exogyra lateralis (Nilsson).

Ostrea lateralis Nils., 1827. Petrif. suecana.

?? *Chama canaliculata* Sow. 1813. Min. conch.

There were obtained from the limestone beds at São José and Pt. Nova Cruz two specimens of Exogyra, which, with very little doubt, belong to the above species and increase its already extended range. *Exogyra lateralis* is found in Europe in the Grès Vert du Mans, Etage supérieur, and in the Greensand of Essen on the Ruhr. It also occurs in the Greensand of New Jersey in the United States. Its occurrence in eastern Brazil will give it a distribution not attained by many of the cretaceous mollusca.

A comparison of the Pernambuco forms with many specimens of the same species, both from Europe and the United States, gives the following results. The Pernambuco specimens are of the medium size attained by *E. lateralis*. In outline and general shape they agree very closely with some of the European and N. American specimens, but the latter vary much among themselves. The lower valve is smooth on the exterior. The upper valve is slightly convex, and ornamented by conspicuous, overlapping, concentric layers of growth, which agree perfectly with the s me features in the N. American and European forms.

But two specimens were found, both moulds of the shell, showing the exterior and interior, one of both valves, the other of only the upper valve.

From São José and Pt. Nova Cruz, Prov. of Pernambuco, Brazil.

Some little confusion exists as to the synonymy of this species. In 1813 Sowerby described a species of cretaceous oyster as *Chama canaliculata*. This, with *Ostrea lateralis*, described and named by Nilsson in 1827, are considered one and the same by D'Orbigny in his Paléontologie Française, published in 1843, and the name of course changes to *Ostrea canaliculata* of D'Orb. Still later some writers, I do not know whether by direct observation or not, have given the two as distinct. In the collections to which I have had access, the specimens, with which I have identified the Brazilian form, have been determined and labeled by good European authorities as *Exogyra lateralis*. I have not seen *Exogyra* (*Chama*) *canaliculata*.

Family NUCULIDÆ.

Nucula Mariæ sp. nov.

Shell minute, slightly elongate, and with the valves moderately convex. In the internal mould the outline is obliquely subovate, the beaks are placed far forward, less than one-fourth the length of the shell from the anterior margin, are prominent, elevated slightly above the hinge and incline strongly forward. The hinge equals a little more than one-half the length of the shell, and descends quite rapidly from the beaks toward the posterior margin, where it ends abruptly. The latter, which has about the same height as the anterior margin, begins, in the internal moulds, at a higher level than the posterior extremity of the hinge, since at this point, as is generally the case in Nucula, the cavity of the shell extends nearer to the true margin than it does along the hinge. It rounds strongly to the ventral margin. The anterior margin curves quite rapidly downward and backward, but is not so fully rounded as is the posterior margin.

The valves are most convex in the lower part of the umbonal region, and curve moderately from the beaks to the ventral margin. The curvature of the surface from the anterior to the posterior margin is also very moderate and quite regular, though the valves are slightly flattened in the middle. By the thickening of the margins of the shell, where they approached one another, there has been formed a slightly flattened or concave area or band on the mould, bordering its margins, which are very acute.

Only a single specimen was obtained, the interior moulds of the two valves attached. In breaking this from the rock, the exterior mould was injured beyond repair, but enough remains to show that the surface of the shell was smooth, or marked only with indistinct concentric lines. Size: length, 3.25 mm.; height, 2.5 mm.; depth of two valves, 1.5 mm.

In its interior characters this form approaches very closely some of the varieties of *Nucula pectinata* Sow. of the European cretaceous, but the latter form is a very much larger one and the surface of the shell is marked with prominent radiating lines.

From the cretaceous limestone bed at Maria Farinha, Prov. of Pernambuco, Brazil.

Family LEDIDÆ.

Leda Swiftiana sp. nov.

Shell very small, elongate and moderately gibbous. It is elongate-ovate in outline, with the length more than one and one-half times the height. The beaks are very large, prominent and quite strongly incurved; they are situated a little in advance of the middle of the shell. Posterior to the beaks, the hinge descends quite rapidly to the posterior margin and forms a slight outward curve. The anterior portion of the shell is a little higher than the posterior and is well rounded. The posterior margin rounds rather abruptly, and the anterior more gradually, downward from the hinge toward the ventral margin, which last is moderately curved. The shell is slightly angular posteriorly, where the line of the hinge bends rapidly downward, at a point a little above the median line.

The surface arches quite strongly from the beaks to the ventral margin. The curvature of the surface from the anterior margin to the posterior is more moderate and quite regular. Hinge teeth minute and numerous. The surface is marked by very numerous, regular, fine, thread-like concentric lines, which are very prominent and are separated by slightly narrower interspaces. On one specimen there were about 25 or more of these lines. Length of shell, 8 mm.; height, 5 mm.; depth of each valve, 2 mm. The shell from which these measurements were taken is somewhat above the ordinary size. This form is distinguished from *Leda braziliensis*, the next one to be described, by its greater proportionate height and convexity.

From the cretaceous beds at Maria Farinha and Pt. Nova Cruz, Prov. of Pernambuco, Brazil, where it is moderately abundant. Dedicated, at Mr. Derby's request, to Mr. H. H. Swift, formerly U. S. Consul at Pernambuco, as a grateful acknowledgement of many favors received from him during the trip.

Leda braziliensis sp. nov.

Shell very small, moderately convex and elongate, with the length a little greater than twice the height. Beaks slightly anterior to the middle. The hinge, posterior to the beaks, forms a slight inward curve and descends gradually in extending backward. The margin posteriorly forms an acute angle with the hinge, or the shell may have been slightly rounded at this point. The ventral margin forms a long, very moderate curve, which is somewhat stronger anteriorly. The anterior extremity of the shell is higher than the posterior, and is well rounded. The hinge margin in front of the beaks is nearly straight, or has a slight outward curvature.

The convexity of the valves is moderate and greatest near the middle. The curve across the valves increases very slightly in strength from the ventral margin toward the beaks, which are minute and pointed. No external moulds have been found. The teeth are very small and numerous. Size : length, 7.5 mm.; height, 3 mm.

This form of Leda has a shape quite common among the species of that genus; yet it seems to differ enough from all the species with which I have been able to compare it to merit description. It is readily distinguished from *Leda Swiftiana*, above described, by its more elongate form, less prominent valves, and by the posterior portion of the hinge descending less rapidly.

From the cretaceous bed at São José, Prov. of Pernambuco, Brazil. A few specimens only have been obtained.

Family ARCIDÆ.

Arca Orestis sp. nov.

Shell of moderate size, elongate, somewhat compressed, and with the vertical axis nearly two-thirds the antero-posterior. In outline it is subelliptical, the height being greatest near the middle, but not varying much throughout the length of the shell. Beaks prominent, rounded, not incurving or inclining forward very strongly. Their distance from the anterior margin is much greater than one-third the length of the shell.

The hinge is equal to two-thirds the length of the shell or slightly more. The anterior extremity is not so high as the posterior and is regularly rounded, the curve of the anterior margin continuing regularly into that of the ventral. The latter is slightly rounded and descends gradually in extending backward. The posterior margin is slightly oblique and rounded.

The valves are most prominent in the umbonal region, but become flattened in the lower two-thirds. The surface rounds gradually into the posterior slope, which forms a slight sigmoidal curve in descending toward the hinge. In no part is the shell angular.

The markings of the shell consist of small, rounded, or slightly angular, radiating raised lines or plications, separated by narrower, subangular interspaces. The lines curve slightly in extending from the beak to the margin. On the posterior slope they are very fine and thread-like. The concentric lines are very small and numerous.

Length of shell, 32 mm.; height, 21 mm.; depth, of each valve, 6 mm.

Only a single specimen, a left valve, was obtained and that is much exfoliated, more especially near the beak. The internal characters are not exposed. This form is readily distinguished by the slight prominence of its valves, and by the surface being everywhere without abrupt curves. The markings are also quite simple.

From the cretaceous bed at Maria Farinha, Prov. of Pernambuco, Brazil. Respectfully dedicated to Mr. Orestes H. St. John, lately of the Museum of Comparative Zoology at Cambridge, Mass.

Arca (Cucullea ?) Harttii sp. nov.

Shell of medium size, elongate, gibbous, with the height nearly two-thirds the length. Outline of internal mould subovate, the height of the posterior extremity being much greater than that of the anterior. The beaks are situated at a little more than one-third the length from the anterior margin, are very prominent and incline strongly forward. Hinge nearly as long as the shell. The posterior margin extends obliquely downward and slightly backward, rounding strongly toward the ventral margin. The anterior margin leaves the hinge abruptly, at nearly a right angle, and curves rapidly round to the ventral margin, which is slightly rounded and descends moderately in extending backward.

The valves are very convex and arch strongly from the beaks to the ventral margin. The depth of each valve is more than one-third the height of the shell. The posterior slope commences abruptly along a line extending from just behind the beaks to the lower posterior corner, and descends rapidly to the hinge and posterior margin. This slope is broad, quite concave just back of the beaks, but becomes nearly straight posteriorly.

The surface is marked by small, rounded or subangular, radiating raised lines, which are very fine at the beaks, where they are of about the same width as the interspaces, or narrower, and increase very gradually in size toward the margin, the interspaces there being much the narrower, and even reduced to mere striæ. Fine concentric lines cross the shell; on the upper portion of the shell they are very regular, but near the ventral margin they become more numerous and are crowded together. As they cross the radiating lines they become very prominent, sometimes giving to the latter a beaded appearance. On the posterior slope the radiating lines are minute, thread-like and near together, being separated by very narrow depressions. These seem to be made even more beaded in appearance by the concentric lines than are the radiating lines on the main portion of the shell, though they are exceedingly fine. The inner margin of the shell is crenulated.

This shell is quite a thick one, and none of the exterior characters appear in the interior, so that the angular appearance presented by the external moulds is not apparent in the very numerous internal ones. The characters of the interior are quite obscure in all the specimens obtained, rendering the determination of the genus a little doubtful. The posterior end of the hinge seems to be marked with the longitudinal teeth peculiar to Cucullea, while in the interior moulds there is a slight, rounded depression, bordering the posterior muscular imprint below, and extending some distance toward the beak. As to shape the form is truly Cuculleän. Size of a medium specimens: length, 27 mm.; height, 18 mm.; depth of both valves, 16 mm.

Very abundant, as interior moulds, in the whitish limestone of the Cretaceous at Maria Farinha, Prov. of Pernambuco, Brazil. Dedicated to my teacher and friend, Prof. Ch. Fred. Hartt.

Cucullea subcentralis sp. nov.

Shell small, elongate, very gibbous, subrhomboidal in outline, and about two-thirds to three-fourths as high as long. The anterior and posterior margins are of nearly the same height, the latter being a little the higher. The posterior margin is slightly oblique and rounded, and curves abruptly to the ventral margin. The anterior rounds gradually into the ventral, which curves but slightly, being a little straightened along the middle, and is subparallel with the hinge. The latter nearly equals the length of the shell, and joins the anterior and posterior margins abruptly.

The surface of the shell arches strongly from the beaks to the ventral margin. Beaks situated just anterior to the middle; from them an undefined prominence or carina generally extends obliquely across the interior mould of the shell to the lower posterior angle. This marks the beginning of the posterior slope which is very abrupt. A shallow rounded depression runs parallel to the prominence, and above it, on the posterior slope; but these features are not always apparent. The valves are most convex in the upper part, in the umbonal region and along the carina, and the whole upper part of the shell is usually very much inflated.

In the interior moulds the beak is quite pointed and incurves about half way to the hinge, above which it is moderately elevated. Its inclination forward is not very strong. A shallow, rounded depression, very narrow where it begins, but broadening out and shallowing as it advances, extends a little obliquely backward from the apex of the beak toward the ventral margin. Near the margin it has disappeared. In the various specimens it is differently developed, sometimes extending but a little way from the beak. This must indicate a corresponding prominence in the interior of the valves. The curved slope in the moulds, between the beak and the hinge, is very broad. Inner margin of the valves crenulated. A specimen of medium size measures: length, 18 mm.; height, 12 mm.; depth of each valve, 6 mm.

This form is readily distinguished from all the others at Maria Farinha by the nearly central beaks. It is moderately abundant, but only internal moulds have so far been obtained; the exact exterior characters are thus unknown. A single, very small specimen, which I have referred to this species as the young, shows the impressions of nearly all the teeth on the hinge, and the extreme ones are longitudinal. The muscular imprints are very indistinct.

From the Cretaceous limestone bed at Maria Farinha, Prov. of Pernambuco, Brazil, associated with *Cucullea Harttii*, which it somewhat resembles.

Family ASTARTIDÆ.

Cardita Morganiana sp. nov.

Shell above the medium size and ventricose, with the length nearly equal to, or slightly exceeding, the height, and the depth of the two valves about three-fourths the length of the shell. The outline of the internal moulds varies from subovate-orbicular, when of medium size, to subtrigonal at an older age. Length of hinge line somewhat greater than one-half the length of the valves.

In the larger specimens the posterior margin is very oblique and nearly straight for about half its length from the hinge; then it rounds rapidly and regularly to the ventral margin, which curves but moderately. The anterior margin is shorter than the posterior and is quite regularly rounded. The posterior margins of the umbones, together with the upper and larger part of the posterior margin of the shell, lie in nearly the same straight line, as do also the anterior margins of the umbones and a small part of the anterior margin of the shell, the two lines so indicated forming a slightly acute angle at the beaks; while the slightly curving ventral margin completes a rather imperfect triangle. This character of outline is observable in the larger and more perfect internal moulds only; in the smaller specimens the outline is frequently nearly circular; but the various forms so graduate into one another as to make their identification easy.

The valves are very convex and swell out rapidly from the margins. They are most prominent just above the middle, or in the lower part of the umbonal region. Beaks large, acute, very prominent and much elevated above the level of the hinge. Their inclination forward is strong, as is also their inward curvature; but they do not approach one another very closely in the internal moulds. Along the antero-posterior axis the valves curve rapidly upward from the posterior margin, and descend quite abruptly to the anterior. The internal moulds of the valves have frequently a very oblique appearance, caused by the more convex portions tending to form a large and prominent, but wholly undefined, ridge, which extends downward and slightly backward from the beaks, and broadens and dies out toward the margin.

As only internal moulds have been obtained, the exterior markings and other exterior details are yet unknown. The inner margin is marked with about sixteen large and prominent, rounded or flattened crenulations, separated by similar interspaces; but the plications of the shell are seldom apparent on the interior. The hinge teeth are not fully exposed on any of the specimens. The anterior and posterior adductor muscular impressions are sometimes rather deeply excavated; they are generally situated nearly on the antero-posterior axis, but the posterior one is at times placed slightly lower than the anterior. Their longer axis is nearly vertical or inclines slightly forward. The imprint of the anterior pedal muscle is very small and entirely separated from the adductor. The size of a large specimen is: length, 42 mm.; height, 39 mm.; depth of the two valves, 31 mm.

This is a rather large form of Cardita, and is represented by several internal moulds both from the cretaceous bed at São José and that at Maria Farinha, Prov. of Pernambuco, Brazil. I take pleasure in dedicating this large and fine form to Col. Edwin B. Morgan of Aurora, N. Y., who has so kindly and liberally aided in Brazilian Exploration.

Cardita Wilmotii sp. nov.

Shell of medium size, moderately gibbous, length and height nearly equal, depth of the two valves about one-half to two-thirds the height. In outline it is subcircular; the anterior, posterior and ventral margins together form quite a regular curve, which is, however, slightly more abrupt near where the posterior and ventral margins meet; this curve, if prolonged above to the beaks, would make nearly a perfect circle. The hinge is short and equal to about one-half the length of the shell. Beaks situated at a little more than one-third the length of the shell from the anterior extremity, and in the interior moulds, in which state alone they have been obtained, they are acute at the apex and curve strongly inward and moderately forward. They closely approach one another.

The valves are most prominent just above the middle, and arch strongly from the beaks to the ventral margin. The curvature along the antero-posterior axis is strong and generally regular; sometimes the slope is more abrupt posteriorly.

The surface is ornamented with prominent narrow plications, separated by broad interspaces. The plications are very fine and high at the beaks, and gradually increase in size toward the margins. The interspaces are profound, flattened or slightly rounded in the bottom, and two to three times as wide as the plications. At the base of each plication, on either side, runs a fine thread-like line, which seems to begin near the beak and extends to the margin, increasing slightly in size. Very fine and numerous concentric lines cross the valves, and on the plications are grouped together so as to form regular bead-like prominences. On worn specimens the separate character of the beads is lost, and the plications appear rounded and thread-like on the summit. In the interior of the valves the plications are very apparent, and they have left their imprint upon the internal moulds, as low rounded plications and interspaces of about equal width, which die out near the beak.

The inner margin of the valves is crenulated, while just within the margin there is sometimes a smooth band or area of varying width. The anterior adductor muscular impression is small and slightly excavated. The imprint of the very small pedal muscle, lying above the anterior adductor, is entirely separated from it.

The general characters of this form are those of Cardita, and the hinge characters, so far as they are preserved or exposed, seem also to agree with those of that genus. There is an elongate posterior lateral tooth, and above this a fine linear prominence. The plications in the genus Cardita do not generally show as prominently in the interior of the shell as happens in this form. A specimen of good size measured: length, about 23 mm.; height, 23 mm.; and depth of both valves, 17 mm.; but the shell is usually more flattened than in this case.

Abundant in the cretaceous limestone bed at São José, Prov. of Pernambuco, Brazil.

Family LUCINIDÆ.

Lucina tenella sp. nov.

Shell very small and lenticular, with the length slightly greater than the height. Valves moderately convex.

The beaks are small, not at all prominent, are situated near the middle of the shell and incline slightly forward. The margins of the valves, so far as can be determined from their imperfect condition, form nearly a circle, truncated slightly at the hinge. Anteriorly the shell is produced a little upward, nearly as high as the beak, the hinge margin forming in front of the beaks a slight inward curve, and then ascending a little to the upper anterior angle. The hinge, posterior to the beaks, is apparently straight and descends moderately toward the posterior extremity.

Valves most convex just above the middle. The surface curves moderately from the beaks to the ventral margin. the curvature decreasing gradually in strength downward. Along the antero-posterior diameter the curvature is gradual and regular. The upper poste ior portion of the shell becomes suddenly slightly compressed from along a line extending from behind the beaks to a short distance below the middle of the posterior margin. This compressed portion forms a rather narrow crescentic space, bordering the margin.

The surface is marked with very fine, regular, slightly overlapping, concentric raised lines of growth, those near the beaks being often quite faint; but they become gradually co rser toward the margin. On the posterior depressed space they are deflected slightly upward. The interspaces are very much broader than the lines and are flattened, and all of about equal width. The muscular imprints are not preserved in the mould.

From the cretaceous limestone bed at Maria Farinha, Prov. of Pernambuco, Brazil. Only two specimens have been obtained.

Family CARDIADÆ.

Cardium Soaresanum sp. nov.

Shell small, gibbous, subquadrangular in outline, and with the antero-posterior and vertical diameters nearly equal. The depth of the two valves equals about two-thirds or three-fourths the antero-posterior diameter. The hinge is nearly as long as the shell, and rounds very rapidly into both the anterior and posterior margins, the latter of which is often nearly straight and about at right angles to the hinge. The anterior and ventral margins together form a single, quite regular curve, uniting somewhat abruptly with the posterior margin.

Beaks small, acute in the interior moulds, strongly incurving and inclining moderately forward. Their apices are situated a little anterior to the middle and are approximate. Valves most convex just above the centre, and arching rather strongly from the ventral margin to the beaks. The most prominent line of curvature of the shell passes obliquely downward and backward from the beak toward the lower posterior angle, sometimes not far posterior to the middle, at others about one-third the length from the posterior margin, thus giving to the shell a slightly oblique appearance. The curvature across the valves, from the anterior to the posterior margin, is very strong and always more abrupt posteriorly. Sometimes the posterior slope is nearly straight, and the valves are then slightly angular along the most prominent line of curvature.

The shell is marked with prominent radiating plications only, about twenty to twenty-five in number on each valve. I have not been able to detect any concentric lines. On the middle and larger portion of the valves the plications are rather broad and flattened, and separated by narrow, shallow, rounded depressions, sometimes scarcely more than striæ. Toward the anterior and posterior extremities the plications become regularly rounded and gradually narrower. At the same time the interspaces, which are also rounded, increase in size and near the margin exceed the plications in width. From the anterior seven or eight plications arise minute spines, having rounded or elongate bases and arranged in single rows. The plications nearest the margin have six or eight spines, but these decrease in number toward the middle, and become limited to the lower part of the plications, the last two or three having but a single spine each, and that near the ventral margin. The posterior ribs were probably also spinous. Length of a large specimen, 20 mm.; height, 20 mm.; depth, 14 mm.

This Brazilian species of Cardium resembles very much in shape *Cardium speciosum*, M. and H. from the cretaceous at the mouth of the Judith river, upper Missouri, but in ornamentation the two differ. In *C. speciosum* the costæ are narrower and the spines much more numerous. I have not seen the interior of the latter species.

From the cretaceous beds at São José and Pt. Nova Cruz, Prov.

of Pernambuco, Brazil. At the former locality it is very abundant, both as interior and exterior moulds.

Dedicated, at Mr. Derby's request, to Sr. Fredrico Marques de Costa Soares, whose hospitality and efficient aid rendered possible the examination of the localities.

Family VENERIDÆ.

Callista McGrathiana sp. nov.

Shell small, elongate, and with the valves moderately convex; length somewhat greater than the height; outline subelliptical.

The beaks are situated a little in advance of the middle, are prominent and incline rather strongly forward. Their internal moulds are sharply pointed and incurve slightly. The hinge margin descends quite rapidly from the beaks posteriorly, and is moderately curved, nearly the same curve being continued in the larger part of the posterior margin, while the ventral margin is also very regularly, but more gradually, rounded.

The point of greatest convexity of the valves is just above the middle, though the curvature of the surface from the beaks to the ventral margin is usually quite regular. The curvature along the antero-posterior diameter is moderate and more or less regular. The slope toward the posterior and hinge margins is usually quite rapid, and increases in strength near the beaks; it is always well rounded.

The surface of the shell is marked with numerous small, rounded, concentric raised-lines, separated by similar interspaces of slightly greater width. They are quite equally disposed, sometimes, however, differing in width and placed nearer together. They round up strongly in front.

The muscular imprints are of moderate size, slightly excavated, and are situated just above the antero-posterior axis. Of the cardinal teeth, the anterior is nearly perpendicular, bending slightly forward below, while the posterior, which is the longer, extends backward, bending a little downward. The dental prominence in front of the cardinal teeth is somewhat elevated.

This small form, not represented by any perfect impression of the exterior, seems to be a true Callista, as indicated by shape and hinge-markings. Size: length, 14 mm.; height, 11 mm.; depth of two valves, 6 mm.

Moderately abundant in the cretaceous beds at Pt. Nova Cruz and São José, Prov. of Pernambuco, Brazil. Respectfully dedicated to Dr. McGrath of Pernambuco, to whom Prof. Hartt and his party are indebted for many favors and valuable information regarding the geology of the vicinity of Pernambuco.

Family TELLINIDÆ.

Tellina pernambucensis sp. nov.

Shell small, compressed, elongate, with the length equal to about one and one-half times the height. Outline longitudinally sub-ovate.

The beaks are situated near the middle, and are minute, pointed and scarcely elevated above the hinge. In front of the beaks the hinge margin descends gradually, curving very slightly toward the anterior margin, which is regularly rounded. Posterior to the beaks the hinge is nearly straight and descends a little more rapidly than in front. The posterior extremity is not quite so high as the anterior, but is quite regularly rounded. The ventral margin curves moderately and regularly.

The valves are depressed-convex, being most prominent anteriorly and just above the antero-posterior axis. The curvature of the shell from the ventral margin to the beaks is very gradual, and increases slightly in strength upward. The surface rises gradually from the anterior margin, curves slightly for one-third the length or more, and then generally descends very gradually to the posterior extremity, in a nearly straight slope. Hence the shell is usually very much compressed posteriorly. Sometimes, however, it is not at all flattened, but nearly equally convex throughout. The surface is marked with very minute, regular, rounded, concentric raised lines, set closely together. The impressions of the muscular markings have not remained on the internal moulds. The imprints of the two minute cardinal teeth are very distinct in one specimen. Length, 17 mm.; height, 12 mm.; depth of each valve, about 2.5 mm.

From the cretaceous beds at Pt. Nova Cruz and São José, Prov. of Pernambuco, Brazil, where only a few specimens have been found.

Notes on Orthoptera from Northern Peru, collected by Professor James Orton. By Samuel H. Scudder.

Nearly six years ago I published an account of the Orthoptera obtained by Prof. Orton on either side of the Andes of Equatorial South America.[1] Prof. Orton has recently placed in my hands another collection, made in 1873 in the same general region, and which is even richer in novelties than the former. A portion of the collection came from the banks of the Amazons, and almost entirely from the Peruvian part of it called the Marañon. A more extensive series was obtained on the road up the Andes, between Yurimaguas on the Huallaga, a tributary of the Marañon, to Chachapoyas, viâ Balsa Puerto and Moyobamba. For the sake of brevity, I shall speak of the specimens from the former locality as from the "Peruvian Marañon"; of those from the latter as from the "Eastern slope of the Peruvian Andes."

It is not a little strange that only five of the species brought home on these two expeditions of Professor Orton should prove identical. This fact, as well as the number of new forms described, shows how well this field would repay the labors of a systematic collector.[2]

The number of new generic types these little collections have afforded is also extremely large, while several of the species have otherwise a special interest. Excepting in the Blattariæ, the proportionate number of the species of the different families is about the same as in the previous collection; the mass is composed of Locustarians and Acridians and, with a single doubtful exception, not a single species of these two families could be referred, either in 1869 or now, to any previously described.

Besides the descriptions of the species obtained by Prof. Orton I have added those of one or two others related to them, and have in some instances given more precision to the generic determination of the insects obtained on the previous expedition.

GRYLLIDES.

1. Gryllotalpa maranona nov. sp.

Head blackish fuliginous, the labrum lighter, sometimes pale; rest

[1] Proc. Bost. Soc. Nat. Hist., XII, 330-345; Ent. Notes, II, 15-30.

[2] Professor Orton writes me: "I never before saw such a variety of Orthoptera, especially grasshoppers and walking sticks, as on the rough journey from Balsa Puerto to Moyobamba; it is the paradise of the entomologist."

of body testaceous, the prothorax with a few irregular, small and faint dusky blotches, the veins of the tegmina dark castaneous. Ocelli moderately large, broadly obovate, distinctly, though slightly convex, each distant from the adjacent eye by its own shorter diameter, or even less, and from the opposite ocellus by its own longer diameter or generally less, directed toward the lower margin of the opposite eye. Terminal portion of the lower edge of the fore femora with a pretty sharp, rather shallow excision. Fore trochanter lenticulate, as in *G. hexadactyla.* Tibial dactyls as in that species but not so divergent. Lateral dactyls of tarsi cultrate, the first twice as long as the second, the upper edge of the latter roundly and considerably heeled at the base; acicular claws slender, delicate, finely pointed, about half as long as the greatest breadth of the second tarsal dactyl. Hind tibiæ furnished with spines only at the tip, four short ones on the outer side, four of varying length, but some very long, on the inner side; claws of hind tarsi not two-thirds the length of the terminal tarsal joint, the inner slightly the longer. Tegmina in repose reaching but little beyond the middle of the hind femora; wings reaching nearly to the tip of the anal cerci. Eighth and ninth abdominal segments furnished above with lateral longitudinal rows of very long, spinous, rufous hairs; anal cerci greatly thickened at the base for nearly one-fourth their length, about three-fourths as long again as the pronotum.

Length of body, 19.5–23.25 mm.; of pronotum, 5.75–6 mm.; breadth of same, ♂, 4.25, ♀ 4.75 mm.; length of tegmina, 5.75-8.5 mm.; of wings, 21–24 mm.; of hind femora, 5.75–6.5 mm.; of anal cerci, 9.5–10.5 mm.; of upper tibial dactyl, 1.8–2.2 mm. 2 ♂, 2 ♀, Peruvian Marañon.

This species differs from *G. hexadactyla* Perty, to which it is most closely allied, in its much smaller size and slenderer form, its blackish head, the size and relative position of the ocelli, the shortness of the tegmina and length of the wings, the length of the anal cerci, and other minor points which will appear from the description.

It is also distinct from *G. chiliensis* Sauss., as far as one can judge from the very brief and vague diagnosis given in the Revue de Zoologie.

2. Scapteriscus oxydactylus (Perty) Scudd.

A single female brought home by Professor Orton differs from my description of this species in the Memoirs of the Peabody Academy in having no longitudinal lines on the head, the pronotum almost uniformly covered above with dusky blotches, the femora with three equally distinct and equally distant dark blotches on the upper half of the outer surface, and in having six preapical spines on the inner hinder edge of the hind tibiæ; but I have in my collection specimens from the upper Amazons, departing quite as widely from my previous description in the marking, and which have but four preapical spines on the edge of the hind femora. 1 ♀, Peruvian Marañon.

3. Platydactylus bicolor Scudd. 2 ♂, Eastern slope of the Peruvian Andes.

4. Eneoptera sp.

A single male from the eastern slope of the Peruvian Andes, appears to be an undescribed species, but is too imperfect for description.

LOCUSTARIÆ.

5. The pupa of an unknown insect belonging to a new genus of Locustarians, allied to Steirodon, with a flat hexagonal pronotal disc, its side lobate with crenulated edges, and deeply notched behind the middle third, was obtained on the eastern slope of the Peruvian Andes.

STEIRODONOPIS nov. gen.

Head large, as broad as the prothorax; the eyes prominent and widely separated; front and vertex separated by a prominent broken ridge between the eyes, of which the antennal sockets form a part; vertex a little convex, the fastigium reaching just as far forward as the antennal sockets, with a slightly impressed longitudinal sulcation; it is scarcely longer than broad, tapers a little and meets at tip an upturned projection of the front, consisting of a pair of lenticular lobes, at the base of and between which is an ocellus, the others occupying the sides of the fastigium of the vertex. Antennæ very slender. Prothorax slightly concave, longer than broad, the lateral carinæ very prominent, parallel, the front margin a little concave, the hind margin convex to a greater degree. Elytra nearly four times as long as broad, subfusiform, tapering from the middle of the basal third, the point rounded off, the principal veins running subparallel to the hind border, with the neuration generally resembling that of Phylloptera. Wings long and comparatively slender, pointed, surpassing the elytra, and therefore furnished with a coriaceous tip. Legs rather short and strongly compressed, notably the tibiæ, which are twice as broad just beyond the base, on a lateral view, as at tip, giving a foliaceous appearance. The foramina of the fore legs are conspicuous, about as large as the terminal joint of the fore tarsi, but are larger at the distal than at the proximal end. All the abdominal appendages are very short. Male only examined.

6. Steirodonopis bilobata nov. sp.

Green; a line following the ridge between the eyes and passing backward from the middle of the eyes across the side of the head reddish or pink; labrum white, edged laterally at base with pink; lateral carinæ of prothorax with minute and dull denticulations, followed on sides below by a longitudinal, narrow, brownish stripe. Cerci curved upward and inward, with a slight hook at the tip; processes of subgenital plate formed of slight extensions of incurved lateral ridges, each with a minute apical bead-like joint.

Length of prothorax, 7 mm.; breadth of same, 5.75 mm.; length of elytra, 46 mm.; breadth of same, 12.5 mm.; length of hind femora, 20.5 mm.; of wings, 49.5 mm.; of cerci, 2.75 mm. 1 ♂, Peruvian Marañon.

7. Orophus peruvianus nov. sp.

Uniform green, the anal area of the tegmina pale brownish fuscous, the tips of the femora and of the tibiæ, and the tarsi infuscated. Tubercle of vertex very full and rounded, the sides abrupt only at the tip, with a scarcely perceptible longitudinal carina above, and a distinct, but not conspicuous, transverse carina between the antennæ. Pronotum only one-third longer than broad, the hind edge regularly convex, and furnished with a row of very short hairs; posterior half of the disc flat, with distinct and abrupt lateral carinæ; anterior half convex, with rounded carinæ; a pair of distant impressed lines cross either side of the middle transversely, curving backward as they approach the median line, which they do not reach but fall into a slight shallow double pit a little behind the centre. Tegmina subfusiform, broadest before the middle, the apex produced somewhat but rounded, the inner edge scarcely convex. Wings extending somewhat beyond the tegmina in repose. Spines of tibiæ black-tipped. Cerci clavate, and bearing at the tip an appressed, triangular, black-pointed tooth, directed inward; subgenital plate produced, subtriangular, bifid, the two points bearing rather long compressed subspatulate styles.

Length of body, 29 mm.; of tegmina, 41 mm.; of hind tibiæ, 27.5 mm.; distance of tip of wings beyond the hind edge of prothorax, 47.75 mm.; length of subgenital plate and styles combined, 5.5 mm. 1 ♂, Eastern slope of the Peruvian Andes.

8. **Phylloptera tripunctata** nov. sp.

Uniform green; the outer third of the costal edge of the tegmina and the corresponding part of the wings dusky; the edges of the apical half of the ovipositor castaneous; the tarsi and tip of femora dusky. Tubercle of vertex scarcely projecting beyond the front line of the eyes, strongly pinched, apically with parallel sides, the upper half separated from the lower by a slender, but pretty deep constriction in the middle between the antennæ. Front edge of pronotum slightly concave; hind edge well rounded, convex; lateral carinæ rounded off but distinctly marked by the abrupt descent of the sides and the flatness or slight concavity of the upper surface; latter traversed a little behind its anterior third by a slight sulcation, which in its middle fifth curves sharply backward, forming a very deep U-shaped bow, its bottom almost reaching the posterior transverse sulcation which crosses the pronotum behind its middle third and is straight, excepting a slight bend in the middle where it crosses the longitudinal sulcation of the posterior half of the pronotum. Fore femora stouter than the middle femora. Tegmina with three little dusky spots at the base of the three principal branches of the lowest longitudinal vein. Ovipositor short and broad, curved sharply upward, broadest in the apical half, tapering rapidly at the apex to a sharply pointed tip, either edge denticulated throughout, the denticulations of the upper straight edge slightly increasing in size apically, lower edge broadly rounded.

Length of pronotum, 5.25 mm.; of tegmina, 34 mm.; of ovipositor, 5 mm.; greatest breadth of ovipositor, 2.2 mm.; distance of tip of closed wings from hind edge of pronotum, 39 mm.; (hind legs wanting). 1 ♀, Eastern slope of the Peruvian Andes.

ANALLOMES nov. gen. (ἀνά, ἅλλομαι.)

Allied to Phaneroptera. Head of equal width with pronotum, of moderate size. Eyes prominent; tubercle of the vertex extending beyond the plane of the eyes, compressed, constricted in the middle between the antennæ and slightly so in the middle of the upper half as seen from above; its superior surface more or less sulcate. Pronotum quadrate, broadening slightly posteriorly, the front edge slightly concave, the hind edge convex; lateral carinæ distinct but not sharp; the surface varied with a slight longitudinal median sulcation and slighter transverse sulcations. Tegmina moderately broad, three and one-half to four and one-half times longer than broad, the costal edge full next the base, beyond nearly straight, the inner edge slightly and uniformly convex, or also straight in the middle; tip rounded, scarcely produced; stridulating apparatus of male slight, wings ample, broader apically than in allied genera, extending but little beyond the wings in repose. Legs long and slender, the middle femora nearly two-fifths longer than the fore femora, the fore tibiæ greatly thickened at base and furnished with a large obovate tympanum, equally distinct on the two sides, about three times longer than broad; hind femora about as long as the body. Ovipositor ensiform, broader in the middle than at base, about half as long again as the thorax, sharply pointed at the tip, either edge denticulate. Cerci of male simple, cylindrical, rather stout, curved inward and a little upward; of female rather slender, conical, delicately pointed.

9. **Anallomes unipunctata** nov. sp.

Uniform green, the tegmina with a single very small dark reddish spot at the base of the first principal branch of the lowest longitudinal vein and one at the extreme base of the principal nervure; spines of of legs tipped with dark reddish, the tarsi dusky. Tubercle of vertex slender, strongly compressed but slightly constricted in the middle above, deeply and broadly sulcate above, the sulcation continued to the back of the head as a slight furrow; the constriction of the front between the antennæ is very deep, separating the two parts completely. Tegmina about three and one-half times longer than broad, the inner edge gently and regularly convex; wings scarcely extending beyond the tegmina in repose. Cerci tapering only on basal half, bluntly rounded at tip.

Length of prothorax, 3.75 mm.; of tegmina, 28.5 mm.; of hind tibiæ, 17.25 mm. 1 ♂, Eastern slope of the Peruvian Andes.

10. **Anallomes maranona** nov. sp.

Uniform green, the tarsi and to a less extent the extremities of the femora and tibiæ dusky; the apical half of the upper edge, the apical fifth of the lower and the whole tip of the ovipositor castaneous. Tubercle of vertex compressed but not very slender, strongly constricted in the middle above, broadly but not deeply sulcate above; the constriction of the front between the antennæ is only a slender though pretty deep strangulation. Prothorax with a pretty deep longitudinal sulcation, inclosing near the middle a small diamond shaped spot;

and in the middle of the posterior half is an equally distinct, slightly curved, transverse sulcation, its concavity facing forward. Tegmina about four and one-half times longer than broad, inner edge straight for most of the length. Wings extending considerably beyond the tegmina in repose. Ovipositor slightly broader in the middle than at the base, beyond it tapering regularly to a delicate point; the denticulations of the edges very slight, the tip of the upper edge smooth.

Length of prothorax, 4.75 mm.; of tegmina, 28 mm.; of hind tibiæ, 14 mm.; of ovipositor, 8.5 mm.; greatest breadth of ovipositor, 2 mm.; distance from tip of wings in repose to hind edge of pronotum, 32.2 mm. 1 ♀, Eastern slope of the Peruvian Andes.

Cœlophyllum nov. gen. (κοῖλος, φύλλον.)

Head rather small, the middle of the front thrust forward like a great tubercle; fastigium of vertex extending beyond the middle of the basal joint of antennæ, tapering, compressed apically so as to be scarcely more than half as broad as the basal joint of antennæ, sulcate above, its sides hollowed. Antennæ very slender. Prothorax flat above, the lateral angles rounded except at the posterior extremity; front border straight, hind border well rounded. Elytra ample, broader in the apical than in the basal half, costal margin excepting at base and tip straight, inner margin convex, the extremity of the elytra tapering so rapidly as to be almost docked; the two principal veins run side by side down the middle of the elytra; wings very large, longer than the elytra. Legs short and slender, the hind femora not half the length of the elytra; fore coxæ furnished exteriorly with a single slender spine; legs furnished only with abbreviated spines. Ovipositor very short, stout, strongly curved, the edges of the apical half serratulate. The female only seen.

11. Cœlophyllum simplex nov. sp.

The single specimen examined, from having been immersed in alcohol, has lost its colors, which were doubtless of a uniform green devoid of markings, the principal veins of the elytra probably infuscated and the apical half of the ovipositor blackish. Prothorax with a lightly impressed mediodorsal line. Elytra somewhat more than twice as long as broad, the tip very bluntly angulated. All the spines of the legs very small, scarcely elevated. Ovipositor very broad, its apical half convex, with flattened, squamiform, imbricated tubercles, the edges directed forward.

Length of prothorax, 8 mm.; greatest breadth of same, 6 mm. Length of elytra, 42 mm.; greatest breadth of same, 19 mm. Length of hind femora, 18.25 mm.; length of ovipositor, 6.75 mm.; breadth of same, 3.25 mm. Length of wings, 47 mm. 1 ♀, Peruvian Marañon.

12. Meroncidius transvittatus nov. sp.

Allied to *M. innotatus* Walk. Obscure dark brown; head a little duskier above, without vittæ, smooth; inner borders of antennal sockets high, rounded, compressed; tubercle of vertex slight, slender, produced, sulcate superiorly, the ocelli slightly raised. Prothorax moderately and uniformly rugose, with two straight, transverse, pretty deeply impressed lines and between them a nearly equally impressed mediodorsal line; posterior edge slightly thickened, smooth; disc blackish above in advance of the anterior impressed line and behind nearly to the posterior impressed line, forming a pair of characteristic transverse blotches. Prosternum bimucronate. Tegmina and wings unicolorous, the latter fuliginous. Hind femora broad, stout, the apical three-fifths of the lower edge with long moderately stout spines, at the tips slightly curving and black; spines of tibiæ growing duskier toward their tips. Ovipositor darkest at base, broad, tapering pretty regularly, sharply pointed, the upper edge straight, minutely serratulate on the apical half, the lower edge very slightly curved, smooth.

Length of body, 40 mm.; of tegmina, 44 mm.; of hind tibiæ, 24 mm.; of ovipositor, 19 mm.; of antennæ, 69 mm. 1 ♀, Eastern slope of the Peruvian Andes.

13. Leptotettix tessellata nov. sp.

Body, legs, tegmina and ovipositor brownish-yellow (after immersion in alcohol), unicolorous excepting an indistinct rather narrow mediodorsal stripe on the prothorax. Head smooth; tubercle of vertex small, triangular, superiorly trituberculate with a deep hollow between the prominences. Prothorax sparsely and irregularly rugulose, with two straight, transverse, rather deeply impressed lines and a mediodorsal line slightly elevated, excepting on either side of the posterior transverse line where it is distinctly impressed; posterior portion of the pronotum somewhat sellate, posterior border smooth, very sparsely ciliate. Wings opaque, the nervures dusky and all the transverse veins broadly bordered with blackish fuliginous, growing fainter away from the costal border and fading away on either side of the cross veins, giving the whole wing a tessellated appearance. Apical half of the spines on the legs dusky, deepening into blackish toward the tip. Ovipositor slender, pretty regularly but not very strongly curved upward, finely pointed, the upper edge a little protuberant near the base and beyond that very minutely and distinctly denticulate; lower edge regularly curved, the apical fourth minutely and retrorsely denticulate.

Length of antennæ, 103 mm.; of tegmina, 41.5 mm.; of hind tibiæ, 26 mm.; of ovipositor, 12 mm. 1 ♀, Eastern slope of the Peruvian Andes.

14. Conocephalus infuscatus nov. sp.

Allied to *C. tenuicauda* Scudd., and *C. exaltatus* Walk. Smoky brown, the under surfaces of all the femora blackish, the apical half of the tibiæ increasingly fuliginous, the tarsi dark fuscous; ovipositor castaneous, becoming infuscated toward the tip, especially along the edges and the median line; wings hyaline, but the veins smoky brown. Head and thorax rugulose, the latter with more or less dusky mottlings. Tubercle of vertex stout, blunt, scarcely longer than broad, extending nearly as far beyond the front border of the eye as it is beyond the front of pronotum, rounded, with a short, blunt, conical, depending tooth and a dusky transverse line below the middle of the front. Ovipositor slender, shorter than the body. Cerci short, slender, tapering more rapidly next the pointed tip.

Length of body, 30 mm.; of tegmina, 44 mm.; of hind tibiæ, 26.5 mm.; of ovipositor, 22.75 mm. 1 ♀, Eastern slope of the Peruvian Andes.

15. Orchelimum Ortoni nov. sp.

Almost wholly unicolorous, judging from a specimen dried after immersion in alcohol; the tibiæ and tarsi, especially the tips of the tarsal joints, dusky; antennæ wholly dusky, excepting near the base. A very slender species, with the fastigium of the vertex pinched at its base, so as to be no more than half as broad as at summit. Tegmina slender, reaching, when at rest, a little further back than the ovipositor, wings when closed extending still further beyond the tegmina. Legs slender, the fore and middle tibiæ with black-tipped, the hind tibiæ with wholly black spines. Ovipositor nearly straight, slightly curved upward at its pointed tip.

Length of body, 14 mm.; of antennæ, 47 mm.; of hind tibiæ, 14 mm.; of ovipositor, 9 mm.; distance of tip of closed wings from hind edge of pronotum, 22.25 mm. 1 ♀, Peruvian Marañon.

ACRYDII.

16. Astroma hastata nov. sp.

Very closely allied to *A. acuminata* (*Cephalocœma acuminata* Scudd.), but differing from it in its longer and less pointed tubercle of the vertex, its longitudinally vittate head and prothorax, its smooth prothorax[1] and rather stouter legs.

Length of body, exclusive of head, 64 mm.; whole length of head, 21 mm.; length of tubercle beyond the eye, 10 mm.; of antennæ, 5.25 mm.; of prothorax, 16.5 mm.; of mesothorax, 4 mm.; of hind femora, 24 mm. 1 ♀, Eastern slope of the Peruvian Andes.

The generic name Astroma (1841) has priority over Cephalocæma (1843).

17. Mastax nigra nov. sp.

Head, whole upper surface of prothorax and tegmina, together with the terminal joints of the abdomen and the smaller joints of the antennæ, black; rest of body, together with the basal joints of the antennæ, the adjacent parts of the front, the labrum and mouth parts, yellow; anterior four legs yellow, but the tarsi blackish infuscated, and the two superior carinæ of both femora and tibiæ blackish; basal half of hind femora yellowish brown, two superior and two inferior carinæ black; rest of hind legs, including tarsi, black; the middle of the outer half of the femora faintly banded above with yellowish; wings uniform chalky white. Tegmina and wings equal, reaching, when at rest, far beyond the tip of the abdomen.

Length of body, 15.5 mm.; of tegmina, 20 mm.; of hind tibiæ, 16.5 mm. 4 ♂, Eastern slope of the Peruvian Andes.

18. Mastax Gundlachii nov. sp.

Head testaceous, the antennæ concolorous, very short. Body brownish testaceous, the lower portion of the lateral lobes of the pronotum with a triangular blackish area, pointed forward; posterior borders of the abdominal joints dusky; hind tibiæ reddish toward tip, the spines largely tipped with black. Tegmina exceedingly minute, no longer than the shorter diameter of the eye, bluntly pointed at tip. Wings wanting.

[1] My description of *C. acuminata* has one very strange inaccuracy; for "Prothorax slightly rugose, with short, transverse, impressed lines and punctures," read: Prothorax sparsely covered with slight, rounded, punctured tubercles, and furnished with slight medio-dorsal and lateral carinæ.

Length of body, ♀, 25.25 mm.; of abdomen and appendages, ♂, 8.75 mm.; ♀, 16.5 mm.; of antennæ, ♀, 3 mm.; of hind tibiæ, ♂, 12, ♀, 17 mm. 1 broken ♂, 2 ♀, Cuba, Dr. Gundlach, with the number $\frac{58}{13}$.

HIPPACRIS nov. gen. (ἵππος, ἀκρὶς.)

Head full, rounded, but the front appressed; tubercle of vertex nearly in same plane with vertex, a little inclined, broad, narrowing beyond the eyes, but squarely docked, flat; the middle of the inner edge of the eyes midway between its tip and the base of the head. Front on a side view vertical, but inclined where it projects forward to reach the tip of the tubercle of the vertex, and here only provided with a frontal costa, which narrows a little below and is shallowly sulcate; space between eyes equal to width of eyes themselves; these are rather small, rather prominent, round, separated by a little more than their own width from the anterior base of the mandibles; the latter exceedingly stout; antennæ more than twice as long as the pronotum, the joints beyond the second depressed and gradually tapering so as to give them somewhat the appearance of a Truxalis. Prosternum unarmed; pronotum very large, broadening posteriorly so as to be fully doubly as wide behind as in front; the disc expanded so that the lateral carinæ become very prominent, increasingly so posteriorly, directed outward rather more than upward, and serrulate; it is destitute of a median carina, and is traversed transversely by three slenderly impressed, equidistant, parallel, curved lines, the convexity backward, the hinder in advance of the middle of the disc; front border straight, a little excised in the middle, hind border obtusely and roundly angulated. Tegmina slender, nearly equal, the tip rounded, fully as long as the abdomen. Wings rather narrow. Legs not very stout, the hind femora flattened above with a sharp superior carina and a similar lateral one. Valves of the ovipositor very stout, their tips strongly curved and pointed.

I do not know of any genus to which this is closely allied. By Stål's tables (Recensio Orth., I) it should belong to the Truxalidæ, which the shape of the antennæ favors; but the small size of the eyes coupled with the almost or quite vertical front, and the posterior lobe of the pronotum longer than the anterior, is at variance with his statement. In some respects it resembles Rhomalea, in others Tropinotus, but the prosternum is wholly devoid of armature.

19. Hippacris crassa nov. sp.

Dull brownish yellow, the antennæ a little infuscated, the tips of the femora and base of the tibiæ blackish; tarsal joints tipped with blackish, the apical half of the claws and spines black; tegmina yellow (green in life?), toward the apex subhyaline; wings hyaline, a little sordid, the veins brownish fulvous. Vertex of the head with a few punctures arranged in rows; front deeply punctate; pronotum, especially the posterior half, rugose; the edges of the lateral carinæ irregularly serratulate.

Length of body, 31 mm; of antennæ, 20 mm; of pronotum, 11.25 mm.; greatest width of pronotum, 10.75 mm.; length of tegmina, 26 mm.; breadth of same, 6.25 mm.; length of hind tibiæ, 14 mm. 1 ♀, Eastern slope of the Peruvian Andes.

20. Zonocerus? bilineatus nov. sp.

Ferruginous brown; the antennæ infuscated beyond the base; the lateral carinæ of the pronotum edged below with a narrow blackish stripe, most intense above, which runs from the hinder edge of the eye to the base of the tegmina. Tegmina blackish fuliginous, mottled with testaceous, the anal area luteous, immaculate. Wings hyaline, faintly fuliginous, increasing slightly in intensity toward the border; costal border blackish, especially beyond the middle. Hind tibiæ infuscated on their posterior third; spines and claws black-tipped.

Length of body, 19 mm.; of antennæ, 10.5 mm.; of hind tibiæ, 6.5 mm.; of tegmina, 15.5 mm. 1 ♀, imperfect, eastern slope of the Peruvian Andes.

21. Machærocera nigromarginata nov. sp.

Blackish brown above; rest of head and prothorax pale cinereous. Upper surface of head bluntly rugulose, with a distinct median carina. Pronotum bluntly rugose in front, depressed rugulose behind, with a distinct, rather sharp median carina. Tegmina blackish fuliginous, darkest on the apical half where the nervures are closer; wings dull orange, sulphureous at the base, surrounded by black, which occupies the whole of the costal area, excepting the very base and the outer border nearly to the middle of the wing; spines of hind legs black tipped.

Length of body, 21.75 mm.; of tegmina, 19 mm.; of wings, 17 mm.; of hind tibiæ, 13 mm. 1 ♂, Eastern slope of the Peruvian Andes.

PRORHACHIS nov. gen. (προ, ῥάχις.)

Allied to Procolpia Stål. Antennæ 22–23 jointed, as long as the abdomen, joints 3–8 broadest and flattened, those beyond punctulate. Eyes very prominent. Tubercle of vertex greatly produced, horizontal, the part in front of the eyes being as long as the rest of the head, slightly concave, tapering, the tip narrow but rounded, the lateral edge with small, slightly upturned, triangular, median denticulations; viewed laterally it is subquadrate, the front edge very strongly compressed to a thin edge without trace of sulcation. Pronotum with small rounded distant tubercles, a slight, uniform, subserrate median carina, the front margin straight, but with a slight triangular projection on either side of the middle; hind border with oblique sides, and a rather large, rounded, median lobe slightly notched posteriorly. Tegmina longer than the abdomen, the front margin considerably and roundly produced near the base; beyond this the tegmina taper and are accuminate. Hind femora moderately stout, tuberculate, rather flattened above; the superior lamina traceable only by the compressed tubercles, but at the extremity of the joint very prominent, compressed, strongly carinate, abruptly docked posteriorly, the carina slightly produced to a point; hind tibiæ with a stout blunt tubercle next the base posteriorly, noticeable only on a side view; interior spines of same tibiæ nearly three times as long as the exterior.[1]

22. **Prorhachis granulosa** nov. sp.

Dusky feruginous. Antennæ reddish brown. Head uniform in

[1] Another genus allied to Procolpia, though not so closely as the foregoing, is *Æolacris* (αἰόλος, ἀκρίς) nov. gen. Antennæ of about the length of the abdomen, joints 3-7 broadest. Eyes very prominent. Tubercle of vertex greatly produced, horizontal, the part in front of the eyes nearly or quite as long as the rest of the head, and separated from it by a transverse sulcation, scarcely concave apically, scarcely tapering, broadly rounded in front; viewed laterally it is triangular, the oblique front edge strongly compressed to a thin edge, but delicately sulcate, excepting above. Pronotum with lateral carinæ which are very stout, coarse, granulate and parallel in the posterior half, noticeable only as a series of granulations and converging in the anterior half; front border angulated on either side of the middle; hind border produced and angulated at slightly less than a right angle. Tegmina longer than the abdomen, subequal throughout, the tip roundly docked. Hind femora slender, a little flattened above, with an equal, very slight dorsal carina; inner row of spines on hind tibiæ excessively long, the upper ones compressed, broadly laminate at the base. Type *Xiphicera octomaculata* Scudd. To this genus also belong *X. Caternaultii* Feisth. and *X. octolunata* Serv.

color. Pronotum with a medio-dorsal, rather broad yellowish vitta, and the lower half of the lateral lobes clouded with the same. Tegmina dark brown, the inner edge yellowish, appearing as a continuation of the pronotal vitta when the tegmina are closed. Wing a little shorter than the tegmina, blackish fuliginous, the cross veins delicately marked in whitish next the longitudinal nervures; the basal portion of the wing, including all that portion lying as near the base as the middle of the front margin, pale, possibly yellowish in life. Legs uniform, the tarsi dull brownish luteous. The tips of the longest spines and all the granulations of the pronotum and hind legs black.

Length of body, 26 mm.; of tegmina, 30 mm.; of wings, 26.5 mm.; of hind tibiæ, 13 mm.; of antennæ, 15.5 mm. 1 ♂, Eastern slope of the Peruvian Andes.

23. Elæochlora Brunneri nov. sp.

Brownish cinereous. Antennæ 15–16 jointed, scarcely longer than the pronotum, joints 3–5 equally broadened and noticeably broader than the others. Tubercle of vertex subtriangular, horizontal as viewed from above, the angles much rounded, the upper surface shallowly concave, with two slight, lateral, longitudinal plicæ within the slightly emarginate edge; viewed laterally it is bluntly rounded at the tip, the frontal costa distinctly sulcate almost to the tip. Head with a slight medio-dorsal sulcation. Pronotum coarsely but slightly shagreened and subtuberculate, with a low but distinct and equal mediodorsal carina, the lateral carinæ scarcely perceptible from the arched form of the pronotum; front border straight or slightly rounded; hind border obtusely angulated, the middle slightly produced but bluntly docked. Tegmina scarcely extending beyond the abdomen, tapering, very bluntly pointed, the front border a little and very roundly produced near the base, pale cinereous blotched with darker cinereous. Wings scarcely as long as the tegmina, full and rounded, pellucid (tinged with yellowish in life?) a little clouded next the apical half of the front and outer border, and the nervures and cross veins of this part blackish. Legs of the color of the body, nearly uniform, but the hind femora with a faint transverse median pale band, and the under surface of the tarsi blackish; spines of hind tibiæ and tarsi, as well as claws, black tipped.

Length of body, 27 mm.; of antennæ, 6.5 mm.; of tegmina, 18 mm.; of wings, 16 mm.; of hind tibiæ, 12 mm. 1 ♂, Eastern slope of the Peruvian Andes.

This species differs so much from Stål's description of Elæochlora, that I have placed it there with much doubt; and have also, on that account, given in my description some parts which more properly belong to a generic diagnosis.

APLATACRIS nov. gen. (ἄπλατις, ἀκρὶς.)

Allied to Lophacris Scudd. Head large, full; space between eyes equal to (♀), or less than (♂), the longer diameter of the eye; median frontal ridge prominent, narrow, sulcate, no broader than the width of the first antennal joint. Antennæ scarcely shorter than the hind tibiæ. Pronotum with a very high, very stout crest, divided into four sections by very deep, transverse sulcations, all but the foremost of which traverse the whole pronotum, the hindmost breaking the otherwise regular curve of the dorsal carina; anterior edge of pronotum produced forward rather more than in Lophacris, and angulated; posterior margin acutely angled; anterior two thirds sparsely covered with very elevated granulations; on the posterior third they are more abundant, more or less confluent and compressed, the spaces between them rugose; prosternal thorn large, stout, straight, bent backward in the ♂, conical, bluntly pointed. Tegmina scarcely reaching the tip of the abdomen, but little more than three times as long as broad, equal throughout, the apex pretty regularly rounded, all the nervures prominent; wings shorter than the tegmina, exceedingly broad, rounded, the longitudinal veins distant and the border of the wing full between them; cross veins at tip as regular, and the cells as large, as in other parts of the wing; area between the first and second branches of anal vein not noticeably broader than in the adjoining areas and divided by cross veins into spaces about half as long again as broad, similar in the two sexes; second branch of the anal vein straight in both sexes, emitting a little beyond the middle a stout superior shoot; intercalary veins of anal area reaching at least half way toward the base of the wing. Outer surface of hind femora swollen. Abdomen stout.

24. Aplatacris colorata nov. sp.

Greenish testaceous, the male duskier. Upper half of head smooth, lower half distinctly rugulose. Tegmina brown with greenish nervures. Wings blackish purple, the disk broadly chocolate brown and the transverse vein of this part with pellucid borders giving a mottled appearance to the wing. Spines of hind tibiæ pretty stout, blackish.

Length of body, ♂ 56, ♀ 79 mm.; of antennæ, ♂ 29, ♀ 36 mm.;

of pronotum, ♂ 18.5, ♀ 28 mm.; of tegmina, ♂ 35, ♀ 42 mm.; of wings, ♂ 29.5, ♀ 38.5 mm.; breadth of wing, ♂ 28, ♀ 33 mm.; length of hind tibiæ, ♂ 28.5 ♀ 37 mm. 1 ♂, Eastern slope of the Peruvian Andes. 2 ♀, Peruvian Marañon.

25. Ommatolampis leucoptera nov. sp.

Female. Ferruginous brown; a dull pale yellowish streak passes from the upper border of each eye to the base of the tegmina of the same side, generally very indistinct upon the head; tip of the hind femora and base of hind tibiæ strongly infuscated, the rest of the hind tibiæ and hind tarsi dull luteous. Tubercle of the vertex with a shallow longitudinal median sulcation; the eyes separated above by the width of the first antennal joint; last palpal joint conspicuously flattened, ovate; apical half of antennæ infuscated. Pronotum without lateral carinæ, and a barely perceptible dorsal carina, the front border very slightly notched in the middle, the hind margin straight; the whole surface, as well as that of the abdomen, rugose, with rather deep, large, roundish pits having sharply defined though rounded walls. Tegmina oblong obovate, rounded at the tip, about four times as long as broad, pale yellowish white with deep large punctures and stabs. Wings not half as long as the tegmina. Distal half of spines of hind legs black; claws and pads black.

Male. In general color the male is much paler, being dull brownish-yellow, without any trace of the lateral stripe on head and pronotum; the apical two-thirds of the antennæ are infuscated, but only the apical half of the claws, while the pads are scarcely darker than the tibiæ. In addition to these colorational distinctions the tubercle of the vertex is deeply sulcate above, the space between the eyes is distinctly less than the width of the basal antennal joint, the pronotum and abdomen are far less rugose, pitted profusely with comparatively small and shallow indentations without sharply defined walls, the pronotum has no trace of a dorsal carina, and the tegmina are broadly obovate, scarcely twice as long as broad. I should have considered the sexes distinct species, did not precisely similar distinctions hold in the one next to be described.

Cerci short, stout, trigono-pyramidal, the middle of the inner surface with a flattened, pyriform, laminate tooth, directed inward, the produced apex rounded, the plane of the whole vertical.

Length of body ♂ 20.5, ♀ 31 mm.; of antennæ, ♂ 17, ♀ 15 mm.; of tegmina, ♂♀ 5 mm.; of hind tibiæ, ♂ 14, ♀ 18 mm. 1 ♂, Peruvian Marañon; 3 ♀, Eastern slope of the Peruvian Andes.

26. Ommatolampis aptera nov. sp.

This species differs most conspicuously from the preceding in the total absence of tegmina and wings, but also in the following particulars: the females have no longitudinal stripe on the head and pronotum, the pronotum and abdomen are less heavily and less regularly rugose, the pronotum has no trace of a dorsal carina, the upper surface of the hind femora are deeply punctate, the whole outer surface of the same femora are deeply infuscated, the tubercle of the vertex is not sulcate, the space between the eyes is narrower than the first antennal joint, and the last palpal joint is not so conspicuously ovate. The male, so far as it can, differs similarly from the male of *O. leucoptera*; the sides of the head, the pleura of the pro- and mesothorax and the lower third of the lateral lobes of the pronotum are pale yellow; the cerci are compressed laminate, rather long, bent inward considerably in the middle, beyond the middle slenderer, a little upturned, and furnished on the posterior edge, before the tip, with a triangular laminate tooth lying in the plane of this part of the appendage.

Length of body, ♂ 15, ♀ 23 mm.; of antennæ, ♂ 13.5, ♀ 9 mm.; of hind tibiæ, ♂ 10, ♀ 12 mm. 1 ♂, 2 ♀, Eastern slope of the Peruvian Andes.

27. Ommatolampis nigroguttata nov. sp.

Brownish ferruginous; antennæ black, summit of head and whole of thorax punctured and rugose as the pronotum is in *O. leucoptera*; the tegmina black with ferruginous veins, leaving a clear, oval, black patch at the extremity of the upper margin; hind femora slightly infuscated at tip. Tubercle of vertex with a shallow, but distinct sulcation; the space between the eyes about equal to the width of the first antennal joint, scarcely narrower in the male than in the female; last palpal joint ovate, but not so conspicuously as in *O. leucoptera*. Pronotum with a stout but slight median carina, and very slight but coarse lateral carinæ, the front border with a slight median notch. Tegmina oblong obovate, the upper border roundly arched in the middle, and on this account only a little more than twice as long as broad. Cerci of female simple, short, stout, conical; those of male similar, but a little produced at tip, and with a distinct superior perforation next the base. The male resembles the female in all the peculiarities of sculpture and marking, whether of the head, pronotum or tegmina.

Length of body, ♀ 25 mm.; of antennæ, ♂ 10, ♀ 11 mm.; of tegmina, 4.15 mm.; of hind tibiæ, ♂ 11, ♀ 13 mm. 1 ♂, 3 ♀, Eastern slope of the Peruvian Andes.

28. Phæoparia curtipennis nov. sp.

Whole front of head and first eight joints of antennæ reddish luteous; rest of antennæ black, excepting the sides of the eighteenth joint and the tip of the apical, which are dull luteous; rest of body reddish brown, the sides of the head and pronotum blackish, the tegmina and tips of the hind femora deeply, the sides of the hind femora and the basal half of hind femora somewhat, infuscated; rest of legs dull reddish luteous, the spine excepting at the base, and the claws excepting the basal half, blackish. Frontal carina very deeply and broadly sulcate, embracing all but the lateral edges; summit of the apical half of the head and the tubercle of the vertex with a rather slight median carina; whole upper surface of head and whole of pronotum irregularly and rather heavily, as well as profusely rugose; a compressed, rather slight, median carina extends the whole length of the thorax and abdomen; lateral carinæ of pronotum wanting, although the dorsal and lateral field are clearly distinct. Tegmina oblong obovate, the tip rounded, the lower border slightly and roundly excised before the middle, the dorsal and lateral areas clearly distinguished, the whole tegmina rugose, about three times longer than broad. Cerci simple, long, conical, slightly flattened, the apical third much slenderer, nearly cylindrical, incurved, the apex bluntly rounded.

Length of body, 21.75 mm.; of antennæ, 11 mm.; of tegmina, 4.5 mm.; of hind tibiæ, 13 mm. 1 ♂, Eastern slope of the Peruvian Andes.

29. Acridium (Schistocerca) occidentale Scudd. 1 ♀, Eastern slope of the Peruvian Andes.

30. Acridium (Osmilia) labratum Scudd. 3 ♂, 1 ♀, Eastern slope of the Peruvian Andes.

31. Acridium (Osmilia) Saussurei nov. sp.

Ruddy brown, whole front of head, including frontal carina, distantly punctate; antennæ a little infuscated at the tip. Vertex slightly sulcate between the eyes. Pronotum with an indistinct median carina, the anterior half of the disc very indistinctly rugulose, the posterior half more distinctly and profusely, and punctulate in the pits. Tegmina concolorous with the body, the apical half subhyaline, and very faintly blotched with fuliginous. Wings hyaline, the nervures and cross veins of basal half of the wing (excepting close to the costal border) yellowish white, beyond blackish; costal edge beyond the middle testaceous. Lower exterior carina of hind femora yellowish; hind tibiæ dull luteous, the spines and all the claws black on apical half, the pads dusky.

Length of body, 33 mm.; of antennæ, 9.25 mm.; of tegmina, 32.5 mm.; of hind tibiæ, 16.75 mm. 1 ♀, Eastern slope of the Peruvian Andes.

EUPARNOPS nov. gen. (εὖ, πάρνοψ.)

Allied to Oxya Serv. Head shorter than the pronotum, the vertex tumid, the tubercle descending in continuation of the curve of the vertex, broadly rounded in front; the front a little oblique, with a prominent, equal, median carina, having a flat field and passing but half way down the face; lateral carinæ rather sharply prominent; antennæ more than double the length of the pronotum, linear. Pronotum rounded transversely, rather smooth, with a slight median carina, the front border a little full, the hind border very obtusely angulated, the lower edge of the lateral lobes very convex on the posterior half. Tegmina long and slender, nearly equal, well rounded at the extremity; wings a little shorter than the tegmina, rather slender; hind femora furnished at the tip beneath with an acutely angulated laminate lobe; upper posterior edge of apical half of hind tibiæ forming a pretty high, sharp, ciliated lamina; lower spines at tip of hind femora very large, elongated, compressed, and claw-shaped, being upcurved at the tip. Valves of female abdomen denticulate on the outer margins; male abdomen somewhat resembling that of Arcyptera, the cerci somewhat compressed, tapering, bent before the middle, the apical portion gently curving.

32. Euparnops cæruleum nov. sp.

Yellowish testaceous, very likely with a greenish tinge in life, the top of the head with a subtriangular black spot pointing forward, extending from the base of the head to the narrowest point between the eyes; a broad blackish brown band extends from the whole hinder edge of the eye to the base of the tegmina; the antennæ are black, excepting the apical three joints, which are luteous, and the outer edge of many of the joints, which are dashed with the same. The tegmina are testaceo-fuliginous, the whole anal area, and the nervures and cross veins of the rest of the tegmina, yellowish. Wings faintly cærulean blue, the apical two-fifths of the costal edge black, and the outer border margined for nearly half its length with fuliginous, the cross veins being black, broadly, or about one-fifth of the length of the costal margin, above, narrowing below. All the femora, but especially the hind pair, blackish; the lower surfaces and sides of the hind tibiæ, excepting a narrow, dull orange belt near the base, blackish; the tarsal joints are more or less blackish, the spines and claws black.

Length of body, ♂ 21, ♀ 25 mm.; of antennæ, ♂ 13, ♀ 10 mm.; of tegmina, ♂ 19.5, ♀ 20.5 mm.; of hind tibiæ, ♂ 13, ♀ 13.5 mm. 2 ♂, 1 ♂, Eastern slope of the Peruvian Andes.

Cornops nov. gen. (κόρνοψ.)

Allied to the preceding. Head shorter than the pronotum, the vertex nearly flat, the tubercle scarcely descending, triangular, longitudinally sulcate, bluntly angulated in front; front rather oblique, perfectly straight, with a rather prominent, nearly equal median carina, running down most of the face and shallowly, broadly sulcate; lateral carinæ sharply defined throughout, a little sinuous. Antennæ fully half as long again as the head and pronotum together, linear. Pronotum rounded transversely, gently punctulate, with a scarcely perceptible median carina and no lateral carinæ, the front margin a little full, the hind border obtusely angulated, lower edge of the lateral lobes full on the posterior half. Tegmina very long and slender, equal, rounded at the tip, but very slightly produced. Wings a little shorter than the tegmina, rather slender. Hind femora with a lower apical lobe, as in Euparnops, but not so conspicuous; upper posterior edge of apical half of hind tibiæ produced slightly to a laminate edge, and ciliate; lower apical spines of hind tibiæ much as in Euparnops, but much more pointed, and produced at the tip. Valves of female abdomen very stoutly, coarsely and profusely denticulate on the outer margin.

33. Cornops bivittatum nov. sp.

Luteous; edges of labrum blackish; antennæ, excepting at base, fuscous; a broad straight black band extends from the posterior edge of the eye to the base of the tegmina. The latter fuliginous, the anal area yellowish, the middle of the costal edge blackish, and all the cross veins of the outer half of the central field black. Wings hyaline, with black veins and cross veins, faintly fuliginous on the outer half, deepening toward the margin, and blackish along the costal edge; the vein marking the anterior fold of the wing and the immediately adjacent parts are luteous. Tip of hind femora, base and tip of hind tibiæ black or blackish, the apical half of all the spines and claws black; denticulations of ovipositor black.

Length of body, 26.5 mm.; of antennæ, 11.5 mm.; of tegmina, 23.5 mm.; of hind tibiæ, 11.5 mm. 1 ♀, Eastern slope of the Peruvian Andes.

34. Cœlopterna Stålii nov. sp.

Top of head and pronotum black, inconspicuously and distantly spotted with yellowish; rest of head and pronotum, as well as the abdomen, yellowish; antennæ testaceous at the base, beyond luteous, with dusky incisures, at the tip infuscated. Fore and middle legs yellowish, spotted and indistinctly banded with brownish; hind femora dull yellowish, the upper surface with a basal, antemedian and post-median, the outer border with a post-median transverse bar of dark brownish; hind tibiæ dull luteous. Tegmina blackish brown on basal third, beyond subhyaline, with brownish fuliginous transverse clouds, most distinct on inner border. Wings hyaline, with blackish nervures and cross veins, excepting next the costal margin, where they are fulvous.

Length of body, 16 mm.; of antennæ, 6.5 mm.; of tegmina, 17.5 mm.; of hind tibiæ, 8.5 mm. 1 ♀. Peruvian Marañon.

The genus Cœlopterna, as well as the sub-family Cœlopternidæ, was founded by Stål upon the *Acrydium acuminatum* of De Geer, of which he says "exampla duo valde mutilata examinavi." Among other parts that were wanting were the hind tarsi, which are very peculiar in the species which I have the pleasure to add to this group. They are excessively slender and strongly compressed; so minute is the middle article that at first I thought them but two-jointed; the first and third joints are equal in length, and either of them scarcely longer than the produced, depressed sulcate apical spines of the tibiæ, between which the basal joint lies; there is a small but well formed pad.

35. Tettigidea cuspidata nov. sp.

Blackish brown, the head a little paler; frontal carina of the head compressed, rather prominent, sulcate from the middle of the eyes downward. Whole head and pronotum as well as hind femora covered rather profusely with minute depressed granulations, giving a brighter appearance to the insect from their reflection of the light. Pronotal shield extending behind nearly to the tip of the posterior femora, the front border angulated, and the compressed, slightly elevated, but very distinct, median carina produced anteriorly to a sharp point, reaching to the upper base of the frontal carina of the head. Tegmina flat with very few and very indistinct granulations, and excessively minute and crowded punctulations. Wings very short, claws sharply spurred at the base; valves of ovipositor rather stoutly serratulate.

Length of body, 17.5 mm.; of pronotal shield, 13 mm.; of hind tibiæ, 8 mm. 1 ♀, Eastern slope of the Peruvian Andes.

PHASMIDA.

36. Bacteria nigripes nov. sp.

Head short, obovate, smooth, pale testaceous, gibbous, with a slight dusky medio-dorsal line, and sometimes with longitudinal dashes on the sides; basal joint of antennæ pale testaceous, depressed, largest just before the apex, the remainder black. Pronotum of the color of the head, sometimes infuscated, the anterior angles a little produced laterally, the sides delicately emarginate; all the legs blackish, the coxæ testaceous and very large, so that the fore femora are straight throughout; middle femora with a slight apical lobe posteriorly. Body, excepting at the posterior extremity of the meso- and metathorax, blackish, but the terminal three segments of the abdomen again testaceous. Abdomen with a slender medio-dorsal yellowish line; joints of abdomen a little dilated at the distal and a little constricted near the proximal extremity, the last three joints greatly swollen. Styles almost straight, rather stout, cylindrical, roundly and very bluntly terminated.

Length of body, 63 mm.; of hind tibiæ, 37 mm.; of middle tibiæ, 52 mm.; of fore tibiæ, 32 mm. 2 ♂, Eastern slope of the Peruvian Andes.

37. Bacteria exigua nov. sp.

Testaceous, very slender. Head subcylindrical, half as long again as broad, with a few distant minute points scattered about, a little appressed anteriorly above, producing a slight, blunt, curved, transverse ridge between the eyes, uniting the posterior bases of the antennal sockets; basal joint of antennæ depressed, of equal width beyond the base. Pronotum of the width of the head, and of equal size throughout, excepting a slight expansion above the coxæ; the front and sides broadly and very slightly emarginate, the anterior half separated from the posterior by a deep sulcation and with a longitudinal impressed line. Legs unarmed, the anterior femora waved at the base; all the femora faintly annulate with alternate broad bands of testaceous and dusky brown, commencing at the base with testaceous. Joints of abdomen marked only by the incisures, the last three joints, and especially the ante-penultimate, considerably swollen; the posterior angles of the last joint produced posteriorly into two short, rounded lobes, delicately serrated along the inner and posterior edges, the serrations directed inward. Styles moderately slender, cylindrical, a little upcurved and a little incurved, the tip depressed and a little twisted, so that the straightly docked apical edge is oblique, its angles rounded off.

Length of body, 79 mm.; of hind tibiæ, 34 mm.; of middle tibiæ, 24 mm.; of fore tibiæ, 38 mm. 1 ♂, Eastern slope of the Peruvian Andes.

This species is evidently allied to *B. turgida* Westw.

38. Phasma radiatum nov. sp.

Blackish, very slender. Head blackish, with smooth parts; excepting apical joints of palpi, and a narrow ferruginous stripe behind the eyes, pale ferruginous; the stripe continued over the whole length of pro- and mesothorax, accompanied by a similar rather broader stripe connecting the fore and middle coxæ. Pro- and mesothorax with a slightly impressed medio-dorsal line, and very slight and very blunt tuberculations above; metathorax and basal joints of abdomen pale above and below. Tegmina scarcely longer than the thorax, the nervures elevated and on the apical half blackish, in contrast to the pale base and interspaces. Folded portion of the wings with a similar effect, the part covered by the tegmina being pale, the rest blackish, with very pale or whitish lines, a median very slender, and one on either side broader but still very slender; rest of wing blackish fuliginous, with a large basal, rounded, very broadly obovate, whitish spot, reaching nearly to the inner border, and in the middle of the wing half way to the outer border. Legs blackish brown, the femora paler at the base and lineate with ferruginous. Styles short, moderately slender, cylindrical, a little upcurved, bluntly rounded and a little thickened at the extremity.

Length of body, 31.5 mm.; of antennæ, 31 mm.; of wings, 21.5 mm.; of fore tibiæ, 7.5 mm.; of middle tibiæ, 5.75 mm.; of hind tibiæ, 9 mm. 1 ♀, Peruvian Marañon.

Apparently allied to *P. ambiguum* Westw.

MANTIDES.

39. Stagmatoptera binotata Scudd. Allied to *S. prædicatoria* Sauss. One specimen from the Peruvian Marañon.

40. Oxyops sp. A single pupa belonging to this genus was brought from the Eastern slope of the Peruvian Andes.

BLATTARIÆ.

41. Periplaneta americana Burm. One larva from the Eastern slope of the Peruvian Andes.

42. Blabera armigera Scudd.

Specimens were obtained on the Peruvian Marañon and at Manaos, all of them females, and, as would be expected, somewhat larger than the males, the body and closed tegmina together being nearly three inches long. It should be noted that the lower posterior edge of the basal half of the fore femora is furnished with three small and short, but stout spines.

43. Panchlora signifera nov. sp.

Head castaneo-luteous, with two small transverse dark spots, one between the distant eyes and one in the middle of the front; eyes black; antennæ dark castaneous, luteous toward the tip. Pronotum having something of the appearance of that of Blabera, smooth, the front and lateral borders slightly emarginate, the centre with a very large roundish spot partially divided in the middle into two sub-reniform spots of dark brown, the surface with slight transverse plications and a medio-dorsal series of inequalities. Elytra luteo-fuliginous. Whole under surface dark brown, the abdomen almost black, shining, the rather stout legs fuliginous brown or castaneous, the middle and hind femora with a pair of slight spines. Wings in repose, reaching the extremity of the tegmina.

Length of pronotum, 8 mm.; breadth of same, 10.3 mm.; length of whole body, 24 mm.; of antennæ, 12 mm.; of tegmina, 27 mm.; of hind tibiæ, 7.75 mm. 1 ♀, Eastern slope of the Peruvian Andes.

FORFICULARIÆ.

44. Thermastris Dohrnii nov. sp.

Head blackish castaneous; antennæ and palpi brownish castaneous. Disc of the pronotum of the same width as the head, similarly colored, but the expanded portion luteous, with a slight medio-dorsal impressed line; all the angles are well rounded. Tegmina with the dorsal area nearly three times as long as broad, blackish castaneous, with a broad, posteriorly narrowing, longitudinal, luteous band, extending from close to the base to near the tip, leaving between it and the sutural line a narrow stripe of blackish castaneous. Exposed part of wings (at rest) yellow outwardly, black inwardly, both tegmina and exposed part of wings covered sparsely with very short, erect, rather stout, black hairs. Femora and tibiæ blackish; tarsi honey yellow. Abdomen castaneo-piceous above, dark castaneous beneath, broadest beyond the middle; the last segment is subquadrate, gibbous, with lateral carinæ growing larger posteriorly, so as to give it a pinched appearance, a broad, sulcate, medio-dorsal depression, deepest in the middle of the segment, at the bottom of which is an impressed line; the sides of the four segments preceding this produced backward into points, increasingly so toward the extremity of the body, the prolongations of the penultimate extending half way down the sides of the last segment. Forceps stout, depressed, subtrigonal, tapering regularly to a blunt point, the apical two-fifths curved more or less strongly inward.

Length of body, exclusive of forceps, 15.5 mm.; of tegmina, 4.6 mm.; of distance of closed wings beyond tip of tegmina, .75 mm.; of forceps, 3.5 mm. 1 ♀, Eastern slope of the Peruvian Andes.

NEOLOBOPHORA nov. gen.

Body moderately convex. Head very slightly convex, of equal length and breadth, narrowing slightly behind; first joint of antennæ long and stout, largest at the distal extremity; second as long only as its breadth, cylindrical; third, fourth and fifth increasing a little in length, each more than the last, slightly obconic, the third at least twice, and the sixth and following more than four times as long as broad. Pronotum quadrate, of about equal breadth with the head, the margins, excepting the posterior, which is slightly convex, straight, the angles scarcely rounded. Tegmina short; wings wanting (?) Legs moderately long, slender, third tarsal joint nearly or quite as long as the first, the second very short, lobed beneath, the lobes passing beneath the base of the apical joint. Abdomen rather gibbous, enlarging in size, and especially in breadth, to beyond the middle, when it rapidly narrows again; the last segment alike in the two sexes, simple, narrowing rapidly, half as long as the breadth of its base; second and third segments with lateral plications, above largest posteriorly. Forceps very long and very slender, cylindrical, and nearly straight, incurved a little at tip.

This genus represents Lobophora in the new world, having the peculiar lobe to the middle joint of the tarsi characteristic of that genus, together with the pinched lateral carinæ of the second and third abdominal segments; it differs from that most conspicuously in the broadened abdomen, and slender, cylindrical forceps.

45. Neolobophora bogotensis nov. sp.

Head and disc of prothorax piceous, the lateral edges of latter castaneous. Tegmina and abdomen blackish castaneous, the wings wanting. Basal joint of antennæ luteo-fuscous, the rest dull luteous. Legs rufo-luteous, the femora and tibiæ infuscated away from the base. Forceps dark castaneous, trigono-cylindrical, slender, tapering, finely pointed, the apical third gently incurved, with a row of very inconspicuous, distant, bead-like prominences along the whole inner edge.

Length of body exclusive of forceps, 10 mm.; of tegmina, 1.8 mm.; of forceps, 3.5 mm.; of hind femora, 3 mm. 1 ♀, Bogota, received from Mr. P. R. Uhler.

I have introduced the description of this form merely to mention that a second species of the genus was found by Professor Orton in the Peruvian Andes, but it is in the pupal state only.

List of the Species of Hemiptera and Neuroptera, obtained by Prof. James Orton, in Northern Peru. By P. R. Uhler.

HEMIPTERA.

Scutelleridæ.

Pachycoris discrepans nov. sp.

Black, polished, minutely rugulose, broadly oval; somewhat resembling *P. Fabricii* Linn., but with a more blunt, low, and transverse pronotum. Head short, deeply, finely, rather closely, in part confluently, punctate; tylus more prominent and longer than the lateral lobes; lateral lobes depressed, sinuated from a little before the eyes, with the margin straight to the tip where it bends bluntly, the edge a little recurved; antennæ blue-black, short, the basal joint fusiform, subequal to the third, the second shorter and more slender, fourth fusiform, as long as the second and third conjoined. Under surface of head polished, steel blue, coarsely, very remotely punctate; rostrum reaching to the base of the venter, the fourth joint nearly as long as the second and third united; bucculæ narrow, as long as the head, sinuated before the middle. Eyes acutely truncated behind, not let into the front margin of the pronotum, but projecting a little beyond the angle. Pronotum short and wide, depressed, the transverse curve at the base much more convex than the curve from the base forwards, the disk more coarsely punctate than the sides and anterior and posterior submargins; lateral submargins broadly depressed, and with a broad transverse depression posterior to each callosity; the lateral margins very broadly curved, with the edge recurved, the anterior angles bluntly rounded; the latero-posterior margins broadly curved and not forming a triangle with the posterior margin; humeri very prominent. Middle line obsoletely carinated; on each side of it is a long-elliptical rufous spot, and nearer to the humeri is an oval spot of the same color. Scutellum high, the posterior downward slant being longer than the basal surface; on each side behind the basal fossæ is a large, rounded rufous spot; lateral edge posteriorly a little recurved, the apex subacutely rounded; the posterior surface minutely, remotely, and obsoletely punctate. Legs blue-black, obsoletely rugulose. Underside steel-blue, highly polished; pectus coarsely, remotely, deeply punctured; venter minutely rugulose, remotely, deeply and distinctly punctate on the sides, but impunctate on the disk.

Length, 10 mm.; width of pronotum, $5\frac{1}{2}$ mm., and length $2\frac{3}{4}$ mm. One male, from west of the Huallaja River in Peru.

Pentatomidæ.

Oplomus tripustulatus Fabr., Syst. Rhyng., p. 172, No. 91.

A single specimen of the steel-blue variety, having a large curved, yellow spot each side anteriorly upon the pronotum, and the basal spine and an arcuated band upon the posterior segment of the venter. From Peru.

Arvelius albopunctatus De Geer, Mémoires, vol. III, p. 331, pl. 5, fig. 6.

A very large female, from the region west of the Huallaja River in Peru.

Coreidæ.

Eubule scutellata Westw., Hope's Catal. Hemipt., pt. 2, p. 7.

A small specimen from west of the Huallaja River in Peru. This species mimics the form of some of the Mexican Archimerids, in the lunate form and in the prominent angles of the pronotum; but the shape of the head with its excavated front, and the stout antennæ and short rostrum abundantly distinguish it.

Nematopus vicinus Dallas, Brit. Mus. Cat., II, p. 425, No. 9.

One male, from the region west of the Huallaja River in Peru. It differs in no important respect from specimens collected near Para, and in other sections of the region of the lower Amazons River.

Pthia lunata Fabr., Mantissa Insect., II, p. 289, No. 107.

Collected in the vicinity of the Huallaja River in Peru. The specimen is of the usual type common to Brazil, Central America, Mexico, and the West Indies.

Leptoglossus vexillatus Stål, Öfversigt Vet. Akad. Förandl., 1855, p. 185.

Two specimens from west of the Huallaja River in Peru. A sufficient number of specimens to show the range of variation may prove this to be a form of *L. zonatus* Dallas.

Pyrrhocoridæ.

Dysdercus ruficeps Perty, Delectus An. Artic. Brazil., p. 172, tab. 34, fig. 7.

One specimen from the region west of the Huallaja River in Peru. This is the commonest and one of the most widely distributed of the South American Pyrrhocorids. It extends from the West Coast through Venezuela, New Granada, Guiana, the Amazons Basin and thence southwards to beyond Rio de Janeiro.

Mononychidæ.

Mononyx amplicollis Stål, Öfversigt Vet. Akad. Förhandl., 1854, p. 239, 1.

One large specimen from near the Huallaja River in Peru. The great width of the pronotum makes this species appear very singular and erratic. It would be interesting to know the conditions of locality in which this insect lives. The breadth of the pronotum and its scooped out inferior surface may give it some advantage when leaping into the air to seize its food or to evade its enemies.

HOMOPTERA.

CICADIDÆ.

Cicada gigas Oliv., Encyc. Méthod., Vol. v, p. 750, pl. 111, fig. 4.

From the region west of the Hualaja River in Peru. It seems to be more common in Central America, Guiana, and Mexico, and it occurs also in the West Indies.

Fidicina mannifera Fabr., Syst. Rhyng., p. 36, No. 13; Stoll', Cicad., p. 88, pl. 23, fig. 126.

Specimens from west of the Huallaja River in Peru.

Fidicina opalina Germ., Thon's Archiv, I, p. 2, No. 52.

One specimen from Peru.

Proarna grisea Fabr., Syst. Rhyng., p. 34, No. 4.

A small specimen was collected west of the Huallaja River in Peru.

Carineta socia nov. sp.

Pale dull fulvous, densely pubescent, body stout and cylindrical. Front tumid, convex, shagreened and remotely punctured above; ocelli amber yellow, placed upon fuscous oblong spots, the intermediate one placed at the anterior extremity of a yellow longitudinal groove. Eyes elevated above the surface of the fore-chest, but scarcely projecting sideways as far as the lateral margin. Rostrum tipped with piceous, extending not quite to the posterior coxæ. Pronotum a little more than twice as wide as long, the lateral margins indented posteriorly and directed obliquely forwards and inwards at an angle of almost forty-five degrees, the posterior angles lamellar, a little upturned and subacute, the anterior angles bluntly rounded; the præscutellum bluntly carinated on its anterior margin; collar of the posterior margin of the pronotum forming a pale band, the disk and anterior surface dark tawny clouded with fuscous. Metanotum also paler than the adjoining surface. Wings soiled hyaline, the veins infuscated near and at the tip. First apical areole narrow, and about one and one-half times longer than the second; second a little wider at tip, with the basal nervule curved inwards at tip; third a little shorter than the first, with its basal nervule a little oblique and curved; fourth longer than the first, with its basal nervule sharply oblique and twice waved; fifth a little longer with its nervule almost straight; sixth with an acutely oblique long basal nervule which runs back from the base of the preceding; seventh broad, shorter, with its basal nervule directly transverse, but curved backward; eighth short, broad at base, produced backwards in an acute angle. Venter dark, and with longer pubescence, particularly at the tip. The male has an acute thorn superiorly beneath the apical middle of the superior segment of the anus, and each side of it there is a long slender stylet; the inferior segment of the anus is broadly oval, subtruncated at tip.

Length, 26 mm.; width of pronotum, 12 mm.; expanse of fore wings, 73 mm.

One male from the basin of the lower Amazons, perhaps near Santarem.

After much hesitation, I characterize this species; since I can find no description which fits it satisfactorily. Nevertheless, it may yet prove, upon comparison with types, to be one of the species previously described by Mr. Walker.

Tettigonidæ.

Tettigonia pruinosa Walk., Brit. Mus. Cat., p. 755, No. 64; Signoret, Ann. Soc. Ent. France, 1853, p. 681, pl. 22, fig. 9.

One specimen from Peru.

NEUROPTERA.

Corydalis armata Hagen, Synops. Neuropt., p. 321; *C. cornuta* Ramb., p. 440, No. 1.

A damaged female from Peru.

Libellula umbrata Linn., Syst. Nat., p. 903, No. 13; Hagen, Synopsis Neuropt., p. 158, No. 19.

One small female from the region of the lower Amazons.

Description of a new species of Agrotis. By Charles V. Riley.

Agrotis Morrisoniana nov. sp.

Size and general coloration of *Agrotis subgothica* Haw., varying to that of *Agrotis herilis* Grote. Reniform spot dark, large, and illy defined by a pale annulus relieved with deeper brown, and most persistent basally above median vein; orbicular spot, when not obsolete, small, pale, and either round or ovate; claviform spot short, never extending farther than the orbicular; the pale interior line obsolete above, elbowed outwardly below median vein; the basal half-line which in *A. subgothica* forms an angle with it, obsolete. Antennæ of the male with beautifully fringed pectinations, nearly six times as long as the diameter of the main stem.

It varies considerably. The primaries of the more obscure form may be described as of a uniform dark gray-brown, with two pale carneous-gray dashes along the inner middle of the wing, and bordering the median vein and veins 1 and 2; the subterminal line indicated by interspaceal pale dots, and the other transverse lines indicated only on costa, by similar pale dots, relieved by dots of deep brown; in the more distinctly marked specimens the ground color is paler, leaving the terminal space, that between the reniform and orbicular spots, and that between the claviform spot and the exterior lines, dark; the orbicular is pale, and the dark reniform and claviform spots are strongly relieved with deep brown; the exterior line less broken and also relieved basally by deep brown, short, sagittate spots, while the posterior and inner borders are finely lined with the same deep brown; the pale color also extends through the subterminal and terminal spaces along veins 3, 4, and 7. Secondaries pale nacreous-gray, with but a slightly deeper shade around the posterior border. Underside pale, with a prominent discal dot on each wing.

Described from two males and six females, all reared from the larvæ.

Compared with the well known *A. subgothica*, as recently defined by Mr. Grote, it is at once distinguished by the very strongly pectinate male antennæ, the broader fringes, more uniform thorax, duskiness of the ordinary spots, greater paleness of the median space along vein 1, and by the subterminal line being relieved with deep brown basally instead of posteriorly.

It is the analogue of the European *A. vestigialis*, and the differences between the two are more easily apprehended from the specimens, than described. The European insect, from two specimens kindly furnished by Prof. P. C. Zeller of Stettin, is paler, with the ground color more suffused with ferruginous, the pale color broader along the median vein and extending around the claviform, while it is less distinct along vein 1.

The question whether the many species of our Noctuidæ, which have their analogues in European species, but which generally show some slight differences, should really be considered as distinct species or as mere varieties, can never be fully determined until careful comparisons are made with numerous specimens from both continents, and the larval habits and characters of each are known. But whether the differences be considered varietal or specific, it seems best to register them under different names.

Notes on some of the Phenomena of Elevation and Subsidence of the Continents. By N. S. Shaler.

In endeavoring to account for the changes of level of the continents, it is necessary to consider not only the changes of the land, but those of the sea as well ; the ancient view of the sea being the mobile region was not without its truth, and was too quickly abandoned. In the following propositions I have endeavored to present the possible cases and means whereby the sea can greatly change its relation to the land. The order of succession by no means represents the relative importance of the action at work in the effecting of change. My only object is, in a brief way to call attention to the complication of agencies which effect this most important class of actions.

Propositions.

1. *The absolute change in height of the continent acting on the whole mass thereof.*

This may conceivably be brought about if we suppose the continents to have been lifted to their positions by constant lateral pressure arising from the more rapid loss of heat in the interior of the earth, thus bringing about a folding of the outer beds to correspond to the diminished interior. Whenever the secular loss of heat brings about a strain sufficient to overcome the resisting friction and weight, there will result an upward movement of the continent. This proposition is merely a brief statement of the prevailing opinion of geologists as to the nature of the principal cause that produces continental folds.

2. *Absolute change of height of parts of the sea floor.*

Sudden and great changes in the contour of any continent may occur without necessarily affecting the sea level, but all changes of the sea floor, be they elevation or depression, unless the alterations of each movement compensate each other, must be attended by modifications of the average shore level upon the whole earth.[1] One of these changes is in a determined direction. The average erosion of the land at present is probably not far from one foot in five thousand years. With the present areas of land and sea this would raise the sea level one foot in about fifteen thousand years. This seems a slow rate, but allowing only sixty-six feet in a million years, and 20,000,000 since the beginning of the carboniferous (probably far too short a time), we have a total of 1320 feet. It is to be noticed that this change is constant and in one direction, so that the other vascillating changes will not overcome it. It will cause a steady accumulation of height through all accidents of elevation and subsidence.

3. *Change in the centre of gravity of the earth arising from the formation of an ice cap on either polar region.*

This hypothesis of Adhèmar accounts for a depression of circumpolar and neighboring regions by the change in the position of the earth's centre of gravity, caused by the accumulation about either pole of a large part of the oceanic waters in the form of an ice cap. The value of this cause cannot be determined. It depends for its existence on the hypothesis that the ice cap is formed in succession at each pole, and is liable to the correction we must apply for the subsidence of the sea caused by the removal from it of a large part of the water. The evidence goes to show that the last glacial period at least was simultaneous in the two hemispheres; this is so entirely against this hypothesis that we are not certain that it has been a true cause. Furthermore the depression produced during the last glacial period was so unequal in regions under the same parallel of latitude that there must have been other causes of depression operating at that time. A depression of one thousand feet in Wales becomes almost nothing in France. The irregularity in the amount of subsidence is almost as great in this country as in Europe, and goes far to disprove the equality of the subsidence under the same parallels, which is essential to the truth of this theory, and when taken in connection with the evidence of simultaneous glaciation in both hemispheres may be regarded as putting this hypothesis far within the bounds of improbability.

[1] My attention was, I believe, first called to this possible cause of change of level, by my friend Professor J. P. Leslie. I am not aware that he has published this conclusion; but as it is indisputable, and is important to the matter treated of here, I venture to make use of it. As it is a recollection of ten years or so, I may not have accurately represented his idea.

It is not to be denied that simultaneous ice caps would still tend to drag the oceans towards both poles, but the amount of water taken from the sea under these conditions would be so great that we should rather expect to find signs of elevation than subsidence. Furthermore, it is worthy of note, that the re-elevation of circumpolar regions now going on, doubtless the same in origin as the other elevations sought to be explained by this theory, is distinctly not traceable to a readjustment of the centre of gravity.

4. *Sinking of the sea level through the abstraction of water stored in glacial sheets.*

This action connects itself in a general way with that just discussed. It is unquestionably a true cause, though its value is not easily determined. Both the depth of the ice and the area it covered are still questionable points; assuming, however, that one-fourth of the earth's surface is the largest amount that can at any time be ice covered, and assuming that a mile is the average thickness of the sheet, then, making allowance for the space occupied by the land in the regions not covered with ice, the depression of the sea level will be something like twelve hundred feet. Prof. Benjamin Pierce, has called my attention to the fact that this depression would decrease the temperature of any point as much as if it had been subjected to positive elevation of the same amount. There are some important biological results following from this depression of the shore level. In the first place, if all the life of the glacial seas was removed to depths twelve hundred feet below the present level of the sea, or in other words, if the shore line was to any considerable extent removed to the seaward of its present position during the height of the period, we can well account for the fact that we have failed to find in the region bordering on the tropics the fossil remains of the fauna driven from the circumpolar region by the advent of the glacial period.

5. *Change in the position of the axis of rotation of the section from the centre of the sea to the centre of the continent.*

I have already called attention to this action, whereby, while the continent is continually rising and the sea floor continually sinking, the different positions of the rotation point of the movement might give us the three phenomena: of gain of land, gain of sea, and apparent steadfastness, according as the pivot point happened to lie to the seaward of the shore, on the land, or just at the coast. The real nature of the movement may be all the while one of constant elevation and yet give us these three effects on the shore line.

6. *Transfer of weight from the sea to the land, by the accumulation of an ice sheet on the land.*

In a previous communication,[1] I have called attention to the fact that if we suppose the present position of the land to be the result of lateral pressure, we must suppose that it is retained in its position by a continuance of this pressure. If this be the cause, then the accumulation of a mass of ice a mile or so thick may still have a great effect upon the form of the curves of the crust, depressing those regions when the weight is accumulated in the form of ice. We should expect to find that such depression of one part of a continent would be attended by an uplift of another region; this seems to have been the case during the last glacial period, when the continent south of the Hudson seems to have been uplifted, while the northern section was depressed. At present the southern section is again sinking while the northern shore seems to be generally rising.

If we proceed to represent to ourselves the amount of elevation of the continent of North America, south of the glacial sheet, necessary to counterbalance the depression below that ice mass, we are surprised at the geographical changes that would necessarily be brought about. It is, in the first place, necessary to notice that we must suppose that the elevation would probably not extend to the tropical regions, but would be greatest at a point not far from the borders of the ice sheet, at least, not further from that line than the point of maximum subsidence. Bringing above the water enough of North America to balance the glacial subsidence, we would connect the West Indian Islands with the main land and make the Gulf of Mexico and Carribean Sea a Mediterranean. We would, apparently, have to extend the Atlantic coast to the seaward until it included that part of the bed of the Gulf Stream which passes over a bottom having a mountainous topography.

In the case of the European continent, a great elevation of its southern part would produce even more important geographical changes than on the American continent.

There are one or two facts that may be well considered in this connection. Along our continents, as has been often noticed, we have a more or less extensive fringe of comparatively shallow water making a sort of shelf beneath the sea, from the outer edge of which the soundings plunge suddenly to the depths of the ocean. May it not

[1] See paper on Recent "Changes of level on the Coast of Maine," Mem. Bost. Soc. Nat. Hist., Vol. II, p. 338.

be that this represents the region of constant alternation between land and sea conditions in the endless rise and fall of the continents! Suppose a dozen or more elevations and depressions within that range; we should then have during each recession a vast amount of solid matter torn from the land carried to the seaward to a little beyond the limit of the upheaval, which would not be carried back during the return of the sea in the next subsidence. As far as I have been able to determine, this submarine shelf is wider, and on the whole deeper submerged, in the boreal than in the equatorial sections. If the circumpolar regions have been the areas of the greatest mechanical erosion, which considering their frequent glaciation seems very probable, then we should expect to find this erosion plane more extensive in those regions.

I have elsewhere endeavored to show that the present shore line of New England is almost exactly where it was before the glacial period. If this be the case it is a confirmation of the idea that the continents are in a state of equilibrium, the stability of which is frequently disturbed by various changes, and that when any of these disturbances is temporary, as that of the glacial period was, they return on its disappearance to their original position.

The other point bearing on this general question is connected with the history of deltas. Nothing shows the essential instability of the land better than the fact that of all the great deltas none have accumulations of several different geological formations on the same level. If the land was unchanging in its level for any great geological time, deltas should show different formations in succession as we descend towards their seaward face at the same level; but deltas are, in fact, generally limited to one geological formation, and that when new deposits of the different geological ages occur together there is usually a considerable difference of level between them.

If the *erosion plane*, above referred to, be really the result of the shore erosion, then it is another and very striking evidence of the perpetuity of the continental forms, and an equally strong argument against the existence of other great continents in recent geological times.

Mr. J. A. Allen exhibited a specimen of the Sharp-tailed Finch (*Ammodromus caudacutus* Sw.), collected the present autumn in the Calumet Marshes near Chicago, Ill., where this species has been obtained in considerable numbers, by Mr. Edward W. Nelson, and others.

This specimen differs very markedly from specimens of the same species taken at the same season in the Charles River marshes, in Cambridge, presenting strongly all the features of a southern race. The size is smaller, with a longer and slenderer bill; the dark centers of the feathers of the breast and sides are stronger and more sharply defined, and the brown markings on the scapulars and wing coverts much brighter and stronger. The top of the head is very dark brown, approaching black, with a faint slaty median line; the buff of the superciliary line, breast and sides, is very much stronger, and the white of the abdomen purer; all the colors being in fact much stronger.

Mr. Allen read extracts from letters from Mr. Nelson, to whose kindness he was indebted for the specimen, in which, under date of Oct. 19, 1874, Mr. Nelson speaks of the bird as follows: "While collecting birds on the Calumet Marshes at Ainsworth, Ill., Sept. 17, 1874, I noticed a number of small sparrows in the tall grass along the Calumet River. At first I thought they were Swamp Sparrows; observing a difference I shot one and at once recognizing it, I went in search of more. Within an hour I had killed eight fine specimens. They were very abundant, as I must have seen over one hundred in walking about a mile and a half. They were very difficult to kill, owing to their habit of rising suddenly, darting off in an irregular manner for a few rods, and then dropping into the grass and lying so close that it was almost impossible to put them up again . . . . . Dr. Velie, while collecting near Ainsworth, Oct. 7, also shot several specimens of the Sharp-tailed Finch, about the sloughs which are found abundantly in this locality." They thus agree in habits with the eastern bird.

Mr. Allen stated that, in answer to inquiries, Mr. Nelson informed him that the specimen sent him was an average specimen of his series, and that the differences between the Calumet birds and a Massachusetts specimen (an average of a considerable series) sent him by Mr. Allen were constant. In view of the marked differences between the two forms, Mr. Allen proposed for the Calumet form the varietal name of *Nelsoni* (*Ammodromus caudacutus* var. *Nelsoni*).

The birds of this genus have hitherto been considered as strictly maritime, as much so as any of the Grallæ. The occurrence of representatives of *A. caudacutus* so far from the seaboard, and in such large numbers, forms a most interesting fact in the distribution of our birds, and if usually so abundant there as during the last autumn it is not a little remarkable that it has so long escaped observation.

Section of Entomology. December 23, 1871.

Mr. H. K. Morrison in the chair. Six persons present.

The following paper was read: —

DESCRIPTION OF SOME LABRADORIAN BUTTERFLIES. BY SAMUEL H. SCUDDER.

The following descriptions have been drawn up to assist those who would compare certain Labradorian butterflies with those from other parts of the continent or from Northern Europe with which they are closely allied.

Brenthis Triclaris (Hübn.) Herr.-Schaeff.

Upper surface of wings deep fulvous, marked with black, with black nervures. *Fore wings* with a narrow, zigzag, transverse, mesial band starting from the apical branch of the sub-costal nervure at a point scarcely three-fifths of the distance from the base to the tip of wing, connected with the costal border by a slender, very oblique streak, directed inward; the first part of this band is arcuate, and takes a general direction toward the middle of the outer border, terminating in the lower half of the subcosto-median interspace; thence it is bent inward along the upper submedian nervule to the point of its nearest approach to the costal border, whence it is bent downward and slightly outward across the next interspace at right angles to the upper submedian nervule, bent again inward following the middle submedian nervule to its origin, from which point it crosses the next interspace, parallel to the preceding portion, and is continued half way across the medio-submedian interspace, bent inward again at right angles and terminates on the submedian nervule, a little past the middle; the upper portion of the band thus forms a **W**, opening inward and upward; a band of similar width borders the outer limit of the cell, within which, with its angle resting on the middle of it, is a V-shaped band of equal width, opening inward; in the middle of the cell, a rather broad arcuate patch, opening outward, depends from the sub-costal nervure, but does not reach the median, and next to, and separated but little from it, is a slender lunule opening inward, and forming the outer limit, at this point, of the general duskiness of the base of the wing; at the first divarication of the median nervure there starts downward a narrow streak, suddenly bent inward at right angles, generally produced outward slightly at the angle; the outer border of the wing is narrowly, but distinctly edged with black, next to which is a row of slender, not very pointed, sagittate spots, enclosing between them and the border a row of fulvous spots, usually entirely continuous, and generally of a lighter color than the other parts of the wing; midway between the border and the mesial band, not so arcuate as the border, is a row of round black spots, very slightly larger toward the inner border, the lowermost a little outside the curve; midway between this and the mesial band, on the costal border, is a narrow dusky patch, crossing the subcostal nervules. A broad, mesial, transverse band crosses the *hind wings*, the outer narrow, black border of which takes the following direction: it crosses the costo-subcostal interspace at two-fifths the distance from the base, follows along the upper subcostal nervule outward to a point opposite the middle of the costal border, crosses the next interspace at right angles to the nervures and the succeeding very obliquely outward, continuing along the lowest subcostal nervule and crossing obliquely the subcosto-median interspace at about one-fourth of the distance from the cell; thence crossing the next two interspaces by two crescents opening inward, each successively nearer the base, it is lost in the duskiness of the inner border; its interior border takes a direction in general parallel to this, and there is besides a transverse streak crossing the extremity of the cell; within this mesial band the base of the wing is very dusky, almost black, except generally some fulvous spots toward the costal border; the band itself is sometimes almost entirely black, but generally encloses between the black nervules ochraceo-fulvous spots of variable size; the outer border of the wing is much as in the fore wings, but the fulvous spots between the margin and the arrow-head spots, are less frequently continuous, generally lozenge-shaped and of a slightly lighter tint, generally ochraceo-fulvous; midway between the border and the mesial band is an arcuate band of round, equal, black spots, separated toward the base by a narrow, faint, ochraceo-fulvous band, from a series of faint dusky crescents, which form a slender transverse band, bent and generally interrupted in the middle. Fringe pale ochraceous, interrupted with black at the extremities of the nervules, longer on secondaries.

Beneath. *Fore wings* pale fulvous, deepest at the base, the markings of the basal half of upper surface repeated ; the outer border has a narrow line of deep fulvous or black, next to which is a rather broad ochraceous band, more or less interrupted at the nervures, except at apex, with fulvous fading into pale fulvous toward inner border, surrounded with slight, sagittate, dusky spots, distinct only in the middle ; the arcuate row of black spots of the upper surface is repeated, the upper ones pupilled faintly with white ; midway between this row and the mesial band on the costal border is a rather faint narrow patch of pale cinnamon-red, dividing a broad patch of ochraceous; between this and the apex is a quadrate patch of pale cinnamon-red. *Hind wings* cinnamon-red; the mesial band is a repetition of that above, very pale straw-color, occasionally whitish, narrowly edged with black; a rather large spot of same color between each of the nervures at the base, that in the costo-subcostal interspace smallest; another spot above the costal nervure; the outer border is very narrowly margined with black, upon which is a row of silvery-white spots, rather large, pointed inward and margined narrowly with black : midway between the outer border and the mesial band is an arcuate band of round silvery-white spots, bordered with black; above this a narrow band of ochraceous, regularly crenulated, and occasionally bordered with dusky scales toward the base, extending downwards in the subcosto-median and upper median interspaces to the black borders of the marginal silvery spots, but more or less mingled with reddish scales.

Body covered above with fulvous, below with ochraceo-fulvous hairs; legs pale cinnamon-red, femora with ochraceous and black hairs; palpi covered with mingled fulvous and black hairs; stalk of antennæ fulvous, black above, interrupted with white at the base of the joints; club of antennæ black, apex fulvous. Expanse of wings 45 mm. The males and females do not differ. 2 ♂, 2 ♀, Caribou Island, Straits of Belle Isle, Labrador, (A. S. Packard, Jr., S. R. Butler). Specimens have also been taken at Mackenzie River (W. H. Edwards) and in Colorado (T. L. Mead).

Many years ago I distributed specimens of this butterfly under the MS. name of *Arg. Lais.*

Brenthis Chariclea (Schneid.) Herr.-Schaeff.

Upper surface deep fulvous marked with black, with black nervures. *Fore wings* with a zigzag, wavy, occasionally broken band of moderate width, extending transversely across the wing, its inner edge starting at the middle of the costal border and terminating at the middle of the internal border; the general direction of the first third being outward, the second third nearly at right angles inward, the last third outward again nearly parallel to the first, but not turned so much outward; the band is formed: first of a straight belt more or less irregular in outline, directed toward a point a little more than two-thirds the distance down the outer border, reaching the median nervure; second, either of two very deep lunules, the lower heaviest limb being parallel to the first band, or of two short, straight bands slightly connected above, having the same general direction, the lunules or bands occupying the next two interspaces; and thirdly, of a broad shallow lunule or band occupying the next interspace and directed at right angles to the lower branch of the median nervure; the inner border behind the submedian nervure is up to this point dusky, as is the whole base of the wing nearly up to the divarication of the median nervure; within the mesial band there are three equidistant transverse bands crossing the cell, and there is another short transverse blotch below the median nervure starting from between the two innermost of those above; the outer edge of the wing is more or less narrowly bordered with black, next to which is a row of triangular slightly arrow-head shaped black spots, enclosing between it and the border a row of small, transverse, fulvous spots, which are usually larger and sometimes continuous at the apex; midway between the band of triangular spots and the mesial band is a slightly curving row of rather large, sometimes squarish spots, the lower one of which falls a little outside the curve, and the upper ones merge at the tip into the band of triangular spots; midway between this row and the mesial band, there is on the costal border a triangular patch, extending, parallel to the mesial band, to the lower branch of the subcostal nervure. *Hind wings:* the mesial band is directed first across the sub-costal nervules at right angles to them, then sharply outward, reaching the upper branch of the median nervure at two-thirds the distance from the base, whence it turns toward the inner border with a sharply indented zigzag course, directed a little outward toward the anal angle; the whole base of the wing within this band is dusky, sometimes quite black, with the exception of from three to five irregularly shaped, variously-sized, but generally small, fulvous spots upon the upper outer half; the markings upon the apical half of the wing are almost exactly as on the fore wings, except that the curving row of round spots has a deeper curve, the spots are more universally round, and increase in size toward the anal angle. The fringe of both wings is alternately light and dark brown.

Lower surface. *Fore wings* pale fulvous, the markings of basal half of the upper surface with the mesial band repeated, but with less distinctness, though there is no duskiness at the base, and the short streak below the median nervure just before its divarication meets a straight band coming at right angles from the junction of the median and submedian nervures; the roundish spots in the curved row are smaller and more indistinct than above; covering that portion of the space between them and the mesial band, which is traversed by the subcostal nervures, is a triangular pale yellowish patch more distinct outwardly, with a transverse streak of pale cinnamon-red across its middle; beyond the triangular patch the wing is pale cinnamon-red, with a transverse streak of pale yellowish at the extreme apex; the sagittate spots are more delicate, and the nervules beyond them are distinctly yellowish or white. Basal half of the *hind wings* deep cinnamon-red; there are three characteristic pearly white or silvery spots upon the basal half: the first is situated in the costo-subcostal interspace, its centre a little outside the divarication of the subcostal nervure; it is square or oblong, with the ends deeply excised and bordered with black, and has the lower outer angle cut off by the upper subcostal nervule; the second is triangular, the sharp apex outward, and is situated between the approximating branches of the subcostal and median nervure, is traversed obliquely at one-third the distance from the base by the transverse nervule, and extends to the white band crossing the middle of the wing; its base is concave, deeply bordered with black, and extends at one side narrowly along the lower edge of the subcostal nervure, reaching the first spot; the third, also triangular, occupies the medio-submedian interspace; its base as far as the divarication of the median is thus united to the second spot, but is encroached upon from the inside by the cinnamon-red of the base of the wing, which, crossing the median nervule, occupies about one-half of its area and forms in the outer portion a triangular spot bordered with black; there are two minute spots of white along the middle of the subcosto-median interspace, the outer with a black centre, and another at the base of the costo-subcostal interspace; the costal nervure also is edged above with white throughout its extent; a narrow, zigzag black band extends across the middle of the wing, bordering the upper side of the second silvery spot on its course, itself generally very narrowly edged with white above; within this black band, next the inner border, the surface is frequently powdered with whitish or ochraceous scales; beyond the black band is another broader band of white or silvery lunules whose general trend is nearly straight, but slightly curved; it rests against the outer angles of the black band along the inner half of its course, often indistinct near the middle, and broader and less defined upon the outer half; the spaces left between the black and silvery band at the outer half are ochraceous yellow between the subcostal nervules, and cinnamon-red between the costal and subcostal nervures; the outer border of the wing is narrowly edged with black, and has silvery triangular or lozenge-shaped spots situated between the nervules, tipped with sagittate black spots; the space between these and the silvery band is of a pale cinnamon-red with scattered ochraceous scales, which indeed occupy the greater portion of the interspaces upon either side of the upper median nervule; the row of round black spots of the upper surface is repeated beneath, though often but indistinctly.

Head and front of thorax covered with fulvous hairs; the upper surface of thorax and abdomen with brownish hairs, interspersed with fulvous upon the sides of the abdomen; below pale yellowish; palpi with pale hairs below, mingled fulvous and black upon the tip; stalk of antennæ white below, black above, with fulvous annulations at the extremity of the joints; club of antennæ black with narrow fulvous annulations. Expanse of wings 38.5–45 mm. The males and females do not differ in their markings. 22 specimens, 12 ♂, 6 ♀, 4 doubtful. Labrador (A. S. Packard, Jr.), Fort Simpson, Great Slave Lake, British America (W. H. Edwards), Natashquam, Southern Labrador (W. Couper), Colorado (T. L. Mead).

This is the butterfly quoted by me as *Arg. Boisduvalii* Somm. in Packard's View of the lepidopterous fauna of Labrador,[1] and also distributed by me in former years under the MS. name of *Arg. Oenone.* Boisduvalii is a synonyme of Chariclea.

Brenthis Freija (Thunb.).

Upper surface rather deep fulvous, marked with black, with black

[1] Proc. Bost. Soc. Nat. Hist., XI, 33.

nervures. *Fore wings:* a narrow broken band extends transversely and very irregularly across the wing, commencing and terminating a little beyond the middle of the costal and inner border; its general direction is at first toward a point on the outer border, two-thirds of the distance from the apex, next by a blind zigzag course toward the inner border at a point one-third of the distance from the base, and then straight toward the inner border; it is made up first of a nearly straight band which reaches the upper median nervule, then by three short transverse dashes, in the three succeeding interspaces, the first midway between the termination of the band and the last divarication of the median nervure, the second below that divarication, and the third outside of the second by its own width; within the mesial band are three narrow transverse bands crossing the cell, the innermost not reaching the median nervure; within these is a small lunule, opening outward; below the divarication of the median nervure is a short dash, suddenly bent inward, and then slightly upward; the extreme base of the wing is slightly dusky; at the outer border is a broad band, regularly angulated on inner border, enclosing a series of slender, transverse or linear, fulvous spots, seldom continuous except at the apex, where they are larger; between this and the mesial band is a curved row of roundish spots, the lower one of which falls outside of the curve; at the apex this row merges into the outer band; between this band and the mesial there is on the costal border a dusky triangular spot, extending to the penultimate branch of the subcostal nervure. *Hind wings:* the mesial band extends, with a very irregularly zigzag course, from the middle of the costal border to a point between the subcostal and median nervures three-fifths of the distance from the base, and then, nearly at right angles, to the middle of the inner border; it is generally interrupted and then formed of five dashes: the first, in the costo-subcostal interspace, at a little less than one-half the distance from the base, is directed inward toward the inner border about one-third the distance from the base; the second starting from outside the first crosses the subcostal nervule at right angles; the third at some distance outward crosses the subcosto-median and upper median interspaces, at right angles to the nervules; the fourth crosses the next interspace in the same general direction, but removed by its own width further toward the base; the fifth turned upward and starting just beyond the fourth, crosses the medio-submedian interspace; both the second and the third are occasionally bent; within this band, the subcostal nervure is broadly bordered with black scales from its divarication to its union with the median, and from the middle of the band so formed a band of equal width crosses the cell to the divarication of the median ; in the middle of the cell is a rather large round spot, and in the costo-subcostal interspace is a black streak, parallel to the mesial band and midway between it and the base; the extreme base of the wing and the inner border are slightly dusky; the outer black border of the wing is rather broad, and within it is a row of large triangular spots, separated from the border by a narrow fulvous stripe, sometimes broken into spots; nearly midway between the row of triangular spots and the mesial band, but approaching the former, is a curved row of rather large round spots in the subcostal and median interspaces. Fringe of outer border dark brown, interrupted with ochraceous.

Lower surface. *Fore wings* pale fulvous with the markings of the basal half and the row of round spots repeated conspicuously ; apex pale cinnamon-red, the tip and a streak on costal border midway between it and mesial band, ochraceous; the black border of the upper surface wanting and replaced by very pale cinnamon-red mingled with some ochraceous scales, the extremities of the nervules being ochraceous, tipped toward the round spots with large, triangular, scarcely sagittate, black spots. *Hind wings:* extreme base pale cinnamon-red, with a white spot generally bordered with black between each of the principal nervures at their origin; at about two-fifths the distance from the base, a broad transverse band of pale cinnamon-red crosses the wing, dusted profusely with ochraceous or white scales at its outer and inner limits and especially where it crosses the spaces between the principal nervures ; it is bordered within and without with black ; the inner black border starts from the costal nervure opposite its divarication from the subcostal, crosses the interspace obliquely inward, takes a sweeping curve along the outer border of the cell back a little past the divarication of the median nervure, and crosses to the inner border by two crescents opening inward; the exterior border is composed of three parts: the first starts from the middle of the costal border and crosses the costo-subcostal interspace in a straight line parallel to the inner border; the second starts from the subcostal nervure opposite the origin of the first and crosses in a straight, sometimes broken, line the next two interspaces, nearly at right angles to the nervures; the third, starting from the lowest branch of the subcostal nervure, passes to the inner border by a series of crescents opening outward, parallel in general direction to the inner border; the narrow outer border of the wing is pale cinnamon-red, resting upon which is a row of transverse, ovoid, white spots surmounted by triangular, somewhat sagittate spots of (sometimes blackish) cinnamon-red; between these and the broad band the space is pale cinnamon-red with scattered ochraceous scales, which, on either side of the last median nervule, near its extremity, form a considerable ochraceous space more or less mixed with reddish scales; but the space between the broad band and the outer border is further occupied by a curving row of round blackish spots, with intermingled reddish scales, bordered delicately with ochraceous; and also by a narrow, nearly straight band, slightly bent and less conspicuous in the middle, where it touches the outer border of the broad band, and formed of pale rosaceous scales, whitish toward the extremities.

Body covered above with greenish-brown hairs, toward the extremity fulvous; beneath ochraceous; palpi with mingled ochraceous and black hairs below, mingled fulvous and black above; stalk of antennæ white below, black above, with white annulations; club of antennæ black, bright fulvous at the tip. Expanse of wings 38.5–43.5 mm. I have only seen males. 5 specimens. Fort Simpson, Great Slave Lake, and Fort Rupert's Land, Eastern coast of Hudson's Bay, British America (W. H. Edwards). Mr. Crotch obtained specimens at Lake Labache. I have never seen specimens from Labrador.

This species is very closely allied to, and representative of *B. Montinus* Scudd., from which it differs principally in the following particulars; the color of the upper surface is not so deep; at the base and along the subcostal interspaces of the hind wings it is not so dusky; upon the lower surface, the markings of the apex of the fore wings are much more conspicuous, as is also the broad mesial band of the hind wings, which here is of a very different tint from the base, while in *B. Montinus* a difference is seldom, and then but slightly, discernible; the submarginal rows of sagittate spots and of round spots are also much more conspicuous, being frequently very nearly obliterated in *B. Montinus*; the space between the arcuate row of round spots and the mesial band is much tinged in *B. Freija* with rosaceous scales, giving it a peculiar appearance; these are present only in a slender band in *B. Montinus*, and then are nearly obsolete; the darker parts of the outer border of the hind wings are darker than in *B. Montinus*, being there somewhat pale cinnamon-red, while here they are rather of cinnamon-brown. In previous remarks on *B. Montinus*, I have spoken of *B. Freija* as *Argynnis Boisduvalii*, by a mistaken identification.

Brenthis polaris (Boisd.)

Upper surface fulvous with black markings; nervures black except the main stem of the median, which is fulvous bordered with black. *Fore wings:* a mesial band crosses the wing, composed of three parts; the first starting from the costal border at a little more than one-half the distance from the base to tip of wing, runs nearly straight to the upper median nervule beyond its basal curve; it is connected with the costal border by a narrower black band; the second part consists of a blotch crossing the interspace between the upper two median nervules, as broad as the previous part, taking nearly the same general direction, its outer edge continuous with the inner edge of the first part of the band; it generally leaves a little fulvous at the extreme base of the interspace; the third part is an equally broad band crossing the next two interspaces, bent at the lower median interspace and reaching the submedian nervure; its upper half stands in the same relation to the middle portion of the band as that to the first portion, and its inner edge generally starts at the divarication of the middle median nervule, although sometimes the whole base of the interspace is filled with black; its lower halt is continuous with the upper but runs at right angles to the nervures; within the mesial band, and narrower than it, are three black streaks which cross the cell; the outer borders its termination; the middle is in close proximity and bent outward in the middle; the last is straight, lies midway between the base and termination of the cell and does not reach the median nervure; below the median nervure, in broken continuation of the inner cell-streak, is a narrow bent streak, the upper portion half crossing the medio-submedian interspace; the other portion bent inward at right angles and sometimes sending a streak outward to meet the mesial band; the duskiness of the base of the wing does not extend over half the cell, and is enlivened by long olivaceo-fulvous hairs; some griseous scales border thinly and broadly the median nervure and its branches as far as the mesial band; the costal border is fulvous, flecked on the basal half rather heavily with griseous, edged with black, with the edge of the wing itself hoary. Beyond the mesial band there are the following markings: two small triangular spots with their bases resting on the subcostal nervure, dividing the distance between the mesial band and the tip of the wing; a row of six circular or subquadrangular spots, of equal size and about half the diameter of the interspaces lying in the interspaces about midway between the mesial band and the outer border; the upper three lie in a nearly straight line or are parallel to the outer border, the uppermost connected with the outer triangular spot; the lower three have a slight curve in the opposite direction; seated upon the outer border upon the tips of all the nervures are roundish spots about the size of the spots in the last mentioned row, the upper two being elongated, conical; just within this row and sometimes touching it, but lying in the interspaces, is another row of six roundish or transversely oblong spots, which grow gradually larger away from the costal border, those in the middle being about the size of the marginal spots. The fringe is white interrupted with dusky next the marginal spots, though the dusky interruptions are not so broad as the marginal spots. *Hind wings:* a very irregular, often indistinct mesial band crosses the wing; it starts near the middle of the costal border, strikes the subcostal nervure nearly half way between the first divarication and the tip of the nervule, and crosses the next interspace at right angles to the nervules; it crosses the following at right angles also, but removed inward at a distance equal to its own width; from this point it doubles its width and, crossing the subcosto-median interspace, its inner edge removed from the cell at a distance equal to its own increased width, continues in a nearly straight line toward the inner border, subparallel to the outer border, till it is lost in the duskiness of the basal portion of the wing, which covers the whole inner border as far as the median nervure; the duskiness of the base is otherwise about as extensive as on the fore wings and is particularly noticeable in the whole cell; the basal half is covered with hairs as in the fore wings, but more extensively; beyond the mesial band the fulvous color is if anything slightly deeper than on the primaries; a row of six circular spots of equal size, in continuation of that on the primaries, occupies the same interspaces as there, the lowest being seen but faintly, obscured by the duskiness of the internal border; they form a bent row, each half of which is straight and subparallel to the outer border; the marginal bands, similar to those on the fore wings, are so confluent that they may be better described as a broad marginal belt with a crenulate inner border enclosing, in the interspaces, small, transverse, fulvous crescents emitting a streak—sometimes a mere line, sometimes one nearly as broad as the crescent — to the outer border; the fringe is white interrupted with black at the nervule tips, but more narrowly than in the primaries.

Under surface. *Fore wings* slightly paler than above, with black markings; the black markings of the basal half of the wing above are repeated narrowly beneath; the mesial band is usually more or less interrupted, and its upper portion is not straight but bent almost at right angles at the lower subcostal nervule, the angle pointing inward; the row of circular spots is repeated distinctly in black, and the spots are of about the same size as above. The submarginal row of roundish spots is also repeated as a row of dusky circular or triangular spots, and from the centre of each, or at least of the upper ones, a white dash extends to the border, broadened generally at the point of contact with the spot and always at the border; the costal border is grayish or olive-brown; there are two transverse streaks of yellowish-brown extending from the costal border across the subcostal nervules, one just within the inner row of circular spots, the other just above the outer row; just within each of these the wing is more deeply tinged than elsewhere, approaching ferruginous. *Hind wings* reddish-brown, or ferruginous, flecked with black scales, more or less fulvous on outer half; sometimes the whole wing is deep fulvous, marked with snow-white; an interrupted mesial white band crosses the wing, the borders marked with black, indicating its direction, the interior mainly white but so much interrupted with broad patches of fulvous or ferruginous (lighter than the rest of the wing) especially next the nervures, that the white is especially noticeable as three reel-shaped patches, the longer diameter along the wing, situated, one between the costal and subcostal, one between the subcostal and median, but including generally a part of the lower subcostal nervule, and one between the median and submedian nervures; the band is bordered within by a line which crosses the costo-subcostal interspace before the divarication of the subcostal nervule, is bent at right angles in the middle, its angle outward; is there broken and starts between the two divarications of the subcostal, forms a similar bent line across the cell just within the subcostal nervure and strikes the median at its first divarication; from here it crosses the next three interspaces by similar bent or curving lines to the inner border in such a direction that its general course is at right angles to the previous general course of the line; on the outside the line curves or is bent in the interspaces in a direction opposite to the interspaceal curves of the inner line; in the middle of the wing the last divarication of the median nervure is in the middle of the band, which is of average equal width except in the area occupied by the subcostal nervules, where it is wider; within this mesial band are four pretty large white spots narrowly bordered with black, one circular between the costal and subcostal nervures, two circular in the cell arranged longitudinally, and the fourth larger and oblong between the median and submedian nervures; the row of circular black spots on upper surface is repeated beneath in black with a few mingled ferruginous scales, each spot being surmounted interiorly by a white spot larger than itself, often embracing it at the sides, and those above the upper three produced interiorly to a greater or less extent; the black markings of the border of the upper surface are reproduced beneath faintly and meagerly in dusky scales, while the interrupted fulvous markings of that border are reproduced and increased beneath in white; between the marginal markings and the row of circular spots are fulvous spots of greater or less distinctness, generally more noticeable in the middle of the wing; the costal border is distinctly edged with white which is enlarged into a spot at the shoulder of the wing and extends along the nervure. The inner border is also narrowly and interruptedly edged with white.

Body above black with brownish-olivaceous hairs; beneath the hairs are brownish-fulvous; on palpi and legs the hairs are the same but at the base on the posterior thighs are black. Legs ferruginous. Antennæ brownish-red, banded above with black scales with many intermingled white scales, especially at base; club black, heavily flecked with white, the tip reddish. Expanse of wings, ♂ 40.5–44.5 mill.; ♀, 41.5–46 mill.

2 ♂, 2 ♀, Labrador; from Square Island northward July 14–Aug. 3. (Dr. A. S. Packard.)

Brenthis Frigga (Thunb.) Herr.-Schaeff.

♀. Upper surface fulvous marked with black, the nervures dusky. *Fore wings:* A zigzag, wavy, continuous band, not of great breadth, crosses the middle of the wing; the general direction of the first third is toward the middle of the lower half of the outer border of the wing, that of the middle third nearly parallel with the costal border, and that of the lower third nearly parallel to that of the first third. The first third consists of a series of short broad crescents, or semi-circular discs between the nervules, their inner edges straight and continuous, starting from the costal border at three-fifths of the distance from the base, and reaching the median nervure; the lower third of the spot on the last interspace is the starting point of the middle third of the band; this consists of three equally short bands in zigzag, the upper and lower narrower than the middle one, the upper crossing the upper median nervule very obliquely, the middle one crossing at right angles the upper median interspace, while the third crosses very obliquely the middle median nervule and extends to its attachment; from just beyond this attachment, the lower third of the band commences; it is broader than any of the other parts of the band, and extends to the submedian nervure, beyond that being merged into the general duskiness of the internal border; it is formed of two halves in the two interspaces which it crosses, the upper half being directed outward more than the lower, and the upper part of the lower removed outward beyond the lower part of the upper by about half the width of the band; but sometimes they are more closely united; the lower half sends inwards a point or narrow streak from its middle. Within the mesial band just described are three equidistant transverse parallel bands crossing the cell; the outer and and narrowest follows the outer border and is twice as broad above as below; the nervures between it and the mesial band are black and marked a little more heavily than those of other parts of the wing; the middle one is constricted in the middle; its lower extremity rests upon the median nervure between its two divarications; the inner one is simple, and there is still another at a similar distance toward the base, the outer border only of which is manifest, the duskiness of the base obscuring the rest; there is also a more or less distinct V-shaped streak below the median nervure, the V directed to meet the inward projection of the mesial band between the median and submedian nervures, the upper ones being a continuation of the third transverse band of the cell, and the lower directed toward the inner border at less than a right angle to the upper arm; sometimes this V-shaped streak is merged in the general duskiness of the base of the wing, which latter is enlivened by long pale greenish-fulvous hairs. There is a marginal row of blackish triangles, sometimes developed into sagittate spots, with their points directed outward, situated in each of the interspaces opening on the outer margin above the submedian nervure. The space between these and the border is filled with commingled dusky and fulvous scales, the dusky scales predominating along the edge, forming a narrow blackish border, deepest in the middle of the interspaces and the fulvous in excess in the middle of the interspaces; the whole, with the triangular spots, forming a dusky border to the wing, slightly broader than the width of the median interspaces at the margin of the wing. There is also a submarginal row of circular blackish discs midway between the marginal band and the outermost limits of the mesial band, running almost parallel to the marginal band ; the upper two between the subcostal nervules fill the whole width of the interspaces and so are confluent, and sometimes touch that of the next interspace; the largest is situated beween the upper median nervules, and the smallest, which is also the lowest partially obliterated, occurs in the medio-submedian interspace. The costal border as far as the extremity of the cell is black speckled with fulvous scales, which become more frequent toward the base; beyond the cell the marginal half is uniformly black and sends downward between the mesial band and the submarginal row of spots a triangular black spot of indistinct outline, its apex resting on the first inferior subcostal nervule; on the lower half of the outer portion of the costal border, caused by the interruption mentioned, are a narrow fulvous streak on either side of the first subcostal nervule, a shorter pale fulvous one on either side of the second subcostal branch, and on the inner side of the upper two of the submarginal row of spots a triangular pale fulvous spot, the upper generally the paler. The basal two-thirds of the inner border is blackish dusky and beyond dusky mixed with fulvous ; the fringe is dirty pale fulvous mixed with dusky, palest in the middle of the interspaces. On the *hind wings* there is an irregular mesial band composed of very deep lunules in the interspaces. The first four are in a straight line, consecutively nearer the outer border, in passing downward ; the first is in the costo-subcostal interspace, and a little outside of the first divarication of the subcostal nervure ; the last is in the subcosto-median interspace, at the point of the closest approximation of the bordering nervules ; a fifth lunule is found close to the base of the upper median interspace ; within this band and within an irregular line from its lower extremity to the tip of the submedian nervure, the whole base of the wing is dusky, covered with pale greenish fulvous hairs as in the fore wing ; above the median nervure, however, and just within the band are many interspersed fulvous scales, while the veins are heavily bordered with black, and a narrow transverse black band crosses the cell ; in the interspaces opening on the outer border, and in continuation of the submarginal row of spots on the fore wing, is a regularly curving row subparallel to the outer border, of five nearly circular black spots, the outer ones smallest, and all situated midway between the mesial and marginal bands ; there is a marginal row of transverse black spots between the nervules of varying shape, those in the subcostal interspaces being confluent double ones. Beyond them a narrow black band seated upon the margin and expanding upon the nervules to double the width, extending thus between the spots last mentioned and becoming often, and especially about the middle of the border, confluent with them, and thus forming a band as broad as the marginal band of the fore wings; fringe pale fulvous, palest midway between the nervules.

Under surface of *fore wings* dull brownish fulvous marked with dusky and black, with grayish nervures. The markings of the mesial band and of the cell are repeated by narrow black streaks; the marginal and submarginal row of spots are repeated, and of about similar size, in dusky scales; the costal border is grayish with a few greenish hairs at the base; the upper half of the submarginal row of black spots is enclosed in a band of ferruginous scales, the outer border extending to the marginal row of spots, and having above a zigzag outline, the inner border extending to the same distance inward, and meeting a pale yellowish spot which extends to the mesial band; below, the ferruginous band merges gradually into the fulvous; outside the zigzag border of the ferruginous band, extending to the tip of the wing, is a pale yellow spot, with scattered ferruginous scales. Outer half of the *hind wings* rosy ash color, more hoary toward the costal border, broadly bordered internally with diffuse dusky, especially on the lower half and near the costal border; the submarginal row of round spots of the upper surface is repeated with dusky scales, and the marginal row is faintly repeated in a manner very similar to the repetitions of the same band beneath on the fore wings. Occupying the basal three-fifths of the wing above the subcostal nervure is a silvery white spot, limited externally by a black line bent at a right angle in the middle of the interspace, the lower half of the line running at right angles to the direction of the nervures, the upper turned outward; ferruginous scales fill the space between this bent line and the dusky band of the middle of the wing. Within the white band next the base, and above the costal nervure is an ochre-yellow spot, and in the middle of the band is another small ochre-yellow spot half crossing the interspaces, bordered outwardly by a slight black line bent at right angles in an opposite direction to the line on the outside of the white spot; the rest of the extreme base of the wing is occupied by a black spot with a few interspersed ferruginous scales; outside of this and within the ashy rose of the outer half, the wing is ochre yellow, flecked with ferruginous, and broken up into spots by black lines which border the veins, and form two very irregular lines crossing the wing; the two cells forming the outer half of the subcosto-median interspaces are paler than the others; the outer of the two transverse black lines starts from the upper subcostal nervule, below the middle of the ferruginous spot, and passes in a series of very deep curves in the interspaces, the convex side outward, to the internal nervure near its extremity. The general direction of the line is at first outward, nearly parallel to the lower median nervule, and afterward at right angles to it, bending in the subcosto-median interspace; in the medio-submedian interspace there are two such curves or loops; that in the upper median interspace is small and very deep; the inner of the two black lines runs subparallel to the first, but follows the nervures more closely; first accompanying the subcostal nervure it crosses the subcosto-median interspace at the divarication of the lowest median nervule, and in the medio-submedian interspace there are two curves, as in the outer line, but in opposite direction, meeting the outer line at its termination on the internal nervure, forming a circular ochre spot on the last interspace.

Body above black, with dusky hairs on the abdomen, and olive brown hairs on the thorax; hairs beneath and at tip of abdomen ochraceous brown. Hairs of palpi and legs ruddy brownish. Antennæ testaceous, above banded with brown and white; club blackish, tipped slightly with brown. Expanse of wings, 45 mm.

Labrador, Okak, Rev. T. Weiz, A. S. Packard. 1 ♂. It has also been taken in Colorado by Mr. Mead.

Agriades Aquilo (Boisd.).

Above glossy brown tinged with cærulean, especially in the male, faintly marked with pale cærulean, especially in the female. *Fore wings:* Male glossy brown tinged delicately with cærulean, which is occasionally more distinct in a broad transverse band next the outer border; the outer border itself with the tip of the costal border is black, and is bordered to a greater or less extent with a dark brown band outside the cærulean band; the tip of the cell is marked very faintly with black; fringe dull white. Female glossy brown, sometimes tinged slightly with cærulean, especially near the base and along the inner border; external border of the wing with the dark markings of the male; besides, there are two transverse rows of cærulean spots in the interspaces, generally pretty distinct, but at other times quite faint. The outer row extends across the whole wing, is seated upon the brown marginal band, and has the inner edges of the spots rounded so as to form a band with a crenulated border; the inner row is formed of five circular or oval spots, of which the upper two are situated midway between the outer row and the tip of the cell, while the lower three form a curving row beneath and a little within these, the open part of the curve outward ; the tip of the cell is marked by a distinct transverse black spot bordered narrowly with pale cærulean. *Hind wings:* a dusky spot at the tip of the cell, as in the fore wings of the female, but less distinct than there, and in the male often obsolète ; a straight row of small circular dusky spots crosses the wing, midway between the cell and the outer border, not reaching either border; it is generally quite obsolete, always so in the male; upon the outer border, which is edged with black, are seated round pale cærulean spots, separated only by the nervules, extending over the subcostal and median areas; each spot encloses a dusky or blackish spot, sometimes a mere dot, sometimes nearly usurping the place of the whitish spots. These markings are sometimes subobsolete in the male, and generally less distinct there than in the female ; fringe whitish.

Lower surface. *Fore wings* pale slate brown, marked heavily with white and spotted with black and fuscous ; at the tip of the cell marked distinctly as it is above in the female, but bordered with white in the middle of the cell a similar mark, except that the inner black streak is generally broken in the middle; sometimes one is obsolete or both are very faint, or, indeed, occasionally the whole marking is reduced to a faint whitish spot; there is a submarginal row of six broad, dusky, or fuscous lunules parallel to the outer margin, their outer edge at least an interspace's distance from it; and midway between this row and the tip of the cell a row of six black spots enclosed in white, usually circular; the fourth from the tip, however, is sometimes triangular, and the last ordinarily transverse, or broken into two small ones, one above the other; the second and third are parallel to the outer border outside of the spot terminating the cell, and about midway between that and the submarginal band, though usually slightly nearer the latter; the first is situated above the principle subcostal nervure, nearer the base of the wing than the second, and even in some cases nearly half way between this and that at tip of cell ; the fourth is a little nearer the base of the wing than the third. and usually just as much nearer as the first is nearer than the second ; the fifth bears the same relation to the fourth as the fourth to the third, and the sixth, in the medio-submedian interspace, lies below the fifth; the upper five therefore form a curving row around the spot at the tip of the cell. The outer margin is edged narrowly with black, and there is generally a transverse interrupted dusky line midway between the submarginal row of spots and the margin. *Hind wings* dark, slightly olivaceous brown, marked heavily with white and with black spots; in the interspaces next the outer border and separated from it only by its black or fuscous edging, is a series of spots; they are ordinarily white, although those in the median and submedian interspaces are occasionally tinged wholly or in part with pale dull orange; they are separated from one another only by the dusky nervules, are sharply curved on the inside, ordinarily extend up the interspaces to a distance equal to the width of the spaces between the nervule tips, and enclose a black or dusky transverse streak (or sometimes a round spot) which is sometimes obsolete; on the inside these spots are bordered with dusky lunules, increasing to black, which occasionally encroach upon the white spots and form a considerable olivaceous brown band, and whether as lunules, or as a continuous band, are generally heaviest in the median interspaces; these lunules, with more distinct outline on their inner side, are the boundaries of a broad white band, enclosing in the middle of each interspace a small black spot which is sometimes obsolete; the band extends from the costal to the internal nervure, its outer crenulated limit is the row of lunules just mentioned, and is more distant from the outer border at the median than at the subcostal nervules; its inner border is quite irregular; between the subcostal nervules it is not half as broad as the interspaces, abruptly enlarging beyond the cell to fully that width, broadening by regular abrupt changes in successive interspaces until in the lower median interspace it has become fully twice as broad as the interspace, while in the lowest interspace it is sometimes no broader than in the first, but generally a little broader; within this band the wing is of uniform tint, except some grayish scales next the base and the following white spots: a large transverse spot covering the vein closing the cell, which sometimes forms a dusky or blackish streak in it; above and just outside two pretty large confluent circular spots, the upper in the costo-subcostal interspace and a little within the lower, which is in the lower subcostal interspace; they each enclose black spots, the upper one containing the largest, that of the lower being sometimes obsolete; a pretty large circular spot midway between the base of the wing and the upper of the spots just mentioned and occupying the same interspace; it encloses a minute black dot; in the middle of the cell, seated upon the median nervure, is a white spot a little smaller, containing an ordinarily obsolete black dot; and upon the internal border and the broad white band is another, similar in all respects to that in the cell; these last two white spots are themselves sometimes obsolete.

Body black, covered above with long silver-gray hairs, and blackish scales; beneath with whitish hairs and scales; legs testaceous, covered closely with white scales; scales at the side of the palpi snow-white, the hairs gray; last joint above dark-brown; eyes rimmed with a distinct row of pure white scales, and these bordered on the front with blackish hairs, between which down the middle of the front runs a row of silver-gray hairs. Antennæ very dark velvetty-brown, annulated with pure white, narrowly above but with scattered scales, giving the sides and under surface a hoary appearance; club dark velvetty-brown above, with a few scattered white scales on the side; beneath dull, dusky ferruginous. Expanse of wings, 24 mm. 5 ♂, 9 ♀.

Hopedale, Aug. 3; Henley Harbor, Aug. 15. First observed at Sloop Harbor, Kynetarbuck Bay, July 19 (Dr. A. S. Packard).

This insect scarcely seems to be the same as that described by Curtis, in Ross's second Voyage, as *Polyommatus Franklinii*, so much does it differ from the figure and description given there. The upper surface of the wings is not "grayish powdered with silvery-green, especially at the base," as there described; nor is the under surface of the hind wings, "fuscous freckled with gold, but blue at base." The figures given differ from my specimens in the particulars given above, and also in that the mesial row of black spots on under surface of the fore wings has but a very slight curve, while the markings outside of this row along the border are not as in the specimens before me. On the under surface of the hind wings, Curtis's figure represents the broad, white band as reduced to a row of circular white spots, scarcely extending so far across the wing as my specimens always show it, and the markings beyond them along the margin differ from my specimens even more than the border of the fore wing; yet it is undoubtedly very closely allied, and a true representative of this species. Ross's two specimens were taken "on *Astragalus alpinus* near the end of July."

In his article on Labrador Lepidoptera,[1] Möschler has compared the

[1] Wien. Entom. Monatsch., iv, 347.

description of Curtis as translated into German by Gröben with his own specimens, and has made some good criticisms upon the character of the description in its German dress, and without having seen the English of Curtis, has actually translated the doubtful passages better than Gröben. All the objections which he makes to the description fall to the ground when the original of Curtis is used.

January 6, 1875.

The President in the chair. Ninety-three persons present

Señ. Don Antonio del Castillo, Señ. Don Mariano Bárcena and Dr. John Hjaltalin, were elected Corresponding Members, and Messrs. Holmes Hinckley, Edward M. Wadsworth, Sereno Watson, William W. Lee, Edward A. Birge, Samuel H. Trowbridge, Edward R. Benton, Zabdial A. Willard, A. E. White, Dr. John W. Brewer, Dr. David Hunt, Jr., and Gen. Francis A. Osborn, were elected Resident Members.

The Secretary announced by title the following paper: "A Prodrome of a Monograph of the Family Tabanidæ of the United States. Part I, the Genera Pangonia, Chrysops, Silvius, Hæmatopota, and Diabasis," by C. R. Osten Sacken, which will be printed in full in the Memoirs, forming No. I, of Part IV, Vol. II.

Mr. F. W. Putnam gave an extended account of his archæological researches in Kentucky and Indiana during the past season.

He prefaced his remarks by a rapid sketch of the races of men found in North America on the first occupation of the country by Europeans. Alluding to the Indians of the New England coast, he called attention to their more prominent characters as shown by their life and their crania. He then mentioned more particularly the race found by De Soto in the South, and their peculiarities of customs as recorded by the early travellers among them; pointing out facts which lead to the belief that the southern Indians of the Natchez type were not only of a different race from the more northern and eastern tribes, but were also probably older inhabitants of the country and much further advanced in the arts and civilization, though having still the remnants of many barbarous customs. This southern race had several characteristics which may prove it to be allied to, if not descended from, the still more ancient and prehistoric race of Mound Builders. The latter, in turn, show so much in common with the early civilization of Mexico, as to lead to the belief that the ancient Mexican races, the Mound Builders of the Mississippi Valley and the early Indians of the South may have been of the same original stock, becoming greatly diversified by migrations and by mixing with other races, which they absorbed in part, and with still others by whom they were conquered. While by no means considering the unity of the Mound Builders with the other short-headed people of North America as proved, he gave many facts bearing on the migration of such a short-headed people over the country covered by the region embracing a broad belt from the northwestern coast to the Ohio Valley, and south to the Gulf of Mexico, and again extending westward to the Pacific. He also alluded to the Pueblo Indians, the Flatheads and the old Mandans as having many resemblances to the ancient mound-building race of which they may have been, originally, isolated portions that rapidly formed mixed races while holding in different ways to some of their original customs.

The more nomadic of the barbarous tribes of the country were then spoken of, and the known feuds between them and the southern race were dwelt upon, in order to show the peculiar condition of archæological research along the Ohio, and as, perhaps, in part, accounting for the singular richness of this region in the relics of several distinct races, or, at least, widely separated families of the historic and prehistoric peoples of North America.

Mr. Putnam then called attention to the numerous ancient fortifications which exist in the Ohio Valley, and gave a description of two which he had visited in Indiana in company with Professor Cox, the State geologist, by whom they have been, or soon will be, described in detail. These ancient fortifications are generally earthworks, many of great extent, but there have been several discovered where immense walls of stone have been used in place of simple earth embankments. The stone walls of the Indiana forts were very extensive. In the fort near Charlestown, on the Ohio River, the principal wall was several hundred feet long, and was built to the height of nearly ten feet, while at one place a wall about seventy-five feet in height had been erected to fill up a gap in the otherwise nearly precipitous portion of the natural wall. The stones of these walls were simply laid, one overlapping the other, so as to break joints, without cement or mortar of any kind. They had been taken from the surface within the fort.

Mr. Putnam also mentioned an ancient pile of stones on a promontory near Lexington, Ind., which he thought was more likely the remains of some prehistoric monument, erected for some other purpose than to mark a burial place, though the stones had been so much disturbed by treasure seekers that the original form of the monument could only be conjectured. It is known that the Southern Indians erected somewhat similar monuments to mark the spot where some noted event had taken place.

He then described a very singular ancient deposit found near Lexington, Ind., which he called a "refuse circle." This circle was about four hundred feet in diameter, and was formed by a ridge about four feet wide. The ridge seemed to be entirely composed of fragments of pottery and broken bones of deer and other animals. The general appearance of this place is that of an ancient camp, or village, protected by a palisade against which the refuse of the camp had been thrown, and after the destruction of the palisade the soil had formed over the débris and made the ridge now seen. Large sugar trees are growing on portions of the ridge, and there is every indication that considerable antiquity can be ascribed to this interesting circle, which will receive a thorough examination by Professor Cox during the coming year.

Crossing to Kentucky, through his connection with the State survey, (which had been so wisely inaugurated by the Legislature, that its chief, Professor Shaler, was able to extend the work into biological departments as well as geological), Mr. Putnam was able to pursue his archæological investigations while engaged in the ichthyological work of the survey, and had the opportunity of making examinations in several distinct archæological fields, viz., rock shelters, caves, mounds and circular graves.

A rock shelter near Grayson Springs proved very interesting from the number of split bones of the animals which had evidently been used for food, fragments of pottery, and flints found. This place was under an overhanging rock which projected about twenty-five feet from the ledge, forming a place where a number of persons could have lived in comparative comfort. On removing some of the soil from the floor of this shelter many bones of animals, fragments of pottery and flints were found, and also two small mortar holes which had been cut in the ledge forming the floor. On the shelving rocks at the back part of this shelter several small piles of bones were found under such conditions as to give the idea that cooked food had been placed on these shelves for future use, but the party placing it there had suddenly left the spot. There was nothing at this place to indicate greater antiquity than the time when the most recent Indian tribes roamed over the country.

The immense number of stone implements, such as axes, pestles, and especially arrow and spear points, found on the surface in Grayson, Barren and Edmonson counties was alluded to, and several interesting forms were exhibited.

He then exhibited a number of skulls and other bones found under various conditions, and described the peculiarities of each group, comparing them with those of undoubted Mound Builders, and with those of the New England Indians. While the skulls of the New England Indians are long and narrow, those from the mounds, the circular graves, the stone graves and the caves, were of the short, broad and high type; but in the caves were found two, if not three, classes of burials, and at least two well-marked forms of skulls.

The skulls found in graves which were, as a rule, protected by slabs of stone, were, so far as his researches went, of a natural form, differing considerably from the high, short and broad crania of the typical Mound Builders, while those from caves which contained a large number of skeletons representing bodies that had been thrown into the caves, or perhaps skeletons which had been placed there after the flesh had decayed, were quite characteristic from the very marked flattening of the frontal bone and the equally marked concavity on the anterior part of the parietals. The skulls from the "circular grave" were distinguished from the others by their decided width and shortness, and the more vertical occipital portion. Several of these latter as well as some from the caves showed undoubted signs of artificial moulding.

A series of shin bones was also exhibited, to show the various degrees of flattening which existed, and to prove, as shown by the researches of others, that platycnemism, while most marked in ancient and uncivilized races, could not be taken as a special race character of any great importance.

He spoke of an examination of a group of mounds near Glasgow; and though no human remains were found in these particular mounds, a most interesting burial place on a hill close by may have had some connection with them. This burial place consisted of a number of circular graves, most of which had been destroyed by the cultivation of the land; but one that had not been disturbed by the plough was carefully opened. This grave was in the form of a circle of about four feet in diameter, and had been dug to the depth of about three feet. Upright slabs of limestone about three feet in height, from one to two feet in width and three or four inches in thickness, had then been placed round the hole. The bottom of the grave had been covered with pieces of shale brought from Peter's Creek, about a quarter of a mile distant. The bodies, at least fifteen in number, had been placed in the grave, evidently arranged in a sitting posture, in a circle. A few pieces of stone found on the surface of the grave may indicate that stones had been placed over it. If any slight earth mound had been formed over the grave, it had been washed away, as the edges of the upright stones were projecting a few inches above the present surface of the soil. From the fact that only a fragment of pottery was found among the stones on the surface of the grave, and no implements of any kind with the bodies, it may be that articles, since scattered, were placed over the grave. The number of these circular graves that once existed at this spot on the homestead of Gen. Jos. H. Lewis, who had taken Mr. Putnam to the place, suggested many thoughts as to their connection with the group of mounds in the little valley below; and from the great resemblance of the crania to those from mounds, Mr. Putnam was led to consider that these graves probably indicated a peculiar mode of burial which may yet be found to be as characteristic of the singular mound-building race, as the burial under mounds is now supposed to be. The fact that all the bodies must have been placed in the grave at the same time, and that they were those of persons of various ages, from three children who had still the first set of teeth, as shown by fragments of jaws found, to a person quite advanced in age, while the majority were evidently of middle age, — and also the peculiar hole in one of the arm bones, perhaps indicating a blow with some pointed instrument, — give opportunity for speculations which cannot be proved or disproved by these silent relics of a once populous race inhabiting the beautiful country where their bones were laid so long ago that tradition of the more recent Indian tribes gives no clew to them; whence they came or whither they went, all is lost in the great mystery of the past, and only their empty skulls and wonderful monuments of industry, with their implements of skill, are left to tell us of their former power. We know not if these burials indicate famine, pestilence, war, or the unholy sacrifice. We can only conjecture that they were not the graves of persons who had died a natural death.

The caves of Kentucky were often used as receptacles for the dead, and many of them contain large numbers of human skeletons ; but that they were also used as at least temporary places of habitation is shown by the relics found in Salt Cave, situated near the Mammoth Cave, and belonging to the same proprietors. This cave, which is a rival to the Mammoth in the size of some of its avenues, is difficult of access. A small stream of water flows over its mouth, and runs off, through the loose rocks which have fallen from the roof of the cave, to the passage on the left. After entering the cave, the descent of a steep hill of loose rocks to the right leads into a large avenue of several miles in length, the floor of which is covered with jagged rocks that have fallen from above. After climbing over this rough road for some distance, small areas are observed where the roof rock has not fallen and where the original dirt floor, or old river bed, is seen. In these places there are to be found quite level spots where fires have been kindled, and small piles of stone placed by human hands. Here and there, in favorable places, other small piles of stones are to be seen, erected in such a way as to leave a small hole in their centre, and at the bottom of these holes ashes and the stubs of burnt sticks can be seen; while on some of the rocks about were found small bundles of fagots tied with bark, and of a convenient size to be taken in one hand and placed in the holes of the rock piles, evidently indicating that these bundles of sticks were brought into the cave for use as lights and firewood. Further on, within passages and chambers, other indications of habitation were noticed, and in one small chamber, in which the foot of a white man had never stepped before, were seen on the cave earth the imprints of feet that had been shod with peculiar braided moccasons or sandals. Here were in reality the "footprints on the sands of time." The naked heel and toes and the braided covering to the sole of the foot have left imprints as distinct in the tenacious and heavy soil of the cave as if made but a few days previous. In these side chambers, which had just been discovered by Mr. Putnam's guides, were found a number of cast-off sandals, very finely made of the twisted leaves of the cat-tail flag (*Typha*) braided in a careful and artistic way, identical in the manner of braiding with the straw sandals from China, though of a different shape, and having a raised portion from toe to heel, like the sides of a leather slipper, while all the ends of the braids were brought forward and united on the median line over the toes. About twenty-five of these sandal-like moccasons, of various sizes and of several slightly varying designs, but all worn through at toe and heel, were found in the interior chambers of the cave.[1] A piece of cloth more than a foot square and regularly woven, probably from the inner bark of some tree, was also found. This cloth was specially interesting, showing as it did that it had been dyed or colored with black stripes, and also in exhibiting at one corner a place where it had been mended by darning. The other articles found in the cave, which were exhibited at the meeting with those already mentioned, consisted of bunches of the bark such as was used to make the cloth, and of different degrees of fineness; a number of pieces of bark-twine and rope, several showing knots where pieces had been tied together, some made of twisted strands

[1] The only reference I have yet found relating to existing tribes of Indians using moccasons made of other material than skins of animals, is in Gibbs' notice of the northern California Indians and in Fremont's notice of the same tribes. Both these writers state that moccasons made of braided grass are used by these Indians. It is interesting in this connection to note that the sandals of braided grass and some other articles in general resembling those found with the body in Short Cave mentioned further on have been found in a cave in Spain. I quote the following from Dawkins' Cave Hunting as I have not seen the original work by Don Manuel Gongora y Martinez, cited by Dawkins.

"In the work of Martinez referred to, there is a most interesting account of the pre-historic antiquities of Andalusia. Several interments are described in the Cueva de los Murciélagos, a cave running into the limestone rock, out of which the grand scenery of the southern part of the Sierra Nevada has been, to a great extent, carved. In one spot, a group of three skeletons was met with, one of which was adorned with a plain coronet of gold, and clad in a tunic made of esparto-grass, finely plaited, so as to form a pattern which resembles some of the designs on gold ornaments from Etruscan tombs. At a spot further within, a second group of twelve skeletons lay in a semicircle, around one considered by Don Manuel to have belonged to a woman, covered with a tunic of skin, and wearing a necklace of esparto-grass, a marine shell pierced for suspension, the carved tusk of a wild boar, and earrings of black stone. There were other articles of plaited esparto-grass, such as baskets and sandals; flint flakes, pieces of a white marble armlet, polished axes, bone awls, and a wooden spoon, together with pottery of the same type as that from Gibraltar, fragments of charcoal, and bones of animals."—*Cave Hunting*, p. 209.

simply, while others were a five-stranded braid,[1] and of a different and more pliable substance than those which were simply twisted; a small portion of a delicate fringe or tassel of neatly braided fibres; a number of reed "torches," generally burned only at one end; a few small fragments of burned wood, one showing the rough cutting of a stone axe; several fragments of large gourds; two flint arrow-points; a few fragments of shells of *Unio*, one of which was pierced by a hole as if for suspension; a few feathers, probably of the wild turkey, and a portion of a wooden platter or dish. No bones of animals indicating the food of these cave people were found, and though the earth in one of the chambers had been disturbed and looked in several places as if burials had been made, no human bones were discovered. Mr. Putnam intended to make farther explorations in this cave, but a severe illness, brought on by exposure and fatigue in the caves, prevented him at that time from carrying out his plan. Enough was discovered, however, to show the importance of a thorough exploration of the caves in this country, both to ascertain the facts relating to their having been used as habitations and as sepulchres, and Mr. Putnam stated that it was encouraging to science to feel that the work begun by the Kentucky Survey, with the assistance given by the Peabody Museum of Archæology at Cambridge, would be continued until more is known relating to the archæology of this large and most important group of American caves.

The discovery, by the saltpetre miners of 1812–15, of bodies buried with care in some of the caves of Kentucky and Tennessee, and the numerous articles which had been found with them, was alluded to by Mr. Putnam, who stated that since his return from Kentucky he had examined the body, and what remained of the very large number of articles found with it, that was so widely known as the "Mammoth Cave Mummy" sixty years ago. This body was, in reality, found in Short Cave, situated about eight miles from the Mammoth Cave, and had been taken to the latter place for the purpose of exhibition. Mr. Putnam had visited the spot from which the body had been taken, and, from the location of the grave, thought that there was evidence of the burial having been made prior to the fall of the roof rock, which seems to have taken place in many of the

[1] A long piece of braided rope in every way like this specimen is among the articles found sixty years since with the body in Short Cave. A similar braid, from the Sandwich Islands, but of a brown color, is in the Peabody Museum of Eth. and Arch. Both the Salt Cave and Short Cave specimens are of a light gray color.

caves in this region at a remote time. In some of the caves stalagmites have formed over these fallen rocks, though in most of the caves where this falling has occurred the passages were dry at the time and have so continued. He was glad to state that, though these priceless relics of a former race had been sadly neglected, and many of the articles found in the grave had been lost and others had gone to decay, still enough remained at the rooms of the American Antiquarian Society at Worcester to identify the articles found by him in Salt Cave as the same in material, design and structure with those found with the body in Short Cave, and that he had thus secured undoubted osteological characters of the race to go with the articles of clothing, etc., of the people who had made use of Salt Cave as a habitation. He thought, from all that had been found, we could, with little doubt, class this people among the more highly civilized and agricultural of the prehistoric races of America; and it was also very probable that the cave had only been used as a temporary retreat. A number of fragments of the twine, cloth, etc., found with the body now in the collection of the Antiquarian Society, were exhibited side by side with similar ones from Salt Cave and were seen to be of the same character. All the specimens of cloth, etc., from Salt Cave were extremely brittle, and had been preserved only by saturating in gelatine and afterwards mounting between glass; while those from the grave in Short Cave were, from some cause, still in their natural pliable condition. In this connection it is also interesting to record the fact that the wooden bowl from the Mammoth Cave, in the collection of the American Antiquarian Society at Worcester, is probably the one which tradition gives as having been found in the passage of the Mammoth Cave, still known, from the circumstance, as the wooden-bowl chamber, and it is probable that the fragment of a wooden vessel found in Salt Cave was part of a similar article.

In order to bring together all the important facts relating to the prehistoric race whose dead were often buried with so much care in the caves of Kentucky and Tennessee, and who were so far advanced in many of the arts of civilization, Mr. Putnam read the following accounts from several articles written at the time the discoveries were made. To these quotations he has added a few explanatory footnotes. It is contemplated by Mr. Putnam to publish a detailed account, with proper illustrations, of all the articles which have been found, as well as full descriptions and figures of the crania secured under the several conditions mentioned briefly in the foregoing abstract of his verbal remarks.

Account of the so-called Mammoth Cave Mummy, received in 1815 by the American Antiquarian Society, from Collins' History of Kentucky, published in 1847, p. 256, and probably written by Mr. Merriam of Brooklyn, N. Y.

"On my first visit to the Mammoth Cave in 1813, I saw a relic of ancient times, which requires a minute description. This description is from a memorandum made in the Cave at the time. In the digging of saltpetre earth in the Short Cave a flat rock was met with by the workmen, a little below the surface of the earth, in the Cave: this stone was raised, and was about four feet wide, and as many long; beneath it was a square excavation about three feet deep, and as many in length and width. In this small nether subterranean chamber sat in solemn silence one of the human species, a female, with her wardrobe and ornaments placed at her side. The body was in a state of perfect preservation, and sitting erect. The arms were folded up, [1] and the hands were laid across the bosom; around the two wrists was wound a small cord, [2] designed, probably, to keep them in the posture in which they were first placed; around the body and next thereto were wrapped two deer-skins. These skins appeared to have been dressed in some mode different from what is now practiced by any people of whom I have any knowledge. The hair of the skins was cut off very near the surface. The skins were ornamented with the imprints of vines and leaves, which were sketched with a substance perfectly white. [3] Outside of these two skins was a large square sheet, [4] which was either wove or knit. The fabric was the inner bark of a tree, which I judge from appearances to be that of the linn tree. In its texture and appearance it resembled the South Sea Island cloth or matting; this sheet enveloped the whole body and head. The hair [5] on the head was cut off within an eighth of an inch of the skin, except near the neck; where it was an inch long. The color of the hair was a dark-red; the teeth [6] were white and perfect. I discovered no blemish upon the body, except a wound between two ribs, near the backbone; and one of the eyes had also been injured. The finger and toe nails were perfect and quite long.

[1] One arm is now broken off.

[2] This cord may be the soft, five-stranded braid that is with the collection now.

[3] Fragments of these skins still showing the white markings exist.

[4] A portion of it is still preserved.

[5] The hair has all disappeared.

[6] Many are now missing.

The features were regular. I measured the length of one of the bones of the arm with a string, from the elbow to the wrist-joint, and they equalled my own in length, viz., ten and a half inches. From the examination of the whole frame I judged the figure to be that of a very tall female, say five feet ten inches in height.[1] The body, at the time it was discovered, weighed but fourteen pounds, and was perfectly dry; on exposure to the atmosphere, it gained in weight, by absorbing dampness, four pounds. * * * * * *

"The color of the skin was dark, not black; the flesh was hard and dry upon the bones. At the side of the body lay a pair of moccasins,[2] a knapsack, and an indispensable, or reticule.[3] I will describe these in the order in which I have named them. The moccasins were made of wove or knit bark, like the wrapper I have described. Around the top was a border to add strength, and perhaps as an ornament. These were of middling size, denoting feet of a small size. The shape of the moccasins differs but little from the deer-skin moccasins worn by the northern Indians.[4] The knapsack[5] was of wove or knit bark, with a deep, strong border around the top, and was about the size of knapsacks used by soldiers. The workmanship of it was neat, and such as would do credit, as a fabric, to a manufacturer of the present day. The reticule[6] was also made of knit or wove bark. The shape was much like a horseman's valise, opening its whole length on the top. On the side of the opening, and a few inches from it, were two rows of loops, one row on each side. Two cords were fastened to the one end of the reticule at the top, which passed through the loop on one side, and then on the other side, the whole length, by which it was laced up and secured. The

[1] Probably from my measurements not over five feet.

[2] These are not now with the body.

[3] Another article, which is still well preserved, is made of a very firm and strongly woven material, resembling by its width and strength the webbing saddle girth of the present day. This finely made piece of cloth is thirteen inches long and four inches wide, with the ends fringed, and was probably some special article of female use.

[4] This description agrees very well, in a general way, with the sandals I found in Salt Cave, though the writer is probably incorrect in regard to the shape being the same as that of the leather moccasons of the Indians.

[5] There is a large, bag-like article still with the collection which I suppose is the article called the knapsack.

[6] Still preserved in comparatively good condition.

edges of the top of the reticule were strengthened with deep, fancy borders. The articles contained in the knapsack and reticule were quite numerous, and were as follows: one head-cap,[1] made of wove or knit bark, without any border, and of the shape of the plainest night-cap; seven head dresses, made of the quills of large birds, and put together somewhat in the way that feather-fans are made, except that the pipes of the quills are not drawn to a point, but are spread out in straight lines with the top. This was done by perforating the pipe of the quill in two places, and running two cords through the holes, and then winding round the quills [2] and the cord fine thread, to fasten each quill in the place designed for it. These cords extended some length beyond the quills on each side, so that on placing the feathers erect, the cords could be tied together at the back of the head. This would enable the wearer to present a beautiful display of feathers standing erect, and extending a distance above the head, and entirely surrounding it. These were most splendid head dresses, and would be a magnificent ornament to the head of a female at the present day. Several hundred strings of beads;[3] these consisted of very hard, brown seed, smaller than hemp-seed, in each of which a small hole had been made, and through the whole a small three corded thread, similar in appearance and texture to seine twine; these were tied up in bunches, as a merchant ties up coral-beads when he exposes them for sale. The red hoofs [4] of fawns, on a string supposed to be worn around the neck as a necklace. These hoofs were about twenty in number, and may have been emblematic of innocence. The claw [5] of an eagle, with a hole made in it, through which a cord was passed, so that it could be worn pendant from the neck. The jaw of a bear,[6] designed to be worn in the same manner as the eagle's claw, and supplied with a cord to suspend it around the neck. Two rattlesnake-skins;[6] one of these had fourteen rattles; these skins were neatly folded up. Some vegetable colors [6] done up in leaves. A small bunch of deer sinews,[6] resembling catgut in appearance. Several bunches of thread and twine, two and three

[1] Still preserved in comparatively good condition.

[2] A number of the feathers still exist and a few show the string in place as described. The feathers also exhibit faint traces of artificial coloring of a greenish tint.

[3] Quite a number of these bunches of seed-beads are still preserved.

[4] A few of these hoofs (?) still exist.

[5] Probably lost.

[6] These several articles are no longer with the collection.

threaded,[1] some of which were nearly white. Seven needles,[2] some of which were of horn and some of bone; they were smooth, and appeared to have been much used. These needles had each a knob or whorl on the top, and at the other end were brought to a point like a large sail-needle. They had no eyelets to receive a thread. The top of one of these needles was handsomely scolloped. A hand piece[3] made of deer-skin, with a hole through it for the thumb, and designed probably to protect the hand in the use of the needle, the same as thimbles are now used. Two whistles, about eight inches long, made of cane, with a joint about one third the length; over the joint is an opening extending to each side of the tube of the whistle; these openings were about three quarters of an inch long and an inch wide, and had each a flat reed placed in the opening. These whistles were tied together with a cord wound around them.[4]

"I have been thus minute in describing this mute witness from the days of other times, and the articles which were deposited within her earthen house. Of the race of people to whom she belonged when living we know nothing; and, as to conjecture, the reader who gathers from these pages this account, can judge of the matter as well as those who saw the remnant of mortality in the subterranean chambers in which she was entombed."

Letter from Charles Wilkins[5] to Sec'y Am. Antiq. Soc., respecting an exsiccated body, discovered in a cave in Kentucky, now in the Cabinet of the Society, and described in the preceding letter from John H. Farnham.[6] (Trans. Am. Antiq. Soc., Vol. I, pp. 361–363.)

"I have the pleasure of acknowledging the receipt of your letter, of the fifteenth August last, informing me that the American Antiquarian Society were in possession of the Mummy, which they are pleased to consider a valuable acquisition; and requesting me to give you some account of the manner in which it was found. The

[1] Fragments still in the collection.

[2] These "needles" are more properly awls, and are the horns of young deer sharpened by rubbing. The *scolloped top* is the natural base of the horn. One is still in the collection.

[3] No longer with the collection.

[4] Two reeds, answering to this description and still tied together, exist in the collection. They show that they were once ornamented by feathers.

[5] Dated Lexington, Ky., Oct. 2, 1817.

[6] I have not quoted Mr. Farnham's letter as it does not give additional facts.

simple facts attending this discovery are few; but the subject itself opens a field for philosophical inquiry, worthy the investigation of a man of science, a character to which I have no pretensions.

"I received information, that an infant, of nine or twelve months old, was discovered in a saltpetre Cave in Warren County, about four miles from the Mammoth Cave, in a perfect state of preservation. I hastened to the place; but, to my mortification, found that, upon its being exposed to the atmosphere, it had fallen into dust, and that its remains, except the skull, with all its clothing, had been thrown into the furnace. I regretted this much, and promised the laborers to reward them, if they would preserve the next subject for me. About a month afterwards, the present one was discovered, and information given to our agent at the Mammoth Cave, who sent immediately for it, and brought and placed it there, where it remained for twelve months. It appeared to be the exsiccated body of a female. The account which I received of its discovery, was simply this. It was found at the depth of about ten feet from the surface of the Cave,[1] bedded in clay, strongly impregnated with nitre, placed in a sitting posture, incased in broad stones standing on their edges, with a flat stone covering the whole. It was enveloped in coarse clothes, (a specimen of which accompanied it) the whole wrapped in deer skins, the hair of which was shaved off in the manner in which the Indians prepare them for market. Enclosed in the stone coffin, were the working utensils, beads, feathers, and other ornaments of dress, which belonged to her. The body was in a state of much higher perfection, when first discovered, and continued so, as long as it remained in the Mammoth Cave, than it is at present, except the depredations committed upon its arms and thighs by the rats, many of which inhabit the Cave. After it was brought to Lexington, and became the subject of great curiosity, being much exposed to the atmosphere, it gradually began to decay; its muscles to contract, and the teeth to drop out, and much of its hair was plucked from its head by wanton visitants. As to the manner of its being embalmed, or whether the nitrous earth and atmosphere had a tendency to preserve it, must be left to the speculations of the learned.

"The Cave in which the Mummy was found, is not of great extent, not being more than three quarters of a mile in length; its surface

[1] This probably is intended to imply ten feet from the surface including the fallen roof rock.

covered with loose limestone,[1] from four to six feet deep, before you enter the clay impregnated with nitre. It is of easy access, being about twenty feet wide, and six feet high, at the mouth or entrance. It is enlarged to about fifty feet wide, and ten[2] feet high, almost as soon as you enter it. This place had evident marks of having once been the residence of the aborigines of the country, from the quantity of ashes, and the remains of fuel, and torches made of the reeds etc., which were found in it." * * * * * *

A letter[3] from Dr. Mitchill, of New York, to Samuel M. Burnside, Esq., Secretary of the American Antiquarian Society, on North American Antiquities. (From the Trans. Am. Antiq. Soc., p. 318–321.)

"I offer you some observations on a curious piece of American Antiquity, now in New York. It is a human body, found in one of the lime-stone caverns of Kentucky. It is a perfect exsiccation; all the fluids are dried up. The skin, bones, and other firm parts are in a state of entire preservation. I think it enough to have puzzled Bryant and all the Archæologists.

"In exploring a calcareous chamber in the neighborhood of Glasgow, for saltpetre, several human bodies were found enwrapped carefully in skins and cloths. They were inhumed below the floor of the cave; *inhumed*, and not lodged in catacombs.

"These recesses, though under ground, are yet dry enough to attract and retain the nitrick acid. It combines with lime and potash; and probably the earthy matter of these excavations contains a good proportion of calcareous carbonate. Amidst these drying and antiseptick ingredients, it may be conceived that putrefaction would be stayed, and the solids preserved from decay.

"The outer envelope of the body is a deer skin, probably dried in the usual way, and perhaps softened before its application, by rubbing. The next covering is a deer skin, whose hair had been cut away by a sharp instrument, resembling a hatter's knife. The remnant of the hair, and the gashes in the skin, nearly resemble a sheared pelt of beaver. The next wrapper is of cloth, made of twine doubled and twisted. But the thread does not appear to have been formed by the wheel, nor the web by the loom. The warp and filling seem to have been crossed and knotted by an operation like

[1] Fallen roof rock.

[2] Probably a misprint for one hundred.

[3] Dated August 24, 1815.

that of the fabricks* of the northwest coast, and of the Sandwich Islands. Such a botanist as the lamented Muhlenburgh, could determine the plant which furnished the fibrous material.

" The innermost tegument is a mantle of cloth like the preceding ; but furnished with large brown feathers, arranged and fastened with great art, so as to be capable of guarding the living wearer from wet and cold. The plumage is distinct and entire, and the whole bears a near similitude to the feathery cloaks now worn by the nations of the northwestern coast of America. A. Wilson might tell from what birds they were derived.

" The body is in a squatting posture, with the right arm reclining forward, and its hand encircling the right leg. The left arm hangs down, with its hand inclined partly under the seat. The individual, who was a male, did not probably exceed the age of fourteen, at his death. There is a deep and extensive fracture of the skull, near the occiput, which probably killed him. The skin has sustained little injury ; it is of a dusky color, but the natural hue cannot be decided with exactness, from its present appearance. The scalp, with small exceptions, is covered with sorrel or foxy hair. The teeth are white and sound. The hands and feet, in their shrivelled state, are slender and delicate. All this is worthy the investigation of our acute and perspicacious colleague, Dr. Holmes.

" There is nothing bituminous or aromatick in or about the body, like the Egyptian mummies, nor are there bandages around any part. Except the several wrappers, the body is totally naked. There is no sign of a suture or incision about the belly ; whence it seems that the viscera were not removed.

" It may now be expected that I should offer some opinion, as to the antiquity and race of this singular exsiccation.

" First, then, I am satisfied that it does not belong to that class of white men of which we are members.

" 2dly. Nor do I believe that it ought to be referred to the bands of Spanish adventurers, who, between the years 1500 and 1600 rambled up the Mississippi, and along its tributary streams. But on this head I should like to know the opinion of my learned and sagacious friend, Noah Webster.

" 3dly. I am equally obliged to reject the opinion that it belonged to any of the tribes of aborigenes, now or lately inhabiting Kentucky.

" 4thly. The mantle of feathered work, and the mantle of twisted threads, so nearly resembles the fabricks of the indigenes of Wakash and the Pacifick islands, that I refer this individual to that era of time, and that generation of men, which preceded the Indians of the Green River, and of the place where these relics were found. This conclusion is strengthened by the consideration that such manufactures are not prepared by the actual and resident red men of the present day. If the Abbe Clavigero had had this case before him, he would have thought of the people who constructed those ancient forts and mounds, whose exact history no man living can give. But I forbear to enlarge; my intention being merely to manifest my respect to the Society for having enrolled me among its members, and to invite the attention of its Antiquarians to further inquiry on a subject of such curiosity."

The Original Inhabitants of America consisted of the same Races with the Malays of Australasia and the Tartars of the North. By Samuel L. Mitchill, in Med. Repos., Vol. 18, p. 187. (Trans. Am. Ant. Soc., Vol. I, p. 321.)

"The information we derived from Messrs. Cassedy and Miller, of Tennessee, relative to the human bodies found in a copperas cave, near the Cany Branch of the Cumberland River, was very curious. (Medical Repository, vol. xv. p. 147.)[1] * * * * *

"The fabricks accompanying the Kentucky bodies resembled very nearly those which encircled the mummies of Tennessee. On comparing the two sets of samples, they were ascertained to be as much alike as two pieces of dimity or diaper from different manufactories.

"Other Antiquities of the same class have come to light. Mr. Gratz, of Philadelphia, the proprietor of the vast cavern figured and described in the Medical Repository, vol. xvii, pp. 391–393, has, very obligingly, sent to Dr. Mitchill other specimens of cloths, things made of those cloths, and raw materials, dug out of that unparalleled natural excavation. He forwarded, with the samples, a map of the cave, substantially like that which we had received before from Mr. Bogert; and confirming every thing therein stated. A parcel of these articles, now in Dr. Mitchill's possession, was accompanied with the following note:—

"'There will be found in this bundle two moccasons, in the same

[1] Dr. Mitchill here refers to an account similar to that in the preceding quotation, and illustrated by figures of the "mummy" and of two kinds of the cloth found with it.

state they were when dug out of the Mammoth Cave, about two hundred yards from its mouth. Upon examination, it will be perceived that they are fabricated out of different materials; one is supposed to be made of a species of *flag*, or *lily*, which grows in the southern parts of Kentucky; the other, of the bark of some tree, probably the *pappaw*.'

"'There are, also, in this packet, a part of what is supposed to be a *kinniconecke* pouch, two meshes of a fishing net, and a piece of what we suppose to be the raw material, and of which the fishing net, the pouch, and one of the mocasons are made. All of which were dug out of the Mammoth Cave, nine or ten feet under ground;[1] that is below the surface or floor of the cavern. You will find, likewise, two Indian beads, discovered in a cave, situated in the vicinity of the Mammoth Cave.

"'We have, also, an Indian bowl, or cup containing about a pint, cut out of wood,[2] found also in the cave; and lately, there has been dug out of it the skeleton of a human body, enveloped in a matting similar to that of the *kinniconecke* pouch.'

"This matting is substantially like those of the plain fabrick, from the copperas cave of Tennessee, and the saltpetrous cavern, near Glasgow [Kentucky]. And, what is highly remarkable, and worthy, the attention of every Antiquarian, is, that they all have a perfect resemblance to the fabricks of the Sandwich, the Caroline, and the Fegee islands." * * * * * * * * *

In a table of measurements of crania given by Squier and Davis in "Ancient Monuments of the Mississippi Valley" p. 291, the following are recorded of the "skull of the Mummy taken from the great cave in Kentucky, now in the Museum of the American Antiquarian Society, Worcester, Mass." The skull here indicated is unquestionably that of the female found in Short Cave.

[1] This is the only statement we have of articles of this character being found in the Mammoth Cave, and it is very probable that they are some of the missing articles belonging to the body found in Short Cave.

[2] This bowl is probably the one now in the collection of the Ant. Soc. at Worcester, where it was received with the body from Short Cave, though the above sentence does not make it very clear which cave is referred to. There is little doubt that a "wooden bowl" was found in the Mammoth Cave but it is quite probable that none of the human bodies were found there.

MEASUREMENTS OF SKULL FROM SHORT CAVE. SQUIER AND DAVIS.

Longitudinal diameter	6.7 inches.
Interparietal "	5.5 "
Vertical "	6.2 "
Frontal "	4.5 "
Intermastoid arch	13.5 "
Intermastoid line	5. "
Horizontal periphery	19.7 "

The table mentioned above also contains the measurements of a skull said to have been found in the Mammoth Cave, but this skull is not well authenticated, and the conditions under which it was found are not known.

Mr. W. H. Dall, of the United States Coast Survey, gave a brief account of the archæological work done in connection with the Coast Survey work at the Aleutian Islands. He spoke more particularly of the methods of burying practised by the early inhabitants of these islands, and of their mode of preserving or mummifying the bodies by a process of evisceration and drying. He also described various implements and fabrics formerly manufactured and in use among them.

January 20, 1875.

The President in the chair. Seventy-two persons present.

The following papers were read : —

Some considerations on the possible means whereby a Warm Climate may be produced within the Arctic Circle. By N. S. Shaler.

There is hardly another question in geology which presents greater difficulties than that of the origin of the forest vegetation, preserved to us in the various fossil-bearing beds about the north pole. In Greenland, up to 76° of north latitude, or to within 14° of the pole itself, in Iceland, Bear Island, and at various other points in the

North Atlantic, at various stages of the earth's history, from the time of the carboniferous beds down to the later tertiaries, we have the most unquestionable evidence of the occurrence, from time to time, of periods of sufficient heat to permit the development of extensive forests or of marine life that attests a similar warmth.

When facts of this general nature were first observed, it was the fashion to account for them by the hypothesis that the polar axis was subject to great changes of position; thereby quite altering the relations of the regions which lie within the Arctic Circle. The impossibility of this view having been sufficiently demonstrated on physical grounds, and the hypothesis definitely abandoned by naturalists, it remains for us to consider what other changes can take place calculated in their nature to bring up the circumpolar temperature.

A simple hypothesis would be that the temperature of the earth's surface varying with the temperature of the sun, it might be possible that its whole surface should be so elevated that the temperature of the circumpolar regions would be of the degree of warmth we now find only in tropical or sub-tropical regions. This, however, is unsatisfactory, inasmuch as it would require an increase of the heat of the regions near the equator to about double its present average. Any such temperature would necessarily bring about the destruction of all tropical life. This is by no means an improbable objection to this view. There is, however, reason to believe that the evaporation consequent on any great elevation of temperature in tropical regions would bring about an enormous deposition of moisture about the poles, and lead to glacial conditions by producing a vast precipitation of snow.

There is another and far more satisfactory hypothesis which does less violence to the order of nature, and at the same time gives us the required result. We may suppose that the ocean currents, those mightiest agents in the surface machinery of the earth, may from various causes carry at one time far greater quantities of heat toward the poles than at other times. Mr. James Croll has pointed out the very great value of the Gulf Stream in carrying heat to within the Arctic Circle. If we could double the amount of this heat brought within the Arctic Circle by the ocean currents, we would, beyond doubt, produce a change of climate great enough to account for all the facts. This it seems to me we may do by a very simple and natural process. Of the two great northern branches of the equatorial current, the Gulf Stream and the Japan current, but one now carries its full effect to the region within the Arctic Circle; the other is barred from the circumpolar region by the closure of the land and islands about Behrings Strait. If this barrier to the northern movement of the Japan current could be removed we should have a very great increase in the circumpolar temperature; how great this increase would be may be judged from an inquiry into the present effects of the heat carried from the equator to the inter-arctic regions.

The computations of Mr. James Croll make it quite evident that the amount of this heat carried from the equator to the poles in the present state of the oceanic currents, is so great that the temperature of that part of the earth within the Arctic Circle is brought up to nearly twice the height above the zero of Fahr. that it would have under conditions when no heat was received by this channel. His calculations show that all the heat falling within two hundred and ten miles of either side of the equator passes to the North Atlantic, and goes to determine the average heat of that region. If this be the case, it is clearly seen that the admission of another current of the same dimensions must elevate the mean annual temperature of this region to somewhere between 55°–60° Fahr. This is not far from the mean annual temperature of the Ohio valley; so we have the necessary elevation of temperature. So far these considerations are, in a general way, self-evident, and must have suggested themselves to most persons who have considered this problem; the point which has sufficient importance to warrant farther discussion is the connection between the elevation and subsidence of this land barrier, which shuts the larger part of the equatorial waters away from the circumpolar region, and great changes in the temperature of the northern waters. It is now a well ascertained fact that during the last glacial period the land about the poles was very much depressed below its present level. Occurring in both hemispheres and over all the circumpolar land, this subsidence is certainly connected in some way with the formation of a great sheet of ice. I have endeavored to show the nature of this connection, and to prove that it arises from the direct weight of the ice; but as this does not necessarily concern us in our present inquiry, I shall content myself with the assumption which I believe amply justified by the fact, that the formation over the land of an ice sheet leads necessarily to great subsidence. At the close of each glacial period, when the ice sheet passes away, the circumpolar regions must be far more open to the passage of warm water toward high latitudes than at any other time.

It will be seen by the inspection of a map that gives the height of the land, that with a depression of two thousand feet below the present level, we should have had, at the close of the last glacial period, nearly twice the room for the passage of warm currents and cold currents from the pole. This would have led to the immediate return of very warm conditions to that area on the disappearance of the ice mantle of the glacial period. As the land began to rise and the marine currents to be more and more barred out from the poles, the temperature would necessarily sink below its former height.

These considerations, which can be established on purely theoretical grounds, serve very well to explain the observed change which has taken place in Greenland and Iceland within the historical period. It is quite certain that the climate has greatly changed in Greenland since the settlement of that country in the tenth century, and there seems much evidence of a similar change in Iceland. If we suppose that there has been an elevation of only ten feet in a century of the land about Behring's Strait, the effect upon the movement of warm water into the Arctic Ocean might become considerable within eight centuries. At present a slender thread of the Japan current reaches through the Strait and seems to affect the conditions for some distance to the northward of the north end thereof; eighty feet more added to the depth of water, including what would be gained in width, could not add more than something like a fifth to the heat-carrying power of the northward passing current. Therefore we must look to some greater phase of this cause for the change of the Greenland climate. I think we can find it in the following manner ; let us suppose that during the ten thousand years anterior to the present time there has been a constantly diminishing rate of the elevation during equal periods of time, then we may easily suppose that a thousand feet of altitude had been gained during that time, notwithstanding the present slow rate of elevation. Nothing like the present slow rate of upheaval can be supposed adequate to bring about the great re-elevation of the post-glacial time. It must have been far more rapid for a part of the time during which it has been going on. Thus rapidly lifted during the first part of the period of elevation, the accumulation of ice and the intensification of the cold would hardly keep pace with the change of elevation, but would continue for a while after the beginning of the elevation at a rate hardly to be explained by the elevation itself. In other words, the increasing cold observed in Greeland since the occupation of that country by

Europeans, may be due to changes which took place sometime before that settlement. Fortunately the process of change has already reached a point where all future refrigeration of the Arctic region by its action seems improbable.

A considerable part of the influence which would be brought to bear by the lowering of the Alaskan barrier,[1] would consist in the escape of the cold waters from the pole. It is not only the entrance of tropically heated water but also the deportation of the cold water by the counter current and the icebergs floated therewith that would affect the transformation of Arctic regions. The same machinery which carries heat to the polar regions would take away the ice fields and prevent the accumulation of such a reservoir of cold as is now furnished by the ice cap of that region.

In this connection it may be suggested as an interesting question, whether the deep water in the North Pacific is as cold as that in the North Atlantic, it would seem that the absence of a broad and direct communication between the North Pacific and the Arctic Oceans should make it sufficient for the water of the deep sea in that region to retain the excessively low temperature which has been found in the abysms of the North Atlantic. If the polar water finds its way in sufficient quantities into the depths of the Northern Pacific to produce the excessively low temperature found in the North Atlantic basin, it would seem that it must come from the southern and not from the northern polar region. This question should give an increased interest to the future exploration of that basin.

The conclusions to which we are apparently led by the consideration of the foregoing questions are as follows:

1st. That while the continents have remained in their present general relations with their broad bases turned toward the northern

[1] That worthless and hapless bit of land, Alaska, has already robbed one-half this continent of a decent climate. No other region of its area on the surface of the earth has done so much to reduce the usefulness of a great continent. With the Japan current flowing freely into the Arctic Ocean, we would probably have had a climate in the northern hemisphere where the isochiemals and isotherals and isothermals of Ireland would have been at least as high as in Greenland. It is even likely that the effect would have been greater than this, for the existence of warmth in the Arctic Seas would have lifted the temperature of Northern Europe as well as that of Northern America. If ever man in his advance gets that strong hold on mechanical forces which will enable him to deal with the surface of the earth as he now deals with the smaller matters of his environment, one of his first efforts will be to rid the earth of that unhappy bar to the movement of tropical waters toward the pole.

pole and their apices towards the southern, a small difference in the altitude of the regions about the north pole must have made a very great difference in the penetration of warm water, and the escape of cold water and ice from that region, and thereby profoundly affected its climate.

2d. That the elevation and depression due to glacial action[1] must tend frequently to open and close these barriers; and that we have in these necessary accidents a means of accounting for the occurrence from time to time of warm periods which the geological record shows to have existed.

3d. That the destruction of this barrier and the consequent admission of the Japan current into the Arctic Sea, must tend to bring up the average temperature of Europe and North America, and must have a very great tendency to make the winter temperature less rigorous. Therefore it may be considered a possible cause of the warm climate shown to have existed in Europe during various periods of Cenozoic time. The sudden alternations from cold to warmth becomes thus explicable, being accounted for by the fact that the accumulation of ice brings about the subsidence that opens the way to the tropical currents toward the poles.

4th. That the opening and closing of this barrier must have some effect upon the distribution of the cold polar waters over the depths of the sea floor.

5th. The passage of any considerable part of the Japan current into the Arctic Circle would necessarily not only elevate the temperature of the circumpolar region, but would also lower the equatorial temperature by a proportionate amount. It is not easy to determine the change of temperature in either case, but for the elevation of the inter-Arctic regions by the amount of twenty degrees in the mean annual, the mean temperature at the equator would probably be lowered by at least one fourth that amount.[2]

[1] For a theory of the nature of the forces involved in the production of the depression occuring during the glacial period, the reader is referred to a paper by the author of this notice, in the Memoirs of the Bost. Soc. Nat. Hist., Vol. II, Part III, No. 3, page 335, 1874.

[2] As this paper goes to press, I find in the 4th edition of Dana's Manual of Geology a reference to an opinion of Mr. Bradley, who, it appears, has already called attention to the effect of lowering the Alaskan barrier on polar temperature.

Notes on Birds observed in portions of Utah, Nevada, and California. By E. W. Nelson.

The following notes were taken during the summer and fall of 1872. Although some of the localities have been quite thoroughly worked up by different naturalists, yet I hope that the lists and notes will add to the knowledge of the distribution and habits of many of the species. The lists are not intended to form a complete catalogue of the birds of any of the localities. At Nevada, Cal., owing to the season of the year spent there, only a portion of the summer residents were obtained. The list, however, probably contains a majority of the autumn visitants, with a few summer residents. For several of the species and notes I am indebted to my companion, Mr. W. W. Wentworth. Mr. Drexler's list of the Birds of Ft. Bridger, in the Pacific R. R. Reports, Vol. ix, together with mine, will probably include nearly all the birds to be found at that locality.

I. *Notes on Birds observed in the vicinity of Fort Bridger, Utah, between June 22d and July 24th, 1872.*

Fort Bridger is situated on the Black Fork of the Green River. The stream is bordered by willows and cottonwoods with occasionally a grassy meadow. Beyond these are the sage bush plains. Thirty miles south of the Fort is a range of mountains covered with a heavy growth of pine. Through the kindness of Mr. Carter, who was running several saw-mills there, I was enabled to spend a few days collecting in these mountains. As there is quite a difference in the species observed there and at the Fort, I have placed the notes on those observed in the immediate vicinity of the Fort under Section *A*, and those observed in the mountains under Section B. Along the lower border of the pine forest were scattered clumps of cottonwoods which were frequented by several species not found in the dense pine forest higher up.

A. Vicinity of Fort Bridger.

TURDIDÆ.

1. Turdus migratorius Linn. Robin. Abundant. Found nests containing eggs the last of June. They were built in the willows, often on the very edge of the water.

2. Turdus Swainsoni Cab. Olive-backed Thrush. Common. Frequented the dense bushes along the creek, but were so shy tha although often seen they were difficult to shoot.

3. **Oreoscoptes montanus** Baird. Mountain Mocking Bird. Common in the sage bushes. Generally kept concealed during the middle of the day. Often heard them singing long after dark from the top of some tall sage bush. When alarmed they would fly off close to the ground and suddenly resume their song on a distant bush.

SAXICOLIDÆ.

4. **Sialia arctica** Swains. Arctic Blue Bird. Not common. A pair were seen on a butte several miles from the Fort.

PARIDÆ.

5. **Parus atricapillus** var. **septentrionalis** All. Common in the willows along the stream. Habits the same as those of *P. atricapillus*.

ALAUDIDÆ.

6. **Eremophila alpestris** Boie. Common. Seemed to prefer the flat tops of the buttes.

SYLVICOLIDÆ.

7. **Dendrœca æstiva** Baird. Very abundant among the bushes.

8. **Geothlypis Philadelphia** var. **Macgillivrayi** All. Macgillivray's Warbler. Not common. The few seen were in the larger growth of cotton woods.

HIRUNDINIDÆ.

9. **Hirundo horreorem** Barton. Barn Swallow. Abundant about the Fort, nesting in the government barn.

10. **Tachycineta thalassina** Cab. Violet-green Swallow. Very common. I found a small colony of five or six pairs nesting in holes in the bank of the creek. The holes were about eighteen inches deep, the nests, situated in the extremity of these, were composed of a few pieces of grass and feathers laid together much in the manner of a bank swallow's nest.

11. **Petrochelidon lunifrons** Cab. Cliff Swallow. Very abundant, nesting in large colonies along the rocky cliffs on the banks of the stream.

LANIIDÆ.

12. **Collurio ludovicianus** var. **excubitoroides** Coues. White-rumped Shrike. A few seen in the sage brush. They were so unsuspicious that they allowed me to approach within a few yards.

FRINGILLIDÆ.

13. **Poœcetes gramineus** var. **confinis** Baird. Grass Finch. Common, frequenting the border of the sage brush.

14. **Coturniculus passerinus** var. **perpallidus** Ridg. Yellow-winged Sparrow. Abundant, frequenting the grassy fields. Their habits are the same as those of the eastern species, singing from the top of a tall weed for an hour at a time.

15. **Melospiza melodia** var. **fallax** Ridg. Not common. One nest was found in a tuft of grass near a small slough, containing four eggs, resembling those of the common song sparrow.

16. **Spizella pallida** var. **Breweri** Coues. Brewer's Sparrow. Common in the sage brush.

17. **Spizella socialis** Bonap. Chipping Sparrow. Not common. Frequented open ground near the Fort.

18. **Zonotrichia leucophrys** var. **intermedia** Ridg. White-crowned Finch. Common in the willows along the stream.

19. **Goniaphea melanocephala** Gray. Black-headed Grosbeak. Common. They kept so near the creek that nearly all I shot fell into the water.

20. **Cyanospiza amœna** Baird. Lazuli Finch. Abundant. Morning and evening they could be heard singing from the tops of tall bushes, often several at once, as though trying to outrival each other.

21. **Pipilo chlorurus** Baird. Green-tailed Finch. Common. Their habits resemble those of a cat bird. They prefer keeping in the trees and when alarmed by anything below they ascend to the top of the trees by successive hops.

ICTERIDÆ.

22. **Molothrus pecoris** Sw. Cow Bird. Not common. The only one seen was a young one nearly full grown, which was taken the first of July.

23. **Sturnella magna** var. **neglecta** All. Western Lark. Common. Found a nest the first of July containing five eggs. The

nest was not concealed by an arched cover, as in the East, but was loosely constructed of grass stems.

24. Icterus Bullockii Bonap. Bullock's Oriole. Common. So shy that I did not succeed in obtaining a specimen.

25. Scolecophagus cyanocephalus Cab. Brewer's Blackbird. Very abundant. The first of July the young were nearly full-grown and were flying about with the old birds.

CORVIDÆ.

26. Pica melanoleuca var. **hudsonica** All. Magpie. Not common. Obtained one specimen in a bunch of willows where it had taken refuge to escape the persecutions of a flock of Brewer's Blackbirds which were after it.

TYRANNIDÆ.

27. Tyrannus verticalis Say. Arkansas Flycatcher. Common, frequenting the tall cottonwoods.

28. Contopus virens var. **Richardsoni** All. Richardson's Pewee. They were quite active except during the middle of the day, when they remained concealed in the thickets.

CAPRIMULGIDÆ.

29. Chordeiles popetue var. **Henryi** All. Abundant. Often found them on the bare spots in the sage brush in the hottest part of the day. When scared up they would circle around and alight near the same place.

ALCEDINIDÆ.

30. Ceryle alcyon Boie. Kingfisher. Not common.

PICIDÆ.

31. Colaptes mexicanus Swains. Red-shafted Woodpecker. One pair was often seen near the Fort in a small opening in the bushes. They searched for food on the ground like *C. auratus.*

STRIGIDÆ.

32. Bubo virginianus Bonap. Horned Owl. Mr. Carter had one alive which was brought in by the Indians. It probably came from the mountains.

33. Spheotyto cunicularia var. **hypogæa** Coues. A few pairs had taken up their abode in some deserted "prairie dog" holes near the Fort. The holes occupied by the owls can be readily distinguished from those occupied by the "prairie dogs" by the refuse matter around the entrance. The owls were very expert in avoiding capture, standing in the mouth of the hole and, when approached, gradually sinking down until nothing but their eyes and the top of the head was visible; as soon as the gun was raised they would disappear. If surprised away from the hole they would lie flat on the ground and allow a person to pass within a short distance, but if observed, they would fly off uttering a curious rolling cry.

FALCONIDÆ.

34. Falco sparverius Vieill. Sparrow Hawk. Not common. Frequented the sides of the "buttes."

COLUMBIDÆ.

35. Zenædura carolinensis Bonap. Common Dove. Common. Found one nest composed of sticks laid loosely across two branches where they crossed about four feet from the ground.

TETRAONIDÆ.

36. Centrocercus urophasianus Sw. Sage Hen. Abundant. The young were about one-third grown the last of June. We found one nest that had been forsaken; it was situated under a sage bush, and was merely a hollow in the dry dirt containing seven eggs.

CHARADRIIDÆ.

37. Ægialitis vociferus Cassin. Killdeer. Abundant.

38. Eudromias montanus Harting. Mountain Plover. Saw a few specimens on the tops of the "buttes" but they were so shy that I could not get one.

RECURVIROSTRIDÆ.

39. Recurvirostra americana Gm. Avoset. A pair were seen near a small alkali pond.

SCOLOPACIDÆ.

40. Totanus solitarius Wils. Solitary Sandpiper. Not common.

41. Tringoides macularius Gray. Spotted Sandpiper. Abundant. The young began to appear the last of June. One of these birds which I wounded slightly fell in the creek, and when I went to take it out it dove and, using its wings and feet, swam under water to the other side, a distance of about ten feet.

ARDEIDÆ.

42. Nyctiardea grisea var. **nævia** All. A pair were seen several times on a sand bar in the creek.

ANATIDÆ.

43. Anas boschas Linn. Mallard. A few specimens seen in the creek.

B. Mountains, thirty miles south of Fort Bridger.

SAXICOLIDÆ.

1. Sialia arctica Sw. A pair were nesting in an old woodpecker's hole near the camp.

CERTHIIDÆ.

2. Certhia familiaris Linn. Creeper. Abundant. The young, although full-grown, were still fed by the parents.

TROGLODYTIDÆ.

A species of Wren was frequently seen in some dense bushes along a stream, but could not be procured.

SYLVICOLIDÆ.

3. Dendrœca Audubonii Baird. Audubon's Warbler. Common. Frequented the tops of the pines.

4. Myiodioctes pusillus Bonap. Green Black-capped Flycatcher. Abundant. Found with the preceding. Their habits are so similar that it was hard to distinguish them in the tops of the pines.

HIRUNDINIDÆ.

5. Tachycineta thalassina Cab. I found a pair nesting in a hole in a stub about fifteen feet from the ground, near the foot of the mountains.

FRINGILLIDÆ.

6. **Pinicola enucleator** Vieill. Abundant. Small glades were scattered through the forest, often with a pool of water in the centre. Nearly all of these glades which we visited were inhabited by a family of these birds. We generally found them on or near the ground but they would fly up into the tops of the pines as soon as approached.

7. **Carpodacus Cassinii** Baird. Cassin's Finch. A few were obtained around the borders of the clearings.

8. **Loxia curvirostra** var. **americana** Coues. Red Crossbill. Common. We were often attracted to them by the cries of the nearly full-grown young.

9. **Junco cinereus** var. **caniceps** Coues. Abundant about the clearings near the base of the mountain.

CORVIDÆ.

10. **Perisoreus canadensis** var. **capitalis** Ridg. Canada Jay. Common. They were so familiar that they would come to the window while the men were eating. When skinning birds they would watch us with great curiosity.

TYRANNIDÆ.

11. **Contopus borealis** Baird. Olive-sided Flycatcher. Obtained one specimen from the top of a dead pine.

PICIDÆ.

12. **Sphyrapicus varius** var. **nuchalis** All. Abundant. Several nests were found containing nearly full-grown young. They were excavated in live cottonwoods about ten feet from the ground. I saw the birds on pines a few times, but they preferred cottonwoods.

13. **Sphyrapicus Williamsoni** Baird. Williamson's Woodpecker. One specimen obtained from a small pine in a clearing.

14. **Colaptes mexicanus** Swains. A few were seen in the cottonwoods near the base of the mountain.

STRIGIDÆ.

15. **Otus vulgaris** var. **Wilsonianus** All. Long-eared Owl. One specimen obtained.

MELEAGRIDÆ.

16. ? Meleagris gallopavo Linn. The hunters told of seeing large birds sometimes which looked like turkeys, running through the woods.

SCOLOPACIDÆ.

17. Totanus solitarius Wils. Several pairs seen in a natural meadow on the mountain side. From their actions they probably had young, although I could find none.

18. Tringoides macularius Gray. Found with the preceding. The young were but a few days old.

ANATIDÆ.

19. Querquedula discors Steph. A female with two young but a few days old were found in the stream flowing through the meadow.

II. *Notes on Birds observed near Salt Lake City, Utah, between July 27th and August 8th, 1872.*

Our collecting in this vicinity was done from the mouth of the Jordan River north about ten miles, including the lake shore and the cultivated land to the base of the mountains, about four miles from the lake. Near the lake shore was a strip of weeds which was frequented by several species of birds not found elsewhere. Many of the birds, which were resident there in the early part of summer, were gone. The people said that there were many more small birds earlier in the season.

TURDIDÆ.

1. Turdus migratorius Linn. Robin. Very abundant frequenting the roadsides in flocks.

2. Oreoscoptes montanus Baird. Mountain Mocking Bird. Common in the fields, but so shy that it was hard to get a specimen.

ALAUDIDÆ.

3. Eremophila alpestris Boie. Horned Lark. When we first arrived these larks were found in small flocks of ten or twelve individuals; but before we left they had united into larger flocks, often containing hundreds.

SYLVICOLIDÆ.

4. **Dendrœca æstiva** Baird. Abundant. The only warbler.

LANIIDÆ.

5. **Collurio ludovicianus** var. **excubitoroides** Coues. White-rumped Shrike. Common about unfrequented fields.

FRINGILLIDÆ.

6. **Carpodacus frontalis** Gray. Abundant in a field containing a number of dwarf cedars (?), on the berries of which they were feeding. I did not see them any where else.

7. **Passerculus savanna** Bonap. One specimen obtained.

8. **Poœcetes gramineus** var. **confinis** Baird. Common. Found them most abundant in the weeds along the lakes.

9. **Coturniculus passerinus** var. **perpallidus** Ridg. Common in the fields.

10. **Spizella pallida** var. **Breweri** Coues. Brewer's Sparrow. Abundant in the weeds along the lake shore. They seemed to avoid the vicinity of the farm houses. I rarely saw one except along the lake shore and in old roads grown up with weeds.

11. **Chondestes grammaca** Bonap. Lark Finch. Abundant in flocks along the roadsides.

12. **Cyanospiza amœna** Baird. Lazuli Finch. Common, frequenting the willows along brooks.

ICTERIDÆ.

13. **Dolichonyx oryzivorus** Sw. Bobolink. Saw two large flocks the day we arrived; they were preparing to migrate, and three days after not a bobolink was to be found. Part of the males still retained their black plumage.

14. **Sturnella magna** var. **neglecta** All. Western Lark. Common in the meadows.

15. **Scolecophagus cyanocephalus** Cab. Brewer's Blackbird. Not common. A few small flocks were seen.

CORVIDÆ.

16. **Corvus corax** Linn. Raven. One specimen seen. Said to be abundant in winter.

TYRANNIDÆ.

17. Tyrannus carolinensis Baird. Kingbird. One specimen obtained.

18. Contopus virens var. **Richardsoni** All. Richardson's Pewee. Not common. Kept in the bushes along the creeks.

19. Empidonax Trailli var. **pusillus** Coues. Common in shady situations, preferring willow thickets.

TROCHILIDÆ.

20. Selasphorus platycercus Gould. Common. Morning and evening they frequented the fields; during midday they kept in the bushes along streams.

PICIDÆ.

Several species of woodpeckers were said to be common during the fall and winter. None were observed during our visit.

FALCONIDÆ.

21. Circus cyaneus var. **hudsonius** All. Marsh Hawk. Abundant along the lake shore.

22. Buteo borealis var. **calurus** Ridg. Common. It frequents the sides of the mountains, rarely coming down to the farms.

COLUMBIDÆ.

23. Zenædura carolinensis Bonap. Common Dove. Common.

TETRAONIDÆ.

24. Tetrao obscurus Say. Dusky Grouse. One specimen obtained in the mountains. Said to be common by the inhabitants, who call them "fool hens."

25. Pediocetes phasianellus var. **columbianus** Coues. A few seen; called "prairie hens" by the inhabitants, who said they were formerly abundant but were becoming rare.

26. Centrocercus urophasianus Sw. Said to occur rarely in unsettled places.

CHARADRIIDÆ.

27. Aegialitis vociferus Cassin. Killdeer. Abundant.

28. **Aegialitis cantiana** var. **nivosa** Ridg. Abundant near the mouth of the Jordan. Saw the young a few days old the first of August.

RECURVIROSTRIDÆ.

29. **Recurvirostra americana** Gm. Very abundant. Frequented the lake shore by hundreds. One which I wounded in the water tried to escape by diving and swimming a short distance under water, using its wings in the manner of the *Tringoides macularius* before mentioned.

SCOLOPACIDÆ.

30. **Gallinago Wilsoni** Bonap. One specimen obtained.

31. **Ereunetes pusillus** Cass. Abundant in large flocks along the lake shore.

32. **Totanus semipalmatus** Gm. Abundant, frequenting the lake shore with the Avosets. They were a perfect nuisance; the instant they perceived any one on the shore they would make a great outcry, and hovering over his head keep up such a noise that every bird within hearing would be alarmed.

33. **Tringoides macularius** Gray. Common.

34. **Numenius longirostris** Wilson. Long-billed Curlew Said to be abundant in fall and spring

ARDEIDÆ.

35. **Botaurus minor** Bon. Seen about the mouth of the Jordan.

ANATIDÆ.

36. **Branta canadensis** Gray. Canada Goose. Several flocks seen. Said to be very abundant in fall and spring.

37. **Anas boschas** Linn. Common.

38. **Querquedula discors** Steph. A few seen near the mouth of the Jordan. Several species of ducks were seen, but they were too shy to identify.

PELECANIDÆ.

39. **Pelecanus trachyrhynchus** Lath. Common in flocks.

LARIDÆ.

40 ? **Larus argentatus** Brünn. I saw a large gull at the mouth of the Jordan which I am quite sure was this species.

41. **Larus delawarensis** Ord. Abundant at the mouth of the Jordan.

III. *Notes on Birds observed in the vicinity of Elko, Nevada, between Aug. 9th and 14th, 1872.*

Elko is situated on the Humboldt River, and with the exception of the bushes along the river is surrounded by the sage brush plains. The river has many small grassy sloughs extending into the meadows which border its banks at many places. Away from the river there were many small sloughs in the meadows, sometimes partially enclosed with bushes, affording shelter to many species which we were unable to procure, owing to the shortness of our stay. From here we made a short excursion twenty-five miles north. The locality visited was a cañon with a small stream flowing through, each bank of which was covered with grass and bushes in scattered bunches. This stream was the only water within several miles, making it a favorite haunt of the birds of the locality.

As I was indisposed during the day we spent there, probably many common species were overlooked. For the purpose of comparing the two localities I place the birds observed at Elko under Section A, and those observed in the mountains under Section B.

A. Vicinity of Elko.

TURDIDÆ.

1. **Turdus migratorius** Linn. Robin. Common along the river.

2. **Oreoscoptes montanus** Baird. Mountain Mocking Bird. Common in the sage brush.

LANIIDÆ.

3. **Collurio ludovicianus** var. **excubitoroides** Coues. White-rumped Shrike. Abundant. Its favorite perch seemed to be the telegraph wires along the railroad, where often several could be seen at once.

FRINGILLIDÆ.

4. **Poœcetes gramineus** var. **confinis** Baird. Grass Finch. Common. Not seen far away from the river.

5. **Coturniculus passerinus** var. **perpallidus** Ridg. Not common, found in the meadows along the river.

6. **Spizella pallida** var. **Breweri** Coues. Abundant. They seemed to delight in lying in the road and dusting themselves during the middle of the day. The males occasionally sing from the top of some tall sage bush.

7. **Zonotrichia leucophrys** var. **intermedia** Ridg. White-crowned Finch. Common in the bushes near the river.

8. **Goniaphea melanocephala** Gray. Black-headed Grosbeak. Not common. Frequented thick bushes.

9. **Cyanospiza amœna** Baird. Lazuli Finch. Common.

10. **Pipilo chlorurus** Baird. Green-tailed Finch. Not common. Found in dense bushes.

ICTERIDÆ.

11. **Agelæus phœniceus** Vieill. Red-winged Blackbird. Abundant in small flocks along the river.

12. **Xanthocephalus icterocephalus** Baird. Common. They seemed to associate with the Redwings more than at the east. Two flocks were seen composed entirely of these birds, and two or three pairs were frequently observed accompanying flocks of Redwings.

13. **Sturnella magna** var. **neglecta** All. Western Lark. Not common. A few seen in the meadows.

14. **Scolecophagus cyanocephalus** Cab. Brewer's Blackbird. Common in the bushes near the river.

CORVIDÆ.

15. **Corvus corax** Linn. Raven. Not common. One or two seen on the buttes a short distance south of the river.

16. **Pica melanoleuca** var. **hudsonica** All. Magpie. Abundant, but so shy that I only obtained one specimen by hiding in a barn and shooting it when it came into the yard for food.

TYRANNIDÆ.

17. **Tyrannus verticalis** Say. Arkansas Flycatcher. Abundant along the borders of the bushes. Not so noisy as the Kingbird.

18. **Contopus virens** var. **Richardsoni** All. Richardson's Pewee. Not common. A few seen in the thickets near the river.

CAPRIMULGIDÆ.

19. **Chordeiles popetue** var. **Henryi** All. Western Night Hawk. Very abundant. While at Ft. Bridger, although these birds

were abundant, we rarely saw them flying during the middle of the day except when scared from their resting places. Here they could be seen in large numbers during the middle of the day flying over the meadows in pursuit of insects. They were so unsuspicious that they often passed within a few feet while I was watching them. While flying they kept their mouths open, and when flying very rapidly it produced a low booming sound.

ALCEDINIDÆ.

20. Ceryle alcyon Boie. Kingfisher. Common. I did not hear it utter the peculiar rattling cry so characteristic of it at the East. While returning home the first of January, 1873, the Humboldt was frozen over except a few air holes, and the ground was covered with snow. Over one of these holes near Elko we saw a solitary kingfisher perched on a dead branch watching for its prey.

CATHARTIDÆ.

21. Cathartes aura Illig. Turkey Buzzard. A flock of about twenty of these buzzards were soaring over the meadows every day, but were too shy to get a shot at.

COLUMBIDÆ.

22. Zenædura carolinensis Bonap. Common Dove. Abundant. Frequented the railroad track for the grain scattered there.

TETRAONIDÆ.

23. Centrocercus urophasianus Sw. Sage Hen. We saw their tracks on the road east of Elko, but did not see the birds.

CHARADRIIDÆ.

24. Ægialitis vociferus Cassin. Killdeer. Not common.

SCOLOPACIDÆ.

25. Tringa Bairdii Coues. Several flocks seen on the small sandbars along the river. One specimen obtained.

26. Totanus melanoleucus Gm. Yellow-legs. A few seen and one specimen shot along the river.

27. Totanus solitarius Wils. Solitary Sandpiper. Common. Found the young about half grown. Frequented the sloughs in the meadows. Only one pair, whether with or without young, were found at the same slough.

28. **Tringoides macularius** Gray. Spotted Sandpiper. Abundant. The young were just able to fly. From the condition of the young I think this and the preceding nest nearly at the same time.

ARDEIDÆ.

29. **Nyctiardea grisea** var. **nævia** All. Night Heron. Very numerous. We frequently scared them out of the bushes along the river. They must breed near here, as while making my way through an almost impenetrable thicket, on the bank of the river, I scared out at least fifty herons, nearly all young, some of which were quite ragged and bare they were so young, but I could find no nests. As there were no trees along the river they must nest in the bushes, few of which exceeded twenty feet in height.

30. **Botaurus minor** Bon. Bittern. Nearly as abundant as the preceding. We often found three or four in the same slough. Some of the young were running about in the bushes unable to fly. We tried to capture one alive, but it made such good time through the thick underbrush that it soon escaped.

RALLIDÆ.

31. **Porzana carolina** Vieill. Carolina Rail. Two seen, one of which was obtained.

32. **Fulica americana** Gmelin. Coot. One specimen seen.

ANATIDÆ.

33. **Querquedula discors** Steph. Blue-winged Teal. Abundant. They were so numerous that one morning I found five broods. The young were from three to ten days old. When I approached one side of the slough the old duck would hurry the young out into the grass on the opposite side and then fly off. Although I repeatedly searched for the young in the grass, they were concealed so skillfully that not one was seen.

B. Mountains twenty-five miles north of Elko.

TURDIDÆ.

1. **Oreoscoptes montanus** Baird. Abundant. A few were seen out on the plain about ten miles from water. As we approached the water they became very numerous.

TROGLODYTIDÆ.

2. **Salpinctes obsoletus** Cab. Rock Wren. Several were seen on the cliffs along the cañon, but they were so restless that I only obtained one specimen.

ALAUDIDÆ.

3. **Eremophila alpestris** Boie. Horned Lark. Common on the "buttes."

TANAGRIDÆ.

4. **Pyranga ludoviciana** Bonap. Louisiana Tanager. A few pairs of these beautiful birds were seen in the bushes along the cañon.

HIRUNDINIDÆ.

5. **Hirundo horreorum** Barton. Barn Swallow. A few miles up the cañon a small branch runs off to the right. In this some miners had erected a "shanty" and were prospecting for coal. They had dug a tunnel some distance into the side of the hill, and then deserting it began to sink a shaft near the entrance. Several pairs of swallows had taken possession of the mouth of this tunnel and had young nearly able to fly when we were there. The old birds paid no attention to the miners, who were continually passing within a few feet of their nests. It is a problem how the swallows could have discovered this place, the camp and tunnel being situated in the bottom of a cañon and surrounded on every side by high hills, and the nearest habitation being on the railroad twenty-five miles distant, with a barren sage-bush desert intervening.

LANIIDÆ.

6. **Collurio ludovicianus** var. **excubitoroides** Coues. White-rumped Shrike. The shrikes were very abundant along the sides of the cañon. Whenever one came near the tunnel where the swallows were they were instantly attacked with great fury by the swallows. The rapidity of their movements seemed to confuse the shrike, at first, but it soon found a convenient bush under which it would take refuge, and remaining quiet, the swallows would soon leave it, when the shrike, after taking a cautious look around, would leave as fast as his wings could carry him.

FRINGILLIDÆ.

7. **Spizella pallida** var. **Breweri** Coues. Common.

8. **Zonotrichia leucophrys** var. **intermedia** Ridg. White-crowned Finch. Not common.

9. **Goniaphea melanocephala** Gray. Common.

10. **Pipilo chlorurus** Baird. Not common.

CORVIDÆ.

11. **Corvus carnivorus** Bartram. Raven. Common. Often seen walking along the top of the cañon.

12. **Pica melanoleuca** var. **hudsonica** All. Abundant.

CAPRIMULGIDÆ.

13. **Antrostomus Nuttalli** Cassin. Nuttall's Whip-poor-will. Common. In the evening they came into the road, and when driven up would fly about a person's head and alight a short distance behind. Their cry was much lower than that of the eastern species, and repeated oftener. Several times I heard them keep up a continuous repetition of the same notes for two or three minutes.

FALCONIDÆ.

14. **Circus cyaneus** var. **hudsonius** All. Common. Three specimens were obtained one morning and several others seen.

15. **Falco sparverius** Vieill. Common about the cliffs along the cañon. One specimen obtained.

There were several large hawk's nests on the cliffs, some of which had been used that year, but we did not see any of the birds.

COLUMBIDÆ.

16. **Zenædura carolinensis** Bonap. Abundant. They were breeding in large numbers under the sage bushes on the sides of the cañon. The birds would not fly from the eggs until almost trodden on. Although just at dark when I found the breeding place, I saw several sets of eggs, all deposited on the bare ground; and as I went down the side of the cañon the birds kept flying out in front of me, but it was too dark for me to see the eggs.

TETRAONIDÆ.

17. Centrocercus urophasianus Sw. Common. I put one up near the brook and it flew upon the side of the hill and alighted among the sage bushes. When I went after it I could not find it and stood looking around, when it moved its head and attracted my attention. It was lying flat on the ground within a few paces, but its colors harmonized so well with the color of the ground on which it was lying that if it had not moved I should have overlooked it.

IV. *Notes on Birds observed in the vicinity of Nevada City, Cal., between August 15th and December 15th, 1872.*

This locality has an intermediate situation between the lofty peaks and the foot-hills of the Sierra Nevadas, and is in the midst of the gold mining region. My visit being in the last of the dry season, when the vegetation is dried up by the hot sun, probably many of the spring and early summer residents had gone farther down where the farms are more numerous and less parched than the uncultivated hills surrounding Nevada.

In November, while collecting twenty miles farther down, we found many species abundant which were rare at Nevada; among which may be mentioned, *Sturnella neglecta*, *Zonotrichia coronata*, *Glaucidium californicum*, which assembled in numbers around our camp fire every night and serenaded us with their curious notes; also *Lophortyx californicus*, *Oreortyx pictus*, and many others, were observed on the cultivated flats which were rare at Nevada.

TURDIDÆ.

1. Turdus migratorius Linn. Robin. Common during August and September. In October they became very abundant in large flocks along the creeks.

2. Turdus Swainsoni var. **ustulatus** Coues. Oregon Thrush. Common but very shy. Found along the densely shaded streams. When the rains began in November they came out of the heavy timber into bushes along the outskirts of woods.

3. Oreoscoptes montanus Baird. Mountain Mocking-bird. Not common. Saw two pairs of them in October. They were probably migrating, as I did not see them again.

SAXICOLIDÆ.

4. **Sialia mexicana** Swains. Western Blue Bird. None seen until the last of September, when I found them common about a hill covered with dead pines. The last of October they became abundant about the ranches, and the last of November migrated in straggling flocks.

SYLVIIDÆ.

5. **Regulus calendula** Licht. Ruby-crowned Wren. First taken the last of September; from then until the first of December they were common about the pine thickets and chaparral bushes along the borders of woods, busily searching for insects, as in the East.

CHAMÆIDÆ.

6. **Chamæa fasciata** Gambel. Ground Tit. Saw a pair in November. They were quite difficult to shoot as they kept on the opposite side of the bushes.

7. **Lophophanes inornatus** Cassin. Gray Titmouse. Not common until the first of October, after which they became more and more numerous until in November they were the most common bird. Almost invariably found in oak woods, and always busy searching the branches for insects. They would tap the branches like a woodpecker, making such a loud noise that I often mistook them for the western Downy Woodpecker, *P. Gairdneri.*

8. **Parus atricapillus** var. **occidentalis** Coues. Western Titmouse. Shot two specimens in the pines higher up the mountains in November.

9. **Psaltriparus minimus** Bonap. Least Tit. First taken in October. From the middle of October to the first of December, they were exceedingly abundant in large flocks; I have seen as many as two hundred in one flock. They frequent hillsides covered with chaparral, and are very unsuspicious, allowing a person to approach within a few feet of them. While standing in the bushes I have often had a whole flock assemble around me and act as though they were curious to know what I was doing. Their faint piping note has a far away sound and at first often deceives one as to the distance the bird is from him.

CERTHIIDÆ.

10. **Certhia familiaris** Linn. Creeper. Rare during August, but became common the last of September, and had all migrated by the last of November.

TROGLODYTIDÆ.

11. Thryothorus Bewickii var. **spilurus** Baird. Common during August and September; gradually going lower down the foot hills in October. Not common in November. Frequents bushy hill-sides, rarely coming around the houses. I heard one singing in October with a very powerful voice for such a small bird.

12. Troglodytes ædon var. **Parkmanni** Coues. Parkmann's Wren. Not common; shot one specimen in an orchard in October.

13. Helminthophaga ruficapilla Baird. Nashville Warbler. Shot a male the last of September.

14. Dendrœca æstiva Baird. Yellow Warbler. Abundant about gardens and orchards, habits the same as in the East.

15. Dendrœca nigrescens Baird. Black-throated Gray Warbler. Common during September and October. Migrated the first of November. Frequents oak woods, where it was a characteristic species and seemed to prefer the lower to the higher branches.

16. Dendrœca Auduboni Baird. Audubon's Warbler. Not seen until the first of October; after this it became very abundant, frequenting large oaks. Its habits resemble those of the Yellow-rumped Warbler (*D. coronata* Gray).

17. Geothlypis philadelphia var. **Macgillivrayi** All. Macgillivray's Warbler. Not common. Obtained two specimens in September.

18. Myiodioctes pusillus Bonap. Green Black-capped Fly-catcher. One specimen obtained in pine woods the last of September.

TANAGRIDÆ.

19. Pyranga ludoviciana Bonap. Louisiana Tanager. Rare. One specimen shot in October from a pine tree.

HIRUNDINIDÆ.

20. Hirundo horreorum Barton. Barn Swallow. Common during August and September. I scarcely ever noticed them until late in the afternoon, when they could be seen skimming along the ground in pursuit of insects.

FRINGILLIDÆ.

21. **Carpodacus purpureus** Gray. Purple Finch. Common during the first two weeks of October, after which time I did not observe them. They frequented a newly ploughed field, running about among the furrows after seeds of the weeds which were sticking out of the dirt. They were generally in small flocks of five to eight. I have carefully compared the specimens I shot there with some shot at Evanston, Ill., and can see no material difference, although the birds from this locality probably represent the *C. californicus* Baird.

22. **Chrysomitris pinus** Bonap. Pine Finch. A few seen the last of September. During October and the first of November they were very abundant. I generally found them in flocks feeding on the catkins of a tree growing along the banks of the streams. They were so intent on feeding that I fired at one flock twice before it flew, and while I was reloading they returned and commenced feeding on the same tree.

23. **Chrysomitris psaltria** Bonap. Arkansas Goldfinch. Very abundant during August and September. Found about gardens feeding on seeds of the weeds growing around the sides. They were done moulting by the middle of September, and although I saw large flocks of them daily after the fifteenth of August I saw but one male in full plumage.

24. **Passerculus savanna** Bon. Savanna Sparrow. Not common. Shot one specimen and saw a few others the first of October.

25. **Melospiza melodia** var. **Heermanni** Ridg. Heermann's Song Sparrow. Saw but few. Obtained one specimen in a bunch of willows.

26. **Junco oregonus** Sclat. Oregon Snow Bird. Rare until the middle of September. In October they were very abundant in flocks. Their habits closely resemble those of the Black Snow Bird, *J. hyemalis* Sclat. The last of November they gathered in immense flocks and in a few days disappeared.

27. **Spizella socialis** Bonap. Chipping Sparrow. Abundant about cultivated ground and grassy flats interspersed with clumps of bushes. Not so domestic as in the east. I am quite positive that this and the following species breed, as I found the young in August not fully fledged.

28. **Spizella pallida** var. **Breweri** Coues. Brewer's Spar-

row. Abundant, associating with the preceding in flocks during September and October, and easily mistaken at a short distance for an immature *S. socialis.*

29. **Zonotrichia coronata** Baird. Golden-crowned Sparrow. Not common, except for a few days the last of October, when they were migrating. The first of November I found them common twenty miles farther down the foot-hills.

30. **Chondestes grammaca** Bonap. Lark Finch. Very abundant during August, September and October, frequenting roadsides and hedges. In October they were in flocks at all times. I found them much shyer than in Illinois.

31. **Passerella iliaca** var. **Townsendi** Coues. Oregon Finch. Common until the first of November, when they became one of the most abundant birds. Frequent thick bunches of chaparral and hide at the first alarm. They were all gone the last of November.

32. **Goniaphea melanocephala** Gray. Black-headed Grosbeak. Common until the last of September, when they disappeared. I was told they were a great pest to fruit growers as they ate and lestroyed a great many berries. This I proved by shooting several with their bills stained with black-berries and their crops full of them. I saw many of the berries which they had taken one bite from, leaving the rest.

33. **Pipilo maculatus** var. **oregonus** Coues. Oregon Towhee. Very common everywhere on the bush-covered hills. Had all migrated by the middle of November. They breed here, as I found young not fledged enough to fly well the last of August.

34. **Pipilo fuscus** var. **crissalis** Coues. Crissal Towhee. Rare. Saw but one specimen, which I shot in an orchard the first of October.

35. **Pipilo chlorurus** Baird. Blanding's Finch. Common; breeds, as I found the unfledged young in August. More common around orchards and gardens than *P. oregonus.*

ICTERIDÆ.

36. **Sturnella magna** var. **neglecta** All. Western Lark. Not common at Nevada, where a few stragglers were seen, while on a ranche about three miles from Nevada, and separated from it by a ridge, they were very abundant. The ranche contained considerable grass land, while around Nevada the ground is rough, and has

been mined a great deal, which probably accounts for the larks not being as abundant there. While in the foot-hills farther down, in November, I was walking through a field covered with short grass, just before sunrise one morning, when a flock of these larks arose that must have contained thousands. They did not move until I was in the midst of them, when they sprang up on every side with a noise like thunder. After day-light I found them on the oaks near where they were put up; while on the trees they were very shy, and it was almost impossible to get a shot at one, but when on the ground they would stand and look at any one and allow him walk up within easy range.

37. Icterus Bullockii Bonap. Bullock's Oriole. Rare. One female was obtained in October.

38. Scolecophagus cyanocephalus Cab. Brewer's Blackbird. Rare. One small flock seen and one specimen obtained the first of November.

CORVIDÆ.

39. Corvus americanus var. **caurinus** Coues. Western Fish Crow. Probably accidental. Saw one small flock the last of November. They were circling about in a dense fog apparently lost.

40. Cyanurus Stelleri Sw. Steller's Jay. Very abundant. They were moulting the first of September, and were very shy, keeping concealed in the tops of the large pines on the hills. With their feathers they regained their impudence and would commence screaming as soon as a person entered the heavy pine woods which they frequented. Early in the fall they were shy in approaching the vicinity of the houses, but the last of October and in November they united with the California Jay in carrying acorns from an oak growing in Mr. J. H. Wentworth's yard. I was stopping at this gentleman's house during my stay at Nevada and had a fine opportunity to observe the birds, as there were two very large oaks growing within gun shot of the house.

41. Aphelocoma floridana var. **californica** Coues. California Jay. Very abundant, and lives nearer the houses than the last. Unites with *C. Stelleri* in carrying acorns from the oaks to trees having any crevice or knot-hole into which it can put them. I have seen at least twenty of these two species of jays carrying acorns from one large oak at the same time. The birds would light on the end of a branch bearing acorns, and pecking the acorn vigorously for a minute would loosen it so that they could take it with their bills I never saw either of these jays take an acorn from the ground, even after they had all fallen, nor do I think they make any use of them, as they nearly all spend the winter down in the valleys and at the base of the foot-hills.

TYRANNIDÆ.

42. Sayornis nigricans Bonap. Black Flycatcher. Rare during August, became more numerous during September, and were common in damp fields and along open streams until the middle of November, where they would sit perched on a dead twig waiting for their prey. Their habits and appearance remind one of the *S. fuscus* of the East. They had all migrated by the last of November.

43. Contopus virens var. **Richardsoni** Allen. Western Wood Pewee. Not common. One specimen taken in September, and a few others seen.

44. Empidonax pusillus Cab. Little Flycatcher. One specimen taken the last of September. The only one seen, although probably this and the preceding are common earlier in the season.

CAPRIMULGIDÆ.

45. Antrostomus Nuttalli Cassin. Nuttall's Whip-poor-will. Rare. Shot one specimen in a road after dark one night the last week of October.

TROCHILIDÆ.

46. Selasphorus Anna Bon. Anna Humming Bird. Common until the middle of October about flower gardens. I was shown where a pair had built their nest for several seasons in some vines growing over a porch.

CUCULIDÆ.

47. Geococcyx californianus Baird. Chaparral Cock. Was told of their rare occurrence. Did not hear of any being seen for several years previous to my visit.

PICIDÆ.

48. **Hylotomus pileatus** Baird. Pileated Woodpecker. Not common; shot one specimen, a male, in a heavy pine wood. Its note resembled that of the California gray squirrel (*Sciurus fossor*) which I supposed it was until it began hammering on a dead limb, making a noise like the strokes of an ax, but more rapid. This specimen is much smaller than specimens from Illinois.

49. **Picus albolarvatus** Baird. White-headed Woodpecker. Common in thick pine forests until the last of November. Never saw one of these birds on a hard-wood tree. They commence at the base of a tall pine and gradually work up to the very tip, searching carefully every crevice, then flying to the base of another tree to begin again their search in the same manner. They are unsuspicious, often alighting within a few feet of me while I was watching them. They uttered only one note, which is like that of the Downy Woodpecker. They do not seem to depend on pecking for their food as much as Nuttall's and Gairdner's Woodpeckers do, but look for it in the crevices of the bark.

50. **Picus scalaris** var. **Nuttalli** Coues. Common, frequenting oak woods until December. Habits the same as the Gairdner's Woodpecker.

51. **Picus villosus** var. **Harrisii** All. Harris's Woodpecker. Not common; one pair obtained in oak woods in November.

52. **Picus pubescens** var. **Gairdneri** Coues. Gairdner's Woodpecker. Common until the last of November, frequenting oak woods. Not so abundant about orchards as the eastern form.

53. **Sphyrapicus ruber** Baird. Red-breasted Woodpecker. First seen in October, after which date they were very abundant. Moulted during October and November. Most abundant where the large trees had been cut down and the young pines were thirty to forty feet high.

54. **Melanerpes formicivorus** Bonap. California Woodpecker. Very common. One of the most abundant birds until the last of November. Found almost exclusively on oak trees. I do not think that I ever saw one on a pine tree. I have counted nine on one oak playing and running around the trunk like the Red-headed Woodpecker, *M. erythrocephalus.*

55. **Asyndesmus torquatus** Coues. Lewis's Woodpecker. First met with the middle of October; after this time they were

often seen in straggling flocks high up in the air. I counted over sixty in one flight in October. I saw them alight but once, when they kept on the tops of some dead pines chasing each other from tree to tree. Often saw them fly up into the air, and after hovering return again to the same branch. They sometimes pursue insects, darting after them, and turning in the chase with as much dexterity as a flycatcher. They were very shy; I hunted them for two hours before getting a chance to shoot one, and only succeeded as they flew off, when I shot two on the wing.

56. **Colaptes mexicanus** Swainson. Mexican Flicker. Abundant. Habits the same as *C. auratus* Sw. Moulted in October and migrated the last of November.

STRIGIDÆ.

57. **Scops asio** Bon. Mr. Wentworth told me of a small "Screech owl" that resided for some time in his pigeon house, which from his description I think must have been this species.

58. **Glaucidium passerinum** var. **californicum** Ridg. California Pigmy Owl. Rare; obtained two specimens, one of which was in a small pine looking unconcernedly at a Bewick's Wren (var. *spilurus*) which was scolding at it and appeared to be very much enraged. The second I found bathing at midday in a shaded stream. When it saw me it jumped upon a stone and looked at me curiously, but without any show of fear.

FALCONIDÆ.

59. **Accipiter fuscus** Bonap. Common until the first of December. Often seen about the ranches in October and November.

60. **Buteo sp.** A large species of *Buteo* was frequently seen, but it was so shy that it was impossible to shoot a specimen.

61. **Haliætus leucocephalus** Savigny. Rare. Saw a young one in the black plumage in November.

CATHARTIDÆ.

62. **Cathartes sp.** Saw a flock of about twenty buzzards soaring high over head one warm day in October. They were too far away to enable me to identify the species.

COLUMBIDÆ.

63. **Columba fasciata** Say. Said to be abundant some seasons. I saw only one small flock in October.

64. **Zenædura carolinensis** Bonap. Common until the middle of November. Habits the same as in the East, as far as I had opportunity to judge.

TETRAONIDÆ.

65. ? **Canace canadensis** var. **Franklini** Coues. I was frequently told of a grouse that came down from the mountains in the winter. From descriptions by hunters who had killed it I concluded it was probably this variety.

66. **Oreortyx pictus** Baird. Mountain Quail. Rare until the first of October, when it became quite abundant. It is so shy that it is almost impossible to shoot it without a dog. I have seen a flock run across the trail in front of me and hide so effectually that I could find no trace of them afterwards. In November, while camping in the foot-hills, we found them abundant. Just before sunrise every morning their cries (which closely resemble the call of a hen-turkey) resounded on every side. Although I made special effort to find them I failed in seeing a single flock, but the boys trapped large numbers in box-traps.

67. **Lophortyx californicus** Bonap. Valley Quail. Abundant. Breed on the surrounding hills. The last of August the young were hardly one-fourth grown. During November they gradually descended into the foot-hills and valleys until only a few coveys remained. They are easily domesticated. Mr. J. A. Wentworth told me of an instance where he trapped a flock of the two old birds and the young partly grown. After keeping them some time in a coop they escaped, but returned every day when the chickens were fed to take their share, and continued to do this for a long time.

CHARADRIIDÆ.

68. **Ægialitis vociferus** Cassin. Killdeer. Not common; a few stragglers seen during October.

SCOLOPACIDÆ.

69. Gallinago Wilsoni Bonap. Not common; two specimens were shot in November.

ANATIDÆ.

70. Branta canadensis Gray. Canada Goose. Seen only during migration, when it is sometimes shot while flying over. Saw several flocks in November.

71. Anas boschas Linn. Mallard. Said to be occasionally shot on the mining reservoirs. I did not see any.

PELECANIDÆ.

72. Pelecanus trachyrhynchus Lath. White Pelican. One flock seen in October. Did not hear of their ever alighting here.

The Jurassic and Cretaceous Ammonites collected in South America by Prof. James Orton, with an Appendix upon the Cretaceous Ammonites of Prof. Hartt's Collection. By Alpheus Hyatt.

The species sent me for examination by Prof. James Orton indicate that further research will be fruitful in the discovery of Jurassic and Cretaceous fossils. The apparent identity of many of the forms with those of well known European species is surprising, since one naturally expects the appearance of a greater number of new modifications in such a distant fauna. This, however, is not the case and with the exception of petrological peculiarities due to the character of the matrix, etc., this small collection has precisely the aspect of a lot of Western European fossils. The situation and distance of the different localities indicates that an extensive series of Jurassic rocks exist in Northern Bolivia and in Peru of which we as yet know, comparatively speaking, nothing.

The presence of the Lias or Lower Jura and the Upper Oolites, or Kelloway and Oxford subdivisions of the Jura, are sufficiently well indicated. The equivalents of the higher divisions, those which underlie the Cretaceous, have so far not been discovered, nor do the collections indicate the presence of the Lower Oolitic formations, though these may now be hopefully hunted for. The minor formations cannot of course be fully described from such small collections, but the Lower and Middle Lias are shown to be present, and the difference in the matrices of the specimens indicate still more minute subdivisions. The petrological pecularities of the specimens of *Perispminctes anceps* and *Stephanoceras macrocephalum* also indicate minor subdivisions in the Upper Oolites, but these cannot be characterized upon such slender data.

Arnioceras ceras ? Agassiz.

1. Under this head I am obliged to assemble several very interesting specimens, whose affinities cannot be positively determined without more evidence. One specimen, about three inches in diameter, is the cast of a crushed shell with straight or nearly straight ribs, quite prominent and closely set. Older specimens show a set of bent ribs with prominent keel, and narrow abdomen. The young are distinctly ribbed at a very early period, and but for this might be taken for any of several species, viz., *Arnioceras ceras* or *Bodleyi*, *Asteroceras Turneri* (the English form, not the German). The old-age whorls in the same block have an aspect like that of the full-grown *Grammoceras striatulum* of the radians group. These specimens, though from the same locality as the specimens of this species described below, nevertheless occur in a matrix of argillaceous rock of compact structure with a pinkish color, which does not show the slightest effervescence with strong acid.

Loc., Ipishguanüna, Northern Peru.

2. A large specimen from the same locality, but imbedded in a soft, thin bedded, ferruginous, argillaceous rock of a dark brown color, although much mutilated, shows similar characteristics and exhibits the form of the whorl better. This shows that the species is probably very closely allied if not identical with *Arnioceras ceras*. The ribs run up straight until level with the abdomen, and then assume the abrupt termination so characteristic of this whole group. The septa also, which are visible on this specimen, have the peculiar simple sutures of this genus with the pointed simple minor lobes and cells penetrating the edges of the larger ones, the deep superior lateral lobes and shallow inferior laterals, with no auxiliary lobes appearing on the sides.

The same form is in Europe characteristic of the Lower Lias, occurring in great numbers at Semur.

3. Another specimen also from this dark brown rock, fully agrees with no species with which I am acquainted. It resembles somewhat

Gramm. striatulum, but wants the forward curvature or inflexion of the central part of the ribs which is so characteristic of all the radians group. If it were not for the keel it would be almost identical with the finer ribbed varieties of *Ægoceras angulatum*. The smoothness and form of the young, the linear character, number, and peculiar bend of the ribs, the abrupt geniculæ, and arnioceras-like keel and narrow abdomen appear to demand a place for it in the same genus with the preceding, and perhaps it might be considered a variety of the *Arnioceras ceras* with smoother young than that first described.

Loc., Ipishguanüna.

Arnioceras miserabilis ? Hyatt.

Still another specimen obtained from the same block as No. 2 of *Arnioc. ceras*, has smooth discoidal young and a form which, with the exception of the keel, has the aspect of *Amm. miserabilis* of Quenstedt. It is entirely smooth, very discoidal, and evidently possesses a very narrow, short whorl.

Ipishguanüna is at an elevation of 11,000 feet above the sea level, according to Prof. Orton the highest point in Northern Peru. The Ammonites are associated with a species of Lamellibranch which was so badly preserved that Mr. Richard Rathbun, assistant in the Museum of the Society of Natural History, was unable after close study to identify the species or even determine the genus, his report however is appended below.[1]

Caloceras Ortoni Hyatt. (n. s.)

This species is very similar in external characteristics to the *Amm. sirouatus* of Quenstedt; it differs from it principally in the greater proportional breadth of the abdomen, the deep channels and well developed keel. The living chamber is considerably over one whorl

[1]**Avicula (Gervilia?) sp?**

The two small impressions of Lamellibranchs from Ipishguanüna are moulds of the left valve of the same specimen, one of the exterior, the other of the interior. They indicate a form belonging to *Avicula*, or perhaps *Gervilia*; their imperfect preservation rendering the identification doubtful. To whichever of the above genera they belong, they might represent any portion of the secondary age, since both genera are common throughout that age in Europe.

The shell is quite oblique, with its greatest length from the beaks nearly 12 mm. and the diameter at right angles to this length a little greater than 6 mm. The anterior ear, if such existed, is entirely broken away; the posterior is small and does not extend very far backward, but it is imperfect. The impression of the hinge is very obscure, and no indication is given of either the cartilage pits or the teeth. The surface is marked with indistinct concentric lines of growth. R. R.

in length but was not seen entire, nor were the septa visible. The ribs are fold-like as in other species of Caloceras, bent forward and very closely set, the depressions between being merely linear. On the abdomen they fade out to mere lines, and there are no geniculæ or external shoulders on the ribs. The specimen, which is about four and a half inches in diameter, appears to be full-grown, and the ribs very rapidly disappear upon the last half of the living chamber as if old age had begun to show itself; the channels also become a trifle shallower.

Locality, Tingo, near Chacapoyas in Northern Peru, in a compact blue limestone.

Phylloceras Loscombi Hyatt.

This occurs also at Tingo, but in a distinct rock, a light pinkish, fine-bedded, argillaceous limestone. The specimen was two inches and a half in diameter but very much crushed upon the surface of the stone. The involution covering nearly the entire side of the whorl, the smooth sides and abdomen and the septal sutures, parts of which were clearly seen, left no doubt, however, that it belonged to the compressed forms of Phylloceras, probably *Loscombi*. It was associated with a discoidal ribbed form, about seven eighths of an inch in diameter, too poorly preserved to be identified. This species belongs to the Middle Lias in its lower portion. According to Oppel it is found in the *Davoi* bed, the Lias γ of Quenstedt.

Perisphinctes anceps Waagen.

There are two specimens of this well known species, possessing the usual characteristics of the most unmistakable variety,—that which has the coronate form, with thick prominent spines. One of the specimens is young, a part of the shell in good preservation, and the other is a fragment of a full grown shell, also in good condition. This and the following species show the presence of the highest division of the Brown Jura, the Kelloway formation of Oppel, the Brown Jura ζ of Quensted.

Loc., Compuerta, near Lake Titicaca.

The filling of the shell is a highly ferruginous limestone, with a small piece of dark blue limestone attached to the exterior, which may possibly represent the orginal matrix.

Stephanoceras macrocephalum Waagen.

A very good specimen, with sutures, form, and markings unmistakeably identical with the European form. Filling of the shell dense pinkish limestone, no matrix attached.

Locality, Caracolis, Boliva.

BUCHICERAS (nov. genus.)

Paleontologists have been aware for many years, ever since, in fact, Von Buch published his work upon Ceratites, that the so-called cretaceous Ceratites differed from the triassic forms in the characteristics of the sutural outlines. Being obliged to describe the following species I find that, as Quenstedt has already pointed out, these forms are not Ceratites at all, but, strictly speaking, Ammonites. They show this in the form of abdominal cell in the young, the characteristics of the superior lateral cells, which are invariably divided, as are those of all the Ammonites proper, and also in the tendency of the young sutures of *Buchiceras bilobatum* to assume a wholly ammonitic aspect. The truly ammonitic outline of the cells and lobes in *Buchiceras attenuatum* shows how easily the outlines of the typical divided cells are transformed into those of a true Ammonite by a few digitations, whereas the same digitations applied to the entire outlines of a true Ceratite would produce only a Ceratite, not an Ammonite.

The young have an acute but gibbous whorl, which becomes transformed into a whorl with convergent sides and a flattened abdomen in *Buchiceras bilobatum*, *B. syriaciforme*, and *B. attenuatum*, which together form a natural series also agreeing in the possession of two rows of tubercles and in the amount of involution which extends to the inner row of tubercles. The young of *B. serrata* and *B. pierdenalis* were not seen at a very early age but probably are similar, since the adults have very nearly the form of the young of the preceding series. That a similar relation exists in the development of the sutures is improbable. They, as far as traced in the young of *B. serratum*, indicate a common genesis from *B. bilobatum*. This, however, must be considered doubtful, and it may be found that both *B. serratum* and *B. pierdenalis* spring from other and quite distinct forms. *B. attenuatum* and *Amm. Vibrayeanus* D'Orb. appear to be closely allied in form, though the sutures, as figured by D'Orbigny, are like those of any other cretaceous species of this group. The ribs, however, have the aspect of those of *B. serratum*, and it may be that *B. Vibrayeanum* is allied with the latter which it more closely resembles in its sutures. A very slight error in drawing would convert the sutures of the latter into those of the former, but it is not possible that they may be identical. *B. Vibrayeanum* has a sharp abdomen when fully two inches in diameter and a much thicker whorl. The genus is dedicated to Leopold Von Buch in memory of the great services rendered by him in the study of the fossil forms of the Ammonoides. *Buchiceras Harttii* (*Ceratitis Harttii* Hyatt in Hartt's Geol. and Phys. Geog. of Brazil, Boston, 1870) is doubtless a member of this group, though not closely allied to any of the species here described, either in form or septa.

Buchiceras bilobatum Hyatt.

One well preserved specimen in light blue compact limestone well filled with other fossils, was found at Cachiyacu, on the west side of the river Huallaga in Northern Peru. This presents the condition of the sutures at a young stage when the shell is about an inch in diameter. *Buchiceras syriacum* Von Buch, with which it has been previously identified by myself and other authors, is very distinct, especially at this stage of growth. The short, numerous club-shaped cells of *B. syriacum* each regularly divided by a median minor lobe, are represented by two large cells with scalloped edges. These and the superior lateral lobe occupy the entire breadth of the side. The ribs and form resemble closely those of *Buchiceras syriacum.*

Buchiceras serratum Hyatt, n. s.

There are two interesting specimens of this from the same limestone at Cachiyacu. The abdomen, however, instead of being acute in the young, and becoming squared and blunter with age, continues to retain its youthful sharpness, though the whorl grows much thicker proportionally in the largest specimen, which is about three inches in diameter. The septa of the young, when the shell is about an inch in diameter, present very peculiar characteristics. The abdominal lobe is very broad and short, containing a broad, squarely shaped abdominal cell with perfectly smooth outline. The superior lateral cells slope gradually up from this, beginning with what, at first sight, appears to be an independent cell, which is really only the least prominent branch of the superior lateral cell. The superior lateral lobes are shallower but broaden out at the top, and are minutely serrated. The inferior lateral cells are very broad, with plain sutures, the inferior lateral lobes very much shallower and also minutely dentated. Three auxiliary lobes are visible, mere nicks with broad flattened cells between. The branches of the superior lateral cells become subdivided by the growth of a median minor lobe at the base of each, but the remaining cells remain entire. The form of the superior lateral cell, the depth of the superior lateral lobes and the shallowness of the inferior and auxiliary lobes and cells remind one of the young of *Buchiceras bilobatum* previously described, and indicate a direct genetic connection. The sides round evenly from the umbilicus outwards, broken up by slight fold-like ribs with a median forward bend, which splits into several hardly distinguishable folds having an abdominal forward bend. The abdomen of the cast is obtusely angular, owing to the depressed gibbosity of the sides. Associated with this species in the same block of limestone were several fragmentary fossils of various kinds which were examined by Mr. Richard Rathbun, and his report upon them is given in a note.[1]

APPENDIX.

PERUVIAN AMMONITES OF THE HARTT COLLECTION.

Buchiceras syriaciforme Hyatt.

Several fine specimens from one inch to three inches in diameter, confirm the observations made in the preceding pages. The largest specimen is particularly interesting. The abdominal lobe, which at younger stages is a little longer than the superior laterals, is here a trifle shorter. The superior and inferior laterals are both visible on the side, narrow and long, with triple branches unequally divided. The superior and inferior lateral cells are much deeper and narrower proportionally than in the young, with coarsely scalloped bottoms. The same young specimens compare quite closely in sutural characteristics with the typical *B. syriacum* from Lebanon. They still differ, however, in the number of lobes and cells visible on the sides, there being but three cells and two lobes as in the adults. They differ even more widely from the young of *Buchiceras*

[1] The small fragment of hard grayish limestone from Cachiyacu, near Huallaga River, Peru, with *Buchiceras serratum*, contains a great many other mollusks, but on account of the exceeding hardness of the rock it is difficult to break the specimens out in a condition suitable for their identification. They are all small and belong mostly to common cretaceous genera. Among the Lamellibranchs is a smooth form of *Avicula* or *Gervilia*, not, however, exposing the hinge characters. It resembles much in shape *Gervilia enigma* D'Orb., from the Turonien of France, but is of much smaller size. There is also a medium-sized form of *Leda*, having a nearly smooth surface, and another small shell quite abundant in the fragment of rock, which is probably referable to *Corbula*. The hinge of this latter form is not exposed. There are many casts of very small Gasteropods which seem to represent two species and two genera; one is a *Turritella*. Besides the mollusks just mentioned there is a fragment of the scale of a teleostean fish, in a rather poor state of preservation. R. R.

bilobatum Hyatt, which has, as previously described, Ammonite-like cells, only two on the whole side.

Loc., Cajamarca, Peru. Coll. by J. B. Steere.

Buchiceras attenuatum Hyatt.

In this species the form of the whorl in the adult, and the lobes and cells are more decidedly ammonitic than in the preceding species. It may be seen, however, that this is due to the complication of the outlines of lobes. The young possess lobes and cells of simpler form and outlines. The division of the suture by a median lobe longer than the rest, dividing the numerous shallow auxiliary lobes and cells from the others, is a characteristic indication of an affinity with the previously described *Buchiceras bilobatum*. There is also, although very faintly expressed, a line of tubercles near the abdomen, and another more prominent lateral line on the edge of the abdomen. The whorl is greatly compressed laterally, smooth with the exception of these lines of tubercles, and has a narrow, flat abdomen or channeled area. It is most closely allied with *Buchiceras pierdenalis* [1] but differs not only in the flattened abdomen but in the sutural outlines. The latter has cells with smooth outlines, but in this species the cells and lobes are not only divided into two parts by median minor lobes, but digitated by numerous shallower minor lobes throughout their whole extent.

Loc., Celendin. Coll. by J. B. Steere.

Dr. S. Kneeland made a communication, illustrated by the lantern, on the volcanic phenomena of Iceland, especially as seen in the valley of Thingvalla, where was held the millennial celebration of 1874, at which he were present.

The thanks of the Society were voted to Mr. T. Martin Trippe for a collection of eight skins of Leucosticte from Colorado.

[1] I have had remarkably fine specimens of this species from Texas in the collection of the Museum of Comp. Zoology at Cambridge for comparison, and find that both this and *Glottoceras attenuatum* exist in that fauna.

Section of Entomology. January 27, 1875.

Mr. S. Henshaw in the chair. Seven persons present.

The following paper was read:—

On the Species of Coleoptera described by Mr. J. W. Randall.[1] By P. S. Sprague, with Notes by E. P. Austin.

J. W. Randall, a young and enthusiastic entomologist, a student at Harvard, and a pupil of Dr. Harris, having collected quite a large cabinet of Coleoptera, very many of which were undescribed, commenced in the year 1837 to prepare for publication in the Journal of this Society descriptions of those species which he supposed least likely to have been at that time noticed. At this time entomology in this country was in its infancy, and much less advanced than now in Europe. The large and distinctly marked families were, to quite an extent, well defined, but the smaller and less conspicuous ones had no settled place. The subdivisions of tribes and groups, as well as genera, were recognized, but indefinitely marked; while the lack in America of an extended knowledge of what foreign authors had done, in connection with the fact that each entomologist had a system of his own, produced a confusion in determining the generic position of species which is now seriously felt in working up the species of the older authors. The now large and well marked family of Elateridæ, which in our fauna is composed of tribes, subtribes, groups, and no less than seventy genera, was at that time scarcely divided, and nearly every species came under the generic head of Elater. Of the eighty-four species of Coleoptera described by Mr. Randall in Vol. II of the Boston Journal of Natural History (1838), more than three-fourths have had their generic names changed. Much confusion has arisen from the fact that species resembling each other in general form were by him put under the same generic heads, but now our more extended knowledge of the true differences has placed them far apart. Short descriptions were the rule, or I might say the fashion, and even a published catalogue name was considered sufficient notice to entitle one to hold his species, but the greater present knowledge, the more extended collections, showing the close affinity of many species, have almost wholly

[1] In the Journal of the Boston Society of Natural History, Vol. II, 1838.

changed this way of describing insects. Another source of trouble that we have to encounter is the almost total loss of all of the older collections, either by insect enemies, or through a lack of true appreciation of their great value by those who have had charge of them.

The Say and Hentz collections have now hardly a specimen left, and Randall's is lost. Dr. Harris' cabinet is in a much better condition, and were it not that Mr. Randall often contributed to it, we should be still further in the dark in relation to many of his described species. Randall's descriptions, when viewed with our present knowledge, are short, and not to the point; quite often color, and those parts that have no specific value, being all we have to depend upon.

The beetles known as Randall's species, have long been a thorn in the side of the thorough and systematic entomological student. For years, as each new entomologist has come forward to take his place among the specialists of this department of entomology, Say's, Harris's and Randall's lost species have to a greater or less extent interested him, and all new insects obtained were closely scanned, hoping that in them the lost might be found.

It has seemed to me that as Randall described his species in our Journal, many of which were from this locality, others from the neighboring State of Maine, that some one here should try and rescue from oblivion the labor of this one of our early entomologists. Typical collections of species inhabiting this vicinity, and described here, will strike every naturalist at a glance as of special importance; scarcely a beginning at forming such collections has as yet been made in any department by this Society, the lack of which has been seriously felt by me as well as by others, and I feel specially called upon to remedy as far as possible this difficulty. Therefore I have used my leisure hours to collect together material for a complete series of Randall's species, and make it a special typical collection for students of this Society; and, further, if time and circumstances permit, to extend my labor to Dr. Harris's types of Coleoptera, many of which are not to be found in his private collection. The fact has been forcibly brought to my mind that many of Randall's species, which were then common, have become exceedingly rare, and perhaps some are extinct. The same may be said of the species found in plenty by Dr. Harris in Dorchester and Milton, the same ground having been carefully and thoroughly gone over many times for the last ten years by myself and others. When I undertook to form this collection I anticipated somewhat of a task, but it has far exceeded my worst anticipations. One can have no conception who has not tried to make a species fit some old description, of the quizzing, surmisings and doubtings which come before him. He must also take into consideration the queries of others, and then strike a balance which shall convince all.

When Dr. LeConte's list of Coleoptera was published, over one-fourth of Randall's species were doubtful or unknown. There now remain three doubtful and seven unknown. The following are the special changes from LeConte's list, and some that were marked as doubtful in the Melsheimer Catalogue, where all the species were put down without regard to their identity.

Clivina elongata Rand., was changed by Dr. LeConte, supposing the name to have been previously used. It now appears that Chaudoir's name *elongata* was subsequent (1845) to Randall's, therefore the original name must be substituted.

Patrobus rugicollis Rand., by a typographical error was published *angicollis*.

[This species is found rarely on Mt. Washington, in the upper part of the timbered region of the mountain. E. P. A.]

Hydrochus subcupreus Rand., was for some reason not put in LeConte's list, and was until now unknown, but a careful examination of Dr. Harris's cabinet has revealed a specimen (No. 1382) which is, without doubt, the true *subcupreus*. It was afterwards described by Dr. Melsheimer as *H. rufipes*, which must now be considered as only a synonym.

[If this is the same as *H. rufipes* Mels., which is very probable, it is not uncommon in this vicinity. The description will apply to several species, and is too indefinite to base any opinion on. E. P. A.]

Nitidula avara Rand., under the genus Eupara of LeConte's list, still remains unknown.

[A specimen in the Harris cabinet, No. 1515, has been determined by Mr. Sprague as belonging to this species, but it does not entirely agree with the description, and owing to my not having had an opportunity to consult the Harris catalogue, I am unable to tell on what grounds Sprague has decided it to be Randall's species. The specimen in question differs from *E. infuscata* Makl., by being a little larger and more elongate; the base of the thorax is nearly straight, and it, as well as the elytra, is more coarsely punctured. E. P. A.]

Agrilus vittaticollis Rand. This species is now known, a specimen being in Dr. Harris's cabinet.

[Found occasionally in various parts of this State, and seems ot live on the shadberry (*Amelanchier canadensis*). E. P. A.]

Elater subrufa Rand. is doubtless *Nematodes simplex* LeC. (Proc. Acad. Nat. Sci. Phila., 1866, 388). Only a single specimen known in Mr. Ulke's collection.

Elater filius Rand., Cardiophorus, of LeConte's list, unknown.

Elater basalis Rand. may be, as suggested by Dr. LeConte, *Limonius stigma*. Yet I consider it doubtful, because Dr. Harris had a male of the species in his cabinet at that time, No. 531, and supposed to be a variety of *scapularius*, so named in Harris's Insects of Mass., 1835.

Elater macilentus Randall, unknown.

Elater graciliformis and **tenuicollis** Rand. are varieties of one species, the former with elytra black, the latter testaceous; they belong to the genus Oestodes.

Elater honestus Rand. is, without doubt, the *Sericosomus fusiformis* LeC., which must be put as a synonym.

Elater ærarius Rand. This species was described in Europe before Randall's paper appeared as *E. resplendens* Esch., (*fide* Horn) and belongs to Corymbites.

Elater anchorago Rand., *Kendalli* Kirby, was described by Olivier in Europe as *æneicollis* (*fide* Horn), and belongs to the genus Corymbites.

Omalisus fraternus Rand. is now known, and belongs to the genus Eros.

Malachius cæruleus Rand. is probably a variety of *Anthocomus flavilabris* Say (*fide* Horn).

Tomicus gulosus Rand. is *Xyloterus bivittatus* Kb.

Dircæa decolorata Rand. is *Xylita lævigata* Hellen (*fide* Horn).

Lixus rubellus Rand., unknown.

Lixus calandroides Rand. I have been able to recognize; it is found during July on Nantucket Beach.

Rhynchites viridi-æneus Rand., unknown.

Galeruca salicis Rand. Found in Dr. Harris's collection, No. 1564, determined by Dr. Harris as *sagittaria* Gyll, which being previously described takes the precedence.

Coccinella obliqua and **C. similis** Rand. are now known, and are varieties of the same species.

Coccinella notans Rand. is not the *pullata* of Say.

Coccinella lugubris Rand. is a true species, not the *elegans* of Mulsant.

Languria brevicollis Rand. is *Cephaloleia metallica.*

Hyperaspis (Coccinella) lugubris Rand. having for a long time been confounded with a very similar species, *H. elegans*, yet quite distinct when seen together, I am induced to redescribe, as Randall's description lacks the completeness actually required.

Hyperaspis (*Coccinella*) *lugubris* Rand. (Boston Journ. Nat. Hist., Vol. II, p. 52, 1838.) Black, oval, convex, with the lateral margin of the thorax and the elytra, from the humerus to past the middle, yellowish-white, the latter above with two spots on each side, one in front of the middle, the other near the apex; beneath brown, and sparsely covered with silky pubescence. Long. .09 mm. The head is pitchy brown, obsoletely punctured; the thorax and elytra finely punctured, the latter more distinctly so. The discoidal spot of the elytra is wholly in front of the middle, and directly above a depression in the marginal band; it is situated well up towards the suture, but not as near as the apical one; the latter is wholly behind the marginal band, and as far from the apex as the anterior one is from the base. The elytral border scarcely reaches the humerus, and follows the margin to the middle, where it is somewhat dilatated. Two examples. In one the head and under surface, including the legs, testaceous. This species differs from *Hyperaspis elegans* by its larger size, greater breadth and convexity. The elytra are more finely punctured. In *elegans* the dorsal spot is mealy, its diameter further back, and it has no apical one proper, but the marginal band is sometimes interrupted, leaving close to the margin a detached part. In *lugubris* the apical spot is so much above the apex as to preclude its being a part of the border. The elytral marginal border of *elegans* is dilated at the humerus, the middle, and near the apex, while in *lugubris* it is very dilated at the middle, and scarcely reaches the humerus.

[This species is quite rare in Massachusetts. I have taken only one specimen in the vicinity of Cambridge, which was obtained several years ago. E. P. A.]

The volume in which these species were described is now out of print; therefore I have reproduced the original descriptions of the unknown and doubtful species, and have added some remarks that may assist in throwing light upon the subject.

Nitidula avara Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 18.)

"N. corpore sub-elongato, sub-depresso, duplo longiore quam lato, marginibus sub-parallelis, fusco-fulvo; margine thoracis curvato angulis posticis sub-acutis; elytris sub-planis, singulis ad apicem rotundatis, nigro-bimaculatis.

"Body somewhat elongated, rather depressed, margins somewhat parallel, and a little dilated; color entirely brownish yellow; club of the antennæ rather stout; margin of the thorax curved, posterior angles turning a little inwards, and very slightly acute; elytra smoothish, each with two black spots placed obliquely in relation to each other; apex rounded in each, so as to leave a notch at the suture.

"Length three-twentieths of an inch.

"Bears a close resemblance to the genus *Ips*, in the shape of the body.

"Occurred in similar situations with the above."

Body elongated, depressed, sides nearly parallel, color brownish-yellow, twice longer than wide. Thorax, margin curved, posterior angles turning a little inward, slightly acute. Elytra smoothish, with two black spots, which are not on a line with each other; the apex of each elytrum rounded. Long., .15. The margin of the thorax is broadly rounded, and the base must be emarginate, in order to make the angle acute. I can give no guess as to what this species is. I know of no insect in any family that is near it. [1]

Nematodes subrufus Lec. (*Elater sub-rufus* Rand.) is now *Nematodes simplex* Lec. Although there is not much doubt of the identity of this species, yet it not being known in any collection, except Mr. Ulke's at Washington, I append both Randall's and Le-Conte's descriptions.

Elater (Eucnemis) sub-rufus Rand. (Bost. Journ. Nat. Hist., Vol. II, page 38.)

"E. corpore elongato, angustato, rufo; articulis quinque ultimis antennarum crassis; clypeo sub-convexo; oculis nigris; thorace sub-quadrato, punctulato; elytris indistinctè striatis et punctulatis; pedibus sub-rufis.

"Body elongated, narrow, rufous, especially the thorax, which is subquadrate, punctured, with nearly straight posterior angles and without the longitudinal furrow: antennæ reddish brown, gradually

[1] See remarks under *Nitidula avara*, on page 375.

thickening from the seventh joint inclusive: clypeus rather full: elytra striate and punctured but rather indistinctly: feet reddish.

"Length three tenths of an inch.

"Referable to the genus *Eucnemis* according to Mannerheim, though not according to the strict limitation of that genus by Latreille. For my specimen I am indebted to Dr. Samuel Foster, who obtained it at Greenfield, Mass."

Nematodes simplex Lec. (Proc. Ac. Nat. Sci. Phil., Dec. 1866, p. 388.) "Fusco ferrugineus, elongatus, minus subtiliter helvopubescens, capite confertim punctato, anticè valdè convexo, thorace latitudine ferè longiore, antrorsum subangustato, lateribus rectis, confertim punctato, posticè vagè subcanaliculato; elytris ab humeris subangustatis, striatis, interstitiis confertim punctatis; subtus punctatus, propectore haud sulcato, tarsorum articulo 4to simplici; antennis articulis 3–10 æqualibus. Long. 7.5 mm."

"One specimen from New York in the collection of Mr. Ulke. Resembles in appearance *Agriotes oblongicollis*. This species differs from those previously described by the entire absence of vague grooves for the reception of part of the antennæ, and by the fourth joint of the tarsi not being dilated or lobed. The first joint of the hind tarsi is as long as the three following."

? Cardiophorus (Elater) filius Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 11.)

"E. corpore nigro, elongato; antennis serratis; thorace subtilissimè punctulato longitudine dimidio latitudinem excedente, basi utrinque impressâ, marginibus propè parallelis, angulis posticis obtusis. Elytris striatis, subtillissimè punctulatis, et rugosis: pedibus piceis.

"Body black, elongated: antennæ serrate: thorax almost imperceptibly punctured, length one half greater than the breadth; middle with no furrow; base with an impression on each side; margins nearly parallel; posterior angles moderately elongated, obtuse at the extremity: elytra striate, punctures of the striæ almost imperceptible, as well as the rugosity of the intermediate spaces: feet light piceous.

"Length little more than three tenths of an inch.

"Occurred in June on the Saddleback Mountains."

The fine punctured thorax is indicative of the genus *Cardiophorus*, but the long thorax with sides nearly parallel makes this reference exceedingly doubtful. The serrate antennæ may apply to almost any genus, but for the want of a better place I have left it where LeConte placed it.

Elater basalis Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 9.)

"E. corpore sub-dilatato; capite nigro, antennis serratis, rufo-piceis; thorace nigro, punctulato, angulis anticis capite non latioribus, posticis sub-acutis, scutello ovato, nigro; elytris striatis, punctulatis, basi rufo-sanguineis.

"Body somewhat dilated: head black: antennæ light piceous, subconvex, broadest at base, punctured, a little hairy, without any median furrow; margin gradually curved toward the anterior angles, which are no wider than the head; posterior angles sub-acute and nearly straight; scutel ovate, black, striate, punctured: elytra, subbasal and humeral regions rufo-sanguineous: body beneath black, punctured: feet piceous.

"Length from three tenths to four tenths of an inch.

"Appears allied to the *bimaculatus* of Europe, and to the *geminatus* of Say. Not very frequent."

Elater macilentus Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 13.)

"E. corpore angustato, subtus rufo-piceo; antennis nigro-piceis, villosis, capite densè punctulato; thorace sub-depresso, sub-elongato, marginibus subrectis, angulis posticis acutis; elytris sub-fuscis, leviter striatis, et punctulatis; pedibus rufo-piceis.

"Body slender, beneath reddish piceous, especially on the breast: antennæ blackish piceous, hairy, third and fourth joints subequal: head densely punctured: thorax inconspicuously punctured, somewhat flattened, with very short hairs; length one half greater than breadth; margins nearly straight; posterior angles acute: scutel ovate, darker than the elytra, which are light brownish, universally and minutely punctured; striæ shallow: feet reddish piceous.

"Length more than seven twentieths of an inch.

"Inhabits Blue Mountains, June."

Of this I can give no guess.

Malachius cœruleus Rand. (Bost. Journ. Nat. Hist., Vol. II p. 16.)

"M. capite nigro, polito, labro testaceo, anticè maculâ nigra; antennis nigris; thorace elytrisque cæruleis, tibiis quatuor anticis testaceis, duobus posticis nigris.

"Head black, polished: labrum testaceous, with a black spot before: antennæ black, base piceous underneath: thorax and elytra blue: four anterior tibiæ testaceous, two posterior black.

"Length more than one tenth of an inch.

"Inhabits Hallowell, May.

"Closely allied to the *M. flavilabris* of Say."

Tomicus gulosus Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 25.)

"T. corpore brevi, sub-cylindrico, subtus nigro; antennis fulvis; thorace sub-globoso, granulato; elytris testaceis, leviter striatis, striis punctulatis, apice uni-sulcatis, interdum bi-sulcatis, margine suturâque nigris, apice integro.

"Body short, thick, cylindrical, beneath black; labrum polished: antennæ fulvous: thorax sub-globose, densely and minutely granulated: elytra slightly striated: striæ punctured; above the apex, near and parallel to the suture is a sulcus, and sometimes near it an additional one; color testaceous; margin on each side of suture, black; apex entire: legs black.

"Length not three twentieths of an inch.

"Occurred plentifully in Hallowell, about the sap of newly cut maple trees (*Acer saccharinum*), April."

Dircæa decolorata Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 22.)

"D. corpore elongato; capite thoraceque nigris et punctulatis; elytris leviter punctulatis, sericeis, nigris, basi piceis aut rufo-piceis; pedibus piceis.

"Body elongated, head much depressed: front flattened, minutely punctured: palpi testaceous, last joint of the maxillary ones somewhat short, tri-angular: thorax black, finely punctured, about as broad as long, a good deal lowered upon the sides, before: elytra finely punctured, black, basal half more or less piceous or rufo-piceous: feet piceous.

"Length from two tenths to three tenths of an inch.

"Not very infrequent in the mountainous parts of Maine.

"Nearly allied to an apparently undescribed species from New Hampshire, which has the body wholly black, and rather less elongated than in the present."

Lixus rubellus Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 41.)

"L. corpore elongato, sub-brunneo, pilis minutis ferrugineis et griseis densè tecto; rostro leviter arcuato, carinato; thorace angustato, inequaliter punctulata; elytris striato-punctatis, apice obliquè sub-truncato, producto.

"Body elongate, brownish, densely covered with small reddish-ferruginous and grayish hairs; beneath with yellowish-ferruginous and cinereous hairs: club of the antennæ canescent, somewhat elongate pyriform, last joint somewhat acute: rostrum carinate to the tip, rather depressed, but very slightly arcuated; together with the head a little longer than the thorax: eyes small and black: thorax of about the same width at base with the base of the elytra, gradually and very considerably narrowing before; above, somewhat elevated on each side, the middle punctures unequal, mostly rather large, but not very profoundly impressed: scutel not perceptible: elytra with moderately regular striæ of punctures, very slightly truncated at tip upon the inner side, and terminating in a considerably produced, though somewhat obtuse point, curving slightly outward: legs brown: abdomen beneath with little canescent cirri.

"Length from the tip of the rostrum nine twentieths of an inch.

"A somewhat narrow and elongated species, and occurred in Cambridge, Mass."

Rhynchites viridi-æneus Rand. (Bost. Journ. Nat. Hist., Vol. II, p. 23.)

"R. corpore elongato viridi-æneo; capite sub-nigro, densè punctulato; rostro dilatato, supra utrinque sulcato; thorace æneo, densè et profundè punctulato; elytris viridi-æneis, seriebus vagis punctulatis; pedibus piceis.

"Body elongated, brassy: head darker, profoundly punctured: front somewhat depressed: rostrum dilated, especially at tip which presents a tubercle on each side; an impressed line nearly the whole length on each side: thorax brassy, densely and profoundly punctured: elytra greenish brassy, with profound punctures, disposed in irregular lines; feet inclining to piceous.

"Length about three twentieths of an inch.

"Occurred at Augusta, June.

"Perhaps allied to the *R. æratus* of Say; but the elytra of that insect are described as 'crenato-striate.'"

[Suggested by Dr. LeConte, to be a species of *Rhinosimus*. E. P. A.]

The preceding paper was written by Mr. Sprague several years ago, and his later investigations required some changes, which he was prevented from making by his sickness and death. I have therefore indicated in notes to each species the corrections required in the original paper, and as many changes have been made in the synonomy of the species, I have prepared the following list, which gives the latest adopted names of all the species described by Randall, together with the name given by him, and the number of Crotch's

Check List. When the generic name given by Randall has been changed I have enclosed the original name in parenthesis.

E. P. Austin.

	Boston Journ., Vol. II.	Crotch's List.
Clivina elongata Rand.	*Page* 34	*No.* 259
Randalli Lec.		
Platynus anchomenoides (Agonum Rand.)	2	464
Pterostichus punctatissimus Rand.	3	612
Chlænius niger Rand.	34	792
purpuricollis Rand.	35	794
Patrobus rugicollis Rand.	1	1001
angicollis author's typ. err.		
Hydrochus subcupreus Rand.	40	
rufipes Melsh.		1432
Laccobius agilis (Hydrophilus Rand.)	19	1480
Leucoparyphus silphoides (Linn.)		1688
geminatus (Tachinus Rand.)	39	
Languria inornata Rand.	49	
gracilis Newm.		2514
Peltis ferruginea Linn.		2699
fraterna Rand.	17	
septentrionalis Rand.	17	
Colastus truncatus (Nitidula Rand.)	18	2719
Epuræa avara (Nitidula Rand.)	18	2751
Ips vittatus Say.		2793
sepulchralis Rand.	19	
Anisosticta strigata (Th.)		2841
multiguttata (Coccinella Rand.)	51	
Coccinella affinis Rand.	50	2844
Adalia frigida (Schnh.)		2855
disjuncta (Coccinella Rand.)	33	
Harmonia picta (Coccinella Rand.)	51	2858
Anisocalvia 14-guttata (Linn.)		2860
similis (Coccinella Rand.)	50	
obliqua " "	33	
cardisce " "	32	
Mysia pullata (Say.)		2865
notans (Coccinella Rand.)	49	
Hyperaspis bigeminata (Coccinella Rand.)	32	2890
lugubris " "	52	2892
Hetaerius brunneipennis (Hister Rand.)	40	3099
Aphodius fimetarius (Linn.)		3259
nodifrons Rand.	20	
Anthaxia inornata (Buprestis Rand.)	4	3738
Agrilus vittaticollis Rand.	38	3812

	Bost. Journ., Vol. II.	*Crotch's List.*
Schizophilus subrufus (Eucnemis Rand.)	*Page* 38	*No.* 3901
simplex (Nematodes Lec.)		
Cardiophorus ? filius (Elater Rand.)	11	3945
Cryptohypnus pulchellus (Linn.)		3991
exiguus (Elater Rand.)	35	
Elater semicinctus Rand.	10	4007
? macilentus Rand.	13	4047
Betarmon bigeminatus (Elater Rand.)	37	4124
Limonius stigma (Hbst.)		4184
? *basalis* (Elater Rand.)	9	
Campylus productus Rand,	8	4213
Athous rufifrons (Elater Rand.)	6	4234
Oestodes graciliformis (Elater Rand.)	13	
tenuicollis (Elater Rand.)	14	4244
Sericosomus honestus (Elater Rand.)	9	
fusiformis Lec.		4250
viridanus (Say.)		4252
sublucens (Elater Rand.)	37	
Oxygonus obesus (Say.)		4257
acutipennis (Elater Rand.)	36	
Corymbites virens (Schr.)		4259
anchorago (Elater Rand.)	5	
resplendens (Esch.)		4266
aerarius (Elater Rand.)	7	
appressus (Elater Rand.)	11	4295
triundulatus (Elater Rand.)	12	4309
aeripennis (Kirby.)		4317
appropinquans (Elater Rand.)	5	
Eros thoracicus (Omalisus Rand.)	14	4432
crenatus (Germ.)		4435
cruciatus (Omalisus Rand.)	15	
fraternus (Omalisus Rand.)	15	4436
Photinus borealis (Lampyris Rand.)	16	4458
Anthocomus flavilabris (Say.).		4613
? var. *cæruleus* (Malachius Rand.)	16	
Ptilinus thoracicus (Tomicus Rand.)	25	4868
Endecatomus rugosus (Triphyllus Rand.)	26	4870
Criocephalus obsoletus (Callidium Rand.)	27	4935
Elaphidion unicolor (Stenocorus Rand.)	42	5015
Toxotus vittiger (Leptura Rand.)	29	5173
cinnamopterus (Leptura Rand.)	45	5177
Pachyta monticola (Leptura Rand.)	27	5179
Acmæops pratensis (Laich.)		5205
semimarginata (Leptura Rand.)	30	

	Bost. Journ., Vol. II.	Crotch's List.
Leptura plebeja Rand.	Page 28	No. 5231
subhamata Rand.	44	5232
Monohammus marmoratus (Lamia Rand.)	26	5326
Saperda puncticollis Say.		5419
trigeminata Rand.	43	
Cryptocephalus venustus Fab.		5589
cinctipennis Rand.	45	
Pachybrachys othonus Say.		5663
marginaticollis (Cryptocephalus Rand.)	46	
Galerucella sagittariæ Gyll.		5822
salicis Rand.	31	
Oedionychis sexmaculata (Ill.)		5861
palliata Rand.	47	
quercata (Fabr.).		5862
circumdata Rand.	48	
Disonycha funerea (Haltica Rand.)	47	5872
Stenispa metallica (Fabr.)		5954
brevicollis (Languria Rand.)	48	
Physonota unipunctata Say.		5979
helianthi (Cassida Rand.)	30	
Bolitophagus depressus (Eledona Rand.).	21	6336
Corphyra lugubris (Say.)		6436
inornata (Pyrochroa Rand.)	23	
Xylita lævigata (Hellen).		6548
decolorata (Direæa Rand.)	22	
Ditylus cœruleus (Upis Rand.)	20	6838
Priognathus monilicornis (Ditylus Rand.)	22	6875
Lixus calandroides Rand.	42	7003
rubellus Rand.	41	7012
Pissodes affinis Rand.	24	7030
dubius Rand.	24	7032
Rhynchites viridiæneus Rand.	23	
Trypodendron bivittatus (Kirby.)		7340
gulosus (Tomicus Rand.)	25	

February 3, 1875.

The President in the chair. Twenty-six persons present.

Mr. Richard Bliss, Jr., described some peculiarities in the structure of the fin spines of certain groups of fishes.

The spines of the dorsal and pectoral fins of the Siluroids and Doradoids differ from those of ordinary fishes in that they serve not merely as supports for the fin membrane, but are also modified into weapons of defence. In both of these families, but especially in the Doradoids, the very large spines of the dorsal and pectoral fins are furnished in front with a row of obtusely conical, and behind with a row of recurved teeth. The peculiar structure of these spines may be advantageously studied in the genus *Ælurichthys*, as in that genus the spines do not undergo that complete ossification which in most other genera renders a determination of their intimate structure difficult. The spine in its early stages is simply a jointed rod, each joint sending off from its upper anterior portion a pair of long, slender and nearly erect branches, which are united and somewhat broadened at their outer extremities. As the branches from one joint rest closely against those of the joints above and below it, a hollow space is formed, pervading the whole length of the spine. This space is reduced in diameter as the spine ossifies, till finally there is left only a narrow channel perforating the longitudinal axis of the spine; but it is never closed at the top, as is the case with the spines of certain sharks.

As the spine ossifies, the ends of the branches project a little beyond the anterior border of the spine, and in time assume the form of conical teeth. At the same time the joints develop into aduncous teeth posteriorly, increasing in size as the ossification proceeds; and finally, with the soldering together of the branches and the obliteration of the joints, we have a bony spine apparently homogeneous in structure, furnished with strongly serrated anterior or posterior edges.

In this peculiar structure the spines of the Siluroids differ entirely from those of other Ganoids; as in the sturgeon, the spines are composed of a number of simple rods soldered together, while in the Lepidosteus, the spines along the upper portion of the caudal fin are merely modifications of the plates of the body, elongated and narrowed to serve a special purpose.

Dr. H. A. Hagen gave an historical sketch of the development of natural history museums, bringing the subject, however, for want of time, down only to the period of Linnæus.

He considered the ancient votive offerings deposited in the temples to be the origin of collections of natural history, which, through the number and importance of their objects, were somewhat instructive. This ancient custom still exists to some extent where superstition or faith goes before science. Later we find science advancing by means of collections of natural objects. But the lack of means of preserving them retarded the progress of science fer a number of centuries. From the time of Aristotle to that of Albert the Great, and even of Conrad Gesner, there was only a traditional science. The collections vanished with the masters, and the works containing the results of their duties could not be made accessible before the introduction of printing. The possibility of preserving collections made the work of science easier, while the means of making known its results through the art of printing gave a new impulse to knowledge, and brought into the field a whole army of observers and keen students, who soon overthrew the old scholastic rubbish heaped up purposely over the beautiful results of Aristotle and his followers by an ignorant or wilfully ignoring Church. The beginning of the Reformation was the beginning of science. The time immediately following was overcrowded with new facts, and the number of workers was inadequate to the affluence of the material. Natural history collections presented a curious mass of more or less imperfect objects unscientifically prepared and arranged. Most of the collections were in the hands of individuals richer in money than in learning, yet eager to foster both science and general knowledge. This period of incongruity was that of the sixteenth and seventeenth centuries.

The remarkable time of Linnæus begins a new era in the history of science, which obtained a new basis through the classification of everything existing. Henceforth evidence of the recorded facts in natural history was to be preserved through the preservation of the described objects themselves. Scientific students are unanimous in regarding the works of the great Linnæus as the corner stone of science. The preëminent value of collections of types was first recognized when Sweden did not shrink from sending a man-of-war to recover collections which had been legally sold to another country.

The following paper was read:—

Notes on the Geology of Eastern Massachusetts.

By W. W. Dodge.

By comparison with the prevalent line of strike in New England,[1] it appears that the eastern coast of New England forms a bay cut into the parallel eastern strata. The head of this Gulf of Maine, as it is sometimes called, is at Portland. The gneisses and schists which lie fifteen or twenty miles from the coast in Massachusetts, and stand out to sea in the form of long headlands and lines of islands in south-eastern New Hampshire and southern Maine, seem to be continued to the north-east by similar rocks lying in Maine to the west of the Penobscot River, on the other side of the gulf.[2]

East of the Penobscot, crystalline ranges extend north-easterly through Washington and Hancock Counties into New Brunswick,[3] and are there associated with fossiliferous rocks, partly of the same age as some of those associated with the rocks which, lying in a band across the State, form the sea-coast in Essex, Middlesex, Norfolk and (northern) Plymouth Counties in Massachusetts. This area in Massachusetts is the subject of the present paper. Its probable original connection with that farther to the northeast makes it important that they should be compared carefully, as each may throw light on the other.

The rocks of this vicinity may be treated in two groups: (1) the crystallines, and (2) the more clearly stratified rocks among them. In the absence of adequate knowledge of the ages of these groups, I shall have to content myself with these very insufficient designations.

I. Crystallines.

The rocks of this sea-coast area in eastern Massachusetts have generally been described as "sienite and greenstone," from two varieties which are very prevalent, and apparently in conformity with the now antiquated terminology of the English Geological Survey of half a century ago.

[1] This prevalent line of strike, as is well known to geologists, may be easily determined on a common map by the line of Hudson River, Lake Champlain, Richmond, Quebec, and the south bank of the St. Lawrence to Gaspé, thus consisting of two principal directions: north—south, and east-north-east—west-south-west.

[2] There are also similar rocks in south-eastern Massachusetts, in Plymouth and Bristol Counties, which have the fiord formation on Buzzard Bay, strongly resembling the appearance of the coast of Maine between the Kennebec and the Penobscot Rivers.

[3] Proc. Am. Ass. Adv. Sci. (1867), Vol. xvi, p. 123.

Their dip, when it can be distinguished, is almost invariably to the west and north-west, according to their strike. They underlie unconformably strata holding Paradoxides, etc., and probably formed hill or island ranges very early in the history of this continent. Some geologists have assumed the presence of a barrier in this neighborhood, protecting the inner continental basin from the ocean, to account for the deposition of the Lower Silurian limestones of the States to the westward.

For the most part, metamorphism has been so complete that these rocks have lost almost entirely their probable original character. Moreover, the igneous outflows have been so numerous and complicated that it becomes almost impossible to decide, in some cases, which rocks have been actually fluent, and which were only acted upon by others in that condition, or by the same causes which reduced such others to that condition, in a less degree. On this account, some have considered all the sienite and greenstone of igneous origin. Undoubtedly the igneous and metamorphic varieties are often difficult to distinguish, but inability to separate them is no reason for declaring them identical. While eruptive masses have frequently an appearance of schistose structure, by which this difficulty is increased, in metamorphic sienites and diorites, on the other hand, the original stratification is often so completely lost as to be undiscernible; so that, while of sedimentary origin, they may, in view of the probable presence of heat as an attendant on metamorphic changes, be said, with a certain degree of truth, to be "igneous" rocks. Sedimentary, metamorphic, igneous, — the terms are too little discriminating to be disputed about, and I believe that the question is often merely one of degree of the same action. Metamorphic crystalline rocks usually are cut by veins of the material of which they are in part composed, in a more fluid state than the pasty body of the rock, often in a manner incompatible with the assignment of percolating solutions as the cause; and overlying rocks often have their cracks filled by intrusion from the more fluid mass below. This is often seen in such more recent rocks lying in the direction of the axis, or in the lateral vicinity of a crystalline range, after denudation. Several instances of this are pointed out below.

It has seemed necessary to say so much at the risk of falling into geological commonplaces admitted as such by all, on account of the variety of opinions entertained as to the relations of metamorphic and eruptive rocks, and the consequent different significance attached to these words. The present tendency seems to be to refer to some of the less familiar attendant circumstances of sedimentation, many effects hitherto supposed to be the result of "plutonic" agencies.

Throughout the crystalline area of this vicinity there are immense masses of hornblendic rock, diorite and diabase, usually cryptocrystalline, in which no indication of sedimentary origin can be traced. I can suggest no test by which to distinguish among them; yet, while the theory of subaqueous accumulation by chemical forces seems, in many respects, to be the most satisfactory explanation offered of their existence and characters, in appearance and composition they often bear the closest resemblance to certain eruptives of the stratified group of this vicinity, which undoubtedly had, in some cases, the same origin, unless they were derived from among these crystallines themselves.

The "sienites" consist, for the most part, of quartz and felspar, with little (often no) hornblende. The abundance of quartz seems to point rather to metamorphic than igneous condition, and there is probably no doubt that they are chiefly of sedimentary origin. Not unfrequently there are grains of amethystine quartz. The felspar is usually grayish, varying to blue in the favorite Quincy building stone. This weathers to a light or darker reddish-brown, and the change often penetrates to a great distance along the joints which cleave the rock. In certain districts the felspar is often bright red. Another variety particularly common in Waltham, Weston, Natick and Dover, and the neighboring towns, is larger grained, and consists of red, white or green felspar with less quartz. This often occurs as compact red felspar; sometimes as a large grained, whitish (often greenish), felspathic rock with minute specks, or rarely plates, of mica. There is also a red and white granulite, and a white granular eurite. The hornblende is most abundant, as a rule, in the finer grained rocks. In fact, nearly all possible combinations of the elements in different proportions may be found, and in many conditions of each, large and small. The varieties appear to pass into each other so commonly that they can not be safely separated as occupying distinct areas.

The term "porphyry" as used in the State Geological Report was applied rather indiscriminately to several widely different varieties of felspathic rock. (*a.*) The most familiar of these is the felsite porphyry of Lynn and Saugus. This varies from flesh-color to deep red, purple and black, and from a jaspery and homogeneous texture to granular, either red or white. It often has pale felspar crystals contained in the body of the rock, then becoming true porphyry. It frequently holds translucent quartz grains. The compact felspathic variety is very different in appearance from (*b.*), the felspathic rock above mentioned, which has also been called porphyry, being much less coarsely crystalline; owing to its finer texture it changes less in appearance from its original condition under metamorphism. Pebbles of it are abundant in the Brighton conglomerates. It probably belongs to the crystalline group, but is puzzlingly related to the slates in Malden and towns on the south shore. Perhaps some of the slates are so altered in those two regions of great metamorphic effects, as to resemble the real porphyry, thus leading to confusion of identity. Certainly the slates do become so altered as to approach it in character by several degrees of change which may be clearly traced. A third rock (*c.*) that has been called porphyry differs esentially from the other two. It lies in the southern part of Needham, and may be examined at a quarry about three-quarters of a mile north of Charles River village, on Central Avenue.[1] It is associated with hornblendic rock which, unlike that with the crystallines generally, is amygdaloidal. The rock in question seems in places to be a greenish-white sandstone with a high dip north-westward. So, also, at High Rock, so called, east of the quarry; and along the track of the Woonsocket Division of the New York and New England (formerly Boston, Hartford and Erie) Railroad. A mile east, near a brook which flows south to the river, it is reddish. Again, some specimens of the same granular character contain crystals of hornblende. The crystallines in western Dedham are more markedly crystalline and redder. Farther east, on the north side of the river, the rocks become more crystalline or igneous in appearance, with many quartz veins. (*d.*) There is also in Needham a sienitic rock, which is often porphyritic. The area of felspathic rocks, of which two varieties these form a part, extends into the southern part of Newton.

Beside the clearly crystalline rocks, there are others apparently of this group, which retain their stratification more or less. In Great

[1] To make the following local descriptions permanently useful, it will be necessary to name a few current maps, on which the names of streets (which are especially liable to change), and other local designations adopted are laid down. The map of Boston and vicinity, published by A. Williams (latest ed., 1874), is the cheapest and most convenient for general reference. The Baker & Tilden Vicinity Map, and Walling's county and town maps, though now old, are very useful, being on a large scale. The Boston Directory Map already covers a large and interesting portion of the ground. Atlases of Cambridge, Newton, and other large cities, have lately appeared.

Britain, also, more careful study of many of the old "sienite and greenstone" areas has shown them to contain stratified as well as crystalline portions.

In northern Topsfield and eastern Middleton, it is stated that there are silicious slates, partly cherty, partly granular, like sandstone.

In Woburn there are silicious slates, often very much contorted, dipping west-north-west, in what is known as Shaker Glen, along the course of Mill Brook. Above Spy Pond in Arlington, there are slaty rocks which pass through fine grits to coarse sienite by various stages. So, too, in Medford. There is white quartzite banded with pink, with a high west or north-west dip, in Waltham; and a granular, almost translucent variety in Natick with sienite. In the north-eastern part of Weston, between a brook and the Lexington road, there is a ledge of sandy and slaty rock dipping 60° or 70° west-north-west. In most of these stratified rocks, there are frequently small epidotic bands, apparently of later formation, between the layers, expanding occasionally into nodules. This occurs also quite frequently in the case of more recent slates lying near the crystallines in some places.

Breccia occurs in many places. Two very easily accessible localities are at the end of the band of crystallines of Dedham. One of these, a detached area, east of the Pine Garden Station (Boston and Providence Railroad) in the northern part of Hyde Park, is surrounded by conglomerates. The other is a mile or two south-south-west; that is, about north-west of Hyde Park village. Here the rock is a light colored felsite which is often compact, but in places has a wavy lamination. Where this is brecciated, the fragments are of both varieties of the original rock. At the first locality the breccia is similar but more conglomeritic, and consists apparently of small fragments of flesh-red or ash-colored slates closely massed together or united with a compact felspathic paste.

To illustrate further the lithological character of the crystalline area taken as a whole, it may be well to note some of the less abundant minerals which have been stated to occur. As has been already seen, both the acid and basic types of rock occur, together with many intermediate varieties combining the characters of each. Excepting the hornblendic rocks already mentioned, however, the latter class, well described by Dr. Hunt as "consisting in great part of the silicates of the protoxyd bases, lime, magnesia and ferrous oxyd, either alone or in combination with silicates of alumina and alkalies," is not very extensively represented here. There are occasional limestone beds or veins, as at Newburyport, Nahant, Stoneham, Saugus, and Walpole, and Smithfield, R. I. These are generally more or less magnesian, and beds of steatite are sometimes associated with them. Nephrite occurs at two of these places, Stoneham and Smithfield. Serpentine, usually with asbestus, is found in several localities. Epidote and prehnite are common. Gold, silver and lead have long been known to occur in small quantities, and now seem likely to prove very plentiful at Newbury. Other deposits of these valuable metals may probably be found.

How far lithological character can be made a test of age for these extensive and widely distributed crystalline masses of early rocks, now often roughly classed as Laurentian, Huronian, etc., remains to be determined. The term Silurian was once quite as vague, but recent discovery has now limited it to a comparatively small part of the strata to which it was formerly applied, by making necessary the invention and use of new names to designate newly distinguished groups. Perhaps we may also hope for a more accurate knowledge of these primitive metamorphic rocks and consequent more definite use of the names applied to them. The terminology now in vogue is, no doubt, definite and accurate where it was first locally applied, but as carried elsewhere, frequently means little.

These crystallines occupy distinct bands separated by more recent rocks collected in the area between them. The largest band is bounded on the south and east by a line running from the shore in Lynn; across Saugus and Revere; Malden, north of Salem St.; and Medford, to the foot of Mystic Pond. Here a valley interrupts the line, which begins again in Arlington, west of Spy Pond, runs through Belmont, west of Pleasant and Forest Streets, swings west to the north and west of Waltham village, crossing Beaver Street about midway of its length, and follows South Street and the Boston and Albany Railroad through Weston into Needham.

Another band, which includes the Moosehill range of Sharon, lies south of a line extended W. 20° S, from Minot's Ledge Light through Cohasset, south of Hingham village and Weymouth Landing, north of Little Pond in Braintree, by the south shore of Great Pond, north shore of Reservoir Pond in Canton, north of Canton Centre, and from there south-westerly. This band is probably about seven miles wide, but I have not traced its southern limit.

Between these two, there is a third band more difficult to define. The conformation of the hills in Dover makes it appear to join the first there, and it is so indicated on the geological map in the Atlas of Massachusetts,[1] but the "porphyry," already mentioned, and the other crystallines in Needham and Newton carry the northern boundary of this area several miles farther north, if they are to be included. In the report of the State Geological Survey, the line of the first band, which I have continued southerly from Weston to include certain crystallines at Rice's Crossing and Grantville, is carried south-westerly across Weston to include conglomerates in Natick. The fact is that, particularly at the angles of the bounding lines of the crystalline areas, the overlying deposits are often so shallow as to be correctly described as patches upon the crystalline areas, rather than as distinct regions to be defined by formal lines. The extensive denudation which has taken place over the whole face of the country has probably carried away with the older rocks, many deposits contained in their depressions, leaving now plane surfaces of the crystallines with no suggestion of what once lay above. The north-south line from Weston to Needham, although traced by actual outcrops, may therefore be inaccurate, and the district to the westward may really be or have been a series of E. N. E. – W. S. W. ridges with more recent rocks between them (see p. 416). If any of these last remain, they will probably be found along a line parallel to, and a mile north of the southern boundary of the town of Weston, or in Natick between a continuation westward of that boundary, and the Boston and Albany Railroad.

The northern boundary of the band in question forms a series of angles from the north-west in a zigzag course toward the south-east. Hitherto, these angles have been ignored in geological maps. It is particularly difficult to outline the easterly sides of the angles which break the north-west and south-east line, inasmuch as the ranges of the crystallines trend eastwardly, so that in that direction they appear at intervals among the later rocks which cover them and break their continuity at the surface. Thus in following the outline we frequently have to turn back after defining a peninsula shaped area, to pass around a bay of newer rocks which for a short distance occur in sufficient quantity to separate the continuous, parallel, crystalline ranges. This northern limit is approximately determined by a line passing half a mile south of Wellesley, and as far north of the Highlandville Station of the Woonsocket Division, across Charles River, where this turns from a northerly to a westerly course, and toward

[1] Boston, 1871.

the extreme westerly point of Brookline. Very likely the extensive masses of diorite in this vicinity should be classed among the "crystallines"; and if so, this range extends across Newton, and about a mile into Brookline, where there are great masses of diorite and amygdaloid well exposed to examination on Hammond Street between Newton and Boylston Streets. Then the line is deflected to the westward as far as Charles River again, to exclude conglomerates lying in Newton and West Roxbury, and asserting itself again in the south-eastern part of Needham, runs across Dedham Island to the corner of Beach Street and Shawmut Avenue in West Roxbury. At this place, the continuous area is mostly included by drawing the line south-south-east toward Hyde Park village; but to the east of this lies the breccia above mentioned, and there are slates and puddingstones about Hyde Park which again turn the outline we are tracing to the south-west. Passing around these, we find crystallines again on the south side of Mill Creek, and the line is thence more easily determined in an east-north-easterly direction across Milton, running about quarter of a mile south of the Town House; and Quincy, intersecting Adams Street at the corner of Common Street, as far as the Old Colony R. R. Here it turns south-south-east once more, and then indents to the westward about Town River, before continuing the east-north-east course to Quincy Point. Weymouth Fore River makes a convenient easterly and southerly limit here, the south-east corner of the area approaching very closely to the second crystalline band above described, at East Braintree. This easterly limit is far from geometrically accurate, however. The trilobite slates, so well known at Hayward's quarry, indent it on Quincy Neck and in Braintree; and the slates continuing these in North Weymouth, Hingham and Cohasset, are separated and disturbed by crystalline outcrops or outflows which continue this range as far as the coast. These again present the recurring difficulty of determining whether to consider them as isolated outcrops of elevated metamorphic crystallines, or as intrusive outflows. From East Braintree, the southern line of this third band diverges about 6° from the northern limit of the second as given above; runs through Braintree along, or in some places south of West Street; across Randolph, Canton, and the eastern part of Norwood, crossing the New York and New England Railroad a little south of Winslow's Station, and turning here more to the south-west, Walpole, and the south-eastern corner of Medfield.

So much of this band as lies in Milton, Quincy and Braintree is two and one-half to three miles wide; except east of the Old Colony Railroad, where it is about one and seven-eighths miles wide. That part which lies west of the Neponset River in West Roxbury, Hyde Park and the eastern half of Dedham is about five and one-half miles wide, while the Needham and Newton rocks add almost three miles to this. This diminished width of the sections toward the east ($6x : 3x : \frac{3}{2}x : x$), of itself suggests the successive disappearance in each, of the northerly of several parallel axes of elevation; the most northerly of all ending in Brookline; the second in the isolated breccia of Hyde Park; the third range protracted through Quincy to the Old Colony Railroad; the fourth losing itself at Quincy Point; while the most southerly of all is continued to the coast, showing itself, like the others, at isolated points, or indicating its presence below by its outflows in the manner above suggested (pp. 389, 394, 395), yet not extending so far as the more southern band, the second of the three in order of description above. This idea is consistent with the positions of the geographical valleys and hill ranges which compose these continuous crystalline areas, in spite of the levelling effects of glacial action; and some of the valleys appear to be also geological, containing, as already mentioned, conglomerates in Newton and West Roxbury, slates and conglomerates at Hyde Park, trilobite slates at Quincy Neck and Braintree. Certainly the *en echelon* arrangements of mountain uplifts (of which this is a modification) is common, and the natural result of forces producing these, as now understood. This probability may, perhaps, be the most that we shall know on the subject, for the stratification of the crystallines has been so obliterated that it is usually impossible to determine their actual geological position originally, although in some cases it seems as if anticlinals, simple or hanging, and faulted monoclinals could be recognised in the hills of the crystalline areas.

It will be noticed that while the Blue Hill area, as outlined, is more nearly east and west than the other areas, so that, for instance, at Punkapog it is one mile farther from the second of the three bands than at East Braintree, six miles to the eastward, the geographical hills and valleys run obliquely across it in a direction nearly parallel to the second band.

II. Stratified Rocks.

Between the older rock bands described lie certain more recent and more clearly stratified rocks. The more recent age of these is shown beyond dispute by their position in relation to the underlying crystallines, as well as by the fact that they are composed of detritus of the latter, which may not only be so recognized, but even may at times be referred to the source from which it was probably derived.

Their age relatively to each other is less easily determined. They are, in places, fossiliferous, but elsewhere have not yet been shown to be so. This scarcity of organic remains makes certainty as to age impossible at present, in some instances, for the rocks are much faulted, and are, beside, frequently worn away by glaciation and covered by gravel at critical points. So that mere succession at the surface, in the direction of dip, is not a safe test of superposition.

The occurrence of Paradoxides at Braintree connects the strata holding this characteristic fossil, with rocks at St. John, New Brunswick, and in Newfoundland. It is interesting to notice that the strike of these earlier rocks is about the same at nearly all the places where they have yet been studied; in Sweden and Great Britain, in Bohemia, and in Spain, as well as at the localities just mentioned; as if some identical force had given the east-north-east and west-south-west direction to them before others existed above the water, the force acting as a simple result of the nature of the earth in its then condition.

It is not yet safe to attempt minutely to synchronize the earliest fossiliferous strata in different regions of this country. They are, of course, dissimilar lithologically, and nowhere have they been so accurately worked out as to serve as a standard of comparison for the rocks of other and remote districts. With a few exceptions we do not know what of our rocks correspond to the Lower Cambrian of Wales and England, and there has been much confusion in America in the use of the term " Huronian," which seems to have been made to include early crystallines (such as are represented in this vicinity by the sienites and diorites already described), and higher and more clearly stratified and fossiliferous rocks of Cambrian or Silurian age.

Studying these rocks by their internal characteristics, we arrive conclusively at the result that there are strata of several different ages among them. Thus, the most abundant kind, the pudding-stone, is found to contain among its pebbles, beside those of crystallines, others of later date, other pudding-stones and slates which, I think, can be identified with another extensively developed member of the group. Yet these several strata, which in some places lie in great masses by themselves, appear in other places to be promiscuously intermingled, and here the deficiency of lithological character as a distinction, makes itself felt. Conglomerates pass into slates, which closely resemble others which they seem to overlie unconformably elsewhere, and contain portions of, as pebbles. And the outcrops are often so small and few in the basins, and the basins are separated by such extensive areas of the older crystalline rocks, that it would be almost as unsafe to attempt to make out a correspondence between apparently similar strata in the different basins of this vicinity, as between these and the strata of foreign localities. So that an argument on lithological grounds can scarcely be extended from one of these small areas to another.

It will be seen that beside the small area at Newbury, and the large one occupying portions of Rhode Island, and Bristol and Plymouth Counties in Massachusetts, there are in this more immediate vicinity, three somewhat clearly defined basins of these included stratified rocks. They are so closely locked in among the crystallines that it seems clear that large quantities in the form of less protected anticlinals must have been removed by denudation, and that small basins may yet be found elsewhere within the areas and among the folds of the more durable subjacent rock.

Of these three, the largest, which by way of a harmless designation, may be called the Boston basin, occupies all the country between the two bounding lines of crystallines already given, which have their eastern ends respectively at Lynn on the north and Quincy on the south. Its width, accordingly, is about thirteen miles. On the west it is broken into by several projecting ridges of the underlying crystallines, and eastward it loses itself under the water of Massachusetts Bay, appearing irregularly in islands and ledges at intervals across Boston Harbor.

The second, closely resembling the first in its rocks, lies along the north side of the Moose Hill crystalline range, from Cohasset to Braintree, and is open to the harbor on the north. This I will call the South Shore basin.

The third is long and narrow, curving at about the middle of its length, and tapering to either end; the eastern near the last mentioned basin at Braintree, and the southern where I have not yet examined it carefully, approaching, in the vicinity of Wrentham, the larger basin which lies in Bristol County. This may be called the Norfolk County basin.

To give a clear idea of the various kinds of rocks of the Boston and South Shore basins, and their probable relations to each other, and at the same time to avoid making the observed facts appear unreliable by being involved with the conclusions, perhaps mistaken, drawn from these, the safest method will be perhaps to take up the several kinds separately.

A. Slates.

In nearly, if not quite, all the places where these mixed rocks, such as lie in the vicinity of Boston, occur, there is a mass of slates apparently between the crystallines and conglomerates. Prof. Hitchcock mentions them as found at Sachuest Point, Newport, at Portsmouth in the north of the island, and at other places on it, at Little Compton, at Parker River, Newbury, Mass., and elsewhere. (Proc. Am. Ass. Adv. Sci., xiv., 1861). So, too, these slates or novaculites are found in places throughout the areas under consideration. They probably underlie the whole district, but by far the greater number of the outcrops group themselves in belts whose positions should be noticed as throwing some light on the general arrangement and place of the slates which compose them, in the whole system.

(*a.*) On the north of the Boston basin these slates form a band about three, or inside of three and a half miles wide, parallel to the line of crystallines already described. They may be traced through the western half of Newton among the conglomerate which is there abundant, as far as the Charles River. Other slates which occur in Newton are clearly a part of the conglomerate system. These often resemble the Cambridge slates (to adopt the name given by Prof. Shaler), but are usually thinner bedded and less hard. This band includes Egg Rock, Nahant, Everett, Malden, Somerville, Medford, Cambridge, Belmont, Watertown, Brighton and Newton.

The strike is E. N. E. – W. S. W. with N. N. W. dip, changing in Newton to N. E. or N. N. E. strikes, with dip N. W. or W. N. W., conforming to the bend of the line of enclosing crystallines. The axis of elevation in Somerville and Cambridge is N. W. – S. E. as if the strata were crimped up by the bending together of the ends of the band. The strike is almost invariably parallel to Highland Street, which may serve as a convenient reference on a common map. There are also indications of a parallel uplift along the line dividing Belmont and Watertown, though the ridge here may have been formed by exterior agencies. There may be some connection between this axis, and the average N. W.–S. E. direction of the zigzag northern side of the Dedham and Blue Hill crystalline area.

The dips in Somerville[1] are very various, the rocks ranging from nearly horizontal to vertical. On the southwest side of College Hill, there is a high ledge dipping 89° S. W., while three quarters of a mile from there, on lower ground, at the quarry on Elm Street opposite the old powder house, low dips in almost all directions may be found round the dyke which cuts the slate. The most frequent dip is 10° to 20° S. W. Good exposures of the edges of the slates are on the north side of Central Hill along the Lowell Railroad and the Lexington Branch, northwest from Central Street (Winter Hill Station), and along the Medford turnpike. Perpendicular to the bedding, they are quarried extensively near the Alms House, on Elm Street, and on Milk near Lowell Street.

The upturned edges are so cut by eruptives, and faulted, that it would be impossible to determine the true thickness of the slates by a section here. Considering the exposures as they lie, the strata to the south-west are more uniform in character, being compact, homogeneous masses of felspathic rock, sometimes banded in gray and purple; while going toward the Mystic River they become more sandy. At the Elm Street quarry, the strata are sometimes bands several inches thick, as in the quarries along Milk Street, but again we find close interstratification of slate and sandstone, and wave markings appear at times. Along the Lexington Branch Railroad, the strata are loose nodular grits as well as slates. Still farther north, the compact varieties appear again and are quarried on Medford turnpike.

Although there are a few scattered boulders of conglomerates in Malden and Somerville, the only ledge of conglomeritic rock which I have seen in place north of Charles River, lies in Watertown between School, Belmont, Arlington and Mt. Auburn Streets. It is a passage from pudding-stone to slaty or schistose rock north-westerly. The projecting quartz pebbles at its southeast end show a clean joint at that place, although the softer rock has worn away about them.

[1] Somerville was a part of Charlestown when the State Geological Report was published (1840).

There are slate outcrops along North Street in Belmont, and Belmont Street in Watertown, also on each side of the river, once in the Cattle Market, and again in "Morse's Field" near Newton Corner. To the eastward of these places, there is probably no outcrop on this line of strike. In the College Yard at Cambridge, however, slate was reached twelve feet below the surface while excavations were being made for a sewer in 1871. The quarry at Morse's Field varies from pure slate with conchoidal fracture to fine sandstone. The dip is 50° N. N. W., and the strike N. 70° E. This is undoubtedly part of the Cambridge slates. Other slates in Brighton and Newton must be scrutinized carefully before pronouncing as to their age. The outcrops along the Boston and Albany Railroad to the eastward of Newton Corner Station, near the boundary of the two towns, are perhaps of the same age as the last mentioned. So, perhaps, some of those along the great uplifts of hornblendic rock in Brighton along Cambridge Street. Others are clearly part of the conglomerate formation. Of the former kind, also, are perhaps the ledges in Newton, and at the south-west corner of Waverly and Cotton Streets; east of Murray Street and the immense mass of diorite on its west side (strike E. N. E.); on the west side of Murray Street south of Highland Avenue; the small outcrop across Fuller Street (strike N. 50° E.); and the one near the river at Newton Upper Falls in the north-west corner of Boylston and Chestnut Streets. The curiously crumpled slates at the corner of Maple and Auburn Streets at West Newton probably belong under this head also. Their dip is quite high, some 70° to 80°.

(*b*.) There is a second band of slates crossing West Roxbury and Dorchester in an E. N. E. direction from the southern corner of Newton. There is here a band of territory a mile wide, which forms a geographical valley between the higher conglomerate lands on each side, though encroached on here and there by gravel hills; in which valley are extensive low meadows and the principal streams of that vicinity. The Dedham Branch Railroad turns aside to utilize the convenient course so provided. The conglomerate which elsewhere accompanies the slates is absent here so that they appear alone or nearly so. The slates stand in a nearly vertical position with a strike corresponding to the direction of the valley. They crop out along the Boston and Providence R. R., Dedham Branch, a few rods north-east of Spring Street Station, West Roxbury, and again on each side of Beach Street bridge; on opposite corners where Madison Street and Blue Hill Avenue cross; also east of Dorchester Avenue and south of Centre Street. The middle one of the three eastern points of Squantum is formed by slates. Running across the harbor in the same general direction, we come upon Rainsford and George's Islands, Boston Light and Shag Rocks; a succession of rocky islands forming a long ledge about E. 26° N. Parallel to this lie Lovell's and Gallop's Islands, which are based on rock, Middle and Outer Brewsters, Martin's Ledge, etc. Some of these islands, which I have not examined, may consist entirely (as most which I have seen do partly), of eruptive diorite and porphyry. The dip, as on land, is high, tending to northerly when not vertical.

(*c.*) In North Quincy near the harbor and north of Sachem's Creek, there is a quarry of slates which may belong to the same group. The strike is N. 55° E, and the dip varies from 3° to 6° from vertical. The slate is pure, of a grayish color and conchoidal fracture, and joints into oblique parallelograms of small size.

Dr. Hitchcock speaks of slate on the south side of Hull, and there are specimens of "Graywacke slate, Hull," in the rock collections in Boylston Hall at Cambridge, but I do not know their locality, and have failed to find slate in Hull.

(*d.*) At Hyde Park there are conglomerates and slates; the latter on Gordon Avenue opposite Austin Street, and at the corner of River and Summer Streets. I have not ascertained whether the two kinds are of the same age.

(*e.*) In Quincy, along Black's Creek north of Adams Street, there are conglomerates and slates very near the crystallines. The road runs parallel to the northern limit of the latter for quarter of a mile west of the Old Colony Railroad. Between the road here and the crystallines, and also across the road where it turns southward, is a hard black rock, possibly eruptive (as is often the case between the crystallines and more recent strata), partly, perhaps, quartzite or felsite or very hard sandstone. Then just north of the brook, are large grained conglomerates about 140 feet thick, and above these, after an interval of 92 feet, hidden, are sandstones, 64 feet, and slates, 132 feet, nearly vertical and with strike N. 65° E., apparently the top of the section, and glaciated. Along the railroad track, there are sandstone at the south, just north of the brook, and hard black slate with strata marked in colors, but often flinty, resembling the slate of the Braintree trilobite quarry.

Slates also appear in this line of strike, on the road to Hough's Neck and on Slate Island, one and a half and five miles to the eastward. At Rock Island Cove on Hough's Neck, there is conglomerate varying to sandstone with large quantities of light gray and greenish eruptive rock.

(*f.*) In the South Shore district, the slates are so involved with the crystallines on the one hand as to afford many opportunities of studying their stratigraphical relations.

In Hingham, the slates which lie between the conglomerates and the crystallines on the south of this district, are probably part of the conglomerate system. The others, farther north, seem to belong to an older, or, at least, different series.

Between the second and third crystalline bands, there are slates along the Old Colony Railroad, appearing at the surface nearly the whole distance from the bay of Weymouth Fore River, west of North Weymouth Station, to, and a little beyond, Weymouth Landing. They lie parallel to the northern limit of the second band, and are nearly vertical. On White's Neck, near the bay and a few rods north of the railroad, they are of the common argillaceous variety, but along the track, they are thin and soft, smooth and slippery. They are cut by quartz veins, and near these they sometimes assume an appearance like black plates of mica. The surfaces are often bronzed. Toward Weymouth Landing, igneous outflows are so abundant that it is difficult to determine whether the rock is the intrusive with slate fragments, or slate cut by the intrusions. Just east of the station, the slates are hard and black, and have nodules of pyrites. From here westward, they are very closely locked in among the crystallines, alternating at the surface with these, or in spots among them. On the north side of Monatoquot River the crystallines occur on each side of Quincy Avenue, and westward, very near the railroad at East Braintree station. On the south side, they appear along Union Street and between it and the river. Just west of Quincy Avenue these give place to slates cut by igneous intrusions which extend to the corner, and crop out also on the east side of Quincy Avenue opposite Union Street. In these places, the slate often resembles that of the Braintree trilobite quarry.

(*g.*) Passing north from the crystallines of the second band at this place, we come at once upon those of the third, which occupy the region between Monatoquot River and Quincy. The Paradoxides quarry lies on the south shore of Hayward's Creek, where the slates are closely involved with the crystallines and eruptives. This crystalline range appears again to the eastward in North Weymouth, north of the cemetery, and there, too, are large quantities of slate, particularly on its north side, cut by eruptives and with strike varying from N. W.–S. E. to E. N. E.–W. S. W. Just across Hayward's Creek, north of the trilobite quarry, is a little slate; and quarter of a mile north, it appears again, south of Ruggles' Creek. Passing to the eastward, parallel to the northern limit of the crystallines of the second band, we find at the same distance from it as these slates (about a mile and a half), another outcrop on Eastward Neck in Weymouth between Rowe's and Great Hills; and in the extreme north-western part of Hingham, and on the north side of Hewitt's Cove, other occurrences of similar character; black, thin and contorted. Possibly, unless glaciation has been too deep, careful search westward on this line might disclose other slate outcrops among the crystallines where the ground is low south of Penn's (or Payne's) and Pine Hills, and toward Punkapog. Also about Town River, east of the railroad. Some have connected the two districts (*e*) and (*f*) in East Quincy, but I have seen no indications of the topographical correctness of this.

The slates in all these districts resemble each other closely, and are very likely parts of the same system. I have, however, distinctly marked the outlines of each district so that if they can be distinguished hereafter, they can be separated without destroying such results here reached, as still may remain true.

The slates vary in character from a compact flinty variety to distinctly laminated, or banded with different colors or textures, and not unfrequently the wave action can be traced in the varying thickness of the strata.

In all the localities they are much disturbed by intrusions of igneous rock (which is sometimes poured out over them), are faulted, hardened and distorted. It is to these intrusions that we owe their existence now in many places. The harbor slate islands and Nahant bear witness to the protection against the sea afforded by their hardening and sustaining agency. The conglomerate, if it ever existed between the outer islands, has been worn away where the channels now run.

It is probably to these slates that search for fossils in this vicinity may be most profitably directed. Their approximate [1] age is readily indicated.

The British Lower Cambrian ends with the Tremadoc, which has been synchronized with the Levis division of our Quebec Group. Beneath the Tremadoc are the Lingula Flags, and at their base are the rocks at St. David's in South Wales, the corresponding Bangor group in North Wales, and (equivalent to the lower portion of this Welch section) the Longmynd of Shropshire. Parts of the Lingula Flags are supposed to be on a level with our Calciferous and Potsdam. The Paradoxides of the slates of this vicinity shows so much of them as can be properly grouped together, to be more nearly synchronous with the Menevian and Longmynd than others of the British horizons.

It has been long supposed, and the results of recent investigations tend to confirm the belief, that the early faunas of the rocks of North America more nearly resemble the coeval ones of Scandinavia and Great Britain, than do those of continental Europe. Yet it is noticeable that in these earliest yet known, some of the Braintree specimens are more closely related to *Paradoxides spinosus* of Bohemia than to any of the Menevian species of Great Britain. It is to be hoped that a new State Geological Survey may soon give us more adequate means of studying the parallelism of our rocks with foreign ones, and the relations of their respective faunas.

The last quarter of a century has done but little in this direction. The great trilobite of Braintree, described in 1834, was first discovered in place at Hayward's Creek in 1850 or 1851, but during all the years which have since elapsed, no other locality has been made known, and but one or two species seem to have been recognized from that. This Paradoxides was a better beginning than the worm burrows and few obscure remains found in most localities, inasmuch as it represents, so far as is yet known, the highest existing type of life of that period, as well as because trilobites seem to give the safest test of the age of the strata where they occur. But while it stands almost alone to represent our rocks, the Menevian of South Wales had afforded in 1872, fifty-two distinct species belonging to twenty-two genera; of which, ten genera, including thirty-one species,

[1] It has been remarked that as contemporaneous faunas and floras of different regions differ widely, so similarity of fossils does not necessarily indicate their existence at the same period. Mr. Hicks has remarked that corresponding fossils are found higher in America than in Europe, instancing Olenus, Olenellus, and Dikellocephalus. (Quart. Journ. Geol. Soc. Lond., vol. xxvii, p. 395.)

were trilobites. A number of these have also been identified in North Wales, and some in Sweden.

Although these rocks may be regarded as of the earliest age in which life under similar conditions to the present can, as yet, be safely asserted to have existed, it seems extremely probable that whole faunas, lasting through untold ages, preceded the earliest with which we are acquainted. On this point, Mr. Hicks, who has done more than any other man to reveal the abundance of the fauna of these rocks in Wales, which were previously supposed to be barren of life, says: " The earliest known brachiopods are apparently as perfect as those which succeed them, and the trilobites are of the largest and best developed types. The fact also that trilobites had attained their maximum size at this period (Menevian), and that forms were present representative of almost every stage in development, from the little Agnostus with two rings to the thorax, and Microdiscus with four, to Erinnys with twenty-four, and blind trilobites along with those having the largest eyes, leads to the conclusion that, for these several stages to have taken place, numerous previous faunas must have had an existence, and, moreover, that even at this time in the history of the globe, an enormous period had already elapsed since life first dawned upon it." (Quart. Journ. Geol. Soc. Lond., xxviii, p. 174.)

I remember to have heard our lamented Agassiz lay down the encouraging principle that where a single fossil has been found, an abundant fauna may be expected. And there seems every reason to believe that the rule will hold good in this vicinity, for metamorphic influences have not so altered these slates as to obliterate their fossil contents, however much these may often be obscured.

In all probability these fossils will be discovered in many other localities than at the single quarry at Braintree, when the similar strata elsewhere are subjected to the same scrutiny. Indeed, it was stated when this locality was first made known, that fragments of similar trilobites had been found in erratics on George's Island, in Boston Harbor.[1] We have seen that this island rests on a slate foundation, and a few miles northward across the harbor (beneath which similar slates probably lie) we come upon outcrops of belt (*a*) above described.

The often quoted lingula in a slate pebble in conglomerate at Taunton, again, indicates the existence, at some time, of early fossiliferous slates at no great distance.

[1] Proceedings Boston Soc. Nat. Hist. (1851), Vol. VI, p. 42.

In slate (*e*) of this vicinity, there are many obscure intimations of living organisms sufficient to encourage careful and prolonged search.

There is a small peculiarity, which, occurring in the slates of several localities, may be valuable as indicating a connection between them. I have seen it in the slate in place at Elm St., Somerville, and Adams St., Quincy, and in slate pebbles in a conglomerate-erratic in Randolph, and most abundantly of all in pebbles in a glaciated ledge of pudding-stone in place north of Union Square in Brighton, where, I believe, it was first noticed by Dr. Wyman of Cambridge. My attention was called to it there by my friend, Mr. Morrill Wyman, Jr. It consists in a somewhat indistinct marking of dots and lines on the surfaces, which seems to be produced by the transverse and longitudinal sections of some small object imbedded in the slate. The largest are about three-eighths of an inch long and of a diameter about one-fifth or one-sixth of this length. They are cylindrical and hollow as is shown by the annular transverse and oblique section; and tapering, as appears when they lie flat on the surface, in which case it often happens that they are polished down by glaciation so far as to show a longitudinal depression midway of the width. Occasionally a convex end appears, projecting too slightly to have been worn off. This condition is very deceptively imitated by a projecting grain of sand; and indeed, fine as is the texture of the slate, the markings are all so obscure that it is only after examining a large number with and without a lens, that one feels assured that they may not all be referred to crystallizations or other small accidental irregularities of the rock.

B. Conglomerates.

In this vicinity, as at Newbury and at Newport, the conglomerates are largely developed. It is not easy to mark their exact extent in this vicinity. Boulders occur both to the north and west of any places where I have seen the rock in place. Thus, I have found them in Malden and in Somerville, and it is said they have been thrown up on Nahant east beaches.[1] Then, too, they are abundant about Wellesley in Needham. As already intimated, there may very well be detached localities among the crystallines not exposed to view but from which these erratics were derived; or such deposits once existing may have been entirely worn away by the same glacial action which detached the boulders.

[1] W. Prescott: — Essex Co. Soc. Nat. Hist., 1852, p. 79-91.

While these conglomerates often show no marks of stratification, elsewhere they pass into sandstones and slates. And these latter so much resemble, at times, the slates already described, as to make great uncertainty as to whether they are really different formations. Thus, in Newton, it cannot be determined always whether the frequent slate outcrops are of the Cambridge variety, or connected with the conglomerates. Some of them certainly pass into the conglomerates, while others, though very similar in position and character, seem to belong to the other group.

The passage of conglomerates and slates into each other at Chestnut Hill Reservoir has been described by Prof. Shaler.[1] The slates are sometimes very thin, and often curved. A locality about a mile west, on the north side of Beacon Street, was exposed in the spring of 1874 by the work of tunnelling the rock to make the connection of the reservoir with Sudbury River. Here, conglomerate at the bottom passes to slate in a section well exhibited by a high wall of rock close to the road.

The rippled slates or sandstones in Brighton, south of Cambridge Street, west of Warren, and between Warren and Allston Streets, of course show formation in shallow water.

South of a line from the southern corner of Newton across Brook Farm, south of Weld Street, across Forest Hills Cemetery, and turning more to the northward at Dorchester line, yet including Savin Hill, the conglomerate disappears, giving place to the slate (*b*) above noticed. On this line, there is a passage of conglomerate to slate and sandstone, at the west side of Morton Street, north of Canterbury Street in West Roxbury, where the rock has been quarried, and still forms a high wall showing a high dip southward. A little south, there is a passage of conglomerate to slate, probably a part of the same series. Again at the southern corner of Washington Street and the New York and New England Railroad in Dorchester, the passage can be detected in the unbroken ledges. Erratics of the brown sandstone to which the larger conglomerate gives place, may be seen on Commercial Point.

Although there is perhaps nothing in the apparent lack of stratification in a large portion of the conglomerates inconsistent with their accumulation at a beach, (this being a common occurrence with accumulations of coarse pebbles), this feature accords better with the requirements of the theory of their glacial origin. I need hardly

[1] Proc. Bost. Soc. Nat. Hist. (1869), Vol. XIII, p. 176.

repeat here the familiar suggestion that similar conglomerates would probably be the result of compacting and hardening influences acting on the unstratified masses of pebbly gravel so abundant in this vicinity. Such conglomerates would also, of course, exhibit occasional passages to sandstone and slate.

The materials of the conglomerates may, to a great extent, be traced to the older rocks still preserved in the neighborhood. The form and appearance of many of the pebbles tend strongly to confirm the theory that these early rocks had a glacial origin as well as the recent gravels produced by the later ice action of the commonly so-called "glacial period." I have already mentioned the occurrence in the conglomerate of the more common kind, of pebbles of older slate. The conglomerates associated with some of the slates of this vicinity, too, are apparently of different character from, and are in some cases, probably, the origin of certain pebbles found in the more abundant variety. The vagueness of this latter expression must not be taken to imply the identity of all the conglomerates I have brought together in this section. The grouping of the conglomerates of these various localities in one system, while probable as an inference, is not sure, owing to the absence of fossils and the insufficiency of lithological character as a test.

The most probable localities for the determination of the relative ages of the conglomerates and slates at those places are, the eastern shore of Squantum; in Newton and Brighton (along the Boston and Albany Railroad) near Charles River; Newton, on Murray Street, north of Otis; between Auburndale and West Newton; at the corner of Waverly Avenue and Cotton Street; the river bank north of Newton Upper Falls on the Newton side, where the slate and conglomerate are exposed near each other. In Weymouth and Hingham, the eruptives, conglomerate and slate seem to be so related that the conglomerate must be more recent than the slate. The conglomerate has a low dip, while the slates are nearly vertical, and both are cut by the intrusive outflows. The most satisfactory proof on this point would be to find a slate ledge striated by early glacial action under a mass of overlying conglomerate.

Regarded as a whole, the conglomerates of this northern area, north of slate (*b*), and their associated slates, dip northerly from nearly horizontal to 45° or more, with a strike of about E. N. E.— W. S. W. The principal system of joints seems to be in N. N. E.—

S. S. W. direction, corresponding to the course of the streams which drain this area and empty on the north into Charles River.

In Newton, the conglomerate extends but little north of the Boston and Albany Railroad. Near Newton Corner, on Tremont Street between Park and Moore Streets, there is a quarry of schistose conglomerate with pebbles of green slate, and varying to a hard, sandy variety. The mass of the rock here is smooth and has the slippery feeling of steatite. The peculiar composition of the crystallines repeats itself noticeably in many instances in these rocks derived from them. In West Roxbury, I have found serpentine aggregated on the pebbles of loose conglomerate. Small particles of magnetic iron are frequently disseminated through the sandstones.

The prevalence of pebbles of reddish felspathic crystallines in the conglomerates between Grove Hill Cemetery, Newton, and Allston Street, Brighton, is rather noticeable.

If the marking in the slate pebbles found in conglomerate north of Beacon and west of Cambridge Streets, in Brighton (as well as in a boulder in Canton), can be taken as significant of the identity of these slates with those in place at Somerville and Quincy, which have similar markings, this gives a valuable test of the relative ages of the two rocks.

The most westerly exposure of conglomerate I have seen is in Needham, about three-quarters of a mile east-north-east of Wellesley Station, where at the north-western end of a long hill, there is an outcrop of the rock, apparently in place there. It is abundant between Rosemary Brook and Charles River, and just south of the bridge at Newton Upper Falls it forms a gorge through which the river runs. Half way from Rosemary Brook to the river and about three-quarters of a mile south of the road from Newton Upper Falls to Grantville, the strike is N. E. or N. N. E, and the dip northwestward. A pebble of ash colored schist in the rock here resembled the laminated felsites near Hyde Park. Next, south of this is a great ledge with large round quartzite pebbles such as may be found *in situ* at Natick. The cement is chloritic and scanty.

The ridges of conglomerate following the line of strike from this place across Newton, Brookline and Roxbury, are particularly high and the outcrops unusually extensive. At the quarry just north of the Roxbury Station of the Boston and Providence Railroad the conglomerate had layers of red sandstone. The ledge has been nearly blasted away in the last year or two for a space covering whole squares.

North-east of a line from here to Savin Hill, the conglomerate disappears. It probably underlies South Boston, however, and there was, in fact, a quarry of "slate" near "Nook's Hill" in the western part of the peninsula, while this was still a pasture two centuries ago. The land has been so raised from its former low level at the place, that I have not found any traces of outcrop there, and ascertained the fact from other sources. The "road to the Nuke" ran from Dorchester Street at Seventh Street, northerly to the corner of Fourth and E Streets, then north-westerly, and west of this angle was "quarry meadow." There is a sunken ledge off the north side of South Boston.

South of the crystallines of Newton and Brookline, the conglomerates are very extensive and prominently placed. The picturesque country produced by such rocks has been well treated in laying out private grounds in the northern part of West Roxbury, and the most magnificent opportunities still remain in that town and in Brookline.

In the vicinity of the southern part of Newton the conglomerate is not so hard and compact as, for instance, in the Washington Street quarries in Roxbury. It crumbles easily, owing partly to the rusting out of numerous grains of magnetic iron.

The high conglomerate masses between slate band (*b*) and the Neponset River, seem to continue the line of uplift of the Dedham range of crystallines. Across the river there are extensive conglomerates in Milton, and westward in Hyde Park and West Roxbury, which probably belong wholly or in part to this group.

The chief peculiarity of the South Shore conglomerates is the close relation in which they are involved with the crystallines or eruptives in Hingham, Cohasset and Nantasket. They seem to be interlocked in incomprehensible confusion on Planter's Hill, and eastward to the sea. The strike is preserved, however, as appears in the islands in Hingham Harbor and continuing ledges at Downer's Landing. The pudding-stone approaches the slate at Hewitt's Cove, and excavations may show their relations at that place.

The probability is very strong that most of the conglomerates of this vicinity are more recent than most of the slates. And in view of the facts that there are Carboniferous strata in New Brunswick adjoining Paradoxides slates, and that at Newport the Carboniferous conglomerates, which occupy apparently the same position as our conglomerates, resemble them almost precisely in general character, it is a most natural inference that the conglomerates of this vicinity are also of the Carboniferous age.

Norfolk County Basin.

This band of stratified rocks is of varying width, and extends between the areas of crystallines from near the south shore district at Weymouth, through Braintree, Randolph, Canton, Norwood, Walpole, and thence southwestward. Beyond this point I have not yet traced it.

The strata of this group are in some respects different from any existing elsewhere in this vicinity, so far as I know. The narrow area which they occupy has been so protected from the transverse glacial action by the high crystalline hills to the north and west, that the peculiar red schists and sandstones of Randolph and the adjoining towns, may occur here alone, simply because here only have the conditions been favorable for their preservation. It is from their distinctive character that Punkapog pond and river derived their Indian name, which is said to signify stream flowing out of red earth. Other conglomerates in Canton and Walpole are somewhat similar to those so well known in Roxbury and vicinity.

The valley of Monatoquot River in Braintree is part of a glaciated valley south-east of Pine Hill, and the crystallines are hidden beneath the surface. Westward, where they appear, for example, at Franklin Street, this basin between them is narrow; at the Old Colony Railroad about a quarter of a mile, at Great Pond from one half to three quarters. At the northern end of Great Pond, there are clear, bright colored sandstones and conglomerates on both sides of the road as far north as the brook. The pudding-stone has pebbles of slate; and in western Randolph, south-east of Punkapog Pond, an erratic has pebbles with the dot-and-line marking above described. This ledge is continued south-westerly on the north side of Punkapog.

Along the E. N. E.—W. S. W. road south of Punkapog Pond, (Farm St. in Canton, Canton St. in Randolph) for a mile each way from the boundary of the two towns, the outcrops are mostly of fine red sandstone, sometimes of gray conglomerate and sandstone with transparent quartz grains, very hard where it approaches the crystallines a mile southwest of Great Pond.

At Punkapog Village, south of Punkapog River, there is some large conglomerate on each side of Washington Street very like that north of the Blue Hills in towns near Boston. About two miles west-south-west, there is a very interesting section exposed by a cutting of the Boston and Providence Railroad. This, in fact, affords almost the only opportunity of getting more than the most superficial acquaintance with the strata of this region. The track passes through a hill capped with much gravel which rests on a ridge of various strata dipping 45° N. and with a strike of about E. N. E. Their order from the top southward is,

Schists,	5 feet thick.		Sandstone,	7 feet thick.	
Quartz,	3 "	"	Schist,	25½ "	"
Red schist,	49 "	"	Sandstone,	14 "	"
Quartz vein,	2 "	"	Schist,	11 "	"
Limestone,	2 "	"	Sandstone,	64 "	"
Schist,	7½ "	"			
			Total,	190 feet.	

The sandstone is very crystalline in appearance. The schists are invariably red and ferruginous. The quartz veins have a southerly dip and are massive and milky, sometimes varying to transparent green, and again reddish. The limestone is white, but becomes impure when it merges into the schists with which it is interstratified. It is somewhat contorted, although the other strata show no such appearance. The philosophy of the association of these strata seems to be that by the decomposition of felspar (which consists of silica and alumina with lime or soda and often ferrous oxyd), and hornblende (which is composed of silica, magnesia and lime or ferrous oxyd), and other minerals, the materials are accumulated in whose quiet sedimentation, the mechanical deposition of the less finely divided gravels and sands alternates with that of iron particles and the precipitation of lime.

Passing farther in the same direction, there is an island of conglomerates in the Neponset meadows on the west side of the river, with a dip 45° N.; other outcrops a mile farther on, east of the river; and across it, along its southern bank until it is again reached higher up, on the western side of the loop it here makes around the last named ledges. Across the river again, south-west of the last, a little farther than it from the crystallines to the north, the conglomerates appear again on both sides of Centre Street, the straight road to South Walpole, extending south-westerly as a ridge of red sandstone with high dip, along the north side of the river toward Plymptonville. On the east side of the river, on the north side of Water Street, under the bridge, there is some very hard reddish sandstone dipping south-east, and with it much intrusive quartz. On the same side of the street, on the shore of the pond, there are ledges of pudding-stone.

A mile south-east of the south-east corner of Medfield, I noticed boulders of conglomerate in walls on the north side of Powder House Hill, in Walpole. A mile south-east of the hill there is a quarry of red and white grits or flagstones dipping W. N. W. Half a mile south-east of this quarry, on an island in the swamp, over which the road passes, are considerable outcrops of large conglomerate apparently dipping north-westward.

A specimen of "graywacke" from Wrentham in the rock collection of the Harvard College Mineralogical Cabinet, resembles the coarse gray variety of sandstone in Canton.

In Canton, on the Boston and Providence Railroad, there is another cutting through rocks of different character, about a mile south of the one described. The strike is N. 60° to 65° E., and the dip 70° N. The joint-cleavages are N. N. E. dipping E. S. E. The strata are conglomerate, sandstone and schists. The latter are light gray and of obscure stratification. They contain dark, cylindrical forms which appear to be branching stems of some kind. Prof. Hitchcock describes a cylindrical stem, perhaps fucoidal, found in hard dark slate in Attleboro at the southern end of this basin, (No. 400, State Geological Survey Collections).

Eruptives.

It has been very common to resort to imaginary escapes of fluid matter from a vague molten interior of the earth, to account for the existence of intrusive masses of crystalline rocks penetrating and overlying those clearly stratified. The origin of such intrusions, formed at so late a period in the history of the earth as were the igneous outflows among and upon the stratified rocks in this neighborhood, must be sought in a more superficial region than is generally understood by this non-committal interior.

Judging from indications constant in regions of metamorphic rocks, and most marked where metamorphism is most complete, molecular rearrangement and crystallization of sediments, the patent facts of metamorphism, however produced, must presumably have been attended with more or less pressure, heat, expansion and softening, directly produced by great depth of subsidence or other causes, and assisted by the operation of these forces to increase each other. The effect of pressure would, of course, be a tendency to escape in the direction of least pressure, and fusion would be assisted by the presence of alkalies. Furthermore, as some of the mineral constituents of the mass acted upon would be more affected than others, the resulting outflows forced to the surface would have different composition from the less affected portions. Assuming heat as the softening cause, as hornblende is more fusible than felspar, the more truly igneous rocks would, of course, *a priori*, be in great part hornblendic.

As a matter of fact, so close is the resemblance in chemical composition, appearance and minerals developed in them, of the eruptives among the slates and conglomerates, to the more fusible portions of the crystallines, that it seems almost unreasonable to doubt that the former were derived from among deep lying masses of the latter. For the same reason, it is far from easy at the borders of the included areas, to tell to which series such rocks belong, especially as they are particularly abundant where the crystallines and stratified rocks meet. In Weymouth, for instance, wherever the slates are covered, and crystalline rock appears alone above the gravel, accurate discrimination is almost impossible.

The eruptives seem to follow one of two principal directions; E. N. E. — W. S. W. or N. W. — S. E.; as one or the other of the chief axes of elevation has disturbed the rocks through whose cracks they have been protruded.

They vary somewhat in character. At Nahant and elsewhere, there is a very coarse crystalline hornblendic rock, which is often very micaceous. Another variety more common than the last is crystalline granular. A mass of this at the corner of Elm and Morrison Streets, Somerville, is strongly magnetic. Not infrequently the joints of this kind of rock show glassy surfaces lined in one direction. A coarsely crystalline dolerite occurs in place on a hill between Newton Corner and Charles River, near the road to Watertown. Specimens of this taken from a boulder at the western end of Kendrick Street give a specific gravity of 2.97. The eruptive masses near the corner of Milk and School Streets, Somerville, are very varied, ranging from felspathic rock to hornblendic rock, often very micaceous, sometimes granitic by the absence of hornblende.

The felspar is white, flesh-colored, red or gray; often well crystallized. One specimen has crystals in which one face shows a white layer between two parallel red layers. This ledge and similar ones in Medford, and under the old powder-house on Winter Hill in Somerville, decompose readily, giving the familiar appearance, when the gravel is cleared away, of rounded masses piled upon one another. Where the intrusives cut the slate, pyrites is often developed in the latter near the dykes.

A kind of diorite very common in Newton, is fine grained, grayish or greenish, and has a specific gravity of 2.77, containing therefore a large proportion of felspar; hornblende being about 3.3 and felspar 2.4 or 2.5. This and a cryptocrystalline variety which is grayish inclining to purple, are frequently amygdaloidal.

These amygdaloids, though common throughout the vicinity, are particularly abundant in the two large isolated masses of hornblendic rocks, one occupying a district on both sides of the horse car line of Brighton, extending about two miles east and west; the other between Otis, Murray, Homer, Fuller, Maple and Auburn Streets, in Newton. The direction of the long, narrow, and nearly continuous area which they occupy here would seem, at a casual observation, to put them in the same category with the parallel ranges of crystallines; but the position of the stratified rocks about them, and their own disposition, distinguish them from the very similar rocks, for instance, two miles south in Newton and Brookline, referred to above on page 375. Whether these rocks as a whole are of the crystalline stratified class, or whether they have undergone such change as to entitle them more appropriately to a different name, this is certain, that some of them are found cutting the slate and conglomerate, and poured out over them, and that near the contact the slate is greatly hardened.

There is a kind of concretionary arrangement of curved bands and wavy layers in the mass, sometimes seen, which shows best when the rock has been fractured in a smooth plane. Such "ribboned lavas" may be seen at the south-east corner of Beacon and Harvard Streets in Brighton.

The nodules of these amygdaloids, which are usually small, rarely as large as a bean, contain, as usual, quartz, calcite, anhydrite and chlorite. These, with epidote, prehnite, the zeolites, apatite, copper and iron pyrites, are the most common crystalline minerals of the eruptive series. Intrusions of quartz, as well as the quartz veins common among and apparently derived from the amygdaloids and slates, sometimes hold small quantities of specular oxyd of iron and usually contain calcite and anhydrite. Galena occurs occasionally. The body of the amygdaloids, as well as the nodules and veins, sometimes contains small quantities of red oxyd of copper and malachite, very likely the result of the decomposition of copper pyrites.

Glacial Effects.

Between the formation of the solid rocks described, and of the loose soils which rest upon these and are for the most part derived from them, is a long interval. There are some interesting points to be noticed in the action upon the peculiarly situated rocks of this vicinity of the great ice-sheet, now generally believed to have covered the northern part of this continent in geologically recent times.

In the great natural glacis of crystallines which surrounds the Boston basin there is a large gap now occupied by the line of ponds in Woburn, Winchester and Arlington. This valley across the ridges of the rock was probably formed, to a considerable extent, by glaciation, the rock being at that point less durable; for where great eruptive masses occur, they still stand prominent as hills in the midst of the depression. The course of the ice seems to have been considerably guided by the conformation of the surface over which it passed. Here the direction is several degrees to the east of south. In Billerica, some deep furrows on granite and mica schist indicate about S. 25° E.; in Woburn, S. 20° E., about the course of the chain of ponds in that valley.

In the basin of stratified rocks, the ice, following this course of about S. S. E., generally strikes the upturned strata almost at right angles to their strike. In Somerville, the slates lying N. W. – S. E. are polished on their stratification planes in some cases where the ice masses slid over the sloping sides of hills running in the direction of their course, as at the Alms House Quarry, Cambridge. In all cases the erosion has been great. Often the basset edges of hard slate strata are planed off as level as a floor. A good illustration of this action on a horizontal plane is at the quarry near Newton Corner, lying partly in Watertown, in "Morse's field."

But irresistible as the power at work seems to have been when it met with equal opposition at all points, its plasticity is even a more noticeable feature. Thus, while the average of fifty-three observations of localities (including nearly, if not quite, every town from Somerville to Medfield and Hingham) is a small fraction inside of 35° E. of S., local causes have produced occasional striæ, whose direction varies to S. 55°, 60°, and even 65° E.

These, however, mark only the direction of some single pebble moving on a surface, and the deviation might be caused by internal movements of the ice itself, expanding or contracting. Where the moving ice was forced against a rock too firm to be either pushed aside or crumbled, and there was easier passage elsewhere, it adapted itself to the shape of the obstacle. Accordingly we find polished and striated surfaces not only on vertical rock walls, but even under underhanging ledges. An instance of the first may be seen in the high face of rock a few rods east of the Clarendon Hills Station of the Boston and Providence Railroad, in the northern part of Hyde Park, while a good example of an overhanging wall is the slate ledge which crops out from under pudding-stone on Murray Street, Newton, corner of Highland Avenue.

Such obstacles were presented by the numerous outflows of igneous rock which, in fact, were almost the only buttresses sufficient to resist the pressure of the ice stream, dividing it instead of being forced from their place and carried along, as were the sienites, pudding-stones and slates. And to these intrusive hornblendic masses may be referred the existence, particularly in Newton and Brighton, of numerous ridges of conglomerate which lie parallel to the course of the glacial stream, and transverse to the original ridges of elevation of that rock. The crag and tail formation so common about Edinburgh is, in short, exhibited here, with solid conglomerates in place of the gravels; fit reminders of the solid stream from which they were protected. More or less perfect examples of this may be seen under the lee of most of the larger intrusive masses. From the large ones near Allston Station in Brighton, to Savin Hill, the slope of the conglomerate highlands to the low ground of Charles River marshes, Boston Neck and South Bay, forms a line which can be marked very correctly by a rule upon a map. The smaller cradles on land between neighboring eruptives afford by analogy a fair presumption that the larger hollow to the north-east of that line protracted, now filled with water, was also produced by the absence of such protection in that region.

In regard to the gradual pulverization of the rock fragments torn from their original ledges, it still remains an interesting inquiry how far boulders were carried entire from their original position. At any given point, the soils seem to consist, for the most part, of comminuted fragments of the underlying solid rocks. But large masses are frequently found at considerable distances from their source. In this vicinity the glacial stream ran across the parallel bands of rock; so that, although boulders can be traced but a short distance, they can be referred with certainty to their origin. Thus a boulder of gneiss on the beach at Weymouth clearly came from the neighborhood of Billerica or Bedford, twenty to twenty-five miles away, the nearest point where similar rocks occur in place. Another precisely similar in Cambridge has travelled half that distance. Again, in Newton, two boulders of gneiss, one dark and micaceous, the other brown, granular and granitic, resemble no rock nearer than Concord, where (and farther west) such may be found. The light red porphyry of Essex County may be found on Nahant abundantly, and occasionally also on the beaches of the harbor islands. It is curious to notice that pebbles of the crystallines are as characteristic of the conglomerate in Brighton and Newton, as slate fragments from Somerville are of the Cambridge drift.

The Committee appointed to prepare a Memorial urging upon the Legislature of Massachusetts the importance of the proposed new Survey of the State presented their report, which was accepted, adopted, and ordered to be respectfully submitted to the Legislature, as follows: —

To the Honorable the General Court of Massachusetts:

The Boston Society of Natural History, feeling the great importance of such a survey of the State as has been urged upon the attention of your honorable body by the memorial of the American Academy, respectfully represents, that in its view the time has fully come when the interests of the people of the State, material and otherwise, call for a new and thorough survey, topograpical, geological and biological; one that shall be of the most comprehensive character, meeting alike the requirements of such as seek directly the development of material wealth, through better knowledge of the mineral resources, of the water-sheds, of the areas and capacities of ponds and rivers to supply water for economical purposes, etc., etc., and of such as have at heart more particularly the advance of science and higher culture, which such a survey will surely foster among our people. In urging strongly the re-survey of our territory, the Boston Society of Natural History is not unmindful of what was done, and for the time well done, through the action of the State, in authorizing the first survey, forty years since. On the contrary, it recalls with patriotic pride, the fact that that survey was the first made by any State, and that it inaugurated like scientific work over our country, to the inestimable advantage of the whole people; and it recalls too, with just pride, the fact that a very large portion of the work was done by its own members.

Some of the reports of the first survey were so thorough, and have since received so much revision by their accomplished authors, that but little additional field-work will be necessary in again treating upon the subjects of them. This may, for instance, be well said of the Report on the Trees and Shrubs of Massachusetts, now soon to be re-published; nor will much field-work be necessary in some other departments of scientific research, so much having been already accomplished by the labors of distinguished naturalists. Nevertheless, all the results of such labors should be embraced in a final report of the state survey. In other departments only the continued labor of competent observers in the field for many years can accomplish the results desired, and this can only be done through state action. Such is that of the geology of our territory, embracing the knowledge of our mineral deposits.

The importance of a new geological survey is, perhaps, better recognized than that of any other, as so much concerning our rock formations and their mineral contents remains unknown; and yet no work of the former survey was more thoroughly and conscientiously performed than that of Prof. Hitchcock. Perhaps nothing better illustrates the great progress that has been made in knowledge concerning the strata of the earth than the fact of the absolute need of new investigation in order to fully comprehend those of our State after his faithful work forty years ago. His views at the time were singularly comprehensive, and betokened not only great knowledge of what had been done abroad, in the field and in the study, but an accuracy of observation and a power of analysis and comparison which made him peculiarly adapted for the work he was called upon to do. Yet the great progress in science since, notwithstanding the importance of the facts given by him and of his generalizations, make his report comparatively antiquated. No one would more readily appreciate the importance of a re-survey than would Dr. Hitchcock if he were still living.

The complicated character of our rocky strata renders it necessary that not only should much time be given in the field to the elucidation of the structure, but that this work should be in the hands of the most able of the distinguished geologists whose services can be secured,— those whose experience in the field, both within and without our borders, and whose thorough practical acquaintance with rocks and minerals shall have fitted them peculiarly for the work. Perhaps there is no portion of our country where the rock-formations require more accurate study than in Massachusetts in order to their full understanding, and it is by no means certain that such thorough examination as is suggested, may not reveal mineral wealth that will a hundred fold repay the pecuniary cost of the work to the State, leaving out of question all other considerations.

Sooner or later, it may safely be predicted, coal, in not inconsiderable quantities, will be economically mined within our State, adjoining the Rhode Island boundary, and it may depend upon the result of a new survey whether the present or a remote generation shall have the advantage of the deposits known at least to occupy some considerable extent of territory.

The remarkable discovery, too, of lead ore, bearing silver in considerable quantity, in Newbury, lately made, suggests forcibly the wisdom of a more accurate study of our rocks than can be made otherwise than by thoroughly scientific and long continued work, only to be accomplished through your action.

Of great importance, too, does the Society deem the proposed biological survey, as every passing year demonstrates more and more the necessity of as full a knowledge as can be gained of all the life within our territory, whether subservient or injurious to the welfare of man. But as the memorial of the Essex Institute, presented with this, dwells fully upon this branch of inquiry, it is not thought advisable for this Society to more than express full concurrence in the views so ably presented by that body. This Society will, however, express strongly the feeling held by it, that any survey undertaken by the State should be as thorough and complete in every respect as can be made in the present state of science; and it would deprecate any partial action as one not justified by enlarged views of the requirements of the period, or based on true economy.

Section of Microscopy. February 10, 1875.

Mr. R. C. Greenleaf in the chair. Six members present.

Mr. Charles Stodder read a letter from Mr. J. Sullivant to Prof. Christopher Johnston respecting the discovery of the Bermuda Tripoli in Maryland. The letter, dated June 18, 1874, is as follows: —

After so many years, and not having preserved any of my correspondence on the subject, I cannot be positive as to the dates, but my recollections are as follows: —

Sometime about 1859, having procured a good microscope, I became interested in the study of Diatoms and infusorial earths, and for specimens of the latter my brother William and myself were indebted to Prof. Bailey, of West Point. Among the specimens received was a small quantity labelled, "Bermuda Tripoli." I received also, about this time, from a friend, a quantity of what he termed "Richmond marl," from the vicinity of Richmond, Va., but which I found on examination to be infusorial earth. From a study of these specimens, I was struck with their similarity in several particulars and so wrote you after we entered into correspondence. Soon afterward you wrote me a friend had informed you that in the vicinity of *Bermuda Hundreds* there was a fine white earth used for scouring tin and silver vessels, and believing it was infusorial earth, you proposed visiting the locality, for it suggested the possibility of this being the true locality of the famous Bermuda Tripoli. I urged the visit. Very soon afterward you informed me you had made the visit, but without success; but gave me an account of your discovery of the Nottingham earth, and forwarded specimens, together with others from Marlborough and Piscataway, etc.

From the facts communicated in your letters, I expressed several times to my brother the belief that *Bermuda Hundreds*, and not the island of Bermuda, would be found to be the locality of the Bermuda Tripoli, and had strong hopes that the locality of Bailey's specimen would still be found there. I divided the Nottingham earth and the other specimens with my brother, and after an examination of the contained organisms we had no doubt that the Nottingham earth, if not the true original of the famous Tripoli of Bailey, was, at least, its true equivalent. At this time my brother, Wm. S. Sullivant, was in correspondence with Dr. Arnott and Mr. Norman of Hull, England, and I know he sent a portion of the specimens you furnished to England, and have every reason to believe he then communicated the idea of the re-discovery of the Bermuda Tripoli by yourself.

I have little doubt that the specimens sent by my brother were the first sent to England and thus brought to the notice of the microscopists there. My impression is that he sent also at the same time to Smith and Beck.

I never was in correspondence with Arnott or Norman, but my brother was. It is probable, then, that your quotation about them was in one of his letters, not mine, although I had access to their correspondence, as my brother had to mine, and if the quotation was in one of my letters it must have been taken from his (their) letters. I do not recollect what I did write as to this quotation, but if contained in one of my letters it must have been as above. If you have the letters that will decide. At any rate my strong impression is that we never heard any suggestion as to Bermuda Hundreds, and the rediscovery of the Tripoli, until it was made on this side of the ocean.

February 17, 1875.

The President, Mr. T. T. Bouvé, in the chair. Thirty-eight persons present.

Dr. S. Kneeland gave an account of the Geysers of Iceland.

Mr. Samuel H. Scudder described the structure and transformations of *Eumæus Atala*, which, with a paper presented by Dr. A. S. Packard on Gynandromorphic Lepidoptera, will be published in the Memoirs, forming No. 2 of Part 4, Vol. II, the two papers together being illustrated by a plate.

Dr. C. F. Winslow read a paper entitled "Physics and Biology discussed in regard to their mutual relations."

Mr. T. T. Bouvé called the attention of the meeting to an analysis of a very rare and interesting mineral, the Samarskite, made by Miss Ellen H. Swallow of the Institute of Technology. He stated that this species was first found thirty or forty years since, near Miask in the Ural Mountains, where it occurred in very small quantity. The largest pieces obtained were only of the size of hazel nuts, and until recently no other locality of this mineral was known. Analyses of the Miask mineral have been made by a number of chemists, all of whom agreed in its being a columbate of uranium, iron and yttrium, whilst some of them found in it, also, notable quantities of the rare earths zirconia and thoria. Some ten or twelve years ago a small piece of a mineral, which turned out to be of the same species, was found in the loose soil in North Carolina and was analyzed by Dr. Hunt, the result being given in the American Journal of Science.

Last year Col. Joseph Willcox of Philadelphia, discovered a locality of Samarskite in Mitchell Co., North Carolina occurring in a pocket of small size, but from which he was able to procure a number of good specimens, two of which I procured from him, one for my own cabinet and one for that of the Society. He also presented me with a very pure piece for analysis, if I should wish to have one made in Boston. This I placed in the hands of Miss Swallow, who appears to have done herself great credit by the thoroughness with which she performed the analysis, and by the full account given of her method.

Analysis of Samarskite from a new Locality. By Ellen H. Swallow.

The sample on which all the the tests were made was a perfectly compact, homogeneous piece handed to me by Mr. Bouvé. It weighed nearly seven grammes. Color black. Streak dark reddish-brown.

Lustre vitreous like obsidian. Fracture conchoidal. G. 5.755. H. 5.5. The characters as determined by the blowpipe corresponded to those given under Samarskite in Dana's Mineralogy.

Two portions were treated according to the method described by Hermann in the Journal für Prakt. Chemie, 107 Band (1869), p. 139, which was the latest available research on this mineral. This treatment was undertaken in order to ascertain whether tungsten, titanium, thorium and zirconium were present.

No test was obtained for thorium, and the precipitates which might contain the other elements gave only the reactions for columbic acid, which probably escaped precipitation on account of the degree of concentration of the first solution. These precipitates amounted to only one or two tenths per cent.

One portion was also treated according to the method given by Dr. Hunt in the American Journal of Science and Arts, Vol. 14 (1851), p. 341, in the account of the only analysis of American Samarskite. The mineral was decomposed by sulphuric acid, the columbic acid separated by filtration, all the remaining constituents precipitated by ammonia, and the precipitate so obtained treated with carbonate of ammonia, to dissolve the uranium. The insoluble portion was dissolved in chlorhydric acid and the cerium and yttrium precipitated by oxalic acid. But this specimen of Samarskite from Mitchell Co. was decomposed by sulphuric acid with great difficulty; moreover, as Dr. Hunt says, yttrium and cerium, especially yttrium (see Graham-Otto's Chemie, Band II, page 912), are soluble in excess of carbonate of ammonia (although an insoluble double salt soon forms), and the oxalates are readily soluble in chlorhydric acid and the addition of oxalic acid increases the acidity of the solution; therefore it was deemed best to decompose the mineral by fusion with bisulphate of potash, and to precipitate the cerium and yttrium by oxalate of ammonia before separating the uranium by carbonate of ammonia.

The analysis given was made on 0.9091 gramme of the powdered mineral which lost nothing on drying at 100°. Another portion weighing 1.07365 grammes gave results which confirm those given below. The analysis by Dr. Hunt and the analysis of a specimen of the same specific gravity from Miask by Hermann are given for comparison.

		Mitchell Co., N. Carolina, 1875.	*Rutherford Co., N. Carolina, Dr. Hunt, 1852.*	*Miask, Urals, Hermann, 1869.*
The metallic acids of the Tantalic Group		54.96	54.81	56.36
Oxide of Tin	SnO_2	.16		
Oxide of Uranium	UO	9.91	UO_3 17.03	16.63
Oxide of Iron	FeO	14.02	14.07	8.87
Oxide of Manganese	MnO	.91		1.20
Oxide of Cerium (La, Di)	CeO	5.17	3.95	2.85
Yttria	YO	12.84	11.11	13.29
Magnesia	MgO	.52		.50
Insoluble residue from the oxalate of Cerium		1.25		
Loss on ignition		.66 [1]	.24	.33
		100.40	101.21	100.03

The quantity at hand was too small to warrant an attempt at separating the metallic acids of the tantalic group. It is to be hoped that enough may be found to enable some one this side the Atlantic to undertake the investigation. Hermann yet maintains the existence of Ilmenium in Samarskite, Aeschynite and the Columbite from Haddam, Conn. (See Journal für Prakt. Chemie. 1870).

The final analysis was made by the method detailed below, which is essentially that of Hermann, with the omission of the tests which gave negative results in the preliminary examination and with addition of such precautions and modifications as could be gathered from the methods of separation given under the different elements in Graham-Otto's Chemie, and Rose's Analyse Quantitative, and the experience of the preceding tests. The weighed portion was fused with an excess of bisulphate of potash, treated with 400 c.c. distilled water and allowed to remain forty-eight hours, as the fused mass is very slowly decomposed. The solution (and residue) was then heated to about 90° C. and after half an hour the columbic acid was allowed to settle out and was filtered off and well washed with warm water. It was treated on the filter with warm sulphide of ammonium to dissolve the tin. The solution so obtained was evaporated and ignited in a platinum crucible, again ignited with chloride of ammonium and the tin calculated from the loss.

The columbic acid was slightly blackened by the sulphide of ammonium and was consequently digested with very dilute chlor-

[1] Determined on another sample.

hydric acid, filtered, and the filtrate added to the first filtrate. The columbic acid was then ignited and weighed. It was light yellow while hot, and white when cold.

The filtrate was evaporated somewhat, boiled with nitric acid and precipitated by ammonia. The filtrate so obtained was evaporated to dryness, ignited, dissolved in the least possible quantity of chlorhydric acid, and the manganese was then precipitated by ammonia. The magnesia was precipitated as phosphate in the filtrate; it was free from manganese.

The precipitate by ammonia was dissolved in dilute chlorhydric acid, reprecipitated, and the third time dissolved in slight excess of acid, and oxalate of ammonia added in quantity just sufficient to precipitate. It was allowed to stand twelve hours. The white flocculent precipitate had then settled to a fine powder and was filtered, washed, dried, ignited, dissolved in chlorhydric acid, and reprecipitated; this was repeated three times and the filtrates evaporated and tested each time. The weight of the oxides of cerium and yttrium was taken as a check upon the subsequent separation. The chlorhydric acid solution of the two oxides was treated with a hot saturated solution of sulphate of potash and a crystal put in to ensure complete saturation. The whole bulk of the liquid was about 10 c.c. After twelve hours the double salt of cerium and potash was filtered off, washed with cold sulphate of potash and dissolved in water; in the duplicate analysis it was precipitated in the very dilute solution by oxalate of ammonia, and this showed a loss of oxide of cerium; in the analysis given, the dilute solution was first precipitated by ammonia, and this precipitate, well washed, dissolved in chlorhydric acid, and reprecipitated by oxalate of ammonia, gives the correct per cent. as shown by the check weight.

There was a small residue insoluble in water and in chlorhydric acid, which in fusing with bisulphate decomposed into a soluble portion, which gave all the reaction of cerium, and a white powder, which may have been titanic acid but which gave reaction of columbic acid. This residue was too small to obtain satisfactory results; it was about 1 per cent. of the mineral. The solution of yttria in sulphate of potash was diluted, precipitated by oxalate of ammonia, ignited and weighed. The filtrate from the precipitated oxalates of cerium and yttrium was just neutralized with ammonia, boiled, and carbonate of ammonia added. After twelve hours the solution of uranium was filtered off, evaporated to a small bulk and precipitated by ammonia, dissolved, neutralized, and treated with carbonate of ammonia. This was repeated three times, as also in the same manner the iron precipitate, and thus the separation of the uranium was nearly or quite complete.

Mr. Bouvé also presented a paper by Miss Swallow upon the occurrence of Boracic Acid in mineral waters, with the results of numerous analyses made by her of waters not before analyzed. This, too, will be found by chemists and geologists to be a very valuable contribution to our knowledge of mineral waters.

On the occurrence of Boracic Acid in Mineral Waters. By Ellen H. Swallow.

In May, 1872, a small bottle of water from Bitlis, Turkey, was given me to analyze. In making the qualitative tests I found boracic acid in considerable quantity. I do not remember what led me to test for it; probably it was a suggestion of Prof. Ordway. The presence of boracic acid in this water caused me to make special test for it in all the mineral waters that I had occasion to analyze.

It occurred in the hot spring of Idaho, Colorado, in Chicken Soup Spring and Bath Spring, both hot waters of Elko, Nevada, and in a cold water from Laramie Plains, Wyoming. These all belong to the class of alkaline waters. It was also found in a chalybeate spring in Albany, Maine, which is in the tourmaline region, and probably that fact may account for its presence in the Albany spring as well as in a spring of very pure water on Pike's Hill, Norway, Maine. It was observed in one of the Spa Springs, Wilmot, Nova Scotia, which belongs to the class of calcic waters, and it occurred in considerable quantity in the mud of another of the Spas. It will be remembered that ulexite and other borates are frequent in the gypsum of Nova Scotia.

The query is at once suggested what are the properties of boracic acid and what are its effects upon the system when taken internally. There seems to be little known as regards its effect in mineral waters, but by comparing the medicinal properties as given in medical treatises with the reputed effects of noted springs which are known to contain boracic acid, we may hope to get a hint of the value of this constituent. Externally applied, borax is very effective in allaying irritation and healing skin diseases. Taken internally it acts especially on the mucous membranes of the respiratory and digestive organs, consequently it is very beneficial in internal catarrhs and hœmorrhoids. It is especially adapted to sensitive temperaments and nervous constitutions, hence is potent in female diseases. It is very highly extolled in nephritic and calculus complaints.

If we now consider the waters which are known to contain either borax or borate of magnesia in respect to the diseases which they are celebrated for curing, we shall find a noteworthy coincidence, to say the least.

The following statements concerning foreign waters are taken from "Balneotherapie," edited by Dr. Valentiner, and those referring to American Springs from Walton's "Mineral Springs of the United States and Canada."

Eilsen, among the sulphur waters, is beneficial in catarrh, and the mud baths are still more noted as curative agents and are said to be somewhat different in their action from the Nenndorf baths, without any apparent cause. St. Sauveur, used for bathing, has "a very marked sedative effect on the skin, and is the most noted bath for women in France." Eaux Bonnes, "the only drinking water among the several springs, has a very marked effect, even on the first day. . . . . this action is not to be expected according to the chemical analysis. Its great fame lies in the cure of bronchitis, catarrh, and tuberculose phthisis." Among the alkaline waters, Fachingen, Nassau, is very effective in all bronchial diseases, blennorrhœa, and catarrh, of the urinary organs with gravel and stones; it contains of borax 0.03 part in 100,000, according to Fresenius. Giessübel, a mile from Carlsbad, is much used for the same diseases. The famous Vichy and Carlsbad waters contain traces of boracic acid, as also nine out of the fifteen springs at Saratoga, and the Balston Spa. Others less known are St. Leon Springs, Canada, the Tuscan Springs, Shasta Co., California, and the Gettysburg Springs which contain 0.032 grain of borate of magnesia in a gallon. The latter water has great reputation in gravel, calculus, and catarrh of the bladder and stomach.

Now as it is acknowledged by the best authorities in all schools of medicine that it is often the substances present in small quantity in mineral waters that are the most efficacious, and as many springs are curative in their action without any apparent reason, it may be possible that the remedial virtue lies in the presence of the neglected constituents like that one under consideration.

A table of the analyses of the mineral waters of which there is no known previous analysis, is appended. The results are expressed in parts per 100,000.

	Idaho, Colorado.[1]	*Laramie Plains, Wyoming.*	*Chicken Soup Sp'g, Elko, Nevada.*	*Bath Spring, Elko, Nevada.*[2]	*Albany, Maine.*[3]	*Pike's Hill, Norway, Maine.*	*Bitlis, Turkey.*
SiO_2	6.15	3.00	9.80	6.40	1.85		
$Fe_2O_3 + Al_2O_3$.	.38	trace			.90	.56	6.70
CaO	2.24	40.00	6.71	8.29	.55	.44	32.50
MgO	22.20	10.00			traces		6.50
Na_2O	45.93	32.00	16.50	11.50	undet.	undet.	22.60
K_2O	5.69	1.30	1.68	13.50	"	"	13.08
SO_3	20.20	80.00	4.29	6.63	"	"	18.27
B_2O_3	2.66	undet.	undet.	undet.	"	consid.	6.50
CO_2	2.40	22.00	5.23	21.34	"		115.60
Cl	4.97	4.00	2.40	2.00	"		11.82
P_2O_5	traces						
H_2S		1.93					

The following paper was also presented: —

Synopsis of the American Leporidæ. By J. A. Allen.

The following synopsis of the species and varieties of American Leporidæ is based mainly on the specimens of this group contained in the museum of the Smithsonian Institution at Washington, but those in the Museum of Comparative Zoology at Cambridge have also been used, as well as all accessible material from other sources. The present paper is an abstract of a monograph, in which the synonomy will be given in full, with extended tables of measurements and detailed descriptions.

Analysis of the Species and Varieties.

I. Skull much arched above; breadth one half the length; post-orbital processes distinct, not soldered with the skull; nasals of medium length, their length equal to about four-fifths of the width of the skull.

A. Hind feet longer than the head. Size large. Postorbital processes divergent, not in contact with the skull posteriorly. Pelage white in winter.

[1] B_2O_3 found in the Tufa.

[2] B_2O_3 found in the Tufa.

[3] Much iron was deposited and filtered from the water on which the determinations were made.

a. Size large. Nasals about as wide in front as behind.

1. Ears rather shorter than the head. Pelage dusky yellowish gray in summer, pure white to the roots in winter. Tail short, black above in summer. Size very large.
timidus var. *arcticus.*

2. Ears much longer than the head. Pelage pale yellowish gray in summer, in winter white at the surface and base, and reddish in the middle. Tail long, white on both surfaces. Size smaller . . . . *campestris.*

b. Size medium. Nasals considerably narrower in front than behind.

3. Ears about equal to the length of the head . . *americanus.*

3*a.* Pelage in summer pale cinnamon brown; in winter white at the surface and plumbeous at base, with a *narrow* middle band of reddish brown.
var. *americanus.*

3*b.* Pelage in summer cinnamon brown; in winter white at the surface and plumbeous at base, with a *broad* middle band of reddish brown, which shows through the white of the surface, the white being often a mere surface wash. Fully as large, or rather larger than var. *americanus.*
var. *virginianus.*

3*c.* Pelage redder in summer and whiter in winter than in the last, and size smaller.
var. *Washingtoni.*

3*d.* Size of the last, with the pelage more dusky in summer, and in winter nearly or wholly pure white to the base, the middle reddish band being more or less obsolete. . . . . var. *Bairdii.*

B. Hind feet not longer than the head. Size small. Postorbital processes convergent, frequently (in old specimens) in contact with the skull posteriorly, but only rarely anchylosed with it. Pelage never white.

4. Gray above, varied with black, and more or less tinged with light yellowish brown; under parts white . . *sylvaticus.*

4*a.* Above yellowish brown, with a tinge of reddish.
var. *sylvaticus.*

4*b*. Paler, rather smaller, with slightly larger ears, and rather stouter lower jaw . . . . var. *Nuttalli.*

4*c*. Color nearly as in var. *sylvaticus*; rather longer ears, more distinctly black-tipped . . var. *Auduboni.*

5. Smaller than *sylvaticus*, with the postorbital process scarcely touching the skull posteriorly. Colors generally more finely blended, and darker. Tail very short, almost rudimentary . . . . , . . . *Trowbridgei.*

6. Above gray, varied with black and pale yellow. Size of *Trowbridgei*, with the colors and sparsely clothed feet of *palustris*. Tail very short . . . . ***brasiliensis.***

II. Skull less convex above; breadth considerably less than half the length; length of nasals more than four-fifths the width of the skull. Ears and hind feet longer than the head. Postorbital processes convergent, touching the cranium behind. Pelage never white. Tail long, black above, this color extending forward on the rump.

A. Lower jaw large, massive.

7. Above pale yellowish gray, varied with black; below white, more or less tinged with fulvous . . . . *callotis.*

B. Lower jaw disproportionably small, relatively smaller than that of any other American species of Lepus.

8. Somewhat smaller than *callotis*, and more rufous above. *californicus.*

III. Postorbital process anchylosed with the skull. Hind feet short. Pelage never white.

A. Width of the skull half of the length.

9. Size medium. Tail long . . . . *palustris.*

B. Width of the skull considerably less than half the length.

10. Size large. Tail short . . . . *aquaticus*

1. Lepus timidus var. articus.

Lepus variabilis Pallas, Schreber, Gmelin and other early writers.

Lepus timidus Fabricius, Faun. Grœnl., 25, 1780.

Lepus articus Leach, Ross's Voyage, II., App. 151, 1819.

Lepus glacialis Leach, Ibid., 170.

Lepus glacialis Sabine, Richardson, Baird, and subsequent writers generally.

Habitat. Arctic America, southward on the Atlantic coast to Labrador and Newfoundland; in the interior southward to Fort Churchill, the northern shore of Great Slave Lake and the upper Youkon Valley.

2. Lepus campestris.

Lepus variabilis Lewis, Bartram's Med. and Phys. Journ., II, 159, 1806.

Lepus virginianus, var.? Harlan, Faun. Amer., 310, 1825.

Lepus virginianus Richardson, Faun. Bor. Am., I, 224, 1829.

Lepus campestris Bachman, Journ. Acad. Nat. Sci. Phila., VII, 349, 1837. — Baird, Mam. N. Am., 585, 1857.

Lepus Townsendi Bachman, Journ. Acad. Nat. Sci. Phila., VIII, 90, 1839.

Habitat. Plains of the Saskatchewan southward to middle Kansas, and from Fort Riley westward to the Coast Range.

3. Lepus americanus.

a. var. **americanus.**

Lepus americanus Erxleben, Syst. Reg. Anim., 330, 1777. (Based wholly on Hudson's Bay specimens.)

Lepus americanus Baird and most modern authors. (In part only, this name also generally including var. *virginianus.*)

Lepus hudsonius Pallas, Nov. Sp. Glires, 30, 1778.

Lepus nanus Schreber, Säugt., II, 881, 1792. (In part only.)

Lepus campestris Baird, Ms. (Labels and Record Books, Sm. Inst.) — Hayden, Am. Nat., III, 115, 1869.

Lepus variabilis var. Godman, Am. Nat. Hist., II, 169, 1826. (In part only.)

Lepus borealis Schintz, Synopsis, II, 286, 1845.

Habitat. From the Arctic Barren Grounds southward to Nova Scotia, Lake Superior, and Northern Canada, and in the interior throughout the wooded parts of the Hudson's Bay Territories, and Alaska. Replaced west of the Rocky Mountains by var. *Washingtoni.*

b. var. **virginianus.**

Lepus virginianus Harlan, Faun. Am., 196, 1825. (Based wholly on Virginia specimens.)

Lepus americanus Bachman, Journ. Acad. Nat. Sci. Phila., VII, 403, 1837. (In part only). — Baird, Mam. N. Amer., 579, 1857. (In part only.)

Habitat. Nova Scotia to Connecticut on the coast, the Canadas and the northern parts of the northern tier of States westward to Minnesota, and southward in the Alleghanies to Virginia, or throughout the Alleghanian and Canadian Faunæ.

c. var. **Washingtoni.**

Lepus Washingtoni Baird, Proc. Acad. Nat. Sci. Phila., VII, 333, 1855. — Ibid., Mam. N. Am., 583, 1857.

Habitat. West of the Rocky Mountains, (mainly west of the Cascade Range?) from the mouth of the Columbia northward into British Columbia.

d. var. **Bairdii.**

Lepus Bairdii Hayden, Am. Nat., III, 115, 1869.

Habitat. The higher parts of the Rocky Mountains, southward to New Mexico, northward into British America.

4. **Lepus sylvaticus.**

a. var. **sylvaticus.**

Lepus nanus Schreber, Säugt., IV, 881, 1792. (In part only.)

Sylvilagus nanus Gray, Ann. and Mag. Nat. Hist., 3d Ser., XX, 221, 1867.

Lepus americanus Desmarest, Mammalogie, II, 354, 1822. — Bachman, Journ. Acad. Nat. Sci. Phila., VII, 326, 1837.

Lepus sylvaticus Bachman, Journ. Acad. Nat. Sci. Phila., VII, 403, 1837. — Ibid., VIII, 78, 1839. — Baird, Mam. N. Am., 579, 1857.

Habitat. United States east of the 97th meridian, excluding those portions embraced in the Canadian Fauna, (Northern New England and the more elevated parts of Appalachian Highlands).

b. var. **Nuttalli.**

Lepus Nuttalli Bachman, Journ. Acad. Nat. Sci. Phila., VII, 345, 1837. (Based on an immature specimen.)

Lepus Bachmani Waterhouse, Proc. Zool. Soc. Lond., VI, 103, 1838. — Ibid., Nat. Hist. Mam., II, 124, 1848. — Baird, Mam. N. Am., 606, 1857.

Lepus artemisia Bachman, Journ. Acad. Nat. Sci. Phila., VIII, 94, 1839. — Baird, Mam. N. Am., 602, 1857.

Habitat. United States west of the 97th meridian, excluding a narrow belt along the Pacific coast, and possibly southwestern Arizona and southern California.

c. var. **Auduboni.**

Lepus Auduboni Baird, Mam. N. Am., 608, 1857.

Habitat. Southwestern Arizona, southern and Lower California.

5. **Lepus Trowbridgei.**

Lepus trowbridgei Baird, Proc. Acad. Nat. Sci. Phila., VII, 333, 1855.—Ibid., Mam. N. Am., 610, 1857.

Habitat. West of the Sierra Nevada Range, from northern California to Cape St. Lucas.

6. Lepus brasiliensis.

Lepus brasiliensis Linnæus, Syst. Nat., 12th ed., I., 78, 1766.—Also of subsequent authors generally.

Lepus tapeti Pallas, Nov. Sp. Glires, 30, 1778.

Tapeti brasliensis Gray, Ann. and Mag. Nat. Hist., 3d Ser., XX, 22, 1867.

Habitat. Throughout the greater part of South America.

7. Lepus callotis.

Lepus callotis Wagler, Nat. Syst. Amph., 35, 1830.—Baird, Mam. N. Am., 590, 1857.

Lepus nigricaudatus Bennett, Proc. Zool. Soc. Lond., I, 41, 1833.

? "*Lepus mexicanus* Licht." Richardson, Sixth Rep. British Ass., (1836), 150, 158, 1837.

Lepus [*callotis* var.] *flavigularis* Wagner, Suppl. Schreber's Säught., IV, 107, 1844.

Lepus texianus Waterhouse, Nat. Hist. Mam., II, 136, 1848.—Aud. and Bach., Quad. N. Amer., III, 156, pl. 133, 1853.—Baird, Mam. N. Am., 617, 1857.

Habitat. United States between the 97th meridian and the Sierra Nevada Mountains, and from Northern Kansas and the Great Salt Lake Basin southward into Mexico.

8. Lepus californicus.

Lepus californicus Gray, Charlesworth's Mag. Nat. Hist., I, 586, 1837.—Baird, Mam. N. Am., 594, 1857.

Lepus Richardsoni Bachman, Journ. Acad. Nat. Sci. Phila., VIII, 88, 1839.

Lepus Bennetti Gray, Zool. Voy. Sulphur, 35, pl. 14, 1844.

Habitat. California, west of the Sierra Nevada Range, south to Cape St. Lucas, Lower Cal.

9. Lepus palustris.

Lepus palustris Bachman, Journ. Acad. Nat. Sci. Phila., VII, 194, 336, pl. 15, 16, 1837.—Baird, Mam. N. Am., 615, 1827.

Lepus Douglassi, var. 2 Gray, Charlesworth's Mag. Nat. Hist., I, 586, 1837.

Hydrolagus palustris Gray, Ann. and Mag. Nat. Hist., 3d Ser., XX, 221, 1867.

Habitat. South Atlantic and Gulf States.

10. Lepus aquaticus.

Lepus aquaticus Bachman, Journ. Acad. Nat. Sci. Phila., VII, 319, pl. 22, fig. 2, 1837.—Baird, Mam. N. Am., 612, 1857.

Lepus Douglassi, var. 1 Gray, Charlesworth's Mag. Nat. Hist., I, 586, 1837.

Hydrolagus aquaticus Gray, Ann. and Mag. Nat. Hist., 3d Ser., XX, 221, 1867.

Habitat. Gulf States, south through the lowlands of Mexico to Central America, (Orizaba, Mex., *Sumichrast*, *Botteri*; Tehuantepec, Mex., *Sumichrast*; Merida, Yucatan, *Schott*).

March 3, 1875.

The President in the chair. Twenty-five persons present.

The following paper was read: —

Catalogue of the Birds of New England, with brief notes indicating the manner and character of their presence; with a list of species included in previous catalogues believed to have been wrongly classed as Birds of New England. By T. M. Brewer.

It may seem almost presumptuous, in view of the carefully prepared lists, both general and local, that have been published in regard to New England birds, for me to appear to deem it worth the while to prepare another, and thus seem to regard myself able to add sufficient novelty to what has already appeared, to justify the attempt. When Prof. Verrill and Mr. Boardman have done so much to illustrate the ornithology of eastern and western Maine, when Mr. Putnam has so thoroughly gone over the birds of Essex County, and more especially, when our good friend Mr. Allen, whose carefulness no one questions, whose accuracy no one gainsays, and whose thoroughness of observation no one can hope to surpass, has done so much to perfect the catalogue of the birds of Massachusetts, it would almost appear as if there could be nothing more to be added.

The most recent list covering the whole field of New England is that of Dr. Elliot Coues, published seven years since. It is remarkable for the laborious research and investigation it displays, and is by far the most complete catalogue we have. But even this fails to contain a few names, the undoubted presence of which in New England had previously been established, and since its publication several remarkable captures have added other names.

My principal, indeed my only important, criticism of this list is that it retains quite a number of species, which, in my judgment, have no claim to be classed as New England birds, whose appearance here is both improbable in itself and rests upon no reliable testimony. I have, besides the list of birds known to have been taken in New England, given a supplementary list of about thirty species which have been given as New England birds, but which, so far as I know, have no claim to be retained. It has been my sole aim to furnish a list that shall be reliable so far as it goes. I may have omitted some that are entitled to a place. Be it so; I had rather omit ten that may be found, than retain one that never has been, for the one mistake is easily rectified, the other is most difficult.

Some of these corrections I am the more anxious to make because I have been made, to appear as if responsible for the mistake in the beginning. For instance, somewhere about 1838 I wrote to Mr. Audubon that Dr. Cabot had procured specimens of the Nashville Warbler, then regarded a rare bird, and that Dr. James Trudeau had found Swainson's Warbler breeding in Louisiana. Probably writing without having carefully re-examined my letter, Mr. Audubon cites me as authority for the capture of Swainson's Warbler in Massachusetts; and although I have, time after time, sought to set this matter right, every list published during the past thirty-five years persistently repeats this mistake, and cites Dr. Brewer as authority. it is high time this error is set right. Four or five birds stand thus wrongfully credited to New England, and I am made their voucher. How far I am really responsible for this diffusion of error it is now Impossible to say, but I wish at least to do my best to correct what I deem to be erroneous.

There is also another class of oceanic birds, whose presence in New England seems to have been always taken for granted, and their names have been given in every list without a particle of recorded evidence. Among these are the Fulmar Petrel, the Least Petrel, the Manx Shearwater, etc. — all European forms and, so far as I know, unknown to our shores. I challenge their right to be counted as New England birds until that claim can be confirmed by something more than guess-work.

Accidental visitants, birds very local in their distribution in N. E. and these only known to have occurred, each in single instances are marked with an asterisk prefixed to their number.

1. **Turdus mustelinus** Gm. A summer resident in southern New England.

2. **Turdus fuscescens** Stephens. Summer resident.

3. **Turdus Aliciæ** Baird. Migratory in spring and fall.

4. **Turdus Swainsoni** Cabanis. Migratory in Southern New England, summer resident in Northern New England.

5. **Turdus Pallasi**[1] Cabanis. Migratory spring and fall (S. N. E.); summer resident (N. N. E.).

*6. **Turdus nanus** Audubon. Of rare occurrence. (Wenham Lake, Mass., Dr. Charles Pickering, see Audubon, Birds Am., III, p. 132.)

7. **Turdus migratorius** Linn. Summer resident.

*8. **Turdus naevius** Gm. Of rare occurrence (Mass., Maynard).

9. **Harporhynchus rufus** Linn. Summer resident (S. N. E.).

10. **Mimus polyglottus** Boie. Rare summer resident (Conn., R. I., and Mass.).

11. **Galeoscoptes carolinensis** Linn. Summer resident, except N. E. Maine.

12. **Sialia sialis** Baird. Summer resident, except in N. E. Maine.

13. **Regulus satrapa** Licht. Summer resident (N. N. E.). migratory, spring and fall (S. N. E.).

14. **Regulus calendula** Licht. Summer resident (N. N. E.). migratory, spring and fall (S. N. E.).

15. **Parus atricapillus** Linn. Resident.

16. **Parus hudsonicus** Forster. Resident (N. N. E.); of rare occurrence (Mass.).

17. **Sitta carolinensis** Lath. Summer resident, partially resident.

18. **Sitta canadensis** Linn. Migratory (S. N. E.); summer resident (N. N. E.).

[1] As I prefer to treat *Turdus nanus* and *T. pallasi* as distinct species I have retained these names unchanged. If, however, they are not species, but with *T. Auduboni* are but " forms " or " varieties " of one species, as Mr. Allen, Dr. Coues, and Mr. Ridgway regard them, the nomenclature by which they are usually given is not in accordance with the law of priority. *Turdus nanus* was given to one of these so-called " forms " in 1839, *T. pallasi* was not given until 1847, and *T. Auduboni* in 1864. The species should, therefore, be not *T. pallasi* var. *nanus* and var *Auduboni*, but *Turdus nanus*, variety *pallasi*, *T. nanus*, var. *nanus*, and *T. nanus* var. *Auduboni*.

19. Certhia americana Bonap. Resident.

20. Troglodytes aedon Vieill. Summer resident.

21. Troglodytes hyemalis Vieill. Resident (N. N. E.); winter visitant (S. N. E.).

22. Cistothorus stellaris Cabanis. Summer resident.

23. Cistothorus palustris Wilson. Summer resident (S. N. E.).

24. Anthus ludovicianus Licht. Winter visitant.

25. Mniotilta varia Vieill. Summer resident.

* **26. Protonotaria citrea** Baird. Of accidental occurrence (Eastern Maine, and New Brunswick, Boardman).

* **27. Helmitherus vermivorus** Bonap. Rare summer resident (Saybrook, Conn.).

28. Helminthophaga chrysoptera Cabanis. Rare summer resident (S. N. E.).

* **29. Helminthophaga leucobronchialis** Brewster. Rare summer visitant (Mass, Brewster).

* **30. Helminthophaga pinus** Baird. Rare summer resident (Saybrook, Conn.).

31. Helminthophaga ruficapilla Bd. Summer resident.

* **32. Helminthophaga celata** Baird. Rare (Western Mass., Allen; Lynn, Jan. 1st., 1875).

33. Helminthophaga peregrina Cab. Migratory (S. N. E.); summer resident (N. N. E.).

34. Parula americana Bonap. Summer resident.

* **35. Perissoglossa tigrina** Bd. Rare summer resident (N. N. E.) migratory in spring and fall (S. N. E.).

36. Dendroica æstiva Baird. Summer resident.

37. Dendroica coronata Gray. Summer resident (N. N. E.) ; migratory, spring and fall (S. N. E.).

38. Dendroica maculosa Baird. Summer resident (N. N., E.); migratory, spring and fall (S. N. E.).

39. Dendroica pennsylvanica Baird. Summer resident.

40. Dendroica striata Baird. Summer resident (N. N. E.); migratory in spring and fall (S. N. E.).

41. Dendroica castanea Baird. Summer resident (N. N. E.) ; migratory (S. N. E).

42. Dendroica cærulescens Baird. Summer resident (N. N. E.) ; migratory (S. N. E.).

43. Dendroica virens Baird. Summer resident.

44. **Dendroica pinus** Baird. Summer resident (S. N. E.).

45. **Dendroica palmarum** Baird. Summer resident (N. N. E.); migratory (S. N. E.).

46. **Dendroica discolor** Baird. Summer resident (Mass., R. I., and Conn.).

47. **Seiurus aurocapillus** Swainson. Summer resident.

48. **Seiurus noveboracensis** Nutt. Summer resident (N, N. E.); a rare summer resident chiefly migratory (S. N. E.).

*49. **Seiurus ludovicianus** Bonap. Rare, occasional (Mass.); summer resident (Conn.).

50. **Oporornis agilis** Baird. Migratory, possibly a summer resident in (N. N. E.).

51. **Geothlypis trichas** Cabanis. Summer resident.

52. **Geothlypis philadelphia** Baird. Rare. Migratory (S. N. E.); rare summer resident (N. N. E.).

53. **Icteria virens** Bonap. Rare summer resident (Mass. and Conn.).

*54. **Myiodioctes mitratus** Aud. Rare summer resident (Saybrook, Conn.).

*55. **Myiodioctes minutus** Baird. (Wenham, Mass.)

56. **Myiodioctes pusillus** Bonap. Rare. Migratory (S. N. E.); summer resident (Me.).

57. **Myiodioctes canadensis** Aud. Summer resident.

58. **Setophaga ruticilla** Swain. Summer resident.

59. **Progne subis** Baird. Summer resident.

60. **Petrochelidon lunifrons** Baird. Summer resident.

61. **Hirundo horreorum** Barton. Summer resident.

62. **Hirundo bicolor** Vieill. Summer resident.

63. **Cotyle riparia** Boie. Summer resident.

64. **Vireosylvia olivaceus** Bonap. Summer resident.

65. **Vireosylvia philadelphicus** Cassin. Summer resident (Northern Maine).

66. **Vireosylvia gilvus** Cassin. Summer resident.

67. **Lanivireo solitarius** Baird. Summer resident

68. **Lanivireo flavifrons** Vieill. Summer resident.

69. **Vireo noveboracensis** Bonap. Summer resident.

70. **Ampelis garrulus** Linn. Winter visitant.

71. **Ampelis cedrorum** Scl. Summer resident. Nomadic.

72. **Collurio borealis** Baird. Winter visitant (S. N. E.); resident (N. N. E.).

*73. **Collurio ludovicianus** Linn. Accidental, (Mass.).

74. **Pyranga rubra** Vieill. Summer resident.

*75. **Pyranga æstiva** Vieill. Accidental (Mass.).

76. **Pinicola enucleator** Cabanis. Winter visitant (S. N. E.); resident (N. N. E.).

77. **Carpodacus purpureus** Gray. Summer resident.

78. **Chrysomitris tristis** Bonap. Summer resident. Nomadic in winter.

79. **Chrysomitris pinus** Bonap. Migratory (S. N. E.); summer resident (N. N. E.).

80. **Loxia americana** Wilson. Resident (N. N. E.); winter visitant (S. N. E.).

81. **Loxia leucoptera** Gmelin. Resident (N. N. E.); winter visitant (S. N. E.).

82. **Ægiothus linarius** Cabanis. Winter visitant.

*83. **Ægiothus canescens** Cab. Winter visitant (Eastern Maine).

*84. **Ægiothus Brewsteri** Ridgway. Accidental, Mass.

85. **Plectrophanes nivalis** Meyer. Winter visitant.

86. **Plectrophanes lapponicus.** Rare. Winter visitant.

87. **Pyrgita domestica** Cab. Resident. Introduced.

88. **Passerculus savanna** Bonap. Summer resident.

*89. **Passerculus princeps** Maynard. Migratory, rare (Mass.).

90. **Pooecetes gramineus** Gmelin. Summer resident.

91. **Coturniculus Henslowi** Bonap. Summer resident, rare (Mass.).

92. **Coturniculus passerinus** Bonap. Summer resident, rare (S. N. E.).

93. **Ammodramus caudacutus** Swainson. Summer resident (S. N. E.).

94. **Ammodramus maritimus** Swainson. Summer resident (S. N. E.).

*95. **Chondestes grammaca** Bonap. Accidental (Mass.).

96. **Zonotrichia leucophrys** Swainson. Migratory, rare.

97. **Zonotrichia albicollis** Bonap. Migratory (S. N. E.); summer resident (N. N. E.).

98. **Junco hyemalis** Sclater. Winter visitant (S. N. E.); resident (N. N. E.).

99. **Spizella monticola** Baird. Winter visitant.

100. **Spizella pusilla** Bonap. Summer resident.

101. **Spizella socialis** Bonap. Summer resident.

* 102. **Spizella Breweri** Cassin. Accidental (Watertown, Mass. Brewster).

103. **Melospiza melodia** Wilson. Resident (S. N. E.); summer resident.

104. **Melospiza Lincolni** Aud. Rare; Migratory (S. N. E.); summer resident (N. N. E.).

105. **Melospiza palustris** Wilson. Summer resident.

106. **Passerella iliaca** Swainson. Migratory.

107. **Euspiza americana** Bonap. Summer resident, rare (S. N. E.).

108. **Hedymeles ludovicianus** Swainson. Summer resident.

* 109. **Guiraca cærulea** Swainson. Accidental (Calais, Me.).

110. **Cyanospiza cyanea** Linn. Summer resident.

* 111. **Cardinalis virginianus** Bonap. Rare summer resident (Mass.).

112. **Pipilo erythropthalmus** Vieillot. Summer resident (S. N. E.).

113. **Eremophila alpestris** Boie. Winter visitant.

114. **Dolichonyx oryzivorus** Swainson. Summer resident.

115. **Molothrus pecoris** Swainson. Summer visitant.

116. **Agelaius phœniceus** Vieillot. Summer resident.

117. **Xanthocephalus icterocephalus** Baird. Accidental (Mass.).

118. **Sturnella magna** Swainson. Summer resident.

119. **Icterus spurius** Bonap. Summer resident (S. N. E.).

120. **Icterus Baltimore** Daudin. Summer resident.

121. **Scolecophagus ferrugineus** Swainson. Migratory (S. N. E.); summer resident (N. N. E.).

122. **Quiscalus purpureus** Bartram. Summer resident, (S. N. E.).

123. **Quiscalus æneus** Ridgway. Migratory (S. N. E.); summer resident (N. N. E.).

124. **Corvus carnivorus** Bartram. Resident (N. N. E.).

125. **Corvus americanus** Aud. Summer resident; a few winter.

126. **Cyanura cristata** Swainson. Resident.

127. **Perisoreus canadensis** Bonap. Resident (N. N. E.); occasional visitant (S. N. E.).

128. Tyrannus carolinensis Baird. Summer resident.
***129. Tyrannus dominicensis** Brisson. Accidental (Mass.).
***130. Tyrannus verticalis** Say. Accidental (Pembroke,[1] Me.).
131. Myiarchus crinitus Cabanis. Rare summer resident.
132. Sayornis fuscus Baird. Summer resident.
133. Contopus borealis Swainson. Rare summer resident.
134. Contopus virens Cabanis. Summer resident.
135. Empidonax Traillii Aud. Summer resident (N. N. E. and Western Mass.).
136. Empidonax minimus Baird. Summer resident.
137. Empidonax flaviventris Baird. Migratory (S. N. E.); summer resident (Maine.)
138. Ceryle alcyon Boie. Summer resident, occasional in winter.
139. Chordeiles popetue Vieillot. Summer resident.
140. Antrostomus vociferus Bonap. Summer resident.
141. Chaetura pelagica Linn. Summer resident.
142. Trochilus colubris Linn. Summer resident.
***143. Thaumatias Linnæi** Bonap. Accidental (Mass.).
144. Coccygus americanus Bonap. Summer resident.
145. Coccygus erythrophthalmus Bonap. Summer resident.
146. Picus villosus Linn. Summer resident.
147. Picus pubescens Linn. Resident.
148. Picoides arcticus Gray. Winter visitant.
149. Picoides americanus Brehm. Winter visitant.
150. Sphyropicus varius Linn. Summer resident (N. N. E.).
***151. Sphyropicus nuchalis** Baird. Accidental (Mass. and N. H.).
152. Hylotomus pileatus Linn. Resident.
153. Centurus carolinus Bonap. Rare (S. W. N. E.)
154. Melanerpes erythrocephalus Swainson. Summer resident (S. W. N. E.).
155. Colaptes auratus Swainson. Summer resident, rare in winter.

[1] Proceedings of Boston Nat. Hist. Soc., 1865, p. 96, where it is printed Plympton, Me. As there is no such town in that State and Dr. Bryant made collections in Pembroke, there is little doubt it should so read.

*156. **Strix pratincola** Bonap. Accidental (Mass. and Conn.).

157. **Otus wilsonianus** Less. Summer resident.

158. **Brachyotus Cassini** Brewer. Summer resident (N. N. E.).

159. **Syrnium cinereum** Audubon. Winter visitant.

160. **Syrnium nebulosum** Gray. Resident.

161. **Nyctale Richardsoni** Bonap. Rare winter visitant.

162. **Nyctale acadica** Bonap. Summer resident.

163. **Scops asio** Bonap. Resident.

164. **Bubo virginianus** Bonap. Resident.

165. **Nyctea arctica** Gray. Winter visitant.

166. **Surnia hudsonica** Gmelin. Winter visitant.

*167. **Spheotyto hypogæa**[1] Bonap. (Mass., May 4th, 1875, Ruthven Deane.)

168. **Hierofalco islandicus** Sabine. Winter visitant (N. N. E.).

*169. **Hierofalco labradora** Audubon. Rare resident (Dummerston, Vt.).

170. **Falco anatum** Bonap. Resident.

171. **Æsalon columbarius** Linn. Migratory visitant (S. N. E.); summer resident (N. N. E.).

172. **Tinnunculus sparverius** Linn. Summer resident.

*173. **Nauclerus furcatus.** Accidental (Western Mass., Allen).

174. **Pandion carolinensis** Gmelin. Summer resident.

175. **Circus hudsonius** Linn. Summer resident.

176. **Nisus fuscus** Gmelin. Summer resident.

177. **Nisus Cooperi** Bonap. Summer resident.

178. **Astur atricapillus** Wilson. Migratory (S. N. E.); summer resident (N. N. E.).

179. **Buteo pennsylvanicus** Wilson. Summer resident.

*180. **Buteo Swainsoni** var. **insignatus** Cassin. Accidental (Salem, Mass.).

181. **Buteo lineatus** Gmelin. Resident.

182. **Buteo borealis** Gmelin. Resident.

[1] This addition to the New England fauna has been made known since the list was read. The specimen was taken in the marshes near Newburyport by Messrs. H. Joyce and I. K. Clifford. It is the only one known to have been taken in New England.

183. **Archibuteo lagopus** Linn. Winter visitant.

184. **Archibuteo lagopus** var. **Sancti Johannis.** Resident, rare (Maine).

185. **Aquila canadensis** Linn. Resident, rare.

186. **Haliætus leucocephalus** Linn. Resident.

*187. **Rhinogryphus aura** Linn. Accidental (Me., Conn.).

*188. **Catharista atrata** Bartram. Accidental (Mass., Me.).

189. **Ectopistes migratoria** Swainson. Irregular summer visitant.

190. **Zenaidura carolinensis** Bonap. Summer resident; rare.

191. **Meleagris gallopavo** Linn. Resident, probably extinct.

192. **Canace canadensis.** Resident (N. N. E.).

193. **Cupidonia cupido** Linn. Resident (Mass.).

194. **Bonasa umbellus** Stephens. Resident.

*195. **Lagopus albus.** Rare, accidental winter visitant (N. N. E.).

196. **Ortyx virginianus** Bonap. Resident.

197. **Ægialitis vociferus.** Summer resident.

198. **Ægialitis semipalmatus.** Migratory.

199. **Ægialitis melodus** Cab. Summer resident.

200. **Charadrius virginicus** Borck. Migratory.

201. **Squatarola helvetica** Cuvier. Migratory.

*202. **Hæmatopus palliatus** Temn. Rare (coast, Mass. and Me.).

203. **Strepsilas interpres** Illig. Migratory.

204. **Himantopus nigricollis** Vieill. Occasional. Rare, (Mass., Me.).

205. **Phalaropus Wilsoni** Bon. Migratory. Rare (Mass.);

206. **Phalaropus hyperboreus** .Cuv. Migratory, usually along the coast.

207. **Phalaropus fulicarius** Bon. Migratory. Rare on the land, more common at sea. Summer resident, Me. (Boardman).

208. **Philohela minor** Gray. Summer resident.

209. **Gallinago Wilsoni** Bon. Summer resident (N. N. E.) migratory (S. N. E.).

210. **Macrorhamphus griseus** Leach. Summer resident (N. N. E.); migratory (S. N. E.).

211. **Macrorhamphus scolopaceus** Lawrence. Rare, migratory, not in company with 210, (coast of Mass.) Brewster.

212. **Micropalama himantopus** Baird. Migratory (Mass.).
213. **Ereunetes petrificatus** Ill. Migratory.
214. **Tringa canutus** Linn. Migratory; abundant, May 20th, 1875, Barnstable Co. Mass.
215. **Calidris arenaria** Ill. Migratory.
216. **Arquatella maritima** Bd. Winter visitant.
*217. **Ancylocheilus subarquatus** Kaup. This is an European species, of rare and accidental occurrence in America. Up to the present time no authenticated instance was on record of a single specimen having been taken any in part of New England. It had been given on the strength of three individuals taken at St. Andrews, N. B., on the St. Croix, and within a few miles of the Maine line. A single individual has been recently taken at Ipswich, Mass., and the same is now in the collection of Raymond Newcomb, Esq., of Salem.
218. **Pelidna americana** Baird. Migratory.
219. **Actodromas maculata** Cassin. Migratory.
*220. **Actodromas Bairdii** Coues. Migratory, rare (Mass.).
221. **Actodromas minutilla** Coues. Migratory.
222. **Actodromas Bonapartei** Cass. Migratory.
223. **Symphemia semipalmata** Hart. Summer resident.
224. **Gambetta melanoleuca** Bon. Migratory.
225. **Gambetta flavipes** Bon. Migratory.
226. **Rhyacophilus solitarius** Baird. Migratory (S. N. E.); summer resident (N. N. E.).
227. **Tringoides macularius** Gray. Summer resident.
*228. **Machetes pugnax** Gray. Rarely occasional (Mass.).
229. **Actiturus Bartramius** Bon. Summer resident (S. N. E.).
230. **Tryngites rufescens** Cab. Migratory.
231. **Limosa fedoa** Ord. Migratory, rare (Mass., Me. coast).
232. **Limosa hudsonica** Swainson. Migratory.
233. **Numenius longirostris** Wilson. Visitor in mid-summer, coast.
234. **Numenius hudsonicus** Latham. Migratory, coast.
235. **Numenius borealis** Lath. Migratory, of irregular appearance.
236. **Ibis Ordii.** Occasional (Mass.).
237. **Ardea herodias** Linn. Summer resident.

238. **Herodias egretta** Gray. Summer visitant.
239. **Florida cærulea** Baird. Rare straggler (Mass., coast).
240. **Garzetta candidissima** Bon. Summer visitant, rare.
241. **Ardetta exilis** Gray. Summer resident, rare (S. N. E.).
242. **Botaurus lentiginosus** Steph. Summer resident.
243. **Butorides virescens** Bon. Summer resident.
244. **Nyctiardea Gardeni** Baird. Summer resident.
*245. **Nyctherodius violaceus** Bd. Accidental (Lynn, Mass.).
*246. **Rallus elegans** Aud. Accidental (West Haven, Conn., Batty).
*247. **Rallus crepitans** Aud. Breeds in S. W. Conn., in salt marshes on shore of L. I. Sound. Not found in any other portion of New England; quoted as of Massachusetts, on authority of Dr Cabot, but the individual referred to came from Long Island, N. Y.
248. **Rallus virginianus** Linn. Summer resident.
249. **Porzana carolina** Vieill. Summer resident.
*250. **Oreciscus jamaicensis** Gm. Rare summer resident (Hazenville, Conn., Batty).
251. **Coturnicops noveboracensis** Cass. Rare summer visitant (Mass., Conn. Prof. G. B. Goode).
*252. **Porphyrio martinica** Latham. Accidental (Mass., Me.).
253. **Gallinula galeata** Bon. Rare summer resident (Mass., accidental Me.).
254. **Fulica americana** Gm. Summer resident.
255. **Cygnus americanus** Sharpless. Rare, migratory (Mass.).
256. **Anser hyperboreus** Pallas. Migratory, rare.
257. **Anser gambelli** Hartlaub. Rare, migratory.
258. **Bernicla canadensis** Boie. Migratory.
259. **Bernicla Hutchinsii** Aud. Migratory.
260. **Bernicla brenta** Steph. Migratory.
*261. **Bernicla nigricans** Lawrence. Accidental (Mass., Henshaw).
262. **Anas boschas** Linn. Migratory.
263. **Anas obscura** Gm. Resident..
264. **Dafila acuta** Jen. Migratory.
265. **Nettion carolinensis** Baird. Migratory.
266. **Querquedula discors** Steph. Migratory.
267. **Spatula clypeata** Boie. Migratory, rare.

268. **Chaulelasmus streperus** Gray. Migratory, rare.
269. **Mareca americana** Steph. Migratory.
270. **Aix sponsa** Swainson. Summer resident.
271. **Fulix marila** Baird. Migratory.
272. **Fulix affinis.** Rare, migratory.
273. **Fulix collaris.** Summer resident, rare (Maine). Migratory.
274. **Aythya americana** Bon. Migratory, summer resident, rare (Me).
275. **Aythya vallisneria** Bon. Migratory, rare.
276. **Bucephala americana** Bd. Winter visitant (S. N. E.); resident (Me.).
277. **Bucephala islandica** Bd. Migratory (S. N. E.); summer resident, rare (Me.).
278. **Bucephala albeola** Bd. Migratory (S. N. E.); summer resident (Me.).
279. **Histrionicus torquatus** Bon. Winter visitant.
280. **Harelda glacialis** Leach. Winter visitant.
281. **Camptolæmus labradorius** Gray. Winter visitant.
282. **Melanetta velvetina** Bd. Migratory.
283. **Pelionetta perspicillata** Kaup. Migratory.
284. **Oidemia americana** Swainson. Migratory.
285. **Somateria mollissima** Leach. Winter visitant.
286. **Somateria spectabilis** Leach. Winter visitant.
287. **Erismatura rubida** Bon. Migratory.
*288. **Erismatura dominica.** Accidental (Vermont).
289. **Mergus americanus** Cass. Summer resident (N. N. E.); migratory (S. N. E.).
290. **Mergus serrator** Linn. Summer resident (N. N. E.).
291. **Lophodytes cucullatus** Reich. Migratory (S N. E.); summer resident (N. N. E.).
*292. **Pelecanus erythrorhynchus** Gmel. Accidental (Mass.).
*293. **Pelecanus fuscus** Linn. Accidental, (Mass.).
294. **Sula bassana** Brisson. Winter visitant.
295. **Graculus carbo** Gray. Rare summer resident (Maine); migratory.
296. **Graculus dilophus** Gray. Winter visitant.
297. **Larus glaucus** Brisson. Coast in winter.
298. **Larus leucopterus** Fabr. Coast in winter.

299. Larus marinus Linn. Coast in winter.

300. Larus Smithsonianus Coues. Summer resident (Me.); coast in winter.

301. Larus delawarensis Ord. Coast in winter.

302. Rissa tridactyla Bon. Coast in winter.

303. Chroicocephalus atricilla Lawrence. Summer resident.

304. Chroicocephalus philadelphia Lawrence. Summer resident, Me. Migratory.

305. Stercorarius pomarinus Temn. Off the coast in winter.

306. Stercorarius parasiticus Gray. Off the coast in winter.

307. Stercorarius Buffoni Baird. Coast of Maine, winter.

*** 308. Xema Sabini** Leach. This species is new to our fauna, and is entitled to a place on the strength of a single specimen in immature plumage taken in Boston Harbor, Sept. 27th, 1864, by Mr. H. W. Diamond. It is now in the collection of Mr. Wm. Brewster, Cambridge.

309. Gelochelidon aranea Wilson. Although mentioned as of occasional occurrence by Emmons, Putnam, Samuels and Allen, I can find no special confirmation of its actual presence except a single specimen recently taken at Ipswich by Mr. Maynard and now in Mr. Brewster's possession.

*** 310. Thalasseus acuflavidus** Cabot. Dr. Coues names this bird as of undoubted occurrence on our coast. At the time of the publication of his list, there was, so far as I can find, no data for that belief. It had not even then been traced so far north as Long Island, or New York, and only a single specimen had been traced so far north as Grassy Bay, in Southern New Jersey. The capture of two specimens by Mr. Vickary at Chatham, Cape Cod, has now given it, I believe for the first time, a right to take its place among the rare and accidental birds that visit our coast.

***311. Thalasseus caspius.** Occasional, Mass., Brewster; (Me.?)

***312. Thalasseus regius.** Rare summer visitant, Brewster and Maynard, Mass., 1874.

313. Sterna Forsteri Nuttall. Occasional in fall (Mass.).

314. Sterna hirundo Linn. Summer resident.

315. Sterna macroura Naum. Summer resident.

316. **Sterna paradisea** Brünn. Summer resident (S. N. E.).

317. **Sterna antillarum** Summer resident (S. N. E.).

*318. **Sterna portlandica** Ridgway. Of rare appearance (Me., Mass.).

319. **Hydrochelidon fissipes** Gray. Occasional in fall (Mass.).

320. **Cymochorea leucorrhoa** Coues. Summer resident (coast of Me.).

321. **Oceanites oceanica** Coues. Summer visitant in August, on the coast.

322. **Puffinus fuliginosus** Strick. Occasional on coast in summer.

323. **Puffinus major** Fabr. Coast (Me., Boardman; Granby, Conn., Goode).

324. **Colymbus torquatus** Brünnich. Summer resident (N. N. E.)

325. **Colymbus septentrionalis** Linn. Migratory on coast.

326. **Podiceps cornutus** Gm. Summer resident (N. N. E.); migratory on coast.

327. **Podiceps griseigena** Bodd. Summer resident (N. N. E.); migratory on coast.

328. **Podilymbus podiceps** Linn. Rare summer resident (Me.); migratory.

329. **Alca impennis** Linn. Extinct species, formerly resident on the coast.

330. **Alca torda** Linn. Summer resident (Me.); off coast in winter.

331. **Fratercula arctica** Linn. Summer resident (Me.); off coast in winter.

332. **Mergulus alle** Linn. Winter visitant.

333. **Uria grylle** Linn. Summer resident (Me.); off coast in winter.

334. **Lomvia troile** Linn. Summer resident (Me.); off coast in winter.

335. **Lomvia ringvia** Brünnich. Off coast in winter.

336. **Lomvia arra** Pallas. Off coast in winter.

The following species, which have been enumerated in various lists as of occurrence in New England, I have purposely withdrawn, and challenge their right to be regarded as in any sense New England birds. It is quite possible that a few of them may hereafter be met with within our limits. At present I can find no evidence that will warrant me in retaining them.

Saxicola œnanthe Bechst. This species, included by Dr. Coues, has never to my knowledge, been taken in New England, and should not be retained. The specimen referred to by Mr. Cassin as from Nova Scotia, was given him by me, and had been taken at Cape Harrison, Labrador.

Polioptila cærulea Sclat. I can find no authority for retaining this among the birds of New England. It is of very rare occurrence near New York city, two instances only being on record, and is, so far as I am aware, wholly unknown in any New England State.

Oporornis formosus Baird. This species is given by Dr. Coues, but apparently on conjecture. In my judgment it should be excluded.

Helmitherus Swainsoni Bonap. This bird, rare everywhere, and unknown in New England, has been included in nearly every list of New England and Massachusetts, and my name is given as authority. This is a mistake, originating in the first place with Mr. Audubon. It is not a New England bird.

Dendroica cærulea Wils. This species has been included by Mr. Putnam in his list of the birds of New England by a misunderstanding on the part of his informant. I ascertained by careful inquiry that the species meant was *D. cœrulescens*. I can find no evidence that this bird has ever crossed our borders.

Lophophanes bicolor Linn. I think this bird has no claim to be included in the avi-fauna of New England.

Collurio excubitoroides Sw. This species, given originally by Emmons and by Peabody, appears to have no claim to be retained. It is given by Dr. Coues as of very doubtful occurrence, and should be excluded until its claim is established by positive proof.

Hesperiphona vespertina Bonap. Dr. Coues includes this species hypothetically. So far there is no positive evidence to corroborate this claim, yet its presence as a straggler may be looked for as possible in Vermont or New Hampshire. The nearest approach to our borders that has come to my knowledge is Elizabethtown, Essex Co., New York, where Rev. Dr. Cutting of Brooklyn, saw one in the winter of 1875.

Quiscalus major Vieill. This is a southern species; is not known to occur, and should be excluded.

Corvus ossifragus Wils. This is included by Dr. Coues, but its claim rests on no reliable data. Mr. Lawrence has never known of an individual taken north of Squam Beach, New Jersey.

Empidonax acadicus Gm. Mr. Allen informs me that the species found in western Massachusetts, and included by him in the list as the Acadian Flycatcher, is really *Emp. Traillii.* This leaves us without any evidence of the occurrence of this species, and I have therefore taken it from the list.

Ægialitis Wilsonius Cass. I am in doubt in regard to this species. It is not of Massachusetts, although my name is usually quoted as authority therefor. Its occurrence on the coast of Connecticut is quite probable, but as I have no data therefor, I take it from among the birds of New England, at least for the present.

Recurvirostra americana Gm. This has been placed among the birds of New England by Prof. Verrill and by Dr. Coues, on the strength of a single specimen said to have been taken by Mr. G. A. Boardman, near Calais. As this specimen was not taken near Calais, but at Point Lepreaux, New Brunswick, we are without any evidence that this bird belongs to our fauna, and therefore I take it out.

Scolopax rusticola Linn. The European Woodcock has been placed in our list by Dr. Coues inferentially only. We have no facts that warrant our following his conclusion, and I have to omit it.

Anser cærulescens Cassin. Dr. Coues says that if this bird be really a valid species it should take its place in the list of New England birds. But I can find no data for this conclusion. I believe it to be a good species, but one exclusively western, and I have no evidence that a single individual has ever been taken within our limits. Mr. Boardman, who has been quoted as authority, writes me that he has never met with it.

Bernicla leucopsis Linn. I omit this from among the birds of New England, because I am confident that all the instances of its supposed capture have been birds that had escaped from confinement. It is a bird, at best, only accidental in America in a wild state, is not uncommon in private collections of water fowl, and occasionally escapes. Eight birds escaped from the grounds of a gentleman in Halifax, in the fall of 1871 or 1872, many of which were afterwards shot at various points along the coast. The specimen taken in North Carolina and referred to by Mr. Lawrence was probably one of these escaped birds..

Nettion crecca Kaup. The English Teal has been repeatedly taken in various parts of North America. It is, of course, liable to occur in New England; it never has been, so far as I can learn, and therefore comes within my rule of exclusion, as not proven.

Mareca penelope Bon. The same remark applies to the European Widgeon.

Sula fiber Linn. This is given by Mr. Putnam and by Mr. Linsley, and retained by Dr. Coues. As its occurrence would be, as the latter gentleman well remarks, "entirely exceptional," and as the evidence is incomplete, I prefer to place it on probation and await further proof.

Fulmarus glacialis Leach. This is a European North Atlantic species, found off Greenland and Labrador, and generally supposed to be found off our own coast. I am disposed to challenge this as a too readily conceded supposition. It is wholly unsupported by facts. Mr. George A. Boardman, after many years' search, and the offer of large rewards, has been unable to procure a specimen, and doubts its occurrence on our coast.

Puffinus anglorum Temm. Although Dr. Coues gives this as "of not uncommon occurrence off the coast in winter," I can find nothing to encourage this belief. No specimen has been taken, that I can ascertain; Mr. Boardman has never been able to procure one and has no other reason to suppose it is found on our coast than that the fishermen speak of a smaller kind of Hagden, an authority altogether too vague. Nor is there any evidence that it is even a North American bird.

Procellaria pelagica Linn. I omit this for the same reason. Its presence on the shores of North America is unsupported by any facts.

Stercorarius skua Brünn. This, it is now generally conceded, has no claim to be placed in the avi-fauna of New England. Except as accidental in Greenland, it is not even North American.

Larus Hutchinsii Richardson. This is probably identical with *L. glaucus*. If not, it is entitled to a place.

Sterna fuliginosa Wagl. This is a southern species, unknown on our coast, or that of New Jersey.

Rhynchops nigra Linn. This bird evidently has no claim to a place in our avi-fauna. It is of rare occurrence, even on the southern coast of Long Island.

Colymbus arcticus Linn. I can find no authority for including this species among the birds of New England, though its presence is far from being improbable. The nearest approach that I can ascertain is one taken near Point Lapreaux, New Brunswick.

Podiceps cristatus Lath. Although this species has been given as a New England bird, and Mr. Boardman named as authority, this is a misapprehension. Mr. Boardman informs me that he has never met with it. It must therefore be taken from the list. Its right to be regarded even as North American is also questioned.

Mormon cirrhata Pallas. The references to Mr. Boardman as authority for the presence of this Pacific species on our coast, are founded in error. He has never met with it. It rests its claim only on an example, given to Mr. Audubon, and said to have been take off the mouth of the Kennebec River. This, though not impossible, is so improbable that I prefer to place it among the apochryphal birds of New England, until its claim can be supported by stronger evidence.

Dr. J. B. S. Jackson exhibited a curiously malformed sternum of a turkey, containing a large cavity through which the intestine passed.

March 17, 1875.

Vice President S. H. Scudder in the chair. Forty-five persons present.

The following papers were read: —

A Century of Orthoptera. Decade II. — Locustariæ. By Samuel H. Scudder.

Stålia nov. gen.

Head of excessive size, very tumid, smooth, with no prominence excepting the rather irregular raised edges of the antennal sockets, in the region of which the head is slightly depressed; labrum very large, circular; last joint of maxillary palpi very slender, obconical, nearly as long as the two preceding joints combined; first joint of antennæ cylindrical, scarcely depressed, nearly twice as long as broad; second scarcely longer than broad, conical, tapering rapidly; remaining joints filiform, the antennæ being much longer than the body. Pronotum selliform, exceedingly contracted in the middle; the anterior and posterior extremities greatly elevated, covering the head and base of the tegmina, furnished along the lateral carinæ with half a dozen long, acuminate, curving spines; prosternum with a pair of straight acicular spines. Fore femora longer than the middle pair, both provided at the apex, the former anteriorly and a little interiorly, the latter posteriorly and a little exteriorly, with an extensive spinous and deeply serrate, laminate expansion nearly three times as broad as the femora; bases of the fore and middle tibiæ compressed into similar foliate expansions, but not so greatly nor so unequally as the femora; otherwise these limbs are quadrate, sulcate superiorly, enlarged a little at the apex; hind femora exceedingly long and slender, cylindrical, scarcely larger at the base than at the apex, provided apically on either side with a stout divergent spine, and along the entire under surface with a double row of obliquely divergent spines; hind tibiæ conspicuously longer than the femora, slightly sulcate above, the apical spines no larger than the others; first and second tarsal joints bluntly carinate above, the second and third with lateral lobes, those of the third joint larger, bluntly acuminate apically, partially embracing the cylindrical base of the last joint. Tegmina large, exceedingly broad, not so long as the abdomen, erect, the edges broadly eroded, especially below near the apex, the principal vein very prominent, the whole bearing a striking resemblance to a dead leaf; the dorsal and lateral fields are sharply separated by a prominent ridge; wings longer than the tegmina, the exposed portion resembling them. Abdomen very stout, with a single mediodorsal series of small, backward directed spines at the apices of the joints; ovipositor exceedingly broad, compressed, turned abruptly upward in the middle and then rapidly tapering to a point.

This genus, which belongs to the Phyllophoridæ, is very distinct from any other known to me, but is evidently allied, not very distantly, to Hetrodes. It is even more hideous in its appearance, and the close resemblance of its tegmina to a dead leaf with the foliate expansion of the two anterior pairs of legs renders it a most striking object. A similar insect, from Silhet, is figured (Pl. VI, fig. 2) in Wood's "Insects abroad" and called there *Sanaa imperialis*; but it differs entirely from the *Acanthodes imperialis* of White.

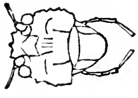


Fig. 1.

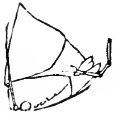


Fig. 2.

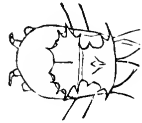


Fig. 3.

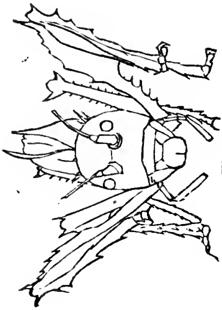


Fig. 4.

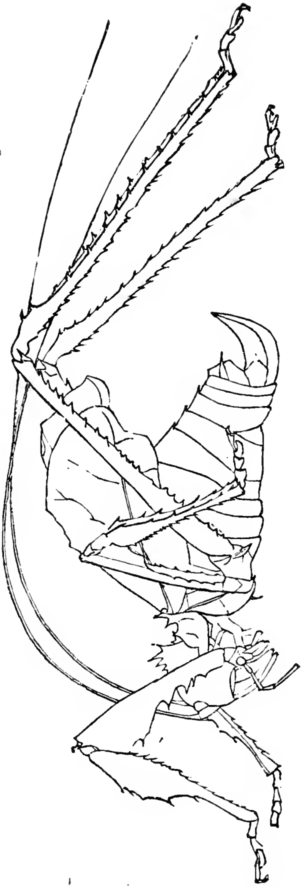


Fig. 5.

11. Stålia foliata. (Figs 3–5.) Obscure yellowish-brown, the antennæ beyond the base blackish, the foliations of the legs, the tegmina and portions of the wings exposed when at rest, of the colour of a dried leaf; lower edge of the pronotum and sides of the meso- and metathorax yellowish; all the femora, excepting the expansions alluded to, brownish-yellow dotted with brown; the middle smaller portion of the fore and middle tibiæ paler than the rest of the joint; tarsi dusky; all the spines black-tipped; under surface and prosternal thorns yellowish; wings surpassing the tegmina by four millimetres, the parts not exposed deep black. Abdomen blackish; ovipositor not half the length of the abdomen, profusely rugulose, dark yellowish-brown.

Length of body, 55.5 mm.; of tegmina, 35.5 mm.; of hind femora, 44.5 mm.; of hind tibiæ, 53.5 mm.; of ovipositor, 14.5 mm.; greatest breadth of ovipositor, 5.75 mm.; of fore femoral foliation, 8.5 mm.; of fore tibial foliation, 5.5 mm. 1 ♀, Old Calabar; received from Andrew Murray, Esq.

Lirometopum (λιρός, μέτωπον) nov. gen.

Body exceedingly stout and heavy. Head large and very short, the entire front completely appressed, declivant, forming less than a right angle with the sides and summit of the head, the trituberculate vertex, the basal antennal joints, eyes and tubercles below them all forming a part of the separating ridge; vertex with a pair of blunt lateral basal tubercles larger than itself, each much larger than and surpassing the basal antennal joint, the minute bidentate apex of the vertex lying between and not surpassing them; the globose prominent eyes are thus separated by a space equal to half the entire breadth of the expanded front, which is itself broader than the pronotum; antennæ slender, longer than the body; mandibles compressed in front with sharp lateral edges. Prosternum unarmed; pronotum well arched transversely without lateral carinæ, the front edge broadly convex, the angle of the posterior humeral sinus large, the posterior border of the upper surface almost straight; legs short, stout, thick; all the femora spined beneath, the fore and middle femora of about equal length; the third tarsal joint prominently bilobed, each lobe produced apically to a sharp angle; tegmina longer than the body, ovate lanceolate, compact; wings not surpassing the tegmina. Ovipositor stout, moderately broad, long and straight.

This most remarkable genus belongs to the Conocephalidæ, but is not closely allied to any of the known genera; its laterally tuberculated and apically bidentate vertical spine allies it to Vestria Stål, but the extreme breadth and shortness of this spine, and the extraordinary flatness of the front of the head, distinguishes it at a glance from every other genus.

12. Lirometopum coronatum. (Figs 1–2.) Uniform testaceous (but doubtless green in life), the prominences of the head, front of mandibles, labrum and the parts above it, as far as a line uniting the bases of the mandibles, piceous; the apices of the principal cross veins on the posterior border of the tegmina, the spines of femora and tibiæ and the ovipositor marked with ferrugino-testaceous; tips of the claws blackish. The lateral carinæ of the head below the eyes rendered conspicuous by about half a dozen slightly appressed, short, blunt, conical tubercles of about the size of the apical portion of the vertex; front with a few broad, slight, vescicular elevations in the central portions and some scattered rugosities between them and the coronate edges of the face. Pronotum with an exceedingly slight impressed line. Ovipositor longer than the body, equal, excepting close to the tip, where it tapers by the excision of the lower side, terminating in a blunt point.

Length of body, 38 mm.; of (broken) antennæ, 60 mm.; of tegmina, 35 mm.; of hind femora, 19 mm.; of ovipositor, 26 mm.; height of face, 16.5 mm.; breadth of face, 12.75 mm. 1 ♀, Greytown, New Granada; received from Mr. P. R. Uhler.

Belocephalus (βέλος, κεφαλή) nov. gen.

Allied to Conocephalus. Body stout. Head of the general form of that of Conocephalus, the vertex greatly produced as a stout subcylindrical thorn, tapering apically, bearing an inferior basal tooth, but no lateral teeth; eyes small, not very prominent. Prosternum bispinous; fore coxæ armed with a slender pointed thorn; pronotum equal, arched, the front and hind border equally rounded, the latter not produced and with a scarcely perceptible humeral excision, the lower anterior angle of the lateral lobes distinct, the lower edge nearly horizontal, slightly and roundly excised in the middle; fore and middle femora of about equal length; hind femora slender, tapering very gradually throughout, the lower terminal lobes with a slight acute spine; tegmina and wings excessively small in the only species known. Ovipositor stout at base but not broad, tapering throughout, very slightly upcurved on the apical half, not very sharply pointed.

13. Belocephalus subapterus. Brownish-yellow, perhaps green in life. Mandibles and lower edge of front black; labrum and palpi yellow; the upper surface of the head and pronotum slightly darker and bounded on either side by a faint slender yellowish line, which runs from the upper edge of the sides of the vertical spine to the back of the head, diverging regularly from the opposite line, and continued parallel to it along the pronotum to the inner edge of the tegmina; it is bordered interiorly on the vertex and the pronotum with blackish, which marks above the outer edges of the vertical spine. This is about as long as the head, its basal half, as viewed from above, equal, beyond tapering to a point which is slightly hooked downward and black; the depending tooth is rather stout, triquetral, black. Tegmina minute, padlike; wings obsolescent. Abdomen with a scarcely perceptible, interrupted, mediodorsal carina; ovipositor about as long as the abdomen, deepening in color at the tip.

Length of body, 38.5 mm.; of vertical spine, 3.5 mm.; of tegmina, 4 mm.; of hind femora, 20,5 mm.; of ovipositor 19.5 mm. 2 ♀. One from N. E. Florida, the other from Florida (Wurdeman).

This is figured by Mr. Glover in his unpublished plates (Orth. pl. XVI, fig. 17). It is also described by Mr. Thomas (Bull. U. S. Geol. Surv., II, 71) as *Acanthacara acuta* Scudd., but it is very different from that species, besides being four times as large.

14. Orchelimum nigripes. Green, with the usual markings of the genus upon the upper surface of the head and pronotum; but readily distinguishable from all other species by the legs, all the tibiæ and tarsi of which, as well as the apical fourth of the hind femora are blackish, though the spines of the hind tibiæ are pale at the base. The wings when closed extend slightly beyond the tegmina, and are a little clouded about the tip; the tegmina surpass a little the hind femora. The ovipositor of the ♀ is rather larger than in allied species, somewhat more curved, broadest in the middle and tapering to a delicate point.

Length of body, 18 mm.; of antennæ, 80 mm.; of tegmina, ♂ 21 mm.; ♀ 25 mm.; of hind femora, ♂, 16.5 mm.; ♀, 19 mm.; of ovipositor, 10.5 mm.; 1 ♂, 1 ♀, Dallas, Texas, J. Boll.

15. Xiphidium strictum. Sides of head and body, together with all the femora and tibiæ, green. Summit of the head with a rather broad reddish-brown longitudinal band, extending from the front extremity of the fastigium to the back of the head, edged narrowly with white, distinctly on the fastigium, indistinctly behind it, and traversed by a faint pale mediodorsal line. Pronotum with a narrow lateral stripe of reddish-brown on either side, bordered exteriorly and to a slight extent interiorly with whitish, the two stripes parallel, separated from each other by a sufficient space to include the cephalic stripe between them, united by a slender cross line of reddish-brown next the front edge; tegmina exceedingly short, padlike, greenish next the hind edge, the rest striped longitudinally in brown and sordid white; wings reaching when at rest the tip of the tegmina; tarsi more or less infuscated, spines of tibiæ blackish. Abdomen dull reddish-brown above with a pale lateral stripe edged beneath more or less distinctly with dark reddish-brown or blackish; ovipositor excessively long, being longer than the whole body, pale testaceous, tinged near the base with green.

Length of body, 18 mm.; of tegmina, 4.5 mm.; of hind femora, 16.5 mm.; of ovipositor, 25 mm. 2 ♀, taken July 18, and October 5, by J. Boll in Dallas, Texas.

16. Xiphidium antipodum. Green, with a broad mediodorsal very dark reddish-brown stripe on the head and pronotum, sometimes intense only at its outer borders and generally indicated on the abdomen by a lateral blackish stripe. Tegmina testaceous; hind femora tipped at the extreme apex with fuscous, all the tibiæ tinged with testaceous, the tarsi dusky. Vertex moderately broad, much constricted at the front edge of the eyes, greatly narrowing on the face to meet the slender frontal costa. Pronotum with a faint mediodorsal impressed line; tegmina more (♂) or less (♀) than half as long as the abdomen, broadly rounded at the tip, the veins rather prominent, the tympanum of the male unusually large and coarse; legs rather long. Ovipositor rather slender, fully as long as the abdomen, scarcely upcurved on the tapering apical fourth, delicately pointed.

Length of body, ♂, 17.5 mm.; ♀, 16 mm.; of tegmina, ♂, 8 mm.; ♀, 5 mm.; of hind femora ♂, 14 mm.; of ovipositor ♀, 12 mm.; 1 ♂, 1 ♀, and several immature. N. Zealand, H. Edwards.

17. Xiphidium meridionale. Green, with the whole upper surface rather dark reddish-brown, faintly bordered with yellowish; hind femora tipped with fuscous at the extreme apex, the hind tibiæ rather dull green, the tarsi infuscated. Vertex moderately broad, somewhat pinched at the front edge of the eyes, narrowing but little to meet the frontal costa. Tegmina much abbreviated, less than half as long as the abdomen, tapering, sub-triangular, bluntly pointed, the veins moderately prominent; legs rather short, the hind femora with a row of very distant black spines, five in number, along its inferior carina beyond the swollen base. Ovipositor much longer than the abdomen, very nearly straight, rather slender, tapering on the apical fourth, delicately pointed.

Length of body, 14 mm.; of tegmina, 5.5 mm.; of hind femora, 13 mm.; of ovipositor, 13 mm. 1 ♀, Brazil; purchased of Mr. Janson.

18. **Xiphidium ictum.** Green, with a brownish abdomen; the usual dorsal markings of the head and thorax are intense in color, forming a broad dark reddish-brown, almost blackish stripe, extending from the tip of the vertex to the extremity of the pronotum, widening posteriorly, but growing faint at its extreme posterior extremity; it is bordered narrowly with citron-yellow; the tegmina are wood-brown, the tarsi and tips of hind femora a little dusky, the hind tibiæ scarcely infuscated. The fastigium of the vertex is moderately broad, scarcely pinched at the front edge of the eyes, narrowing but little on the face to meet the frontal costa. Tegmina as long (♂) or half as long (♀) as the abdomen, rounded at the tip, the cross veins rather prominent. Ovipositor a little longer than the abdomen, perfectly straight, moderately broad and tapering only at tip.

Length of body, ♂, 12 mm.; ♀, 14 mm.; of tegmina, ♂, 8 mm.; ♀, 5.75 mm.; of hind femora, ♂, 10 mm.; ♀, 12 mm.; of ovipositor, ♀, 10.5 mm. 9 ♂, 14 ♀, Mexico, April, Sumichrast; Guatemala, Van Patten.

19. **Xiphidium gossypii.** Green, with the whole upper surface not very dark reddish-brown bordered externally with faint, dull citron-yellow, the antennæ and tegmina testaceous; fore and middle femora a little infuscated above, the hind tibiæ slightly tinged with testaceous and all the tarsi a little infuscated. Vertex moderately broad, somewhat pinched at the front edge of the eyes, narrowing somewhat to meet the frontal costa. Tegmina about half as long as the abdomen, sub-acuminate, the veins moderately prominent. Ovi-

positor dark testaceous, longer than the abdomen, perfectly straight, tapering only on apical fourth, finely pointed.

Length of body, ♀, 16.5 mm.; of antennæ, ♀, 50 mm.; of tegmina, ♀, 8.75 mm.; of hind femora, ♀, 16 mm.; of ovipositor, ♀, 13.5 mm.; 2 ♀. Texas, Belfrage; Mississippi. This is the insect referred to in the Proceedings of the Boston Society of Natural History, XI, 434–5, as laying its eggs in the stems of the cotton plant. Dr. Hagen's specimens were from Chicot Co., Arkansas. "The eggs were pale yellow, one-fifth of an inch long, cylindrical, bluntly pointed and a little tapering at the end from which the larva emerges; the other extremity was rounded."

20. Xiphidium nemorale. Greenish-brown; the usual dorsal markings more or less distinct. Fastigium of vertex broad, but little pinched at the front edge of the eyes, as viewed from above, rapidly narrowing in front to meet the frontal costa. Tegmina covering about two-thirds of the abdomen, the veins and cross veins unusually prominent, giving the tegmina a coarse and scabrous look; they are broadly rounded at tip, and the tympanum of the males is stout and elevated; tip of hind femora and all the tarsi dusky. Ovipositor as long as the abdomen, a little ensiform, rather delicately tapering in the apical half, finely pointed.

Length of body, ♂, 13 mm.; ♀, 14 mm.; of tegmina, ♂, 6 mm.; ♀, 6.25 mm.; of hind femora, ♂, 11 mm.; ♀, 13 mm.; of ovipositor, ♀, 8.25 mm. 14 ♂, 24 ♀, "taken only in groves" by Mr. J. A. Allen, Sept. 1–3, in Dallas Co., Iowa.

Notes on the Chemical Composition of some of the Mineral Species accompanying the Lead Ore of Newburyport. By Miss Ellen H. Swallow.

The country rock is apparently a fine grained gneiss. The strike of the vein is about East North East.

The rock of the south wall is of unknown thickness. The distance between the vein as now opened and the gneiss may be fifty feet or more. This rock is compact amorphous, pale yellowish green in color with the lustre of serpentine. Quartz grains are evenly distributed through it as seen under the microscope, and as confirmed by examining the powder with polarized light. It also contains small crystals of pentagonal pyrite. Sp. Gr. 2.766, Hardness 2.5, fusible only on thin edges, very little attacked by acids.

The analysis gave:—

Silica SiO_2	66.53
Alumina Al_2O_3	25.09
Peroxide of Fe_2O_3	trace
Potash K_2O	4.67
Soda Na_2O	.39
Water H_2O	2.64
MgO, CaO	traces
	99.32

These percentages taken in connection with the physical characters point to the Pinite group. Taking the alumina as a basis of calculation the results are:—

SiO_2	56.93
Al_2O_3	33
K_2O	6.11
Na_2O	.51
H_2O	3.45
	100.00

which would leave 22.56 per cent. of silica as quartz.

The calculated percentages most nearly agree with Agalmatolite from China as given in Dana's Mineralogy.

The north wall is a rather fine grained, very compact, dark grayish green rock, containing numerous small crystals of pyrite. Sp. Gr. 2.71. Fusible on the edges to a black slag which is magnetic. Equally attacked by hydrochloric, nitric and sulphuric acids. Effervesces with cold dilute acid, which dissolves a portion of the iron as well as lime. When powdered and examined under the microscope it seemed to be composed of three minerals; one a pale yellowish green resembling the south wall, an olive green transparent mineral sometimes bladed or showing cleavage in one direction, and very small opaque fragments appearing black. After treatment with acids the green mineral was wanting.

Analysis gave:—

S	.14
CO_2	3.31
H_2O	5.53
FeO	7.54
Al_2O_3	22.32
CaO	2.58
SiO_2	15.01
$Na_2O + K_2O$	.85
Insoluble	42.59
	99.59

The insoluble portion was fused with carbonate of soda and found to be a silicate of somewhat similar composition as the south wall.

Soluble portion.		*Insoluble portion.*	
S	.25	SiO_2	66.44
CO_2	5.60	Al_2O_3	26.73
H_2O	9.67	CaO	6.10
Na_2O, K_2O	1.50	MgO	traces
SiO_2	26.25	Na_2O, K_2O	.80
FeO	13.19		100.07
Al_2O_3	39.03		
CaO	4.51		
	99.90		

The composition of the soluble portion does not agree with any described species and may be owing to a mixture of two or more, although the microscopical examination seemed to indicate a definite mineral. Siderite is perhaps present here.

Siderite is quite abundant in the vein rock, especially in connection with the blende. Among the specimens are 1st, a black variety containing traces of lime and magnesia with some manganese and slight traces of lead and copper. 2d. A yellowish gray of nearly the same composition minus the lead and copper. 3d. A nearly pure white variety traversing quartz. This was subjected to examination. Lustre like feldspar. The analysis gave: —

Quartz as impurity	.72
$FeCO_3$	46.84
$MnCO_3$	6.49
$MgCO_3$	8.83
$CaCO_3$	34.32
H_2O	undet.
	98.20

The per cent. of magnesia and lime is unusually high. Monheim's analysis of the Altenberg mineral which approaches this more nearly in composition than any other given by Dana, is as follows: —

$FeCO_3$	64.04
$MnCO_3$	16.56
$CaCO_3$	20.12

A very pure piece of the Tetrahedrite from the vein gave: —

S	27.60
Sb	25.87
As	traces
Cu	35.85
Fe	2.66
Zn	5.15
Ag	2.30
	99.40

Note on some Points connected with Tidal Erosion. By N. S. Shaler.

Owing to the fact that tidal waves heap themselves up in every indentation on the coasts against which they sweep, we have in them a continued diversifying agent, the geological effects of which it is important to consider. Taking, for instance, the most striking example of tidal wear on this coast, that which is going on in the Bay of Fundy, it is quite easy to see that the erosion there is dependent on the closure of the bay on the north, or, in other words, the preservation of the wedge-like arrangement of the shores. As soon as the eating action has opened a pass into the Gulf of St. Lawrence, the tides will cease to act with the same vigor, and whenever the current has swept out the opening to considerable width, the extraordinary rise of tide may be almost entirely effaced.

When we look at the shore lines of the world we find that they are generally much indented and strewn with islands in those regions where tide runs are pretty strong. It happens that in many places, especially in the North Atlantic, the indentations due to the glacial period and to tides are mingled together. In the British Isles we have a remarkable mingling of the two types of erosion, giving us, in many cases, substantially the same results. I am inclined to think that the coast line of Scotland owes little to tides, while southern England probably owes very much to their action. In the formation of the Bristol Channel tidal action has had a very great part, and I am inclined to think that the English Channel is in good part due to this form of erosion. If we could close the Straits of Calais by an isthmus, we would at once cause the tides on both sides to rise very much above their present level, and thereby immensely increase their erosive power. At present the slight value of tidal wear is no fair measure of its value while its work was incomplete.

These considerations could be used to explain the erosion phenomena of many parts of the earth's surface, but in the limits of this note I only desire to present the following propositions, which embody what seem to me to be the essential points in a consideration of tidal erosion.

1. The intensity of the forces of tidal erosion is proportional to the height to which the wave rises.

2. Given any slight irregularities of a shore, tides tend to deepen the indentations until one of two results is obtained: (A) that a channel is broken open into another great water basin, or (B) the bay or indentation becomes so narrow that friction arrests the further rising of the wave.

3. Operating in this way tidal currents tend to form islands by breaking them away from the continents, or other islands; when the sundering is effected the intensity of the eroding agent is at once lost.

4. This sort of erosion may, in its results, closely simulate the forms of shore given by glacial action; in many cases glacial action may have simply developed and given the details to bays that were really of tidal origin.

5. By familiarizing ourselves with the type of topography formed by tidal action, we may be able to determine the fact that the run of tidal currents has been considerably changed on particular shore lines. For instance, it is quite likely that a close study of the topography of the north coast of the Mediterranean will show, what seems to me probable on a preliminary inspection, that this coast has been formed during geographical conditions, which allowed strong tidal currents to work upon it.

6. That in general we must look to this cause as the natural diversifying agent of all shore lines. The elevatory forces merely give the great outlines of the coast. The detail must be worked in by the action of the sea, and this is to a great extent effected by tides.

7. Tides act most where the waves act least. Were it not for them the action of the sea would be mainly limited to the parts which could get the full surge of the ocean. This latter action tends rather to straighten than to complicate shores.

The thanks of the Society were voted to Capt. Charles Bendire, U. S. A., for the donation of ten bird-skins to the Museum.

Section of Entomology. March 24, 1875.

Mr. J. H. Emerton in the chair.

The following paper was read: —

Spharagemon, — a Genus of Œdipodidæ; with a Revision of the Species. By Samuel H. Scudder.

Spharagemon (*σφαραγέομαι*) nov. gen.

Body compressed. Head rather tumid above, the vertex as declivant as the back of the head, broad, tapering rapidly, scarcely sulcate, the eyes separated by more than double the width of the basal antennal joint. Front vertical, scarcely convex on a side view, the costa moderately broad, nearly equal, slightly contracted above the antennæ, more or less sulcate throughout, excepting at the extreme upper end, its lateral ridges continuous with those of the vertex, the lateral foveolæ rather small, scarcely sulcate but more or less distinct, triangular, close to the eyes. Eyes rather small, transversely short obovate. Antennæ about as long as the hind femora in both sexes, a little flattened, especially near the base, some of the apical joints very short. Disc of pronotum moderately flat, the median carina cristate or subcristate, strongly compressed almost from its very base, divided obscurely but to the very base by the principal transverse furrow into two parts, the front portion a little the longer, the edge of the ridge straight or nearly straight on the front lobe, and arched more abruptly in front than behind on the hind lobe; lateral carinæ nearly obsolete, excepting behind; the front lobe equal, its front margin very slightly angulated; hind lobe expanding posteriorly, its hind margin generally more acute than a right angle. Tegmina extending beyond the tip of the abdomen, nearly equal, slightly sinuous, obliquely excised apically, traversed by three bands of more or less distinctly agglomerated dark flecks. Wings subtriangular, yellowish at the base, crossed beyond the middle by a continuous broad dark belt. Hind femora rather stout and short, scarcely, if at all, surpassing the tip of the abdomen. Type: *Gryllus æqualis* Say.

Synopsis of the species.

1. Median incision of the pronotal crest distinctly oblique . 2.
1. Median incision of the pronotal crest vertical . . . . . 4.
2. Median carina very high, the height of the front portion of the posterior lobe equalling the height of the eye . . . . *cristatum.*
2. Median carina moderately high, the height of the front portion of the posterior lobe nearly equalling the depth of the eye . . . . 3.
3. Tegmina with the usual transversely trifasciate arrangement of fuscous dots . . . . *collare.*
3. Tegmina "with a broad stripe of fuscous dots and small spots along the middle field, from the base to the apex" (Thomas) . . . . *wyomingianum.*[1]
4. Tip of wings infuscated . . . . 5.
4. Tip of wings pellucid, excepting the dark veins . *balteatum.*
5. Hind tibiæ red, with a distinct pale basal annulus, more or less, generally very broadly and distinctly bordered on both sides with black . . . . *Bolli.*
5. Hind tibiæ wholly red, or at most with only a faint pale basal annulus . . . . *æquale.*

1. Spharagemon æquale.

Gryllus æqualis Say, Journ. Acad. Nat. Sc. Phil., IV, 307; Ib., Ent. N. Amer., ed. LeC., II, 237.

Locusta æqualis Harr., Hitchc. Report, 583; Ib., ib. 2d ed., 576; Ib., Catal., 56; Ib., Ins. Inj. Veg., 1st ed., 144; 2d ed., 165; 3d ed., 178.

Œdipoda æqualis Erichs., Archiv f. nat., IX, ii, 230; Uhl., in Harr. Ins. Inj. Veg., 3d ed., 178; Scudd., Can. Nat., VII, 287; Ib., Bost. Journ. Nat. Hist., VII, 470; ? Thom., Proc. Acad. Nat. Sc. Phil., 1870, 80; Walk., Cat. Derm. Brit. Mus., IV, 731.

Trimerotropis æqualis Scudd., Geol. N. Hampsh., I, 377.

This species has been confounded by Uhler and Smith with *Trimerotropis verruculata* (Kirb.) Scudd., from which it is generically distinct. I have taken it in Vermont, about Boston, on Cape Cod and at Nantucket, Mass., in Minnesota and the Red River of the North. It has been taken in Maine by Dr. Packard and Mr. Smith,

[1] I have never seen this species.

and by other persons in Maryland, Iowa, Dakota and N. Illinois. Walker refers specimens from Florida to this species, and Mr. Boll took a single specimen last year on July 7, in northern Texas. Thomas refers specimens from Colorado and Wyoming doubtfully to this species.

2. **Spharagemon Bolli** nov. sp.

Brownish fuscous, the face with a greyish cinereous (♂) or yellowish cinereous (♀) tinge, distinctly punctate, the pits dusky or blackish; antennæ brownish yellow on the basal half, infuscated beyond, the whole more or less annulate with dusky yellow and blackish in the male. Tegmina flecked throughout with minute blackish spots, and transversely trifasciate with rather broad blackish clouds, much more distinct in the male than in the female. Wings light greenish yellow at the base, with a broad median arcuate band, blackish or almost piceous in color, sending a broad, short shoot toward the base, next the upper border. Beyond, the wing is at first hyaline, with broadly blackish fuliginous veins, while the extreme tip is black as the median band. Hind femora dull brownish, quadrifasciate transversely with dark brown, more distinctly in male than in female, the basal two-fifths of the hind tibiæ blackish, with a broad whitish annulus, beyond coral red. Crest of pronotum very high, that of the posterior lobe independently arched, much more elevated in front than behind.

Length of body, ♂, 28.5 mm., ♀, 36.5 mm.; of antennæ, ♂, 16 mm., ♀, 18 mm.; of tegmina, ♂, 32 mm., ♀, 34.5 mm.; of hind femora, ♂, 18 mm., ♀, 20.5 mm. Described from 4 ♂, 4 ♀. The males taken Sept. 10, the females July 18 and August 18, 21, 23, at Dallas, Texas, by J. Boll.

This species has been confounded with *S. æquale*, from which it may be readily distinguished by the hind tibiæ; the tip of the wings is generally darker, and the median band does not approach the anal angle so closely; the tegmina are more distinctly trifasciate, the front half of the median crest of pronotum is less pinched posteriorly, and the hinder half less arched.

I have specimens also from Vermont, Massachusetts, Maryland and Iowa. They are smaller than those from Texas.

3. **Spharagemon balteatum** nov. sp.

Grayish fuscous, the face generally pale cinereous, dotted obscurely with fuscous; antennæ dusky, paler next the base; tegmina dull testaceous, the usual transverse fasciæ present but obscure, sometimes very inconspicuous. Wings pale greenish yellow at the base, with a very broad, median, arcuate, blackish fuscous band, emitting near the costal margin a broad short shoot toward the base; the costal margin at the limit of the band, and for an equal space beyond it blackish fuscous, generally a little darker than the band; beyond the median band the wing is hyaline, with brownish fuliginous nervures and cross nervures, and in the male a very slight infuscation at the extreme tip. Hind femora brownish cinereous, transversely fasciate with brown, more or less deep in tint; hind tibiæ coral red, unusually sinuous at the base, broadly banded at this point with dull white, bordered broadly, and generally very distinctly, with blackish. Crest of pronotum moderately high, the front lobe usually, the hind lobe always, slightly arched, the two lobes having a slight angle to each other.

Length of body, ♂, 19 mm., ♀, 34 mm.; of antennæ, ♂, 12.25 mm., ♀, 15.5 mm.; of tegmina, ♂, 25 mm., ♀, 35.5 mm.; of hind femora, ♂, 13 mm., ♀, 20 mm.

Described from 1 ♂, N. Jersey; 9 ♀, Norway, Me. (S. I. Smith); Brandon, Vt., on upland; Maryland, Aug. 10, 13, and Sept. 15, 19 (P. R. Uhler); Dallas, Texas, Aug. 13 (J. Boll).

4. Spharagemon wyomingianum.

Œdipoda wyomingiana Thom., Geol. Surv. Terr., 1871, 462; Ib., Syn. Acrid. N. Amer., 113; Glover, Ill. Orth., pl. 14, fig. 1, pl. 15, fig. 2 (ined.).

Considered by Thomas as possibly a variety of the next species. Eastern Wyoming.

5. Spharagemon collare.

Œdipoda collaris Scudd., Geol. Surv. Nebr., 250; Thom., Geol. Surv. Terr., 1871, 459; Ib., Syn. Acrid. N. Amer., 113; Glov., Ill. Orth., pl. 13, fig. 8.

This species, first described from the borders of the Platte, in Nebraska, has been taken by Mr. Dodge in Glencoe, Dodge Co., of that State; by Mr. Thomas in Colorado, east of the mountains; in northern Illinois and the Red River of the North by the late Mr. Kennicott; by Mr. J. A. Allen in Jefferson, Iowa, between July 20 and 24, and in Dallas Co., Iowa, Aug. 20–23.

6. Spharagemon cristatum nov. sp.

Dark yellowish brown, profusely mottled and flecked with grayish cinereous, the dark color generally predominating, and sometimes becoming blackish upon the summit of the head, the sides of the pronotal crest, and in a couple of short longitudinal stripes along the anterior half of the lateral lobes of the pronotum; the hinder edge of the pronotum is usually alternately pale and dark; antennæ dusky, yellowish brown at the base, and annulate with yellowish brown for some distance beyond it; tegmina mottled with dark cinereous and blackish brown, the latter most conspicuous in an agglomeration of these spots just before the middle, half way between that and the base, and at an equal distance beyond the middle band; the apical fourth of the wing is obscurely subhyaline, occasionally with a slight concentration of dark spots at the tip; the lighter colors predominate along the costal margin on either side of the median dark patch. Wings light greenish yellow at the base, sometimes tinged to the least possible degree with saffron (more noticeable in the closed wing), with a moderately broad, blackish fuscous, arcuate mesial band, at the costal border (but omitting the costal edge) extending abruptly a short way toward the base of the wing; beyond this band the wing is hyaline, with blackish fuscous nervures, some of the cells near the tip partially or wholly fuligino-fuscous, forming a more or less marked infuscation. Hind tibiæ coral red, the extreme base black, followed by a more or less distinct pale annulation. Crest of pronotum exceedingly high, arched pretty regularly, the hinder extremity of the anterior lobe sometimes overlapping the front of the posterior lobe; the posterior border of pronotum very acutely angled.

Length of body, ♂, 26.5 mm., ♀, 36.5 mm.; of antennæ, ♂, 13.5 mm., ♀, 14.6 mm.; of tegmina, ♂, 30.25 mm., ♀, 36 mm.; of hind femora, ♂, 16 mm., ♀, 20 mm.

Described from 11 ♂, 7 ♀, taken in Dallas June 3, 23, Aug. 21, 23, by J. Boll, and one specimen in Waco, as late as Oct. 16, by G. W. Belfrage.

April 7, 1875.

Vice-President, Mr. S. H. Scudder, in the chair. Fifty-two persons present.

Dr. W. J. Hoffman, of Reading, Pa., was elected a Corresponding Member; Mr. Stephen P. Sharples, Lieut. E. L. Zalinski, Messrs. Warren B. Potter, W. K. Brooks, Prof. John

McCrady, Messrs. J. Frank Brown, B. E. Brewster, Andrew G. Weeks, Prof. George L. Goodale, Rev. Walter R. Brooks, Messrs. Edward B. Crane, and Alfred P. Gage were elected Resident Members.

The following papers were read: —

A CENTURY OF ORTHOPTERA. DECADE III. — ACRYDII (PEZOTETTIX, CALOPTENUS). BY SAMUEL H. SCUDDER.

21. Pezotettix olivacea. Bright olivaceous green. Summit of the head with a dark green median stripe, broadening posteriorly; sides of head, and sometimes the front, tinged with yellow; the pronotum covered rather profusely with short longitudinal dashes of lemon yellow, rather irregularly distributed, but distinctly marking the median carina, excepting at its posterior extremity, and also the two extremities of the lateral carinæ; antennæ green at base, beyond orange, infuscated at the extreme tip. Tegmina half the length of the abdomen, green; legs stout, green, the fore and middle femora more or less tinged with dull orange; the outside of the hind femora slightly infuscated, the tibial spines black-tipped. Terminal segment of the male abdomen acuminate at the tip, but with an apical tubercle; cerci slender, the basal half tapering, the apical half as broad, equal, the tip rounded, but a little produced, the outer surface slightly furrowed on the apical half.

Length of body, ♂, 21 mm., ♀. 29 mm.; of antennæ, ♂, 10.5 mm., ♀, 10.5 mm.; of tegmina, ♂, 8.5 mm., ♀, 13.5 mm.; of hind femora, ♂, 13.5 mm., ♀, 17.5 mm. 2 ♂, 1 ♀, taken Sept. 9, at Dallas, Texas, by J. Boll.

22. Pezotettix acutipennis. Blackish fuscous, with a dull olivaceous tinge; excepting the abdomen pilose throughout. Head mottled irregularly with darker and lighter shades, a dark triangular spot in the middle of the posterior part of the summit, and generally an obscure dark band passing backward from the hinder edge of the eyes and crossing a portion of the sides of the pronotum; antennæ pale yellowish, infuscated at extreme tip. Pronotum delicately rugulose, the median carina distinct, the dorsum sloping more in the female than in the male; wings less than half as long as the body, tapering to a blunt point, dark brown, the veins and cross veins generally paler and olivaceous; legs dusky, the middle femora blackish externally; the hind femora more or less indistinctly trifasciate with blackish; hind tibiæ livid, mottled minutely and profusely with brown; the apical half of the spines black. Extreme tip of abdomen in the male acuminate, but tubercled; cerci slender, tapering, more rapidly in the basal than the distal half, to a dull point.

Length of body, ♂, 20.5 mm., ♀, 24.5 mm.; of antennæ, ♂, 10.5 mm.; of tegmina, ♂, 8 mm., ♀, 8 mm.; of hind femora, ♂, 13 mm., ♀, 15 mm. 2 ♂, 1 ♀, Dallas, Texas, J. Boll. In woods on plants and bushes, September – October, Bosque Co., Texas, G. W. Belfrage.

23. Caloptenus ponderosus. Brownish testaceous. Front of head and sides of pronotum a little paler, tinged with yellow, the head obscurely flecked with brown; antennæ yellow, infuscated toward the tip. Slight black markings follow the anterior portion of the lateral carinæ of the pronotum and the transverse incisures of its lateral lobes; tegmina as long as the body, light brownish fuscous, rather obscurely mottled with faint dusky quadrate spots in the median area, mostly confined to the basal half of the field; legs stout, a little darker than the under surface of the body, the middle femora infuscated, the hind femora obscurely, transversely bifasciate with black, broken by the paler incisures; hind tibiæ and tarsi yellow, the former with a slender black basal annulus, the spines black. Vertex between the eyes much broader than (♂) or twice as broad (♀) as the basal antennal joint, the foveola broad, broadening in front, scarcely depressed, the lateral edges sharp; frontal ridge broad, broadening below, broadly and shallowly sulcate excepting above. Pronotum broadening a little on the rugulose posterior lobe, the median carina slight, broken by every transverse furrow; lateral carinæ rather distinct, but slight. Terminal segment of abdomen of male produced but rounded; cerci very stout, subspatulate, compressed, largest at tip, the basal two-fifths being equal and straight, the remainder expanding into an obliquely transverse, obovate, rounded lobe, directed upward and more produced above than below, making the tip fully half as broad again as the base.

Length of body, ♂, 30 mm., ♀, 33 mm.; of antennæ ♂, 12 mm., ♀, 12.5 mm.; of tegmina, ♂, 21.5 mm., ♀, 23 mm.; of hind femora, ♂, 17.5 mm., ♀, 19 mm. 1 ♂, 1 ♀, taken October 10, at Dallas, Texas, by J. Boll.

24. Caloptenus robustus. Brownish fuscous with more or less of a cinereous tint. Front of head livid, very heavily mottled with dark brown; mouth parts pale, the tip of last palpal joint black; antennæ pale at base, beyond dull reddish more or less tinged with yellow, toward the tip infuscated. A slender blackish stripe passes from behind the eyes to the hind lobe of pronotum, sometimes interrupted, sometimes accompanied by an infuscation beneath, broadening the band; upper surface more or less flecked with dark brown, sometimes collected into a V-shaped patch opening forward, the apex at the middle of the posterior lobe; hind border dotted with blackish; posterior lobe profusely, rest of upper surface sparsely, all shallowly, punctate; sides of metathorax with an pale oblique stripe narrowing upward to a point; tegmina blackish or brownish fuscous, flecked rather distantly with brownish spots, relieved by similar pale ones along the middle; legs of the color of the undersurface, the fore and middle femora a little deeper or duskier; hind femora broadly bifasciate with blackish, the apex black at the sides; hind tibiæ and tarsi yellow, occasionally tinged with red, paler next the base with a black annulus; spines black. Vertex broader (♂) or much broader (♀) than the first antennal joint, the fastigium with a scarcely perceptible depression (♀) or slightly sulcate (♂), broadening in front; frontal ridge broad, nearly equal, a little sulcate below the ocellus. Median carina of pronotum slight, distinct only on the posterior and anterior lobe, cut by all the transverse furrows; lateral carinæ rather distinct, rounded. Last abdominal segment of the male a little produced, rounded; cerci very large and stout, compressed, broadening apically, well rounded, very similar to those of *C. ponderosus*, but not so broad at the tip.

Length of body, ♂, 29.5 mm.; ♀, 34.5 mm.; of tegmina, ♂, 21 mm.; ♀, 24 mm.; of antennæ, ♂, 13.5 mm.; ♀, 15 mm.; of hind femora, ♂, 17.5 mm.; ♀, 21 mm. 3 ♂, 4 ♀, Dallas, Texas, J. Boll.

25. Caloptenus devorator. Yellow, tinged more or less with brown. Head and prothorax yellowish-brown above, bright yellow on the sides and front, with a distinct, well defined, black band, passing from the hinder edge of the eyes to the division between the middle and hind lobes of the pronotum, narrowly interrupted at the front edge of the pronotum and sending a shoot downward around the lower edge of the eye; sides of the thorax with a broad oblique blackish stripe enclosing the spiracle; abdomen yellow obscured with fuscous; antennæ yellow at base, dusky beyond; legs yellow, the two front pair of femora tinged with dirty orange above, the upper half of the hind femora blotched with reddish fuscous, the hind tibiæ and tarsi and the inferior carinia of hind femora bright orange-red; spines black tipped; tegmina yellowish-brown with a few minute dusky dots scattered through the middle area, especially in the basal half of the wing where it narrows. Vertex of the head very narrow between the eyes, scarcely broader than the first joint of the antennæ, the foveola rather deeply sulcate, broadening a little below with high but rounded edges; frontal ridge nearly equal throughout, rather shallowly sulcate at and below the ocellus. Pronotum scarcely enlarged posteriorly; median carina very slight, equal, cut only by the posterior transverse furrow; lateral carinæ obsolescent, posterior lobe of pronotum punctulate. Terminal segment of abdomen of male squarely docked at tip; cerci rather broad at base, tapering on basal half to about half their width, then equal, and slightly incurved, the lower outer angle rounded off and the outer surface slightly ridged.

Length of body, 21.75 mm.; of antennæ, 9.5 mm.; of tegmina 18 mm.; of hind femora, 13 mm. 2 ♂, taken 15 July, at Dallas, Texas, by J. Boll.

26. Caloptenus deletor. Brownish fuscous, darkest above, Front of head and sides of pronotum dull, livid brown, with an indistinct maculate dusky band between the eyes and the hind lobe of the pronotum, sometimes reduced to a mere line below the lateral carinæ; antennæ pale reddish, infuscated apically. Tegmina as long as the body, brownish fuscous, with a median line of alternate pale and fuscous spots; fore and middle legs pale dull brownish, the middle femora blackish above, all the tarsi marked with blackish; hind femora with the upper outer half blackish, sometimes broken into very oblique dashes by a median and postbasal yellowish streak; hind tibiæ and tarsi red with a narrow black basal annulus, the tarsal joints tipped with blackish fuscous. Head not elevated, well arched; vertex a little broader than the first antennal joint, the foveola shallow with slight but rather sharp lateral edges, greatly expanding anteriorly; frontal ridge broad, expanding a little next the ocellus and a little sulcate in the same part. Pronotum faintly constricted in the middle, the median carina distinct but slight, nearly equal, cut only by the posterior transverse furrow; lateral carina indistinct excepting on the posterior lobe, the latter obscurely punctate. Terminal segment of abdomen in the male broadly rounded at the tip; cerci long and slender, compressed, a little incurved, broadest at the base, uniformly and very slightly tapering on the basal half, beyond equal, bent a little forward, broadly and roundly docked at tip, and emitting from the posterior angle a slender, compressed, scarcely tapering shoot rounded at the tip, running in the direction of the upper edge of the basal half of the cerci in the same general plane.

Length of body, ♂, 23.5 mm., ♀, 30.5 mm.; of antennæ, ♂, 11.5 mm., ♀, 12 mm.; of tegmina, ♂, 21 mm., ♀, 22 mm.; of hind femora, ♂, 14.5 mm., ♀, 16 mm. 1 ♂, 1 ♀, Dallas, Texas, J. Boll.

27. **Caloptenus helluo.** Dark yellowish-brown. Head with a superior, median, maculate, black stripe broadening posteriorly, extending from the foveola of the vertex, just behind which it is interrupted, to the hind edge of the head; foveola of vertex and frontal ridge maculate with black; antennæ dusky. A broad irregularly maculate black band passes from behind the eyes to the last transverse furrow of the pronotum; tegmina dusky olivaceous with small, quadrate, nearly equal, dusky spots scattered throughout; legs brownish-yellow flecked with black, the hind femora transversely and rather indistinctly fasciate with blackish; hind tibiæ dull reddish, indistinctly livid along the outer edge and next the base, flecked next the base with dusky specks, pilose throughout; spines black. Head much elevated, rounded; vertex narrow, equalling between the eyes the width of the first antennal joint; foveola more than usually declivant, broadening in front, rather deeply and uniformly sulcate, the lateral edges pretty high and sharp; frontal ridge moderately broad, equal, shallowly sulcate below the ocellus. Pronotum with the posterior lobe expanding; the median carina distinct but cut by all the transverse furrows, distinctly angulated, on a side view, in front of the posterior lobe; the latter rather heavily punctate; lateral carinæ obsolete, excepting in the posterior lobe; whole head and pronotum sparsely pilose.

Length of body, 27 mm.; of antennæ, 12 mm.; of tegmina, 23 mm.; of hind femora, 14.5 mm. 2 ♀, Dallas, Texas, J. Boll.

28. **Caloptenus glaucipes.** Wood brown. Head and pronotum livid brown, flecked heavily with blackish, more heavily and minutely above, giving it a wood-brown appearance; a broad black band extends from behind the eyes to the posterior edge of the pronotum, broadening on the hinder lobe of the latter; antennæ orange red, paler at base. Tegmina as long as the body, brown, with a few dusky flecks along the central field; legs darker or lighter brownish yellow, flecked with dusky, the hind femora bifasciate above with blackish, besides a blackish base and apex; hind tibiæ and tarsi glaucous, with a pale annulus at the base, interrupted in the middle by a blackish glaucous ring. Vertex moderately narrow between the

eyes, scarcely wider than the first antennal joint; foveola of vertex narrow, with sides broadening a little in front, pretty sharply defined, enclosing a moderately deep sulcus, deepest posteriorly; frontal ridge rather broad, the sides nearly parallel, fading out below with a sulcus scarcely perceptible, excepting about the ocellus. Pronotum equal, the median carina very slight, most distinct on posterior lobe, cut by every transverse incision; lateral carinæ obsolete. Terminal segment of abdomen in male roundly acuminate; cerci broad at base, scarcely twice as long as broad, subreniform, well rounded, but little smaller on the apical half. Allied to *C. flavolineatus*.

Length of body, ♂, 22.5 mm., ♀, 28 mm.; of antennæ, ♂, 9.5 mm., ♀, 9.5 mm.; of tegmina, ♂, 16 mm., ♀, 18.75 mm.; of hind femora, ♂, 12 mm., ♀, 15.5 mm. 2 ♂, 1 ♀, taken Aug. 18, at Dallas, Texas, by J. Boll.

29. **Caloptenus fasciatus.** Brownish yellow. A broad dark brown, or blackish median band extends from the vertex between the eyes to the posterior extremity of the pronotum, broadest on the latter, and occupying about one-third of it; besides this another band runs from behind the eye to the posterior transverse sulcus of the lateral lobes of the pronotum; this is comparatively narrow, but often sends off streaks of blackish fuscous down the incisures; antennæ yellow, somewhat infuscated apically. Tegmina brownish fuscous, with a row of dusky quadrate spots down the middle of the basal half; legs yellow, tinged with dull orange, the hind femora faintly bifasciate above internally, and with the upper exterior carina black; hind tibiæ glaucous, paler and dull at the apex. Vertex quite as broad between the eyes as the first abdominal joint: the fastigium slender, with parallel sides, and rather deeply sulcate; frontal ridge rather broad, equal, scarcely sulcate below the ocellus. Posterior lobe of pronotum expanding a little, the median carina scarcely perceptible, excepting on this part of the pronotum, the transverse furrows distinct. Terminal segment of abdomen of male entire, rounded, but a little produced; cerci rather small, quadrate, squarely docked at tip, nearly equal throughout, but smallest in the middle, strongly compressed, bent inward.

Length of body, ♂, 28.5 mm., ♀, 26 mm.; of antennæ, ♂, 12.5 mm., ♀, 10.5 mm.; of tegmina, ♂, 24.5 mm., ♀, 23 mm.; of hind femora, ♂, 16 mm., ♀, 15 mm. 2 ♂, taken July 16, at Dallas, Texas, by J. Boll. 1 ♀, taken at Glencoe, Nebraska, by C. R. Dodge.

It is closely allied to *C. bivittatus* (Say), but lacks the humeral vitta of the tegmina, and has very different cerci.

30. Caloptenus minor. Dark brownish fuscous. Head and sides of pronotum very dark livid brown, mottled obscurely with blackish; summit of the head with a median blackish stripe; and another similar piceous stripe behind the eye, extending over the lateral lobes of the pronotum, where it is broader and distinct, as far as the posterior transverse furrow; antennæ dusky yellow. Tegmina wholly similar in appearance to those of *C. femur-rubrum*; legs yellowish, the femora dusky outside, the hind femora blackish along the middle, the apex black above, dull orange beneath; the hind tibiæ plumbeous, paler toward the tip. Vertex between the eyes about as wide as the first antennal joint, the foveola narrow, equal, deeply sulcate, the sides pretty high and sharp; frontal ridge moderately broad, broadening below, shallowly sulcate below the ocellus. Pronotum broadening very slightly on the posterior lobe, the median carina slight, equal, cut only by the posterior sulcation; lateral carinæ obsolete. Last segment of the male abdomen slightly tuberculate at tip; cerci with the basal portion stout, quadrate, not very strongly compressed, nearly twice as long as broad; the apical portion of the same shape, but broadly rounded at the tip, nearly as long as the basal part, but narrower, bent from it upward at half a right angle, bent also inward, much compressed and shallowly sulcate, with an inferior bounding ridge.

Length of body 17.5 mm.; of antennæ, 7 mm.; of tegmina, 12.5 mm.; of hind femora 9.75 mm. 2 ♂, Nebraska, G. M. Dodge.

Revision of two American genera of Œdipodidæ. By Samuel H. Scudder.

Encoptolophus (ἐγκόπτω, λόφος) nov. gen.

Allied to Tragocephala Harr. Head but little tumid above; front vertical above, roundly declivant below the costa, nearly equal, but broadening and fading on approaching the labrum, a little constricted above the antennæ; vertex moderately broad, the eyes being separated by about their own width, the summit of the head minutely and bluntly carinate as far forward as the middle of the fastigium; the latter somewhat declivant, tapering anteriorly, distinctly though not very deeply hollowed; lateral fastigia triangular, slightly transverse, scarcely sulcate; eyes moderately large, shaped as in Tragocephala; antennæ as long as (♀) or much longer than (♂) the combined head and pronotum, the joints flattened, on the apical half punctate.

Disc of pronotum nearly flat, the median carina abrupt but not greatly elevated, cut into two equal halves by a distinct though slight notch; lateral carinæ distinct but broken, very slightly arcuate; posterior margin of the pronotum forming a rather sharply marked right angle; tegmina rather broad and short, but little surpassing the tip of the abdomen, the basal half of the costal margin sinuate, the apex broadly rounded, scarcely obliquely docked; wings short and broad, pellucid or nearly pellucid, with a post-median costal stigma and more or less duskiness near the outer border, the principal veins of the front area broader than long. Type: *Œdipoda sordida* Burm.

The flatter disc of the pronotum, with its slight but abrupt median carina and almost equally distinct lateral carinæ distinguish this at once from Tragocephala, with which Dr. Stål unites it. As he has pointed out, the intercalary vein of the tegmina approaches the ulnar vein, instead of lying midway between it and the radial vein, as in Tragocephala.

Synopsis of the species.

1. Wings most deeply fuliginous at the apex. . . . *sordidus.*
1. Wings most deeply fuliginous next the middle of the outer border. . . . . 2.
2. Summit of head with a faint median carina. . . . *costalis.*
2. Summit of head with a distinct, but slight, median carina. *parvus.*

1. Encoptolophus sordidus.

Œdipoda sordida Burm., Handb. d. Ent., II, 643; Scudd., Bost. Journ. Nat. Hist., VII, 473; Walk., Cat. Derm. Brit. Mus., IV, 732; Thom., Syn. Acrid. N. Amer., 116; Glov., Ill. Orth., pl. 10, fig. 11.

Acridium (Œdipoda) sordidum De Haan, Bijdr. Kenn. Orth., 143.

Tragocephala sordida Stål, Recens. Orth., I, 119; Scudd., Geol. N. Hampsh., I, 373.

Locusta periscelidis Say. Ms.; Harr., Cat. Ins. Mass., 56.

Locusta nebulosa Harr., Ins., Inj. Veg., 1st ed., 146; 2d ed., 157; 3d ed., 181; Emm., Agric. N. York, V, 146, pl. 9, fig. 7.

Œdipoda nebulosa Erichs., Arch. f. Nat., II, 230; Uhl., in Harr. Ins. Inj. Veg., 3d ed., 181.

This insect is found from middle N. England to Maryland and Tennessee and, more rarely, to N. Florida; and westward to Nebraska, Iowa and Minnesota.

2. Encoptolophus costalis.

Œdipoda costalis Scudd., Bost. Journ. Nat. Hist., VII, 473; Walk., Cat. Derm. Brit. Mus., IV, 732; Thom., Syn. Acrid. N. Amer., 112.

Tragocephala costalis Stål, Recens. Orth., I, 119.

Known only from Texas.

3. Encoptolophus parvus nov. sp. This insect is closely allied to *E. costalis*, from which it differs in its smaller size, comparatively shorter tegmina and wings and in the following other points: the head is less tumid, the fastigium of the vertex much more sulcate and less oblique, the median ridge from the back of the head to the middle of the fastigium much more prominent, the frontal costa deeply sulcate throughout and separated abruptly from the fastigium of the vertex by a not very broad transverse ridge. The disc of the pronotum is not marked by X-shaped pale markings on a dark ground as in *E. costalis*, but is darker in parallel lines along the lateral carinæ, deepest and broadest posteriorly; the brevity of the tegmina is entirely confined to the apical portion containing the parallel veins; the transverse pale stripe at their base is much narrower than in *E. costalis*, and followed apically by a uniform fuscous cloud, instead of a cluster of fuscous flecks; the inner transverse stripe is also much narrower; the wing is less heavily clouded.

Length of body, 16 mm.; of antennæ, 7 mm.; of tegmina, 15 mm.; of hind legs, 11 mm. 2 ♂, Dallas, Texas, taken Mar. 12 and 24, J. Boll. These two specimens are the only ones I have received and the species appears to be much rarer in Texas than *E. costalis*.

Tragocephala Harris.

Synopsis of the species.

1. Lower apical half of the wings broadly and more or less distinctly fuliginous . . . . *viridifasciata*.
1. Lower half of the outer border no darker than, or not so dark as, the upper half . . . . 2.
2. Tegmina and wings shorter than the abdomen. . *brevipennis*.
2. Tegmina and wings surpassing the abdomen . . . . 3.
3. Disc of pronotum delicately scabrous; no distinct median carina on the summit of the head . . . . *cubensis*.
3. Disc of pronotum coarsely scabrous; a distinct and sharp median carina on the summit of the head. . . . . *pacifica*.

Tragocephala obiona Thom. does not belong to this genus.

1. T. viridifasciata Harr., Ins. inj. Veg., 1st ed., 147.

(VIRGINIANA Fabr.)

Acridium viridifasciatum De Geer. Mém., III, 498, pl. 42, fig. 6; Ib., Goeze, Gesch., III, 325, pl. 42, fig. 6; Retz., Gen. et. Spec. Ins., 98.

Gryllus (*Locusta*) *viridifasciatus* Goeze, Beytr., II, 115.

Locusta viridifasciata Harr., Catal., 56.

Locusta (*Tragocephala*) *viridifasciata* Harr., Ins., inj. Veg., 1st. ed., 147; 2d ed., 158; 3d ed., 182, pl. 3, fig. 2.

Gomphocerus viridifasciatus Uhl., in Harr., Ins. inj. Veg., 3d ed., 181.

Tragocephala viridifasciata Scudd., Bost. Journ. Nat Hist., VII, 461; Thom., Syn. Acrid. N. Am., 103, pl., fig. 3; Glov., Ill. Orth. N. Amer., pl. 5, fig. 9; Stål, Rec., Orth., I, 119.

Gryllus virginianus Fabr., Syst. Ent., 291; Ib., Spec. Ins., I, 368; Ib., Ent. Syst., II, 57; Turt., Linn. Syst. Nat., II, 562.

Gryllus (*Locusta*) *virginianus* Goeze, Ent. Beytr., II, 106 Gmel., Linn. Syst. Nat., I, iv, 2078.

Acridium virginianum Oliv., Encycl. méth., VI, 224.

Acridium (*Œdipoda*) *virginianum* De Haan, Bijdr. Kenn. Orth., 143.

Œdipoda virginiana Burm., Handb. Ent., II, 645.

Gryllus (*Locusta*) *Chrysomelas* Gmel., Linn. Syst. Nat., I, iv, 2086; Turt., Linn. Syst. Nat., II, 569.

Acridium marginatum Oliv., Encycl. méth., VI, 229.

Acridium hemipterum Pal. de Beauv., Ins., 145, pl. 4, fig. 3.

(INFUSCATA Harr.)

Locusta (*Tragocephala*) *infuscata* Harr., Ins. inj. Veg., 1st ed., 147; 2d ed., 158, 3d ed., 181.

Gomphocerus infuscatus Uhl., in Harr., Ins. inj. Veg., 3d ed., 181;

Tragocephala infuscata Scudd., Bost. Journ. Nat. Hist., VII, 461. Thom., Syn. Acrid. N. Am., 102, pl., fig. 7; Glov., Ill., Orth., pl. 10, fig. 10; Scudd., Geol. N. Hampsh., I, 373.

Locusta radiata Harr., Cat. 56.

Locusta (*Tragocephala*) *radiata* Harr., Ins. inj. Veg., 1st ed., 148; 2d ed., 159; 3d ed., 183.

Gomphocerus radiatus Uhl., in Harr., Ins. inj. Veg., 3d ed., 181.

This species is not only exceedingly variable, but presents us with an interesting case of dimorphism, which also appears to be repeated in *T. cubensis*. The two forms, for which the names *virginiana* and *infuscata* are retained, differ from each other in the presence (in the former) or absence (in the latter) of bright green colors;

these colours in *virginiana* replace the griseous of *infuscata* on the whole of the head, pronotum, thoracic pleuræ and hind femora and on the greater portion of the costo-basal half of the tegmina, besides forming spots at and beyond the middle of their front border, which are pale in *infuscata*; these differences are mainly, but by no means exclusively sexual; for out of about one hundred and fifty specimens in my collection, 84 per cent. of the males are *infuscata*, and 77 per cent. of the females are *virginiana*; males of *virginiana* are therefore perhaps rarer than females of *infuscata*. These proportions are nearly the same in all districts, judging from a comparison of considerable material from New England, Florida and Texas.

Specimens from these three regions, however, differ strikingly from each other, so that I was at first inclined to consider them as distinct species. As, however, a perfectly parallel dimorphism runs through them all, and certain parts of the organization of these insects present some degree of variability within each district, one is forced to the conclusion that they must be identical. The great disparity in the length of the antennæ between New England and Texan specimens is most remarkable, but as individuals from such northern localities as Norway, Me., and the White Mts., N. H., show an exaggerated abbreviation, we can hardly doubt that a southern habitat is favorable to length of antennæ.

The differences between specimens from these several regions will best be presented in a tabular form: —

	New England.	*Texas.*	*Florida.*
Antennæ	♂ about three-fourths the length of the hind tibiæ. ♀ from one half to nearly three-fifths the length of the hind tibiæ.	♂ about seven-eighths the length of the hind tibiæ. ♀ scarcely two-thirds the length of the hind tibiæ.	♂ about three-fourths the length of the hind tibiæ. ♀ three-fifths the length of the hind tibiæ.
Fastigium of the vertex	distinctly longer than broad, with elevated bounding ridges, narrower at the extremity than in southern specimens.	distinctly longer than broad, with rather slightly elevated bounding ridges.	of equal length and breadth, with rather slightly elevated bounding ridges.
Pale spots in tegmina of male	obscure, sometimes obsolete.	distinct.	distinct.
Cloudiness of wings	faint, and confined to the distal half of the wing.	rather intense, and confined to the distal half of the wing, and also to the lower half, the upper portion being unusually clear.	moderately intense and diffused, often infringing considerably on the basal half of the wing.

The median carina of the pronotum is also slightly less elevated in specimens from New England than in individuals from the extreme south. Guatemala specimens (probably from the elevated country) resemble mostly the New England type; specimens from the Middle States (Maryland, etc.), also accord best with the New England form, although some of them show a tendency to vary toward the Floridan peculiarities. Specimens from Illinois and Ohio again agree in most points with New England individuals, while a specimen from Missouri has most of the Texan characteristics, although the upper distal half of the wing is somewhat infuscated.

As compared then with New England types, specimens from the south show a tendency toward lengthening of the antennæ, softening of the sculpturing of the head, elevation of the pronotal crest, and intensity (with stronger contrasts) of coloration; toward the southwest the coloration is more sharply defined; toward the southeast more diffuse. These facts are entirely in accordance with the laws laid down by Mr. Allen for the variation of birds, which, according to him and other authors, show toward the south an enlargement of peripheral parts and a greater intensity and extent of the dark colors.

This species occurs from the White Mountains of N. Hampshire to Key West, Florida, Texas and Guatemala, and northwestward, to St. Louis, Mo., and Ogle Co., Illinois.

2. **T. brevipennis** nov. sp. Resembling *T. viridifasciata* in form, but wholly green or greenish yellow, with abbreviated tegmina, and wings and antennæ like those of northern specimens of *T. viridifasciata.* Sculpturing of the head similar to that of *T. viridifasciata*, but with a more sulcate fastigium of the vertex, and with a slight though distinct median carina on the summit; the frontal costa is narrowly sulcate throughout; antennæ not so long as the head and thorax together. Prothorax and its dorsal carina as in *T. viridifasciata*; tegmina shorter than the abdomen; wings still shorter, pellucid, the veins of the upper half blackish, but with no trace of any fuliginous clouds; hind tibiæ more or less dusky, with a very indistinct paler band near the base.

Length of body, 22 mm.; of antennæ, 6 mm.; of tegmina, 12.25 mm.; of wings 9.5 mm.; of hind femora, 12.75. 3 ♀, California, Henry Edwards, Esq.

3. **T. cubensis** nov. sp. Body green (♀), or griseo-cinereous (♂, ♀), in the latter case with the disc of the pronotum often marked with a paler X-shaped spot. Tegmina griseo-cinereous, blotched

with darker and paler markings, similar to those seen in *T. viridifasciata*, with a broad longitudinal green stripe down the middle of the basal half of the wing, in green female specimens; wings sordid hyaline, with a greenish tinge near the base, a diffused black stigma on the costal margin, and very faint and diffused infuscation along the outer border; hind femora of the color of the body, marked above with blackish at the base and tip, and in two spots near the middle; hind tibiæ glaucous, the extreme base blackish, followed by a pale annulation. Summit of head well arched, the vertex somewhat declivant, scarcely sulcate, as broad as long, even in the male rather broad at the extremity; frontal costa broadening distinctly between the antennæ, rather deeply sulcate throughout, separated from the fastigium of the vertex, at least in the male, by a slender transverse ridge; antennæ longer than the head and pronotum together. Pronotum rather delicately scabrous, the median carina low, equal, rather distinctly cut in the middle by the transverse furrow, the disc but little tectiform, the lateral carinæ rather distinct, subparallel on the front lobe, divergent behind; front margin of pronotum scarcely angulated; hind margin right-angled, the angle rounded.

Length of body, ♂, 17.15 mm., ♀, 24 mm.; of antennæ, ♂, 7 mm., ♀, 7.25 mm.; of tegmina, ♂, 17.5 mm., ♀, 23 mm.; of hind femora, ♂, 11 mm., ♀, 13.3 mm. 10 ♂, 7 ♀, Cuba, Dr. Juan Gundlach (No. $\frac{66}{6}$), Mr. P. R. Uhler (collected at La Firmina, near Bemba, by Charles Wright), Dr. A. S. Packard.

4. T. pacifica Thom.

Tragocephala pacifica Thom., Syn. Acrid. N. Am., 101; Glov., Ill. Orth., pl. 16, fig. 9, (ined.).

I have received specimens from California from Mr. Henry Edwards, named for me by Mr. Thomas, and others obtained at San Diego, Cal., by Mr. Crotch.

In the Synopsis of the Acridida of North America, p. 103, Mr. Thomas says of *T. infuscata* (which, in the explanation of his plate, he places as a variety of *T. viridifasciata*): "This is very closely allied to *T. pacifica*, and if it were not for the widely separated localities in which they are found, they might be considered as varieties of one species." There is, indeed, between the males such a general resemblance as one might expect between species of the same genus, but the females of *T. pacifica*, which Mr. Thomas appears not to have seen, differ extraordinarily from those of *T. viridifasciata*; even the males are so different that Mr. Thomas's remark seems very strange;

this will best appear from a tabular statement of some of the prominent differences; others might readily be added.

	T. pacifica.	*T. viridifasciata*, var. *infuscata.*
Summit of head	with a distinct median carina.	without a distinct median carina.
Fastigium of vertex . .	very deeply sulcate.	moderately sulcate.
Frontal costa	very deeply sulcate.	shallowly sulcate.
Its upper extremity . . .	strongly compressed.	but little compressed.
Pronotal crest	moderately high.	high.
Hind border of pronotum	right angled.	acute angled.
Intercalary vein of tegmina	not touching the radial at its tip.	uniting with the radial at its tip.
Wings	very narrowly clouded along the outer margin, especially above.	very broadly clouded near the outer margin, below.
Average length from front of head to tip of closed tegmina	20 mm.	25 mm.

Dr. G. B. Wilder exhibited fœtal specimens of the Dugong and Manatee, giving a detailed description of the anatomy of the former, and remarked on the affinities of the Sirenia to the other mammalian orders.

Mr. J. A. Allen exhibited a black red-headed woodpecker, in which the usual area of red was preserved, while the rest of the plumage was wholly an intense black, and referred to the variety of melanism among birds.

Mr. Allen also spoke of the migration of birds with special reference to the observations of the Signal Service Bureau published in the Monthly Weather Review. He stated that he had corresponded with the officers of the Bureau respecting an extension of these observations in the interest of biology, reading a letter from Gen. Albert J. Meyer, Chief Signal Officer, expressing not only his interest in the matter but willingness to extend such observations as far as his limited means would allow. Mr. Allen suggested the desirability of some expression on the part of the Society regarding the importance of the matter; the suggestion was warmly indorsed by Prof. Hyatt and others, and, on motion of Dr. Jeffries, referred to the Council for due action.

The donation of the original specimen of *Leucosticte atri-rosea* Ridg., by Mr. C. E. Aiken was announced, and the thanks of the Society were voted for the gift.

April 21, 1875.

The President in the chair. Sixty-two persons present.

The following papers were read: —

On the Boston Artesian Well and its Waters. By T. Sterry Hunt.

It is known to many that a well has within the last few years been sunk at the works of the Gas Light Company in Causeway Street in Boston. This boring was carried to a depth of 1750 feet, and though I have not been able to obtain an exact record of it, it is said to have been almost wholly in argillite or clay slate, though at the bottom a crystalline rock was reached. This argillite, which appears in various outcrops in this vicinity, both on the mainland and in the islands of the harbor, is supposed to belong to the horizon of the similar argillites of Braintree, Mass., which, as is well known, contain the remains of a Lower Cambrian (Menevian) fauna.

The water from the boring rises into a well of about fifty feet in depth, sunk in the superficial soil. This is not far from the shore of the bay and but a few feet above tide-level. The water, which is raised by pumping from this upper well, and is in daily use for quenching the coke drawn from the gas-retorts, differs widely in composition from sea-water, and contains, according to Prof. J. M. Merrick, besides bromids a sensible quantity of iodids and a large proportion of chlorid of calcium, besides some carbonates of lime and of iron, in all of which respects it is unlike modern sea-water, and closely resembles the waters from the lower paleozoic strata of the St. Lawrence basin, in which, as I have shown by numerous analyses, the united chlorids of calcium and magnesium sometimes exceed the chlorid of sodium in amount, while iodine is present in notable quantity, and the proportion of potash salts is less than in modern sea-water. I am indebted to Prof. Merrick for a quantitative analysis of the water, of which I calculated the chief ingredients for 1000 parts, for the purpose of comparison. I. is the water of the Boston Artesian Well; II. from a well at St. Catherine, Ontario, bored to a depth of 500 feet and ending in the shales of the Hudson River group; III. and IV. from wells sunk respectively at Kingston and at Hallowell, Ontario, in the Trenton limestone; these three analyses are by myself, while V. is an analysis by Schweitzer of the sea-water of the British channel.

	I.	II.	III.	IV.	V.
Chlorid of Sodium	8.617	29.803	7.227	38.731	27.059
Chlorid of Potassium	.133	.355	undet.	undet.	.766
Chlorid of Calcium	5.093	14.854	2.102	15.923	
Chlorid of Magnesium	3.030	3.397	1.763	12.906	3.666
Sulphate of Lime	1.914	2.192	2.388		1.406
Sulphate of Magnesia					2.296
Carbonate of Lime	undet.		.400		.033
In 1000 parts	18.787	50.601	13.880	67.560	35.226

It will be noticed that the waters II. and IV. contain amounts of saline matters much greater than sea-water, from which I have concluded that they are from bitterns enclosed in the lower strata of the paleozoic series, and derived from the evaporation of ancient sea-waters. These must have been distinguished from those of modern seas by the predominance of salts of magnesium and calcium. The amount of the latter element in the modern ocean is insufficient to form gypsum with the sulphate present, so that modern bitterns from which the calcium has thus been separated still contain a large proportion of sulphate of magnesia. The gradual elimination of the lime from the ocean's waters in the form of carbonate by the action of carbonate of soda derived from decaying crystalline rocks, and the consequent production of chlorid of sodium are important processes in the chemical history of the globe, which I have discussed at length elsewhere. (See my *Chemical and Geological Essays*, *passim*.)

After communicating the above note, I received from Mr. S. B. Sharples the results of some analyses of waters from different parts of the city of Boston, which have recently been sunk through the superficial clay and gravel to the underlying rock. It had long been known that the waters got from certain deep wells in the city and its vicinity are bitter, salt and unfit for use, and these analyses show that they owe these qualities to an admixture of the same saline elements as abound in the waters of the Artesian Well. I subjoin two analyses by Mr. Sharples, calculated for 1000 parts of the water. I. is from a well eighty or ninety feet deep at the corner of Brookline Street and Harrison Avenue, and II. from a well 170 feet deep at No. 791 Tremont Street.

	I.	II.
Chlorid of Sodium	1.184	.530
Chlorid of Calcium	.060	.023
Chlorid of Magnesium	.161	.100
Sulphate of Lime	.122	.105
	1.527	.758

Note on the Geological Relations of Boston and Narragansett Bays.[1] By N. S. Shaler.

The indentation of Boston bay and harbor presents some striking points of contrast with most of the fjords of our New England coast. All other indentations of our shore have a general north and south trend, varying but little therefrom, and when varying turning a little to the east of north, and south of west. This break in the shores extends, however, in what seems at first to be a general east and west direction. On closer inspection we see, however, that the principal trends about the harbor and the neighboring bay are northeast and southwest in their direction. I am therefore inclined to think that this opening does not violate the general law of the trends along the coast, but that it only opens towards the north rather than towards the south, as most of these fjords do.

Looking more closely to the structure of this region, I have become convinced that there is here a set of irregularly parallel faults running in a general northeast and southwest direction, the whole forming something like a rude synclinal furrow, which may be compared to those of the ordinary Alleghanian type. The subsidence of the synclinal is accompanied by very great faulting, both in the direction of the fold and transverse to it. On either side of this depression we had anticlinals which are now obscurely marked on account of the extreme degradation to which the region has been subjected. The

[1] In a forthcoming volume of the Coast Pilot, published by the U. S. Coast Survey, I shall discuss the geology of the shore between Boston and New York in a general manner, under the general permission of the superintendent of the Survey, and give a part of the substance of that report in advance of the rest, as it seems to me to have a somewhat important bearing on the studies of the coast geology of New England.

floor of this synclinal gradually rises as we go to the southwest, until near the Rhode Island line the depression ceases.

In Narragansett Bay we probably have a precisely similar furrow coming in echelon order a little to the east of that in which Boston bay lies; its northernmost point lies a little to the north of the most southerly part of the Boston trough. This arrangement will be recognized by those familiar with the Appalachian Chain as quite in the order of its structure. The great downthrow on these faulted folds results in imprisoning within the lower crystaline rocks a great thickness of Palæozoic strata. To this protection we owe the preservation of a great thickness of the rocks between Cambrian and the Upper Carboniferous, which have been lost over the surface where they were exposed to the intense erosion of the successive glacial periods that swept this shore. The Artesian well bored by the Boston Gas Company, penetrated for seventeen hundred and fifty feet through the Cambridge slates without finding the bottom. It is evident, therefore, that if I am right in regarding these depressions as great faulted down-folds, they had a magnitude of dislocation quite commeasurable with the greatest of Appalachian folds.

That there should be an eastern outlier of the Appalachian system of the age of its Pennsylvania section might seem, on general principles, pretty doubtful. There is no doubt, however, that the dislocation lines of our coast correspond generally with the direction of that chain. There is also good evidence of the occurrence of submarine ridges essentially parallel with this system. So it does not seem to me unreasonable to interpret the facts as I have done.

The question will arise, and I propose to discuss it at some extent hereafter, how these ridges of the height of thousands of feet have lost their relief since the Carboniferous period, while the similar ridges of the Alleghanies have not been anything like as much eroded. This is easily answered by supposing that this region has been repeatedly subjected to glacial wearing, giving an erosion rate many times greater than in the Alleghanies, where the glacial erosion has not been so severe. The whole form of the Boston *fjord* shows profound glacial wear working in the relatively soft rocks of the Palæozoic series, and the evidence of glacial erosion in Narragansett Bay is almost as great. Taking an erosion rate of one foot in ten thousand years (probably within the limit in this region), it requires but thirty million years to take away three thousand feet from this region. If glacial wear has done the most of this there would be no reason for surprise at the planing down of the original mountain ridges.

Notice of some Spiders from Labrador. By T. Thorell.

The subject of the following lines is a small collection of spiders, captured in Labrador in the summer of 1864 by Dr. A. S. Packard, Jr., and kindly placed by him in my hands for determination and description. The species contained in this collection are but few, about fifteen; and owing to many of the specimens not being fully developed or not being in a sufficiently good state of preservation, they could not all be with certainty identified. The number of species here named is only ten; but they are of no small interest, as nothing appears hitherto to be known of the spider-fauna of Labrador. Of these ten species two belong to the genus Epeira, one to Tetragnatha, one to Linyphia, one to Clubiona, one to Gnaphosa and four to Lycosa. Among the specimens which could not be with certainty determined, are one Erigone, one Thanatus (closely allied to, if not identical with *Th. arcticus* Thor. from Greenland), and one Trochosa. Two of the Labrador species, *Epeira patagiata* (Clerck) and *Tetragnatha extensa* (Linn.), are also found in Europe; one, *Lycosa grœnlandica* Thor., is common in southern and western Greenland. The species in question are as follows: —

1. Epeira patagiata (Clerck).

Araneus patagiatus Clerck, Sv. Spindl., p. 38, Pt. 1, Tab. 10. (1757.)

Epeira patagiata C. Koch, Die Arachn., XI, p. 115, Tab. CCCLVI, fig. 916–919. (1845.)

Epeira patagiata Thor., Remarks on Synonomy, p. 16. (1871.)

A female specimen belonging to the "forma principalis" of this species was captured by Dr. Packard at Strawberry Harbor, July 28th. A fine variety of ♂ *ad.*, with two large, transverse, oval, yellowish-white spots on the anterior part of the back of the abdomen was found in Square Island, July 2d.[1]

2. Epeira Packardii n. cephalothorace fusco, albo-piloso, pedibus testaceo-fuscis, nigricanti-annulatis, femoribus apice tantum

[1] Of the closely allied *E. sclopetaria* (Clerck), I have seen an example from Newfoundland.

infuscatis; abdomine supra sub-olivaceo-fusco, vitta longitudinali albicanti primum ex Λ angustiore, tum Λ latiore, denique ex vitta angusta geminata, quæ ex linealis parvis sub-parallelis formatur, composita; ventre macula media oblonga flavescenti notata; procursu in latere exteriore bulbi genitalis apice compresso, rotundato, denticulato. —♂ *ad.* Long. corp. 5 mm.

Male.—Cephalothorax as long as the tibia and patella of the fourth pair of legs, its breadth greater than the length of tibia of the same pair; very strongly rounded in the sides of the anterior part of the pars thoracica, less strongly rounded and gradually narrowed backwards, very suddenly and strongly narrowed anteriorly, with the pars cephalica narrow, not one-third as broad as the pars thoracica; yellowish brown, covered with longish white hair. The tubercle bearing the four central eyes very prominent, sloping. Sternum blackish. The line formed by the posterior eyes rather strongly curved backwards; the area occupied by the four central eyes broader in front, the fore central eyes separated by an interval at least double as great as their diameter, the interval between the hind central eyes, which are somewhat larger, rather greater than their diameter; the interval between the central and the lateral eyes about double as great as that between the centrals of the same row. Mandibles straight, brownish, about as thick as the tibiæ of the first pair. Maxillæ brownish, with the interior side of the apex paler. Labium brownish, pale at the apex. Palpi brownish, with the greater part of the genital bulb brownish black. The clava is at least double as broad as the anterior thighs; the femoral part, when raised, reaches a little higher than the tubercle of the lateral eyes; the patellar joint is nearly as long as broad, with two long bristles above, at the apex; the tibial joint is about as long as the patellar, gradually broader towards the apex: its outer side is produced into a broad lamellar process gradually dilated towards the broadly truncated extremity, the posterior angle of the extremity being right, the anterior produced and sub-acute; the inner side of the apex of the tibial joint forms a rather prominent angle. The tarsal joint or lamina bulbi turns its convex side inwards, and bears at the base, on the outer side, a blackish brown process curved forwards, which is thick at the base, narrowed towards the apex, which is again somewhat thickened, rounded and knob-like. When the palpus is seen from above, the genital bulb exhibits on the outer side a long process, which is at first almost straight and linear, and at the apex compressed into a lamella, equally dilated on both sides; the edge of this lamella is rounded, and denticulated anteriorly with about six small teeth, of which the three anterior are larger than the others, which are very small. Somewhat below and in front of this process are two other lamellar processes with obtuse apices, close to each other, of which the superior is very broad at its base, narrowing towards the apex; the inferior, which appears to be longer, is almost straight and linear. In front, above and at the outer side, issues a strong, forward directed, arched, brown lamellar process, tapering towards the obtuse apex. The legs are yellowish brown; the thighs more or less distinctly darker at the apex, the patellæ also somewhat darker at the apex; the tibiæ and metatarsi have each three dark rings; the tarsi are blackish at the apex. The tibiæ of the second pair of legs are very slightly curved outwards, evidently thickened on the inner side, towards the apex, and here armed with some spines, which are stronger than the other spines of the tibia; two of these spines are placed on very low tubercles. The coxæ of the first pair are, on the under side, armed with a slightly curved obtuse spine. Abdomen ovate, olive brown, with long whitish hairs; it has along the back a whitish marking, which consists of two short slightly diverging lines near the anterior margin, forming almost a narrow $\wedge$, two such lines, more strongly diverging, forming a broader $\wedge$ immediately behind them, and followed by a narrower whitish, geminated band tapering towards the anus, and composed of two or three pairs of small, almost parallel, whitish lines. The belly has a large, oblong, yellowish spot in the middle, and probably also smaller yellowish spots towards the sides, especially behind.

Length of the body, 5 millim.; length of cephalothorax, 2.5 millim., its breadth, 2 millim.; length of legs: first pair, 10.5 millim.; second, 8.5 millim.; third, 5.5 millim.; fourth, 8 millim.; length of patella and tibia of the fourth pair, 2.5 millim.; of tibia, 1.75 millim.

A single adult male specimen of this spider was captured on Square Island, Labrador, in July. The specimen is in a very bad state of preservation, and its color could not therefore be so accurately described as I should have wished. It may, however, readily be distinguished from the very closely allied European species *Epeira ceropegia* Walck. and *E. Victoria* Thor., not only by its smaller size, but also by some differences in the organs of copulation. The process on the outer side of the bulbus genitalis, for instance, has the denticulated apex *emarginate* in *E. ceropegia* ♂, *truncate* in *E. Victoria* ♂, and strongly *rounded* in *E. Packardii* ♂. This last named species is perhaps still more closely allied to *E. carbonaria* L. Koch,[1] the male of which is unknown to me: it is said to have the denticulated edge of the above mentioned process rounded, as it is in *E. Packardii*, but the anterior thighs of *E. carbonaria* ♂ are, according to L. Koch, blackish above, and the posterior thighs have two black lines on the sides; the breadth of its cephalothorax equals the length of tibia of the fourth pair; it appears also to be larger than the species from Labrador.

3. **Tetragnatha extensa** (Linn.), forma principalis.

Aranea extensa Linn., Syst. Nat., ed. 10. I. p. 621. (1758.)

Tetragnatha Nawickii L. Koch, Beitr. z. Kenntn. d. Arachn.-fauna Galiz., pp. 13, 15. (1870.)

Tetragnatha extensa forma *T. extensa vera* Thor., Rem. on Syn., p. 459. (1873.)

An adult male *Tetragnatha* (in which however the abdomen is wanting) does not appear to me to differ from the true *T. extensa* (Linn.) or *T. Nawickii* L. Koch, by anything more than its smaller size and by the yellowish triangular spot on the dark sternum being less distinct. The cephalothorax, mandibles, maxillæ, palpi and legs are brownish-yellow, only the extreme apex of the tarsi blackish. The distance between the lateral eyes is somewhat less than that between the anterior and posterior centrals. The mandibles are somewhat shorter than the cephalothorax; they have no tubercle or spine near the apex above besides the ordinary great spine, which is slightly curved at the extremity; the extreme apex of this spine is slightly emarginate, with the anterior (exterior) lobe longer than the other. The armature of the claw-furrow is as follows: the anterior margin has first a rather small tooth directed somewhat backwards, which is placed opposite to the fifth tooth of the posterior margin; then follows a very long and strong, almost straight, tooth (not weaker, and but little shorter than the great bilobed spine); behind this, at a somewhat greater distance, are three pointed, gradually smaller teeth. The posterior margin has near the basis of the claw one very small and one rather long tooth (longer than the next following); then, after an interval double as great as that between the next following teeth, comes a row of six teeth gradually diminishing in size. The long lobe, or apophysis of the tibial joint of the palpi,

[1] Beiträge z. Kennt d. Arachn.-fauna Tirols, *in* Zeitschrift d. Ferdinandeums, 1869, pp. 168, 206.

shows no tubercle. The patella, tibia, metatarsus and tarsus of the fourth pair is longer than metatarsus and tarsus of the first pair. There appear to have been perpendicular hairs on the under side of the anterior tibiæ and metatarsi.

Length of cephalothorax somewhat more than 2 millim.; breadth nearly 1.5 millim. Legs of the first pair, 14.5 millim.; second, 10.5 millim.; third, 5 millim.; fourth, 10 millim.; patella and tibia of fourth pair, 3.33 millim.; mandibles, 1.75 millim. In a couple of young females captured together with this male, a yellowish spot is distinctly visible on the sternum, and the perpendicular hairs on the underside of the anterior tibiæ and metatarsus are very numerous.

The male here described was captured on Square Island, in the month of July; two not fully developed females and a few very young specimens, no doubt belonging to the same species, were found in the same locality.

4. **Linyphia Emertonii** n. cephalathorace pallide rufescenti-fusco, pedibus fusco-testaceis, aculeis trinis in femoribus primi paris, singulo in secundi et tertii paris, nullo in quarti: metatarsis primi paris aculeis saltem 4, quarti paris saltem 2 armatis; abdomine supra albicanti, vitta lata ovato-lanceolata fusca; in lateribus sub-undulata, intus pallidiore, sub-cinerea, secundam dorsum extensa; ventre nigro, vulva fere ω formi.— ♀ *ad.* Long. corp. 2.75 millim.

Female.—Cephalothorax of the ordinary form, pale reddish brown, with the extreme edge blackish; forehead rounded and about half as broad as the pars thoracica; cephalic furrows strongly marked. Sternum large, convex, blackish. The anterior row of eyes almost straight, the posterior row (seen from above) slightly curved backwards; the area of the four central eyes much broader behind than in front, slightly shorter than broad behind; the fore central eyes, which are somewhat smaller than the others, are separated from each other by an interval not fully as large as their diameter, and from the anterior laterals by an interval double as great; the interval between the posterior central eyes is somewhat larger than that between them and the posterior laterals, and much greater than (nearly double as great as) their diameter. The height of the clypeus is nearly half as great again as the length of the area of the central eyes. The length of the mandibles is double the height of the clypeus; they are of a pale reddish brown color, almost cylindrical, but slightly tapering towards the apex, as thick as the anterior thighs, twice as long as broad at the base. The maxillæ are brownish, the labium blackish. Palpi brownish yellow, with the apex of the tarsal joint blackish. The legs are slender, the first pair the longest; they are of a brownish yellow color, with black spines; the thighs of the first pair have three spines, those of the two following pairs one spine each; the thighs of the fourth pair are without spines. The metatarsi of the first pair have at least four spines, three towards the base and one towards the apex, those of the fourth pair at least two spines. The abdomen is high, ovate, whitish above, with a large ovate-lanceolate or leaf-like band along the whole back; this band, which is at least as broad as the cephalothorax, is at the sides formed of large brownish black spots more or less united with each other; inwardly, between these two series of spots, the band becomes paler, grayish, with a fine blackish, somewhat branched, longitudinal middle line. Inferiorly the sides of the abdomen are blackish with a series of two or three whitish spots (or a longitudinal broken band) limiting the black belly. The vulva consists of a transversal area more than double as broad as long, strongly rounded in the sides; in front and on the sides this area is bordered by a high, narrow margin; from the middle of the anterior part of this margin proceeds backward a rather broad, black process, by which the area is divided into two large, deep, rounded foveæ. The vulva thus has some resemblance to an ω. The mamillæ are dark brown.

Length of the body, 2.75 millims.; length of cephalathorax, somewhat more than 1 millim., breadth rather more than .75 millim. Length of first pair of legs, 5.5 millim.; second pair, 5 millim.; third, 3.5 millim.; fourth, 4.5 millim.; patella and tibia of the fourth pair, 1.5 millim.

Two male specimens, which probably belong to this species, are distinguished by their longer and narrower, black abdomen, and by their clypeus, the height of which is nearly double the length of the area of the central eyes. The length of the mandibles is not fully half as great again as the height of the clypeus. The blackish brown tarsal joint of the palpi towards the middle of the superior (exterior) margin is elevated into a blunt tubercle; its very base, on the other side, is drawn out into a long, very fine, pale, spine-like process curved forwards; the bulbus genitalis has on the under side, behind, a very large reddish lamellar appendage, which inwards ends almost in the form of a crescent; outwards it is cleft into two parts by a deep, broad fissure, the anterior part being narrower than the other, dilated, emarginate and somewhat denticulated at the apex, the posterior part still more dilated at the apex, which shows a few fine teeth at the exterior angle; towards the apex, near the inferior (interior) margin of the pars tarsalis, the bulbus emits a strong, forward directed curved spine or claw.

A female specimen of this fine species was captured near Dumplin Harbor (or perhaps Sloop Harbor), in the middle of July; the males above mentioned on Square Island.

5. **Clubiona frigidula** n. cephalothorace tibiam cum patella quarti paris longitudine æquanti, testaceo-fusca, oculis anterioribus spatiis æqualibus disjunctis, mediis posticis longius inter se quam a lateralibus posticis remotis; palpis pedibusque testaceis, primi et secundi parium pedibus sub-æqualibus, quarti paris pedibus multo (metatarso suo) longioribus quam primi; metatarsis quarti paris pæne duplo longioribus quam primi, tibiis tertii paris subter 20 aculeis instructis; abdomine supra unicolore, obscuro, area vulvæ foveis duabus sat magnis, spatio lato disjunctis impressa.—♀ *ad.* Long. corp. 5.5 millim.

Female.— Cephalothorax as long as tibia and patella of the fourth pair, yellowish brown, with the extreme margin blackish, covered with fine yellowish or whitish hair, and also provided with long sparse black hairs; it is but slightly rounded on the sides, and much narrowed in front, the breadth of clypeus being about three-fourths of the breadth of pars thoracica; central furrow rather long. Sternum reddish brown, with a tubercle near the insertion of each of the six anterior coxæ. Maxillæ and labium of a darker brown. The eyes of the front row equidistant from each other; the hind central eyes more distant from each other than from the hind laterals. Mandibles as long as metatarsi of the first pair, rather thicker than the fore thighs, strongly convex above, towards the base, more than double as long as broad at the base, smooth and shining, of a dark rusty brown color. Palpi and legs brownish yellow; first and second pair of legs nearly of the same length (the second perhaps a little longer than the first); fourth pair (with the length of its metatarsus) much exceeding the first pair in length. The tibia of the third pair has two spines on the under side. The metatarsi of the fourth pair are nearly twice as long as those of the first pair. The abdomen is of a dark blackish brown, and appears to have been covered with fine pale hair; the belly is paler than the back; the area of the vulva is blackish, and is on each side elevated into a low, broad, inwardly curved costa, which limits the outer side of a rather large fovea; the space between the two foveæ is broad, truncated behind, of a paler color, and shows a fine longitudinal middle furrow. The mamillæ are long, yellowish.

Length of the body, 5.5 millim.; length of cephalothorax, 2.5 millim., breadth, 1.67 millim.; mandibles little more than 1 millim. long. First and second pair of legs nearly 5.5 millim.; third, 5 millim.; fourth, 7.25 millim.; patella and tibia of fourth pair, 2.5 millim.; metatarsi of the first pair nearly 1 millim., those of the fourth pair somewhat more than 1.75 millim.

A female example was captured on Square Island, in the month of July. The species is closely allied to the European *C. frutetorum* L. Koch, but differs by an entirely different form of the vulva.

6. Gnaphosa brumalis n. cephalothorace breviore quam tibia cum patella quarti paris, obscure ferrugineo-fusco, limbo sat lato nigro circumdato, pube sub-lutescenti tecto; oculis lateralibus seriei anticæ majoribus quam mediis, a margine clypei spatio diametro suo dimidio majore remotis, area oculorum mediorum rectangula; pedibus obscure luteo-fuscis, secundi paris parum longioribus quam tertii, tibiis primi paris aculeo singulo in apice subter, secundi paris subter duobis in apice et singulo parvo versus medium armatis; abdomine nigro, pube densa appressa nigra et sub-lutescenti tecto; vulva et fovea magna sub-ovata constanti, quæ secundum medium costam latam, deplanatam, antice pro receptione procursus crassi retro directi excavatam ostendit.—♀ *ad.* Long. corp. 9 millim.

Female.— Cephalothorax longer than patella and tibia of the fourth pair, equably and rather strongly rounded in the sides; breadth of clypeus equal half the breadth of pars thoracica; central furrow rather short. As to the color, the cephalothorax is of a dark and rusty brown, bordered with a very distinct, rather broad black "hem," and having a blackish V bordering the pars cephalica behind, as also a few faint blackish radii on both sides; it is rather densely covered with fine, short, appressed, grayish yellow hair, and, moreover, strewed with longer, more erect black hairs. The sternum, maxillæ and labium are dark brown. The anterior eye-series is rather strongly curved forwards; the posterior is curved backwards; the fore lateral eyes are larger than the fore centrals, which are separated from each other by an interval as large as their diameter, the interval between them and the laterals being but half as large; the area of the four centrals is rectangular, longer than broad, the interval between the posterior centrals being much smaller than their diameter, and the interval between them and the posterior laterals evidently greater than their diameter. The distance from the margin of the clypeus to the anterior lateral eyes is about half as great again as their diameter. Mandibles rather narrower than the anterior thighs, as long as the anterior patellæ, straight, only convex at the very base, dark rusty brown. Palpi dull yellowish brown, with the tibial joint rusty brown, the tarsal joint blackish brown. Legs of a dark and dull yellowish, or rusty brown; the first pair evidently (with the length of its tarsus) longer than the second, which is but little longer than the third; the length of the fourth pair is about the length of the first and the tarsus of the fourth pair. The tibiæ of the first pair have only one spine, at the apex of the under side; the tibiæ of the second pair have two spines at the apex, and besides, one small spine more towards the middle, all on the under side. The tibiæ of the third pair have one spine above and two before and behind (besides three pairs of spines beneath); the tibiæ of the fourth pair have no spine above. The abdomen is blackish, densely covered with fine appressed hair, which appears to be partly black, partly of a rusty yellow, the abdomen thus showing a less distinct rusty yellow marking, consisting of a middle band along the anterior part of the back, and a few transverse oblique bands on either side, behind. The belly is blackish, covered with short appressed hair of a rusty brown color. The vulva consists of a large, broad, almost egg-shaped fovea, which is more depressed or excavated on the sides, thus showing in the middle a broad, corneous, elevated, flat band or ridge tapering backwards towards the obtuse apex; this ridge has a transverse depression near the apex; the anterior margin of the fovea is produced into a backward directed, thick, transversely striated process, which lies in an oblong excavation of the said ridge. Mamillæ of a dusky yellowish brown.

Length of the animal, 9 millim.; length of cephalothorax, 4.33 millim.; breadth of cephalothorax, 3 millim.; first pair of legs, 10.5 millim.; second pair, 9.5 millim; third pair, 9.25 millim.; fourth pair, 12.5 millim.; patella and tibia of fourth pair, 3.75 millim.

Of this species I have seen but one adult specimen, a female, which was captured at Strawberry Harbor, July 28.

7. Lycosa grœnlandica Thor.

Aranea saccata O. Fabr., Fauna Grœnl., p. 228. (1780.)

Lycosa grœnlandica Thor., Rem. on Syn., p. 300. (1872.)

" " id., Om. några Arachn. fr. Grönl; in Öfvers. af Vet. Akad. Förhandl., XXIX (1872), p. 157. (1872.)

An adult female of this species was captured at Strawberry Harbor, July 28th.

8. **Lycosa furcifera** n. cephalothorace in fundo nigro-fusco, vittis tribus pallidis albicanti-pilosis, lateralibus continuis, inæqualibus, media antice in ramos duos valde divaricantes, incurvos producta; pedibus obscure fusco-testaceis, femoribus supra nigro-maculatis et-lineatis; abdomine sub-olivaceo-fusco, vitta media angusta albicanti antice; vulva ex fovea antice angusta, tum fortiter dilatata constanti, septo persecta angusto, ad longitudinem sulcato, in medio leviter dilatato, apice fortius in laminam transversam, in lateralibus rotundatam dilatato; partibus patellari et tibiali palporum maris albicanti et nigro, tarsali nigro-pilosa, bulbo genitali ad latus exterius dente nigro armato, basi in tuberculum magnum incrassato, quod antice e fovea dentera sub-porrectum emittit, hoc dente basi dente minore armato. — ♂ ♀, *ad.* Long., ♂ corp. 7, ♀, corp. 8 millim.

Male.— Cephalothorax shorter than patella and tibia of the fourth pair, its back, from the eyes to the hind declivity, straight, not depressed behind the eyes; blackish brown, with the area between the four posterior eyes darker, and covered with grayish white hairs; adorned with three longitudinal pale bands, covered with whitish hair. The median band is about as large in the middle as the anterior tibiæ, and here geminated by the fine, black, ordinary central furrow; behind it gradually tapers to a point; in front it also at first slightly tapers, then, on the hind part of the pars cephalica, divides itself into two branches which diverge very strongly, and are curved towards each other. The lateral bands of the cephalothorax are situated somewhat above its margin; they are narrow, continuous and uneven, at least in their upper or interior margin. In one specimen, also, the very edge of the cephalothorax is pale, and covered with whitish hair, and in this case the lateral bands are broad, and geminated by a blackish line. Sternum black; labrum blackish, with the truncated apex paler. Mandibles as long as patellæ of the first pair, dark yellowish brown. The anterior eye-series is straight, its eyes of the same size, and equidistant from each other. The palpi are of a dark yellowish brown, with exception of the tarsal joint, which is somewhat darker; the femoral joint is spotted with black; the apex of the patellar joint and the tibial joint are covered with shorter whitish hair, both joints also with longer, rarer, black hairs; the tarsal joint is densely clothed with fine black hair. The patellar and tibial joints are cylindrical, of the same thickness, the patellar somewhat longer than the tibial, which is slightly longer than it is broad the tarsal joint is as long as the patellar and tibial joints, narrowly egg-shaped, pointed. The genital bulb is at its base much inflated; seen from the side this posterior high part is obliquely truncate in front; it has on the anterior side a large, not very profound fovea, situated somewhat more inwards, from which proceeds a rather strong obtuse tooth directed forwards and outwards, and bearing at its base a smaller tooth directed outwards, and not rising out of the fovea. Immediately in front of this elevated hinder part of the bulb, and lying close to it, is a fine and long spine-like costa, which issues from the anterior margin of the bulb, and is directed transversely inwards and slightly curved upwards; near the outer margin the bulb shows a black, pointed, downward and forward directed tooth, and behind it a stronger obtuse tooth, or short process, of a paler color. The anterior part of the bulb, outwards, has the form of a low, broad lobe, rounded at the apex. The legs are of a dark yellowish brown; the thighs have on their upper side black spots and lines, including two very long pale spots, divided by a fine, black, longitudinal line; also the tibiæ present slight traces of dark spots or rings. The anterior tibiæ, seen from the under side, show four pairs of spines, of which the third pair, however, belong to the sides of the joint. The abdomen is of blackish or olive brown, with a rather narrow, pale, white-haired median band reaching from the anterior margin to the middle of the back, or shorter; the belly is pale; the mamillæ black.

The *female* is of the same color, and about of the same size as the male, with the legs somewhat shorter; the palpi are dark yellowish brown, the femoral joint with black spots. The interval between the central eyes of the first row is greater than that between them and the laterals. The vulva consists of a large oblong fovea, which in its anterior third part is narrow and of equal breadth, then strongly dilated, with the sides rounded; it is divided longitudinally by a narrow septum, which is gradually and slightly dilated from the fore end to the middle, then again slightly narrowing, and at last dilated anew into a somewhat broader transverse lamina, rounded in the sides, and closing the fovea behind; this lamina appears to have a large shallow impression on either side; in front of it the septum shows a longitudinal furrow, broader in the middle.

♂. Length of the body, 7 millim.; of cephalothorax, 4 millim.; breadth of cephalothorax, 3 millim.; first pair of legs, 12 millim.; second, 11.5 millim.; third, 11.25 millim.; fourth, 15.5 millim.; patella and tibia of the fourth pair, 4.5 millim.; tibia somewhat more than 3.33 millim.

♀. Length, 8 millim.; cephalothorax, 4 millim. in length, nearly 3 millim. in breadth; legs of the first pair, 11.5 millim., of the second and third pairs, 11.25 millim.; fourth pair, 16.5 millim.; patella and tibia of fourth pair, 5 millim.; tibia somewhat more than 3 millim.

The above described male and female were found in Square Island (July), another male near Dumplin Harbor (or Sloop Harbor). The species may, I think, be without difficulty distinguished from the next following, and other nearly related species, by the form of the middle band of the cephalothorax, and the structure of the sexual organs.

9. Lycosa fuscula n. cephalothorace nigro-fusco vittis tribus longitudinalibus satis angustis pallidis, lateralibus sub-continuis, in margine superiore crasse dentatis, media fere ad partem cephalicam pertinenti, geminata sed vix furcata; pedibus sordide fuscis, femoribus supra et in lateribus nigro-maculatis et -lineatis, tibiis quoque supra nigricanti-lineatis, metatarsis vestigiis annulorum trinorum; abdomine sub-olivaceo-fusco, vitta antica media abbreviata, albicanti; vulva ex fovea profunda sub-transversa, antice non angustata constanti, quæ in lateribus fortiter rotundata est et septo angusto in foveas duas rotundatas divisa, hoc septo postice fere in formam aculei sagittæ obtusi dilatato.— ♀, *ad.* Long. corp. 9 millim.

Female.— Cephalothorax slightly shorter than tibia and patella of the fourth pair, with the back straight, not depressed behind the eyes, and the sides of the pars cephalica, seen from in front, evidently sloping; brownish black, with three longitudinal pale bands, the middle one short, reaching the pars cephalica only, and geminated by the fine, black, central furrow, about as broad as the anterior tibiæ, tapering behind; the lateral bands of about the same breadth, supramarginal, continuous (or perhaps slightly interrupted once or twice?) coarsely dentated in the upper margin. Sternum black. The front row of eyes nearly straight, scarcely perceptibly curved forwards; its eyes of equal size, the centrals somewhat more distant from each other than from the laterals. The eyes of the second series are separated by an interval much greater than (nearly double as great as) their diameter. Mandibles dark brown, their back rather strongly convex longitudinally; rather longer than patellæ of the first pair. Maxillæ brownish. Palpi of a dull brown color, the femoral joint with black spots. Legs of a dull brownish color, the thighs somewhat darker at the base, with black spots and streaks above, and on the sides; the tibiæ have also distinct blackish lines above, and the metatarsi show traces of three dark rings. The anterior tibiæ, seen from the under side, show four pairs of spines, the third pair being inserted on the sides of the joint. Abdomen of a dark olive, or perhaps blackish brown, with traces of a whitish longitudinal middle band in front; belly paler. The vulva consists of a large, deep, rather transverse fovea, strongly rounded in the sides, truncate, or slightly rounded in front, its edges being behind incrassated into a rounded tubercle on each side; the margin is in the middle, in front, drawn out somewhat triangularly backwards, and continued into a short narrow septum, which towards its posterior end is rapidly dilated into an oblong lamina, narrowing towards the obtuse apex, and having the form of a narrow, elongated rhomboid, or an arrow-head; this lamina fills with its hind part the open space between the incrassated and incurved margins of the vulva. By the septum the vulva is divided into two large rounded foveæ, showing each in its bottom a paler lamina, rounded in front. Mamillæ black.

Length of body, 9 millim.; of cephalothorax, 4 millim.; breadth of cephalothorax, 3 millim.; legs of the first pair, 10.75 millim.; second and third pairs, 10.5 millim.; fourth pair, 16 millim.; patella and tibia of fourth pair, 4.5 millim.; tibia alone, 3 millim.

The female here described was captured at Strawberry Harbor, July 28th. It will probably be difficult to distinguish this species from other closely allied forms, e. gr. *L. glacialis* Thor., and *L. aquilonaris* L. Koch. (both from Greenland), by any other characteristics than the rather peculiar form of the vulva. The specimen is very much damaged, and appears to have been left to dry for some time; this is also the case with the female of the next following species, *L. labradorensis*.

10. **Lycosa labradorensis** n. cephalothorace nigricanti, vittis tribus satis angustis pallidis albicanti-pilosis, lateralibus supramarginalibus, continuis, in margine superiore paullo inæqualibus, media ad partem cephalicam tantum pertinenti, in medio geminata, antice sub-truncata, posteriora versus angustata; palpis pedibusque obscure testaceo-fuscis, femoribus supra et in lateribus nigro-lineatis-maculatisque, patellis et tibiis quoque supra nigricanti-lineatis, abdomine fusco, vitta media antica abbreviata albicanti; area vulvæ elevata, antice angusta, postice dilatata, impressione media in duas partes divisa, parte anteriore sulcis duobus longitudinalibus notata, parte posteriore foveis duabus lunatis obliquis, aream triangulam,

sulco longitudinali profundo notatam amplectentibus.— ♀, *ad.* Long. corp. 6 millim.

Female.— Cephalothorax shorter than tibia and patella of the fourth pair, rather long and narrow, with the sides of the pars cephalica almost perpendicular; brownish black, with three rather narrow longitudinal bands covered with whitish hair, the middle one reaching to the pars cephalica, truncated and geminated anteriorly, narrowing backwards, the lateral bands supra-marginal, continuous, rather uneven in the upper margin. Sternum black, labium also blackish, with pale, slightly rounded apex. The anterior row of eyes but very slightly, scarcely perceptibly, curved forwards, its central eyes of the same size as (at least not greater than) the laterals, and somewhat more distant from each other than from the lateral eyes; eyes of the second series separated by an interval not much (about one-fourth) greater than their diameter. Mandibles narrow, but slightly convex longitudinally; their length is greater than the height of the face and the length of the patellæ, their color a dull yellowish, or ferruginous brown. Maxillæ dark yellowish brown. Palpi of the same color, the femoral joint with blackish longitudinal streaks and spots. Legs of a dark and dull yellowish brown, the thighs with dark streaks and spots above and on the sides, limiting above two large, oblong, pale spots, divided longitudinally by a fine black line; the patellæ and tibiæ have each three blackish longitudinal lines. Seen from the under side, the anterior tibiæ show four pairs of spines, the third pair belonging to the sides of the joint. Abdomen brownish, with traces of a short white band at the anterior margin of the back. The vulva forms no deep fovea, as in *L. fuscula*, ex. gr.; the elevated ferruginous area vulvæ shows, when the hair is rubbed off, a system of short furrows and impressions rather difficult to describe, and forming a large, oblong figure, rather narrow in its anterior half, then dilated gradually with rounded sides, and truncated behind; the anterior part, which is divided from the posterior by a large, but not deep, transverse depression, shows two longitudinal parallel furrows, the anterior apices of which are rounded; the narrow interval between these furrows is pointed anteriorly, and has in the middle a very fine longitudinal furrow. The posterior broad part of the area vulvæ shows on each side a deep, oblique, incurved, crescent-formed fovea; the space between these foveæ is triangular, with the apex directed backward, and divided by a deep middle longitudinal furrow. Mamillæ blackish.

A male, which I think belongs to this species, differs by the cephalothorax being of a purer black, with the lateral bands less distinct; the legs, which have the same markings as in the female, are of a clearer yellowish brown color than in that sex, but darker at the base: the coxæ are black above and blackish beneath, the thighs also blackish on the under side towards the base; the tarsi are yellowish brown, scarcely black at the extreme apex (as in the male). The palpi are very dark yellowish brown (the tibial joint almost black) with black lines, and the tarsal joint quite black; the tibial joint is thickly clothed with black hair; also the other joints are black haired. The patellar joint is somewhat longer than broad, cylindrical, the tibial joint scarcely longer than the tibial, but broader, being slightly and gradually dilated towards the apex; the tarsal joint is as long as the two preceding joints together, almost pear-shaped. The genital bulb is very high at the base on the under side, this elevated part being obliquely truncated and emarginate on the outer side; it shows in front a large fovea, from which issues a very short and coarse obtuse tooth directed obliquely forward and outward, and bearing at its base a longer and narrower pointed black tooth directed outwards and curved backward and downward; this latter tooth lies almost concealed in the fovea. In the middle of the outer margin of the bulb a strong, pointed, downwardly directed black tooth is visible; close to the anterior side of its posterior elevated portion is a transverse spine-like costa. The anterior lower part of the bulb shows on the outer side two pale appendages or narrow lobes. The abdomen has a very distinct narrow band covered with whitish hair on the anterior part of the back; the belly is blackish.

♀. Length of the body, 6 millim.; of cephalothorax, 3.5 millim.; breadth of cephalothorax, 2.25 millim.; first pair of legs, 9.5 millim.; second, 8.5 millim.; fourth, 13 millim.; patella and tibia of fourth pair, 3.75 millim.; tibia, 2.75 millim.

♂. Length of body, 6.5 millim.; of cephalothorax, 3.25 millim.; breadth, 2.25 millim.; first pair of legs, 8.75 millim.; second, 8 millim.; fourth, 11.75 millim.; patella and tibia of the fourth pair, 3.25 millim.; tibia, 2.5 millim.

The female here described was captured at Strawberry Harbor, July 28th; the male on Square Island, also in July. This species greatly resembles the next preceding, *L. fuscula*; but it is smaller, with the sides of the head more perpendicular, the interval between the two largest eyes is smaller, and the form of the vulva quite different. *L. labradorensis* is a Pardosa C. Koch, while *L. fuscula* (and *L. furcifera*) appear to belong to Leimonia C. Koch.

On the Structure of the Palpal Organs of Male Spiders.

By J. H. Emerton.

It has long been known that the copulation of spiders is performed by the introduction of peculiar organs on the ends of the palpi of the male into openings near the outlet of the ovaries in the abdomen of the female.

Treviranus, who discovered the testes of *Aranea domestica* in 1812, thought that the palpal organs were used to excite the female, or to open the passage to the ovaries, and that the true copulation took place afterward, by the contact of the openings in the abdomens of the two sexes.

Lyonet, in Memoires du Museum d'Histoire Naturelle, 1829, described and figured the palpal organs of three species of spiders, and showed clearly that they were furnished with a tubular process, which he called the penis, with an opening at the end. In the palpal organ of *Aranea domestica*, he showed that a fine duct passed from this orifice toward the base of the organ.

Menge, in 1843, in his memoir on the habits of spiders, Schriften der Naturforschenden Gesell. Danzig, gave the first account of the whole process of copulation. He saw the male drop the semen from the opening in his abdomen, on the web, and then take it up by his palpi, and afterward copulate in the usual way. Menge considered the essential parts of the palpal organs to be a hard process (Eindringer), the tubular structure of which he does not mention, and a rough membranous appendage (Samenträger), which wipes up the semen from the web and carries it to the female opening. This view of the structure of the palpal organ he repeats in the introduction to his monograph of the spiders of Prussia, in 1866.

In 1851, Dr. W. I. Burnett examined the palpal organ of *Agelena nœvia* Hentz, and found a duct leading from an opening at the end of the penis to a capsule at the base of the palpal organ. This he describes in the Proceedings of the Boston Society of Natural History, Vol. IV, and in a note in his translation of Siebold's Anatomy of the Invertebrata.

In 1868, C. O. Hermann published in the Proceedings of the Zoological-Botanical Society of Vienna, a paper on the sexual organs of *Epeira quadrata*, in which he asserts that the palpal organ not only has a hollow penis, but that a tube passes from it through the thorax to the testes in the abdomen of the spider.

The true structure of the palpal organ is best seen in some large species of Mygale, where it consists simply of a hard bulb, prolonged

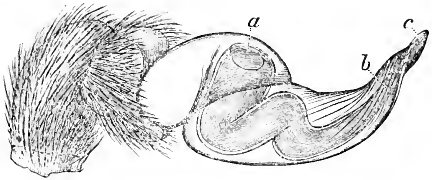


Fig. 1.

into a hollow penis, Fig. 1. Within the bulb is a sac, attached by its base to the side of the bulb at *a*, and narrowed at the other end into a tube *b*, which leads to the orifice of the penis *c*. In other spiders the essential structure of the palpal organ is the same, though often obscured by the spines and appendages of the bulb, and modifications of the shape of the tarsal and tibial joints of the palpus. In almost all species the tarsal joint is flattened and hollowed on the under side, to receive the shortened and twisted bulb. The simplest case of this is seen in *Attus tripunctatus*, and several other species of Attus, where the penis is a short, blunt tube, and the bulb flat, smooth, and without appendages. Where the penis is long it is almost always accompanied and supported by a thin, flat process of the bulb, called, by Lyonet, the conductor, as in the palpi of Dictyna, figured by Lyonet, in the American species of the same genus, in *Tegenaria medicinalis*, *Clubiona pallens*, and many others. In most Epeiræ the penis is short, and accompanied by several large processes, as in *Epeira vulgaris* Hentz, Fig. 2. This latter figure represents a palpal organ made transpar-

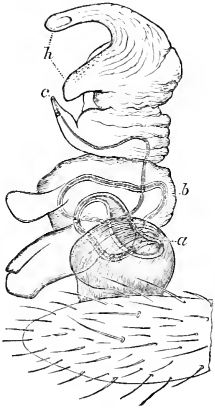


Fig. 2.

ent by potash, and shows the sac attached by its base at *a*, as in Fig. 1, and the tube *b* much lengthened, passing twice round the inside of the bulb, and opening in the penis at *c*. In the various species of Linyphia and Erigone the complication of the palpal organ is still greater, but the internal structure is the same. The only variation I have seen is in *Linyphia autumnalis*, and an allied undescribed species, where the duct has a spherical enlargement midway between the sac and the penis.

The Physical Features of the State of Massachusetts.

By W. H. Niles.

The geographical position of the State of Massachusetts inseparably unites her territory to the Appalachian mountain system, and gives rise to the most conspicuous features of her hills and mountains. Massachusetts presents four distinct physical regions, in two belts of highlands and two of lowlands, which cross her territory from the northern boundary to the southern. The western region is that part of the Green Mountain chain which is within the State, and it embraces a large portion of the Taconic and Hoosac ranges. East of this lies the Connecticut Valley region. This is succeeded by a broad belt of uplands, forming a central region of distinct physical features, but which has no recognized name by which it may be designated. The fourth is that extent of relatively low land adjoining the coast, which is a part of what has been called the "Atlantic Plain."

The laws of elevation discernible in a comparative study of these regions are but a part of the system embodied in the structure of the Appalachians. Throughout that portion of this mountain system, which lies east of the valley of the Hudson and south of the highest of the Green and of the White Mountains, the ranges increase in height as they succeed each other toward the west, and both highlands and lowlands gradually rise towards the north. As Massachusetts is a part of this region, her surface is elevated in accordance with both of these more general laws. Thus the western belt of highlands exceeds the eastern in elevation, and the Taconic Mountains average higher than the Hoosac range; and hence the northern part of each of the four physical regions is higher than its southern part. Thus the mountain-forming forces, increasing the elevations toward the west and likewise towards the north, have resulted in establishing the highest mountains of Massachusetts in the northwesterly portion of her territory, and in leaving the broadest extent of lowlands in the southeastern part.

The parallelism of feature lines, which is so characteristic of the Appalachians, is so decidedly marked in the general course of the physical regions and of the ranges of hills, as to show an intimate correspondence with and dependence upon the structure and plan of this mountain system. Even in the eastern region, the one most removed from the axis of the system, the range of low hills which skirts the tide-water region from the Charles River to Salem and continues to the extremity of Cape Ann, is, throughout, parallel to the more central mountainous regions west and north of it. There are ranges, however, which are not strictly conformable, in their courses, to the principal ones. We have an example of these in the east and west ridges of the vicinity of Boston, and in the hills of Quincy and Milton. The trend of these so closely corresponds with the strike of the rocks, as to show that their courses are determined by proceses of elevation rather than by erosion.

From these, and other similar data, it is argued that the general character of the most conspicuous features, seen in the configuration of the State, is derived from their inseparable dependence upon the structural plan of the Appalachian mountain system; that other features of secondary importance have arisen from minor systems of elevation, which, although associated with, do not appear to have been essential parts of the more general one, and that the different meteoric agents have modified these without obliterating them, and have added others, which, without wholly obscuring the plan, have increased the diversity and complication of the topography of Massachusetts.

A discussion of some points touched upon in the communication of Prof. Niles followed, being carried on principally by Dr. Hunt, Prof. Hitchcock and Prof. Shaler. Prof. Shaler alluded to the granitoid character of the rocks at Braintree, to which Prof. Niles referred. Dr. Sterry Hunt spoke still further on the same subject.

The crystalline rock, said Dr. Hunt, seen in contact with the fossiliferous Lower Cambrian (Menevian) strata of Braintree, Mass., is clearly a variety of the feldspar-porphyry or orthophyre, which is so abundant along the eastern coast of Massachusetts, Maine and New Brunswick, and which passes on the oné hand into a jaspery petrosilex, and on the other, into a finely granular, almost granitoid rock. In its typical and most common form, it is a fine-grained impalpable mixture of orthoclase and quartz, generally colored some shade of red, brown, or purple, and porphyritic from the presence of feldspar crystals, chiefly orthoclase, often with grains of crystalline quartz. The porphyries of Lynn, Marblehead and Salem, and the so-called jaspers of Saugus and Newbury, belong to it. This rock is identical with the porphyry which accompanies the crystalline iron ores of southeastern Missouri, and is also well displayed on the north shore of Lake Superior. It is, in all of these localities, distinctly stratified, and has been by the speaker referred to the Huronian series of rocks. [See the Proceedings of this Society for October, 1870, pp. 45, 46, and also the late descriptions of Pumpelly and Schmidt, in the geological report of Missouri for 1873.] This porphyry, in the form of pebbles, often forms conglomerate beds in the Keweenaw or copper-bearing series of Lake Superior, as is well seen in the Calumet and Hecla, and the Boston and Albany mines.

As regards the relations of the eruptive granites of our Eastern coast to the Braintree fossiliferous slates, Dr. Hunt remarked that granites on Marblehead Neck, which resemble those of Cape Ann, are seen to cut the still older porphyries, as he had pointed out in the Proceedings of the Society, cited above.

In reply to another question, Dr. Hunt said that the relation of the similar fossiliferous slates in the vicinity of St. John, N. B., to the Huronian or Green Mountain series, was very apparent. The unchanged fossiliferous strata are seen to rest on the crystalline Huronian strata, and include, in some cases, fragments derived from these. He also remarked that in this region there is a series of granular limestones interstratified with micaceous quartzites, which pass into micaceous gneisses, containing veins of endogenous granite. These strata, which are like some portions of what he has called the White Mountain, or Montalban series, are likewise seen to be older than the Menevian, which, at St. John, includes material derived therefrom. These ancient rocks are also largely represented in Hastings County, Ont., where they occupy a position between the Laurentian and the fossiliferous limestones of the Trenton group, and are the equivalents of similar limestones and micaceous quartzites in Berkshire County, Mass., and elsewhere in New England, which have been by some assumed to be paleozoic strata in an altered condition, and the stratigraphical equivalents of the fossiliferous Lower Cambrian rocks of Vermont. There has long existed a notion among many of our geologists, that there is nothing in New England below the mesozoic which is not included in the categories of the New York system, and that our great and varied series of crystalline stratified rocks, if not of the Laurentian gneiss of the Adirondacks, can be nothing else than members of the New York system altered in some mysterious manner. He had, for many years, endeavored to teach what he conceived to be correct views on this point, and had shown the existence between the proper Laurentian and the Lower Cambrian of several series of crystalline stratified rocks, which play a conspicuous part in the geology of eastern North America, and in various parts of this and other continents. He referred for further details to a paper on "The Geology of New England," in the American Journal of Science for July, 1870.

Section of Entomology. April 28, 1875.

Mr. H. L. Moody in the chair. Seven persons present.

The following paper was presented: —

A Century of Orthoptera. Decade IV. — Acrydii. By Samuel H. Scudder.

31. Chloealtis brunnea. Brown, sometimes tinged with yellowish, sometimes brownish-green. Head and prothorax rather abundantly but obscurely flecked with brownish atoms, the sides of the face above and the upper limit of the lateral lobes of the pronotum blackish. It differs from *C. viridis* Scudd., to which it is closely allied, in the greater tumidity of the summit of the head, the broader vertex between the eyes, which is less hollowed but slightly more declivant, and the less prominent veins upon the dorsal area of the closed tegmina; it seems never to be of so vivid a green.

Length of body, ♂, 19.5 mm.; ♀, 29 mm.; of tegmina, ♂, 9 mm.; ♀, 11.5 mm.; of hind femora, ♂, 12 mm.; ♀, 16 mm. 1 ♂, 3 ♀ taken October 1, at Dallas, Texas, by J. Boll.

32. Amblytropidia subhyalina. Dark brownish-fuscous, the head and pronotum obscurely clouded with black, and obscurely, longitudinally vittate above with dull yellowish; antennæ infuscated toward the tip; frontal costa shallowly punctulate, the summit of the head faintly rugulose. Pronotum sometimes dotted with black next the posterior border both of disc and lateral lobes, punctate throughout, both median and lateral carinæ distinct; tegmina much longer than the abdomen, obscurely dotted throughout with fuscous spots; wings rather sordid hyaline, slightly fuliginous next the apex, the veins blackish; hind femora blackish on the fuller parts externally, deepest above; hind tibiæ dull yellowish-brown, merging into blackish on the apical half, especially beneath, the extreme apex pallid and the tips of all the spines black.

Length of body, ♂, 20 mm.; ♀, 28 mm.; of antennæ, ♂, 7.25 mm.; ♀, 6.5 mm.; of tegmina, ♂, 18.5 mm.; ♀, 23 mm.; of hind femora, ♂, 14 mm.; ♀, 18.5 mm. 3 ♂, 1 ♀, collected March 10 and 12, at Dallas, Texas, by J. Boll.

33. Gomphocerus virgatus. Pretty uniform brown; a broad, straight, blackish stripe, darkest on the pronotum, extends from above each eye to the outer posterior edge of the pronotum, bordered rather faintly and narrowly with yellowish on the inner side throughout its entire length, and distinctly with yellowish-white externally on the pronotum; this latter whitish line marks the slightly raised, nearly straight lateral carinæ and is minutely edged on either side with black; the inner border of the broad stripe is marked by an intermediate carina, nearly as high as the median carina, and extending from above the front edge of the eyes to the posterior border of the pronotum;[1] antennæ brownish, infuscated on the apical half, scarcely longer than the pronotum, the joints depressed. Tegmina brown with a narrow green stripe just below the costal margin, followed by a longitudinal, scarcely disconnected series of fuscous spots, causing in the middle of the tegmina a mottled appearance; wings pellucid; legs brownish, the outer surface of all the femora infuscated along the middle, or, in the case of the hind femora, the upper portion of the thickest parts; spines black tipped, the outer of the inner, apical, aduncate spines of the hind tibiæ of great length.

[1] The same is true of *G. carinatus* Scudd., a species from the Middle States, scarcely differing from this excepting in having decidedly fuliginous wings, becoming infuscated on the apical half of the costal area.

Length of body, 20 mm.; of antennæ, 5.5 mm.; of tegmina, 15 mm.; of hind tibiæ, 14.5 mm. 2 ♀, taken March 26 and May 1, in Dallas, Texas, by J. Boll.

Psoloessa (ψόλος) nov. gen.

Allied to Tragocephala. Head but slightly tumid above; front regularly arcuate and slightly declivant, the frontal costa broadening constantly in width toward the labrum, acuminate above; vertex narrow, the eyes being separated by a space less than equal to the diameter of one of the eyes, the fastigium scarcely declivant; eyes pretty large, sub-acuminate above; antennæ equal to or shorter than the combined head and pronotum, the joints flattened, on the apical half punctate. Disc of pronotum nearly flat; the median carina distinct but slight, broken once in the middle; lateral carinæ distinct throughout, sinuate, at first approximating a little and then diverging greatly in passing backward; posterior margin bent at more than a right angle; tegmina slender but not extending much beyond the body; wings with the principal cells of the front area longer than broad, pellucid with a more or less fuscous tip; lower interior apical spine of the hind tibiæ nearly, quite, or more than half as long again as the upper one.

34. **Psoloessa texana.** Summit of the head with a very slight medio-dorsal carina reaching as far as the base of the fastigium of the vertex; this is about as broad as one of the eyes in the female, slightly narrower in the male, having much the form of that of *P. ferruginea*. Head blackish on the upper half, below paler, livid, with olivaceous tinges on the sides, heavily mottled with yellowish and blackish in front (excepting the frontal costa) and about the mouth parts; extreme basal joints of antennæ yellowish, beyond dusky, darkening toward the tip, joints 4–5 minute, but the sixth longer than broad. Pronotum blackish above, faintly and inconspicuously flecked with dull yellowish, the sides mostly dull yellowish with a blackish, longitudinal, irregular band below the middle; tegmina blackish fuscous, the veins blackish, a few pale dots indistinctly seen in a row near the costal margin beyond the middle; wings faint bluish hyaline, distinctly fuliginous on the apical fourth, fading interiorly; all the veins black; legs brownish-yellow, dashed and dotted with black; the apex of the hind femora blackish, and the spines of hind tibiæ black excepting at base. Abdomen bright reddish, or roseate above, duller beneath and on sides.

Length of body, ♂, 15.5 mm.; ♀, 19.25 mm.; of antennæ, ♀, 6 mm.; of tegmina, ♂, 13 mm.; ♀, 17 mm.; of hind femora, ♂, 10 mm.; ♀, 12 mm. 2 ♂, 1 ♀, taken March 24 and June 6, at Dallas, Texas, by J. Boll.

35. Psoloessa ferruginea. Summit of the head with a slight medio-dorsal carina extending nearly or quite to the tip of the vertex; the latter about as broad as one of the eyes on a top view, the sides raised and parallel for a short distance beyond the eyes, then meeting at less than a right angle, the edges still raised. Head dark brown with light brown mottlings and a broad, equal, medio-dorsal stripe, of the width of the vertex, extending from its tip backward, edged laterally with blackish; antennæ dusky, joints 4-6 about as long as broad. Pronotum generally light yellowish brown above, the lateral carinæ slightly paler, the latter edged rather broadly on the outer side anteriorly, on the inner side posteriorly with black; middle of sides of pronotum with some obscure dark markings, the lower border flecked with ashen; tegmina variable, the portion forming the superior field, when closed, of the color of the dorsum of the pronotum; the remainder generally much darker, occasionally with dark dots along the middle field and darker veins; wings hyaline, the veins along the costal area broadly, the rest delicately, black; the extreme apex of the wing dark fuliginous; legs brownish gray mottled with dark brown, the hind femora dotted externally with blackish and the spines black tipped. Abdomen ferruginous above, the sides flecked with brown; beneath paler.

Length of body, ♂, 14 mm.; ♀, 21.5 mm.; of antennæ, ♂, 6.2 mm.; ♀, 6.5 mm.; of tegmina, ♂, 13 mm.; ♀, 17 mm.; of hind femora, ♂, 10 mm.; ♀, 12.2 mm. 1 ♂, 3 ♀, taken March 24 and April 25 and 29 at Dallas, Texas, by J. Boll.

36. Psoloessa maculipennis. Summit of the head with a slight medio-dorsal carina extending to the middle of the fastigium of the vertex; the latter about as broad as one of the eyes, short, longitudinally obovate, a little angulated in front, pretty deeply depressed, with sharp sides and a median transverse furrow. Head dark reddish brown, much and irregularly mottled with darker brown; antennæ fuscous growing darker toward the tip, joints 4 – 6 about half as long as broad. Pronotum uniformly brown above, excepting a pair of small oblique black dashes situated just behind the middle of either side; the sides of the pronotum as in *P. ferruginea*; tegmina ash-brown, sprinkled rather profusely, excepting in the middle area, with blackish and whitish fleckings, generally disposed longitudinally; wings hyaline, the veins black, with the slightest possible cloudiness at the extreme tip; legs brown, flecked, and the fore and middle pair delicately subannulate with blackish; hind tibiæ dull yellowish, edged beneath with blackish, the apical half of the spines black. Abdomen dull ferruginous, slightly paler beneath, marked on the sides next the incisures with blackish.

Length of body, 19 mm.; of antennæ, 6.5 mm.; of tegmina, 16.5 mm.; of hind femora, 12.2. 2 ♀, taken March 23 at Dallas, Texas, by J. Boll.

37. Arphia simplex. Brownish fuscous. The general color is very uniform, but the lower half of the head, and especially of the face, passes to ashen; lateral foveolæ of the head scarcely distinguishable from the parts below, the lower limits being very obscurely marked. The edges of the lateral lobes of the pronotum are sometimes dotted irregularly with yellowish; pronotum somewhat scabrous; pronotal crest not high nor arched, uniform; tegmina flecked with fuscous dots pretty uniformly distributed over the whole, excepting in being a little crowded in the basal half of the middle area; wings at base red, with a slight orange tinge, bounded by a moderately broad, nearly equal, arcuate, dark fuscous band, passing from the middle of the outer half of the costal border nearly at right angles to the same, until it reaches the opposite border, when it curves inward, following the border more than half way to the anal angle; it sends inward fully half way to the base of the wing, a broad, generally tapering shoot just below the costal margin; beyond the arcuate band the wing is fuligino-pellucid, and at the tip fuliginous, all the veins dusky; hind femora very indistinctly transversely trifasciate, with an indistinct pale annulus just before the tip, the hind tibiæ obscure glauco-plumbeous, with a pale annulus next the base.

Length of body, ♂, 24.5 mm., ♀, 32 mm.; of antennæ, ♂, 9 mm., ♀, 9.5 mm.; of tegmina, ♂, 26 mm., ♀, 31 mm.; of hind femora, ♂, 16 mm., ♀, 18.5 mm. 2 ♂, taken June 3 and 6, 1 ♀ taken April 26, in Dallas, Texas, by J. Boll.

38. Arphia conspersa. Greyish cinereous or blackish fuscous, the whole head rugulose and punctate with blackish fuscous; antennæ greyish-cinereous more or less dusky at base, beyond blackish. Pronotum somewhat rugose, the median carina rather elevated, gently arched, subincised in the middle; whole of pronotum mottled or sprinkled with dusky dots, noticeable only in the lighter specimens, in the darker indicated as pale dots along the borders; tegmina light cinereous or brownish fuscous, more or less sprinkled with small dark fuscous spots throughout, generally absent from the inner field and infrequent near the apex; wings coral-red at base with an arcuate, extra mesial, not very broad band of blackish fuscous crossing the wing and emitting baseward a broad shoot, two thirds at least of the distance to the base in the upper area of the wing, separated from the costal margin only by a narrow streak of coral-red; below, the arcuate band follows the border nearly to the anal angle, diminishing only a little in width as it passes; apex of wing pellucid, very slightly fuliginous outwardly, all the veins coarsely black; hind legs brownish yellow quadrifasciate with blackish; hind tibiæ dark plumbeo-fuscous, with a whitish annulation next the base.

Length of body ♂, 21 mm.; ♀, 34 mm.; of antennæ, ♂, 8 mm.; ♀, 8 mm.; of tegmina, ♂, 23.5 mm.; ♀, 28 mm.; of hind femora, ♂, 13 mm.; ♀, 15 mm. 1 ♂, 3 ♀, taken March 19 and 26, in Dallas, Texas, by J. Boll.

39. Arphia luteola. Head dark brown, sometimes blackish above, the sides and face more frequently brownish yellow, not infrequently with a broad, more or less obscure band of this color, extending obliquely on either side, from the middle of the upper edge of the labrum to the middle of either side of the posterior border of the head; above this the front is often much mottled; antennæ yellowish at base, beyond dusky. Pronotum rugose, pinched on either side of the middle of the dorsal carina, the latter moderately elevated, scarcely arched, with the slightest possible indication of a central incision; pronotum very variable in color, but usually dark brownish fuscous, sometimes pale yellowish cinereous, the median carina marked by a small V-shaped black spot in the middle, and at the anterior extremity and the posterior extremity of the disc by oblique black dashes broadest next to the border, which they do not generally reach; lateral lobes of pronotum generally marked in the middle by a rather large, quadrate, dusky spot; tegmina dark brownish fuscous, sprinkled profusely with small dark spots, generally larger and more conspicuous in the female, the base of the veins, and generally, at least the basal half of the radial vein, yellowish; wings unusually broad, pale citron yellow, sometimes faintly tinged with orange, with an arcuate, not very broad band of fuscous or blackish fuscous, commencing above in the middle of the outer half of the costal margin and crossing the wing at right angles to that margin, and then following down the outer margin to its broadest portion; along the border the band is fully half the width of the tegmina; but above this it narrows, and is not half so wide as that in the upper area of the wing, along the lower edge of which it sends a slender acuminate shoot much more than half way toward the base; the apical half of the remaining outer portion of the wing is fuscous, and the part between fuligino-hyaline, with black veins; hind femora brownish yellow or cinereous, broadly bivittate with blackish, the base above and the apex also blackish; hind tibiæ blackish fuliginous at base, followed by a broad conspicuous pallid belt; the rest of the tibiæ dark glaucous, merging at either end into blackish fuliginous, the spines tipped with black.

Length of body, ♂, 28 mm., ♀, 36 mm.; of antennæ, ♂, 10.5 mm.; ♀, 10.25 mm.; of tegmina, ♂, 31.5 mm., ♀, 34 mm.; of hind femora, ♂, 18.75 mm., ♀, 21.5 mm.; of wings, ♂, 29 mm., breadth of same, ♂, 19 mm. 8 ♂, 5 ♀; the males taken April 22, 28, June 3, 6, and July 15; the females June 1, 6, and July 15, 16, at Dallas, Texas, by J. Boll. Mr. Belfrage found it common the last of June, in Bosque Co., Texas, in sandy or dry prairies.

Phlibostroma (φλίβω, στρῶμα) nov. gen.

Somewhat closely allied to Psinidia Stål, but with less angular vertex, as seen from the side, and without any intersections of the anterior half of the median carina of the pronotum. Head rather tumid, a little elevated, the summit arched, higher than the pronotum, the eyes separated by a space at least double the width of the first joint of the antennæ; vertex pretty strongly declivant, shallowly sulcate toward the angular apex; lateral foveolæ broad, transverse, sometimes scarcely separable from the parts below; ocelli touching the eye at the extremity of its upper third; front but slightly declivant, frontal costa rather narrow, narrowed above the antennæ, sulcate only below; eyes separated by fully their own length from the base of the mandibles; antennæ linear, in the female much longer than the head and pronotum combined (those of male not seen). Pronotum strongly contracted in the middle above, the lateral carinæ, which are slight though sufficiently distinct, having a clepsydral outline; disc nearly flat, the median carina very slight, distinct, equal, divided once in the middle; hind border roundly and rather obtusely angulated; tegmina surpassing the abdomen a little, rather slender, equal, broadly rounded apically, the cross veins rather distant; wings moderately broad, hyaline in the species seen, the cells large, in no part exceptional.

40. Phlibostroma pictum. Livid brown, with an olivaceous tinge above; upper interior edge of eyes margined with black, and the summit of the head with a more or less distinct dark median stripe; antennæ yellow, a little rufous toward the tip. A triangular brown stripe behind the eye, the apex a little above the middle of the eye, connected with a broad blackish brown stripe on the sides of the pronotum, extending to, and sometimes a little beyond, the principal transverse sulcus, faint in front and enlivened by a short longitudinal white line, extending, a little below the middle of the stripe, from the anterior transverse sulcus forward; posterior lobe of pronotum dusky externally on the disc; tegmina pale cinereous, the middle area with four or five large, oblique, quadrate or triangular, fuscous blotches, darkest at the edges, extending from the base three quarters of the distance to the tip, the outer ones more transverse than the others and directed from below upward and outward; wings hyaline, some of the veins blackish; hind femora cinereous, black at tip, with two or three very oblique, fuscous stripes, all but the basal one covering also the superior sulcation, sometimes confluent on the sides; hind tibiæ pale red, paler toward the base, the extreme tip of which is black.

Length of body, ♂, 16 mm.; ♀, 22.25; of antennæ, ♀, 9.25 mm.; of tegmina, ♂, 16 mm.; ♀, 18 mm.; of hind femora, ♂, 11.5 mm.; ♀, 1.35. 1 ♂, 1 ♀, Glencoe, Dodge Co., Nebraska, G. M. Dodge.

ERRATA ET ADDENDA.

Page 75, line 25. For *missouriense* read *missouriensis*.
Page 164, line 10. For *Agr. simplicius* read *simplaria*.
Page 339, line 24. For *horreorem* read *horreorum*.

On p. 173, it is necessary, through accidental transposition of matter, to make the following important correction, namely, to substitute for the first six lines the following:

That the cavity upon the ventrals, containing the muscular gland, fills so readily with the sperm when the claspers are erected, and that its contents are expelled, upon contraction of the muscles around it, with such certainty to their ends, when restored to their normal position, are evidences that it acts as a forcing or squirting apparatus.

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