FORTY-FIRST ANNUAL REPORT

OF THE

TRUSTEES

OF THE

State Museum of Natural History

FOR THE YEAR 1887.

TRANSMITTED TO THE LEGISLATURE MAY 7, 1888.

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MAY 7, 1888.

FORTY-FIRST ANNUAL REPORT

OF THE

TRUSTEES OF THE STATE MUSEUM OF NATURAL HISTORY.

To the Legislature of the State of New York:

I have the honor to transmit herewith the Forty-first Annual Report of the Regents of the University as Trustees of the New York State Museum of Natural History, as required by law.

H. R. PIERSON,

Chancellor.

OFFICE OF THE REGENTS, *May* 7, 1888.

BOARD OF REGENTS.

* Deceased.

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REPORT OF THE TRUSTEES.

To the Legislature of the State of New York:

The Regents of the University, as trustees of the State Museum of Natural History, submit their forty-first annual report.

Included with this report will be found the report of the Director, together with the reports of the State Botanist, the State Entomologist and the State Geologist. The trustees refer to these reports for details of the operations of the Museum during the past year.

The Museum has been materially increased by the addition to its collections of the important and beautiful collection of minerals and gems purchased from Mr. George F. Kunz. This collection is one of the most perfect to be found in any American Museum. It has been arranged in the office rooms on the right hand of the entrance from State street.

The Zoölogical collections have been restored and fitted in new cases during the past year. The restoration had become necessary on account of the condition of many of the specimens. In some cases the original specimens were of an imperfect character and they had become still more decayed and dilapidated by the ordinary causes which prevail in every museum. In other cases the specimens were deficient in one of the sexes, showing only in many cases the male sex. The whole collection has been examined and the imperfect specimens removed by Prof. Henry A. Ward, of Rochester, N. Y. There are still a considerable number of deficiencies which it is hoped may be filled during the coming year. The cases, which occupied the center of the Zoölogical collection in the third story, have been renewed and made to conform to the cases that were already there; on the whole the entire Zoölogical collection has been greatly improved and, especially, when the deficiencies above referred to are supplied, it will make an interesting and an important part of the Museum collections.

No material progress has been made during the past year in fitting up the room in the State Hall for the purpose of the Museum. The State officers who still occupy rooms in the State

Hall have not yet been provided with quarters in the New Capitol. In consequence of this, additional rooms for the use of the Museum have not been available. Mention should be made, however, of the introduction of steam-heating in the various rooms of the State Hall. This has been done by Superintendent Andrews, and will greatly add to the comfort and convenience of the rooms. Previous to this time the several rooms have been heated by the use of stoves, which, of course, greatly inconvenienced the occupants. Another step in the preparation of the rooms for the use of the Museum has been made by the erection of an elevator. In view of the amount of work conducted in the upper story of the hall, the addition of an elevator has proved of great utility. The work of introducing this elevator has been conducted by Superintendent Andrews, but paid for by the Trustees of the Museum from the appropriation made by the Legislature for the fitting up of the State Hall for the use of the State Museum.

The Legislature entrusted to the Trustees of the Museum the work of publishing the Palæontology of the State. Another volume has been issued during the past year. This was on the subject of Corals and Bryozoa. There still remain the volumes upon Crustacea and Brachiopoda. The first of these is in a good condition of forwardness, and will be published early in the year 1888.*

The work of the Museum has been conducted by the usual scientific staff. Professor Hall has continued as Director of the Museum ; but he has devoted the chief part of his time to the publication of the Palæontology. The principal work of the Museum has been under the care of Assistant Smock, who has been denominated by the Trustees as Assistant-in-charge.

Assistant Beecher has notified the Trustees of his acceptance of a position in the Peabody Museum of Natural History, in New Haven. He will leave the service of the Trustees about January first. The Trustees desire to express their special commendation of his earnest and intelligent activity during the time spent in their service. They part with him with great regret and with an earnest wish that he may succeed in the position to which he has been called.

The Trustees desire to mention in this report the death of Mr. John Gebhard, in the eighty-fifth year of his age. In his earlier

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* Published in May, 1888.

days he was an active scientific man, and the collections in Palæontology which are now in the Museum bear evidence to his scientific activity. He was at one time the Curator of the State Cabinet, and he has been at all times highly regarded for his scientific ability.

After the death of Mr. Gebhard the Trustees nominated for his successor Mr. William B. Marshall, who has had a varied experience in Museum work at the Philadelphia Academy of Sciences. Mr. Marshall has entered upon the performance of his duties at the Museum, but has not yet been examined by the Civil Service Commission. This, however, will shortly take place and then his appointment will be made permanently and completely.

H. R. PIERSON,
Chancellor.

December 7, 1887.

STATE MUSEUM
OF
NATURAL HISTORY.

REPORT OF THE DIRECTOR.

REPORT OF THE DIRECTOR.

ALBANY, N. Y., *November* 21, 1887.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN.— I have the honor to submit herewith the annual report (being the forty-first in consecutive order) upon the State Museum of Natural History, and the condition of its collections in the several departments so far as the same has come under my knowledge or direction.

The report of last year is not yet delivered from the State printer, and, therefore, not accessible for reference for an account of the work accomplished in the State Museum and of the additions to the collections in the several departments thereof during the year 1886.

Owing to the requirements for the completion of the volumes upon the Palæontology of the State within a specified time, the Director is precluded from the preparation and presentation of any scientific papers in connection with the State Museum report, as has been his custom till within the past few years. There are no special scientific papers in the hands of the Director to be communicated with this report. The report of the State Botanist, the State Entomologist, and the State Geologist, will form a part of the entire communication to the Board of Regents.

The special data regarding the Museum work and arrangement, and the additions thereto, have been furnished by Prof. J. C. Smock, Assistant-in-charge, and Mr. C. E. Beecher, in charge of the Palæontological department of the Museum.

Very extensive and important changes in the arrangement and exhibition of some of the collections of the Museum have been made necessary during the year to accommodate the additions through purchases and donations. The most important of these changes has been made in appropriating the former offices of the Curator upon the first floor of the building to the arrangement of the general collection of minerals, including the Kunz collection. By this change the exhibition space has been largely increased, and nearly all the four stories of the building are now given to exhibition uses. Excepting a small area in the front room reserved for an office, and a like space partitioned off from the back room for storage and work, the whole of the first story is now devoted to exhibition.

The library has been removed to suitable cases in the Museum rooms in the State Hall, and the stock of duplicate reports has also been removed to the same building.

New cases, specially designed for the exhibition of minerals, were constructed along the walls of the rooms, having an aggregate length of 120 feet. Three large and double table cases have been placed on the floor. The case containing the collection of precious stones and cut gems occupies a window alcove in the south room. In one of the table cases the unique and valuable collection of minerals from Bergen Hill, N. J., has been arranged. Another has a selected collection of the finer and more showy minerals, while the third case holds a small collection of pseudomorphs and the calcites of the original Emmons collection of minerals. In the wall cases the general collection, consisting largely of the minerals purchased last year of Mr. George F. Kunz, of New York, is exhibited, arranged according to Dana's system of classification.

The main part of the Mineralogical department thus occupies the first-floor rooms of the Museum building. The collection of gems and the large and finely crystalized minerals in these new and well-lighted cases forms an interesting feature of the Museum, and attracts the attention of visitors.

In the second-story room the New York State collection of fossils still occupies its old place and arrangement, and shows the order of succession of plant and animal life in the rock formations of the State. The collections of the geological survey of the State make up the greater part of the material shown in the table cases which extend nearly around the entire room and inclose within their area the palæontological cases.

The alterations in the third story have been the removal of the whale skeleton to the rear hall of the Museum building, and of the general collection of minerals to the first-floor rooms.

The room in the fourth story and upper floor of the Museum building is now given entirely to the Zoölogical department. The exhibition of the collection of recent corals which was purchased last year, and of the Beecher collection of fresh-water shells, has made necessary some changes in the arrangement of the cases. In order to use the available space to better advantage, the two large floor cases which had heretofore been occupied for the birds and mammals in part, were taken out and three new double cases placed on the floor, alternating with the three table cases. As now arranged, the wall-cases extend around the room and the center is occupied by three table cases and three vertical cases. The collections of shells are retained in the table cases as heretofore, excepting the west side case which is to receive the New York fresh-water mollusca, and principally the large collection given by Mr. Beecher.

The mammals of the State are arranged in the wide case at the west end of the room ; the smaller mammals occupy the west side of the vertical case at that end of the room. The remaining space in this vertical case and the two new cases is given to the birds. On the north or front side, the wall and table cases are devoted to the corals, sponges and crustaceans. At the east end, on the Lodge street side of the Museum, the old arrangement is retained and the foreign mammals and the osteological specimens are there exhibited in a large wall case divided into three sections as formerly.

In the Zoölogical department the work of renovating and enlarging the collections of birds and mammals belonging to the fauna of New York, was begun last autumn by Prof. Henry A. Ward, of Rochester, and has been continued quite up to date of writing. The stuffed birds and mammals were all examined and all which could be cleaned and improved were so treated. Several of the mammals have been restuffed and all of them have been remounted on polished walnut pedestals corresponding to the birds which are thus mounted. The examination of the birds showed that some had faded so much as to be worthless and others were badly mounted. Altogether about 100 specimens were thrown out as too poor to be placed in the renovated collection. The loss in mammals was small. The improvement in color, form and mounting made by this work of renovation is great, and adds to the beauty and value of the collection. The improved style of cases, with more space and better light, show the specimens to better advantage and make these collections even more attractive than ever before. The loss in birds will necessitate the purchase of additional specimens to fill the gaps. And at the same time it is of urgent importance that all the birds and mammals belonging to the fauna of the State should be represented in these collections.

In the new arrangement the original De Rham collection has been incorporated with the other specimens, in so far as it contained representatives of the State Fauna. By the adoption of particularly designated labels the specimens originally in that collection can be easily distinguished.

The collection of recent corals purchased in December, 1886, has been mounted and put on exhibition on the third floor of the Museum building. It makes a most interesting and creditable display, and leaves but little more to be desired in order to make this class sufficiently complete for all the purposes of the State Museum. As at present arranged, the corals occupy three flat window-cases, four small vertical cases of five shelves each, and one large wall-case of seven shelves. A window-case has been constructed for the collection of recent sponges, and a similar case is devoted to the echinoderms.

For several years the State Museum has had in its collections the skeleton of a large whale (*Balænoptera musculus*), which has been brought to your notice in previous reports by the Director. The proper mounting and exhibition of this skeleton required a room of nearly seventy feet in length, and it was impossible to find a place in any room or area belonging to the Museum for its exhibition, and no feasible plan of disposition was reached until the present year, when, through the courtesy of the State Agricultural Society and its secretary, Mr. Woodward, a place in the Agricultural Museum was offered and was accepted by the Trustees of the State Museum. The skeleton is now suspended from the roof of the Agricultural Hall on the level of the upper gallery, and is thus exhibited in a very satisfactory manner.

Mr. Wm. B. Marshall, assistant in the Museum, has given much time to cleaning and relabeling specimens. The Reigen collection of shells from Mazatlan has been carefully examined and put in order. The collection of stone implements and the ethnological cabinet have been removed from the top story and placed in cases on the second floor, and new labels have been put on all the articles in these collections. In the New York collection of minerals on the the same floor many new labels have been renewed in place of those which had become illegible. On the first floor the large blocks and slabs with fossils, have been relabeled. In the general collection a card catalogue of the Kunz minerals was made early in the year, affording an accurate statement of the number of specimens and the species and varieties in that purchase. For its exhibition printed labels are to be used, and the minerals are to be mounted on cherry-colored blocks.

The alcoholic collection of fishes from New York has been rearranged and relabeled, and placed in the cases on the top floor on the south side of the room. This attention to distinct and easily read labels on all the specimens has consumed much time, but the increased interest thus given to the collections is evident to all who visit the Museum as amateurs or to study any of its collections.

The specimen of lepidodendron or fossil tree, from the Portage Shales at Naples, Ontario county, mentioned in the last report, has been mounted and placed on exhibition on the first floor of the Geological Hall.

This specimen is of the greatest interest as showing the base of the trunk with the rootlets attached, while the leaf scars are also beautifully shown over nearly the entire length of the trunk. It is probably the finest specimen of a Devonian tree that has ever been found. The length of the mounted specimen is eleven feet, diameter at the base thirteen inches, and at the smaller end four and one-half inches. As originally found, about four feet of the trunk in continuation of the smaller extremity were preserved, but the rock was so badly weathered and broken as to render it impossible to mount this portion.

The field work of visiting the building stone quarries of the State has been in progress since the beginning of autumn and the principal quarry districts of the northern part of the State and of the central and western counties have been seen and notes and data for a report thereon obtained. A few localities along the Mohawk valley and near the Hudson river remain to be visited when the work will be complete. Many letters, asking for statistics and other information about quarries and their methods of working, production and markets, have been sent out and the material thus accumulated is valuable. It will be used in the preparation of the report, and the work of writing will be begun as soon as the outside examinations have been made. It is proposed to give a list of all of the quarries and descriptive notes of the same, accompanied by statistics of production, labor employed, markets and other facts of public interest.

In connection with this work on the quarry industry, a small collection of rocks, typical of the beds worked, has been made. It will serve a useful purpose in showing the varieties of rock which are employed for building and which are quarried in our State.

Besides these specimens, which are of cabinet size, blocks of stone have been obtained from some of the quarry districts for the building stone collection of the Museum. Reference to the appendix will show what additions have been made to this collection.

Applications for collections of minerals and fossils from schools and academies have been more numerous than in previous years, and this fact expresses in a positive manner the usefulness of the State Museum as an educator in remote parts of the State, and also the increased attention paid to the study of the natural sciences.

The following institutions and individuals have received collections aggregating about 2,500 specimens:

1. Troy High School.................................Troy, N. Y.
2. Port Henry Union School.....................Port Henry, N. Y.
3. Walton Union School..............................Walton, N. Y.
4. Niagara University ....Suspension Bridge, N. Y.
5. Whitehall Union School ....Whitehall, N. Y.
6. Rochester Free Academy.....................Rochester, N. Y.
7. Sandy Hill Union School ....Sandy Hill, N. Y.
8. Academic High School............................Auburn, N. Y.
9. Unadilla Academy ....Unadilla, N. Y.
10. Canaseraga Union School ....Canaseraga, N. Y.
11. Coxsackie Union School ....Coxsackie, N. Y.
12. Yates Union Free School and Academy ....Chittenango, N. Y.
13. Marathon Union School and Academy..........Marathon, N. Y.
14. Wilson Academy......................................Angelica, N. Y.
15. North Tonawanda Union School.........North Tonawanda, N. Y.
16. Poughkeepsie High School.................Poughkeepsie, N. Y.
17. Franklin Academy..............................Plattsburgh, N, Y.
18. Hon. Daniel Beach ....Watkins, N. Y.
19. Hon. J. W. Husted ....Peekskill, N. Y.
20. Henry L. Griffis...............................Binghamton, N. Y.

In addition to these miscellaneous and general collections, there have been distributed collections of duplicate Lamellibranchiata, resulting from the completion of the volumes of the Palæontology of New York on this class of fossils.

These collections have been distributed as follows:*

Rensselaer Polytechnic Institute	Troy, N. Y.
Cornell University	Ithaca, N. Y.
Long Island Historical Society	Brooklyn, N. Y.
Syracuse University	Syracuse, N. Y.
Alfred University	Alfred, N. Y.
State Normal and Training School	Potsdam, N. Y.
State Normal and Training School	Oswego, N. Y.
State Normal and Training School	Brockport, N. Y.
State Normal and Training School	Buffalo, N. Y.
State Normal and Training School	Fredonia, N. Y.
State Normal and Training School	Cortland, N. Y.
State Normal and Training School	Geneseo, N. Y.
The Albion Academy and High School	Albion N. Y.
Westfield Academy	Westfield, N. Y.
Norwich Academy	Norwich, N. Y.

The following in exchange:

Prof. O. C. Marsh, Peabody Museum	New Haven, Conn.
Prof. Spencer F. Baird, Smithsonian Institution	Washington, D. C.
M. A. Agassiz, Museum of Comparative Zoölogy	Cambridge, Mass.
Prof. J. P. Lesley, State Geologist	Philadelphia, Penn.
Prof. Dr. A. Von Kœnen	Gottingen, Germany.
Prof. Dr. Beyrich	Berlin, Germany.

Additions by Donation and Exchange Worthy of Special Mention.

Cast of femur of Atlantosaurus immanis, cast of skull of Dinocera mirabile, from Prof. O. C. Marsh, Yale College.

Four hundred specimens of fossils from the Chemung group, Belfast, N. Y., from Emmet Brown, Belfast, N. Y.

Indian implements from near Catskill, N. Y., from Chas. Beach, Catskill, N. Y.

Fifty specimens of crude Petroleum from Penna., N. Y., Ohio and Barbadoes, from Prof. J. J. Stevenson.

In addition to the arranged collection of recent Mollusca presented to the State Museum in 1886, Mr. C. E. Beecher has included his entire series of duplicate specimens, which will furnish valuable material for exchange and distribution.

Mr. W. B. Marshall has devoted much of his time during the past six months to the preparation, labeling and mounting of this

* A part of this list was included in the report of last year.

collection of Mollusca for exhibition in the State Museum. The system of mounting and labeling employed in the Academy of Natural Sciences in Philadelphia, has been adopted. The collection, when properly mounted, will occupy about 300 drawers and by this method of mounting will require a space equal to that now occupied by the entire Molluscan collections.

The purchase of the Kunz collection of minerals has given the Museum a good general collection, and in the rearrangement of the Mineralogical department the old collection which for years occupied the cases at the west end of the third-story room, was broken up and distributed, the choice specimens being added to the Kunz collection and the remainder placed in the stock for exchange and for making up duplicate collections for the schools.

The collection of New York minerals was formerly exhibited in the cases on the front and at the east end of the same room. Excepting the saline class it has been rearranged in the cases which held the general collection. In this rearrangement an effort was made to retain the specimens of the original Beck collection, valuable as a historic record and representative of the Mineralogical department of the State Survey at its close in 1842. The specimens were all compared with the catalogues, and all which could be identified as belonging to the original collection have been left in that arrangement, and 685 of them bear labels of that collection. Although the labels on the remainder have been lost, the localities and their place in the collection prove their origin as the same. About 200 specimens of New York minerals, which had been incorporated in the State collection by additions from year to year, have been removed to the general collection and to the stock of duplicate material. As far as possible the New York localities of minerals are now represented by the best specimens in the general collection in the first-story rooms; and there is no longer a distinctive New York or State collection other than what may be called the *Beck Collection*, which is historic rather than representative.

The mineralogical collections have received important additions by collections made in Essex and Warren counties. The collections from Essex county are principally from the town of Newcomb, and comprise a variety of minerals, notable among which are large and fine crystals of brown tourmaline, furnishing some material suitable for gems. A series of specimens from this locality has been placed on exhibition, and six cut stones have been arranged with the gem collection.

Two large crystals of Pyroxene, from Ticonderoga, are also worthy of special mention on account of their unusually large size. One crystal measured fourteen inches in diameter, and a smaller crystal has a diameter of ten inches.

Since the purchase of the Kunz collection of minerals a special case has been provided for the gems, and they have been mounted and arranged by Mr. Beecher in accordance with the publications of the best authorities. During the past year twenty-four stones have been added by purchase and by collection. The series is now nearly complete, and only lacks about ten specimens in order to have all the species of gems represented. The plan of arrangement is to have each variety exhibited by a specimen in its natural condition, and also by cut specimens showing its variation in color and other features.

As thus presented, the collection is instructive and of scientific interest, besides being one of the most attractive features in the Museum to the general public.

State Hall.

The Museum library having been moved from the building on State street is arranged in cases in the offices of the State Geologist and State Botanist, in the State Hall. In a report made to the Bureau of Education at Washington in 1887, the number of volumes was stated to be 1,056 which is the result of an actual count. Of this number 140 volumes, or one-eighth of the entire library, have been added during the past year. In all 221 volumes and pamphlets have been received by donation, exchange and purchase from sixty-six sources.

In the arrangement and disposition of the Museum collections by the Curator, in 1866 and onward an extensive series of selected duplicates, especially of fossils of the lower Helderberg group and Oriskany Sandstone was reserved for the future use of the Museum, and with a view to meet the requirements of the plan of arrangement recommended by the Board of Regents in 1865.

This collection has now been removed to the State Hall and placed in the type room at the south-east corner of the upper story of the building, thus being separated from the duplicate collections proper. I wish to call especial attention to this collection as one selected with great care from an abundant supply of material, and earnestly recommend that it should be preserved in the Museum collections in order to meet the requirements of the original plan of arrangement should that ever be carried into effect.

In the south-east corner basement room of the State Hall, water and steam connections have been made and the room is now available as a laboratory and storage room. The majority of the mineral duplicates are here arranged in drawers.

A large rock dresser, the invention of Mr. Spang, of Pittsburgh, has been added to the machinery and apparatus in the department of sections and rock cutting. With this instrument large and irregular masses of rock can be reduced in a few minutes to a suitable form and dimensions, thus saving the slow and laborious work of sawing the specimens into the proper shape. In cases of fragile specimens or where translucent sections are required the machinery in previous use is employed with success as heretofore.

Since the introduction of steam-heat and an elevator engine into the basement of the State Hall, we have been able to connect the small engine belonging to the State Museum to the elevator boiler and are saved the expense and labor of maintaining a separate steam generator.

The preparation of the Museum Bulletins upon the Dictyospongidæ and the Palæozoic Lamellibranchiata has not progressed since my last report.

In 1885 the Committee on the State Museum decided to postpone the work of lithographing for these Bulletins, and no action, so far as I am aware, has since been taken. The lithographing of the plates already prepared for the Bulletin on the Dictyospongidæ will occupy a single artist for fully one year, and it is very desirable that this work be completed before the commencement of printing the letter-press. Since the preliminary descriptions were printed I have added some new material, and it has become more than ever desirable to review the original localities of these fossils, and to examine some others of more recent discovery before completing the work.

In order to make this work approximately complete, it will require the services of one person in the field for an entire season. It would be a misfortune to be compelled to publish, at this time, a work which would be only an expression of the knowledge possessed by us in 1882.

For the Bulletin upon the fossil Lamellibranchiata, it was proposed to illustrate the generic character of all known Palæozoic forms of this class. By the completion of the volumes on the fossil Lamellibranchiata of the Upper Helderberg, Hamilton, Portage and Chemung groups, we have almost completely illustrated the Devonian genera and species of this class of fossils. It is only necessary, therefore, to incorporate with these, in their proper relations, the Cambrian and Silurian genera, in order to present a complete synopsis of all the known Palæozoic forms.

As a preliminary to this Bulletin, the Report of the State Geologist for 1882 was accompanied by illustrations of fifty-nine genera, descriptions of which are published in the volume on the Devonian Lamellibranchiata.

To complete the work according to the plan originally proposed, would require the study, description and illustration of about eighty-four additional genera.

I append herewith a list of the genera illustrated in the Report of the State Geologist for 1882, together with a list of described genera not there illustrated, but which are necessary to the completion of proposed synopsis. Such a volume as here proposed would form an important contribution to our knowledge, and become a valuable text-book for reference both for amateurs, students and authors. No similar work has ever been compiled in any country, so far as I know, and heretofore our knowledge of these organism would scarcely permit of such an undertaking; but the extensive contributions more recently made in this direction are so great that we need no longer hesitate to give the results to the public.

I am, very respectfully,

Your obedient servant,

JAMES HALL,

Director.

ADDITIONS

TO THE

COLLECTIONS AND LIBRARY

OF THE

New York State Museum of Natural History.

ADDITIONS TO THE STATE MUSEUM DURING YEAR 1887.

I. ZOOLOGICAL.

By Donation.

Dr. David Murray:

Five specimens glass sponge *(Hyalonema mirabile)*, Yenoshima, Japan.

W. W. Hill:

Two specimens fish (*Couseius prosthemius)*, Beaver river, N. Y.

Christian Bassler:

One specimen milk snake; one specimen *Menobranchus lateralis*, Albany Water Supply.

Emmett Brown:

One specimen great blue heron, Belfast, N. Y.

E. Emmons, Jr.:

One specimen of *Alcyonaria* (Horn Coral), West Indies.

C. E. Beecher:

Several thousand specimens of land, fresh water and marine shells of the United States (duplicates of the collection presented to this Museum by Mr. Beecher in 1886.)

Series of shells described by the donor in the thirty-sixth annual report, under the title: "Some abnormal and pathologic forms of fresh-water shells from the vicinity of Albany, New York."

Prof. John C. Smock:

One specimen *Hippopus maculatus.*

One specimen *Tridacna squamosa.*

Two specimens *Cardium maculatum.*

Two specimens *Murex regius.*

Two specimens *Murex saxatilis.*

Two specimens *Pterocera lambis.*

One specimen *Voluta* (sp. indet).

One specimen *Fasciolaria tulipa.*

One specimen *Cassis Madagascariensis.*

BY EXCHANGE.

J. A. Singley (in exchange for duplicates of the C. E. Beecher collection):

One hundred and fifty-six specimens (nineteen species) of land and fresh-water shells, from Lee county, Texas, as follows:

Three specimens *Unio declivus*, Say.
Two specimens *Unio manubius*, Gould.
Eight specimens *Unio Texasensis*, Lea.
Three specimens *Unio Bealii*, Lea.
Four specimens *Unio Rutervillensis*, Lea.
Five specimens *Unio Lincecumii*, Lea.
Four specimens *Anadonta grandis*, Say.
Five specimens *Sphœrium subtransversum*, Prime.
Nine specimens *Physa Forsheyi*, Lea.
Ten specimens *Planorbis lentus*, Say.
Ten specimens *Bulimus dealbatus*, Say.
Ten specimens *Helix Berlandieriana*, Mor.
Twelve specimens *Polygyra Mooreana*, W. G. B.
Twelve specimens *Polygyra Texasiana*, Mor.
Eleven specimens *Polygyra leporina*, Gould.
Ten specimens *Conulus fulva*, Drap.
Eleven specimens *Hyalina arborea*, Say.
Twenty-four specimens *Helicina tropica*, Jan.
Three specimens *Succinea concordialis*, Gould.

BY PURCHASE.

H. T. Woodman:

Four specimens *Corallium rubrum*, Mediterranean Sea.
Two specimens *Stylaster elegans*, Sandwich Islands.
One specimen *Dendrophyllia* (sp. indet), East Indies.
One specimen *Ctenactis gigantea*, East Indies.
One specimen *Flabellum* (sp. indet), Loc. (?)

II. PALÆONTOLOGICAL.

BY DONATION.

H. L. Griffis:

Water-worn extremity of tusk of mastodon, found in drift while excavating for a sewer at Binghamton, N. Y.

C. E. Beecher:

One specimen *Alveolites explanatus*, from the Lower Pentamerus limestone of the Lower Helderberg Group, near Cedarville, N. Y.

Prof. O. C. Marsh:

Cast of Femur of *Atlantosaurus immanis;* cast of skull of *Dinoceras mirabile.*

By Purchase and Exchange.

(*By Exchange.*)

Emmett Brown:

Fossils from the Chemung Group of Belfast, N. Y., as follows:

Sixteen specimens *Productus hirsutus.*
Nine specimens *Productus arctirostratus.*
Fourteen specimens *Productus Boydi.*
Three specimens *Productus lachrymosus.*
Fifteen specimens *Centronella glansfagea.*
Six specimens *Terebratula Lincktaeni.*
Twenty-five specimens *Rhynchonella* sp. indet.
Fifty specimens *Rhynchonella eximia.*
Twelve specimens *Athyris angelica.*
Eighteen specimens *Leiorhynchus quadricostatus.*
Five specimens *Chonetes setigera.*
Five specimens *Spirifera Verneuili.*
Twenty-five specimens *Spirifera mesacostalis.*
Nineteen specimens *Orthis impressa.*
Twelve specimens *Crania* sp. indet.
Ten specimens *Ambocoelia umbonata, var. gregaria.*
Eight specimens *Discinia Alleghania.*
Ten specimens *Grammysia communis.*
One specimen *Grammysia bisulcata.*
Nine specimens *Crenipecten obsoletus.*
Eight specimens *Crenipecten crenulatus.*
Ten specimens *Sphenotus contractus.*
Two specimens *Aviculopecten rugistriatus.*
One specimen *Conularia* sp. indet.
Nine specimens *Bellerophon mœra.*
Six specimens *Euomphalus Hecale.*
Six specimens *Gomphoceras* sp. indet.
One specimen *Crinoid* (calyx and stem).
One specimen *Dictyophyton* sp. indet.
Three specimens plant remains.
Fifty specimens miscellaneous Lamellibranchs.
Thirty specimens miscellaneous Gasteropods.

(*By Purchase.*)

L. A. Boyd:

Fossil tooth of Mastodon from the junction of Big and Little Raccoon creeks, Indiana.

III. MINERALOGY.

By Donation.

C. E. Beecher:

One specimen Calcite (Nail-head Spar).

One specimen Star Mica.

One specimen Apatite in Chalcopyrite.

H. T. Woodman:

Two specimens Garnet-bearing rock from New York city.

Two specimens Muscovite from New York city.

J. L. Luckey:

Iron ore, Aurora Mine, Gogebic Range, Lake Superior.

J. E. Eldridge:

Pyrite, Johnsburgh, Warren county, N. Y.

A. G. Richmond:

Pebble of Agate.

I. N. Bugbee:

Talc, from Chittenden, Vermont.

Matchless Metal Polish Company:

One specimen calcareo-silicious rock used for polishing powder, from Missouri.

Andrew Lackey:

One specimen Garnet, from Warren county, N. Y.

Hon. Henry R. Pierson:

One specimen Argentiferous Galena, from Colorado.

James Murray:

One specimen Argentiferous Galena, from Morning Star Mine, Leadville, Colorado.

One specimen Silver Chloride, from Lee Basin Mine, Leadville, Colorado.

By Collection.

(*Arranged in the Exhibition Cases.*)

One specimen Pyroxene, 14-inches diameter, Ticonderoga, N. Y.

One specimen Pyroxene, 10-inches diameter, Ticonderoga, N. Y.

One specimen Pyroxene, large group, Ticonderoga, N. Y.

One specimen Pyroxene, with Scapolite, Ticonderoga, N. Y.

One specimen Pyroxene, small group, Ticonderoga, N. Y.

Three specimens Scapolite, Ticonderoga, N. Y.
One specimen Garnet, Thurman, N. Y.
Three specimens Garnet and Hornblende, Thurman, N. Y.
Four specimens Quartz in Black Tourmaline, Johnsburgh, N. Y.
One specimen White Hornblende, Minerva, N. Y.
Eleven specimens Quartz crystal, Ticonderoga, N. Y.
Eight specimens Wernerite, Newcomb, Essex county, N. Y.
Four specimens Graphite, Newcomb, Essex county, N. Y.
Two specimens Tremolite, Newcomb, Essex county, N. Y.
Four specimens Scapolite, Newcomb, N. Y.
Eleven specimens Smoky Quartz, Newcomb, Essex county, N. Y.
One specimen Albite, Newcomb, Essex county, N. Y.
One specimen Feldspar, Newcomb, Essex county, N. Y.
Twenty-four specimens Brown Tourmaline, Newcomb, Essex county, N. Y.
One specimen Green Tourmaline, Newcomb, Essex county, N. Y.
Five boxes of minerals from Newcomb, Essex county, N. Y.
One box of minerals from Thurman, Minerva and North Creek, N. Y.
One barrel of minerals from Ticonderoga, Essex county, N. Y.

By Purchase and Exchange.

(By Exchange.)

Prof. B. K. Emerson:
Five specimens Spodumene.
Two specimens White Garnet.
One specimen Prehnite.
One specimen Datolite.
One specimen Olivine.
One specimen Beryl.
Two specimens Anthophyllite.
Two secimens Albite (pseudomorphs).
Two specimens Antillite.

Prof. J. J. Stevenson:
Fifty specimens of crude petroleums from New York, Pennsylvania, Ohio, West Virginia, Colorado, California and Barbadoes.

(By Purchase.)

Dr. James W. Hall:
One specimen of native gold in quartz, Montana.

ADDITIONS TO THE GEM COLLECTION.

(*By Purchase.*)

One Diamond, Diamantina, Brazil, cut stone.
Three Zircons, Ceylon, cut stone.
One Danburite, Russell, N. Y., cut stone.
One Hiddenite, Stony Point, North Carolina, cut stone.
One Iolite, Ceylon, cut stone.
One Epidote, Tyrol, cut stone.
One Rutile, North Carolina, cut stone.
One Peridot, Gallup, New Mexico, cut stone.
Two Jade, China, cut stone.
One Alexandrite, crystal.
One Obsidian var. Moldavite, cut stone.
One Agate, Uruguay, cut rectangular block.
One Crocidolite, South Africa, cut block.

(*By Collection.*)

Six Brown Tourmalines, Newcomb, Essex county, N. Y., cut stone.
Three Brown Tourmalines, Newcomb, Essex county, N. Y., crystals.

IV. ARCHÆOLOGY AND ETHNOLOGY.

BY DONATION.

Dr. David Murray:
Three Japanese shell pictures; one Abacus from Japan.

Chas. Beach:
One stone mortar (twelve inches diameter, three inches deep).
One stone pestle (eight inches and a half in length).
One stone hammer.
All from near Catskill, N. Y.

A. G. Richmond:
Forty-five specimens of Indian pottery, pitted stones and fishing net sinkers, from the shore of Cayuga Lake, N. Y.

Emmett Brown:
Four arrow-points (in exchange).

Arthur McCormick:
One Indian arrow-head from Bath-on-the-Hudson.

V. ADDITIONS TO THE LIBRARY.

By Donation.

John Croumbie Brown (the Author):

Forestry in Norway.

Finland and its Forests.

Forests of North Russia.

Forestry in the Ural Mountains.

Forests and Forestry in Poland and Lithuania.

Schools of Forestry in Germany.

Schools of Forestry in Spain.

Study of Forest Economy.

French Forest Ordinance of 1669.

Forests of England in By-Gone Times.

Reboisment in France.

Pine Plantations on Sand Wastes of France.

Hydrology of South Africa.

Water Supply of South Africa.

Forests and Moisture.

The Academy:

Annals of the New York Academy of Sciences, Vol. I, II (incomplete), III, IV, Nos. 1, 2.

Transactions of the New York Academy of Sciences, Vol. I, II, IV, V, Nos. 7, 8.

The Society:

Journal of the Society of Arts, Vol. XXXV, Nos. 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1790, 1791, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1811, 1812, 1813, 1814, 1815, 1816, 1817, 1818, 1819, 1820, 1821, 1822, 1823, 1824.

The Society:

Bulletin of the American Geographical Society, Nos. 4, 5, 1885; Nos. 3, 4, 5, 1886; Vol. XIX, No. 1, 1887; No. 3, 1887.

Johns Hopkins University, Baltimore:

Studies from the Biological Laboratory, Vol. 3, No. 9; Vol. 4, Nos. 1, 2.

U. S. Patent Office:

The Official Gazette of the United States Patent Office, Vol. 38, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; Vol. 39, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; Vol. 40, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13; Vol. 41, Nos. 1, 2, 3, 4, 5, 6, 7.

Annual Report Commissioner of Patents, for 1886.

U. S. Patent Office — (*Continued*):

Alphabetical Lists of Patentees and Inventions for the quarter ending June 30, 1886. The same for the quarter ending December 31, 1886. The same for the quarter ending March 31, 1887.

Bausch and Lamb Optical Co.:

Manipulation of the Microscope. By Edward Bausch.

R. Ellsworth Call:

Bulletin of the Washburn College Laboratory of Natural History, Vol. I, No. 7. The same, Vol. II, No. 8.

Verplanck Colvin:

Report on Adirondack and State Land Surveys, 1886.

Geo. H. Cook, State Geologist of New Jersey:

Annual Report of the State Geologist for the year 1886.

Atlas of New Jersey. Sheets, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

The Author:

The Cayuga Flora: Part I, a Catalogue of the Phænogamia growing without cultivation in the Cayuga Lake basin. By Wm. R. Dudley. (Bulletin of the Cornell University — Science, Vol. II, 1886.)

David T. Day, U. S. Geological Survey:

Mineral Resources of the United States, calendar year 1885.

The Author:

Rev. Dr. Barris, the Critic, Reviewed.

Geology of Scott county, Iowa, and Rock Island county, Illinois, and the adjacent territory. By A. S. Tiffany.

J. H. Dodge, City Auditor:

Annual Report of the City Auditor of Boston, for 1886–1887.

Hon. Wm. M. Evarts:

Tenth Census of the United States. Volumes, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 20.

The Author:

Odontornithes; a Monograph on the Extinct Toothed Birds of North America. By O. C. Marsh.

Dr. David Murray:

Geological Survey of New Jersey: County of Cape May. By Geo. H. Cook, 1857.

Natural History of New York: Part 1, Zoölogy; Part 1, Zoölogy, Reptiles and Fishes; Part 1, Zoölogy, Mollusca and Crustacea; Part 3, Mineralogy; Part 5, Agriculture, Vols. I, II, III, Text and Plates; Part 6, Palæontology, Vol. III, Text; Vol. V, Part 2, Text and Plates.

Dr. David Murray — (*Continued*):

New York Meteorology, 1826–1850. By F. B. Hough.

Reports of U. S. Coast Survey, 1850; 1851 and sketches, 3 copies; 1852; 1853; 1854; 1855; 1856; 1857; 1858; 1859; 1860; 1861; 1862; 1863; 1865, 2 copies; 1866; 1867; 1868.

First and Second Report on the Noxious, Beneficial and other Insects of the State of New York. By Asa Fitch, M. D., 1856.

The New York State Museum:

Thirty-ninth Annual Report of the New York State Museum of Natural History. (2 copies.)

Natural History of New York, Palæontology, Vol. VI. By James Hall.

The Museum:

Thirty-fourth Annual Report of the Committee of the Free Public Library, Museum and Walker Art Gallery of the city of Liverpool.

The State Geologist:

First, Second (3 copies, 4°), Third, Fourth and Fifth Annual Reports of the State Geologist of New York, for the years 1881, 1882, 1883, 1884, 1885.

Bryozoa of the Upper Helderberg Group. Plates and Explanations. (2 copies.)

Published in advance of the Report of the State Geologist for 1886, and of Volume VI, Palæontology of New York, 1886.

The Norwegian Commission Gradwessung:

Vandstandsobservationea, IV Heft.

Geodatische Arbeiten, V Heft.

The Peabody Academy:

Nineteenth Annual Report of the Peabody Academy of Sciences, 1887.

The Author:

Mechanism of Movement in Cucurbita, Vitas and Robinia. By D. P. Penhallow.

Additional Notes upon the Tendrils of Cucurbitaceæ. By D. P. Penhallow.

The Regents:

Annual Reports of the Bureau of Ethnology, 1880–81, 1882–83.

The Society:

Journal of the Royal Geological Society of Ireland, Vol. VIII, Part 1. New series.

The Smithsonian Institution:

Fourth Report of the Bureau of Ethnology, 1882–83.

U. S. Geological Survey :

Sixth Annual Report, 1884–85.

Monographs : Vol. X, Dinocerata. By O. C. Marsh.

Mineral Resources of the United States, calendar year 1885.

Bulletin of the U. S. Geological Survey, Nos, 32, 34, 35, 36, 37, 38, 39.

The Academy :

Ofversigt af Kongl Vetenskaps — Akademiens Forhandlingar, Arg 43, Nos. 9, 10, 1886 ; Arg. 44, Nos. 1, 2, 3, 4, 5, 6, 7. 1887.

The Natural History Society of Montreal :

The Canadian Record of Science, Vol. II, Nos. 6, 7, 8.

Bureau of Education :

Circulars of Information, No. 1, 1886 ; No. 2, 1886.

The Society :

Bulletin de la Société Imperiale des Naturalistes de Moscou, 1886, Nos. 2, 3, 4 ; 1887, Nos. 1, 2.

The Society :

Natur. Gesell. Isis in Dresden Jahr, 1886, Juli bis Dec. Jahr, 1887, Jan. bis Juni.

The Institute :

Proceedings of the Canadian Institute, 3d Ser., Vol. IV, fasc. No. 2, March, 1887 ; 3d series, Vol. V, fasc. No. 1, Oct., 1887.

The Society :

Journal of the New York Microscopical Society, Vol. II, Nos. 8, 9, 9a.

The Museum :

Anales del Museo Nacional de Mexico, t. III, Ent. 10a, 11a. Tom. IV, No. 1.

The Geological and Natural History Survey of Minnesota :

Fourteenth Annual Report, for the year 1885.

Torrey Botanical Club :

Bulletin of the Torrey Botanical Club, Vol. 14, Nos. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11.

The Society :

Journal of the Cincinnati Society of Natural History, Vol. 9, No. 4 ; Vol. 10, Nos. 1, 2, 3.

The Museum :

Annalen des K. K. Naturhistorischen Hofmuseums, Band II, Nos. 1, 2, 3.

The Author :

Report on Building Stones. by James Hall.

Trustees of the Indian Museum :

Annual report and List of Accessions, April, 1881 — March, 1882; April, 1885 — March, 1886. Appendix, Accessions for the quarter ending September 30, 1882 ; June 30, 1882.

New York State Survey :

The Final Results of the Triangulation of the New York State Survey, 1887.

The Author :

On the use of the Name Taconic. By Jules Marcou (from Proc. Bost. Soc. Nat. Hist., March 2, 1887).

United States Fish Commission :

Bulletin of the United States Fish Commission, Vol. VI, for 1886. Annual Report for 1885.

By Exchange.

Geological Survey of Kentucky :

Chemical Analyses, A. Vol. I., 1884. Vol. II., 1885.

Eastern Coal Field, C, 1884.

Bulletin of the Kentucky Geological Survey, No. 1.

Notes on the Yellow Fever Epidemic at Hickman, Ky., during the Summer and Autumn of 1878. By John R. Proctor, 1879.

Report on the Geology of Marion County. By W. T. Knott, 1885.

Report on the Geology of Spencer and Nelson Counties. By W. M. Linney, including Notes on the Birds of Nelson County. By Charles W. Beckham, 1884.

Report on the Geology of Clark and Montgomery Counties. By W. M. Linney, 1884.

Report on the Geology of Washington County. By W. M. Linney, 1882.

Notes on the Rocks of Central Kentucky, with list of Fossils. By W. M. Linney, 1882.

Report on the Geology of Lincoln County. By Wm. M. Linney, 1882.

Notes on the Coal and Iron Ores of Western Kentucky. By Wm. B. Caldwell, Jr., 1878.

Report on the Airdrie Furnace and Property, Muhlenberg County, Ky. By P. N. Moore, 1874. Part IV., Vol. II, 2d series.

Report of a Reconnoissance on the Proposed Line of Railway from Livingston Station to Cumberland Gap. By C. J. Norwood. Part VI, Vol. II, 2d series, 1874.

A Reconnoissance Report on the Lead Region of Henry County, with Some Notes on Owen and Franklin Counties. By C. J. Norwood. Part VII, Vol. II, 2d series, 1875.

Geological Survey of Kentucky — (*Continued*) :

On the Origin of the Galena Deposits of the Upper Cambrian Rocks of Kentucky. By N. S. Shaler. Part VIII, Vol. II, 2d series.

Report on the Geology of the Proposed Line of the Elizabethtown, Lexington and Big Sandy Railroad, from Mt. Sterling to the Big Sandy River. By A. R. Crandall. Part X, Vol. II, 2d series.

General Report on the Geological Survey of Kentucky. By N. S. Shaler. Part I, Vol. III, 2d series, 1873.

History of the Operations of the Survey in 1874 and 1875. By N. S. Shaler. Part II, Vol. III, 2d series.

Annual Report of N. S. Shaler for the year 1876. Part VI, Vol. III, 2d series.

Description of the Preliminary Topographical and Geological Maps of Kentucky, Edition of 1877. By N. S. Shaler. Part VI, Vol. III, 2d series.

Annual Report of N. S. Shaler, State Geologist for year 1877. Part VII, Vol. III, 2d series.

Report on the Unfinished Work of the Survey of the Commonwealth, under the direction of Dr. David Dale Owen. By N. S. Shaler. Part VIII, Vol. III, 2d series.

Report on the Iron Ores in the Vicinity of Cumberland Gap. By P. N. Moore. Part V, Vol. IV, 2d series.

Report on the Geology of a Section from near Camton, Wolfe county, to the Mouth of Troublesome creek, Breathitt county. By P. N. Moore. Part VI, Vol. IV, 2d series.

A Report of a Reconnoissance of a Part of the Breckinridge Cannel Coal District. By C. J. Norwood. Part VIII, Vol. IV, 2d series.

A General Account of the Geology of a Part of Ohio county. By C. J. Norwood. Part V, Vol. V, 2d series.

Report on the Progress of the Survey from January, 1882 to January, 1884. By John R. Procter, 1884.

Report on the Progress of the Survey from January, 1884 to January, 1886. By John R. Procter, 1886.

Agricultural Map of the Jackson Purchase, 1886.

Map of Washington and Marion counties.

Map showing relation between Conglomerate Uplifts and Elliot county Dikes.

Map of Clinton county.

Map of Montgomery and Clark counties.

Preliminary county map of Kentucky, 1887.

May of Boyd, Carter and Greenup counties.

Geological Survey of Kentucky — (*Continued*):

Map of Mason county.

Map of Boyle and Mercer counties.

Map of Lincoln county.

Map of Madison county.

Map of Bath and Fleming counties.

Map of the Jackson Purchase, comprising Ballard, McCracken, Marshall, Graves, Calloway, Hickman and Fulton counties, 1885.

Map of Elliot county.

Map showing relation of Eastern Kentucky Coal Field to the Transportation Routes and Iron Ores of the South Appalachian Region.

Preliminary map of South-east Kentucky.

Preliminary Geological map of Kentucky.

Section from Anderson county, through Mercer and Garrard to Sub-conglomerate Coal in Rockcastle.

Map of the United States, east of long. 102° W.

Tenth Census, Geographical Distribution of the Iron Ores of United States.

Fourth Report of the Geological Survey in Kentucky. D. D. Owen, 1861.

Report on the Geology of Elliott county. By A. R. Crandall.

Notes on the Trap Dikes of Elliott county. A. R. Crandall and J. S. Diller.

On the Fossil Brachiopods of the Ohio Valley. By N. S. Shaler.

Kentucky Fossil Corals. By W. J. Davis. Part II (two copies).

The Smithsonian Institution:

Smithsonian Miscellaneous Collections. Vols. 28, 29, 30.

The Wagner Free Institute:

Transactions of the Wagner Free Institute of Science. Vol. 1 (two copies).

The War Department:

Monthly Weather Review, November, 1886; December, 1886; January, 1887; February, 1887; March, 1887; April, 1887, May, 1887; June, 1887; July, 1887; August, 1887.

The Museum:

Bulletin of the American Museum of Natural History. Vol. I, No. 8; Vol. II, No. 1.

Annual Report of the Trustees of the American Museum of Natural History, 1886–7.

BY PURCHASE.

The Origin of Mountain Ranges, considered Experimentally, Structurally, Dynamically, and in Relation to their Geological History. By T. Mellard Reade. London, 1886.

Greek–English Lexicon. By H. G. Liddell and Robert Scott, 1871.

Latin–English Lexicon. By E. A. Andrews, 1865.

The International Cyclopædia. 15 Volumes.

Annual Reports of New York Geological Survey, 1837-1839.

Nomenclature of Colors for Naturalists. By Robert Ridgeway, 1886.

History of the New York Academy of Sciences. By H. L. Fairchild.

United States Geological Survey of the Territories, Vol. VIII, Cretaceous and Tertiary Floras. By L. Lesquereux.

United States Geological Survey of the Territories, Vol. III, Tertiary Vertebrata. By E. D. Cope.

United States Geological Survey. Older Mesozoic Flora of Virginia. By W. M. Fontaine.

Handbuch der Palæontologie. By Karl Zittel. I Abtheilung, III Band, I Lieferung, Palæozoologie. II Abtheilung, III Band, V Lieferung, Palæophytologie.

Encyclopædia Brittanica, Vol. XXII.

Science :

Vol. IX, Nos. 205, 206, 207, 208, 209, 210, 211, 212, 213, 217, 218, 219, 220, 221, 222, 224, 225, 226, 227, 228, 229.

Vol. X, Nos. 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250.

Geological Magazine :

Vol. IV. Nos. 271, 272, 273, 274, 275, 276, 277, 279, 280, 281.

Nature :

Vol. 35, Nos. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26.

Vol. 36, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26.

The Annals and Magazine of Natural History :

Vol. 19, Nos. 109, 110, 111, 112, 113, 114, 115, 116, 117, 118. 119.

The American Naturalist :

Vol. XXI, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9.

Beiträge zur Palæontologie Oesterreich-Ungarns und des Orients. By E. V. Mojsisovics and N. Neumayr.

American Journal of Science :

Vol. XXXIII, third series, Nos. 193, 194, 195, 196, 197, 198.

Vol. XXXIV, Nos. 199, 200, 201, 202, 203.

Political Science Quarterly:
Vol. II, Nos. 1, 2, 3; Vol. I, Supplement.
Neues Jahrbuch fur Mineralogie, Geologie and Palaeontologie:
I Band, Heft 2, 3.
II Band, Heft, 1, 2, 3.
V Beilage Band, Heft 1 2.
Fresh Water Algae of the United States. By Francis Wolle. Text and Plates.

APPENDIX A.

NEW YORK STATE MUSEUM OF NATURAL HISTORY.

Catalogue of Gems and Precious Stones, arranged in Exhibition Case.

Catalogue Number.	NAME.	Locality.	Condition.	Collection.	Number of specim's.
1	Diamond in matrix	Kimberly mines, South Africa	Crystal	Kunz	1
2	Diamond	Kimberly mines, South Africa	Crystal	Kunz	2
3	Diamond	Kimberly mines, South Africa	Crystal	Kunz	5
4	Diamond	Diamantina, Brazil, S. A	Cut	Kunz	1
5	Diamond	Kimberly mines, South Africa	Crystal	Kunz	9
6	Diamond	Kimberly mines, South Africa	Crystal	Kunz	10
7	Diamond	Diamantina, Brazil, S. A	Crystal	Kunz	9
8	Diamond	Diamantina, Brazil, S. A	Crystal	Kunz	8
9	Unwashed diamond gravel	Diamantina, Brazil, S. A		Kunz	1
10	Washed diamond gravel	Diamantina, Brazil, S. A		Kunz	1
11	Ruby	Mandalay, Burmah	Cut	Kunz	1
12	Ruby	Ceylon	Fragments	Kunz	6
13	Ruby	Franklin, North Carolina	Fragments	Kunz	1
14	Sapphire	Ceylon	Cut	Kunz	2
15	Sapphire	Ceylon	Cut	Kunz	3
16	Sapphire (yellow)	Ceylon	Cut	Kunz	2
17	Sapphire (asteria)	Ceylon	Cut	Kunz	2
18	Sapphire (asteria)	Ceylon	Polished surface	Kunz	2
19	Sapphire (green)	Hill of Precious Stones, Siam	Polished surface	Kunz	1
20	Sapphire	Ceylon	Crystal	Kunz	1
21	Sapphire	Ceylon	Rolled crystals	Kunz	16
22	Sapphire	Helena, Montana	Rolled crystals	Kunz	12
23	Gem gravel — Ruby, Sapphire, Spinel, Zircon Chrysoberyl, etc	Ceylon	Rolled crystals	Kunz	219
24	Chrysoberyl	Minas Geraes, Brazil	Cut	Kunz	3
25	Chrysoberyl	Minas Geraes, Brazil	Fragm'ts of crystals.	Kunz	2
26	Alexandrite	Siberia	Cut	Kunz	1
27	Spinel	Ceylon	Cut	Kunz	4
28	Spinel	Ceylon	Cut	Kunz	10
29	Ruby spinel	Ceylon	Crystal	Kunz	25
30	Ruby spinel and sapphire dust	Burmah	Fragments	Kunz	1 vial
31	White Topaz	Ceylon	Cut	Kunz	1

32	White Topaz	Siberia	Cut	Kunz	3
33	Pink Topaz	Minas Geraes, Brazil	Cut	Kunz	1
34	Topaz	Minas Geraes, Brazil	Cut	Kunz	3
35	Topaz	Minas Geraes, Brazil	Cut	Kunz	2
36	Topaz	Servier Lake, Utah	Crystal	Kunz	1
37	Topaz	Oura Preta, Brazil	Crystal	Kunz	1
38	Emerald	Muso Mine, New Grenada, S. A.	Cut	Kunz	1
39	Emerald	Muso Mine, New Grenada, S. A.	Crystal	Kunz	1
40	Emerald	Stony Point, N. C.	Crystal	Kunz	2
41	Aquamarine	Stoneham, Maine	Cut	Kunz	1
42	Aquamarine	Siberia	Cut	Kunz	2
43	Yellow Beryl	Manhattanville, New York City	Cut	Kunz	1
44	Blue Beryl	Portland, Conn	Fragment	Kunz	1
45	Aquamarine	Mt. Anteros, Colorado	Crystal	Kunz	2
46	Yellow Beryl	Siberia	Crystal	Kunz	1
47	Phenakite	Siberia	Cut	Kunz	2
48	Phenakite	Crystal Peak, Colorado	Crystal	Kunz	1
49					
50	Euclase	Villa Rica, Brazil	Crystal	Kunz	1
51	Zircon	Ceylon	Cut	Kunz	3
52	Zircon	Mudgee, Australia	Crystal, one face pol.	Kunz	1
53	Zircon	Ceylon	Crystals		17
54	Zircon Hyacinths	Aix la Chapelle, Germany	Crystals	Kunz	50+
55	Andalusite	Minas Geraes, Brazil	Cut	Kunz	1
56	Andalusite	Minas Geraes, Brazil	Fragments	Kunz	2
57	Andalusite Chiastolite	Mariposa county, California	Crystals, 1 face pol	Kunz	2
58	Schorlomite	Magnet Cove, Ark	Fragment	Kunz	1
59	Staurolite	Fannin county, Georgia	Crystals	Kunz	2
60	Staurolite	Fannin county, Georgia	Crystal	Kunz	1
61	Blue Tourmaline	Minas Geraes, Brazil	Cut	Kunz	2
62	Green Tourmaline	Minas Geraes, Brazil	Cut	Kunz	3
63	Tourmaline	Auburn, Maine	Cut	Kunz	1
64	Brown Tourmaline	Essex county, N. Y	Cut	C. E. Beecher	3
65	Brown Tourmaline	Essex county, N. Y.	Cut	C. E. Beecher	3
66	Brown Tourmaline	Essex county, N. Y.	Crystals	C. E. Beecher	2
67	Brown Tourmaline	Essex county, N. Y	Crystal in matrix	C. E. Beecher	1
68	Tourmaline	Minas Geraes, Brazil	Crystal, 1 face pol.	Kunz	1
69	Tourmaline	Minas Geraes, Brazil	Crystal, 1 face pol.	Kunz	2
70	Tourmaline	Auburn, Maine	Crystals	Kunz	2
71	Tourmaline	Island of Elba	Crystals	Kunz	2
72	Pink Tourmaline	Minas Geraes, Brazil	Crystals	Kunz	2
73	Chromtourmaline	Siberia	Crystals	Kunz	2
74	Green Tourmaline	Brazil	Crystals	Kunz	1
75	Garnet	Ft. Defiance, Arizona	Cut	Kunz	3
76	Garnet	Ft. Defiance, Arizona	Cut	Kunz	4
77	Garnet Almandite	Bohemia	Cut	Kunz	50
78	Garnet Almandite	Bohemia	Cut	Kunz	1
79	Pyrope Garnet	India	Cut	Kunz	1
80	Almandine Garnet	India	Cut	Kunz	2
81	Essonite Garnet	Ceylon	Cut	Kunz	3

Appendix A — *Catalogue of Gems, etc.* — (Continued).

Catalogue Number.	NAME.	Locality.	Condition.	Collection.	Number of specim's.
82	Rutilated Garnet	Gallup, New Mexico	Cut	Kunz	3
83	Garnet carbuncle almandite	India	Cut	Kunz	2
84	Garnet carbuncle	India	Cut	Kunz	2
85	Garnet beads	Grave in Bohemia	Cut	Kunz	32
86	Garnets in mica schist	Tyrol	Cut	Kunz	1
87	Essonite Garnet	Traversella, Piedmont	Crystals	Kunz	1
88	Garnet Pyrope	FortDefiance, Arizona	Fragments	Kunz	2
89	Garnet Pyrope	Warlick, Burke county, N. C	Fragments	Kunz	1
90	White Garnet	Wakefield, Canada	Crystals	Kunz	2
91					
92	Cyanite	Campo Longo, St. Gothard	Crystal	Kunz	1
93	Danburite,	Russell, N. Y	Cut	Kunz	1
94	Hiddenite	Stony Point, N. C	Cut	Kunz	1
95	Hiddenite	Stony Point, N. C	Crystals	Kunz	3
96	Iolite	Ceylon	Cut	Kunz	1
97					
98	Quartz gems	Brazil, S. A	Cut	Kunz	27
99	Saxon Topaz	Brazil, S. A	Cut	Kunz	1
100	Saxon Topaz	Brazil, S. A	Cut	Kunz	1
101	Smoky Quartz	Brazil, S. A	Cut	Kunz	2
102	Saxon Topaz	Brazil, S. A	Cut	Kunz	3
103	Quartz, stained	Paris, France	Cut	Kunz	1
104	Quartz ball, 2¼ inches diameter	White Plains, N. C	Cut	Kunz	1
105	Quartz Dog	Siberia	Cut	Kunz	1
106	Quartz crystal	Middleville, Herkimer county, N. Y	Crystal	Kunz	1
107	Smoky Quartz	White Plains, Alexander county, N. C	Crystal	Kunz	1
108	Amethyst	Siberia	Cut	Kunz	2
109	Amethyst	Minas Geraes, Brazil	Cut	Kunz	2
110	Amethyst	Minas Geraes, Brazil	Cut	Kunz	2
111	Amethyst, rutilated	Minas Geraes, Brazil	Cut	Kunz	1
112	Amethyst	Minas Geraes, Brazil	Partly worked	Kunz	2
113	Amethyst (type)	Cheshire, Conn	Crystal	Kunz	1
114	Aventurine	Siberia	Polished block	Kunz	1
115	Aventurine	Aragon, Spain	Polished block	Kunz	1
116	Asteriated rose Quartz	Stow, Maine	Cut	Kunz	1
117	Asteriated rose Quartz	Stow, Maine	Fragment	Kunz	1
118	Hornblende in Quartz	Cumberland, R. I	Cut	Kunz	1
119	Hornblende in Quartz	Cumberland, R. I	Cut	Kunz	2
120					
121	Rutile in Quartz	Alexander county, N. C	Cut	Kunz	1

122	Actinolite in Quartz	Japan	Cut	Kunz	1
123	Quartz Cat's-eye	Ceylon	Cut	Kunz	2
124	Quartz Cat's-eye	Hoff, Bavaria	Cut	Kunz	1
125	Tiger Eye (quartz after Crocidolite)	Orange River, South Africa	Cut	Kunz	1
126	Tiger Eye (quartz after Crocidolite)	South Africa	Cut	Bunz	1
127	Quartz after Crocidolite	South Africa	Cut	Kunz	1
128	Quartz after Crocidolite	Orange River, South Africa	Cut	Purchase	1
129	Quartz after Crocidolite	Orange River, South Africa	Cut	Kunz	1
130	Quartz after Crocidolite, artif. color	Orange River, South Africa	Cut	Kunz	14
131	Quartz after Pectolite	Weekawken Tunnel, N. J.	Cut	Kunz	1
132	Thetis Hair Stone	Rhode Island	Cut	Kunz	2
133	Quartz, cross		Cut	Kunz	1
134	Agate ball	Uruguay, South America	Cut	Kunz	1
135	Chalcedony, artificial coloring	Oberstein, Germany	Cut	Kunz	6
136	Carnelian		Cut	Kunz	17
137	Blood Stone	India	Cut	Kunz	25
138	St. Stephen's Stone	Uraguay, S. A.	Cut	Kunz	1
139	Silicified Coral, Favosite		Cut	Kunz	1
140	Moss Agate	Brazil, S. A.	Cut	Kunz	1
141	Moss Agate	China	Cut	Kuuz	1
142	Chrysoprase	Saxony	Cut	Kunz	10
143	Fire Opal	Queretara, Mexico	Cut	Kunz	8
144	Fire Opal	Queretara, Mexico	Cut	Kunz	23
145	Fire Opal	Zimapan, Mexico	Cut	Kunz	3
146	Noble Opal	Hungary	Cut	Kunz	1
147	Noble Opal	Hungary	In matrix	Kunz	1
148	Opal	Honduras	Cut	Kunz	1
149	Opaline	New Mexico	Cut	Kunz	1
150	Opaline	Queensland, Australia	Cut	Kunz	1
151	Geyserite	Yellowstone Park, Wyoming Territory	Natural	Kunz	3
152	Jasper	South America	Polished	Kunz	1
153					
154	Epidote	Tyrol	Cut	Kunz	1
155	Turquois	Persia	Cut	Kunz	5
156	Turquois (Indian beads)	Los Cerillos, New Mexico	Cut	Kunz	5
157	Turquois	Los Cerillos, New Mexico	Polished slab	Kunz	1
158	Rutile	Stony Point, N. C.	Crystals	Kunz	4
159	Rutile	Alexander county, N. C.	Cut	Kunz	1
160	Diopside	Ala, Piedmont	Cut	Kunz	1
161	Diopside	De Kalb, N. Y.	Crystal	Kunz	1
162	Rhodonite	Siberia	Dish and buttons	Kunz	3
163	Pyrite	French Creek Falls, Pa.	Crystals	Kunz	2
164	Pyrite	Gilpin county, Colorado	Crystals	Kunz	1
165					
166					
167	Hematite	Cleator Moor, England	Bead	Kunz	1
168	Oligoclase	Norway	Polished slab	Kunz	1
169	Orthoclase (twin)	Cornwall, England	Polished slab	Kunz	1
170	Leopardite	Iredell county, N. C.	Polished slab	Kunz	1
171	Moonstone	Media, Penn.	Cut	Kunz	1

APPENDIX A — *Catalogue of Gems, etc.*, — (Continued).

Catalogue Number.	NAME.	Locality.	Condition.	Collection.	Number of specim's.
172	Moonstone	Chester county, Penna	Cut	Kunz	1
173	Moonstone	Ceylon	Cut	Kunz	3
174	Moonstone	Ceylon	Fragment	Kunz	1
175	Sunstone	Delaware county, Penna	Cut	Kunz	1
176	Sunstone	Horace Greeley farm, Chappaqua, N. Y	Fragment	Kunz	1
177	Sunstone	Hitteroe, Norway	Fragment	Kunz	1
178	Sodalite	South Litchfield, Maine	Fragment	Kunz	1
179	Amazon Stone	West Chester, Penna	Cut	Kunz	1
180	Graphic Granite	Hitteroe, Norway	Cut	Kunz	1
181	Titanite	Tavetsch, Tyrol	Crystal	Kunz	1
182	Malachite	Siberia	Cut	Kunz	2
183	Malachite	Copper Queen, Arizona	Polished	Kunz	1
184	Chrysocolla and Malachite	Copper Queen, Arizona	Polished	Kunz	1
185	Chlorastrolite	Isle Royale, Lake Superior	Cut	Kunz	5
186	Zonochlorite	Nepigon Bay, Lake Superior	Polished	Kunz	1
187	Smithsonite	Laurium, Greece	Cut	Kunz	2
188	Apatite	Auburn, Maine	Crystals	Kunz	2
189	Masonite	Natic, R. I.	Cut	Kunz	1
190	Peridot	Gallup, New Mexico	One cut, 1 fragment	Kunz	2
191	Chlorophane (type)	Amelia county, Virginia	Cut *	Kunz	1
192	Amber	Germany	Cut (bead)	Kunz	1
193	Amber	Catania, Sicily	Cut	Kunz	1
194	Williamsite	Texas, Penn	Cut	Kunz	1
195	Aragonite	Missouri	Cut	Kunz	1
196	Silicified wood	Chalcedony Park, Arizona	Polished	Kunz	1
197	Silicified wood	Chalcedony Park, Arizona	Polished	Kunz	1
198	Lumachelle (fire marble)	Bleiberg, Carinthia, Austria	Polished	Kunz	1
199	Agate	South America	Polished	Purchase	1
200	Jade	China	Cut	Kunz	1
201	Jade	China	Cut	Kunz	1

* Phosphoresces in warm water.

REPORT OF THE BOTANIST.

REPORT OF THE BOTANIST.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN.—I have the honor to communicate to you the following report:

In the prosecution of the work of completing and arranging the State Herbarium the past year, specimens of the plants of the State have been collected in the counties of Albany, Greene, Lewis, Oneida, Oswego, Rensselaer, Saratoga and Ulster. Specimens have also been contributed which were collected in the counties of Broome, Cayuga, Kings, Orleans, Rensselaer and Wayne. Specimens of one hundred and seventy species of plants have been added to the herbarium, of which twenty-seven were contributed by correspondents and one hundred and forty-three were collected by the botanist. Of those collected by the botanist, one hundred and five species are new to the herbarium and to the State flora. Among the added species are twenty-six flowering plants, some of which are introduced and possibly may not be sufficiently abundant and well-established to be properly considered a part of our flora, but all were found growing without cultivation and it was thought best to place the fact on record. A list of the added species is appended and is marked A.

The number of correspondents who have contributed specimens is seventeen. The contributed specimens of extralimital species are not included in the foregoing enumeration. A list of the names of the contributors, and of their respective contributions, is marked B.

In the eastern part of the State, the months of July, August and September were unusually favorable to the production of fleshy fungi, the Hymenomycetes, and special attention was given to the collection of these plants. They constitute a large percentage of the added species and among them are many that are considered new to science. In consequence of their evanescent colors, painted sketches were made of most of the new species while the plants were yet fresh. A record of the added species, together with descriptions of the new ones, is marked C.

Remarks concerning species previously known to belong to our flora and descriptions of new varieties are recorded in a chapter marked D.

The botanical reports have now become so numerous that an index to them is greatly needed, in order to facilitate reference to them and save time in consulting them. I have, therefore, prepared an index of the genera and species recorded in reports twenty-two to thirty-eight, inclusive. It is alphabetically arranged and is marked F.

Beaver dam is a body of water near to and connected with Beaver lake, in the eastern part of Lewis county. It was reported to me that the red-flowered variety of the white water lily, *Nymphœa odorota*, had been seen growing there. Wishing to obtain specimens of this interesting form, the locality was visited, but only the same form that was found last year in Mud pond was detected here. The external petals are tinged with red but the inner ones are white. The full red-flowered variety is yet a desideratum. There was found, however, in Beaver lake inlet, locally called "The Slough," a scarcely less interesting form of this plant. It has the very large flowers and leaves of the tuberous water lily, *Nymphœa tuberosa*, and yet the very distinct and pleasant fragrance of the white water lily. It is interesting, scientifically, because it tends to support the views of those botanists who consider these plants as mere forms of one species.

A form of the northern or Canadian blueberry, *Vaccinium Canadense*, in which the fruit is jet black and shining, was observed growing plentifully in the cleared land and pastures near Beaver lake. Thus, it happens that each one of our four common blueberries, which contribute to supply our markets with this excellent fruit, has its black-fruited variety, notwithstanding the general application of the name "blueberries." This variation is interesting and worthy of notice, because it indicates a tendency in these plants to vary in a part in which variation may be made the basis of useful improvement under proper treatment and culture. The fruit is the useful part of these plants and variation in it indicates capability of improvement in this direction. A similar variation has also been observed in the fruit of the black huckleberry, *Gaylussacia resinosa.* In it the fruit is commonly dull black without any bloom, but in the variety it is of a shining jet black and is readily distinguishable from the ordinary form. Dishonest berry pickers sometimes take advantage of the similarity in size and shape between this huckleberry and the black-fruited variety of the chokeberry, *Pyrus arbutifolia.* They mix the two fruits and the fraud is not likely to be detected till the taste reveals it. The flavor of large quantities of canned berries is sometimes spoiled by this reprehensible practice.

Mr. P. H. Dudley, civil engineer of the N. Y. C. and H. R. railroad, has, at my request, communicated to me some of the results of his investigations of the fungi destructive to wood. This is of such great practical importance that I have added a copy of his communication to this report. It is marked E.

Very respectfully submitted.

CHAS. H. PECK.

Albany, *December* 6, 1887.

(A.)

PLANTS ADDED TO THE HERBARIUM.

New to the Herbarium.

Ranunculus septentrionalis *Poir.*
Brassica campestris *L.*
Lunaria biennis *L.*
Dianthus barbatus *L.*
Levisticum officinale *Koch.*
Valerianella olitoria *Poll.*
Aster junceus *Ait.*
Phlox maculata *L.*
Myosotis arvensis *Hoffm.*
M. collina *Hoffm.*
Cuscuta tenuiflora *Engelm.*
Physalis lanceolata *Mx.*
Nepeta grandiflora *Bieb.*
Plantago Media *L.*
Aristolochia Clematitis *L.*
Euphorbia Esula *L.*
Salix amygdaloides *Ander.*
Potamogeton Spirillus *Tuckm.*
P. Zizii *M. & K.*
P. Hillii *Morong.*
P. marina *L.*
Eleocharis diandra *Wright.*
Panicum nervosum *Muhl.*
Deyeuxia Porteri *Vasey.*
Eatonia Dudleyi *Vasey.*
Bromus arvensis *L.*
Lepiota granosa *Morg.*
L. arenicola *Pk.*
Tricholoma resplendens *Fr.*
T. Columbetta *Fr.*
T. intermedium *Pk.*
T. terriferum *Pk.*
T. tricolor *Pk.*
T. fuligineum *Pk.*
T. putidum *Fr.*
Clitocybe subsimilis *Pk.*
C. cæspitosa *Pk.*
C. sulphurea *Pk.*
C. tortilis *Bolt.*
Collybia scorzonerea *Batsch.*
C. hariolorum *D. C.*
C. strictipes *Pk.*
C. alba *Pk.*
Omphalia subgrisea *Pk.*
Mycena capillaripes *Pk.*
M. crystallina *Pk.*
Entoloma sericeum *Bull.*
E. flavoviride *Pk.*
Clitopilus erythrosporus *Pk.*
C. conissans *Pk.*
C. cæspitosus *Pk.*
Pholiota minima *Pk.*
Inocybe fibrillosa *Pk.*
I. subfulva *Pk.*
I. violaceifolia *Pk.*
I. asterospora *Quel.*
I. margarispora *Berk.*
I. commixta *Bres.*
Inocybe agglutinata *Pk.*
I. nigridisca *Pk.*
I. vatricosa *Fr.*
Hebeloma crustuliniforme *Bull.*
H. longicaudum *Pers.*
Flammula lubrica *Fr.*
F. subfulva *Pk.*
Naucoria paludosa *Pk.*
N. unicolor *Pk.*
N. triscopoda *Fr.*
N. carpophila *Fr.*
Galera inculta *Pk.*
Agaricus comptulus *Fr.*
Stropharia albocyanea *Desm.*
Psilocybe clivensis *B. & Br.*
P. senex *Pk.*
Deconica subviscida *Pk.*
Psathyrella minima *Pk.*
Cortinarius balteatus *Fr.*
C. pluvius *Fr.*
C. muscigenus *Pk.*
C. brevipes *Pk.*
C. brevissimus *Pk.*
C. albidifolius *Pk.*
C. spilomeus *Fr.*
C. flavifolius *Pk.*
C. griseus *Pk.*
C. badius *Pk.*
C. subflexipes *Pk.*
C. paleaceus *Fr.*
C. rigidus *Fr.*
Hygrophorus Lauræ *Morg.*
Lactarius aspideus *Fr.*
L. maculatus *Pk.*
Russula lepida *Fr.*
R. adulterina *Fr.*
R. atropurpurea *Pk.*
Boletus speciosus *Frost.*
B. auriflammeus *B. & C.*
B. purpureus *Fr.*
B. hemichrysus, *B. & C.*
B. glabellus *Pk.*
B. variipes *Pk.*
B. indecisus *Pk.*
B. albellus *Pk.*
Polyporus flavovirens *B. & R.*
P. rimosus *Berk.*
P. mutans *Pk.*
P. pineus *Pk.*
Merulius Ravenelii *Berk.*
M. himantioides *Fr.*
Hydnum fasciatum *Pk.*
Irpex nodulosus *Pk.*
Radulum Pendulum *Fr.*
Corticium olivaceum *Fr.*
Clavaria albida *Pk.*
C. densa *Pk.*
Geaster Schæfferi *Vitt.*

Geaster vittatus *Kalchb.*
Sphæropsis carpinea *S. & Br.*
Cercospora Gentiana *Pk.*
Oöspora Cucumeris *Pk.*
Sporendonema myophilum *Sacc.*
Zygodesmus violaceofuscus *Sacc.*

Not new to the Herbarium.

Nelumbium luteum *Willd.*
Nymphæa odorata *Ait.*
Stellaria longifolia *Muhl.*
Vicia sativa *L.*
Fragaria Virginiana *Duchesne.*
Rubus villosus *Ait.*
Galium circæzans *Mx.*
G. trifidum *L.*
Aster diffusus *Ait.*
A. Tradescanti *L.*
Erigeron annuus *Pers.*
Solidago rugosa *Mill.*
Gaylussacia resinosa *T. & G.*
Fraxinus viridis *Mx.*
Asclepias tuberosa *L.*
Symphytum officinale *L.*
Myosotis palustris *With.*
Epiphegus Virginiana *Bart.*
Juncus acuminatus *Mx.*
J. marginatus *Rost.*
J. Canadensis *Gay.*
J. tenuis *Willd.*
Cyperus filiculmis *Vahl.*
Scirpus polyphyllus *Vahl.*
S. Torreyi *Olney.*
Eragrostis capillaris *L.*
Panicum clandestinum *L.*
Botrychium lanceolatum *Angst.*
Amanita phalloides *Fr.*
A. rubescens *Fr.*
Lepiota granulosa *Batsch.*
L. illinita *Fr.*
Tricholoma Peckii *Howe.*
T. vaccinum *Pers.*
T. fumosoluteum *Pk.*
Clitocybe nebularis *Batsch.*
C. laccata *Scop.*
Collybia lentinoides *Pk.*
Clitopilus prunulus *Scop.*
Inocybe rimosa *Bull.*
Marasmius præacutus *Ellis.*
M. salignus *Pk.*
Hygrophorus pratensis *Fr.*
Clavaria stricta *Pers.*
C. crispula *Fr.*
C. pistillaris *L.*

(B.)

CONTRIBUTORS AND THEIR CONTRIBUTIONS.

Prof. W. R. Dudley, Ithaca, N. Y.

Lunaria biennis *L.*
Fragaria Virginiana *Duch.*
Aster junceus *Ait.*
A. diffusus *Ait.*
A. Tradescanti *L.*
Fraxinus viridis *Mx.*
Myosotis arvensis *Hoffm.*
M. collina *Hoffm.*
Cuscuta tenuiflora *Engl.*
C. epilinum *Weihe.*
Plantago Media *L.*
Aristolochia Clematitis *L.*
Euphorbia Esula *L.*
Salix amygdaloides *And.*
Juncus Canadensis *Gay.*
Potamogeton Zizii *M. & K.*
P. Spirillus *Tuckm.*
P. Hillii *Mor.*
P. marina *L.*
Panicum nervosum *Muhl.*
Deyeuxia Porteri *Vasey.*
Eatonia Dudleyi *Vasey.*

Prof. B. D. Halsted, Ames, Iowa.

Sphærotheca lanestris *Hark.*
Cercospora rosæcola *Pass.*
Peronospora Claytoniæ *Farl.*
Puccinia prunispinosæ *Pers.*
Uromyces Lupini *B. & C.*
U. Betæ *Kuhn.*
Æcidium Phaceleæ *Peck.*

Prof. W. G. Farlow, Cambridge, Mass.

Puccinia Malvacearum *Mont.*
Ustilago antherarum *Fr.*
Monilia Linhartiana *Sacc.*
Phragmotrichum Chailletii *K. & S.*
Exoascus Wiesneri *Rathay.*
Geoglossum atropurpureum *Pers.*
Microsphæria Vaccinii *C. & P.*
Leptosphæria Silenes-acaulis *DeNot.*
Dothidea Wittrockii *Eriks.*

Prof. H. A. Green, Troy, N. Y.

Umbilicaria Muhlenbergii *Tuckm.*

C. E. Fairman, M. D., Lyndonville, N. Y.

Polyporus sulphureus *Fr.*
Perichæna corticalis *Batsch.*
Nidularia pulvinata *Schw.*

E. C. Howe, M. D., Lansingburgh, N. Y.

Eleocharis diandra *Wright.*
Bromus arvensis *L.*
Agropyrum caninum *R. & S.*

H. C. Gordinier, M. D., Troy, N. Y.

Bromus arvensis *L.*
Aristolochia Clematitis *L.*

Harold Wingate, Philadelphia, Penn.

Orthotricha microcephala *Wing.*

P. H. Dudley, New York.

Lenzites striata *Sw.*
L. abietina *Fr.*
Lentinus Nicaraguensis *B. & C.*
Trametes Pini *Fr.*

W. C. Stevenson, Jr., Philadelphia, Penn.

Lepiota Americana *Peck.*

J. A. Lintner, Albany, N. Y.

Reticularia Lycoperdon *Bull.*

George T. Fish, Rochester, N. Y.

Nulumbium luteum *Willd.*

H. L. Griffis, Binghamton, N. Y.

Sporendonema myophilum *Sacc.*

A. P. Morgan, Preston, Ohio.

Hydnum casearum *Morg.*
Hydnum alboviride *Morg.*

C. J. Curtis, Lincolnton, N. C.

Fistulina hepatica *Fr.*
Hypomyces hyalinus *Schw.*
Boletus flexuosipes *Pk.*
Lactarius atroviridis *Pk.*
Boletus leprosus *Pk.*
Boletus dictyocephalus *Pk.*

Rev. J. L. Zabriskie, Flatbush, N. Y.

Polyporus rimosus *Berk.*

S. H. Wright, M. D.

Polyporus Curtisii *Berk.*
P. sanguineus *Fr.*
Clathrus columnatus *Bosc.*

(C.)

PLANTS NOT BEFORE REPORTED.

Ranunculus septentrionalis, *Poir.*

In wet places, rarely in pine woods. Albany and Rensselaer counties. Common. June. I have not seen, in the vicinity of Albany, the true *R. repens*, with which this species has been confused.

Brassica campestris, *L.*

About houses and in cultivated grounds. Menands, Albany county. June. The specimens belong to variety *colza*, which has probably been introduced in "bird seed."

Lunaria biennis, *L.*

Escaped from cultivation at Ithaca. May. *Prof. W. R. Dudley.*

Dianthus barbatus, *L.*

Established in woods near Ithaca. June and July. *Dudley.*

Levisticum officinale, *Koch.*

Occasionally established by roadsides and in waste places. Cayuga county. *Dudley.* Sandlake, Rensselaer county. June.

Valerianella olitoria, *Poll.*

Frontenac island, Cayuga lake. May. *Dudley.* Introduced and synonymous with *Fedia olitoria* Vahl.

Aster junceus, *Ait.*

Sphagnous swamps. Round marsh, Dryden. September. *Dudley.*

Phlox maculata, *L.*

Roadsides. Sandlake. June. Probably introduced in this locality, or escaped from cultivation, but the plants were growing remote from any dwelling.

Myosotis arvensis, *Hoffm.*

Ithaca. May and June. *Dudley.*

Myosotis collina, *Hoffm.*

Ithaca. May. *Dudley.*

Cuscuta tenuiflora, *Engelm.*

Near Union Springs. Growing on peppermint, *Mentha piperita.* August and September. *Dudley.*

Physalis lanceolata, *Mx.*

Cultivated grounds. Menands. Our plant is well described in the Manual under the name *Physalis Pennsylvanica.* It has probably been introduced from the south or west, but is very persistent.

Nepeta grandiflora, *Bieb.*

Roadsides. Menands. September. Introduced.

Plantago Media, *L.*

University grounds, Ithaca. June. *Dudley.*

Aristolochia Clematitis, *L.*

Lansingburgh, Rensselaer county. *H. C. Gordinier.* Union Springs. June. *Dudley.* Introduced.

Euphorbia Esula, *L.*

Groton. June and July. *Dudley.*

Salix amygdaloides, *Ander.*

Fall creek, Eddy pond, Cayuga lake, Cayuga marshes, etc. Abundant. May. *Dudley.*

Potamogeton Spirillus, *Tuckm.*

Cayuta lake. August. *Dudley.* Lower Saranac lake, Essex county. Sandlake.

Two forms occur. In one the submersed leaves are rather long and straight; in the other they are shorter and somewhat recurved, and give the plant a peculiar appearance. The Cayuta-lake specimens are very small, being but one or two in. long.

Potamogeton Zizii, *M. & K.*

Fall creek. August and September. *Dudley.* Normanskill creek near Kenwood, Albany county.

Potamogeton Hillii, *Morong.*

Malloryville. July. *Dudley.*

Potamogeton marina, *L.*

Near the outlet of Seneca lake. July. *Dudley.*

Eleocharis diandra, *Wright.*

Lansingburgh. *E. C. Howe.*

Panicum nervosum, *Muhl.*

Woods near White church. July. *Dudley.* Cold Spring, Putnam county, and Adirondack mountains.

Deyeuxia Porteri, *Vasey.*

Thatcher's pinnacle, West Danby. August. *Dudley.* This is *Calamagrostis Porteri* of the Manual. It is a rare and local species.

Eatonia Dudleyi, *Vasey.*

South hill. June. *Dudley.* The specimens placed in the State Herbarium by Dr. Torry, and labeled *Kœleria Pennsylvanica*, belong to this species, which has until recently been confused with *Eatonia*

Pennsylvanica. The characters by which it is separated from *E. Pennsylvanica* are, according to the author of the species, "its slender culms and panicle, the very short cauline leaves, the longer and wider lower glume, the more obtuse upper one and the shorter obtuser flowering glumes." The flowers have a peculiarly blunt appearance by which the plant may be easily recognized.

Bromus arvensis, *L.*

Troy. *Gordinier* and *Howe.* Sparingly introduced. June.

Lepiota granosa, *Morg.*

Prostrate trunks of trees, old stumps and decayed wood. Catskill mountains. September.

Our specimens do not agree rigidly with the description of the species to which we have refeıed them. The pileus is either obtuse or umbonate, even or radiately rugose-wrinkled, and is generally even and regular on the margin. The stem also is either equal or slightly thickened at the base, but these variations are not of specific importance. The flesh of the stem is yellowish as in *Lepiota amianthinus* to which this species is closely related, both in color and structure, but from which it may be distinguished by its habitat, its larger size and its entire membranous persistent annulus.

Lepiota arenicola, *n. sp.*

Pileus at first broadly conical, then convex or nearly plane, obscurely punctate with minute granular squamules, whitish or cinereous, substriate and crenulate on the margin; lamellæ broad, subventricose, distant, free, white; stem slender, equal, stuffed, glabrous, whitish, the annulus imperfect, obsolete or quickly evanescent; spores oblong or subfusiform, acute at one end, .0005 to .0006 in. long, .0002 to .00024 broad.

Pileus 3 to 6 lines broad; stem 8 to 12 lines long, about 5 lines thick.

Sandy soil. Karner, Albany county. August.

The spores indicate an affinity of this species with *L. metulispora*, of which it might be regared as a dwarf variety, but it differs in its smaller size, more expanded pileus, distant lamellæ and glabrous stem. The mycelium binds the sand into a globose mass at the base of the stem.

Tricholoma resplendens, *Fr.*

Thin woods. Catskill mountains. September.

Tricholoma Columbetta, *Fr.*

Woods. Selkirk, Albany county. August.

Tricholoma intermedium, *n. sp.*

Pileus thin, campanulate, obtuse, glabrous, slightly viscid when moist, greenish-yellow, flesh white; lamellæ crowded, free or slightly adnexed, white; stem equal, firm, glabrous, white; spores broadly elliptical, .0002 in. long, .00016 broad.

Pileus 2 to 3 in. broad; stem 1 to 2 in. long, 3 to 5 lines thick.

Thin woods. Catskill mountains. September.

This species resembles some forms of *T. equestre,* from which it is separated by its white lamellæ. It appears to be intermediate between that species and *T. sejunctum* from which its glabrous pileus and crowded lamellæ distinguish it.

Tricholoma terriferum, *n. sp.*

Pileus broadly convex or nearly plane, irregular, often wavy on the margin, glabrous, viscid, pale alutaceous, generally soiled with adhering particles of earth carried up in its growth, flesh white, with no decided odor; lamellæ thin crowded, slightly adnexed, white, not spotted or changeable; stem equal, short, solid, white, floccose-squamulose at the apex; spores minute, subglobose, .00012 in. long.

Pileus 3 to 4 in. broad; stem 1 to 1.5 in. long, 6 to 8 lines thick.

Woods. Catskill mountains. September.

This and the next preceding species belong to the section Limacina.

Tricholoma tricolor, *n. sp.*

Pileus broadly convex or nearly plane, sometimes slightly depressed in the center, firm, dry, obscurely striate on the margin, pale alutaceous, inclining to russet, flesh whitish; lamellæ thin, narrow, close, adnexed, pale yellow, becoming brown or purplish-brown in drying; stem stout, short, firm, tapering upwards from the thickened or subbulbous base, white; spores broadly elliptical or subglobose, .0003 in. long.

Pileus 2 to 4 in. broad; stem 2 to 3 in. long, 6 to 12 lines thick.

Woods. Selkirk. August.

Remarkable for its varied colors and for the peculiar hue assumed by the lamellæ in the dried state.

Tricholoma fuligineum, *n. sp.*

Pileus convex or nearly plane, obtuse, often irregular, dry, minutely squamulose, sooty-brown, flesh grayish, odor and taste farinaceous; lamellæ subdistant, uneven on the edge, cinereous, becoming blackish in drying; stem short, solid, equal, glabrous, cinereous; spores oblong, elliptical, .0003 in. long, .00016 broad.

Pileus 1 to 2.5 in. broad; stem 1 to 1.5 in. long, 3 to 5 lines thick.

Among mosses in open places. Catskill mountains. September.

This and the next preceding species belong to the section Genuina.

Tricholoma putidum, *Fr.*

Under pine trees. Catskill mountains. September.

Our specimens agree accurately with the description of *T. putidum*, except that the pileus is not umbonate; but this character is limited by Fries in Icones Selectæ to young plants.

Clitocybe subsimilis, *n. sp.*

Pileus at first conical or subturbinate, then plane, nearly obconical, soft, fleshy, pure white, the margin at first involute and somewhat tomentose, then even or marked with irregular ridges, as if from matted tomentum, flesh white, taste mild; lamellæ in the young plant adnate, in the adult, decurrent, subdistant, often branched, white, the interspaces venose; stem equal or merely subbulbous, by no means obclavate, solid, soft, elastic, white; spores broadly elliptical or subglobose; .0002 to .00025 in. long, .00016 to .0002 broad.

Pileus 1 to 1.5 in. broad; stem 1 to 2 in. long, 2 to 4 lines thick.

Under pine trees. Catskill mountains. September.

This species is closely related to *Clitocybe clavipes*, of which there is said to be a white variety. I have separated our plant not only because of its pure white color, but also because of its peculiar stem, which is not at all obclavate as in *C. clavipes*, though sometimes it is slightly and abruptly bulbous. Its resemblance to *C. clavipes* has suggested the specific name. It is very unlike *C. obtexta* in its dry pileus and subdistant lamellæ.

Variety *monstrosa*. Lamellæ reticulately branched or anastomosing, causing the hymenium to appear porous either wholly or in part.

With the typical form.

Clitocybe cæspitosa, *n. sp.*

Pileus thin, infundibuliform, often irregular, slightly silky, hygrophanous, grayish brown when moist, subcinereous or argillaceous when dry; lamellæ narrow, close, decurrent, somewhat branched, white; stem equal, stuffed or hollow, silky, white; spores minute, subelliptical, .00012 to .00016 in. long.

Pileus 1 to 1.5 in. broad; stem about 1 in. long, 2 to 3 lines thick.

Thin woods. Catskill mountains. September.

The plant is remarkable for its cæspitose mode of growth and its irregular, deformed appearance. The pileus is somewhat perforated. The relationship is with C. expallens, C. Adirondackensis, etc.

Clitocybe sulphurea, *n. sp.*

Pileus convex, slightly umbonate, moist or subhygrophanous, pale yellow, streaked, flesh yellowish; lamellæ subdistant, adnate, uneven or serrulate on the edge, pale yellow; stem equal or tapering upwards, curved or flexuous, hollow, colored and streaked like the pileus, yellowish within; spores broadly, elliptical or subglobose, .00025 to .0003 in. long, .0002 to .00025 broad.

Pileus 1 to 2 in. broad; stem 1 to 3 in. long, 2 to 4 lines thick.

Decaying wood of spruce and balsam. Wittenberg mountain. September.

Distinct from *Tricholoma sulphureum*, which it resembles in color, by its moist pileus, adnate lamellæ, hollow stem and lack of odor.

Clitocybe tortilis, *Bolt.*

Hard ground in an old road. Sandlake. August. A species closely allied to *C. laccata* and appearing like an irregular dwarf form of that species. Sometimes cæspitose.

Collybia scorzonerea, *Batsch.*

Woods. Adirondack and Catskill mountains. July and September. The species is distinguished from *C. maculatus* by the yellowish hue of the pileus and lamellæ. The stem is sometimes attenuated and radicating at the base and sometimes blunt.

Collybia hariolorum, *D. C.*

Woods. Catskill mountains. September.

Collybia strictipes, *n. sp.*

Pileus thin, broadly convex or nearly plane, glabrous, slightly rugose on the disc, moist or subhygrophanous, pale yellow, more highly colored on the disk, paler when dry; lamellæ thin, crowded, adnexed or subfree, white; stem equal, straight, hollow, glabrous, slightly mealy or pruinose at the top, white, with a dense white tomentum at the base; spores ovate, pointed or acuminate at one end, .00025 to .0003 in. long, .00016 broad.

Pileus 1.5 to 2 in. broad; stem 1.5 to 2.5 in. long, 2 to 3 lines thick.

Woods. Catskill mountains. September.

Collybia alba, *n. sp.*

Pileus thin, convex or hemispherical, even, obtuse, glabrous, white; lamellæ broad, subdistant, ventricose, adnexed or nearly free, white; stem short, equal or slightly thickened at the top, solid, glabrous, white; broadly elliptical or subglobose, .00016 to .0002 in. long, .00012 to .00016 broad.

Pileus 3 to 5 lines broad, stem about 1 in. long, .5 to 1 line thick.

Mossy decayed wood and stumps. Gansevoort. July.

A small white species related to *C. Micheliana*, *C. muscigena* and *C. ludia*, but differing from these by its broad ventricose lamellæ.

Omphalia subgrisea, *n. sp.*

Pileus membranaceous, convex or nearly plane, glabrous, striatulate, grayish-brown with a paler margin; lamellæ distant, arcuate-decurrent, cinereous; stem slender, short, stuffed, generally curved, sprinkled with minute mealy particles, colored like the pileus.

Pileus 2 to 3 lines broad; stem 6 to 10 lines long.

Decayed wood of birch, *Betula lutea*. Blue Mountain lake, Adirondack mountains. July.

In color this plant resembles *Mycena vulgaris*, or grayish forms of *M. clavicularis*; in size, *M. corticola*. When very young the stem is conical and the pileus is more narrow than its base.

Mycena capillaripes, *n. sp.*

Pileus membranous, campanulate, glabrous, hygrophanous, livid gray or brownish and striate when moist, paler when dry, odor weak, alkaline; lamellæ ascending, subdistant, adnate, whitish or livid-white, the edge obscurely brownish-purple; stem slender, almost capillary, fragile, glabrous, hollow, colored like the pileus; spores narrowly elliptical, .0003 in. long, .00016 broad.

Pileus 3 to 5 lines broad; stem 1.5 to 2.5 in. long, scarcely .5 line thick.

Under pine trees. Karner. August.

This species is related to *Mycena rubromarginata* from which I have separated it because of its smaller size, slender stem, paler color, smaller spores and alkaline odor. It is also much smaller and paler than *M. purpureofusca*.

Mycena crystallina, *n. sp.*

Pileus membranous, at first conical or convex, then nearly plane, sometimes with a slight umbo and reflexed margin, even or obscurely striate on the margin, everywhere beset with minute shining viscid glandular particles, pure white; lamellæ narrow, thin, adnate, close, white; stem short, slender, hollow, colored and adorned like the pileus, attached by white woolly hairs.

Pileus 2 to 5 lines broad; stem 4 to 8 lines long.

Fallen leaves of pine. Catskill mountains. September.

The species belongs to the Basidipes and is closely related to *M. saccharifera*, from which it is separated because of its larger size, more numerous closer adnate lamellae and pure white color. The glands occur in every part of the plant and cause it to appear as if slightly sticky or viscid when pressed between the fingers. They are not visible to the naked eye, but under a lens they appear like minute globular shining particles. In the dried state the specimens assume a slight yellowish tint.

Entoloma sericeum, *Bull.*

Sandy pastures. West Albany. June.

Entoloma flavoviride, *n. sp.*

Pileus thin, at first broadly conical, then convex or subconcave by the upcurving of the margin, dingy yellowish-green, slightly silky and shining when dry; lamellæ broad, subdistant, ventricose, free or slightly adnexed, dingy or cinereous; stem equal, hollow, fibrous-striate, whitish; spores angular, uninucleate, .00045 to .0005 in. long, .0003 to .0004 broad.

Pileus 6 to 12 lines broad; stem 1 to 2.5 in. long, 1 to 2 lines thick.

Low swampy woods. Karner. August.

The color of the pileus is a peculiar dingy yellowish-green or olive-green by which the species is easily recognized.

Clitopilus erythrosporus, *n. sp.*

Pileus thin, hemispherical or strongly convex, glabrous or merely pruinose, grayish-incarnate, flesh whitish with an incarnate tint, taste farinaceous; lamellæ narrow, crowded, arcuate, strongly decurrent, colored like the pileus; stem equal or slightly tapering upward, hollow, slightly pruinose at the top, colored like the pileus; spores elliptical, rosy-red, .0002 in. long, .00012 to .00016 broad.

Pileus 1 to 2 in. broad; stem 1 to 1.5 in. long, 2 to 3 lines thick.

Decayed wood and among fallen leaves in woods. Catskill mountains and Menands. September and October.

The species is easily recognized by its peculiar uniform color, its narrow, crowded and very decurrent lamellæ and its bright rosy-red spores.

Clitopilus conissans, *n. sp.*

Pileus thin, convex, glabrous, pale alutaceous, often dusted by the copious spores; lamellæ close, adnate, reddish-brown; stem slender, brittle, hollow, white; spores narrowly elliptical, bright rosy red, .0003 in. long, .00016 broad.

Plant cæspitose; pileus 1 to 1.5 in. broad; stem 1 to 2 in. long, 1 to 2 lines thick.

A single tuft of this peculiar species was found growing at the base of an apple tree in the Catskill mountains, in September. The species is remarkable for the copious bright colored spores which were so thickly dusted over the pilei of the lower specimens as to conceal the real color of the surface. They are quite as bright as and a little longer than those of the preceding species. The general aspect of the plant with its dark colored lamellæ is suggestive of some species of Hypholoma or Psilocybe, but the color of the spores requires its insertion in this place.

Clitopilus cæspitosus *n. sp.*

Pileus at first convex, firm, nearly regular, shining white, then nearly plain, fragile, often irregular or eccentric from its tufted mode of growth, glabrous but with a slight silky luster, whitish, flesh white, taste mild; lamellæ narrow, thin, crowded, often forked, adnate or slightly decurrent, whitish, becoming dingy or brownish-incarnate; stem cæspitose, solid, silky-fibrillose, slightly mealy at the top, white; spores very pale incarnate, .0002 in. long, .00016 broad.

Pileus 2 to 4 in. broad; stem 1.5 to 3 in. long, 2 to 4 lines thick.

Thin woods and pastures. Catskill mountains. September.

This is a large, fine species, very distinct in its cæspitose habit, white color and very pale, sordid tinted spores. But for the color of these the plant might easily be taken for a species of Clitocybe. The tufts sometimes form long rows.

Pholiota minima, *n. sp.*

Pileus membranous, hemispherical or campanulate, umbonate, glabrous, hygrophanous, brown and striatulate when moist, pale buff or yellowish-white when dry; lamellæ rather close, subventricose, adnexed, ferruginous; stem slender, solid, glabrous, shining, similar to the pileus in color, annulus near the middle, slight, evanescent; spores elliptical, .0003 in. long, .0002 broad.

Pileus 2 to 4 lines broad; stem 8 to 12 lines long, .5 line thick.

Among Polytrichum. Catskill mountains. September.

The species is distinguished from *P. mycenoides*, to which it is closely related, by its smaller size, paler color, umbonate pileus and solid stem.

Inocybe fibrillosa, *n. sp.*

Pileus thin, convex or nearly plain, obtuse or subumbonate, densely fibrillose, tawny, the disk usually darker in color and adorned with appressed fibrillose scales; lamellæ close, adnate, at first yellowish or yellowish-olivaceous, then cinnamon-brown; stem equal, hollow, fibrillose-squamose, pallid; spores even, .0004 in. long, .00025 broad.

Pileus 10 to 18 lines broad; stem about 1 in. long, 1 to 2 lines thick. Damp mossy banks in woods. Bethlehem, Albany county. August.

The species belongs to the Squarrosæ.

Inocybe subfulva, *n. sp.*

Pileus at first broadly conical or subcampanulate, then convex or nearly plane, umbonate, fibrillose-squamose, tawny-ochraceous; lamellæ broad, close, rounded behind, adnexed, ventricose, pallid, becoming tawny-cinnamon; stem, equal, firm, solid, fibrous-striate, obscurely pruinose, a little paler than the pileus; spores stelletely rough, .0004 to .0005 in. long, .0003 to .00035 broad.

Pileus 8 to 16 lines broad; stem 1 to 2 in. long, 1 to 2 lines thick. Sandy soil, in fields. Selkirk. August.

Related to *I. calospora*, from which it differs in the erect scales of the pileus, the adnexed lamellæ, the solid stem and the somewhat elliptical shape of the spores. The species belongs to the Laceræ.

Inocybe violaceifolia, *n. sp.*

Pileus thin, convex or nearly plane, fibrillose, subsquamulose, grayish; lamellæ close, adnexed, at first pale violaceous, then brownish-cinnamon; stem firm, solid, slender, fibrillose, whitish; spores even, .0004 in. long, 00025 broad.

Pileus 6 to 12 lines broad; stem about 1 in. long, 1 line thick. Mossy ground in woods. Selkirk. August.

A small, pale species, remarkable for the violaceous tint of the young lamellæ. It belongs to the Rimosæ.

Inocybe asterospora, *Quel.*

Woods and open places. Sandlake. June. South Ballston. July.

Inocybe margarispora, *Berk.*

Grassy ground in thin woods. Greenbush, Rensselaer county. June. Our specimens are a little smaller than the typical ones, but they appear to belong to this species.

Inocybe commixta, *Bres.*

Adirondack mountains. July.

Inocybe agglutinata, *n. sp.*

Pileus at first conical, then campanulate or convex, umbonate, fibrillose, pale tawny, streaked or spotted with appressed fibrils, the umbo usually darker; lamellæ close, broad, ventricose, adnexed, at first whitish, then brownish-cinnamon, often white on the edge; stem firm, solid, white or whitish and pruinose above, brownish or tawny and fibrillose below; spores even, .0004 to .00045 in. long, .0002 to .00024 broad.

Pileus 6 to 12 lines broad; stem 1 to 2 in. long, 1 to 2 lines thick. Under pine trees. Catskill mountains. September.

This is a beautiful and well marked species. The fibrils of the pileus appear as if agglutinated to its surface, though it is not viscid. Sometimes they form tawny spots like appressed scales. In very wet weather they are apt to wash away and disappear. In general appearance the plant resembles *I. Whitei,* but the umbonate dry pileus at once distinguishes it. The real affinity is with *I. geophylla.*

Inocybe nigridisca, *n. sp.*

Pileus thin, at first convex, then nearly plane or somewhat centrally depressed, umbonate, moist, minutely fibrillose, blackish-brown with a grayish margin when moist, cinereous when dry; lamellæ close, rounded behind, free or slightly adnexed, at first grayish, then ferruginous-brown, sometimes tinged with yellow; stem slender, firm, solid, flexuous, minutely villose-pruinose, reddish-brown; spores nodulose, .0003 in. long, .0002 broad.

Pileus 4 to 8 lines broad; stem 1 to 1.5 in. long, .5 line thick.

Under cinnamon fern, *Osmunda cinnamomea.* Kasoag. Oswego county. June.

The adornment of the pileus and stem is so minute that at first sight the plant appears to be glabrous. The margin of the pileus soon becomes elevated, causing the center to appear depressed. The species belongs to the Velutinæ. It is distinguished from *I. paludinella* by its darker color, and its moist or subhygrophanous character.

Inocybe vatricosa, *Fr.*

Damp ground under willows. Catskill mountains. September.

The pallid color, decumbent stem and webby veil are characteristic of this species. The European plant is said to be inodorous, but our specimens had a radish-like odor. In it the spores are even, elliptical, .0004 in. long, .00024 broad. I find no description of the spores of the European plant. A variety with the disk reddish occurs in the same locality. It appears somewhat like a diminutive form of *Hebeloma longicaudum.*

Hebeloma crustuliniforme, *Bull.*

Open woods. Catskill mountains. September.

A small form, but exhibiting well the characters of the species.

Hebeloma longicaudum, *Pers.*

Woods. Catskill mountains. September.

In our plant the pileus is not umbonate, nor do all the descriptions ascribe this character to the species.

Flammula lubrica, *Fr.*

Decayed wood and ground among fallen leaves. Catskill mountains. September.

This species closely resembles *F. spumosa* in general appearance, but it may be distinguished by its somewhat spotted pileus and its white flesh. The spores also are paler than those of *F. spumosa.*

Flammula subfulva, *n. sp.*

Pileus convex, viscid, innately fibrillose, spotted toward the margin with darker appressed scales, sordid-tawny, flesh grayish-white; lamellæ close, adnate, brownish-ochraceous; stem equal or slightly tapering upward, fibrillose, solid, whitish; spores brownish-ochraceous, elliptical, uninucleate, .00024 to 0003 in. long, .00016 broad.

Pileus 1.5 to 2.5 in. broad; stem 2 to 3 in. long, 2 to 4 lines thick.

About the base of trees. Catskill mountains. September.

The plant is more or less cæspitose. It is allied to *F. spumosa,* but differs in its tawny squamose-spotted pileus and grayish-white flesh.

Naucoria paludosa, *n. sp.*

Pileus very thin, broadly convex or plane, glabrous, hygrophanous, brown and striatulate on the margin when moist, buff-yellow when dry; lamellæ close, thin, rather broad, adnexed, at first yellowish or pallid, then brownish-ochraceous; stem slender, equal, hollow, brittle, glabrous, pallid or brownish; spores ferruginous, elliptical, uninucleate, .0004 in. long, .0002 broad.

Pileus 6 to 12 lines broad; stem 1 to 2 in. long, .5 to 1 line thick.

Wet, marshy or damp ground under willows and alders. Catskill mountains. September.

Naucoria unicolor, *n. sp.*

Pileus thin, broadly convex, plane or slightly depressed, glabrous, hygrophanous, yellowish-brown and striatulate on the margin when moist, paler when dry; lamellæ thin, close, slightly rounded behind, colored like the pileus; stem equal, tough, hollow, glabrous, colored like the pileus, with white mycelium at the base; spores broadly elliptical, brownish-ferruginous, .00025 to .0003 in. long, .0002 broad.

Pileus 6 to 10 lines broad; stem 1 in. long, .5 to 1 line thick.

Decayed wood and old stumps of deciduous trees. Selkirk. August.

Naucoria triscopoda, *Fr.*

Decayed wood. Catskill mountains. September.

Our specimens belong to the form having the pileus striatulate on the margin when moist. This form is figured and described in Icones Selectæ as *Agaricus triscopus.*

Naucoria carpophila, *Fr.*

Borders of woods. Catskill mountains. September.

Galera inculta, *n. sp.*

Pileus thin, somewhat fragile, campanulate, then convex or nearly plane, obtuse or rarely with a small umbo, hygrophanous, cinnamon color and striatulate when moist, buff color and atomate when dry, sometimes minutely pitted or corrugated, rarely rimose-squamulose; lamellæ broad, subdistant, ventricose, adnexed, white crenulate on the edge, at first pallid, then pale cinnamon; stem straight or subflexuous, hollow, brittle, slightly silky striate, reddish-brown, sometimes slightly pruinose-mealy at the top and white villose at the base; spores subelliptical, pointed at each end, brownish-ferruginous, .0006 to .00065 in. long, .0003 broad.

Pileus 6 to 12 lines broad; stem 1 to 1.5 in. long, .5 to 1 line thick.

Damp ground under willows and alders. Catskill mountains. September.

This is a very distinct species. The pileus, when dry, resembles in color that of *Galera tener;* when moist, that of *Clitocybe laccata* in its small glabrous striatulate form. The specimens were found growing with *Naucoria paludosa,* from which they may be distinguished by the more campanulate pileus, the broader, more distant lamellæ and the larger spores.

Agaricus comptulus, *Fr.*

Cultivated ground. Menands. August.

Closely allied to *A. campestris,* from which it may be separated by its smaller size, the yellowish hue of the dry plant and by the smaller spores.

Stropharia albocyanea, *Desm.*

Bushy pastures. Catskill mountains. September.

Psilocybe clivensis, *B. & Br.*

Borders of woods. Catskill mountains. September.

Psilocybe senex, *n. sp.*

Pileus thin, hemispherical, obtuse, hygrophanous, dark brown and striatulate when moist, pale cinereous and shining when dry, somewhat squamose with superficial subfasciculate whitish fibrils, the margin appendiculate with the same; lamellæ broad, subdistant, adnate, at first grayish, then brown or blackish-brown with a white edge; stem slender, hollow, fragile, minutely floccose-pruinose, subpellucid, white; spores brown, elliptical, .0003 in. long, .0002 broad.

Pileus 6 to 10 lines broad; stem 1.5 to 3 in. long, 1 line thick.

Decayed wood in woods. Catskill mountains. September.

The species is apparently related to *P. canifaciens*, but is at once distinguished by its slender white stem. The specific name has reference to the white hairs or fibrils of the pileus, which are suggestive of the white hairs of old age.

Deconica subviscida, *n. sp.*

Pileus thin, at first subconical, then convex or nearly plane, often slightly umbonate, glabrous, hygrophanous, pale chestnut or reddish tan color, subviscid and striatulate on the margin when moist, pallid or dull buff when dry; lamellæ broad, subdistant, adnate or slightly decurrent, at first whitish or dingy, then brownish ferruginous; stem equal or tapering downwards, fibrillose, hollow, brownish toward the base, paler above, the fibrils whitish or grayish; spores ovate, brown, .0003 in. long, .0002 broad.

Pileus 3 to 6 lines broad; stem about 1 in. long, 1 line thick.

Horse dung and manured ground. Menands. August.

This species has many characters in common with *D. bullacea*, from which I have separated it because of its scarcely viscid pileus without a separate cuticle, and its different spores. It is gregarious, and in wet weather appears in great abundance and in successive crops. The slight whitish veil is perceptible in the young plant.

Psathyrella minima, *n. sp.*

Pileus membranous, hemispherical, obtuse, obscurely striatulate when moist, even and pruinose-atomate when dry, dingy-yellow or reddish-brown, becoming paler in drying; lamellæ broad, adnate, white, becoming yellowish-cinnamon; stem capillary, minutely mealy or furfuraceous under a lens, pellucid, white; spores black, narrowly elliptical, .00025 to .0003 in. long .00012 to .00015 broad.

Pileus 1 to 2 lines broad; stem 4 to 6 lines long.

Excrement of deer in woods. Adirondack mountains. July.

About the size of and growing with *Coprinus radiatus* from which it is clearly distinct by its entire pileus and persistent adnate lamellæ.

Cortinarius balteatus *Fr.*

Grassy ground in pastures. Catskill mountains. September.

Our specimens belong to a form which may be called variety *bulbosus*. Stem strongly bulbous, at first almost wanting, the pileus appearing to rest on the bulb which is abruptly pointed beneath.

The typical form occurs in Europe and is said to grow especially under pine trees.

Cortinarius pluvius, *Fr.*

Woods. Catskill mountains. September.

Cortinarius muscigenus, *n. sp.*

Pileus at first ovate, then convex or concave from the recurving of the margin, subumbonate, glabrous, viscose with a separable pellicle, tawny-orange and widely striate on the margin when moist, tawny and shining when dry, flesh dingy white, tinged with yellow; lamellæ broad, ventricose, adnate, with a broad shallow emargination, somewhat rugose on the sides, yellowish, becoming cinnamon; stem long, subequal, viscid, even, silky, solid, white or whitish; spores .0005 to .0006 in. long, .0003 to .00036 broad.

Pileus 1.5 to 2.5 in. broad; stem 3 to 4 in. long, 3 to 4 lines thick. Mossy ground under balsam trees. Wittenberg mountain. September.

Closely related to *C. collinitus* from which it is separated by its more highly colored pileus, striate margin and even, not diffracted-squamose, stem.

Cortinarius brevipes, *n. sp.*

Pileus convex, silky-fibrillose, sordid white, flesh yellowish-white; lamellæ close, adnexed, pale violaceous becoming cinnamon; stem short, silky-fibrillose, bulbous, whitish, pale violaceous within; spores subelliptical, .0004 in. long, .00024 broad.

Pileus 1 to 2 in. broad; stem about 1 in. long, 4 to 6 lines thick. Woods. Catskill mountains. September.

The species belongs to the tribe Inoloma and is related to *C. alboviolaceus*, from which it is separated by its smaller size, short stem and yellowish-white flesh.

Cortinarius brevissimus, *n. sp.*

Pileus convex, often irregular, at first minutely silky, then glabrous, dingy white or argillaceous, flesh whitish; lamellæ close, adnexed, at first pale violaceous, then whitish, finally cinnamon; stem equal, very short, hollow, silky-fibrillose, white, pale violaceous within; spores broadly elliptical, .00024 to .0003 in. long, .0002 to .00024 broad.

Pileus 8 to 12 lines broad; stem 5 to 8 lines long, 3 to 4 lines thick.

Thin woods. Catskill mountains. September.

Related to the preceding species, but smaller, with a hollow stem and shorter spores.

Cortinarius albidifolius, *n. sp.*

Pileus thin, convex, subglabrous, whitish, tinged with yellow or pale ochraceous, the epidermis sometimes cracking and forming squamules, flesh whitish; lamellæ subdistant, slightly emarginate, adnate, whitish, becoming cinnamon; stem equal or slightly thickened at the base, solid, white, variegated below with yellowish floccose squamules, silky-fibrillose at the top; spores subglose or broadly elliptical; .00025 to .0003 in. long, .0002 to .00025 broad.

Pileus 1 to 2 in. broad; stem 2 to 3 in. long, 2 to 4 lines thick.

Woods. Catskill mountains. September.

Related to *C. ochroleucus*, but apparently distinct by the yellow scales of the stem and the adnate subdistant lamellæ. Both it and the preceding species belong to the tribe Dermocybe.

Cortinarius spilomeus, *Fr.*

Woods. Catskill mountains. September.

Cortinarius flavifolius, *n. sp.*

Pileus convex or nearly plane, fibrillose or squamulose, sometimes longitudinally rimose, varying in color from sordid buff to tawny yellow, flesh whitish; lamellæ subdistant, adnexed, at first a rich sulphur yellow, then yellowish cinnamon; stem slightly tapering upward, solid, whitish, peronate and slightly annulate by the copious silky, whitish veil; spores broadly elliptical, .0003 in. long, .0002 broad.

Pileus 2 to 3 in. broad; stem 2 to 3 in. long, 5 to 8 lines thick.

Woods. Catskill mountains. September.

The pileus is not truly hygrophanous, but the character of the stem indicates that the species belongs in Telamonia near *C. bivelus*. It differs from *C. limonius* by its dry pileus, and from *C. infucatus* by the color of the young lamellæ.

Cortinarius griseus, *n. sp.*

Pileus convex, obtuse or gibbous, fibrillose-squamulose with grayish hairs or fibrils, moist, pale gray; lamellæ subdistant, adnexed, at first pallid, then brownish-ochraceous; stem tapering upward from a thickened or bulbous base, silky-fibrillose, whitish; spores .0004 to .0005 in. long, .0003 broad.

Pileus 1 to 3 in. broad; stem 2 to 3 in. long, 3 to 6 lines thick.

Mossy ground under balsam trees. Wittenberg mountain. September.

The fibrils of the pileus are similar to those of *C. paleaceus*, but the plant is much larger and stouter, and the spores are larger than in that species. It is well marked by its grayish color.

Cortinarius badius, *n. sp.*

Pileus thin, at first conical, then convex or broadly campanulate, umbonate, hygrophanous, blackish-chestnut color when moist, bay-red or chestnut color when dry, sometimes tinged with gray, the umbo darker, usually whitish-silky on the margin when young, flesh, when moist, colored like the pileus; lamellæ broad, subdistant, ventricose, adnexed, at first yellowish or cream-color, then subochraceous; stem slender, equal, hollow, silky-fibrillose and subannulate by the whitish veil, when old colored like the pileus both without and within; spores .0005 in. long, .0003 broad.

Pileus 8 to 12 lines broad; stem 1 to 1.5 in. long, about 1 line thick.

Mossy ground. Catskill mountains. September.

The species is related to *C. nigrellus*, from which it differs in its broad lamellæ which are paler in the young plant and in its larger spores.

Cortinarius subflexipes, *n. sp.*

Pileus thin, conical, then expanded and subacutely umbonate, hygrophanous, blackish-brown with the thin margin whitened by the veil when moist, subochraceous when dry; lamellæ thin, close, ventricose, adnexed, at first reddish-violaceous, then cinnamon; stem equal, flexuous, silky, shining, subannulate by the whitish veil, pale violaceous when young, pallid or reddish when old; spores .00024 to .0003 in. long; .0002 broad.

Pileus 6 to 10 lines broad; stem 1 to 1.5 in. long, about 1 line thick.

Thin woods. Catskill mountains. September.

Apparently related to *C. flexipes*, from which I have separated it because of its more glabrous pileus and different lamellæ. It and the two preceding species are referred to the tribe Telamonia.

Cortinarius paleaceus, *Fr.*

Mossy or bare ground in open places. Catskill mountains. September.

Cortinarius rigidus, *Fr.*

Catskill mountains. September.

Hygrophorus Lauræ, *Morg.*

Woods. Catskill mountains. September.

The squamules at the top of the stem are sometimes reddish. The disc is sometimes yellowish.

Lactarius aspideus, *Fr.*

Borders of woods. Catskill mountains. September.

A pretty but rare species, easily known by its pale yellow or straw color and the lilac hue assumed by wounds of the lamellæ or flesh. In Systema Mycologicum the stem is described as hollow and spotted. In our specimens the stem is hollow but not spotted. It is colored like the pileus and the spores are broadly elliptical or subglobose, slightly rough, .0003 to .0004 in. long.

Lactarius maculatus, *n. sp.*

Pileus fleshy, firm, at first convex and umbilicate or centrally depressed, then subinfundibuliform, glabrous, viscid when moist, concentrically spotted, especially toward the margin, varying in color from grayish-buff to grayish-lilac, flesh subconcolorous, taste acrid and unpleasant; lamellæ close, thin, sometimes forked, adnate to decurrent, pallid or cream color; stem short, equal or tapering toward the base, hollow, spotted, colored like, or a little paler than, the pileus; milk at first whitish with a cream-colored tint, wounds of the flesh and lamellæ changing to lilac; spores subglobose, echinulate, .0004 to .0005 in. long.

Pileus 3 to 5 in. broad; stem 1 to 2 in. long, 5 to 8 lines thick.

Thin woods and pastures. Catskill mountains and Menands. August and September.

This species is allied to *L. uvidus*, with which it was united in the Thirty-eighth Report as variety *magnus*. Having had the opportunity of investigating it in the fresh state, it seems to me to be a distinct species, readily recognized by its larger size and its firmer, spotted pileus which is centrally depressed or infundibuliform. I have not seen it at all umbonate. The spots of the pileus are arranged in concentric circles and by their confluence the pileus often appears to be zonate. The change of color assumed by wounds is similar to that which takes place in *L. uvidus*.

Russula lepida, *Fr.*

Woods. Menands. August.

Generally with the pileus red, but quite variable in this respect.

Russula adulterina, *Fr.*

Low swampy ground. Karner. June.

This is placed by Fries as a variety of *R. integra.*

Russula atropurpurea, *n. sp.*

Pileus at first convex, then centrally depressed, glabrous, dark purple, blackish in the center, the margin even or slightly striate, flesh white, grayish or grayish-purple under the separable pellicle, taste mild, odor of the drying plant fetid, very unpleasant; lamellæ nearly equal, subdistant, sometimes forked near the stem, at first white, then yellowish, becoming brownish where bruised; stem equal, glabrous, spongy within, white, brownish where bruised; spores subglobose, minutely rough, pale ochraceous with a salmon tint, .0003 to .0004 in. long.

Pileus 3 to 4 in. broad; stem 2 to 3 in. long, 5 to 8 lines thick.

Open woods. Gansevoort. July.

In color this species resembles *R. variata,* but in other respects it is very different. It is very distinct in the peculiar color of its spores, and in the brownish hue assumed by wounds.

Boletus speciosus, *Frost.*

Woods. Sandlake and Bethlehem. August.

A beautiful species belonging to the Calopodes.

Boletus auriflammeus, *B. & C.*

A single specimen of this very rare but well-marked species was found in Sandlake. August.

Boletus purpureus, *Fr.*

Oak woods. Menands. August.

Boletus hemichrysus, *B. & C.*

Pine stumps. Gansevoort. July.

The Boleti are generally terrestrial fungi as affirmed by Professor Fries in Hym. Europ., but this species appears to be an exception to the prevailing habit of the genus. *B. subtomentosus, B. paluster* and *B. felleus* sometimes grow on decayed wood, but they are usually terrestrial. Of this species only three specimens have been seen, all of which grew from the side of an old pine stump. The tomentum of the pileus is nearly one line thick. The species belongs to the tribe Pulverulenti.

Boletus glabellus, *n. sp.*

Pileus fleshy, thick, broadly convex or nearly plane, soft, dry, subglabrous, smoky-buff, flesh white, both it and the tubes changing to blue where wounded; tubes nearly plane, adnate, small, subrotund, ochraceous tinged with green; stem subequal, glabrous, even, reddish toward the base, pallid above, adorned with a narrow reddish zone or circumscribing line at the top; spores oblong, brownish-ochraceous, with a tinge of green when fresh; .0004 to .0005 in. long, .00016 broad.

Pileus 3 to 5 in. broad; stem 1 to 3 in. long, 5 to 10 lines thick.

Grassy ground under oaks. Menands. July.

The species belongs to the Subpruinosi, and is easily distinguished from its allies by the reddish circumscribing line at the top of the stem. This disappears in the dried specimens.

Boletus variipes, *n. sp.*

Pileus from convex to nearly plane, thick, soft, dry, squamulose, punctate-squamulose or minutely tomentose, pale grayish-brown, sometimes tinged with yellow or ochraceous, flesh white, unchangeable; tubes convex or nearly plane, slightly depressed around the stem, small, subrotund, at first white, then greenish-yellow, the mouths dingy ochraceous; stem nearly equal, firm, more or less reticulated, whitish or pallid; spores oblong-fusiform, brownish-ochraceous with a greenish tinge, .0005 to .0006 in. long, .0002 broad.

Pileus 3 to 6 in. broad; stem 2 to 4 in. long, 4 to 12 lines thick.

Oak woods. Menands. August.

The species belongs to the Edules. It is separated from *B. edulis* by its squamulose pileus. This character and its paler stem also separate it from *B. separans*. The stem is variable in color, length and degree of reticulation.

Variety *albipes*. Stem whitish, wholly reticulated, the reticulations coarser toward the base.

Variety *pallidipes*. Stem pallid, slightly scurfy, even or obscurely reticulated toward the base.

Variety *tenuipes*. Stem elongated, slender.

Boletus indecisus, *n. sp.*

Pileus convex or nearly plane, dry, slightly tomentose, ochraceous-brown, often wavy or irregular on the margin, flesh white, unchangeable, mild; tubes nearly plane or convex, adnate, small, subrotund, grayish, tinged with flesh color when mature, becoming dingy or brownish where wounded; stem minutely scurfy, often irregular or flexuous, reticulated at the top, pallid without and within; spores oblong, brownish flesh color, .0005 to .0006 in. long, .00016 broad.

Pileus 3 to 4 in. broad; stem 2 to 4 in. long, 4 to 6 lines thick.

Oak woods. Menands. August.

It belongs to the tribe Hyporhodii. It has the general appearance of *B. modestus,* but the tubes are not at all yellow. It differs from *B. alutarius* in color and in having the stem reticulated at the top, not scrupose. Its mild taste will separate it from any form of *B. felleus.*

Boletus albellus, *n. sp.*

Pileus convex, soft, glabrous, whitish, flesh white, unchangeable; tubes convex, free or nearly so, small, subrotund, whitish, not changing color when wounded; stem glabrous or minutely furfuraceous, substriate, bulbous or thickened at the base, whitish; spores brownish-ochraceous, .00055 to .00065 in. long, .0002 to .00025 broad.

Pileus 1 to 2 in. broad; stem 1 to 2 in. long, 3 to 6 lines thick.

Woods. Sandlake. August.

Closely related to *B. scaber,* of which it may possibly prove to be a dwarf form; but it is easily distinguished by its smooth or only slightly scurfy stem without any appearance of the colored dot-like squamules which are a constant and characteristic feature of that species.

Polyporus flavovirens, *B and R.*

Ground in woods. Selkirk. August.

Our specimens agree very well with the description of *P. flavovirens,* except that they are smaller and the dry plant is not tough and fibrous. They are to this extent doubtful.

Polyporus rimosus, *Berk.*

Trunks of locust, *Robinia pseudacacia.* Flatbush, L. I. *Rev. J. L. Zabriskie.*

Polyporus mutans, *n. sp.*

Resupinate rather thick, tough, following the inequalities of the wood; pores minute, rotund, short, buff-yellow or cream color, becoming dingy red or dull incarnate where wounded, the subiculum fibrous, changing color like the pores, the whole plant assuming an incarnate hue when dried.

Decaying wood of deciduous trees. Selkirk. August.

Sometimes a narrow, reflexed obtuse margin of a yellowish-brown color is formed. The pores are often oblique. The species appears to be quite distinct by reason of its peculiar colors.

Polyporus pineus, *n. sp.*

Resupinate, irregular from the inequalities of the matrix, rather tender but separable from the matrix, the thin subiculum and margin whitish, sometimes tinged with yellow; pores rather large, angular, unequal, two to three lines long, often oblique and lacerated, dingy whitish, becoming blackish where bruised or wounded, the whole plant becoming blackish or blackish-brown in drying.

Wood and bark of pine. Selkirk. August.

The species is apparently allied to *P. obliquus*, but the pores can not be described as very small, nor has our plant an "erect crested margin." It has a distict subiculum on which the pores are formed and by reason of which the plant is separable from the matrix.

Merulius Ravenelii, *Berk.*

Bark of prostrate trunks of spruce, *Abies nigra.* Adirondack mountains. July to September.

This fungus varies in hue from flesh color to dark smoky red or brownish-red. The pores are at first shallow with obtuse folds or dissepiments, but with age these become thinner and the pores deeper so that the plant might easily be taken for a Polyporus. Its pure white margin contrasts conspicuously with its dark waxy hymenium. The specimens labeled *Merulius serpens* in Ravenel's Exsiccati, Vol. IV, 9, belong to this species.

Merulius himantioides, *Fr.*

Prostrate trunks of hemlock. Catskill mountains. September.

The color of the hymenium resembles that of *M. lacrymans*, but the subiculum is very different. The fungus is soft, tender and membranous, and by confluence becomes widely effused. The subiculum is sometimes studded with drops of a reddish color, and is composed in part of branching strings of mycelium.

Hydnum fasciatum, *n. sp.*

Pileus thin, coriaceous, nearly plane, umbilicate, blackish-brown, adorned with three to seven narrow elevated scabrous, tawny-gray concentric zones; aculei short, decurrent, ferruginous-brown; stem short, slender, tough, tawny-gray or blackish; spores subglobose, rough, .00016 in. broad.

Pileus 6 to 12 lines broad; stem 4 to 6 lines long.

Naked ground in woods. Catskill mountains. September.

The specimens were past maturity when collected, and the colors of young plants may vary somewhat from those here given. The species is well marked by the peculiar elevated zones or lines of the pileus. The plant is closely gregarious, and sometimes the pilei are confluent. The relationship is with *H. connatum* and *H. zonatum.*

Irpex nodulosus, *n. sp.*

Resupinate, forming suborbicular patches four to ten inches or more in diameter, subseparable; the subiculum thick, tough; the hymenium dentate-porous toward the thick definite margin, centrally nodulose and prolonged into unequal compressed truncate or laciniate, rarely terete acute aculei, whitish, centrally yellowish or pale ferruginous.

Bark of standing trunks of poplar. Gansevoort. July.

Radulum pendulum, *Fr.*

Dead prostrate trunk of basswood, *Tilia Americana.* Argusville. July.

This is distinct from our other species by its reflexed pileate form. The pileus is whitish and pubescent, or at length nearly smooth. The species is quite rare.

Corticium olivaceum, *Fr.*

Decayed wood. North Greenbush and Slingerlands.

Clavaria albida, *n. sp.*

Plants 2 to 4 in. high, whitish ; stem short, thick, generally tapering downwards, divided above into a few short, thick, much-branched ramuli, ultimate branches densely crowded, terminating in a few short, blunt teeth ; flesh firm, dry, whitish, taste tardily acrid, then bitter; spores oblong, pale ochraceous, .0005 to .0006 in. long, .0002 broad.

Ground in thin woods. Menands. August.

The species has the structure of *C. botrytis* and *C. flava*, but it is readily distinguished from these by its uniform whitish color, the tips of the branches being concolorous.

Clavaria densa, *n. sp.*

Tufts 2 to 4 in. high, nearly as broad, whitish or creamy-yellow, branching from the base ; branches very numerous, nearly parallel, crowded, terete, somewhat rugose when dry, the tips dentate, concolorous ; spores slightly colored, subelliptical, .0003 to .0004 in. long, .0002 to .00034 broad.

Ground in woods. Selkirk. August.

Apparently closely allied to *C. condensata*, but differing decidedly in color.

Geaster Schæfferi, *Vitt.*

Woods. Catskill mountains. September.

The interior stratum of the external peridium is very thick in the fresh plant and conceals the short pedicel of the inner peridium, but in the dried state this stratum contracts and exposes the pedicel, which is about one line long. This character distinguishes the species from *G. rufescens.*

Geaster vittatus, *Kalchb.*

Under pine trees. Catskill mountains. September.

The thin outer coat of the external peridium cracks in parallel lines, causing the laciniae or rays to appear as if striped with white longitudinal lines. This character gives name to the species and serves to distinguish it from *G. saccatus* to which it is otherwise very closely related.

Sphæropsis carpinea, *Sacc. & Br.*

Dead twigs of water beech, *Carpinus Americana.* Menands. May.

Cercospora Gentianæ, *n. sp.*

Spots suborbicular, brown or reddish-brown, sometimes confluent; hyphæ amphigenous, short, subflexuous, slightly colored, .0006 to .0012 in. long, growing from minute blackish tubercles; spores more narrow than the hyphæ, cylindrical or gradually narrowed toward one end, one to three-septate, colorless, .0012 to .0024 in. long.

Living leaves of gentian, *Gentiana linearis.* Number Four, Adirondack mountains. July.

Oöspera Cucumeris, *n. sp.*

Tufts loose, subconfluent, whitish or grayish, forming soft, velvety patches; hyphæ erect or diverging; spores catenulate, elliptical or oblong, colorless, .0004 to .0008 in. long, .00025 to .0003 broad.

Decaying fruit of muskmelon, *Cucumis Melo.* Menands. October.

Sporendonema myophilum, *Sacc. in litt.*

Hyphæ colorless, simple or branched, densely interwoven and forming a soft whitish somewhat waxy mass, some of them producing chains of globose or broadly-elliptical spores, .00016 to .0003 in. long.

Inhabiting the bodies of living mice. Binghamton. *H. L. Griffis.*

In the specimen contributed by Mr. Griffis the fungus had broken the skin of the mouse near the eyes, and also on the left shoulder. In the latter place the white patch was about six lines broad, and the ruptured margin of the skin had in some parts a bloody appearance. The mouse was said to be alive when caught, but it is quite probable that the fungus would have killed it in a short time. It would be interesting to know if the fungus could be communicated to healthy mice in their food or otherwise, but my efforts to obtain a subject on which to try the experiment were unsuccessful.

Zygodesmus violaceofuscus, *Sacc.*

Roots of beech. Selkirk. August.

(D.)

REMARKS AND OBSERVATIONS.

Nymphæa odorata, *Ait.*

A form with very large leaves and flowers, equaling in size those of *N. tuberosa,* grows in the inlet of Beaver lake, Number Four, Lewis county. It has the decided and delightful fragrance of the ordinary form.

Rubus villosus, *Ait.* **var. humifusus,** *T. & G.*

Professor Dudley finds this variety near Ithaca. The variety *frondosus* is much more plentiful, and from it most of the cultivated varieties appear to have been derived, if we may judge by the character of the fruit offered for sale in the markets. It is less cylindrical, more acid and has larger seeds than the fruit of the typical form. I am quite confident that the true *R. villosus* would produce a fruit of far better quality, if brought under successful cultivation, and it seems strange that some of our enterprising nurserymen have not succeeded in introducing it into more frequent cultivation.

Vaccinium Canadense, *Kalm.*

A black-fruited variety of this valuable little shrub is plentiful at Number Four, Adirondack wilderness. There is also a black-fruited variety of *V. vaccillans.*

These varieties do not appear to have been designated by name, but they correspond to variety *nigrum* of *V. Pennsylvanicum* and variety *atrococcum* of *V. corymbosum.* Thus each of our common edible blueberries has its black-fruited variety. These black fruits are destitute of the bloom of the ordinary ones, and have a shining luster, but are scarcely different in flavor or quality from the ordinary blue ones. The black huckleberry, *Gaylussacia resinosa,* also has its corresponding variety, in which the fruit is jet black and shining. It also sometimes differs slightly in shape from the ordinary dull black fruit.

Scirpus polyphyllus, *Vahl.*

Gansevoort. July. A rare species with us.

Scirpus Torreyi, *Olney.*

Beaver lake at the inlet from Beaver dam. July.

This is a form in which the cluster of spikes is subtended by a bract equaling or slightly exceeding it in length.

Lepiota amianthina, *Scop.*

Specimens sometimes approach *L. granulosa* in the structure of the lamellæ which are somewhat emarginate and adnexed, but in all other respects they are true *L. amianthina.*

Lepiota granulosa, *Batsch. var.* **albida.**

A persistently whitish variety. Pastures. Catskill mountains. September.

Tricholoma fumidellum, *Pk.*

In the Catskill mountains a form of this species occurs which has the pileus umbonate and the umbo decidedly brown or smoky brown. Sometimes the cuticle is rimose areolate and then the plant imitates *Lepiota cristata* in general appearance. It is moist in wet weather and belongs to the tribe Spongiosa.

Tricholoma fumosoluteum, *Pk.*

Abundant among moss under balsam trees near the summit of Wittenberg mountain. The pileus is sometimes spotted thus indicating a relationship with the tribe Guttata, though its real affinities are with the Spongiosa. The taste is farinaceous and slightly bitter. The flesh is tinged with yellow under the subseparable epidermis.

Tricholoma Peckii, *Howe.*

This rare species occurs in the Catskill mountains.

Both the pileus and stem are adorned with beautiful tawny or tawny-red scales. The lamellæ when old become stained or spotted with brown or are discolored or dotted on the edge. The white flesh of the pileus has a farinaceous taste, then bitterish. The odor is also somewhat farinaceous. The pileus is viscid when moist, and the species is allied to *T. transmutans* and *T. albobrunneum.*

Clitocybe nebularis.

A cæspitose form of the species was observed in the Catskill mountains. Also a form in which the whole plant is white. This is the common form in these mountains. It has the same shape as the typical form, from which it differs only in color.

Clitocybe laccata, *Scop. var.* amethystina.

Specimens of this beautiful variety were found at Menands and at Karner in August. Two forms occur, in both of which the pileus is umbilicate and dark violaceous when moist, canescent or greyish when dry ; in one the pileus is about one inch broad, convex and regular ; in the other it is two to two and a half inches broad, and has the margin reflexed and often much lobed and wavy. In this form the lamellæ are broad, distant and often ruptured transversely. They are also more highly colored than in the typical form. The ordinary form has been found growing in circles in grassy places.

Collybia lentinoides, *Pk.*

A description of this species was published in the Thirty-second Report. Two varieties have been observed the past season.

Variety *rufipes*. Stem even, colored reddish-alutaceous like the pileus. This variety closely resembles ordinary forms of *Collybia dryophila* in color, and but for the serrated edge of the lamellæ it might easily be taken for that species. Albany Rural cemetery. June.

Variety *flaviceps*. Pileus buff-yellow and striatulate on the margin when moist, pale buff when dry ; stems cæspitose, hollow, whitish.

In all the forms the essential characters of the species are the glabrous, hygrophanous pileus, the lamellæ with serrated edge and the stuffed or hollow stem.

Collybia rubescentifolia, *Pk.*

In the Thirty-ninth Report this species was referred to Tricholoma, but subsequent observations indicate that it is a Collybia. The pileus is pretty constantly umbilicate and is hygrophanous, being dingy-yellow or smoky-yellow when moist and pale-yellow or buff when dry. The change in the color of the lamellæ in the dried plant is a marked and constant character, and is suggestive of the specific name. The species is closely allied to *C. luteoölivacea* B. & C., but no hygrophanous character is attributed to that species nor any change in the color of the lamellæ. Besides, its stem is described as scurfy.

Mycena pura, *Pers.*

This species is quite variable in color. A form occurs under pine trees in the Catskill mountains, in which the whole plant has a purplish color, with the lamellæ a little paler than the pileus and stem. It is darker than the ordinary forms.

Naucoria Highlandensis, *Pk.*

This was found in the Catskill mountains, growing on buried pieces of charcoal. This habitat is the same as that of *Flammula carbonaria*, a species to which our plant is evidently allied, but from which it is separated by its white flesh and its adnexed lamellæ.

Stropharia Johnsoniana, *Pk.*

A form of this very rare species, which has hitherto been found in but one locality, occurs in the Catskill mountains. In it the pileus is wholly yellowish and sometimes marked with darker spots, and the stem is squamulose below the annulus, with upwardly directed squamules.

Hygrophorus miniatus, *Fr.*

This species is very abundant in wet weather in all our woody and swampy districts, and is very variable in size and somewhat in color.

Variety *subluteus*. Pileus yellow or reddish-yellow, stem and lamellæ yellow, plant often cæspitose.

Thin woods. Catskill mountains. September.

Lactarius rufus, *Fr.*

Among moss, under balsam trees, near the summit of Wittenberg mountain. A small form, but very acrid, and thus distinguishable from large forms of *L. subdulcis*.

Lactarius affinis, *Pk.*

This occurred plentifully in the Catskill mountains in September. It is readily distinguished from *L. insulsus* by the characters indicated in the Thirty-eighth Report.

Lactarius scrobiculatus, *Fr.*

Fine specimens were found growing under hemlock trees in the Catskill mountains. The pileus in some was eight inches broad, pale yellow, very viscid, slightly zoned and distinctly bearded on the margin with coarse hairs.

Russula sordida, *Pk.*

A large form of this species was found growing under hemlock trees at Gansevoort. The pileus was four to eight inches broad, at first white or whitish, umbilicate or centrally depressed; then more or less stained with smoky-brown or blackish hues and subinfundibuliform. The flesh is white and taste mild; the stem is short, one to two inches thick, solid, white, and somewhat pruinose; the lamellæ are distant, unequal, very brittle, tinged with yellow. Every part of the plant turns blackish or violaceous-black where wounded. By this character it is distinguished from *R. nigricans*, in which the flesh at first becomes red where broken.

Marasmius salignus, *Pk. var.* major.

Pileus six to ten lines broad; lamellæ broad, distant, decurrent, the interspaces venose; stems often cæspitose.

Bark of willows. Gansevoort. July.

Marasmius androsaceus, *Fr.*

Two forms of this species occur here as in Europe. There the form with paler pileus grows on fallen leaves of frondose trees, the one with darker or fuscous pileus on leaves of acerose trees. Here the form with pale pileus abounds, in wet weather, on fallen leaves of spruce trees, and the one with fuscous pileus on fallen pine leaves. Often the two forms grow in close proximity to each other, yet, in every instance observed, the difference of color corresponds to this difference in habitat.

Marasmius præacutus, *Ellis.*

Fallen pine leaves. Catskill mountains. September.

Polyporus cæruleoporus, *Pk.*

On exposure to the light the blue color gradually fades to a grayish hue. Sometimes specimens occur with one-half of the pileus exposed and faded, the other half sheltered and retaining its normal grayish-blue color. The pores retain the blue color longer than the pileus, but the whole plant fades in drying. The flesh of the pileus is white.

Polyporus vulgaris, *Fr.*

A form with vesicular pores, a vertical section of the hymenium being porous, was found on poplar at Gansevoort. September. *P. obducens*, *P. adustus* and *P. subacidus* have all a similar vesicular form. I am satisfied that the genus Myriadoporus, which was founded on such forms, is not a good one and should be abandoned.

Solenia villosa, *Fr. var.* **polyporoidea.**

At first granuliform, then cylindrical, often crowded and forming a continuous pure white stratum, appearing like a resupinate Polyporus, the villosity scarcely visible to the naked eye, but perceptible with a lens.

Decayed wood of hemlock. Adirondack mountains. July.

This differs from the typical form in its crowded mode of growth. Is it, therefore, a distinct species?

Clavaria stricta, *Pers. var.* **fumida.**

The whole plant is of a dingy, smoky-brownish hue. Otherwise as in the typical form. Catskill mountains. September.

In the fresh state the specimens appear very unlike the ordinary form, but in the dried state they are scarcely to be distinguished.

Geoglossum microsporum, *C. & P.*

A rare species, not observed since its discovery in 1871, till it was again found this year in the Catskill mountains.

(E.)

FUNGI DESTRUCTIVE TO WOOD.

NOTE.— P. H. Dudley, C. E., has investigated the action of certain fungi upon railroad ties and wooden structures. At my request he has communicated to me some of the results of his investigations. These results are of such great practical and economic importance, that with his permission, I have added to this report a copy of his communication.

66½ PINE STREET, NEW YORK, *December* 5, 1887.

Prof. CHARLES H. PECK, *State Botanist:*

MY DEAR SIR. — The well established fact that the decay of all timber, under ordinary usages, is due to the growth of many species of fungi, gives to your long and patient work, in collecting, identifying and calling attention to different species, a value and bearing of practical importance hardly expected a few years since. The enormous annual consumption of timber by railroad companies, ship-builders, architects, manufacturers and farmers, in conjunction with the decreasing supply and increasing cost, gives value to any knowledge which will help check any unnecessary decay of timber.

The experience gained from the failures of many of the expensive efforts to preserve timber has shown that specific knowledge of the

Fig. II. Mycelium of Polyporus radula, one-fourth size.

habitats and growth of definite species of fungi is required to best adapt the means to accomplish the desired work. Now that knowledge of the habitats of species of fungi has been acquired, simple and effective preventive measures suitable for many cases, without treatment, can at once be put into practice.

The study of the decay of timber used for construction is rendered very difficult in most cases, from the fact that the entire structure of the wood may be destroyed by the growth of the mycelium, or its fermentative process, of the fungus without fructification taking place. This is especially true of railroad ties and bridge timbers. So little is seen in proportion to the destruction accomplished, it is due to this feature more than to any other, that the true function of the fungi on wood is not more generally understood by users and consumers of timber. It is not strange the idea is so prevalent that fungi are the accompaniments, instead of the cause of the decay of wood. A growth of mycelium, nearly similar to that shown in Fig. II,* of a fungus on the under side of a plank, as in station platforms or between boards when piled in close contact, has not been sufficient in most cases to call attention to the injury, if not the destruction of the plank or timber upon which it is growing.

Fig. II shows the mycelium of *Polyporus radula,* Fr. growing on the under side of a plank from a station platform. After the mycelium has run over the wood in a dense mass, then, by means of the fluids it generates — some of them having an acid reaction — the fibers or wood cells are softened and penetrated by the mycelium, and in this way the process of disorganization is carried on.

This causes the wood to shrink, crack, and finally fall to pieces.

The mycelium of many other species of the higher Fungi differs from this to some extent, but the final effect of its growth on and through the wood is to destroy it. Besides the visible mycelium there are many other growths and ferments, invisible to the eye, which cause a rapid internal decay of large unseasoned painted blocks, such as truck bolsters, transoms, buffers, dock timbers, and end sills to cars.

In warm and damp weather it is not uncommon for such growths to occur upon timber when piled in close contact, according to the species of wood and fungi, in three to eight weeks. In this vicinity the timber on which such growths have started may not be considered sufficiently injured for construction — to be rejected. If it is thoroughly

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*Figures I, II and III are from my paper entitled "Woods and Their Destructive Fungi," in the *Popular Science Monthly*, August and September for 1886, and are used by permission of the editor, Prof. W. J. Youmans. P. H. D.

dried or seasoned before use, the decay commenced is checked and will not revive until the wood again becomes moist from external causes. On the contrary, if such wood is put into structures while damp and unseasoned, then painted or confined where the moisture is retained, the decay will continue, the rapidity depending upon the continued amount of damp and warm weather or equivalent conditions. This is commonly and erroneously called "dry rot." Decay of dry wood can not take place without moisture.

It is well established by numerous proofs that seasoned woods last in all conditions of service where it is unfavorable for the growth of fungi, and decay in all conditions where they can grow, unless the timber is judiciously treated. The propagation of fungi upon timber may be either by germination of spores, which are thrown off by thousands when in fructification and disseminated by the air, or by revival of mycelium already on or in the wood.

Besides the ever-present spores of a fungus or its mycelium in timber, three essential conditions in combination are necessary for the decay of wood, or in other words, the growth of a fungus.

First. Moisture, either external or internal.

Second. A temperature between 40° and 120° Fahr., 75° to 90° being the most favorable for the maximum growth of fungi.

Third. A small amount of air, still or nearly quiet. Free circulation or winds check the growth of mycelium when in direct contact with it.

When wood must be exposed to these three conditions, sooner or later, according to its structure and cell contents, fungi grow and destroy it as a result of a natural law of their growth. Therefore, to protect seasoned wood from decay, the combination mentioned must be prevented from taking place by rejecting either one of the three elements; or, if that is impossible, an antiseptic or preservative must be used to prevent the growth of any fungi. This brief statement comprehends, both theoretically and practically, what is necessary to be done to preserve timber structures from decay, but to reduce the principles to practice, so as to meet all conditions of service which may occur, requires a knowledge of the structure of the particular wood, its cell contents, size of stick to be used and care in seasoning. Also a knowledge of the special fungus or fungi attacking the species of wood, and the value and proper use of preservatives and antiseptics.

Species of fungi which I have found upon specific woods when used as railroad ties or in bridges.

The fungi peculiar to white oak, *Quercus alba*, L., are *Polyporus* *applanatus*, Fr.; *P. versicolor*, Fr.; *P. pergamenus*, Fr.; *Dœdalea unicolor*, Fr.; *D. quercina*, Pers., and *Lenzites vialis*, Pk.

Polyporus applanatus attacks the heart wood of the white oak tie and is very destructive, and requires a moderate amount of air and moisture for its growth. The characteristic decay of these ties is from the under to the upper side, and is most rapid in stone ballast, or a coarse ballast which retains a little moisture and permits access of air. In a ballast containing considerable loam, which checks the circulation of air, and in wet cuts, the growth of the mycelium is retarded and the durability of the ties increased. In porous ballast, unless wet, the deeper the white oak ties are imbedded the better are the conditions of the growth of the fungi and the more rapid the decay of the ties. On the contrary, only imbedding the ties sufficient for the stability of the track increases the service of the ties by retarding the rapidity of the upward growth of the mycelium.

Polyporus versicolor attacks the sap wood of white oak ties and posts, and to a limited extent the heart wood.

Polyporus pergamenus attacks those ties from which the bark has not been removed.

Dœdalea unicolor, *D. quercina* and *Lenzites vialis* have been found on ties laid on railroad bridges.

The structure of the white oak is so firm and dense that it readily sustains the heaviest traffic and it is quite difficult to impregnate the internal cells of the ties. Unless a process has been used which would sterilize the spores lodged in the wood or possible traces of mycelium, the exterior treatment on the unseasoned wood prevents the escape of the internal moisture, the same as a coat of paint. This will hasten decay, for it furnishes the requisite conditions for fermentations and internal growth of mycelium.

The fungi attacking ties of the chestnut, *Castanea vulgaris*, variety *Americana*, A. D. C. (*Castanea vesca*, L., variety *Americana*, Mx.), are *Polyporus sulphureus*, Fr.; *P. spumeus*, Fr. ? ; *P. hirsutus*, Fr.; *P. versicolor*, Fr.; *P. pergamenus*, Fr.; *Agaricus Americanus*, Pk. and *A. sublateritius*, Schæff.

Polyporus sulphureus is also very destructive to telegraph poles and large posts, attacking them near the ground line.

The chestnut contains naturally a stronger antiseptic than the white oak and resists, in contact with the soil, the growth of the fungi until the antiseptic is destroyed by the air, or contact with the rails and spikes. The decay of the chestnut tie is from the top downwards; therefore the deeper the tie is imbedded the longer the body lasts. The full advantage of this is lost in some degree from the decay which takes place around the spikes and under the rails, from the fact that the iron in contact with this wood neutralizes its natural antiseptic. The ends and centers of chestnut ties are sound after the rails have cut into the wood enough to necessitate their removal. The opinion is quite prevalent that they do not decay, but are mostly destroyed by mechanical abrasion; which is not the fact, for the microscope reveals the truth, the presence of the mycelium of a fungus and its destructive work on the wood fibers as an important reason of their rapid abrasion.

The chestnut is lighter than the white oak and many of the wood fibers much coarser, which enables it to be impregnated with an antiseptic quite readily. The large ducts of the two woods are about the same size. The medullary rays of the chestnut are fewer than of the white oak, and it is, therefore, more easily indented as a tie.

The fungus which principally attacks the white cedar, *Chamœcyparis sphœroidea*, Spach., is *Agaricus campanella*, Batsch. It even attacks the growing tree, and in most cases its mycelium is found in the ties when cut. The tree is a very slow grower and, as the lower limbs become shaded, they die and are attacked by their special fungus, and this communicates with the upright cells of the tree. It takes from ten to twenty years before the limbs break off and the wound or orifice is closed by the growing wood. As long as air has access to the mycelium it slowly grows and destroys the wood above and below the wound, the decay spreading laterally very slowly, owing to the small medullary rays and the preservatives they contain. As soon as the orifice is closed, shutting off the air supply, the decay for the time is nearly if not entirely checked. When the trees are cut for ties it is not uncommon to find one or more decayed spots, from one-half to an inch in diameter, extending nearly the entire length of the tie.

The durability of the wood is so great that such ties are not rejected as long as there is sufficient sound wood for spiking. This wood contains a natural preservative and is very durable in contact with the soil, but its structure is too light and delicate to long withstand the heavy traffic of trunk lines, though from its durability it is valuable for those of moderate traffic.

The fungi which destroy ties made of Tamarack, *Larix Americana*, Mx., are *Polyporus pinicola*, Fr. and *Trametes Pini*, Fr.

The fruit of the former always shows traces of phosphoric acid.

This wood is heavier than white cedar, the wood cells being larger, with thicker walls. It is also much stronger because the cells in the annual layer formed in the autumn are nearly solid and in sufficient number to resist indentation or cutting of the ties by the rails under heavy traffic. It is a wood which can be easily treated so as to resist the attacks of fungi, and such ties have lasted over thirty (30) years in actual service.

The fungi attacking the hemlock, *Tsuga Canadensis*, Carr., are numerous. The following is a list so far as observed:

Agaricus melleus, Vahl.	*Polyporus lucidus*, Fr.
A. campanella, Batsch.	*P. benzoinus*, Fr.
A. porrigens, Pers.	*P. epileucus*, Fr.
A. succosus, Pk.	*P. Vaillantii*, Fr.
A. rugosodiscus, Pk.	*P. subacidus*, Pk.
A. epipterygius, Scop.	*P. medulla-panis*, Fr.
Paxillus atrotomentosus, Fr.	*P. pinicola*, Fr.
Lenzites sepiaria, Fr.	*P. abietinus*, Fr.
Stereum radiatum, Pk.	*P. borealis*, Fr.

This wood does not contain any natural antiseptic or preservative, and is readily attacked by a host of fungi, and decays very quickly. It is heavier than white cedar, but lighter than the tamarack, and, when well preserved by metallic antiseptics, makes a valuable tie.

The fungi destroying the wood of yellow pine, *Pinus palustris*, Mill., are *Lentinus lepideus*, Fr. See Fig. I.

Sphœria pilifera, Fr. See Fig. III.

Trametes Pini, Fr., and *Merulius lacrymans*, Fr.

The first is the most destructive to ties in this vicinity, the decay being most rapid on the bottom and extending upwards. In porous ballast the deeper the ties are imbedded the shorter the duration of service, so far as decay is concerned. The mycelium requires considerable moisture for its growth, and some air. A ballast which prevents a free circulation of the latter checks its growth. The sun and wind check its growth and oftentimes a tie which looks sound upon the surface will be so badly decayed underneath that its removal from the track will be necessary.

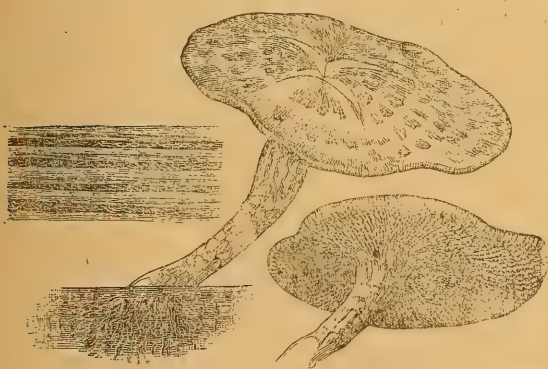

Fig. I. Lentinus lepideus, Fr. on Yellow Pine.

Showing the fruit of the fungus on, and the mycelium in, the wood. The size of the fruit varies from an inch to eight inches in diameter.

The mycelium of this fungus is usually pure white, and is not killed by freezing in the wood. In bridges it is very destructive.

Trametes Pini is also found upon ties of this wood, but is confined to the portions above ground. It will grow and fruit with less moisture than *Lentinus lepideus*, but as far as observed, its rapidity of destruction is not so great.

The fungus shown in Fig. III appears on the sap-wood of yellow pine, giving it a dark, dingy appearance, and if the dampness continues fermentations are set up, destroying the wood.

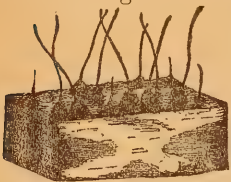

Fig. III. Sphæria pilifera, Fr., magnified five diameters.

Sphœria Pilifera attacks the sap-wood, discolors and quickly destroys this portion of the wood under favorable conditions for its growth. The resinous matter in yellow pine does not protect it in out-door situations, from attacks of the fungi mentioned.

The heart wood of yellow pine is so dense and firm that it is not readily penetrated by antiseptics. The same remarks in regard to imbedding white oak ties apply to this wood. In buildings, yellow pine is attacked by *Merulius lacrymans*, Fr., where it is warm and damp and the air stagnant.

White pine, *Pinus Strobus*, L., when used in bridges and trestles, is attacked by *Lentinus lepideus*, Fr., *Agaricus melleus* Vahl., *Polyporus Vaillantii* Fr. and, in warm inclosures, *Merulius lacrymans* Fr. Both the latter are very destructive.

There are many other woods whose structure is well adapted to their use as railroad ties, but which are so quickly destroyed by fungi as to be of no value unless judiciously treated. These are the beech, birches, elms and maples.

The above will be sufficient to call attention to the practical importance of a study of the fungi, in an economic sense as applied to the decay of wood.

The following simple but effective measures for the preservation of wood can at once be put in practice:

Timber, ties and boards should be seasoned before using, except when submerged. Green wood, according to the species, contains from twenty-five to forty-eight per cent of its weight of sap or moisture, and fully one-half these amounts must be removed to prevent decay in lumber painted on one side, or large sticks of timber painted on all sides, as buffers and car sills, transoms, truck bolsters and timbers.

All lumber and timber should be piled so there can be a free circulation of air around and between each board or stick. Stringers, six to ten inches thick, should first be laid down, and the lumber piled on them in tiers, with narrow sticks between each board at the ends and centers. Grass and weeds should not be allowed to grow near the piles of lumber, impeding the circulation of air under them.

Large timber should be seasoned under sheds and not exposed to the rays of the sun, as the latter dries an exterior portion so rapidly that it prevents the proper escape of moisture from the outside, and internal decay is liable to occur.

If timber, ties or boards are piled in close contact, and remain so for any length of time, dampness will revive and start the growth of mycelium. It is not uncommon to see large sticks of timber, especially for freight cars, taken into the shops partially covered by mycelium, dressed, framed, put into cars and then painted, thus completing the essential condition for slow but certain decay. Such wood has only one-fourth to one-third the life of seasoned wood.

Boards, especially those used for sheathing freight cars, when piled in close contact, in summer, are attacked in a short time by fungi, which discolor the wood by filling the cells with growths, often similar to those shown in Fig. IV.

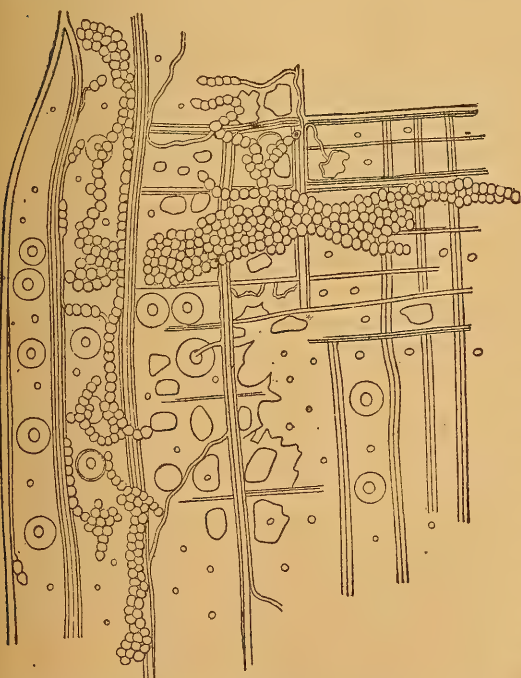

Fig. IV. Magnified 150 diameters, showing fungus growths discoloring the sap-wood of white pine.

The species of fungi which discolor the sap-wood and then set up fermentations are exceedingly numerous and grow with great rapidity. Some of the forms found in white pine are spheres resembling those shown in Fig. IV.

This wood, on being dried, will remain discolored, but the seasoning will check the decay. Such boards, when put into cars and painted, quickly decay when moisture reaches the unpainted surface. This class of decay is not confined to cars and railroad structures, but exists also in buildings, wharves and docks, where timber forms the major part.

The reasons for the first steps in checking the present unnecessary decay of timber must be first understood before we can derive full benefits of more expensive and complex treatment of timber.

Yours truly.

P. H. DUDLEY.

(F.)

BOTANICAL INDEX TO NEW YORK STATE MUSEUM REPORTS — TWENTY-TWO TO THIRTY-EIGHT.

REPORT

OF THE

STATE ENTOMOLOGIST

TO THE

Regents of the University, State of New York,

FOR THE YEAR 1887.

CONTENTS.

NOTE.

By provisions in an act of the Legislature, S. N. Y. — Chapter 355 of the Laws of 1883 — entitled an act to regulate the State Museum of Natural History * * * "the State Entomologist is placed on the scientific staff of the Museum, and the Trustees of said Museum are authorized to publish each year his scientific contributions, which publication shall be in lieu of the report now required by law from the State Entomologist."

In compliance with the above provisions, four reports have subsequently been made to the Regents of the University of the State of New York, and have been published in the Annual Reports on the State Museum. As the desired facilities for publication were not afforded under the then existing system of public printing, the reports have been brief and without the illustration and other features that were thought to enhance the usefulness and value of those preceding.

The report for 1883 will be found in pages 45–60 of the Thirty-seventh Report on the New York State Museum of Natural History. It contains notices of official work and field collections, and of depredations by Orgyia in Albany and by the Chinch bug in Northern New York.

The report for 1884, is contained in the Thirty-eighth Museum Report, pages 67–76. In addition to a list of the publications of the State Entomologist for the year and contributions to the Department for the same time, a sequel to the insect attacks of the preceding year is appended.

The report for 1885, occupies pages 77–125 of the Thirty-ninth Museum Report. For an enumeration of its contents see page 320 of this volume.

The report for 1886, is contained in pages 79–154 of the Fortieth State Museum Report, published in 1887. For its contents see page 324 of this volume. Of this report, 200 copies, with title-page and cover were printed as separates for the Entomologist for his distribution. Although not so designated, it may be regarded as the "Third Report on the Insects of New York," etc., in continuation of the series (the present being entitled the Fourth), and for permitting a readier reference to it in citations. It has already been so referred to in scientific publications.

Of the reports for 1883, 1884 and 1885, no copies having been printed outside of the small museum edition, such portions of them as may be deemed of interest, will probably be incorporated in the next (Fifth) report of the State Entomologist.

REPORT.

Office of the State Entomologist,
Albany, *December* 14, 1887.

To the Honorable Board of Regents of the University of the State of New York:

Gentlemen.—In accordance with the law of 1883, regulating the State Museum of Natural History, I herewith beg leave to present to your Honorable Board the following report of some of my labors and investigations during the past year. In connection therewith, I will refer incidentally to some entomological studies which are being prosecuted by others.

As in preceding years, my studies have been almost entirely in the direction of the economic relations of insects. So important are these relations to the farmer, the gardener, the fruit-grower, the florist, the manufacturer, the exchanger of produce or manufactures, and, in consideration of our numerous household pests — to every member of community, that no apology is needed if they are permitted, for the time, to claim almost the exclusive attention of your entomologist. It was to meet this need of reliable information of our insect pests, and of the most efficient means of controlling their ravages, that this Department was established in 1880, and has since been sustained by the State. Yet, pure science must ever form the basis of the applications of science. The proud position that economic entomology has attained, is but the result of the earnest, patient, and long-continued scientific study that has preceded it, and without which it would have been an impossibility. To particularize: a very large proportion of the insects of the United States have been described, named and classified,—our catalogues embracing about twenty-five thousand species. The several orders and suborders have been taken up by special students who have devoted their best energies and the greater part of their lives to descriptive and classificatory study. Thus: Dr. LeConte, whose name is inseparably connected with American Coleopterology —

during the forty years that he devoted to the work, had described nearly the one-half of our known species of Coleoptera, viz., 4,739, and given original definitions of more than 1,100 of the higher groups.* Since his death in 1883, the order which he had so greatly advanced, has continued to receive the untiring study of Dr. Horn, and is being rapidly progressed through frequent monographic and other publications of superior excellence.

To Mr. E. T. Cresson we owe much of our present knowledge of the Hymenoptera, through lists and monographs of several of the principal families, and last, through a Synopsis of the Hymenoptera of North America just published, giving the leading characters of families and genera, with synoptic tables which will afford the means for their ready recognition. One of the families of this order — perhaps the most difficult, from its many species and microscopic size of most of the number — the *Chalcididæ*, is being successfully studied by Mr. L. O. Howard, of the Entomological Division of the U. S. Agricultural Department at Washington.

Dr. S. W. Williston, of New Haven, is presenting from time to time, monographs of families in Diptera — an order which has been greatly neglected among us since the retirement of B aron Osten Sacken from the Russian Legation at Washington, and his removal to Germany. Fortunately for us, Baron Osten Sacken's interest in American Diptera, is still maintained, as may be seen in his occasional publications, and in a contribution from him in this report and other services acknowledged.

The Hemiptera still claim the devoted attention of Mr. P. R. Uhler, of Baltimore, who has recently given us our first list of the order, comprising the suborder of Heteroptera, to be followed soon, it is promised, by that of the Homoptera. Mr. E. P. Van Duzee, of the Grosvenor Library at Buffalo, is also working earnestly and successfully upon these insects — by far too generally regarded as unattractive.

Mr. S. H. Scudder's studies of the Orthoptera are being suspended, for a brief time only it is hoped, during the preparation and printing of his long-promised and anxiously awaited "Butterflies of New England."

Dr. H. A. Hagen, of the Museum of Comparative Zoölogy at Cambridge, Mass., still continues to be the highest authority in the Neuroptera, and a most diligent collector and custodian of all that

* Scudder, in *Trans. Amer. Ent. Soc.*, iv, 1884, p. xviii.

relates to the literature and biological illustration of North American insects.

In Lepidoptera, Mr. William H. Edwards is continuing his invaluable publications and illustrations in the Butterflies of North America; while the Heterocera (moths) are receiving their share of attention at the hands of Mr. Henry Edwards, Professor Fernald, Rev. Mr. Hulst, Mr. J. B. Smith, and others.

To such special students as are above named, the economic entomologist, whose field of study necessarily embraces all the orders without particular devotion to any one, has often occasion to apply for aid in the determination of new forms, discrimination between those that are closely allied, geographical distribution, extrication of perplexing synonymy, etc., etc. Much that he lacks may, by this means, be readily supplemented. In all cases such desired aid is cordially extended. I take great pleasure in acknowledging my personal obligations to each of the above named gentlemen — specialists, for the assistance that has always been promptly and cheerfully—ofttimes unsparingly, extended to me.

An unusual number of interesting insect attacks have been brought to my notice during the present year. Owing to the brief time that could be given to the preparation of this report but a few of them can be noticed, and those not to the extent that seems desirable.

The cereals of the State have not been visited to any unusual degree, with insect injuries, with the single exception of a demonstration of the joint-worm fly, *Isosoma hordei* (Harris), in some wheat fields of Niagara county. As there is apprehension that its presence in the western fields may be continued for a series of years, as is its wont when a footing has been secured, a somewhat extended notice of it has been given in the following pages, in which means are suggested, which, if diligently employed, should arrest its spread.

I have not heard of a continuation of the Hessian fly injuries, which for a few preceding years had been the cause of heavy losses to the wheat crop of Western New York, as notably in Wayne and Ontario counties in 1885, when the aggregate loss was estimated at $100,000, and in Seneca county, where, in the town of Junius, it was claimed that 40,000 bushels of wheat had been destroyed.

Less damage has been reported by the clover-seed midge, *Cecidomyia leguminicola* Lintn., from Central New York. Perhaps, as its distribution extends into adjoining States and into Canada, its operations will be less severe where they were first observed. It has become very destructive in Canada, especially in Central and South-western Ontario, where its injuries are only being met by cutting but one crop of clover during the season. Mr. Fletcher, entomologist of the Dominion of Canada, has stated in a recent report: "The only instances where any seed has been reaped are where, instead of allowing the clover to stand in the field till the end of June, it has been fed off by cattle and sheep till the beginning or middle of June, and then left to go to seed for the autumn crop. * * * The verdict of all the growers who have tried the experiment now seems to be that two crops can not be secured, and to get any seed at all, the first crop must be pastured until the beginning, and not later than the middle, of June. In this way the minute larvæ of the flies, which are to lay the eggs for the second brood, are eaten by the cattle at the same time as the clover and destroyed."

In my report for 1886, reference was made to the nearly entire destruction of the hop crop of the State, by the hop-vine aphis, *Phorodon humuli* (Schrank), only about one-twelfth of an average crop having been secured. As predicted — in part from the remarkable abundance throughout the latter part of the season of its insatiable destroyers, the lady-birds, and particularly of one species, *Adalia bipunctata* (Linn.), the two-spotted lady-bird — the hop-yards, the present year, have been favored with an almost entire exemption from aphis attack. Those who are interested in hop culture — so important an interest in our State — may be especially congratulated in that the mystery that has so long enveloped a large portion of the life-period of the hop-vine aphis, viz., from its disappearance from the yards in the autumn to its reappearance therein the following spring, has, during the present year, been satisfactorily solved. For this gratifying achievement we are indebted to the United States Department of Agriculture, through the patient and laborious investigations conducted, almost unintermittingly from May to November, by Professor Riley and his assistants, of the Entomological Division. I extract from a note appended to proof-sheets of my report for 1886 (not yet published), the following summary of the life-history of the insect, as it has been worked out within the last few months:

"The eggs are deposited on the twigs of plum trees in the autumn (October). They hatch at the putting out of the leaves the following spring. Three generations follow on the plum, of which the last only is winged, which at once migrates to the hop-yards. The fourth and the succeeding generations on the hop, to the eleventh inclusive, are wingless females. The twelfth generation consists of winged males and females — the latter, agamic, and these return to plum trees in September. Here the thirteenth generation is composed of sexual wingless females, which, after mating, deposit the eggs which are to hatch the following spring, in continuation of the species. For a detailed statement of the above, see a communication made by Mr. L. O. Howard, of the Division of Entomology, under instructions from Professor Riley, in the *Country Gentleman*, for November 17, 1887, page 875, giving also the latest studies of Professor Riley upon the insect, made in England during the present autumn."

Now that the winter abode of the hop-aphis has been ascertained to be on plum trees, in the egg state, thereby, to a certain extent, bringing it within our reach (some entomologists are not yet willing to concede that it does not, in part, hibernate in the soil of hop-yards), it may with propriety be claimed that "the practical outcome of the investigation is very great." But it is to be feared that our worthy Commissioner of Agriculture, who has lent the aid of his department to this investigation, has been over sanguine in his announcement in his report of the present year, that "there is now no reason why this pest, which last year damaged the crops to the extent of hundreds of thousands of dollars, should be longer feared by hop-growers."

The onion crop has suffered severely from insect attack in various portions of the State. Serious complaints have been made of injuries from the onion maggot (the larva of the onion fly, *Phorbia ceparum* Meigen), in Suffolk, Queens, Rensselaer, Essex and Genesee counties. In Otsego county, wire-worms are reported as having done much harm, while in Queens county, cut-worm attack was combined with that of the onion-fly. These injuries were not general, for in Saratoga and Livingston counties the crop is represented as having been remarkably free from the ordinary depredations of its insect enemies.

Young corn, in Bethany, Genesee county, was attacked in June, by caterpillars, living within webs and silken tubes in the ground among the roots, which they leave to feed upon the stalk beneath the ground and to some extent, on the leaves above, after the habit of the cut-worms, although belonging to a different family from the *Noctuidæ*, viz., the *Pyralidæ*. In some cases, the injury caused by them had necessitated replanting. From examples sent to me by Mr. W. E. Harding, I was able to rear the moth, and to find it to be a species of *Crambus*, distinct from *C. zeëllus* Fern., which has been so injurious to corn in Illinois, although the larval operations as described to me are almost identical with those of that species. A description of the caterpillar was made, which will be given, together with a fuller notice of the insect and its operations, after the moth, at present in the hands of Professor Fernald for determination, shall have been named. *Crambus zeëllus*, known in Illinois as the root web-worm, in an instance related, was found to have cut down every hill of corn in a field of twenty acres.

Injury to corn is reported by Mr. C. L. Landers, of Afton, Chenango county, from the larvæ of one of the larger Chrysomelid beetles, which, upon rearing the imago, proves to be *Chelymorpha Argus* Licht. He also observed the same, feeding on barley, cabbage, grass, plantain and other weeds. The occurrence of this insect in harmful number upon a valuable field crop is so unusual that it was noticed in a communication to the *Country Gentleman* of September 1, 1887, as a "Milkweed Beetle with Bad Habits;" see page —, of this Report. Beetles from the pupæ sent to me, emerged August nineteenth.

Under date of May ninth, Mr. J. W. Babcock, of Rochester, observed an attack upon his apple trees, the nature of which was quite new to him. Both the buds and blossoms were being spun together and rapidly eaten. From examples received, and from moths subsequently reared, it was ascertained that the insect was the eye-spotted bud-moth, or *Tmetocera ocellana* (Schiff.). The perfect insect was obtained on June third, although July is given as the usual time of its appearance. Mr. Babcock was informed that the attack could be arrested by spraying the trees with London purple in water — one-fourth pound to a barrel.

The rose-beetle, *Macrodactylus subspinosus* (Fabr.), made an appearance in unwonted numbers in Granby, Oswego county, in the fore part of June. The *Oswego Times* of June tenth, stated that they were in such force as to devour all the foliage of the apple trees and eat the young fruit. Examples of the insect were sent to me for name, with inquiries of their nature and of means for arresting their ravages, as they were exciting much alarm among the fruit-growers of that region. A reply was made in which were given the best known remedies against the pest, which was published in the *Oswego Times* of June eighteenth (see summary of the communication in another page of this Report). At Memphis, Onondaga county, at the same time, the beetles were said to be eating the young peaches and killing the corn.

An attack on apple trees at Moriches, Suffolk county, in early June, by the fall canker-worm *Anisopteryx pometaria* Harris, was recognized, in examples of the caterpillars sent.

A formidable attack was made by the quince curculio, *Conotrachelus cratægi* Walsh, late in September, in the quince orchards of T. C. Maxwell & Bros., at Geneva, N. Y. The injury had been serious the preceding year, but this season it was still more severe. Of the crop of 1,000 bushels, fully one-third was more or less affected. Some of the quinces that appeared the finest outwardly, were found upon cutting, to contain several of the larvæ feeding in cavities within, defiled with their blackened excrementa. It was learned on inquiry, that probably about one-twentieth of the fruit dropped from the trees, the larvæ continuing therein until driven out by decay. The entire crop ripened earlier than usual, and much of it decayed while still upon the trees. Recommendation was made of working the ground of the orchard thoroughly so as to destroy the larvæ by crushing and exposure after they had buried for pupation.

The novel form of injury inflicted upon the elms of Albany in the year 1883, by the white-marked tussock moth, *Orgyia leucostigma* (Sm.-Abb.), in girdling the young tips of elms and causing them to fall, has been repeated this year, as will be found noticed hereafter.

The imported elm-leaf beetle, *Galeruca xanthomelæna* (Schrank), which for several years past, to the southward of us, has been such a merciless defoliator of the elms, completely robbing them of their value as shade and ornamental trees and reducing them to unsightly harborers and propagators of a disgusting insect presence, has continued steadily to progress over the south-eastern portion of the State, until it has reached Poughkeepsie — midway between Albany and New York — in its northern extension. It is devoutly to be hoped that through the discoveries and improvements made within the last few years in insecticides and in means by which they may be conveyed into and distributed over our larger shade trees, the distribution of this obnoxious foreign intruder may speedily be arrested.

Another of our numerous imported pests, the larch saw-fly, *Nematus Erichsonii* Hartig, has for some time been extending slowly over Northern New York, and this year has been observed in some of the south-eastern counties of the State, as in Albany, Schoharie and Otsego. In some localities where it has been the most abundant, it has caused the death of large numbers of the native larchs or tamaracks, *Larix Americana.* I had hoped to present in this report an account of observations made by me upon this insect the past summer, in Hamilton county and elsewhere, but it is necessarily postponed for the present.

A strawberry leaf-folder, of somewhat different habits from those ascribed to the leaf-folder known to infest this plant, was observed by Prof. Peck, at Menands, Albany county, the latter part of June. It was believed to be identical with one that had appeared in September and October of the preceding year, thus indicating a double brood. The attempt to rear the moth was unsuccessful.

The Zebra cabbage worm, as from its peculiar markings it has been named — scientifically, *Mamestra picta* (Harris), which has won for itself a bad reputation from its readiness to feed upon a large number of quite dissimilar food-plants, as several of the garden vegetables, flowering plants, ornamental shrubs, buckwheat, etc., has been discovered at Chatham, Columbia county, by Mr. George T. Powell in defoliating currant bushes. They were found in their young stage feeding socially in large companies, and from having been rarely seen at that age they were not recognized until subsequent moltings developed their well-known and characteristic ornamentation.

In occasional instances where insect injuries are presented for which no explanation can be offered, it is thought proper to report them in the hope that they may have been observed and accounted for by some other entomologist or careful observer. Attention was called in August to such an attack, by Mr W. E. Harding, of

Bethany, N. Y. Larvæ had been seen by him eating into the ripe kernels of wheat in the head, but he neglected at the time to save any of them for examination. Later when they were looked for, none could be found. The aggregate injury could not have been very great, for it was stated that "sometimes a head was found with several injured kernels." From the irregular manner in which the eating had been done, it could not have been the work of the Angoumois moth, *Sitotroga cerealella* (Oliv.). Mr. Harding thought from the appearance of the depredator as he observed it, that it belonged to the Lepidoptera. Examples of the injured grain have been preserved in the State collection.

A similar form of attack on plums was submitted by Mr. J. J. Thomas, of Union Springs, N. Y., which could not be identified. Three Lombard plums, nearly ripe, were sent, which had been excavated in each case within one-eighth of an inch of the stem, to the depth of about one-tenth of an inch, and of about the same diameter. The original punctures probably had not been so large, but the skin surrounding it may have shrunken and parted in its drying. The excavations had more or less gum in them. One of the plums showed a smaller puncture a little removed from the larger, but in none could any oviposition or trace of larval operation be discovered. The pits and their contents were in their natural state, with no evidence of having been reached by the larva of the plum-gouger, *Coccotorus scutellaris* Lec.— a curculionid beetle of general distribution throughout the Mississippi valley whose habit is to penetrate the stone while still tender and feed upon the kernel. The plums were from Mr. H. C. Allen, of Erie county, who states that at least one-half of his crop had been destroyed in this manner — the cavities developing into rot. He had not been able to discover any insect making the puncture.

Another unexplained attack, presenting itself for the first time the present year, is a girdling of the tips of currant bushes, by some unknown insect, observed in Albany and vicinity during the months of May and June. The observations made and some speculations thereon are given in this Report.

Some other insect attacks brought to notice the past season may be found among the "Brief Notes on Various Insects," with which this Report concludes.

During the year I have availed myself of opportunities offered, in an endeavor to extend a knowledge of insect life and insect habits in their economic aspects, in addresses made before the following societies and organizations:

Western New York Horticultural Society at Rochester.
New York Farmers' Club, New York city.
Farmers' Institute, at Batavia.
Farmers' Institute at Schenectady.
Agassiz Association, Albany Chapter.
Dana Natural History Society at Albany.
Albany Institute.
Troy Scientific Association.
Torrey Botanical Club, New York city.
Entomological Club of Amer. Assoc. Adv. Sci.
American Pomological Society at Boston.

In conclusion, I beg leave to present herewith the following: Notices of insect attacks and miscellaneous observations; a list of the contributions made to the Department during the year; and a list of the publications of the Entomologist, for the same period, which, while given mainly as a record of entomological literature, may also serve to show some of the additional work of the Department other than that presented elsewhere in the Report.

Respectfully submitted.

J. A. LINTNER.

INSECT ATTACKS AND MISCELLANEOUS OBSERVATIONS.

THE INSECTS OF THE HEMLOCK.

[NOTE.—The following list of insects feeding on the hemlock, together with a reference to amount and character of injury inflicted, was drawn up at the request of Professor A. N. Prentiss, of Cornell University, for use in the monograph on the hemlock, *Tsuga Canadensis*, which he had been engaged to prepare for the Division of Forestry, in the U. S. Department of Agriculture. It is understood that his manuscript was some time since presented to the Department, but in the absence of the needed facilities for prompt publication of the labors of the Division, there is no prospect of its early issue. Under the circumstances, in compliance with the request made, Professor Prentiss has kindly given me permission for the present use of the notes communicated to him. A few additions have been made to the paper since its return, and some figures introduced.]

While the statement of Dr. Fitch, that "the hemlock is much the most free from insects of any tree in our country," may not be strictly true, yet its comparative freedom from insect attack is a fact, and one for which no satisfactory reason may be assigned. The peculiar pungent odor of turpentine is generally thought to be repulsive to insects, and the spirits of turpentine is not infrequently employed to protect clothing, woolens, and specimens of natural history from the attack of moths, and some of the smaller coleoptera. To some insects it is undoubtedly poisonous, and even its odor is fatal to them. And yet, there are Lepidopterous larvæ, as for example, *Pinipestis Zimmermani* Grote (*Bull. U. S. G.-G. Surv. Terr.*, iv, 1878, p. 700), and *Harmonia pini* Kellicott (*Entomologica Americana*, i, 1885, pp. 171–173) which live just within the sap-wood of young and vigorous pines; their bodies are constantly coated with the pitch, it constitutes part of their food, as it is found mingled with their excrement, and their pupal stage of transformation is undergone within a mass of pitch-exudation upon the bark of the tree. The pines furnish the requisite food for a large number of insects, most of which are limited to them, although a few extend their range to other *Coniferæ*, and to some of the deciduous trees. M. Edouard Perris has given a list of more than a hundred species which infest the maritime pine of Southern Europe. Dr. Fitch in his *Fourth Report on the Insects of New York*, in 1858, notices sixty-six pine-feeding insects. Dr. Packard in his *Insects Injurious to Forest* *and Shade Trees*, in 1881, has extended the number to 106, occurring on the different species of pines in the United States, while omitting several Hemiptera (bugs) which occur in greater numbers upon other kinds of vegetation. It will be safe to say that we know of, at least, 125 species of pine-inhabiting insects.

About thirty species are recorded as infesting spruces (*Abies nigra* and *A. alba*), and about the same number the firs (*Abies balsamea*, mainly). Dr. Packard (*loc. cit.*) names fifteen species on the Junipers (*Juniperus Virginianus* and *J. communis*), and but three on arbor vitæ (*Thuja occidentalis*).

The species known to feed upon the Hemlock are the following:

LEPIDOPTERA.

Eacles imperialis (*Drury*); Fitch, 4th Rept. Ins. N. Y., p. 62.

Thyridopteryx ephemeræformis (*Haworth*); Glover, Ent. Ind. Agr. Repts., p. 90.

Tolype laricis (*Fitch*); Lintner, 1st Rept. Ins. N. Y., p. 85.

Cleora pulchraria *Minot*; Packard, Rept. Comm. Agr. for 1885, p. 327.

Tephrosia Canadaria *Guen.*; Hulst, Ent. Amer., iii., p. 49.

Eupithecia luteata *Packard*; Packard, Bull. 3, Div. Entomol., p. 24.

"The Hemlock inch-worm;" Packard, Ins. Inj. For.-Sh. Trees, p. 242.

"The ten-lined pine inch-worm;" Packard, ib., ib.

Tortrix fumiferana *Clem.*; Pack., Rept. Comm. Agr. for 1883, p. 146.

Gelechia abietisella *Pack.*; Id., ib., p. 150.

A leaf-miner, undetermined; received from Prof. Prentiss.

COLEOPTERA.

? Dicerca sp.; Packard, Ins. Inj. For.-Sh. Trees., p. 241.

Hadrobregmus foveatus (*Kirby*); Packard, loc. cit. sup.

Orthosoma brunneum (*Forster*); Packard, loc. cit. sup.

Hylotrupes bajulus (*Linn.*); Fitch, 4th Rept. Ins. N. Y., p. 62.

Callidium sp.; Thomas, 6th Rept. Ins. Ill., p. 149.

Leptura Canadensis (*Fabr.*); Packard, loc. cit., p. 240.

"A large longicorn borer," indet.; Packard, loc. cit., p. 241.

"A short longicorn borer," indet.; Packard, loc. cit., p. 241.

Nyctobates Pennsylvanicus (*De Geer*); Schaupp, Bull. Brook. Ent. Soc., iv., p. 23.

Pissodes strobi *Peck*; Packard, loc. cit, p. 231.

Crypturgus atomus (*LeConte*); Packard, loc. cit., p. 231.

HEMIPTERA.

Cicada septendecim *Linn.*; Riley, 1st Rept. Ins. Mo., p. 24.

Lioderma ligata (*Stal*); Fitch, 4th Rept. Ins. N. Y., p. 62.

ORTHOPTERA.

Caloptenus spretus *Uhler;* Riley, 1st Rept. U. S. Ent. Comm., p. 253.

The injuries from the above insects (twenty-five species) differ in character and in degree, as will appear from the following brief notices of their depredations:

Eacles imperialis, or the pine Emperor moth, is among the largest of the family of *Bombycidæ,* which contains our largest lepidopterous insects. Its caterpillar, from its great size, is necessarily quite voracious as it approaches maturity, and will readily denude a limb of its leaves; but fortunately it never occurs in numbers sufficient to enable it to inflict any serious injury. It is seldom that more than two or three occupy the same tree. A figure of the moth — not a good one, but serving the purpose of recognition — is given in the *Natural History of the State of New York — Agriculture,* by E. Emmons, vol. v., pl. 40, fig. 7.

Tolype laricis, the larch-lappet, infests also the larch (*Larix Americana*), from which it has drawn its specific name. It also occurs upon pines, and is but seldom met with on the hemlock. It is a beautiful, interesting and rare species — never becoming so numerous as to prove a pest. A detailed account of its transformations, life-history, distribution, etc., is contained in the first Report on the Insects of New York. The male is shown at figure 1, and the female at figure 2.

Fig. 1.— The male TOLYPE LARICIS.

Fig. 2.— The female TOLYPE LARICIS.

Thyridopteryx ephemeræformis, the basket or bag-worm, is also seldom met with on the hemlock. Of its twenty known food-plants, its favorites are, apparently, the red cedar (*Juniperus Virginianus*), and the arbor vitæ (*Thuja Occidentalis*).

Cleora pulchraria is one of the "measuring worms" (as are the three following species), which is found frequently on the hemlock, but it is of an inconsiderable size, and never multiplies to an injurious extent.

Tephrosia Canadaria is another measuring worm, which feeds on tamarack and spruce, and probably on pine, as the moth has been found abundantly at Center, N. Y., amidst the pines of that locality.

Eupithecia luteata is common on several of the evergreens. It is a small larva, and of no special economic importance.

The hemlock inch-worm (a *Eupithecia* species) and the ten-lined inch-worm, as in the absence of a knowledge of the moths which they produce, the two are designated by Dr. Packard, have only been observed in Maine, and nothing has been recorded of their habits.

Tortrix fumiferana, or the spruce-bud worm, has been very destructive to spruces in portions of Maine, as observed and reported by Dr. Packard. It has occurred in very large numbers in some localities, where it has caused the death of a large number of trees, by eating off the buds in June as they were developing, and arresting the new growth. In a few instances only, it has been detected feeding on hemlock. It is found, also, in Massachusetts, New York, Pennsylvania, Ohio, Illinois and Wisconsin.

Gelechia abietisella is a small insect belonging to the *Tineidæ*. It is known, up to the present, only on the hemlock, in which the caterpillar causes dead patches on the smaller twigs by biting off and weaving together several of the leaves into a broad, flat, irregular case, within which it lives in a rude silken tube.

The Coleopterous larvæ infesting the hemlock, are of greater economic importance, as they are all borers in the trunk, limbs and twigs, or excavate smaller burrows between the wood and bark.

The *Dicerca* sp? was found under the bark of a dead tree. Most of the species of this genus burrow in the sap-wood a little beneath the bark, and usually attack trees only of an impaired vitality.

Hadrobregmus foveatus has been found not very abundantly, not only in logs and in stripped and piled bark, but also within the bark of large healthy trees (Packard). It belongs to the destructive family of *Ptinidæ*, which contains a large number of species, mostly of small size, and of injurious habits, although more generally living in vegetable matter in an incipient stage of decay.

Orthosoma brunneum is a common and well-known longicorn beetle, of a large size, the larva of which sometimes measures two inches in length. It is a member of the extensive family of *Cerambycidæ*, consisting of an immense number of species — some of remarkable size and great beauty. Their larvæ subsist exclusively on the woody parts of plants, within the trunks, branches and roots of trees. *O. brunneum* is generally distributed over the Atlantic States, but fortunately its attack is usually confined to dead or dying trees, unlike a closely allied species formerly embraced in the same genus with it, viz., *Prionus laticollis*, which, at times and in certain localities, is very destructive to grape vines and apple and pear trees, which it kills by burrowing into their roots.

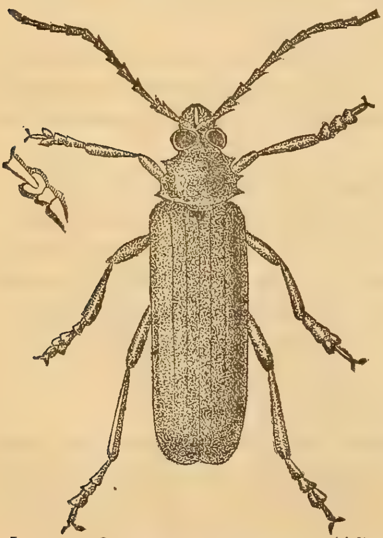

FIG. 3. — ORTHOSOMA BRUNNEUM. (After Emmons.)

O. brunneum is identical with the *cylindricum* of Fabr., the *Pennsylvanicum* of De Geer, the *sulcatum* of Beauvois, and the *unicolor* of Drury, which are redescriptions and renamings of Forster's *brunneum* of 1771. The figure represents an individual of the maximum size, 1.80 inch.; smaller examples measure from 0.90 inch, upward.

Hylotrupes bajulus is another of the *Cerambycidæ*. Dr. Fitch records it among the pine insects, and also as sometimes attacking the hemlock (*loc. cit.*). Dr. Thomas, formerly State Entomologist of Illinois, mentions it as occasionally seriously injurious to hemlock lumber. Dr. Harris represents it as one of the most common of its kind in the vicinity of Boston (*Insects Injurious to Vegetation*, page 100, plate 2, fig. 12). Kirby and Spence state of it that the grubs greatly injure the wood-work of houses in London — piercing the rafters of the roofs in every direction, and when arrived at maturity, even penetrating through sheets of lead which covered the place of their exit. It has probably been introduced in this country from Europe, as it is met with more abundantly near the sea-board.

Callidium sp? belongs to the same tribe with the preceding, and is of similar habits. The extent of its injuries is not recorded.

Leptura Canadensis has been taken from hemlock stumps in the Adirondack mountains. It is probably seldom injurious to living trees. I have found the beetle common on blossoms of the golden-rod (*Solidago*) at Long lake in the Adirondacks, in August.

Fig. 4.—Larva of a longicorn beetle from under hemlock bark.

The two longicorn borers, of which the species were not identified occurred in the bark of fallen hemlock. The smaller one (Figure 4) resembled the larva of the common longicorn pine-borer, *Monohammus confusor* (Kirby)— the most pernicious of the pine-borers. The figures are from the *Third Report of the U. S. Entomological Commission*, pl. xii., one of two plates prepared to illustrate, by enlargements and details of structure, a paper by Dr. A. S. Packard entitled "Descriptions of the Larvæ of Injurious Forest Insects."

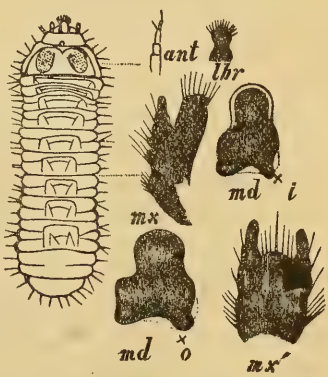

Fig. 5.—Larva of a longicorn beetle from under hemlock bark with enlargement of mouth parts.

Nyctobates Pennsylvanicus is one of the *Tenebrionidæ*, or "ground beetles." Its pupæ were found by Mr. Schaupp, on July eighteenth, in hemlock. It probably will not prove to be a destructive species, as the group to which it belongs have their habitat under dead bark.

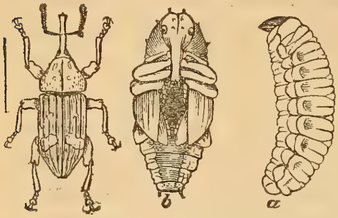

Fig. 6.—The white-pine weevil, Pissodes strobi; *a*, its larva; *b*, the pupa.

Pissodes strobi is the notorious white-pine weevil, the larvæ of which inflict such serious injuries on young pines by infesting and destroying the topmost shoot, checking its upward growth and causing an unsightly bend at this point, as future upward growth can be continued only through one of the lateral shoots. The beauty of the trees and their value for commercial purposes are thereby greatly impaired. The operations of this beetle do not, however, prove as serious to the hemlock as to the pine, seldom producing deformation in it.

In the Annual Report of the United States Department of Agriculture for 1885, plate ix, from which the figures illustrating this insect and its operations are taken, also gives representations of remarkable deformations produced in white pines through the customary destruction of the terminal shoots by this insect attack. Figure 6 shows the beetle, its larva and the pupa. In Figure 7, the larval burrows in the sap-wood and in the heart-wood are represented at *a;* and in *b* the pupa-cases or cocoons beneath the bark removed, and the interior burrows in the heart-wood, are shown.

Crypturgus atomus, the smallest known beetle among the Scolytid beetles, was found by Dr. Packard in considerable numbers in and under the bark of standing dead hemlocks in Maine. It has also been observed in the same situation in pines, in Canada, New York and Massachusetts. It is especially destructive to spruces, as it burrows the bark irregularly, and not in the plane of the sap-wood. Its galleries are very numerous, a great many being contained within a square inch of extent.

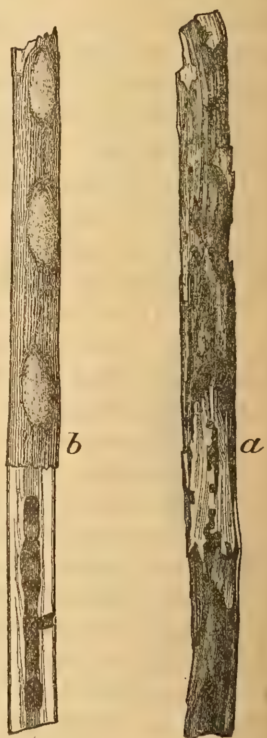

Fig. 7.—Twigs showing burrows and cocoons of Pissodes strobi.

Of the two Hemipterous insects recorded as infesting the hemlock (there are probably several other species of the order which have been overlooked up to the present), one is the seventeen-year cicada (commonly, but improperly, called locust), *Cicada septendecim.* Its injuries are inflicted by the female boring into the twigs for the deposit of its eggs. It has not been observed to oviposit in pines (1*st Rept. Ins. Mo.*, p. 24). The other, *Lioderma ligata,* or the bound tree-bug, so named from the red band surrounding its margin, is represented by Dr. Fitch, as "sometimes clinging on this tree, and probably sucking the juices of the leaves." It may not, however, be accepted as an injurious species without further observation of its habits, as several of its near relatives are known to subsist upon the juices of other insects which infest our trees. Dr. Fitch, in his 3d Report, page 71, No. 100, includes this insect, under the name of *Pentatoma ligata,* among those which affect the leaves of grapes by puncturing them and sucking their juices. It is shown in Figure 8.

Fig. 8—The bound tree-bug, Lioderma ligata (After Glover).

Of the Orthoptera, the Rocky Mountain locust, *Caloptenus spretus* (Figure 9), according to Prof. Riley, in periods of its abundance, often strips the leaves of the hemlock, arbor-vitæ, the pines, and the Norway spruce. The injury to these evergreens is serious, as they are much more sensitive to defoliation than deciduous trees. (*First Report U. S. Entomological Commission,* p. 253.)

Fig. 9.—The Rocky Mountain Locust. Caloptenus spretus—Female.

Several of the insects noticed above are believed either to attack only sickly or diseased trees, or those already dead, yet their operations and their history may be quite as important and as deserving of observation and study as those which confine their attacks to living and healthy vegetation. This view of the comparative importance of the two classes has been so ably presented by Dr. Asa Fitch, that we quote from his *Fourth Report on the Insects of New York* (1859, pp. 2, 3), a portion of his remarks prefatory to his consideration of the Insects Infesting Evergreen Forest Trees :

"The evergreens are so highly esteemed for ornamental purposes, and some of them, particularly the pines, are so valuable on account of the timber that they yield us, that we are much interested in knowing the insects which we have in this country, which infest these trees to their injury, either by stunting their growth, marring and deforming them, or causing their premature decay and death. Fortunately for us, it is upon trees that are sickly and decaying, or upon their dead trunks and timber, that most of these insects make their attack. Such insects are currently regarded as being of but little importance, those only which are the source of the evil, which prey upon trees which are healthy and in full vigor, causing them to become sickly and decrepit, being deemed of a character so pernicious as to merit special observation. And yet those insects which only invade dead trees and their timber, are at times occasioning serious losses, showing that they are far from being such trivial evils as we are accustomed to deem them. While this Report is in course of preparation, a casualty occurs in our midst, which furnishes a forcible illustration of the truth of this statement. I allude to the breaking of a railroad bridge over the Sauquoit creek, near Utica, on the morning of May 11, 1858, by which frightful disaster eight persons lost their lives and upwards of fifty others were maimed or injured more or less severely. We are informed by the Utica Morning Herald, in an article prepared immediately after the writer had visited the scene of the catastrophe, that the principal timbers of the bridge, though externally perfectly sound in their appearance, were profusely perforated with minute worm holes, whilst all the interior was so decayed and rotten that the slightest force sufficed to break it into fragments. This fully explains why a structure which had been so recently erected that no suspicions could be reasonably entertained of its being in the least defective and unsafe, was yet in reality fearfully so. Some one of these minute timber-beetles which subsist upon the wood of dead trees, had here its abode, multitudes of them probably mining their burrows everywhere through the interior, as is their habit, and then eating their way out to found new colonies elsewhere. As the little pin-holes which they perforate scarcely diminish the strength of the timber in the heart, they are deemed of no consequence. And yet from every shower that passes, water is admitted through these perforations to the interior of the timber, filling the multitude of little cells which these insects have there excavated, and saturating the wood as though it were a sponge. The outer surface being exposed to the atmosphere speedily dries and thus remains perfectly sound, whilst the interior continuing damp for several days, rapidly though insiduously decays. Thus the sad disaster to which we have alluded, and the destruction of property and loss of life with which it was attended, there can scarcely be a doubt, was caused by one of those minute insects, which are popularly regarded as being of trifling consequence, since they never attack living trees."

The Chalcid Parasites of Cecidomyia Betulæ Winn.

From some galls of the above species of the transformed seeds of the catkins of white birch, *Betula alba*, received from Mr. Peter Inchbald, of Fulwith Grange, Harrogate, England, three species of Chalcid parasites were obtained, which, being submitted to Mr. Howard of the Agricultural Department at Washington, were determined, generically, as *Torymus* sp., ♀, *Tetrastichus* sp., and *Entedon* sp. — one female and five males. The galls were kindly sent that they might give me their Cecidomyian inmate for comparison with our native species, but not a single one was disclosed. The parasites emerged during April sixteenth to April twenty-seventh.

Some infested catkins, which had been collected by me during the month of October 1886, also failed to give any of the producing insects, probably from having been deprived of moisture during the winter and spring, as Mr. Inchbald has stated in his letter to me, that they require moisture for their development and need to be sprinkled with water occasionally. Some galls, gathered in Albany on March twenty-first, which had begun to disclose their imagines on May fifth, also gave out quite a number of Chalcid parasites, the first of which made their appearance on April twenty-eighth. Others emerged about the middle of May, and continued to appear until the twenty-fifth of June — the last date recorded. They were quite numerous. As it would be of no little interest to compare these with the European parasites above noticed, they were also sent to Mr. Howard for his examination, who returned the following answer:

"They are different from those bred from the English specimens. It will probably be necessary to found a new genus of the *Pteromalinæ* for them. In some characters they come close to *Merisus*, of which Professor Riley has bred and described two species from *Cecidomyia destructor* [*Proc. U. S. National Museum*, viii, 1885, pp. 413, 416] but the metanotal and claval characters separate them from this genus."

Isosoma hordei (Harris).

The Joint-worm Fly.

(Ord. Hymenoptera: Fam. Chalcididæ.)

Harris: in New Eng. Farmer, ix, July 23, 1830, No. 1, p. 2 (original description); Treat. Ins. New Eng., 1852, p. 441; Ins. Inj. Veg., 1862, pp. 551–561 (as *Eurytoma h.*); Ent. Corr., 1869, p. 361 (*Ichneumon h.*).

Fitch: in Trans. N. Y. St. Agricul. Soc., xxi, 1862, pp. 830–851; 7th Rept. (in 6th–9th Repts.) Ins. N. Y., 1865, pp. 144–165, pl. 1, fig. 1 (as *Eurytoma tritici*, *E. hordei*, and *E. secalis*).

Walsh: in Pract. Ent., i, 1865, pp. 10-12, p. 37-8 (what it is); Amer. Ent., ii, 1870, p. 329-30, figs. 3, 4 (referred to *Isosoma*).

Walsh-Riley: in Amer. Ent., i, 1869, pp. 149-158 (figures, nat. hist., parasites, varieties, etc.).

Bethune: in Ann. Rept. Ent. Soc. Ont., for 1871, pp. 59-61, figs. 58, 59.

Lintner: in Count. Gent., xxxix, 1874, p. 584 (mode of attack); id., xlix, 1884, p. 857 (as *Isosoma tritici*).

Packard: in 9th Rept. U. S. G.-G. Surv. Terr., 1877, pp. 693-695.

Cook: in Rural N. Yorker, xliv, May 9, 1885, p. 314 (as *I. nigrum* n. sp.); in Amer. Nat., xix, 1885, pp. 804-808 (as *I. ? nigrum*).

Riley: in Rur. N. Yorker, xliv, June 20, 1885, p. 418, fig. 215 (in Ohio); in Rept. Commis. Agricul., for 1886, pp. 539-542; in Encyc. Brit., Amer. Edit.—Agriculture, page 139, fig. 18.

Comstock: in Count. Gent., lii, 1887, p. 529 (life-history, remedies, etc.).

Pieces of wheat straw showing insect attack, were received from Mr. C. H. Boyd, of Johnson's Creek, Niagara county, N. Y., on September fifth. They had been taken from a mow as a sample of much of the straw in it. The attack was new to those to whom it had been shown, and it was learned that it was quite common throughout Niagara county.

The straw contained the larvæ, apparently about full-grown of the joint-worm fly, *Isosoma hordei*. The larvæ were small, about one-tenth of an inch long, footless, of a yellowish-white color, and embedded in elongate cavities in the stalk near one of the lower joints, converting that portion into a hard, woody substance. Their location within could be detected by a smooth, elongated, and more or less swollen portion of the stalk immediately over them, appearing as if slightly blistered.

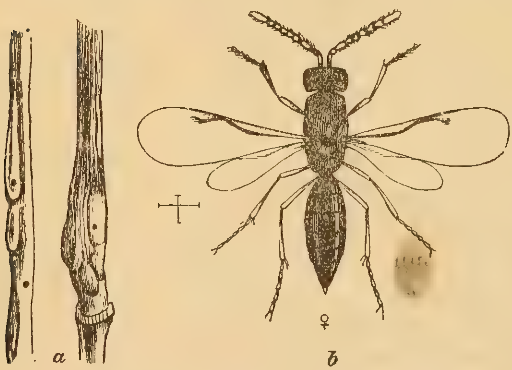

Fig. 10.—The Joint-worm Fly, Isosoma hordei, and its galls.

Sometimes these swellings are larger, more prominent and gall-like, as in the pieces of straw illustrated in Figure 10, at *a*, in their natural size. The perfect insect that emerges from them through the small round hole shown in some of the galls, is represented in enlargement at *b*.

In the portion of the plant infested, and also occasionally, in the deformation, swelling, and bending over of the stalk, the joint-worm attack resembles that of the Hessian fly, *Cecidomyia destructor* — a more common and better known insect. The two, however, need not be confounded.

While the joint-worm is imbedded *within* the straw, the larva of the Hessian fly invariably lives *outside* of it, between the straw and the sheath, at the joint. The "flaxseeds" which are found in this position are the larvæ of the Hessian fly transformed into pupæ, and are unfortunately, too familiar to many of our farmers.

Joint-worm Injuries.

It is a destructive insect, not only to wheat but also to rye and barley. A few years prior to 1829 and 1830, when the first notices were published of it, it had proved so injurious to barley in some portions of Massachusetts as to compel the abandonment of the cultivation of that crop. Many fields failed to yield the amount of seed sown. Dr. Harris described the new insect, in 1830, and named it from the plant on which it occurred, *hordeum* being the Latin name for barley.

Its Further History.

Its early history is detailed in Harris' "Treatise on Insects Injurious to Vegetation," pp. 551–561. Its ravages did not long continue in Massachusetts, for after the year 1831 it ceased to attract particular attention. Later, it became destructive in Virginia, where it occasioned such serious losses that, in 1854, a "joint-worm convention" was held at Warrenton, to discuss the insect and learn the best remedies that could be employed against it.

In 1852, it was observed in some of the central counties of the State of New York, when it was brought to the notice of Dr. Fitch, Entomologist of the N. Y. State Agricultural Society, who gave it careful study, and in 1859, from variations in colors of specimens examined, named and described as new species, *Eurytoma tritici* and *Eurytoma fulvipes* — the first from wheat, the other from barley. Later, from specimens infesting rye in Eastern Pennsylvania, he described *Eurytoma secalis.* But each of the above three (for an account of which see his *Seventh Report on the Insects of New York*, published in the *Transactions of the N. Y. State Agricultural Society*, vol. xxi., 1862, pp. 830–851) have been pronounced only colorational varieties of *Isosoma hordei* (Harris).* See Walsh-Riley in *American Entomologist*, i, pp. 152-153.

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* If the antennal features of the "yellow-legged barley-fly," *Eurytoma fulvipes*, have been correctly given by Dr. Fitch, namely: In the male "the antennæ are thread-like or of equal thickness through their whole length, and thinly bearded with short robust bristles," whereas, in *Isosoma hordei*, "the joints are surrounded by whorls of hairs" — then *Isosoma fulvipes* will be entitled to retain its designation as a valid species. It does not appear that it has been observed since its description."

Within a few years, after a long cessation, apparently, of its depredations among us, this insect has again appeared, resumed its destructive work, and caused attention to be drawn to it.

In the year 1884, it was observed to abound to a considerable extent in portions of Ohio, in wheat straw that was being threshed.

Recent Attacks in New York.

In the autumn of 1884, examples of infested straw and injured wheat grown thereon, were received from the farm of Mr. Robert J. Swan, of Geneva, N. Y. The injury committed had been severe, involving, it was stated, nearly a total loss of the crop. Large numbers of the larvæ were found imbedded in the straw near the lower joint — eleven in one piece of an inch and three-fourths in length; and of the wheat, only about one per cent of the kernels was fully developed — a large proportion of the grains being shrivelled, and nearly one-half were so light in weight as to float when dropped in a glass of water. If the sample sent was a fair representation of the infested field, it would appear to have fallen from sixty to seventy-five per cent below its normal yield.

From an examination of the straw and the contained larvæ, the insect, in this case, was believed to be identical with *Isosoma tritici*, which had been discovered in wheat in Illinois, in 1880, and was so named and described by Professor Riley in the *American Naturalist* for March, 1882. A notice of the attack by the above named insect, as new to the State of New York, was communicated by me to Dr. Sturtevant, of the N. Y. State Agricultural Experimental Station, and published as Bulletin No. C [100] of the Station. When, in the following spring, examples of the perfect insect emerged from the straw, they proved to be, not the species supposed, but our old acquaintance, *Isosoma hordei*.

In 1886, the insect occurred abundantly in the vicinity of Ithaca, Chemung Co., N. Y. Some straw that was being used for making paper at the paper mill in Ithaca, was found to be unsuitable for the purpose, from the woody nature of some portions of it. On examination at the mill, small insects were discovered in these woody pieces, which, being submitted to Professor Comstock, of Cornell University, were readily identified by him, as the joint-worm, *Isosoma hordei*. About one straw in twenty-five was infested.

How it may be Discovered.

When the insect abounds in the straw, and many are contained in a single stem, they frequently cause the stalk to curl and bend over at the infested point; but often the external appearance is unaltered, except to careful and intelligent observation. The presence of the insect has in several instances first been detected at the time of threshing, when many of the hardened and wooden portions of the straw containing the larvæ, in pieces measuring from a half-inch to three inches in length, are broken off, and by their weight are carried from the threshing machine with the grain.

The Fly Seldom Seen.

The winged insect into which the joint-worm develops, is so small and delicately formed (being but about one-eighth of an inch in length) that it would probably escape notice, unless it be sought for by inclosing some of the infested pieces of wheat straw which has had its ordinary winter exposure, in a tight box or jar, about the middle of May. During the latter part of the month the imprisoned insect, having attained its maturity, will eat a small round hole outward from its cell, and emerge as a shining black little creature with four transparent, almost veinless wings, and with legs entirely black or having more or less yellow on them. Dr. Fitch compares it in general appearance to a small ant. Figure 11 represents the male and female "fly," with enlargements of the abdomen and antenna, which differ so conspicuously as readily to indicate the sex.

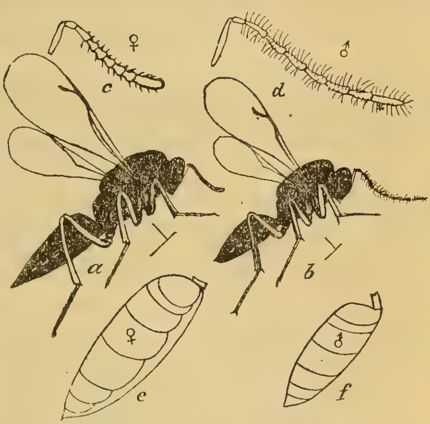

FIG. 11.—Male and female of ISOSOMA HORDEI.

What the Insect is.

It belongs to the order of Hymenoptera, of which are the bees, wasps, ichneumon flies, etc., and to the family of *Chalcididæ.* The species of this group are very numerous — perhaps a thousand existing in this country alone. They are minute forms, and usually occur as parasites, living, in their earlier stages, within the bodies of other insects, and the family is, therefore, regarded as holding high rank among our beneficial insects. The genus *Isosoma,* however, is an exception, as its members are vegetable feeders, living upon growing plants and often producing galls in them.

Reasoning from its family relationship, which, as a rule in the insect world, is attended with a general uniformity in habits, both Drs. Harris and Fitch, for some time during their simultaneous study of *Isosoma hordei* (referred by them to the parasitic genus *Eurytoma*), were of the belief that it must necessarily be parasitic, and that its occurrence within the straw was that of a destroyer of the real cause of the injury, which they supposed to be a dipterous insect — a *Cecidomyia*, allied to the Hessian fly.

The parasitism of *Isosoma* is not yet entirely removed from the sphere of discussion and doubt, for although it may be claimed as effectually disproved by recent observations upon its actual oviposition, it is still maintained by eminent European writers.

Other Species of Isosoma.

The associates in the genus of the joint-worm fly are not numerous. The following have been described:

Isosoma tritici, described by Professor Riley, in 1882,* from specimens obtained in Illinois and other Western States, and found feeding singly within the upper joints of wheat. In some publications it has been named the "wingless joint-worm fly," as nearly all the examples are without wings, or having them greatly aborted. This species should not be confounded with *Eurytoma tritici* of the Fitch Reports (vii, pp. 144–155 of vi–ix), which has been referred to *I. hordei*, as before stated.

Isosoma grande Riley, † named the "larger wheat fly," as it is a larger and stouter form than its congenors. Its habits and general features are so much like those of *I. tritici* that it is thought it may prove, upon further study, to be but a dimorphic form of that species. In its original description, in the Report of the Department of Agriculture for 1884, page 358, it is described by comparison with *I. tritici*, from which its principal differences may be seen. No males have yet been found of either. Figure 12 is a representation of *I. grande*, much enlarged.

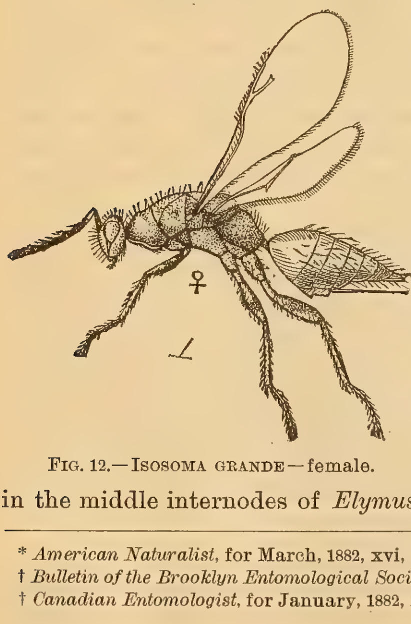

FIG. 12.—ISOSOMA GRANDE—female.

Isosoma elymi French,§ feeding in the middle internodes of *Elymus Canadensis* — a perennial grass of

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* *American Naturalist*, for March, 1882, xvi, p. 248.

† *Bulletin of the Brooklyn Entomological Society*, for December, 1884, vii, p. 111.

‡ *Canadian Entomologist*, for January, 1882, xiv, p. 10.

river banks, meadows, and rich shaded woods of the Southern and Western States, and sometimes known as "wild rye."

Isosoma vitis Saunders,* known as the "grape-seed insect," the larva of which, represented in natural size and in enlargement in Figure 13, feeds within the seeds of grapes before the ripening, causing the fruit to shrivel and fail of maturing.

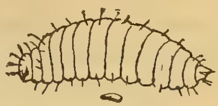

Fig. 13.—Larva of the grape-seed midge, Isosoma vitis.

Remedies.

It is fortunate that we have at our command means for controlling the depredations of this insect, which are simple, easy, and inexpensive.

Since its entire life, from its hatching to its emerging in its perfect state, is passed within the straw and in quite a limited locality therein, it is evident that if the straw be destroyed by burning, or by any other as effectual a method, at any time prior to the emerging of the winged insect, the entire brood will be destroyed with it.

If the grain is not cut unusually close, a large proportion of the larvæ will be left in the stubble. The stubble of an infested field should be burned over at any convenient time favorable for the burning. There is not the objection to this expedient in this case, that may properly be urged against burning for the Hessian fly — that it destroys the many parasites which render such excellent service in reducing its numbers — for the known parasites of the joint-worm are but few, and thus far they have proved of but little value in its reduction. Dr. Harris has justly remarked: "We need not be restrained by the consideration that the diseased straw contains also some truly parasitical larvæ; for these are very few in number compared with the immense swarms of the *Eurytoma* [*Isosoma*] that are annually produced. If we can succeed in exterminating these destroyers, we shall have no occasion for the services of the parasites." In figure 14, its principal parasite, *Semiotellus chalcidiphagus* Walsh, is figured in both sexes. *Eupelmus Allynii* (French) is also parasitic upon it, but to a much more limited extent.

Fig. 14.—Joint-worm Parasite, Semiotellus chalcidiphagus — female and male.

It is believed that a *deep* plowing under of the infested stubble

* *Canadian Entomologist*, ii, 1869, pp. 25–27. *Country Gentleman*, for September 21, 1876, xli, p. 599. *Entomological Contributions*, iv [Lintner] 1878, pp. 24–28.

would be fatal to the contained larvæ, and almost as effective as burning. An *ordinary* plowing was found ineffective in Massachusetts, as the insects having only been buried to a moderate depth, completed their transformations and made their way to the surface.

The broken-off, hardened pieces of the straw, observed as before stated in threshing and cleaning, should be carefully collected and burned. The grain should also be examined for these pieces and picked out by hand.

Examination should be made of the threshed straw, and if the larvæ are found therein, it should be destroyed, either by feeding or some other consumption of it, before the ensuing spring. Dr. Harris records an instance where so many of the insects infested a straw-bed in Cambridge, Mass., that they proved troublesome to children sleeping in the bed — their bites or stings being followed by considerable inflammation and irritation, which lasted several days. So numerous were they, that it was found necessary to empty the bed-tick and burn the straw.

Another Species Associated with I. hordei.

This report not having been published in compliance with the law that requires the printing and presentation to the Legislature on or before the first day of February of each year of all State Reports — the delay in its appearance has permitted the addition of the following note:

The attack on the wheat straw noticed on page 148, and there identified, from the appearance of the larvæ and characters of their cells, as that of *Isosoma hordei*, proves not to have been confined to that species.

During the month of March, 1888, from some infested wheat straw received from Mr. Boyd, on December 14, 1887 (a second sending), which had subsequently been kept in a jelly glass, forty specimens of Isosomas emerged. Of these, nine examples were characteristic *Isosoma hordei* — one male and eight females. The others were evidently a different species, as they were of a larger size in both sexes, — the abdomen of the female distinctly angulated at the base of the ovipositor, and prolonged conically in an acute point, and with the veins of the anterior wings whitish, instead of black as in *I. hordei*. Nine of these were males (in some of the species of Isosoma the male, as before stated, is not known), and twenty-two females.

The Associated Species is Isosoma captivum.

On submitting examples of the above to Professor Riley, they were recognized as a species which had been collected abundantly in Illinois and Indiana in sweeping with a net in fields of blue grass, timothy, and rye, but had not been reared from its food-plant. Professor Riley has given it the manuscript name of *Isosoma captivum* and will shortly give description and illustration of it.

From the straw received from Mr. Boyd in September of 1887, and kept during the winter in a paper box, none of the insects were obtained. A few of the cells — less than a half-dozen, had given out the imago, but they had escaped from the box. The larger number of the cells show at the present time, invariably at the upper end, the black head of the dead insect within the open round hole that had been eaten for its escape; in the remainder, a blackish spot indicates the head beneath the thin film of straw covering it. The death of nearly all the insects was doubtless the consequence of the straw having been kept for three months longer than in the other instance, within a warm room. The straw was badly infested. In one piece — within two inches of the joint, eleven cells were counted — six open and five closed.*

No parasites were obtained from the straw.

Thalessa lunator (Fabr.).

The Lunated Long-Sting.

(Ord. Hymenoptera: Fam. Ichneumonidæ.)

Ichneumon lunator Fabricius: Spec. Ins., i, 1781, p. 430, No. 64; Mant. Ins., i, 1787, p. 266, No. 76; "Ent. Syst., ii, p. 162."

Pimpla lunator Harris: Treat. Ins. N. Engl., 1852, p. 427; Ins. Inj. Veg., 1862, p. 538, fig. 251 (reference to).

" " Glover: in Rept. Com. Agri. for 1866, p. 41 (brief mention).

" " Walsh–Riley: in Amer. Entomol., i, 1868, p. 59; id., ii, 1870, p. 96 (as *Rhyssa*.)

Rhyssa " Packard: Guide Stud. Ins., 1869, p. 196, fig. 128, of male.

Thalessa " Cresson: in Trans. Am. Ent. Soc., iii, 1879, p. 169; Synop. Hymenop. N. A., 1887, p. 215 (in list).

Rhyssa " Quay: in Amer. Entomol., iii, 1880, p. 219 (oviposition).

" " Fletcher: in 11th Rept. Ent. Soc. Ont. for 1880, p. 67 (brief notice).

" " Harrington: in Canad. Entomol., xiv, 1882, p. 82; the same in 13th Rept. Ent. Soc. Ont. for 1882, pp. 23–25.

" " Clarkson: in Canad. Entomol., xiv, 1882, p. 223; in Bull. Brook. Entomolog. Soc., vii, 1885, p. 124 (oviposition).

" " Riley: in Science, iv, 1884, p. 486 (not lignivorous); in Bull, Brook. Entomolog. Soc., vii, 1885, p. 123.

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* These were subsequently opened with a knife and a perfect imago removed from each, three only of which were males; all were *Isosoma captivum*.

Pimpla lunator Gade: in Bull. Brook. Ent. Soc., vii, 1884, pp. 103–4 (sexual attraction and oviposition); in Science, 1884, No. 92, p. v.
Thalessa " Lintner: in Count. Gent., xlix, 1884, p. 331 (general notice).
Rhyssa " Smith: in Bull. Brook. Entomolog. Soc., vii, 1884, p. 125 (remarks on oviposition).

The singular appearance presented by this large Ichneumon fly, in its long extended ovipositor and lateral guides proceeding from the end of its abdomen, looking, particularly when in flight, as if some thread or other fibre had become accidentally fastened to it, never fails to excite curiosity, and often is the occasion of its being brought to the entomologist as a supposed rare insect.

It is a common insect in the State of New York, and in other of the northern states, and extends over a large portion of the United States.

A living example of it was received from Augusta, Georgia, taken on April 1, with its ovipositor inserted in a shade tree, from which it could with difficulty be drawn. Numbers of it had been noticed the preceding year, when they occurred somewhat later, and continued for about ten days or two weeks. The date of the capture of the specimen would seem to be an unusually early one, even for the southern states, and the present record is therefore made of it.

It is not unusual to meet with this insect fastened by its ovipositor to the tree so firmly that it is not able to disengage itself. Numbers of dead individuals have been seen suspended in this manner from a single tree. The insect has occasionally been met with while engaged in ovipositing, in remarkable abundance. In one instance recorded, "the bark of a large tree from which the top had been broken, was dotted all over with *lunators*, often massed in rows or patches, so that there must have been several hundreds present." A few males (usually quite rare) were among the number. Figure 15, is an indifferent representation of the male, but it will serve to show the long and slender form of the abdomen, which is flattened above, and black, without the yellow bands that characterize the female.

Fig. 15.— Thalessa lunator — male.

Its Different Names.

This curious insect, one of the largest of our Ichneumons, originally described by Fabricius as *Ichneumon lunator,* is figured and briefly referred to by Dr. Harris, in his *Insects Injurious to Vegetation,* as *Pimpla lunator.* Later writers have referred it to the genus *Rhyssa,* but Mr. Cresson, in his recent arrangement of the group, has separated it from that genus and placed it in *Thalessa,* of Holmgren, together with four other United States species, one of which is the common "black long-sting," or *T. atrata.* The specific name of *lunator* is drawn from the yellow crescents (shown angular in the figure) which mark the sides of the abdomen, one upon each segment.

Description.

The insect has been described by Mr. Harrington (*loc. cit.*) as varying much in size, the larger specimens being fully twice as large as the smallest ones. The body varies in length from three-fourths of an inch to one inch and a half, and bears at its posterior extremity an ovipositor projecting from one and one-half to three and three-fourths inches.

The head of the female is yellow, with a dark band on its summit, in which are inserted the three ocelli between the eyes, parallel to which and posterior to it runs another dark line which almost encircles the head; lines also run from the base of the antennæ to the mandibles. The slender antennæ are dark brown, many jointed, and about an inch long. The thorax and abdomen are dark brown, ornamented with lines and bands of yellow, which is also the color of the legs. The abdomen is gradually flattened laterally toward its extremity, where it is broadly dilated. The front wings expand from one and one-quarter to two and one-half inches, and have a quadrangular dark patch on the anterior border, and a brown patch at their tip. The black ovipositor, given out from the fifth segment beneath, varies in different sized individuals, from one and one-half to three and three-fourths inches in length, and is flattened on its sides. Its two guides of nearly the same length and proceeding from the extremity of the abdomen are broader, and are channeled for the reception of the ovipositor and for holding it when serving as supports.

Is not Injurious, but Beneficial.

Contrary to the belief of many of those who have seen the operations of this insect and who entertain the opinion that all of the boring insects are harmful to the vegetation that they attack, this one is not only not injurious, but it renders excellent service in the destruction of a noted pest of several of our shade trees. It is from its large size and peculiar appearance, a distinguished member of the large family of *Ichneumonidæ*, the province of whose members it is to prey upon other insects, often so effectively as to rid us of some of our greatest insect scourges, when all human efforts to arrest their multiplication and injuries have been of no avail.

It Preys upon Tremex columba.

The trees in which *T. lunator* is often seen inserting its long ovipositor for the deposit of its eggs, are largely infested by the grubs of the pigeon Tremex, *Tremex columba* Linn., upon which the larva of *T. lunator*, preys. The perfect insect is a large, wasp-like creature, as shown in Figure 16, with narrow, semi-transparent, smoky-brown wings, a reddish head and thorax, and a long, cylindrical, black body, marked with seven yellow bands, most of which are interrupted on the middle. The body bears beneath a black ovipositor of about an inch in length, projecting three-eighths of an inch beyond its tip, held in place by two guides — the whole forming a stout, horn-like instrument, whence we have the common name of "horn-tails" for this insect and its associate *Uroceridæ*. The Tremex larvæ run their large and destructive burrows in the trunks of the maple, beech, elm, oak, sycamore, apple, pear, etc., not infrequently causing the death of the tree when the attack has been long continued.

Fig. 16.—The Pigeon Tremex — Tremex columba,—female.

How Thalessa Oviposits.

The operation of boring for oviposition has been described by Mr. Harrington, as follows:

Sitting upon the bark where perforations mark the exits of previous occupants, she runs around until she finds a promising spot, as, for instance, the hole made by a Tremex in depositing her eggs. Placing herself so that the tip of the abdomen will be above the orifice to be probed, she makes herself as tall as possible, and, by elevating her abdomen and carrying under the ovipositor, succeeds in inserting the tip of the latter in the hole.

If the dorsal surface of the abdomen be examined, there will be observed, between the sixth and seventh segments, a gap closed by a whitish membrane. This marks an admirable contrivance to enable the insect to use her seemingly unwieldy weapon, for the membrane is so dilatable as to be capable of forming a cavity in the posterior part of the abdomen, in which can be coiled a large portion (more than one-third) of the ovipositor, which thus becomes perpendicular under the insect, where it is guided and supported by the sheaths, which bend up in loops over her back. By vigorous muscular contractions of the sac, the delicate ovipositor is slowly forced down the larva's burrow, often to its full extent.

In the accompanying figure, the insect is represented in the attitude above described, with her ovipositor emerging from the lower angle of the end of the abdomen, already thrust some distance into the wood, while held in position, braced and guided by the two stouter guides, which, given out at the upper angle, are curved upward over the abdomen, and downward along its sides.

Fig. 17.—The Lunated Long-sting, Thalessa lunator — female ovipositing.

The above observations of Mr. Harrington, are supplemented by those of Mr. J. Quay (*loc. cit.*), which, from the interest attaching to the operation, we also quote:

I observed that after raising the abdomen as far as possible, the drill was worked forward so as to slightly bend under, giving the insect a purchase on same. Then followed a bearing down motion on the bent tube, curving the end of the abdomen forward and upward, and next forcing the ovipositor, near its attached end, to curve also and pass up through the abdomen and above into a cavity which there opened for its reception. The cavity was inclosed by a membranous sack, capable of great distention, and while the drill was being continually forced up through, it curved about within the sack forming one complete bend of about three-fourths of an inch in diameter, and another partial one. When fully distended the sack was very thin, quite transparent, and seemingly upon the point of bursting apart. But the ovipositor was in this manner brought to the edge of the worm-hole, was slipped in, and thus made to ease away upon the distended sack which by collapsing forced out again the drill by its mere force of contraction, and the coil now soon disappeared.

Another writer has stated: "The long ovipositor is passed between the posterior legs, the abdomen is elevated almost to a right angle with the thorax, and the ovipositor guided by the anterior tarsi is forced with a ramming motion into the wood to the depth of from two to three inches." (Dade.)

Its Eggs Not Placed in Tremex Burrows.

The purpose of the long ovipositor has generally been stated to be for insertion and penetration in the burrow made by the horn-tail borer, the *Tremex columba* above referred to, its extraordinary length (from three to five inches) enabling it to reach the larva of this insect and deposit an egg within it. Although this statement is to be found in all books treating of this insect and its habits, it was a few years ago, for the first time we believe, questioned, by a writer in the *Canadian Entomologist* (vol. xiv, 1882, page 223), Mr. F. Clarkson. This gentleman there asserts that in every instance observed by him, "the ovipositor, instead of penetrating through the burrow of a *Tremex* or other wood-borer, entered through wood that had not been previously attacked." This was shown by repeatedly "cutting off, to the depth of six inches, such portions of the stump as had been attacked, but failing to detect in any of the cuttings either the burrow or larva of *Tremex* or other larva." He suggests that possibly the larva of *Thalessa* that would hatch from the buried egg, may have the power of boring in search of its food.

Does Thalessa Oviposit in Exposed Larvæ?

In a communication made by me to the *Country Gentleman* of July 12, 1883 (page 561), upon "Rhyssa atrata," after noting the above observations of Mr. Clarkson, I wrote as follows:

"The question is therefore raised — are the commonly accepted habits of the 'long-stings' correctly given? Has any one actually seen them in the act of probing the burrows of a *Tremex?* Such an operation has never come under my observation, while probably all field entomologists have repeatedly found them fastened by their ovipositor firmly inserted in apparently solid wood. I recall an instance observed by me several years ago, when what I think must have been *Rhyssa lunator*, was earnestly engaged in placing its eggs in the following singular manner in a colony of a species of *Datana*, feeding upon a branch of hickory: Its ovipositor was bent beneath it, extending between its legs, with its tip projecting in front of its head, enabling it with perfect ease to select one caterpillar after another for the reception of its eggs. Why would not this be a much better method of using the long ovipositor than the one generally ascribed to it? There would certainly be no haphazard work in such oviposition, or any waste of material. In the instance above recorded, each thrust told, as was seen in the well-known alarm-jerk of these larvæ, at once communicated from the victim to the entire group. Unfortunately, the importance of the observation was not known to me at the time, and no further attention was given to it."*

Its Oviposition and Larval Habits.

Professor Riley, referring to my remarks as above published, kindly gave me the following interesting statement of his observations upon the habits of this species, which adds so much to our previous knowledge of the insect, that I take the liberty of inserting his note, written under date of July 15, 1883:

"I have on several occasions had opportunity of closely studying not only the mode of oviposition, but of larval growth of *Rhyssa*. My sketches and notes are at home [written from Boscawen, N. H.], but the salient facts bearing on your question I can give from memory. In all instances, where I have found the female depositing, it has been in trees infested with *Tremex columba,* and I have found her most numerous on badly affected or injured trees, or even on stumps or broken trunks already partly decayed. The instinct to reach the egg or larva of Tremex, so dwelt upon in popular accounts, is imaginary. She bores directly through the outer parts of the tree, and doubtless probes for a burrow; but her egg is consigned anywhere in the burrow; the young larva seeks its prey, and lives and develops without penetrating the body of its victim, but fastened to the exterior. This habit among parasites is much more common than is generally supposed. A great many *Rhyssa* larvæ doubtless perish without finding food, and a great many females die in probing for a burrow, especially when they burrow through wood that is sound and hard."

Other Species of Thalessa.

But three other Thalessas, beyond the two mentioned in the foregoing, are recorded in our lists, viz.: *T. Quebecensis* Prov., from Canada; *T. nitida* Cresson, from Canada and Virginia; and *T. Nortoni* Cresson, from Canada and Colorado. Of the last-named species, described in *Proceed. Entomolog. Soc. of Phila.*, iii, 1864, p. 317, and characterized by its transparent, unspotted wings, the semicircular yellow dorsal spot on the first and second segments, and the large, rounded, yellow spot on the sides of each of the third, fourth and fifth segments — a single example (the only one

*An identical operation of either this species or by the black long-sting, *T. atrata* — judging from the careful description of the insect and its subsequent identification of the form in my collection, has been observed and narrated to me by Mr. J. S. Woodward, Secretary of the New York State Agricultural Society. The ovipositor was extended between the legs, reaching in front of the insect, and was being used on a colony of caterpillars upon a limb, the species of which was not known to the observer.

known to me) was taken by me on August 22, 1883, in the Adirondack mountains, at Elk Lake, Essex county, N. Y.; altitude, 2,000 feet, approximately.

Amphibolips prunus (Walsh).

The Oak-plum Gall Cynips.

(Ord. Hymenoptera: Fam. Cynipidæ.)

Walsh: in Proceed. Ent. Soc. Phila., iii, 1864, p. 639, note.
Walsh–Riley: in Amer. Ent., i, 1869, p. 104, figs. 80, 81 (as *Cynips*).
Ashmead: in Trans. Amer. Ent. Soc., xiv, 1887, p. 130.
Cresson: Synop. Hymenop. N. A., 1887, pp. 175, 178.

Galls of this insect, growing from the cup of an acorn, were sent for name and information, October 26th, by Mr. Augustus Floyd, from Moriches, N. Y., where they have been numerous this year. From ridges within the cup, looking like elongate blisters, and from a rupture or disarrangement of the scales on its outer side opposite to these, it appears that six galls had been attached to the one cup. Five were received, which measured from four-tenths to five-tenths of an inch in diameter, of a dark brown color, and wrinkled like a dried plum, except somewhat finer. They were of a leathery texture, but could be cut through without difficulty, disclosing the suboval, smooth cell within of about one-tenth of an inch in diameter. The first one opened contained a number (perhaps ten) of white larvæ, closely twisted together in a ball, and filling the cell. They were evidently parasitic on the cynips larva, and apparently dipterous. But one other of the galls was opened for examination, and that showed the cynips larva.

The gall was first described by Mr. Walsh, as *Quercus prunus*, in the *Proceedings of the Entomological Society of Philadelphia*, for 1864, from specimens found in August and September, on *Quercus rubra* and *Q. tinctoria*.

In an extended valuable paper on "Galls and their Architects," published in the *American Entomologist* for February, 1869, by the editors, Messrs. Walsh and Riley, this peculiar gall and the insect producing it, are noticed and figured. Their brief account (omitting the scientific description of the insect) and the figures are herewith given.

"The oak-plum gall is remarkable for being the only American gall that is known to grow out of the acorn. It occurs indiscriminately upon black and red oak, reaching maturity in August and September. At that period it is solid but fleshy, and when cut into is a pink color inside, shading into yellow toward the middle. Subsequently, as it dries, it becomes so hard as to be cut with difficulty, its color inside changing first to black-red, and afterward to brown. The insect that produces this gall (*Cynips q. prunus*, new species) makes its appearance in April, and is remarkable for lying two years in the gall before it eats its way out, remaining in the larva state over a year: indeed, some of them remain in the larva state for over two years, and do not eat their way out until the end of the third year. Figure 18, *b*, shows the same gall when cut open, and *c*, the central cell inhabited by the larva."

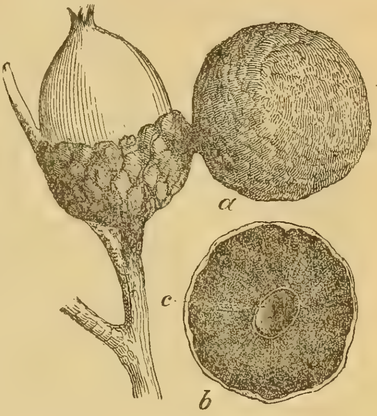

FIG. 18.—The Oak-plum gall of AMPHIBOLIPS PRUNUS.

New Generic Reference.

In Mr. W. H. Ashmead's paper on the "Cynipidous Galls of Florida," giving synopses of the described species of North America (*loc. cit. sup.*), this species is referred to the genus *Amphibolips* of Reinhart (*Berl. Ent. Zeits.*, 1865, 10). This is in conformity with the classification given by Dr. Mayr, in his "Genera der gallenbewohnenden Cynipiden," published in 1881, based on a special study of the European species and a large number of American forms. It has been accepted in the arrangement and nomenclature of the *Cynipidæ* in Mr. Cresson's recent *Synopsis of North American Hymenoptera*.

Description of the Insect.

The insect is shown in Fig. 19, in enlargement. Its head is rough; face pubescent; antennæ exceeding half the length of the body; thorax coarsely punctate with a conspicuous dorsal groove; abdomen, second joint polished with rather large shallow punctures on its basal three-fourths; joints 3–7, densely covered with small confluent punctures, giving a silvery appearance; legs rufous; tips of tarsi black; wings subhyaline; on the front wing, a dark brown cloud extending from the first cross-vein over the upper portion of

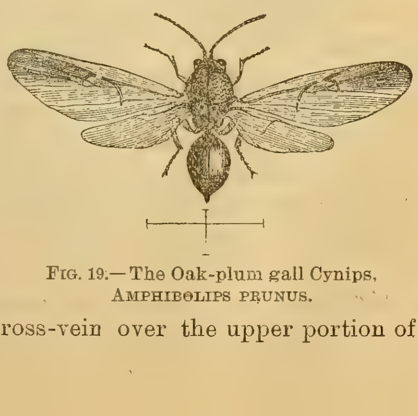
FIG. 19.—The Oak-plum gall Cynips, AMPHIBOLIPS PRUNUS.

the wing to its apex; veins brown. Expanse, 0.47–0.65 in.; length, ♀, 0.20–0.30 in.

For a more detailed description, see *American Entomologist*, vol. i, 1869, p. 104, from which the above is abridged.

A Second Acorn-cup Gall Insect.

Since the publication of the above, as the only American gall that is known to grow out of the acorn, a second species has been described by Professor Riley, as Cynips gall, *Quercus glandulus.* It differs from the above conspicuously, in that the new gall is more or less completely imbedded in the cup. It is a pip-like body, averaging, when well-developed, one-fifth of an inch long by about one-half so broad; its sides are either parallel or slightly bulging, more or less deeply corrugate, and of a whitish-green color. The larva occupies a cell near the flattened or slightly concave nipple-tipped crown. The insect has not been described. The gall occurred in October, at Toughkenamon, Pa., on a shade-tree of *Quercus bicolor* in a pasture. Two-thirds of the acorn cups were affected. (*Transactions St. Louis Academy of Science,* vol. iii, 1887, p. 577–8.)

This species appears to have been overlooked (or perhaps omitted from want of knowledge of the insect) by Mr. Ashmead, in his paper above cited. In the Cresson Synopsis, it stands as *Cynips? glandulosus* Riley.

Aulacomerus lutescens *n. sp.*

The Poplar Saw-fly.

(Ord. Hymenoptera: Fam. Tenthredinidæ.)

Larval Habits.

A number of saw-fly larvæ were discovered in the early part of June on a small poplar, *Populus monilifera,* in my garden, feeding in parallel rows side to side on two leaves, which had apparently been eaten from the tips downward. On the foot-stalk of the leaves the scars of the egg-deposit from which they had been hatched were seen, to the number of thirty in one and twenty-eight in the other. They were probably the oviposition of one female. They fed heartily and rapidly, abandoning one leaf when all but so much of the basal parts as would afford them a convenient footing had been consumed, and then passing to another. Some of the stronger veins were left uneaten. Their social habits continued to maturity, although as they approached this period, they separated into smaller groups, and would at once do so if disturbed by the act of removing some of them from the leaf.

Description of the Larvæ.

When near maturity, they were seven-tenths of an inch long, of an orange-yellow color, with two rows upon the back (subdorsal) of twelve large irregularly rounded black spots, of which the middle ones are the larger, measuring in diameter about one-half the length of the segment. There is also a row on the side (stigmatal) of twelve smaller black spots, of which the two anterior ones are the largest, and semicircular in form. Numerous short white hairs are given out from two transverse rows of tubercles on each segment, the longest of which about equals one-half the diameter of the body. The head is black superiorly and laterally, with a central black spot in front surrounded with brown. The tarsal hooks are brown.

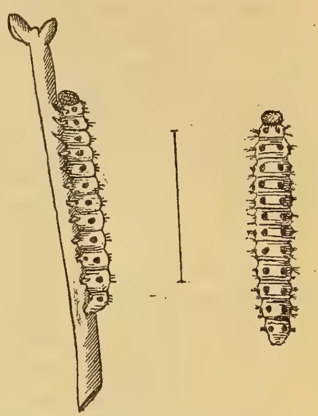

Fig. 20.—Larva of the poplar saw-fly, Aulacomerus lutescens.

Figure 20, shows the larva in a dorsal and in a side view.

On the twenty-fifth of June the larvæ commenced to spin up in irregular shaped cocoons, between the leaves on which they had been feeding. Ground had been given them in which to bury, if so inclined, but it was refused. By the twenty-seventh they had all made their cocoons. The perfect insects emerged July 13–18.

Description of the Saw-Fly.

The following memoranda of the more prominent characters of the saw-fly are hastily drawn up, to serve the purpose of identification, until proper description can be made:

Head, shining black, short, broad, not so wide as the thorax; antennæ brown, the seven long joints are slender, tapering regularly to the last. Thorax black above, yellow laterally and beneath, except posteriorly where it is black. Abdomen yellow, distinctly incised, short, flat, subovoid; legs yellow. Wings yellowish toward the base and particularly on the costa; the stigma large, conspicuous, with a black spot on its base. Expanse, 0.7 inch; length, 0.3 inch.

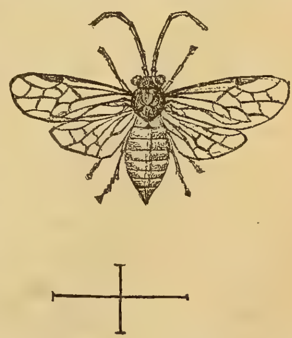

Fig. 21. — The poplar saw-fly, Aulacomerus lutescens, enlarged.

The insect is shown in Figure 21, enlarged to about two diameters.

Its Generic Reference.

The insect was submitted to Mr. E. T. Cresson for identification. It was unknown to him, and had not been described unless it had been given erroneous generic position, possibly with *Nematus*, to which it is closely allied, but differs therefrom by the second submarginal cell receiving both recurrent nervures. It was believed to belong to the genus *Aulacomerus* of Spinola (*Ann. Soc. Ent. France*, ix, 1840, 137), to which only a single North American species has hitherto been referred — *A. ebenus* Cresson, from Colorado, with larva unknown.

A Second Brood Observed.

A second brood of the insect was observed upon the same tree during the month of August. A large number of the foot-stalks of the leaves at this time bore the marks of egg-deposit, in two parallel rows on opposite sides, usually, of a rib on the upper side of the petiole. The rows had apparently been made the one after the other, as they were seldom of equal length, and each, for the most part, having the punctures in a perfectly straight line. The foliage of the tree was so badly eaten, that in order that it might continue to serve as an ornament, it was necessary to pluck off such of the leaves as could be conveniently reached that had been fed upon, of which only the ribs and a basal section remained. Another tree of the same species, which was daily passed by me in one of the streets of Albany, also showed the attack of this saw-fly — first, in the eaten leaves, and on closer observation, the larvæ feeding thereon.

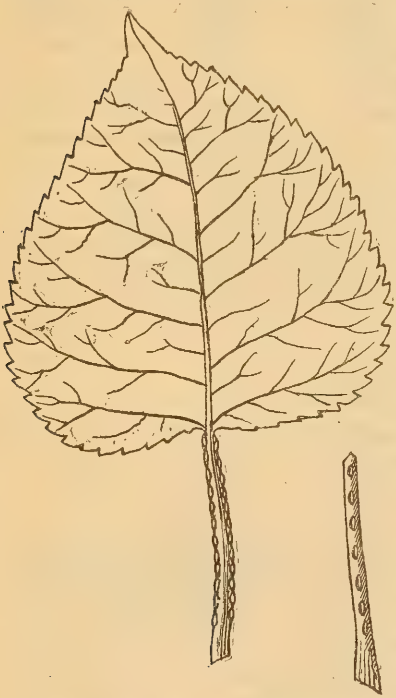

Fig. 22.— Poplar-leaf showing scars made in oviposition by Aulacomerus lutescens, in natural size and in enlargement.

Larvæ of this brood were gathered and fed, but they failed to secure proper care, and none of them, although a few spun up in cocoons, entered into their pupal stage.

Currant Bushes Girdled by an Unknown Insect.

The Attack an Extended one.

Tips of currant bushes, girdled by some insect, were discovered by Professor C. H. Peck, N. Y. State Botanist, in his garden, at Menands, near Albany, during the latter part of May. Examinations in gardens in Albany showed similarly affected tips, and indicated that the attack was somewhat general in this vicinity. In my own garden, a large black currant had many of the fresh, succulent tips girdled in the same manner. Nothing of the kind, so far as could be learned, had been observed before.

Features of the Attack.

The features of the girdling were these: A short distance below one of the larger leaves of a tip, five or six sharp, somewhat curved cuts could be seen, encircling the stalk, and from their depth, nearly severing it, causing the tip to fall over and hang suspended by only some small points of attachment. In some instances, where from the dried condition of the end of the stalk, it was probable that the cutting had been done a few days previously, the tip had broken off and fallen to the ground.

The Insect Unknown.

Effort was made by Professor Peck to discover the author of this new injury, but no insect upon which it could be chargeable was found. It was evidently done during the night, for after removing all the tips that had been cut in this manner late in the afternoon, freshly cut ones would be discovered on the following morning. Two or three species of *Lampyridæ* fell under his suspicion from being the only insects noticed on or about the bushes, but such an operation would be quite at variance with what is known of their habits; and furthermore, no manifestation of the kind was made by the specimens that were brought to me, and tied in gauze upon bushes in my garden.

Compared with the Raspberry-stem Girdling.

This attack is quite distinct from that of the raspberry-stem girdler, *Oberea bimaculata* Oliv., in which there is a double girdling, the one at about one inch from the other, with the egg inserted between the two, and the larva when hatched burrowing downward in the cane. In this there is but one cutting as has been described, nor does the larva burrow and mature within the stalk, for the most careful examination failed to give any indication of egg-deposit or larval presence therein. In all probability, the egg is placed just above the point of girdling. The tip, either from the continuity of the encircling cuts, the action of winds or the vegetal changes that take place at the wounded part, soon falling to the ground, the young larva escapes therefrom and enters the earth. That the food for an insect of the size of one indicated by the cuts made by its mandibles could not be furnished by the excised and soon dried tip of less than a half-dozen inches in length, is evident. It is probable that its food-supply would be found among the roots of the plant.

The Young Insect Seen.

Of a large number of the tips which were dissected in the search for the insect, in a single one, only, was it discovered, as a minute, whitish, oval creature, apparently just from the egg, occupying place very near the point of excision. Its structural characters were too imperfectly developed to admit of its positive reference to any one of the orders, but it was believed to belong to the Hymenoptera. Other tips kept for several days in a moist condition, gave no further developments.

How the Attack may be Determined.

If its habits and food be such as above conjectured, there is but little chance of obtaining the insect by rearing it from the egg, unless with the aid of potted plants kept under observation within doors. A better method of ascertaining the author of this secret attack, would be, to detect it in its work, by seeking it with a lantern at night. Will those whose interest or curiosity may be awakened by the above account, bear in mind the character of the attack, and embrace any opportunity that may be offered in its recurrence to aid us in the effort to obtain the scientific name of the current-stem girdler?

Orgyia leucostigma (*Sm.–Abb.*).

The White-marked Tussock-Moth.

(Ord. Lepidoptera: Fam. Bombycidæ.)

Repetition of the Elm-twig Girdling.

The peculiar form of attack by the caterpillar of this moth, noticed in the *Second Report on the Insects of New York,* 1885, pp. 86–89, figs. 11–15, in which immense numbers of the tips of the elms in the city of Albany, during the summer of 1883, were girdled in the new growth and subsequently fell to the ground, was again

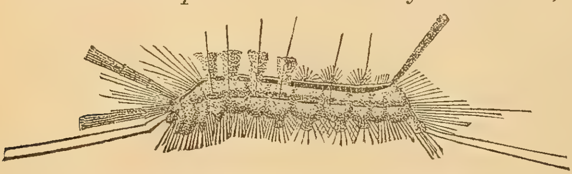

Fig. 23.—The Caterpillar of the White-marked Tussock-moth, Orgyia leucostigma. (After Emmons.)

observed in Albany the present year, 1887, but to a much less extent than before. Early in June individual leaves of elm were picked up from the sidewalks, having their foot-stalk so peculiarly eaten to a point that it at once suggested the former demonstration above mentioned, which had not been observed in the intervening years. The suspicion was confirmed a few days later (June 10th) by the falling of girdled tips in every respect like those of 1883. The fall continued for some time thereafter — perhaps throughout the remainder of the month, but as it was not very abundant, and was only conspicuous in certain localities in the city — the most marked one being in the vicinity of St. Peter's Church, at the intersection of Maiden lane and Chapel street, — no particulars were noted of its extent or continuance. The caterpillar is represented in figure 23.

The Same Observed at Utica, N. Y.

In the first notice of this attack, above cited, it was stated that it had also been observed by me at Troy, N. Y., at the time that it was prevailing at Albany, but had not been reported elsewhere, although it probably extended to other localities where the Orgyia abounded under similar climatic conditions. My only knowledge of its occurrence at other places, is from a communication made to the *Utica Morning Herald,* by Mr. Daniel Batchelor, of that city, in June of 1887. The cutting from the paper is before me, but its date was not preserved. Mr. Batchelor states:

Yesterday, L. B. Root, of New Hartford [six miles west of Utica], informed me that the leaves of an elm tree on his lawn were falling off in showers sufficiently to cover the ground immediately under the tree. On riding into town, Mr. Root had observed an elm on the north-east corner of Genesee and Dakin streets, where the same green shower of leaves was fluttering down. The writer went to the tree, and there saw the fresh, green, glossy leaves fast falling and bestrewing the street about as thickly as do the faded leaves in autumn. The leaves are severed from the twigs about midway of the petioles or stems, a few only being cut off nearer to the axils. The severing is as clean as if done with a razor. Professor Lintner, the State Entomologist, first witnessed the same kind of defoliation of elms in Albany, early in June, about five years ago.

Must the Insect be Renamed?

It is possible that the above attack, together with all that I have hitherto published of the presence and operations of *O. leucostigma* in Albany, may have to be referred to another species. Mr. John B. Smith, of the National Museum at Washington, who is conceded to be excellent authority in the Lepidoptera, and has for a long time been a careful student of the order, having lately seen examples of the moth so labeled in my collection and also taken examples with him for further study and for comparison, has since written to me in relation to them, and pronounced them to be *Orgyia definata* Packard (*Proc. Entomolog. Soc. Phil.*, iii, 1864, p. 332). The question of the correct determination of this very abundant species with us, deserves prompt attention, and I will therefore extract a portion of the letter received from him, as of special interest to Lepidopterists.

The *Orgyia*, as I expected, proves to be *O. definata* Packard. It is certainly a good species, distinct from *O. leucostigma.* The specimens of *leucostigma* in Meske's collection [made largely in the vicinity of Albany, and lately added to the National Museum], also turn out to be, on examination, *O. definata.* It is an interesting question, therefore, whether *O. leucostigma* really occurs near Albany. *O. definata* does not occur in or near New York city, and, so far as I am aware, none of the local collections have it. It occurs again in Maine, but it has probably been so generally confused with *O. leucostigma* that little is recorded of it. The latter I found on Cape Cod in great abundance. It will be a matter of interest, also, to find whether the larva differs. Thaxter has bred it and says that it does.

The following is Dr. Packard's description of *Orgyia definata,* from *loc. cit. sup.:*

Umber-brown; head, thorax, base and inner margin of primaries more testaceous [than in *O. leucostigma, cit. prec.*]. A faint, basal dark straight transverse line. Beyond and near the linear lunate discal spot, which is surrounded by the testaceous brown, is an indistinct nearly straight line. An outer very distinct curved line, being straight on the costa to where it is angulated on the fifth subcostal nervule, and again half-way between the discal spot and internal margin. Beyond this line on the costa is an oblong, dark, well-defined spot succeeded by a submarginal row of dots, ending in a white spot near the internal margin.

Beneath lighter, lines faintly seen beneath, the outer one extending faintly on to the secondaries, which have a discal dot.

The markings are much more distinct in this species than in *O. leucostigma,* while the outer line is angulated nearer the middle.

Length of body, ♀, 0.60; exp. wings, 1.20 inch.

Boston (Sanborn).

The question raised in the above should be satisfactorily decided by observations that can easily be made the coming season.

A Second Brood in New York.

The operations of the second brood of *O. leucostigma* were observed by me in New York city, on the fifteenth of August last. Nearly all of the larvæ had already disappeared, but some not yet full-grown were feeding or wandering about in search of food. Maples in various parts of the city had been badly eaten. A large horse-chestnut at the north-west corner of Second avenue and Twelfth street, had only the principal ribs of the leaves left. The blackened remains, enveloped in the threads of the larvæ which had been spun in their dropping from the branches above, with grains of excrement clinging to them, gave to the tree a more repulsive appearance than any that I had ever seen as the result of insect attack.

Lagoa opercularis (Sm.-Abb.).

The Rabbit Moth.

(Ord. Lepidoptera: Fam. Bombycidæ).

Smith–Abbot: Nat. Hist. Lep. Ins. Geo., 1797, p. 107, pl. 54 (as *Phalœna*).
Morris: Synop. Lepidop. N. A., 1862, p. 257 (descr. of male, from Walker).
Packard: in Proc. Ent. Soc. Phil., iii, 1864, p. 334 (descr. of female).
Walsh: in Amer. Ent., ii, 1869, p. 29 (brief notice).
Harris: Entomolog. Corr., 1869, p. 365—is not *opercularis*, but *crispata*.
Riley: 5th Rept. Ins. Mo., 1873, p. 126 (in list of stinging larvæ); in Amer. Ent., iii, 1880, p. 51 (brief description).
Murtfeldt: in Canad. Ent., viii, 1876, pp. 201-2 (stinging powers).
Hubbard: Ins. Affect. Orange, 1885, pp. 140-1, figs. 57, 58, 59.

An unusually abundant occurrence on an apple tree, of the strange-looking larva of this species, shown in Figure 24, was reported by Mr. C. R. Moore, of Birdsnest, Va. Eighteen were counted on a small tree, which had been almost denuded of its leaves. Of examples sent on the nineteenth of August, two had spun their cocoons when received on the twenty-third.

Fig. 24.—Caterpillar of Lagoa opercularis.

Stinging Power of the Larva.

Mr. Moore gives the following as his experience with the insect: "I find that when the caterpillar crawls over the skin on the back of my hand, that it causes the place to smart considerably for three hours or more, and moisture to exude from the skin."

The irritating powers pertaining to the hairs of this caterpillar have long been known: under rough and incautious handling they may be far more severe than above stated. Miss Murtfeldt has related in the *Canadian Entomologist*, for November, 1876 (viii, 201–2), experiments made by her with one of the larvæ, which she permitted to strike one of her fingers. The slight prick felt was speedily followed by irritation, and later in the day with severe pain, inflammation and swelling of the finger. Soda, ammonia, arnica, camphor, and acids were successively resorted to, but none served to allay the burning pain — as intense as if the finger had been held against glowing coals. A night of sleepless suffering followed, and it was not until the next morning that the pain subsided.

Other Stinging Larvæ.

Experiments, similar to these, made by me upon two other stinging larvæ, viz.: *Hemileuca Maia* (Drury) and *Lagoa crispata* Packard, may be found recorded in the *Twenty-third Report on the State Cabinet of Natural History*, 1872, pp. 143, 144,* and *Twenty-fourth Report on the State Museum of N. H.*, p. 140-1.† The last reference is to a portion of a paper — "Transformations of Lagoa crispata" (pp. 138–145, *loc. cit.*)— based upon collections made at Center, N. Y., during a season of such a phenomenal abundance of the larvæ, on *Quercus vaccinium*, *Pteris aquilina* (common brake), and other plants, that at least a thousand examples, although feeding separately and scattered, could have been taken within an hour's time.

The Poisoning Attending the Sting.

Dr. George Dimmock, in an elaborate paper "On Some Glands which open Externally on Insects," contained in *Psyche*, for September, October, 1882 (iii, pp. 387–401), gives authority for the assertion that "the severe poisoning produced by the hairs of certain larvæ of the *Bombycidæ*, is caused by the secretion from a minute gland at the base of each hair. The secretion of these glands, which may be formic acid or a formate in solution, fills the hollow central portion of the hair, and when the sharp, often barbed, hairs are broken in the flesh of attacking animals, the broken parts carry with them the poisonous secretion." The writer attests to an instance in which one of these larvæ in being brushed away from the neck, inflicted so severe a sting upon a middle finger, that the distal joint, healing only after several months, remained somewhat stiffened and deformed at the time of writing — after a lapse of thirty-seven years.

The Moth.

The moth is shown in Figure 25. It has a very woolly, pale yellow body tinged with brown. The front wings are umber-brown at the base, fading to pale yellow outwardly. Their surface is marked with fine lines of silver-gray, and the front margins are nearly black. The legs are yellow with dusky feet. The wings of the male moth spread about one inch ; those of the female, one inch and a-half. (Hubbard.)

Fig. 25.— Lagoa opercularis — female.

Of the two cocoons, made in August, by the larvæ received from Mr. Moore, one gave out a male moth on May 16th. The pupa had

* Or, *Entomological Contributions* [I], pp. 11, 12. † Or, *Ent. Contrib.*, II, pp. 36-7.

pressed open the lid, and working half its length out of the cocoon, the empty pupal case was held in this position after the escape of the moth.

Is a Southern Insect.

Lagoa opercularis is a Southern insect, but according to Mr. J. B. Smith, it is somewhere recorded as occurring within the State of New York. It has also occurred at Reading, Pa., which is but a small fraction of a degree south of the southern limits of New York. In its western range, it extends, at least, into Texas.

The Caterpillar.

Mr. H. G. Hubbard, an Assistant of the Division of Entomology at Washington, has included *Lagoa opercularis* in his Report on the *Insects Affecting the Orange* (the accompanying illustrations are from the Report), and has written of it as follows:

The caterpillars of this moth are covered with long, silky hair [see the figure], underneath which are concealed shorter, stiff hairs, exceedingly sharp at the points, and powerfully nettling when they penetrate the flesh. Upon some persons the invisible wounds made by these hairs produce swellings, and an amount of irritation equivalent to a sting; the larvæ are, in consequence, popularly supposed to be very poisonous. When young, the caterpillars are white and resemble a flock of cotton wool. They undergo six molts, at one of the last of which they become darker, the color varying in individuals, from red-brown to light clay-color. When full-grown, the larvæ present the singular appearance of a lock of hair possessing sluggish life, and a gliding, snail-like motion. Its peculiar appearance is well illustrated in the figure given.

Dr. Packard has pointed out an interesting feature in the larva of *Lagoa crispata*, which, in all probability, exists also in *L. opercularis*, viz.: it has seven pairs of abdominal or false legs, instead of the normal number of five pairs. They are located as follows:

The first abdominal segment is footless; the second bears rudimentary feet; segments 3–6 bear normal prop-legs; the seventh bears a pair of rudimentary legs; segments eight and nine are footless, while the tenth bears the fully-developed anal or fifth pair of genuine prop-legs.

While these two pairs of tubercles differ from the normal legs in being much smaller and without a crown of curved spines, they are protruded and actively engaged in locomotion: in situation, as well as in the presence of the basal tufts they are truly homologous with the normal abdominal legs. (*American Naturalist*, xix, 1885, pp. 714–715).

The Cocoon.

Its dull brown, felt-like cocoon represented in Figure 26, usually placed on a branch or in a crotch of a tree, has a protuberance on its back which almost exactly counterfeits a winter bud. It is provided with an accurately fitting hinged trap-door, which is skillfully built by the larva at the time of the construction of the cocoon, instead of being subsequently cut by its jaws, as are many of the lids of cocoons of the Lepidoptera, Hymenoptera, etc. For a detailed account of the peculiar structure of the lid in the cocoons of *Lagoa*, and evidences of design shown therein, the article on *Lagoa crispata* previously cited, may be referred to.

FIG. 26.—Cocoon of LAGOA OPERCULARIS.

Nephelodes violans Guenée.

The Bronze-colored Cut-worm.

(Ord. LEPIDOPTERA: Fam. NOCTUIDÆ.)

[For Bibliography, see First Rept. on the Insects of New York, 1882, p. 99.]

Caterpillars of the above named species were received under date of March 30th, from Prof. D. P. Penhallow, of McGill University, at Montreal, which had been taken a few days previously from a large number traveling over the surface of the snow, and had therefore, from the unusual nature of such an appearance, excited no little curiosity. Not being able to recognize the species in its immature state, examples were sent to Washington for comparison with the alcoholic specimens in the National Museum, where they were identified as *Nephelodes violans*—the bronze-colored cut-worm, a notable demonstration of which in the pastures and meadows of St. Lawrence county, N. Y., in the spring of 1881, is narrated in my *First Report Ins. N. Y.* Figure 27 represents the caterpillar in its mature size.

FIG. 27.—Caterpillar of NEPHELODES VIOLANS.

Upon requesting from Prof. Penhallow that he would obtain all the particulars possible of so interesting an occurrence as the appearance of this caterpillar in winter, under the conditions named, in such a northern latitude, he kindly sent the following communication, from Mr. David Robertson, of Brockville, Ontario:

Occurrence of the Larvæ in Winter, in Canada.

The larvæ were first noticed on the afternoon of March 25. On the previous day we had had a sudden thaw, with high winds and very heavy rains during the evening, and before morning the temperature had fallen to five degrees above zero. With the exception of rising somewhat with the sun, it continued at that temperature for several days.

The larvæ were found in a field six hundred feet in width, scattered over that distance for about three hundred feet in length, at an average distance apart of perhaps two feet; but in certain places, they lay in great quantities and all alive. The field was covered, as well as all of the surrounding country, with from one to two feet of snow and ice. There was no manure in the field.

On the following day I found that the greater part had disappeared, and the few that were left were dead, and a number of crows were busy in picking them up and eating them.

I did not look for them beyond the space named, and am unable therefore to say anything about the area over which they fell.

Description of the Winter Caterpillar.

One of the snow caterpillars received from Professor Penhallow was fed on spinach leaves to maturity. It pupated May 13, but failed to disclose the moth. The following notes were made of its appearance when full-grown:

Dorsum dull yellow, with numerous interrupted, crinkled, longitudinal lines — the two dorsal ones, defining the mesial stripe, continuous; two black dots on the anterior portion of each segment dorsally. Head small, less than one-half the breadth of the middle segments, brownish, with black reticulations, with two black lines over its front, dividing to border the △ — the latter pale; the four eyes black; hairs long. Abdomen with a subdorsal dark green stripe, paler at the sutures, bordered below with a narrower white one; a broader substigmatal stripe just above the spiracles, traversed medially with a paler line, and bordered by white; a pale green stripe between this and the subdorsal above; below this a stigmatal pale yellow stripe bearing the small oval black stigmata; ventral region watery-green; posterior end of body quite tapering. Legs and prolegs pale — the latter with a black band outwardly at their base. Length of larva, 1.25 inch; breadth at widest, 0.23 inch.

Its Midwinter Occurrence in Sullivan County, N. Y.

A similar appearance of this caterpillar in midwinter, had been brought to my notice two years previously through some newspaper accounts of "a shower of yellow worms," that had followed a snow storm at Liberty and at Stevensville, in Sullivan county, N. Y., on December 27, 1884. After communicating with several persons in search of some precise information of the phenomenon, I was so fortunate as to obtain what I desired from the gentleman who observed the occurrence, and who was able to give an intelligent account of it —

Mr. Isaac H. Soules, of Mongaup, Sullivan county, N. Y. — a teacher of a school at that place. From his letters I extract as follows:

On my way to school, early in the morning, upon leaving the main road to cross the fields, I saw in the snow, moving quite fast, numbers of worms of different sizes, from about one-eighth of an inch to one inch long. I stooped down and examined them, and found them to be of a yellowish color, darker on the sides than on the back, and lighter beneath. They were very lively, and traveled as fast as if on the ground. I called one of my neighbors and showed them to him, but had nothing with me in which I could carry any away. * * * When I took them in my hand they appeared to be very sensitive, and would curl up like this [giving a figure representing the curved position assumed by cut-worms when disturbed], and would remain so as long as held in the hand, but as soon as replaced in the snow, would crawl as lively as ever. The snow was about six inches deep, and falling at a very rapid rate, although it was quite cold — two degrees below zero. There was a hard crust underneath the falling snow. The worms were only on the surface, and seemed to be confused, crawling in every direction. They were in the road, fields and woods. I never saw anything to equal it, and my curiosity was aroused. * * * * * I observed them from about 7.30 to 8 A. M. How long they continued on the surface, I am unable to say, as I called school at 9 o'clock, and was not out again until noon, when I could not find any of them, much to my surprise and regret, as I had arranged to secure some of them. * * * * The local papers are making all sorts of sport about the worms. * * * * * They were not seen at Stevensville, as reported, but in the town of Bethel, Sullivan county, about two and a-half miles from the former place. * * * * * The smaller ones resembled cut-worms, such as we commonly find in our gardens. The larger ones were like those that are seen on timothy hay when ripe or nearly so [meaning, probably, *Leucania albilinea* Hübn.], except that they were of a brownish color and not striped on the sides.

Later, Mr. Soules informed me that the worms were seen at another place (not stated, but presumably in the town of Bethel) by some workmen on the canal. The snow was falling fast at the time, the temperature was below zero, and the worms were moving rapidly. Upon questioning the men closely, he concluded that they were of the same kind as seen by him, and their occurrence was at the same time.

Identification of the Caterpillar.

Two weeks thereafter, Mr. H. M. Stoddard, Postmaster at Stevensville, of whom I had requested information and specimens, sent me a number of "the worms found crawling on the ice at our place." They were submitted to Mr. Soules, who identified them as of the same kind as seen by him. They were also sent to Washington, to the Entomological Division, where, on comparison with the alcoholic specimens, they were pronounced *Nephelodes violans*.

The Mature Larva Described.

The following description of a nearly matured larva of *Nephelodes violans*, drawn by me from an example taken from beneath a stone, at Centre, N. Y., on June 13th, was overlooked in my preparation of the notice of the insect in the *First Report on the Insects of New York:*

Head brown, mouth rounded, broader than long, breadth 0.15 inch; mandibles blackish. Collar glossy black, traversed by three yellow lines, which are continued over the body as a dorsal and subdorsal sharply defined, pale, dull green stripes — the dorsal stripe slightly narrower than the others; the three, in their continuation over the caudal plate, become yellow-green. In addition to these — an obscure narrow lateral green line, and a substigmatal stripe which is broader than the other three, and terminates in the anal prolegs; the small black stigmata rest on the upper margin of this stripe. The body is of a glossy bronze-green color, with a slightly shagreened appearance above, and beneath paler green. The legs and prolegs are obscure green; the latter marked outwardly with a glossy black crescentic spot. When held up to the light in a plane with the eye, the body shows short whitish hairs at the setiferous points.

The larva fed on grass, and passed its final molting three days after its capture. It subsequently gave the moth, but the date of its emergence and of its pupation were not noted.

Homoptera lunata (Drury),

As a Rose Pest.

(Ord. Lepidoptera: Fam. Noctuidæ.)

Phalæna (Noctua) lunata Drury: Illus. Nat. Hist., i, 1770, pl. 20, fig. 3; (without name); Id. App., ii, 1773 (named).
Phalæna (Noctua) edusa Drury: Ill. Nat. Hist., App., ii, 1773, pl. 24, fig. 4.
Noctua lunata Westw.-Drury: Ill. Exot. Ent., i, 1837, p. 37, pl. 20, fig. 3.
Erebus edusa Westw.-Drury: Ill. Exot. Ent., ii, 1837, p. 46, pl. 24, fig. 4.
Homoptera lunata Guenée: Sp. Gen. Lep.—Noct., iii, 1852, p. 12.
H. edusa Guenée: Id. ib., p. 14.
H. Saundersii Bethune: in Proc. Ent. Soc. Phil., iv, 1865, p. 215.
H. lunata and *edusa*. Bean: in Canad. Ent., ix, 1877, p. 174.
H. " " Lintner: Ent. Contrib., iv, 1878, p. 108–9;
H. " " 30th Rept. N. Y. St. Mus. N. H., 1878, p. 220.
H. lunata. French: in Canad. Entomol., xiv, 1882, pp. 130–134.
H. edusa. Grote: Ch. List. N. A. Moths, 1882, p. 42, No. 1301.
H. lunata. Lintner: in Count. Gent., xlix, 1884, p. 737.

Occurrence in a Rose-house.

The beautiful moth bearing the above name has long been known as an ornament of entomological collections, while its larva has seldom come under observation, and consequently little has been written of its habits. The caterpillars have recently been discovered as operating injuriously in a rose-house in Madison, N. J. Their work had been conducted with secrecy, as during the day they rested quietly on the stakes to which the roses were tied, selecting such as resembled them in color so that they were scarcely observable; but at night they became active, and resorting to the plants, fed upon the buds, of which they consumed large numbers. The time of their greatest injury was from October to January. Moths reared from them, were sent for name, history, habits, etc.

Habits and Natural History.

The moths are a large and prettily marked species of the *Noctuidæ*, known as *Homoptera lunata* (Drury).

The habit of the caterpillar of hiding on the stakes to which rose bushes are tied, counterfeiting the color of the wood upon which it rests, and leaving its retreat at night to feed upon the buds, has not been previously recorded, and is quite interesting. It seems to feed upon quite a number of greatly differing food-plants, as upon plum, willow and maple, according to Prof. French, and on oak, as stated by Guenée. Abbot, according to Guenée, has figured it in association with a species of *Hypericum*.

The eggs laid by the parent moth hatch in five days. There are apparently two annual broods of moths. Eggs of the spring brood, deposited April thirtieth, gave the moth at intervals between June twenty-first and July tenth, the average period for the change into the perfect insect being sixty days. Of the autumnal brood, larvæ captured abroad on willow and other bushes, have formed their cocoons the last of September, and disclosed the moths early in November; or wintered as pupæ, and gave out the moth the following spring. The above items in the life-history of the insect are from a paper by Prof. French, narrating its preparatory stages, in the *Canadian Entomologist* for July, 1882, pp. 130–134.

The Caterpillar.

The caterpillars are described by Guenée as whitish, shaded with gray, with a blackish dorsal and subdorsal interrupted lines. Upon the incisure, between the fourth and fifth rings, is a large yellowish spot, and on the back of the fourth, two blackish circles, inclosing each a small wart. There is a small yellowish spot on the sixth incisure. On the seventh ring is a large gray space. The first three rings have each a black mark on the side. The legs and head are of the color of the body; upon the latter are some black marks. The pupa is entirely covered with a violet-like efflorescence.

The above differs in several particulars from the more extended and carefully prepared description of the same stages by Prof. French.

A Marked Sexual Difference in the Moths.

The sexes of this species differ so much in their markings that they were described, above a century ago, as two species, viz., *Noctua lunata* and *Noctua edusa*, and were accepted as distinct until shown by me in 1878 (*Entomological Contributions*, No. IV, pp. 108–9) to be but sexual forms of the same species. All the "*edusa*" of our collections were found, on examination, to be males, and all the "*lunata*" females.

Not Usually Injurious.

It is distributed over a large portion of the United States, but has never been found to be very common or injurious anywhere. When occurring in rose-houses its injuries could be prevented by looking over the stakes during the few weeks that the larvæ appear, and collecting them by hand and crushing them. When occurring elsewhere they should be sought for during the day upon the stalks or trunks of the plants that they infest, or on other objects in the vicinity to which they would be attracted by a similarity of coloring with themselves, favorable to their concealment.

A Hemlock Leaf-Miner.

Some twigs of hemlock, *Tsuga Canadensis*, communicated by Prof. A. N. Prentiss, of Cornell University, during the month of January, were found to have a number of their leaves mined by a minute larva, which was evidently a lepidopterous insect, and probably belonging to the *Tineidœ*, judging from a head-case discovered among the threads that bound together some of the mined leaves. No larva is known to attack the hemlock in this manner, and it is not improbable that the insect is new to science.

There is a possibility, however, that it may be the *Gelechia abietisella*, which Dr. Packard has described and figured in the *Report of the Commissioner of Agriculture* for 1883 (pp. 150–151, pl. 3, f. 2, pl. 13, figs, 7, 7a, 7b), as having been observed in the spring of 1883 in the vicinity of Providence, R. I., causing sere and dead patches of leaves on the smaller branches and twigs of hemlocks, both large and small. The operations of the Gelechia caterpillar had consisted in biting off from six to eight leaves of which to construct a broad, flat, irregular case, within which it lived in a rude silken tube, and fed upon the inside of the leaves.

No larvæ were found within the mines, but from the fact that several leaves were observed to be fastened together and separated from the twig, it is possible that at the approach of winter they may have abandoned their mines to hibernate, as Dr. Packard suggests that *G. abietisella* may do, within a silken tube inside of the leaf-case.

Professor Prentiss states that the injury to the hemlocks was first noticed at Ithaca, at about the first of December, since which time it had apparently increased, or at least become more conspicuous. Hundreds of trees in Cascadilla ravine, near the college grounds, were thus affected.

Cecidomyia balsamicola n. sp.,

And Its Gall.

(Ord. Diptera: Fam. Cecidomyidæ.)

For the past two years galls occurring in abundance in some localities, within the leaves of the balsam fir, have been in my possession and under observation, in the hope of obtaining the perfect insect from them for description. Late observations have shown that there is no prospect of securing the imago very soon — certainly not before the lapse of another year — as carrying the larva to its final stage promises to be both difficult and uncertain. In the belief that publication of what is known of the insect and its operations will serve to draw attention to it and aid in the early completion of its life-history, it is herewith given a scientific name, some of the more prominent features of the larva are mentioned, and its gall is described.

The Gall only Known on the Balsam Fir.

The galls have been observed by me only on the balsam firs, *Abies balsamea,* of the Adirondack mountains, but they will probably prove to be of somewhat wide distribution, for in the collection of the Museum of Comparative Zoölogy at Cambridge, Mass., is a balsam tip bearing the same gall, which Dr. Hagen informs me was obtained at Shelbourne, N. H., in September 1882, by Professor Farlow. I have not been able to find them on balsam firs in the vicinity of Albany, nor on any other species of *Abies* examined by me other than *balsamea.*

Its Abundance at Lake Pleasant, N. Y.

During July and August last they were observed in large numbers at Sageville (Lake Pleasant), Hamilton county, N. Y. To many of the trees they imparted a peculiar nodose appearance, in instances where they abounded to such an extent that at least three-fourths of the leaves of the tips of the season's growth bore the gall. At this time each contained its larva, which but partially filled the gall, yet appearing as if it had nearly attained its growth. The larvæ, when exposed to examination, were inactive, hardly showing any motion, and giving no evidence of a disposition to feed.

The Gall Described.

The gall consists of an oval enlargement of the leaf near its base, varying in position from entirely basal (rarely) to one-fifth of an inch removed (also rarely); the average distance does not exceed 0.05 of an inch. The average length of the gall may be somewhat above one-eighth of an inch, with a diameter two-thirds as great, which seldom exceeds twice the width of the leaf. Its elevation above the surface of the leaf is about equal on the two sides, although sometimes seeming more depressed superiorly from the bending of the leaf by its deformation forming a concavity above. The exterior of the gall is smooth, except as showing some trifling irregularities of growth.

c b a

Fig. 28.—Balsam tip with galls of Cecidomyia balsamicola: *a*, leaf enlarged with gall seen on upper side; *b*, the same with gall from lower side, with opening for escape of the larva; *c*, leaf from which the larva has escaped through opening on upper side.

The Larvæ Elude Efforts to Rear them.

Examples of the galls collected at Lake Pleasant were inclosed in tin boxes, glass jars, and bottles, and occasionally sprinkled with water, as the transformations of many of the *Cecidomyidæ* are known to be quite dependent upon moisture. Examinations of the contained larvæ at intervals during September and October showed them apparently unaltered in condition. Later, they were found hardened and dead.

Efforts made by myself and by the secretary of the New York State Forest Commission, Mr. A. L. Train, to obtain, from parties applied to, fresh galls during the autumn, were unsuccessful, and it was not until the last week in December that fresh material was procured, through the kindness of Mr. S. D. Andrews, of the Lake Pleasant House, at Sageville. The insects at this time had emerged. In only one gall was a larva discovered, which seemed to have recently died, and from which the following notes were drawn:

The Larva Described.

Color, reddish-yellow; surface delicately pitted under a high magnifying power, like fine shagreen; eleven segments deeply incised, the terminal twelfth showing indistinctly as a narrow appendage to the eleventh; laterally on each segment a very short black bristle visible under a three-fourth-inch objective; no other process apparent, even stigmatal ones. The stalk of the "breast-bone" is gradually widened toward its V-shaped anterior portion, of which the space between the arms is about equal to the width of one of the arms toward their junction where they widen exteriorly into a U-like character. Length of the larva, 1.20 mm.; breadth, 0.70 mm.

The Larva leaves the Gall for its Pupation.

The insect had left the gall through a longitudinal opening of more than one-half its length, which subsequently closed, leaving a border somewhat elevated, like lips. The opening, in the larger number of instances, is on the upper surface of the leaf — in thirty-four leaves out of fifty examined : in such cases, it is linear and usually in exact line with the midvein. When occurring on the under side, it is lateral on the gall, and only to be seen by turning the leaf sideways. The midrib of the lower surface is not continued over the gall. Upon cutting into the galls they disclosed a corky structure, and the interior surface of some displayed a transverse thready appearance.

From the above observations it seems probable that the larvæ of *C. balsamicola* mature in the late autumn, when they escape from the galls, and fall to the ground, either to enter the earth for pupation, or find suitable place for change among the thick bedding of leaves beneath the trees. Here they would hibernate, perhaps as larvæ, to pupate in the early spring, and disclose the perfect insect at about the time when the new leaves are developing.

The Galls Occasion Partial Defoliation.

It will be of interest to learn to what extent the occurrence of this gall tends to the defoliation and consequent injury of the trees which it infests. From the examples of the foliage received by me, it is seen that leaves bearing the galls were still attached to the tree at the close of the year, but were so loosely attached that a slight pressure removed them. Many had broken off in transit, and were loose in the package when received. The twigs showed the scars of detached leaves to at least double the number of the galls inclosed, indicating a considerable fall of the infested leaves, under natural conditions, during the month of December. Later, all the galls fall from the tree.

The Insect not Known in Europe.

The insect appears to be a native species. Baron Osten Sacken, who has seen the gall, after searching the European literature of the *Cecidomyidæ* states that there is nothing analogous to it in Europe. Dr. F. Loew, of Vienna, concurs in the above, and remarks incidentally that the gall belongs to a group which have their habitat in the parenchyma of the leaf (Blatt parenchymgallen), occurring on *Quercus*, *Ulmus*, *Tilia*, *Centaurea*, *Hieracium*, etc.

Lasioptera vitis O. S.

(Ord. Diptera : Fam. Cecidomyidæ.)

Osten Sacken : Monog. Dipt. N. A., Pt. i, 1862, p. 201–2; Cat. Dipt. N. A., 1878, p. 6.
Walsh-Riley : in Amer. Entomol., i, 1869, p. 247, fig. 183.
Riley : 5th Rept. Ins. Mo., 1873, p. 117–8, fig. 45.
Reed : in 13th Rept. Ent. Soc. Ont., for 1883, p. 49, fig. 33.
Saunders : Ins. Inj. Fruits, 1883, p. 295, fig. 306.
Lintner : in Count. Gent., xliv, 1879, p. 407; id., liii, 1888, p. 511.

Lasioptera vitis — a minute dipterous insect, belongs to the group of gall-making *Cecidomyidæ*. The genus *Lasioptera* is readily distinguished from *Cecidomyia*, to which it is quite near, by its nervulation, for while the latter, with few exceptions, has four longitudinal veins, this has but three, and of these the first and second run so close to the costal margin as to be almost undistinguishable. Its third vein, the only conspicuous one in the wing, is forked much as in *Cecidomyia* and *Diplosis*.

Description of the Galls.

The tip of a seedling grape and some separate leaves were received on the seventh of June, from Mr. Henry Lee, of Middlehope, Orange county, N. Y., upon which were numerous galls of *Lasioptera vitis.* The tip, for about five inches of its extent, was covered by the abnormal growth upon it, and so distorted that it was bent downward until its natural direction was completely reversed. The older galls were bright red, the younger ones still green. They were frequently confluent — three or four having united to form one elongated, irregular swelling. Figure 29, represents a vine infested in this manner.

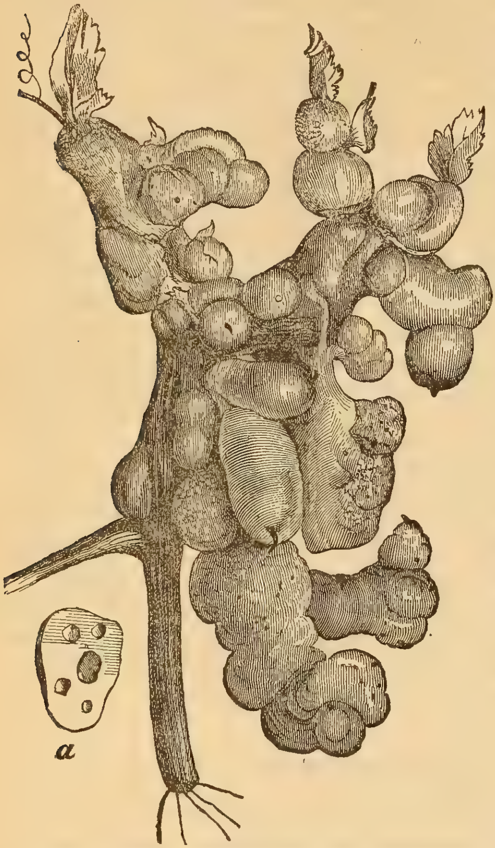

Fig. 29.—Galls of Lasioptera vitis, on grape-vine; *a*, section of a compound gall, showing the larval cells.

The leaf-galls are of a smaller size than those of the tip, averaging two-tenths of an inch in diameter. They, in most cases, rest on the veins, but a few only touch them on one side; rarely, they are entirely disconnected. Their upper side is red (on the upper side of the leaf), while the obverse, withdrawn from sunlight, is green. Those containing a single cell, are round, with more than one-half of the gall showing on the under side of the leaf, and with its connecting vein bent downward on its surface. The larger number are single-celled — the result of a single oviposition. The confluent ones, or even the elongated, occurring on the vine more frequently than on the leaf, of course contain two or more cells, as shown in section, in the figure at *a*.

On a part of a leaf within an area of an inch and a half in diameter, thirty galls were counted.

Escape of the Larvæ.

Most of the galls had given out their larvæ when received; a number had emerged en route, and were found within the box: they were given ground in which they speedily buried. Others continued to escape from the galls for the two following days. Perhaps from thirty to fifty larvæ were transferred to the small box of ground and seen to enter therein. No note was made of their appearance, but it is remembered that they were of an orange-yellow color.

The larvæ emerge, indifferently it seems, from either the upper or the lower side of the gall, depending, probably, on the position of the leaf, as in one, nearly all have escaped from the upper side, and in another, the reverse. The opening through which the larva escapes is quite small; a pale ring surrounding it on the surface of the gall, looks as if the margin had been eaten away for its outer enlargement.

On the twenty-seventh of June, other specimens of the same gall were received from Dr. M. G. Planck, of Schenectady, N. Y., taken from wild grapevines. These were also disclosing their larvæ at the time when they were received. (*Query,* suggested by the inability to rear the larvæ: does the picking off of the vine have such an effect upon the sap as to cause the larvæ to desert the galls at once, even before they have fully matured? The apparent eagerness with which the closely related larva of the clover-seed midge, *Cecidomyia leguminicola* creeps from the clover head very soon after it is plucked, is recalled in this connection.)

The Only Known Remedy.

There is no known method by which the oviposition of this little midge can be prevented. The attack can best be met by plucking the infested tips and leaves before the larvæ leave the galls, and burning or otherwise destroying them.

The Larvæ Attacked by a Parasite.

In the month of July several chalcid parasites were found within the box containing the galls, and a single example of the gall-fly—all dead. Whether they were given out from the galls or from ground where the larvæ buried, is not known, as both were under the same cover. As the time for the appearance of the gall-fly seems to be in June (Osten Sacken obtained it on the 29th of June) and perhaps in early July, there is no prospect of obtaining further examples of the flies. It would seem as if the larvæ had died from immaturity or had been very generally parasitized. The chalcid obtained has been determined by Mr. Howard as an undescribed species of *Tridymus* Ratz.— a genus very near, in place, to the *Pteromalinæ,* and not previously recognized in this country.

First Notice of the Insect.

Our first knowledge of this gall and its author is found in Baron Osten Sacken's admirable paper "On the North American Cecidomyidæ," forming part of the late Dr. Loew's *Monographs of the Diptera of North America*—Part I, 1862. The gall is thus characterized: "Swelling of the stem and leaf-stalks of the wild grape. This irregular succulent swelling, which becomes red on its stouter and riper portions, extends not only along the stem and leaf-stalks, but also invades the leaf-ribs. It contains round hollows of about 0.1 in. in diameter with an orange-yellow larva in each. Some of the hollows are often abandoned by their inmates and invaded by numerous *Thrips.*"

The fly has not been figured; its description is as follows:

Description of the Fly.

L. vitis O. S.—0.04 in. long, pale reddish, head blackish, antennæ black, apparently 23-jointed, filiform, joints broader than long, sessile, with a short pubescence (they answer exactly Winnertz's figure of the antennæ of *L. rubi* Wz.), two basal joints yellow, thorax blackish above, with a golden pubescence near the collar and down to the origin of the wings; scutellum pale reddish; abdomen covered superiorly on each segment with rows of blackish scales; legs pale reddish, wings with gray pubescence, anterior margin with a black fringe of hairs (*loc. cit.,* page 202).

Various Forms of the Galls.

The figure given on page 184 shows one of the many remarkable forms which this gall assumes. It is from Prof. Riley's 5th Missouri Report, where he has named it "the grapevine tomato gall," and remarks of it that it is a "most variable gall, being found of all sorts of fantastic shapes, from the single, round, cranberry-like swelling on a tendril, to the large collection of irregular bulbous swellings on the stem or leaf-stalk; sometimes looking not unlike a bunch of currants or a bunch of grapes, but more often like a collection of diminutive tomatoes." From a brief notice accompanying an earlier presentation of the same figure — in the *American Entomologist* for August, 1869 (page 247), it appears that the specimens identified from Ridgewood, N. J., were irregular, compound swellings on the stems and leaves, each swelling being of about the size of a large pea. Such forms certainly could not be suggestive of small tomatoes, nor those illustrated in the figure, nor any that have come under my observation. The common name proposed above for the gall would, therefore, seem to be an inappropriate one.

Localities of its Occurrence.

The editors of the American Entomologist have identified the galls from Des Moines, Iowa. The Osten Sacken catalogue of N. A. Diptera gives its habitat as "District of Columbia and elsewhere." In former years I have received it from Staatsburg, N. Y., and from New Jersey, where it occurred on the Concord grapevine. It has also been received by me from Orange county, N. Y., on a Muscadine vine; from Worcester, Mass., on a "Rogers 15" seedling; and from Schenectady, N. Y., as before stated, on a wild grapevine.

Chloropisca prolifica Osten Sacken, n. sp.,

And Its Winter Gatherings in Dwellings.

(Ord. Diptera: Fam. Oscinidæ.)

The immense numbers in which various insects, which are not recognized as social in their nature, are observed to congregate at certain times, and under certain conditions, is a phenomenon full of interest, and one for which no satisfactory explanation has been offered. Without citing an extended list of such assemblies, a few of those in which species of *Chlorops*, belonging to the family of *Oscinidæ*, have been drawn together for hibernation will be mentioned, in connection with two recent instances of the kind brought to my notice.

A Remarkable Assemblage of Flies at Franklin, N. H.

In March last, examples of a small fly were received from Mr. W. F. Daniels, of Franklin, N. H., with the statement that they were infesting his residence in such number that it was impossible to rid the house of their presence. They had become a great nuisance. Through several letters received in relation to them, the following account has been compiled:

The fly had been observed as early as the last week in August, in quite an active state about crevices in the wood-work and the windows of the second floor, where it was seeking entrance.

Later in the season a favorite gathering place for them was found to be in the space between the window sashes and the casings. Here they appeared to rest in stupid condition, but if the attempt was made to capture them, they flew briskly away. When the gas was lighted they flitted around the room in great numbers, and alighted on the ceiling and walls. They were not distributed generally over the house, but were almost confined to the north side — the front of the house — and to the second story. None were seen on the third floor, and comparatively few on the first. In a closed room thousands could be killed by the use of pyrethrum, but without seeming to diminish their number in the least. They collected at times upon the windows so numerously as to soil the panes greatly.

Their Spring Awakening.

Their principal annoyance to the family seems to have been in the spring when they were awakening from their hibernation. Many that had doubtless been excluded from the house by the screens that covered the windows, had found acceptable retreats in crevices between the brick wall of the building and a substantial wooden covered porch erected over the front door. On April fourth of the present year, large numbers of the fly were observed at each side of the porch, moving sluggishly over the ice and snow which lay there at a depth of two feet. So abundant were they that kerosene was poured over them where they were the thickest, and very many were thus killed. At the same time they could be seen climbing up the front wall of the house, even to the roof.

Efforts for their Destruction.

On April twelfth, upon the discovery that multitudes were emerging from the crevices between the porch and wall, insect powder was blown in upon them with a powder-bellows, and in an hour's time, as reported, "millions were scattered over the stone steps. They were taken up three or four times that day, and again on the eighteenth, twentieth and twenty-second, and dropped quickly into boiling water, for if left awhile they revived. Since that time they gradually disappeared," and on May third, the date of a letter received, none were to be seen. So many had been killed by the persistent means taken for their destruction that it is thought that they must have been nearly exterminated, and hopes are entertained that another autumnal visit may not be received from them.

Annual visitations of the same fly had occurred for at least five or six years past. They had not been noticed in any other dwelling in the vicinity. This house was quite alone from any other.

Conjecture as to their Source.

In reply to the inquiry made of me of the probable source of these flies, answer was returned that several of the *Oscinidæ* are known to breed in the stems and roots of the *Gramineæ* (grass family), and that the breeding-places of the Franklin chlorops might, perhaps, be discovered in some of the neighboring grain fields, if they gave evidence of being infested. To this, reply was made that within many miles of the place, very little grain was grown and there was none that had been infested with insect pests to any material extent. The house was surrounded with a broad lawn, and in front was fine, green grass for two hundred feet or more. Across the road was a hill rising to a height, perhaps, of a hundred feet, extending for an eighth of a mile, and covered with a growth of oak, pine, and locust trees.

As the source of such "mass meetings" of Chlorops is unknown and a matter of much interest, we quote some remarks made by Schiner, in a paper entitled "Ueber massenhaftes Auftreten einer Chlorops Art, Verh. Zool. Bot. Ges. Wien, 1872, pp. 61–73," based on specimens received by the distinguished Dipterist, which had occurred in enormous numbers in a villa near Fiume on the Adriatic. These were referred to the genus *Chloropisca* — the same to which the Franklin examples belong: in the presence of half a dozen descriptions equally fitting and equally uncertain, they were given a new specific name, namely, *Chloropisca copiosa*.

The aim of these mass meetings of flies, I do not know, and do not want to add a new hypothesis to those already offered. * * * The known habits of several species of Chlorops make it probable that the larva of the present one must be looked for in stems and roots of *Gramineæ;* but our cereals seem to be out of the question, as there have never been any complaints about the depredations of a species like this; and owing to the immense numbers of the fly such complaints would certainly have been forthcoming if this species attacked cereals, like the larvæ of some other larger species of *Chlorops*. Those who happen to come across assemblages of this kind may find an opportunity for searching the *Gramineæ* in the environs, the more so as these assemblages are only local phenomena, but apt to occur in the same locality for several years in succession. With some patience, the flies themselves might, perhaps, be used as guides towards their breeding-places: by dint of watching their motions and following their flight, the truth might be learned.

Another Assemblage of the Fly in Western New York.

A second instance of an assemblage of this fly — found to be identical with the Franklin examples — was brought to my notice as occurring at Alfred Centre, Allegany county, N. Y., a village in the western part of the State. Dr. H. C. Coon, connected with the Alfred University, communicated several specimens which he had taken within his house, from the wall paper and a window, on the 18th of September. Others were seen on the outside of the window. On October 3d, "upon drawing down a sash of a window opening on a covered porch at the north end of the house, the casings at the sides and top were so covered with the flies that they could be scraped off by handfuls." They were not found about other windows, or in similar localities in neighboring houses where search was made for their presence. It was recalled that they had been observed the preceding autumn in numbers sufficient to cause them to be swept together and burned.

In this instance, the invasion does not rank with the first recorded, but it may develop an increase in following years.

The Fly Submitted to Baron Osten Sacken.

As the fly was apparently unknown to us, it was submitted to Baron Osten Sacken, of Germany, for determination, and by him was referred to the genus *Chlorops*, subgenus *Chloropisca.* It was found to have some points in common with *C. copiosa* of Schiner, previously mentioned, but was different from it. As the species belonging to this subgenus vary greatly in color, even more than the true Chlorops, and are therefore quite difficult to identify from description however carefully made, I requested of Baron Osten Sacken that he would describe the examples placed in his hands, for publication in the present report. The task was no light one, as may be seen from the following description which he has most obligingly sent in compliance with the request:

Description of the Fly.

Chloropisca prolifica *n. sp.* [Osten Sacken.]

The breadth of the cheek under the eye is about equal to the distance between the eye and the antenna; the front is but little projecting in the profile, the face distinctly retreating. Front reddish-brown, shining, with a narrow yellowish border along the edge of the occiput and the frontal orbits; a more or less distinct brown stripe in the middle of the front, attenuate anteriorly and including the ocelli posteriorly; two shorter and often less distinct lateral stripes; frontal triangle large, nearly reaching the anterior edge of the front, its anterior angle rather broad (not acute as in some species of *Chlorops*), bounded on each side by shallow furrows (in some specimens, however, they are deeper); near the occipital edge the bottom of these furrows shows a couple of short, deeply-cut striæ; the surface of the front is marked with scattered punctures (sometimes nearly smooth; in front of the ocelli, in most specimens, there is a shallow impression (coinciding with the intermediate brown frontal stripe). Face and cheeks brownish-yellow. Occiput black or brown, yellow along the orbits. Palpi reddish-yellow; above them, a pair of black dots on the oral edge; when the proboscis is withdrawn these dots may be easily mistaken for the end of the palpi. Antennæ reddish-brown; third joint rounded, darker brown on its distal half, sometimes altogether brown. Thorax brownish-yellow, with the usual three black stripes and a shorter and narrower dark streak above the supra-alar cavity; the intermediate stripe is cut off squarely some distance before the scutellum, the lateral ones are elongate-wedge-shaped, their pointed end nearly, but not quite, reaching the scutellum; a faint longitudinal groove along each side of the intermediate stripe; on the sternum a large black triangular spot between the front and middle coxæ, on each side; a similar spot, but much smaller, above the hind coxæ; smaller black or brown spots on the lower part of the mesopleura and on the pteropleura, near the mesopleural suture.* Scutellum flat, brownish in the middle, yellowish towards the sides and tip; surface smooth; it requires a strong lens to discover a sparse microscopic pubescence, issuing from equally microscopic punctures; a pair of somewhat larger, approximate bristlelets at the tip. Halteres with a conspicuously yellowish-white knob. Metanotum black. Abdomen dark brown above; hind corners of the segments, and especially of the second, yellowish; hind margins of the segments, and especially of the penultimate, paler; these paler regions are variable in extent, and sometimes the upper side of the abdomen is almost altogether brown; the distal half (or less) of the last segment, is always yellow. On the ventral side, the extent of the brown and pale-yellowish is equally variable. Legs reddish-yellow, more or less distinctly brownish in the middle of the femora and tibiæ, especially of the last pair. Wings hyaline, veins brownish-yellow; anterior crossvein nearly opposite the tip of the auxiliary vein; the distance between it and the posterior crossvein is equal to about double the length of the latter; third vein, beyond the crossvein, nearly straight, parallel to the second; fourth and fifth veins very thin, except a very short distance beyond the great crossvein; the course of the fourth vein is a little diverging from the third; the costal vein reaches the tip of third.[†] Length 2–3 millim. I have about 30 unpinned specimens before me; they seem to be all females.

Fig. 30.—Wing of Chloropisca prolifica showing nervulation—greatly enlarged.

N. B.—It is at the special request of Mr. J. A. Lintner that I venture to describe this species, which belongs to a family I am very little acquainted with. Descriptions of Chloropisca are difficult to draw on account of the sameness of the coloring of the species and of the inconstancy of the same coloring. And in the present case I have not been able to use chætotactic characters, the specimens being unpinned and most of the bristles having fallen off. One of the principal characters is the flatness of the scutellum, which proves this species to be a *Chloropisca;* the proportions of the venation may likewise be of use in identifying the species. Two other *Chloropiscæ* have been described by Loew from N. America: *C. grata* Loew, Centur. III, 92 and *C. trivialis* ibid, III, 87. I can not identify my specimens with either of them.

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* I use the terminology adopted by me in my paper on Chætotaxy, *Trans. Ent. Soc. London,* 1884, p. 503.

[† Although drawn by camera, the engraving fails to show some of these features.]

Noted Assemblages of Chlorops in Europe.

The following literature upon the great accumulation of specimens of Chlorops within buildings — a phenomenon well-known in Europe — has been kindly collected, and communicated to me in letter by Baron Osten Sacken — always so ready to aid in the advancement of American Dipterology:

In September, 1831, an immense number of *Chlorops* gathered in a room in Provost's Lodge, in Cambridge, England. An account by Rev. L. Jenyns was published in *Loudon's Magazine of Natural History*, v, p. 302. The same phenomenon was observed in the same place in September, 1870, when "there must have been millions of them." It is added, however, that they occur regularly every season. (Compare *Proc. Ent. Soc. London*, 1870, p. xxxiv, and 1871, p. —.)

In 1833, the phenomenon took place in the court library in Weimar. Zenker took the fly for a new species, and named it *Traumatomyia prodigiosa*. (*Frorieps Notizen*, xxxv, p. 344.)

In September, 1847, Professor Wager found millions of *Chlorops* in the cupola of the observatory at Warsaw, on the ceiling of a botanical conservatory, and in other places. He computed that there were about 17,971,200 specimens on the ceiling of the conservatory. He observed these accumulations every year. All these localities are surrounded by fields of cereals, and principally wheat. Compare *Rev. de Zoöl.*, 1872, and Schiner's article quoted.

Kiesenwetter, in Zittau, Saxony (*Berl. Ent. Zeit.*, 1857, p. 172); Krauss, in Stuttgart (comp. Brauer, *Jahresber*, 1867, p. 142); Perty, in Switzerland (ibid.); H. Müller, in Lippstadt, in autumn of 1880 (comp. Katter's *Entom. Nachr.*, 1881, p. 17); Guerin Méneville and Laboulbene, in France (*Ann. Soc. Ent. Fr.*, 1875, p. ccvi), made similar observations. Most of them took place in September. Perty saw the phenomenon in March. Most of the observers notice the fancy of the flies for particular rooms, neglecting adjoining localities situated in apparently similar conditions. That the object of the flies was to seek shelter from cold is probable. The following observation by Aubé, although it does not refer to human dwellings, may be suggestive: "About the end of March last, after a not very cold but a prolonged winter, I collected thousands of *Chlorops nasuta* in the state of hibernation. They were huddled together behind a very dense covering of ivy, on the eastern wall of a building" (*Ann. Soc. Ent. Fr.*, 1858, p. lxxiv).

Whether in all the above cases the same species was observed is a very doubtful question. The species is called *Chlorops lœta* (Wager, Krauss, Laboulbene), *C. nasuta* (Kiesenwetter, Aubé, H. Müller), and *C. lineata* (Perty). These identifications have no value whatever, as none of them were made by competent persons, and the nomenclature and synonymy of *Chlorops* is an unsolved problem even for dipterologists.

Phytomyza lateralis (Fallen).

The Marguerite Fly.

(Ord. Diptera: Fam. Phytomyzidæ.)

Fallen: Dipt. Suec., iii, 1823, 3, 2.*
Meigen: Syst. Beschr. bek. europ. zweifl. Ins., vi, 1836? p. 190.
Westwood: Introduc. Classif. Ins., i, 1839, p. 152; id., ii, 1840, p. 573.
Curtis: British Entomology,—Diptera, viii, 1849, pl. 393.
Kaltenbach: Pflanzenfeinde Classe Insekten, 1874, p. 387.
Glover: MS. Notes Journ.—Diptera, 1874, p. 40 (mention).
Goureau: in Ann. Soc. Ent. France, ii, ix, p. 156.
Falconer: in Amer. Florist, ii, 1887, p. 297 (as *P affinis*).

Its First Observation in this Country.

The operations of this insect, an European species, were first detected in this country in October, 1886, in the greenhouse of Mr. Charles A. Dana, at his country residence, Dosoris, near Glen Cove, N. Y. The leaves of some daisies (Marguerites) were seen to show some wart-like specks and irregular, whitish, linear markings, and soon afterward to shrivel up and die. Examination for the cause disclosed small "worms" working within channels in the interior of the leaves.

Some of the infested foliage was sent to Albany on the fifteenth day of February last. When received (two days later) the insect had entered upon its pupal stage, and a single fly had been disclosed and was found within the box. Another fly appeared the following day, and quite a number emerged from time to time until the tenth of March.

Operations of the Marguerite Fly.

In response to request made by me for further information of the attack, it was learned that the operations of the insect had been first noticed by Mr. Wm. Falconer, head gardener at Dosoris, during the preceding autumn, as above stated, and that thus far it seemed to be confined to plants of the Order of *Compositæ*. As it apparently displayed a preference for the daisy, *Chrysanthemum frutescens*, it had been given in the greenhouse the name of the Marguerite fly. Infested leaves of tansy (*Tanacetum*) and of three other species of the *Compositæ* (not identified), each bearing the pupæ, were sent to me. In each of the plants the mining operations of the larvæ had been exten-

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* The following references to other European authors have kindly been given me by Dr. S. W. Williston:

Zetterstedt: Dipt. Scand., vii, p. 2836, 24.—Rob. Desvoidy: in Ann. Soc. Ent. Fr., 2d ser., ix, p. 156.—Schiner: Faun. Austr., ii, p. 313.—Brauer: Denkschr. k. Akad. Wissensch, xlvii, p. 90.

sive, and had caused the leaves to wilt and shrivel to such a degree that it was only by careful unfolding, spreading and pressing that the character of the mines could be made out.

The Larval Mines Described.

The mines observed in the daisy were run with remarkable uniformity, commencing at a point where there was indication of egg-deposit, at the margin of the foot-stalk of the leaf or at one of the lower lobes, following closely the margin up the lobe, excavating it somewhat broadly at the apex, then descending on the opposite side, to turn and mine the next higher lobe and following ones in the same manner. A characteristic feature of the mine is its punctulation along its entire length by small black grains of larval excrement, deposited at rather regular intervals, and almost invariably on the marginal side. An exception to this was an instance where a wavy broad channel had been run toward the center of the leaf, in which the excremental matter was not granular nor deposited marginally, but was diffused throughout the mine — indicating plainly some abnormal condition of the larva.

FIG. 31. A daisy leaf showing the mines and pupæ of the Marguerite fly, PHYTOMYZA LATERALIS.

The mines do not always originate in the lobes. One was observed to commence half-way down the stem of a leaf, and in another instance almost at the base of the stem. They are run upon the upper side of the leaves, just beneath the upper cuticle.

Pupation within the Mines.

When the larva has attained its growth, it excavates a blotch-like space on the lower side of the leaf, where it transforms to a pupa, which, covered only by the thin and transparent cuticle that in drying contracts over and closely about it, seems as if it were lying exposed upon the outer surface. Its deeply incised segments show distinctly, and its two subcylindrical contiguous anal spiracles — projected almost at a right angle one with the other, are thrust outward through the cuticle in its contraction.

It is believed that all of the pupa observed in the month of February, were in the position above stated. In several of those received by me the present November, and now before me, they are plainly to be seen occupying the upper surface of the leaf. Can this be accidental or is it a seasonal feature?

Mr. Falconer's Account of the Insect.

Mr. Falconer has contributed to the *American Florist*, for March 15, 1887, ii, p. 297, a short notice of "The Marguerite Fly, *Phytomyza affinis*" (the scientific name taken by him from some European journal), giving items of its habits and life-history, which we copy:

The fly is a small insect and might readily be mistaken for one of the little flies so abundant about fermenting horse-manure. When disturbed it hops about rather lazily or flies from one branch to another, but seldom flies away for more than a few feet. It lays its eggs singly under the skin of the leaf, and wart-like specks form over the eggs. In a few days time little white grubs are hatched, which are the evil workers. * * * After two weeks energetic eating, the larva thrusts its head outside of the skin of the leaf and pupates. From the laying of the egg till the perfect fly issues from the chrysalis is within five weeks. I conclude this to be the case, from some clean cinerarias which were brought into the greenhouse in which the Marguerites were growing, the leaves of which at the end of five weeks contained not only eggs, larvæ, and pupæ, but also empty pupæ cases. The work of increase appears to proceed incessantly.

Successive Broods of the Insect.

Mr. Falconer is doubtless correct in his belief of successive broods, for from the evidence he adduces above of its maximum life-cycle, coupled with my observations, there would seem that there must be at least three broods during the autumnal and winter months. Leaves sent to me on November 14th of this year contained pupæ (crushed), indicating an appearance of the fly at about the middle of November. Flies emerged in my office from pupæ, during the middle of February last. The intervening period would give more than the required time for another brood occurring at the assumed interval of five weeks.

Larval Food-plants.

Mr. Falconer gives the following report (*loc. cit.*) of the larval food-plants:

Although the Marguerite seems to be its favorite food, it does not at all restrict itself to this plant, but attacks every other composite plant within its reach. Judging from its behavior here, it even prefers the double white feverfew to the Marguerite. It has also attacked

Eupatoriums, Gazanias, *Helianthus multiflorus*, and, as above mentioned, Cinerarias. These, at present, are about all the composites within its range. I have not observed it on any other order of plants.

Localities.

In addition to its presence at Dosoris, the insect is also operating in the greenhouse of Mr. T. L. M. Barlow, at Glen Cove Landing, and in the greenhouses at Queens, L. I., and at Hinsdale — a station on the Long Island Railroad, about fifteen miles from New York city.

Importance of Arresting its Spread.

It will be readily seen that from the prolificacy of this new insect pest, and the character of its injury to the foliage of the plants of the favorite and extensive family which it claims for its food, that it will prove, both to florists and lovers of flowers generally, an unwelcome addition to our insect fauna. It would, therefore, be well, if earnest and persistent and a successful effort can be made for destroying it in the limited locality to which it seems for the time restricted. It should be borne in mind that almost without exception, newly-introduced insect pests display a wonderful ability to inflict greater injuries in their new home than they were wont to do in their old. Up to the present, we only know this fly as a greenhouse pest. Should it be found hereafter continuing its propagation during the summer months in the garden, a great increase of harm would be the result from the large number of our valued *Compositæ* that would then be exposed to its attack.

Remedies.

Leaf-miners, like the numerous larvæ that find secure shelter within their burrows in plant-stalk and tree-trunk, or beneath the surface of the ground, are almost wholly beyond the reach of our best insecticides; and when occurring in large numbers, as does the Marguerite fly, it is useless to attempt to fight them by any of the ordinary applications which the economic entomologist is accustomed to recommend against the larger and more vulnerable class of exposed insects. Experiment can alone show the best method of meeting this newly introduced greenhouse pest. Perhaps vessels of diluted molasses and vinegar, or other liquid developing fermentation, placed in flat vessels, would attract the flies and drown them as soon as they emerge from pupæ and before they are in readiness to deposit their eggs. But, until some other successful method can be found, it would be best to examine the plants at brief intervals after the first recognition of the attack, and pick off every infested leaf and burn it. This, we learn, was done at Hinsdale in early winter, with the result of arresting the attack and securing a full bloom. Crushing the larvæ between the thumb and finger, as sometimes recommended, would prove too slow and too costly an operation. When the plant is seen to be so badly attacked that the removal of the infested leaves would almost involve its defoliation, then the plant should be burned at once. By such stringent measures there is but little doubt that an attack taken at, or soon after, its commencement would be arrested.

Identified with the European Form.

As the insect and its attack seemed to be unknown in this country, examples of the fly, together with its pupæ and mines, were forwarded to Baron Osten Sacken, who readily identified it as the *Phytomyza lateralis* Fallen, of Europe, and cited the following literature upon it:

"It is figured in Curtis' *British Entomology*, vol. viii., Diptera, plate 393. The description is incorrect and misleading; a better one may be found in Schiner's Fauna.

"According to Kaltenbach, *loc. cit.*, the fly has been found in the heads of *Compositæ* (*Anthemis, Pyrethrum*, and *Chrysanthemum*) and also in the stems of *Centaurea* (of the *Compositæ*), *Verbena*, and *Urtica dioica*.

"Schiner quotes from *Ann. Soc. Ent. Fr.*, ii., 9, 156, to the effect that Goureau had found the larva mining in *Sonchus oleraceus*, or sow-thistle. It is nowhere else recorded as a leaf-miner."

Description of the Fly.

Curtis' description above cited, is as follows: Silky cinereous. Head and antennæ black; lip and face yellow: eyes with a reddish tinge when alive, entirely black when dead; several black bristles on the crown of the head and a row down each side of the face. Thorax with the pleuræ yellow, six longitudinal rows of strong black bristles and several of smaller ones between them. Abdomen black, shining, and pilose, a broad margin on each side beneath and the anterior edges of the segments yellow, that of the sixth being the broadest. Wings yellow at the base, nervures brown, the central one very faint. Halteres yellow. Legs black, tips of the thighs yellow.

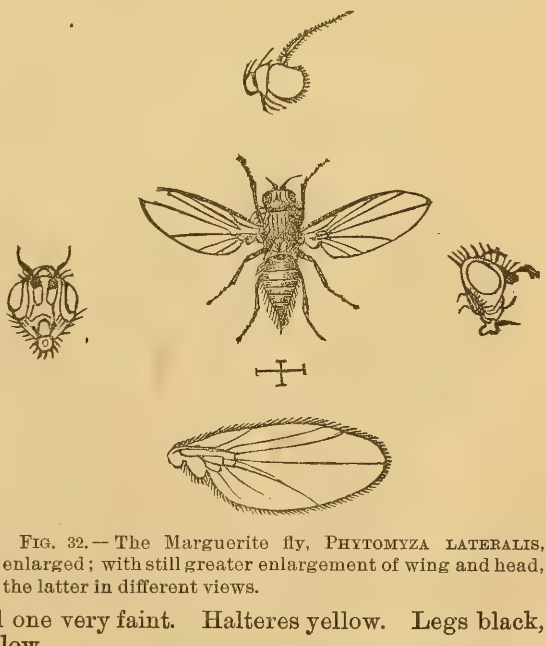

Fig. 32.—The Marguerite fly, Phytomyza lateralis, enlarged; with still greater enlargement of wing and head, the latter in different views.

Generic characters accompanying the above, which will be serviceable in identification, are the following (omitting the details of the head-parts — antennæ, proboscis, etc.):

Head somewhat vertical, broad and rather short, pilose. *Eyes* lateral, remote, oval. *Ocelli* three, minute. *Thorax* somewhat globose. *Scutellum* subtrigonate, rounded. *Abdomen* seven-jointed in the female, ovate-conic, tapering to the apex which is furnished with a retractile tubular ovipositor. *Wings* incumbent, longer than the body, rather broad and ovate, iridescent, ciliated, subcostal nervure very short, second and third not reaching the apex, united near the base, fourth passing along the center, fifth remote, the three last united near the base by a transverse nervure. *Halteres* clavate. *Legs* nearly of equal length, slender. *Tarsi* five-jointed, basal joint the longest. *Claws* minute.

The following brief memoranda of colorational features were made by me from fresh examples of the fly:

Head and thorax ash-colored, the latter with six rows of curved black bristles. Abdomen above black except at the sutures; beneath greenish, traversed by a broad black mesial stripe, which is narrowed before and widens to twice its anterior width behind, interrupted at the sutures. Balancers greenish, as the abdomen beneath. Legs black, the tips of the femora pale. Wings iridescent, pale at base.

Family Relations.

The *Phytomyzidæ*, to which this species belongs, is a small family which has representation in North America in only the single genus which gives it name. It finds place toward, and almost at, the end of the Brachycera — the second of the three sections in which the Diptera are divided, following after the more familiarly-known families of *Oscinidæ* and *Agromyzidæ*.

Allied Species.

Nothing, apparently, has been published by our writers of the habits of the North American species of *Phytomyza*, of which there are seven named in the Osten Sacken Catalogue of 1878. The European species seem to be more numerous, as Prof. Westwood, in his *Introduction to the Classification of Insects* (1839) has given nineteen British species, with *P. lateralis* as the type; but a recent list would doubtless differ materially from this, as the result of subsequent generic changes and discovery of additional forms.

Of the habits of *Ph. lateralis* in Europe, Prof. Westwood states (*loc. cit.*, p. 573) that its larvæ and pupæ are found in the center of the receptacles of *Pyrethrum inodorum* (corn-feverfew), there being seldom more than one in each. Glover says that "the larva forms a gall in the center of the receptacle" of the feverfew.

The larvæ of the European *Ph. flava*, according to Doubleday, are subcutaneous in the leaves of *Scolopendrium vulgare* (hart's-tongue — a fern, which also occurs, although rarely, in Central New York).

Ph. flaviceps mines the leaves of the woodbine, and *Ph. obscurella*, those of the holly (Holiday). The latter, according to Glover, feeds on honeysuckle and pupates in the earth.

Ph. nigricornis Macq., according to Curtis, mines in the underside of leaves of turnips, peas, etc., and forms long galleries beneath the lower cuticle, at the end of which the pupa is formed. Glover has figured the fly on plate x, fig. 12, of his MS. Notes on Diptera. It is also figured in Mr. Whitehead's "Report on Insects Injurious to Root and certain other Crops," 1887, as the "black-horned turnip-leaf miner." Its method of mining the leaves of turnips is shown in a figure, and described as burrowing in the parenchyma under the cuticle of the lower side of the leaf, so that it can not be seen in looking at the leaf from above. As many as eighty of its larvæ had been counted in a single Swede plant. Kaltenbach states that this species mines the leaves of monkshood [*Aconitum*].

An Aquilegia Leaf-miner of Similar Habits.

I am under many obligations to Dr. James S. Cooley, of Glen Cove, N. Y., for first calling my attention to the operations of *Phytomyza lateralis;* for sending me material from time to time for its observation, and for communicating to me information regarding it.

Dr. Cooley has also sent leaves of a columbine, *Aquilegia*, which have been destroyed by the operations of a leaf-miner, the attack of which is made only during the summer. The mines usually start at near the base of a leaf, are pretty broad even at the commencement, are wavy or curved at times in their progress toward one of the lobes, where they terminate, not in a blotch, for the larvæ leave them (probably for pupation in the ground) at this point, through a rupture of the cuticle (often crescentic) at their outer margin. The mines, of which there may be three or four on a single

Fig. 33.—Columbine leaves showing operations of an unknown leaf-miner.

leaf, are seen only from the upper surface. They are white, crinkled, conspicuous, and with the small excremental grains often deposited in two parallel lines near the margins.

Effort will be made the coming summer to procure the insect producing these mines, which may perhaps prove to be another species of *Phytomyza*.

Megilla maculata (De Geer).

The Spotted Lady-bird.

(Ord. Coleoptera: Fam. Coccinellidæ.)

Coccinella maculata De Geer: Mem. Hist. Ins., v, 1775, p. 392, pl. 16, fig. 22.

Coccinella 10-maculata Fabricius: Spec. Ins., i, 1781, p. 99, No. 29; Mant. Ins., 1787, p. 57, No. 44.

Hippodamia maculata Melsheimer: Cat. Coleop. U. S., 1853, p. 129.—Glover: in Rept. Comm. Agricul. for 1866, p. 41 (parasitic attack); id. for 1874, p. 123 (feeds on Colorado potato-beetle eggs).—Walsh-Riley: in Amer. Entomol., i, 1868, p. 46, fig. 36; p. 186, fig. 138: p. 194, fig. 135.—Riley: 1st Rept. Ins. Mo., 1869, p. 112, fig. 49.—Packard: Guide Stud. Ins., 1869, p. 511, fig. 509 (mention).—Reed: in 2d Rept. Ent. Soc. Ont. for 1871, p. 71–2, fig. 72.—Saunders: in 8th Rept. E. S. O. for 1877, p. 36, fig. 10.—Williams: in 9th Rept. E. S. O. for 1878, pp. 43, 44, fig. 30.—Comstock: in Rept. Comm. Agricul. for 1879, p. 177, fig. 30 (mention).—Forbes: Bull. 6, Ill. St. Lab. Nat. Hist., 1883, pp. 51, 52 (food); 14th Rept. Ins. Ill., 1885, p. 21–2 (eats corn).

Megilla maculata Crotch: Ch List. Coleop. N. A., 1873, p. 49, No. 2823; in Trans. Am. Ent. Soc., iv, 1873, p. 364 (description).—Webster: in Bull. 3, Ill. St. Lab. N. H., 1880, p. 152; in Amer. Entomol., iii, 1880, p. 173 (eats pollen).—Riley: in Amer. Nat., xv, 1881, p. 326 (feeds on corn); id., xvii, 1883, p. 322–3 (food-habits).—Griffith: in Amer. Nat., xvi, 1882, p. 408 (eaten by *Microcentrus retinervum*).—Lintner: in Count. Gent., xlviii, 1883, p. 941 (a corn pest).—Saunders: Ins. Inj. Fruits, 1883, p. 125, fig. 129.—Dimmock: in Cassino's Stand. Nat. Hist., ii, 1884, p. 312.—Hunt: in Miss. Ess. Econ. Ent., 1886, p. 92–3 (bibliog. of corn insects).—Howard: Bull. 17, Chinch Bug; Div. Ent., U. S. Dept. Agricul., 1888, p. 22, fig. 4 (food).

A New Corn Pest.

In the autumn of 1883, beetles sent for name, from Fairfield, Conn., as "making bad work with corn," were identified as this species. In response to the inquiry made of them, the following communication was published, substantially, in the *Country Gentleman*, of November 22, 1883.

The insects sent are "lady-bugs," of the species popularly named "the spotted lady-bird," and the *Megilla maculata* of our present catalogues — formerly *Hippodamia maculata.* Its detection on corn, as above, is of special interest, as it is the third time that testimony has been borne to the effect that the above species, for a long time thought to be entirely harmless, may, under certain circumstances, become decidedly injurious.

Not all of the Lady-bugs are Carnivorous.

The family of *Coccinellidæ,* comprising the lady-bugs, has been regarded as entirely carnivorous, and as the food of very many of the species consists largely of plant-lice, they have been taken under the protection of entomologists and of all others who knew of the great service that they render in checking the prodigious multiplication of the destructive aphides. Within a few years past it has come to light that the members of the family are by no means exclusively confined to an animal diet, but that a number of them subsist, in part, upon vegetable food. In several of the species it constitute the larger proportion of their diet. This has been brought out by the pains-taking studies made by Professor Forbes, State Entomologist of Illinois. In a valuable paper published by him, in *Bulletin No.* 6, *of the Illinois State Laboratory of Natural History,* January, 1883, entitled "The Food Relations of the Carabidæ and Coccinellidæ," 31 pages, the results are given of the examination of the contents of the alimentary canal of twenty-one specimens of lady-bugs (*Coccinellidæ*), collected at different times throughout the year, and in various localities, mounted on glass slides, and examined under high magnifying powers. It was ascertained that more than one-half of their food (fifty-three per cent.) had consisted of vegetable matter — mainly the spores of fungi. Of the animal food, above one-third (thirty-six per cent.) was of plant-lice.

We would be very glad if the above investigations, while they have served to greatly extend the known range of food of our pretty friends — the lady-birds — and by their consumption of the spores of useless lichens and noxious fungi, to place us under additional obligations to them, could also have shown us that their mouth-parts were of such a structure as to limit their diet to insect pests and worthless vegetation. But other observations have told us a different story.

The Leaves of Corn Eaten by the Beetle.

In the summer of 1874, an insect, which proved to be *Megilla maculata* — the same as the species above mentioned — was sent from St. Inigoes, Md., with the statement that it had done considerable injury to corn by eating holes in the blades (*American Naturalist,* for April, 1881, xv. p. 326). Upon the attempt being made by Professor Riley to verify this statement, which was at variance with previous knowledge of the insect's habits, negative results were obtained, as the beetles refused to eat tender leaves of corn, grapevine, clover, et cet., offered to them.

The Beetle seen Feeding on Corn in the Ear.

In August of 1882, Mr. Pergande, of the Entomological Division of the Department of Agriculture, while searching for injurious insects on corn, near Washington, "saw several imagos and larvæ of this species actually eating into the soft kernels of the ear. The beetles were almost entirely hidden within the nearly empty kernels, and it could plainly be observed that they were eating. Upon removing them, the most careful observations failed to disclose any other insect in the kernel. The larvæ were found in similar situations, actually engaged in eating the substance of the soft seeds." (*American Naturalist*, for March, 1883, xvii, page 323.)

In reply to my request made to the gentleman, Mr. Sturges, of Fairfield, Conn., who had sent the beetles, for additional information in regard to their attack on his corn, he has written as follows:

> I send you herewith some ends of corn eaten, as I suppose, by the bug. I at first thought that the damage was done by birds, but I found the bug under the leaves, and I watched closely, and in every ear I discovered some of these in the kernels. The corn was then in the milk and the kernel soft. As the corn hardened the eating stopped.
>
> I have found them in three pieces of corn, widely separated, and also in my garden. All of the bugs that I sent you were taken out of kernels.

Its Manner of Feeding on the Corn.

Twelve of the beetles were sent me by Mr. Sturges. The ends of ears, of which there were a number, are eaten from two to nearly five inches downward from the tip. The interior of the kernels is entirely eaten, leaving only the outer shell, dried, black, and shriveled. Where the injury has been the greater, it is seen to have extended by holes eaten into the sides of the kernels adjoining the already eaten portions, quite unlike an opening made by a bird, and, judging from accounts, after the same manner of the like injury committed by another corn-pest recently brought to light, viz., *Diabrotica longicornis* (Say) — one of the *Chrysomelidæ*.

The corn-eating propensity of the beetle is also confirmed by observations of Professor Forbes, given in the Fourteenth Illinois Report, as follows: "Last August we saw it eating the exposed kernels at the tip of the ear, hollowing out their substance, and partly buried in the cavities thus made."

In consideration of the above authorities and circumstantial statements, we are compelled to admit that the Megilla does, occasionally at least, become injurious to corn. It is known to occur in great abundance, at times. I have seen it during the month of August collected by hundreds around the base of some honey-locusts (*Gleditschia triacanthos*), between the trunk and ground, at Middleburgh, N. Y. It has also been reported as found "lying in piles under the leaves and grass about the roots of apple trees, and always upon the south side of the tree." (*American Entomologist*, i, 1869, page 186.)

Its Injuries to Corn not of Frequent Occurrence.

At times of such abundance as above, it may be driven for sustenance to other than its ordinary food. Should this prove to be the explanation of its occasional foray upon our cornfields, we should not find fault with it, if by way of dessert it should indulge moderately in corn-in-the-milk, after all the substantial viands of its accustomed bill of fare, as plant-lice, chinch-bugs and Colorado potato-beetles in the egg, have been consumed. The vast amount of service that it renders us entitles it to all the praise that we have hitherto bestowed upon it, and all the protection that we have endeavored to extend to it previously to the discovery of this one bad trait in its perhaps otherwise faultless habits.

The Beetle Described.

That similar attacks upon corn by this insect may be recognized and reported, the following description of it is given, together with an enlarged representation of it and of its earlier stages :

Fig. 34.—Megilla maculata: *a*, tarsus; *b*, antenna; *d*, larva; *c*, pupa—all enlarged. (After Emmons.)

The beetle is one-fourth of an inch long, more elongate-oval than the lady-bugs usually are, and of a peculiar red color, often called pink. The head is black, with the exception of a median red line. More than half the area of the thorax is occupied by two pyriform black spots, narrowed behind. On the wing-covers are ten black spots, of which the three anterior ones are in line, followed by two larger on the middle, then by three others, and last by two on the tips of the covers; one-half of the central one in each line of three spots rests on each wing-cover. The legs and body beneath, except its margin, are black.

Its Extended Distribution.

This insect has an unusually wide distribution over the world, occurring in Canada, the United States, Central America, South America and Europe.

Chauliognathus marginatus (Fabr.).

The Margined Soldier-Beetle.

(Ord. Coleoptera : Fam. Lampyridæ.)

Fabricius : Syst. Ent., 1775, p. 206; Spec. Ins., 1781, p. 259, No. 8; Mant. Ins., 1787, p. 157, No. 9 (*Cantharis marginata*).

Hentz : in Trans. Amer. Philos. Soc., 2d Ser., iii, 1830, p. 460, pl. 15, figs. 1, *a–f* (description, habits and peculiar structure).

LeConte : in Proc. Acad. Nat. Sci. Phil., v, 1851, p. 338 (as *C. Hentzii*); in Trans. Amer. Ent. Soc., ix, 1881, pp. 44, 68.

Walsh : in Amer. Entomol., i, 1868, p. 52 (compared with *C. Pennsylvanicus*).

Riley : 5th Rept. Ins. Mo., 1873, p. 154 (food-habits).

Provancher : Pet. Faun. Entomolog. Can.—Coleop., 1877, p. 414–5 (descript).

Glover : MS. Notes Journ.—Cotton, 1878, pl. 13, fig. 6 (on cotton).

Trelease : in Comstock's Cotton Ins., 1879, p. 322 (food).

Lintner : in Count. Gent., xlix, 1884, p. 897 (larva in apples).

Henshaw : List Coleop. N. A. Amer., 1885, p. 77, No. 4876.

The Insect Mistaken for a Fruit Pest.

The need of such a knowledge of insects as will enable the agriculturist, the fruit-grower, etc., to know and readily recognize his insect friends, and thereby spare them so far as may be from the destruction with which he would visit his insect foes, has often been urged by entomological writers. Such need is shown in the following note received:

Inclosed please find specimens of an insect very destructive to our better class of apples,— wine saps, etc. I should like to learn its name, habits, and how to meet it practically. This larva makes a round hole in the apples sideways, enlarging the hole often to half or three-quarters of an inch in diameter, when, as a result, the apple rots and drops. To destroy the larva by hand would necessitate removal of more than one-sixth of the crop — too slow and not thorough, for obvious reasons. The small ants attack the insect, biting into its back, and adhering sometimes, but without effect. The larger ants, bugs (of the white grub transformation), etc., feed in company with the insect. Quinces rot enormously, and, in about two-thirds of the specimens on the ground, I find the holes probably made by this same insect.

Importance of Knowing our Many Insect Friends.

The above communication is a strong argument in favor of the importance of the study of the habits of insects by the economic entomologist, and the distribution of the knowledge thus obtained through publications easily to be understood, illustrated with good figures, and accessible to all to whom they may be of service.

It should generally be known that not all insects are injurious. There are those that are the farmer's best allies, though often occurring under circumstances so suspicious as usually to cost them their lives. Of these are the numerous species of "lady-birds," or "lady-bugs," which often abound upon sickly vegetation infested with plant-lice, where they have been drawn to feed upon the destructive aphides. Nearly all of the entire family of *Ichneumonidœ* (ichneumon flies) are of great service to the agriculturist, from the immense number of caterpillars which they destroy. Many of the *Hemiptera* (bugs) prey upon caterpillars and other injurious forms. A large proportion of the *Lampyridœ* — the family of beetles to which the "lightning-bugs" or "fire-flies" belong — feed upon other insects in both their larval and perfect stages.

Appearance of the Larva of Chauliognathus.

It is to this last-named family (or the sub-family of *Telephoridœ*) that the insect pertains, of which inquiry is made. As stated, the example sent was in its larval stage. It has the form characteristic of many of the Coleoptera — a head of goodly size armed with stout jaws, a thorax not much larger than the head, bearing six conspicuous legs, and a long, soft abdomen, somewhat broader centrally. This particular one is dark brown in color and of a peculiar velvety appearance, not differing greatly from some of its congenors. It was identified by Prof. Riley as *Chauliognathus marginatus* (Fabr.).

The Margined Soldier-Beetle, a Beneficial Insect.

It is the first time that the margined soldier-beetle (its common name) has been noticed under circumstances that show it to be entitled to a place among our beneficial insects, although its habits were previously suspected. There can be no doubt but that it was drawn to the fruit in such numbers as above stated (infesting one-sixth of the entire crop), for no other purpose than to feed on the common apple-worm, the larva of the codling moth, *Carpocapsa pomonella.* It would naturally, we think, enter the fruit in search of its prey, through the hole already made by the apple-worm in the side of the apple for the discharge of its excrements, and for its final exit. But in the event of the hole being too small for entrance, its enlargement would be necessary, and if, as we infer from the above communication, it has been actually seen eating into the fruit, it would probably be while engaged in such enlargement. It would be an interesting fact if it had been observed in the act of making a perforation where none previously existed.

Service Rendered by the Pennsylvania Soldier-Beetle.

In the Fourth Report of Prof. Riley on the insects of Missouri (page 28), he notes his discovery that the larva of another species of *Chauliognathus* — the *C. Pennsylvanicus* of De Geer (the *C. Americanus* of Forster), "destroys the apple-worm while leaving the fruit, and in all probability, seeks them out while in the fruit." It had previously been known to prey upon the larva of the plum curculio. Figures of the insect in its larval and perfect stages are here given. In its final stage of a beetle — quite in contrast with its earlier life, it is believed to feed only on the pollen of flowers; and actively engaged in this pursuit, it may be found abroad during the months of August, September and October. From the 5th to the 18th of August, 1884, it was observed by me in unusually large numbers upon the blossoms of the golden-rod, *Solidago*, at Palenville, N. Y., the larger proportion of the individuals occurring at that time mated.

FIG. 35. — The Pennsylvania soldier-beetle, CHAULIOGNATHUS PENNSYLVANICUS; *a*, the larva; *b*, its head enlarged; *i*, the beetle.

Comparison of the Two Soldier-Beetles.

C. Pennsylvanicus has frequently been figured in Entomological reports, as, in addition to the previous citation — in the First Missouri Report, p. 19; Fourth Illinois Report, p. 108; American Entomologist, p. 51, "A Friend Unmasked;" Packard's Guide, p. 487, etc. By referring to the figures given, with the aid of the following quotation from Walsh, its congener, *Chauliognathus marginatus* — the newly detected apple-worm eater — may easily be recognized in its beetle state.

A very closely allied species [to *C. Pennsylvanicus*], the margined soldier-beetle (*Ch. marginatus* Fabr.) swarms everywhere in South Illinois in June and July, on the flowers of the blackberry, the redroot, etc., but it is not met with in the more northerly parts of the State. It might be readily mistaken at first sight for the other one, but is distinguished by being several times smaller, and by usually having its entire wing-cases except a very narrow yellow margin all around (hence comes the specific name) occupied by the black color, which in the other species forms a mere black patch at the tip.

The following is added to the above in relation to the supposed habits of the larva: "The habits [carnivorous] of the two are doubtless the same, or nearly the same. Spare their lives, I beg and pray you, for your own sake, ye pitiless haters of everything that ye have chosen to label with the three ominous letters —B U G! Ye may not, perhaps, care for bugs, but I know that ye dearly love peaches." (The Pennsylvania soldier-bug has been found abundantly in and beneath peaches lying upon the ground, infested with the curculio.)

The eggs of the margined soldier-beetle are probably deposited loosely in masses in the ground during the month of July, to hatch into larvæ and to mature slowly, after the habits of the other species with which it has been compared, as detailed in the *Second Report of the United States Entomological Commission*, p. 261–2.

C. marginatus may Feed on the Quince Curculio.

The holes in the quinces, of which mention is made in the communication given on page 204, if originally smooth and round, were probably bored by the larva of the quince curculio (*Conotrachelus cratægi* Walsh) as it emerged from the fruit in August or September for its winter burial in the ground. Through these holes the soldier-beetle larva might enter the fruit in search of the remaining curculio larvæ, of which there are often several in the same quince, as these would doubtless prove quite as palatable to it as the apple-worm.

Observations Desired.

Careful observation and account of the actions of the larvæ of the soldier-beetles in their search for, and while preying upon, the apple worm or other insects, would be an acceptable contribution to their history, which we hope may be ere long supplied by some of our fruit growers who have recognized the importance to them of the study of insect-habits.

Description of the Beetle.

Yellow-orange. Antennæ and palpi brown, yellowish at the base. Head with a large black spot on the vertex, bifurcating to meet the eyes. Prothorax a little longer than broad; its sides straight, lightly rounded before, with a broad longitudinal black band in the middle. Wing-covers elongated, narrow, yellow, margined with a paler line and bearing near to its extremity a black spot more or less elongated. Beneath yellow; prosternum, with the extremities of the femora, tibiæ, and tarsi more or less darker. Length 0.40 inch.

Var. Wing-covers entirely brown with the exception of their pale yellow margin. (Provancher, *loc. cit.*)

It will be seen that the black coloring on the wing-covers varies greatly in this species, as it does also in *C. Pennsylvanicus*, in which it sometimes covers nearly the entire surface.

The synoptical characters given by Dr. LeConte, in his admirable "Synopsis of the Lampyridæ of the United States" (*Trans. Amer. Ent. Soc.*, ix, 1881, pp. 15-72), are the following:

Prothorax longer than wide, opake yellow, with a broad, black, dorsal stripe, sides very narrowly margined; elytra with discoidal spot sometimes extending nearly the entire length, sometimes wanting. Length 8–11 mm., = .32–.44 inch. New York; Florida.

Sitodrepa panicea (Linn.),

As a Leather-Beetle.

(Ord. Coleoptera: Fam. Ptinidæ.)

Dermestes paniceus Linn.: Syst. Nat., ii, 1767, p. 564, No. 19.
" " Fabr.: Syst. Ent., 1775, p. 57, 14; Spec. Ins., i, 1781, p. 66, No. 18; Mant. Ins., i, 1787, p. 35, No. 22.
Anobium obesum Say: in Journ. Acad. Nat. Sci. Phil., v, 1825, p. 173; Compl. Writ., ii, 1883, p. 281.
" " Melsheimer: in Proc. Acad. Nat. Sci. Phil., ii, 1844, p. 309.
" " Glover: in Rept. Commis. Pat. for 1854, p. 72, pl. 5 (in wheat from Algeria).
" *paniceum* Horn: in Proc. Ent. Soc. Phil., i, 1861, p. 29 (food and pupation).
Sitodrepa panicea Glover: in Rept. Commis. Agr. for 1868, p. 98, fig. 152 (transformation, food, etc.); id. for 1870, p. 66 (tobacco, etc., eaten).
" " LeConte: in Proc. Acad. Nat. Sci. Phil. for 1865, p. 229.
" " Packard: Guide Stud. Ins., 1869, p. 470, fig. 440 of larva, p. 131 (parasitic [?] on humble bees).
" " Shimer: in Amer. Entomol., ii, 1870, p. 323, fig. 200 (feeding habits).
" " Thomas: 6th Rept. Ins. Ill. [1877], p. 122, fig. 12 (description, habits, etc.).
" " Saunders, W. E.: in Canad. Entomol., xv, 1883, p. 80 (a drug pest).
" " Hamilton: in Canad. Entomol., xv, 1883, p. 92 (a museum pest).
" " Henshaw: List. Coleop. N. Amer., 1885, p. 83, No. 5267.

An Insect Attack on Leather Reported.

A letter was received under date of May 10, 1887, from the editor of "Boots and Shoes,"—a weekly journal published in the city of New York — stating:

"One of our subscribers writes that he has had a lot of shoes ruined by a small bug which burrows into the leather and deposits its eggs, perforating the leather in all directions. He would like to know the nature of this bug, and also how to prevent further ravages in his stock. Can you, without seeing the bug, suggest what it probably is, and a remedy? If so you will confer a favor on the writer as well as the subscribers of "Boots and Shoes."

Dermestes vulpinus as a Leather-beetle.

To the above, reply was made to the following effect: The depredator is probably the *Dermestes vulpinus*, or the leather-beetle. It has for some time been known to be injurious to skins and hides, and has also been found abundantly about some bone-boiling works in England. Two years ago, it was brought to the notice of Prof. Riley (see his report, in that of the Commissioner of the Department of Agriculture, for the year 1885, pp. 258–264 [from which the accompanying illustrations have been obtained], as occurring in a number of wholesale boot and shoe houses in St. Louis, where boxes of shoes that had been packed for some time, were swarming with the insect in the different stages of its development. It was observed that the soles and heels of boots and shoes were more liable to be injured than the uppers, probably resulting from the oily dressing used in the latter. The operations of the larva are described as boring round and smooth holes through the leather in every direction, very often entering the shoe at the joining of the heel with the sole, or at any point in the crevice between the upper and the sole, where the larva could find the purchase for its boring.

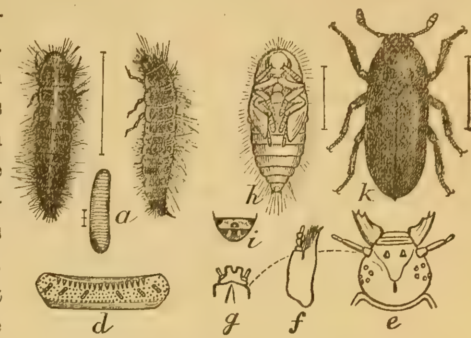

Fig. 36.—The Leather-beetle, Dermestes vulpinus: *a*, egg, and larva; *h*, pupa; *k*, beetle; *d*, a denuded middle joint of the larva to show spines, etc.; *i*, ventral view of tip of abdomen of male beetle; *e*, head of larva; *f*, maxilla and palpus of same; *g*, labium with palpi—enlarged.

The larva sometimes transforms to the pupa state within the leather, but it usually leaves it for a crack in the box containing the shoes, or in the floor adjoining, where it burrows out a suitable place for its change to the pupal and perfect stages.

The beetle, also, is injurious to the leather by gnawing its surface, but it does not burrow into it as does the larva.

Professor Riley, in the paper cited, offers the following remedies for its attack:

The contents of the infested cases of boots and shoes might be overhauled and treated with benzine or some other efficient insecticide.

The larva could be destroyed by placing an open saucer containing bisulphide of carbon on the top of the contents, the heavy vapor of which, if the box is a tight one, will fall downward and kill the insects within.

To the above, I would add the suggestion that a degree of heat might easily be applied to the infested stock that would suffice to destroy the larvæ without injury to the leather.

Sitodrepa panicea also Eats Leather.

Another beetle, which is widely distributed over the civilized world, and is such a general feeder that it has been said of it that "it will eat anything except cast iron," viz., *Sitodrepa panicea* (Linn.), has also been brought to my notice in former years as having injured boots and shoes. But in this instance, it is probably the first-named species that is the culprit. If it be so, it may be known from the statement above given of the manner in which it does its work.

Sitodrepa the Author of the Reported Injury.

Later, one of the infested shoes was sent to me at my request, which permitted identification of the author of the injury by giving forth several of the beetles. The editor of "Boots and Shoes" was accordingly written, substantially, as follows, the communication appearing in the issue of June fifteenth:

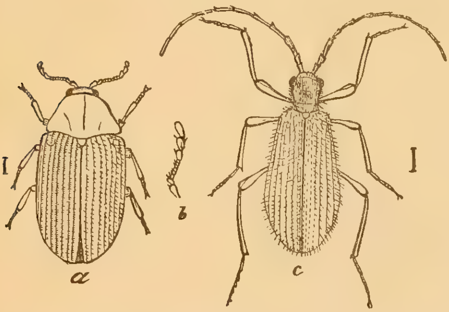

FIG. 37.—*a*, SITODREPA PANICEA; *b*, antenna of same; *c*, PTINUS BRUNNEUS.

The insect previously reported to me as burrowing into shoes, and which, in consideration of the few particulars given me of the nature of its operations, was believed to be *Dermestes vulpinus*, is found to be another insect — the second one that was suggested as the possible culprit, viz., *Sitodrepa panicea*. [The beetle is shown at *a*, in figure 37.]

Nature of its Injuries.

The shoe containing the larvæ, subsequently sent to me by your direction, to show the nature of the attack, was duly received. It is an Oxford strap of calf with kid uppers. If I may judge from its shape and general appearance, it is not of recent manufacture, but has been in stock for some time. Perhaps its age may have invited the attack. The nature of the injury to the shoe is as follows: In two places on the side where the vamping is stitched to the upper, the former is cut through just below the stitching—on one side to the extent of about an inch — showing the leather within to be nearly all eaten away by the burrowing of the larvæ of the beetles. The extent of the burrowing in other parts of the shoe can not be stated, as it is not permitted to take it apart for further examination. It is inferred, however, that a large portion of the leather has been burrowed in the same manner, judging from the number of little round holes of the diameter of the beetle eaten through the calf just below, within a half-inch of the stitching. The holes are as round as if they had been cut by a punch, and their slight difference in diameter is evidently caused by the difference in size of the beetles. Of these holes, sixty-six were counted, indicating as many beetles, which, having completed their transformations, had eaten their way outwardly, for their escape. That the holes were made in this manner and for this purpose, is evident by their enlarged size within (somewhat funnel-shaped), and the small pile of powdered leather that lay in the box in which the shoe had been placed, beneath the point of exit of each of the five beetles that have escaped during the week that the shoe has been under observation. There may still be many within it, to mature and escape hereafter.

The kid-upper also shows two of the holes near the stitching and one at the upper edge near the binding. The last named one appears as if it may have been eaten inwardly from the outside.

I judge from the indications that the eggs of the parent beetle had been deposited at the upper edge of the stitching, and that the larvæ upon hatching had burrowed downward beneath it.

Mr. Myer Mandelbaum, boot and shoe dealer of this city, to whom the attack was shown, stated to me that he had in one instance seen shoes, purchased in New York, that had been perforated in the same manner, although not to an equal extent.

Sitodrepa Almost Omnivorous.

This beetle, *Sitodrepa panicea*, has long been known to science, and has often been written of, it being a common species which has been distributed through commerce over nearly all the civilized world. While many of the beetles are confined to one article of food, this is remarkable for its feeding on a very large number of substances differing greatly in character. I have known it to occur abundantly in the cayenne of druggists, feeding in its larval state on this pungent material, and making of the powder little cells within which it transformed to the pupa, and subsequently to the perfect insect. It is a well-known pest in drug stores, as will appear from the extended list of drugs, in which it has been reported as occurring, by Mr. Wm. E. Saunders, of London, Ontario, viz.: Aconite root, bitter almonds, sweet almonds, angelica, boneset, calumba, chamomile, chocolate, coriander, dandelion, elm bark, ergot, extract of licorice, German chamomile, orris root, prince's pine, rhubarb, squill, and sweet flag. (*Canadian Entomologist*, 1883, xv., p. 81.)

It is also reported as feeding on collections of dried plants, collections of insects, cork in insect cases, binding of books, wafers, ginger, cantharides, stored wheat, flour, stale bread, ship biscuit, barley meal, oatmeal, beads made of a certain paste, etc. According to Dr. Packard, it is occasionally parasitic on honey-bees.

Will Probably not Become a Leather Pest.

From the above statements, length of time during which the species has been known, its extensive distribution, and its almost omnivorous habits, the inference may safely be drawn that this beetle will never present itself as a serious leather pest unless it shall be permitted to continue a local attack and multiply itself without efforts made for its arrest. In the greatly extended range of its food, there are many substances upon which it would feed in preference.

How its Attack on Shoes may be Arrested.

An attack by it on boots and shoes in stores can be arrested by the means published in my former communication. If but a few shoes are found to be infested, the insect, in any of its four stages in which it may be present, may be killed by oiling the leather with a sufficient quantity of kerosene to permit of its penetration so as to reach the insect. Kerosene is an infallible insecticide in all cases where it may be safely applied.

Another Leather-eating Beetle.

Associated with *Sitodrepa panicea* in Figure 37, is another beetle, *Ptinus brunneus* Duftsch, the larva of which has shown a peculiar fondness for leather, especially when it has been used in the binding of books. Dr. Shimer has written of its operations in his library, in the *American Entomologist*, ii, 1870, p. 322, as follows:

They usually operate in leather-bound or half-bound volumes, by boring galleries along in the leather where it is joined to the back of the leaves of the book; most frequently about the lineal angle formed by the board-back, and the edge of the back of the leaves. Sometimes they are in the middle of the back, or about its corners. They usually bore along quite under the surface of leather, cutting it almost through; occasionally a small round hole penetrates through the leather to the outer surface. The galleries are filled with the debris. Sheep-bound books seem to be their favorite resort.

This species has not yet, to my knowledge, shown itself as a museum pest, feeding upon objects of natural history, but it may become so enrolled at any day, in the company of two of its congeners — *Ptinus fur* Linn., as recorded by Dr. Hagen,* and *Ptinus quadrimaculatus* Melsh., from my own experience. Several examples of the latter were discovered, dead, in the month of February, in a case of dragon-flies which had been received the preceding summer from South Britain, Conn. Two examples of the same had previously occurred in another case of insects, in which they had evidently undergone their transformations and committed some damage.

Xylotrechus colonus (Fabr.).

(Ord. Coleoptera: Fam. Cerambycidæ.)

Fabricius: Syst. Ent., 1775, p. 91; Syst. El., 1801, p. 345 (*Clytus*).
Olivier: Ent., iv, 1795, genus 70, p. 31, t. 6, fig. 67 (as *Callidium*).
LeConte: in Journ. Acad. Nat. Sci. Phil., ser. 2, ii, 1850, pp. 28, 104 (as *C. agrestis*).
Melsheimer: Cat. Coleop. U. S., 1853, p. 105 (as *Clytus campestris*).
Provancher: Pet. Faun. Ent. Can.—Coleop., 1877, p. 599 (description).
Packard: Bull. 7, U. S. Ent. Comm.—For.-Sh. Trees, 1881, p. 27 (as *Clytus*, pupa descr.), p. 114 (mention); 3d Rept. U. S. Ent. Comm., 1883, p. 258 (description of larva), pl. xii, figs. 2, 2a, 3.
Riley: in Amer. Ent., iii, 1883, p. 239 (bred from oak).
Henshaw: List Coleop. N. Amer., 1885, p. 99, No. 6179.
Leng: in Ent. Amer., ii, 1887, p. 200 (European synonymy and references).

The Beetle Described.

The following description of the beetle is that given by l'abbé Provancher, *loc. cit.* It is stated to be a common species in Canada:

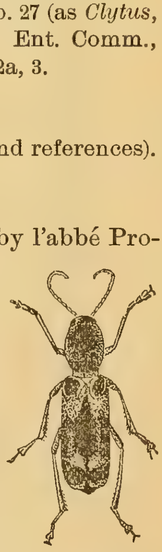

Fig. 38.—Xylotrechus colonus, enlarged. (After Emmons.)

Brown, more or less deep. Front with two approaching longitudinal carinæ, a little more separated between the antennæ. Antennæ reddish, lighter at the extremities. Prothorax with numerous transverse striæ, subcylindrical, with a spot at each angle not very distinct. Wing-covers with two broad transverse bands, the first yellowish-white near the base, and the second, reddish-white at the extremity; this last with a black spot in the middle, and the first often with a point mounting to the scutellum, near the suture, and inclosing another detached spot near the shoulder. Feet reddish with white hairs; femora (thighs) strongly clubbed. Length, 0.50 inch.

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* *Proceedings of the Boston Society of Natural History*, xx, 1878, p. 59.

The Beetle Abundant in a Dwelling-house.

Examples of this beetle, represented in enlargement in Fig. 38, occurred quite frequently in a dwelling-house in Albany, during the month of March. Their distribution through different rooms on the several floors where they had never been observed before, excited curiosity as to their source.

In reply to inquiry made for their name and some information respecting them, answer was returned that they were a species of Longicorn beetle, bearing the scientific designation of *Xylotrechus colonus*, but which was not sufficiently common or of enough economic importance to have received a popular name. (Dr. Packard has designated it as "the common oak Clytus," from the tree which it more usually infests, and the genus to which it was formerly referred.) It was, however, by no means rare in the State of New York, and it not unfrequently fell into the collector's hand in his field excursions.

Limited Knowledge of the Insect.

Little seems to have been written of its habits or life-history, beyond the brief account given by Dr. Packard, viz.: The larva excavates broad, shallow, and irregularly sinuous burrows, about five mm. wide, at its broadest part between the bark and wood of the oak, upward and downward, and extending partly around the trunk. The larvæ, pupæ, and imago may be found in these burrows in the month of May and early June. The newly transformed beetle has been taken as early as the 27th of May. The beetle has also been found under the bark of an old sugar maple in the Adirondack Mountains, N. Y. The figure of the larva given, is from Dr. Packard's "Descriptions of the Larvæ of Injurious Forest Insects," illustrated in ten plates, contained in the 3d *Report of the U. S. Entomological Commission.*

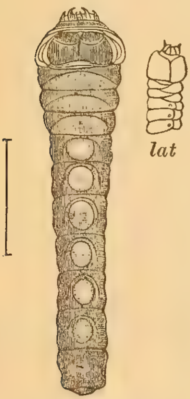

Fig. 39.—Larva of Xylotrechus colonus.

How it May Have Been Introduced within Doors.

The species of the family to which it belongs (*Cerambycidæ*) are seldom seen within doors, and no satisfactory reason can be assigned for the presence of *X. colonus* in such numbers as reported in the present instance. They may perhaps have been contained as larvæ or pupæ in maple or oak fuel, if such was used in the house, or in furniture made of these woods, and their appearing in their final stage of perfected beetles at so early a season, may have been the result of the higher within-door temperature to which they had been subjected.

Long Imprisonment of Beetles within Furniture.

Many instances are recorded where different species of longicorn beetles have made their escape from furniture within the wood of which they had lived as larvæ, after a period of years so greatly in excess of what is known of the natural term of life in the larval and pupal stages of the same insects, that the statements, if accepted, can only be explained through the operation of the artificial conditions under which they had been placed. It is not impossible, that in such instances of unnaturally prolonged lives, there may have resulted a lethargic condition in which respiration and accompanying phenomena were almost or entirely suspended through the complete exclusion of air (a hermetic sealing) by the rubbing, oiling, varnishing, or other polishing which the furniture had undergone.

As an example of such prolonged vitality, the following extract is made from the Third Report on the Insects of New York, by Dr. Fitch (3d–5th Reports, 1859, p. 8), compiled from a more extended notice contained in the History of the County of Berkshire, published at Pittsfield, 1829, p. 39:

In 1786, a son of Gen. Israel Putnam, residing in Williamstown, Mass., had a table made from one of his apple trees. Many years afterwards the gnawing of an insect was heard in one of the leaves of this table, which noise continued for a year or two, when a large, long-horned beetle made its exit therefrom. Subsequently the same noise was heard again, and another insect, and afterwards a third, all of the same kind, issued from this table leaf — the first one coming out twenty, and the last one twenty-eight, years after the tree was cut down.

From evidence obtained by Dr. Fitch, he believed that there could be no doubt but that the insect was the longicorn beetle *Ceraspho-rus balteatus*, figured on Plate 1, fig. 8, of the Report above cited — now known as *Chion cinctus* (Drury).

In Silliman's Journal of Science and Arts, vol. x, 1826, p. 65, is a short reference to a more detailed notice elsewhere, of an insect believed by the writer to have been a species of *Urocerus* — a large hymenopterous insect commonly known as a "horn-tail" — which had escaped from a table made of an apple-tree, twenty-eight years after the cutting of the tree. It would appear as if the two accounts might refer to the same occurrence.

Silliman's Journal, vol. ix., p. 85, copies from Brewster's Edinburgh Journal, No. 3, p. 85, a paper on the escape of an *Urocerus* (different from *U. gigas*) from a table made of deal and veneered with mahogany, in England, but without giving the age of the table or other desirable particulars.

Xylotrechus Probably Conveyed in Hickory Wood.

Subsequently to the reply made to the inquiry of the probable cause of the presence of *X. colonus*, it was learned that a half-cord of hickory fire-wood had been stored in the basement of the dwelling in which the beetles made their appearance. There is, therefore, hardly room for doubt that they had escaped from the wood, and that the insect, at times, may infest hickory, in addition to oak and maple.

Xylotrechus colonus, described by Fabricius in 1775, has an extensive distribution throughout the United States east of the Rocky Mountains. According to l'abbé Provancher, it is not uncommon in Canada. Its European synonymy and bibliography may be found in Mr. Leng's "Synopses of the Cerambycidæ," *Entomologica Americana*, ii., 1887, p. 200.

Examples of a congener of the above — *X. undulatus* (Say), have been taken by Mr. Erastus Corning, Jr., of Albany, at Murray Bay, Canada, in the month of August, as they were emerging from their burrows in the trunks of spruces. The species has not been previously recorded as infesting the spruce, nor do we know of any record of its food.

Haltica bimarginata (Say).

The Alder Flea-beetle.

(Ord. COLEOPTERA: Fam. CHRYSOMELIDÆ).

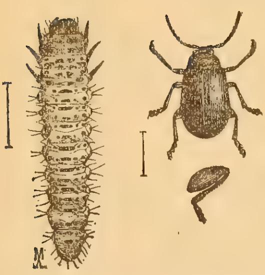

FIG. 40.—The grape-vine flea-beetle, HALTICA CHALYBEA, and its larva.

This devastating devourer, at times, of the foliage of the alder over extended areas, is among the larger of our flea-beetles, being one-fifth of an inch in length. It may be recognized by its general resemblance to the well-known grapevine flea-beetle, *Haltica chalybea* Ill., and its uniform deep prussian blue color with greenish reflections on the head, and the elevated line near the outer border of each wing-cover. A figure of *H. chalybea* is herewith given, which may serve to illustrate its principal features.

It was described by Say, in the *Journal of the Academy of Natural Sciences of Philadelphia*, vol. iv, 1824, p. 85, in the following terms :

Body oblong-oval, blue, minutely punctured ; antennæ black ; thorax with an impressed, transverse, rectilinear line behind the middle, attaining the lateral margin, and another impressed line before, which is interrupted in the middle and abbreviated each side ; elytra with an elevated, submarginal line each side, originating on the humerus, and nearly parallel with the exterior edge.

First Notice of its Injuries.

The first mention that we find of the operations of this insect is that given in the *Entomological Correspondence* of Dr. Harris, 1869, page 267, where, of "Haltica alni Harr. MSS." it is stated :

In traveling from Centre Harbor, N. H., to Conway, on the second of August, 1854, * * * * I saw the alders (*Alnus serrulata*) everywhere ravaged by insects which destroyed the leaves in the manner of canker-worms. Upon examination the spoilers were found not to be all dispersed, and several were seen upon the leaves still continuing their work: at the same time were found in Conway numerous beetles, which proved to be a species of *Haltica*, eating the leaves of the same alders. The larvæ which had ravaged these shrubs were doubtless those of the Haltica before mentioned [*H. alni*].

Its Operations in Maine and New Hampshire.

Dr. A. S. Packard appears next to have noticed the ravages made by this insect in Maine and New Hampshire. As it seems to be only at intervals and in certain localities that these serious demonstrations are made, they are of considerable interest as often as they occur. We therefore copy Dr. Packard's recital, from Bulletin No. 13, Division of Entomology, U. S. Department of Agriculture, 1887, together with his excellent description of the insect :

At Merepoint, near Brunswick, Me., during the middle of August, 1886, we noticed clumps of alders standing in dry soil partly defoliated or with skeletonized, brown or blackish leaves, on which, as well as the still remaining green leaves, were black grubs, sometimes seven or eight on a leaf. All of the alders in the region were not molested, the grubs occurring locally. August fifteenth, we found a single beetle. On placing a number of leaves with the grubs in a tin box, we found a white pupa lying loosely on the bottom of the box, August twentieth; soon more pupæ appeared, and the beetles began to appear in considerable numbers the last week of August. It is evident that in nature the larva falls to the ground to transform, the pupæ entering the earth.

Afterwards, September tenth, we found whole clumps of alders at the base of Iron Mountain, Jackson, N. H., stripped by the grubs, nearly all the riddled, brown, dead leaves having fallen off and thickly covering the ground under the bushes. Such a wholesale devastation of alders we never saw. By this time the beetles had become very abundant, and were apparently feeding on the few leaves still attached to the tree. * * * * * There seems to be a periodicity in the appearance of this beetle, Harris having seen the same grubs in great abundance in the same place in 1854. We have never observed it so common and destructive before in Maine. It is most probable that the beetles hibernate under the leaves, and soon after the leaves expand in May, lay their egg in masses on them, the grubs scarcely stirring from the leaves on which they are born, until ready to pupate. The grubs are probably distasteful to birds, otherwise they would fall an easy prey to them and be kept within due limits.

Larva and Pupa Described.

Larva.— The body is somewhat flattened; head scarcely two-thirds as wide as the body in the middle, black, becoming brown in front near the jaws. Body livid-brown above; the tubercles black; paler beneath, with three pairs of black jointed thoracic legs; no abdominal legs, but an anal prop-leg. The abdominal segments each with a transverse, oval-rounded, ventral, rough space forming a series of creeping tubercles; and in front of each segment is a transverse, oval, crescentic, chitinous area bearing two piliferous tubercles; the back of each segment divided into two ridges, each bearing a row of six sharp tubercles, bearing short hairs; a single ventral row on each side of the ventral plate. Length, 7–10$^{mm.}$ [0.28 to 0.4 inch].

Pupa. — Body rather thick, white. Antennæ passing around the bent knees (femero-tibial joints) of the first and second pairs of legs, the end scarcely going beyond the middle of the body. Elytra with five or six rather deep, longitudinal creases. The salient points of the body armed with piliferous warts. Abdominal tip square at the end, with a stout, black spine projecting from each side. Length, 6$^{mm.}$ [0.24 inch].

The following descriptive notes were made by me of living examples of the larvæ, on July 25, when nearly grown :

Black, fuscous in the incisures, and beneath. Head small, shining, about one-half as broad as the adjoining segment, with some brown hairs. First segment with a glossy black plate (collar) and bordered anteriorly with a few short hairs ; abdominal segments, as seen from above, showing two transverse rows divided by a deep constriction, of six setiferous tubercles — two small ones on each side, the two mesial ones on the front of the segment contiguous or subconnected, forming an elongated spot, and the two posterior ones connected in a shorter spot ; in addition to these is a broad stigmatal tubercle which projects so as to give an angulated form to the segment at this point. Beneath, on each abdominal segment anteriorly, is a roughened ellipsoidal mesial spot, and two smaller ones behind (the creeping tubercles of the Packard description), distant from one another about the length of the front spot, each with two short whitish setæ. Legs long, shining black ; a single terminal proleg. The abdomen tapers uniformly at each extremity.

The excrementa are scrap-like or thread-like, instead of rounded as in many Coleoptera.

Length of larvæ nearly one-half of an inch.

Its Recent Occurrence at Lake Pleasant, N. Y.

When at Lake Pleasant, in Hamilton county, N. Y., almost as soon as my interest in insects became known, it was asked if I had noticed a strange attack on the alders, which had never been observed before, causing them to look as if a fire had swept over them; and a locality was mentioned where it could be seen.

Visiting the place indicated, near the inlet of Lake Pleasant, on July sixteenth, immense numbers of the dark brown shining larvæ of *Haltica bimarginata* were found on the outskirts of the infested area of alders, rapidly eating away all the green material of the leaves — feeding from both the upper and lower sides, to the number, often, of twelve or more on a single leaf. The area over which the devastating scourge had passed, presented a strange appearance with its completely skeletonized foliage — only here and there an overlooked bit of green leaf being visible on some of the branches near the ground. A closer examination showed beautiful and almost perfect skeletonization of unbroken ribs and branching veins and interconnecting reticular structure, giving almost as attractive specimens for the cabinet as if they had been prepared by hand for ornament or study.

A large number of the larvæ were collected and placed in alcohol, while others were confined in a box, and furnished with leaves for food. They appeared at this time to be about full-grown. Although supplied frequently with fresh leaves of which they partook, they showed scarcely any increase of size, and, much to my surprise, up to the time of my leaving Lake Pleasant — August fifth — none had entered upon their pupal stage.

The Larvæ Destroyed by a Fungus.

The day prior to my departure I visited an infested locality near Round Lake, for the purpose of finding, if possible, the pupæ and its hidden place of pupation. The period of active larval operations had passed, for only one example of the larva could be found still feeding. In that portion of the alder clump where the attack had centered, every leaf had been skeletonized, and apparently more than half of the destroyed foliage had fallen to the ground where it had formed a matted mass of the thickness of an inch or more. In turning over the leaves in search of pupæ, and also on the exposed surface of the debris, many larval remains were noticed showing a fungus attack. The fungus had pervaded the entire larva, covering its surface and enlarging its diameter with a solid white matter, giving to the distorted object much the appearance of the excrementa of some of the smaller birds.

The fungus, from collections made, was identified by the State Botanist, Prof. C. H. Peck, as identical with one that we had in company observed in driving from Elizabethtown, N. Y., to Keene Valley, on August 1, 1877. Very large numbers of dead larvæ were found at that time, on dead leaves, and on, and under, small stones on the ground beneath alders skirting the roadside that had been skeletonized in the same manner and to the same extent as has been described. The insect was not then determined, but as now recalled, there can be no doubt but that it was *Haltica bimarginata,* operating even more severely and over a more extended territory than as observed the present year.

The fungus was described by the State Botanist as a new species, in the 32*d Report on the N. Y. State Museum of Natural History,* 1879, page 44, under the name of *Sporotrichum larvatum.*

The Pupæ and their Pupation.

None of the pupæ could be found in the alder clump under or among the fallen material, or beneath the stones, or in the ground; but on passing to some large bowlders three or four rods distant, and lifting a thin coating of moss that had accumulated on their top, a few of the pupæ were discovered beneath. On further searching, their regular habitat was disclosed, in the mossy and black vegetable mold margining a large rock partly imbedded in the soil. Hundreds of the pupæ were here brought to light, lying loosely in the mold, without the slightest indication of a cocoon or even a cell, at the depth of about an inch from the surface, and for the most part, about the same distance from the rock. Associated with them were a few of the larvæ which had not yet undergone their change, and also two specimens of the newly transformed beetle. Larvæ, pupæ, and imagines, thus associated, gave evidence of an unusually short period of pupation.

Dr. Packard (*loc. cit.*) has described the pupa as *white.* The description may have been drawn from alcoholic specimens, or from an example that had just undergone its pupation, for of the large number collected by me at this time from their bed of vegetable soil, and on the point of disclosing the imago, all were conspicuously *yellow.*

Pupæ were placed in mold and taken to Albany, where they gave out the beetles from August tenth to seventeenth. From the larval collections made, as before mentioned, hardly any progressed to the pupal state, but died at intervals, after ceasing to feed.

Is it an European Species?

It is probable that *Haltica bimarginata* of Say — the *H. alni* of Harris, may prove to be identical with the *H. alni* Fabr., of Europe. In the Museum of Comparative Zoölogy, at Cambridge, Mass., are examples of the last named insect, in the pupa and imago, which seemed to me (without *H. bimarginata* at hand for comparison) to be the same as our form. The skeletonizing of the leaves of the alder by the European insect, of which there are also specimens in the Museum in connection with the insects, was apparently, the same as ours.

Has it been Confounded with Haltica chalybea?

Prof. Riley states (in *American Entomologist*, ii, 1870, pp. 327–8, and in the same article reproduced in the 3d Missouri Report, pp. 80–81) that the grapevine flea-beetle, *Haltica chalybea* Ill., "habitually feeds on the alder (*Alnus serrulata*), as well as on the wild and cultivated grapevine," and that it is "apt to be most troublesome where alder abounds in the woods." Is alder a common food-plant of this species, or has the larva of *H. bimarginata* been mistaken for it? The two larvæ resemble one another so closely, that were the figure of *H. chalybea*, given on p. 216 more elongated in proportion to its breadth, it would be an excellent representation, in position and proportionate size of tubercles and in other features, of *H. bimarginata.* This resemblance is not traceable in the figure of the larva given in the Third Missouri Report.

Remedies.

The alder upon which the operations of the beetle have thus far been observed — *Alnus serrulata*, is a very common road-side and field shrub of extensive distribution, and is seldom regarded as of any special value. If from its introduction in clumps in landscape gardening or from employment as hedges, some degree of value may have been given it, attack upon it may readily be checked by spraying the foliage at the commencement of the injury with any of the arsenical poisons or with pyrethrum water.

Crepidodera rufipes (Linn.).

The Red-footed Flea-Beetle.

(Ord. Coleoptera: Fam. Chrysomelidæ.)

Chrysomela rufipes Linnæus: Syst. Nat., ii, 1767, p. 595, No. 65.
Altica rufipes Fabr.: Syst. Ent., 1775, p. 114, No. 14; Sp. Ins., i, 1781, p. 135, No. 108; Mant. Ins., i, 1787, p. 77, No. 140.
Crepidodera erythropus Melsheimer: in Proc. Acad. Nat. Sci. Phil., iii, 1847, p. 165.
Crepidodera rufipes Crotch: in Proc. Acad. Nat. Sci. Phil. [xxiv], 1873, p. 71.
Crepidodera rufipes Henshaw: List Coleop. N. Amer., 1885, p. 112, No. 6979.

An Apple-tree Pest.

This little beetle, belonging to the group of flea-beetles, which embraces those that by means of their stout hind legs, are able to leap to a considerable distance, is a member of the destructive family of *Chrysomelidæ*, or leaf-eaters.

It measures one-tenth of an inch in length, and is of an oblong ovate form. It is shining, with the head, antennæ, thorax and legs, red; the wing-covers are blue, and punctate in lines; the breast and abdomen are black. Its range is given as Middle and Southern States. No differences are apparent between it and the European form.

Examples of the beetle have been sent to me from Coleman's Falls, Va., by Mr. George E. Murrell, where it seems to have developed a habit hitherto unrecorded of it, in feeding upon the buds of apple trees. Mr. Murrell detected its operations during the latter part of May. He has written as follows of it:

Its Injuries to Apple Buds.

The beetles appeared upon my apple trees as the buds began to swell, and beginning with the topmost ones they gradually worked downward, leaving behind them holes that penetrated to the heart of the scion, and having the appearance of being gouged out with a chisel or burned out with a hot wire. The twigs of my bearing orchard were attacked in this manner, and of 650 young trees set out this spring very few escaped; but beyond a loss of symmetry and a foot or two of wood in some cases, they do not now show any serious effects from the attack. In the same field with the young trees just mentioned were several thousand of one year old, set out at the same time, but in nursery rows; but although of the same varieties of, and interspersed with, the injured ones, they entirely escaped injury. I did not observe how long the beetles remained, but noticed that they left during a heavy rain in the latter part of May. I have not heard of the insect in other orchards in my vicinity. My orchards are in narrow mountain valleys inclosed by woods.

Injuries to Leaves by C. Helxines.

This, we believe, is the first time that *Crepidodera rufipes* has been reported as injurious to apple trees, although one of its congeners, resembling it in appearance, *C. Helxines* (Linn.), has been detected by Professor Forbes, State Entomologist of Illinois, in riddling the leaves of apple trees near Normal, Ill. (14th *Rept. Insects of Illinois*, 1885, p. 98). As the last named species — a common and wide-spread insect both in this country and in Europe — commonly occurs on willows, but is also found not unfrequently on the Lombardy poplar and Balm of Gilead (*Populus dilatata* and *P. balsamifera*), it is to be hoped that neither of the above-named beetles will acquire the habit of feeding on the apple tree, so as to become one of its regular pests.

Another Bud-eating Chrysomelid.

This bud-eating propensity, has recently been displayed by another member of the same sub-tribe of *Halticini* to which *Crepidodera* pertains, which, unfortunately, is one of the most common and broadly distributed of our leaf pests — the well-known striped cucumber beetle, *Diabrotica vittata* (Fabr.). The pear crop, in portions of California, has suffered severely from its attack, during the spring of 1887. In one locality (Byron) the trees, as reported, swarmed with the beetles, which commenced upon the buds and continued on the blossoms, eating off the bloom, and frequently penetrating into the calyx. The fruit ceased to grow and dropped to the ground. The pear crop was an entire failure, such as had never been known in the locality before. Quinces were also attacked, but not with fatal results. The same beetle also destroyed the almond crop. Later, they attacked the apple trees, but were driven away by bees. (*Pacific Rural Press*, June 11, 1887, xxxiii, p. 527.)

The cucumber beetle had for a long time been known to feed on the blossoms of the apple and other fruit trees, but had not been previously observed in eating into the buds.

Remedies.

In the event of *C. rufipes* developing a propensity for feeding on the buds of the apple, the minute beetles could be poisoned by spraying with Paris green in water — a rather stronger mixture than that used against the codling-moth — at least one pound to 100 gallons of water. Spraying with a strong solution of whale oil soap or tobacco, should render the buds distasteful to it, and it would also serve the purpose of protecting from the apple tree aphis which makes its attack at the time of the putting forth of the buds, and can be more effectively reached at this period than later when the leaves have expanded.

Scolytus rugulosus (Ratzeburg).

The Wrinkled Scolytus.

(Ord. Coleoptera : Fam. Scolytidæ.)

Ratz.: Forstinsecten, 1837, i, p. 187, pl. 10, fig. 10, pl. 11, fig. 4; ib. edit. 2, 1839, p. 230 (as *Eccoptogaster rugulosus* Koch).

LeConte: in Proc. Amer. Philos. Soc., xvii, 1878, p. 626 (introduc. in U. S.).

Riley: in Amer. Entomol., iii, 1880, p. 298 (distribution, etc.).

Penhallow: in Houghton Farm — Diseases of Plants, Series iii, No. 2, 1882, p. 38; ib. No. 3, 1883, p. 63 (operations on peach).

Hagen: in Canad. Entomol., xvi, 1884, p. 162 (literature, habits, etc.).

Henshaw: List Coleop. N. Amer., 1885, p. 149, No. 9153.

Hamilton: in Canad. Entomol., xvii, 1885, p. 48 (variation in color).

Lintner: in Count. Gent., l, 1885, p. 575 (in cherry, peach and plum); in New Eng. Homestead, Sept. 25, 1886.

Atkinson: in Journ. Elisha Mitchell Scientific Soc. for 1885–'6, pp. 74, 75.

SCUDDER: in Canad. Entomol., xviii, 1886, pp. 195-6 (its galleries).
SMITH: in Entomolog. Amer., ii, 1886, p. 127 (food-plants).
BEDEL: in Ann. Soc. Ent. France—Faune Coléop. Bass. Seine, vi, 1888, p. 406 (literature and European distribution).
SCHWARZ: in Proc. Ent. Soc. Wash., ii, 1888, p. 30 (hickory species of Hamilton different).

A Fruit Tree Bark-borer.

This destructive bark-boring beetle, which, since its introduction in this country a few years ago, has made fatal attack on our three principal stone fruit trees, has recently, in accordance with its known European habit, extended its range of operations to apple trees, of which, judging from pieces of the infested wood received from Mr. C. H. Hedges, of Charlottesville, Va., it has already become a serious pest. This is the first instance, it is believed, that its occurrence in apple trees has been recognized in the United States.

From some pieces of apple twigs and branches, and perhaps trunk sections of young trees sent to me in the early winter, about a hundred examples of the beetle were given out during late winter and early spring. They were taken at intervals from the box containing the wood, as follows: On February 23, 1887, 5 examples; on Feb. 25, 13 examp.; on March 3, 16; March 7, 22; March 22, 32; April 4, 10; and on April 23, 1, and the last — 99 in all.

The Larval Burrows.

Removal of the bark from portions of the apple-tree received, showed the sapwood to be furrowed over most of its surface by the burrows of the beetle, sometimes joining or overlapping so that they could not be separately traced. When occurring in the smaller trunks they had apparently commenced in the branches and had extended downward, very gradually increasing in width—at their widest part at the entrance to the hole sunk in the wood for pupation, measuring one-twentieth of an inch. The extent of the longest burrows observed, was apparently two inches; they were so interconnected that no positive measurement could be made. Their general direction was perpendicular to the trunk, but in some instances, for short distances, they ran in a transverse or oblique direction. Figure 41, is from a section of a trunk of a young tree received from Mr. Hedges as above stated.

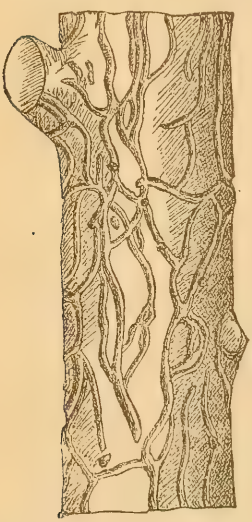

FIG. 41.—Burrows of SCOLYTUS RUGULOSUS, beneath the back of a young apple-tree.

A section of a cherry tree before me, of two inches diameter, shows still greater destruction of the surface of the sapwood. The burrows are so close that they can not be separated. In a space of one square inch, thirty-two holes made for pupation can be counted.

I have not been able in the specimens of infested wood received, to make out the "mating chamber" of the beetles, or as termed by some writers, "the cradle." They were probably in the lateral branches which had been removed. Dr. Hagen states that "the cradle is perpendicular in most cases except where it begins just below the base of a bud, and is about an inch long." He further adds of the burrows: "The galleries are [*sic.*] to four inches long, and rather deeply injuring the sapwood. The holes for the pupa go deeply, to 4 mm. in the wood" (*loc. cit.*).

Mr. Scudder, in referring to a mine of an European example of *rugulosus* on cherry, in the Museum of Comparative Zoölogy at Cambridge, Mass., states: "The larval mines emerge and diverge from one point of the mating chamber. The main galleries [cradles] are reduced to almost nothing, and the normal mine of this species, as figured by Ratzeburg, shows nothing of the kind" (*loc. cit.*).

Strongly Attacked by Parasites.

Fortunately, the beetle has been met by a strong parasitic attack, which it is hoped will not permit of a great increase of its injuries. From *S. rugulosus* infested wood sent from Virginia on the twenty-third of December, examples of a chalcid emerged two days after its reception, from which it would seem that others may have been disclosed at an earlier date. These were sent to the Division of Entomology at Washington for identification, where they were referred to the Pteromalid genus *Raphitelus*, of uncertain species, but probably *maculatus* — identical with some that had been bred at the Department from the same insect infesting other fruit trees in Ohio and North Carolina.

Later — in January and February — another species of chalcid appeared, characterized by two subquadrate spots on the fore-wing, which Mr. Howard kindly identified as *Chiropachys colon* (Linn.). A third species, obtained more numerously than either of the two preceding, was referable, according to Mr. Howard, to the genus *Eurytoma* — species not ascertained.

Its Injuries to Cherry, Plum, and Peach Trees.

Frequent complaints have been made within the last few years of the injuries of *Scolytus rugulosus* to cherry, plum, and peach trees.

A correspondent from Philadelphia, Pa., has well described its operations in the following note :

A beetle about one-eighth of an inch long, scarcely thick enough to stick a pin through, divided in the middle into two sections [it has an unusually long thorax compared with the length of its abdomen], has killed cherry and peach trees on my place, and now two plum trees, that I had moved last autumn into the chicken-yard to get rid of the curculio, have been destroyed by them. They puncture the trunk and limbs through to the hard wood, here and there, with a bore about the size of a small pin's head. From these wounds the saps exudes and the trees die. Quite large trees are killed by them.

Another correspondent, from near Annapolis, Md., has written of the insect injuries as follows:

I find that they are more abundant than I at first supposed; attacking cherry, plum, apple, and peach. I was going through a peach orchard about two miles distant from my place, where I found that they had killed about a dozen trees and as many more were in a dying condition. I noticed a fine cherry tree failing — leaves beginning to turn yellow and withering, and upon a close examination, I found gum running down the bark in great quantities from the tunnels of these borers. If they increase in numbers as Colorado beetles and many other pests, they will prove the worst enemies that the fruit-growers have to contend with. G. W. D.

Its Introduction and Spread in the United States.

The beetle has probably been brought from Europe within the past fifteen years. It was first discovered at Elmira, N. Y., in an attack upon peach trees, according to Dr. LeConte, who has written of it in 1878 (*loc. cit. sup.*), as follows: "This is a suitable opportunity to notice the introduction of this European species into the United States. I have received specimens from Elmira, N. Y., where it attacks peach trees. According to Ratzeburg, it is rare in Germany, but is found upon plum and apple trees." In 1880, it was reported from Fair Haven, N. J., as destroying all the cherry, peach, and plum trees that had been set out in a particular lot, by boring innumerable holes through the bark, which filled with gum—the death of the trees soon following. A similar attack on cherry trees was reported from Coopersburg, Pa. It had been previously known to infest peach trees in localities as remote as Missouri and Maryland. In 1882, Dr. Hagen found this beetle inhabiting densely large branches of young pear trees that were killed by pear-blight. Although a coccid insect was associated with the beetle it was thought that the branches had been killed by the scolytus and not by the coccid, or by bacteria, believed by some to be the *cause* of pear-blight. In 1885, Mr. John Hamilton, of Allegheny, Pa., announced his breeding of the insect from hickory twigs (*loc. cit.*). The color of these differed from the ordinary forms. Mr. Scharwz pronounces these examples not *rugulosus*, but probably an undescribed species, to which he has given provisionally, the MS. name of *S. icoriæ*.

Preventive Measures.

No way is known by which a tree once attacked in force by this insect, can be saved. The female lays a large number of eggs in its burrow under the bark, and there are probably two broods a year. The best means of diminishing its numbers and preventing its spread is to take up and burn the infested trees. Where there is danger of attack from the existence of the insect in the vicinity, it may, perhaps, be prevented by applying to the trunk and principal branches of the trees, the wash of carbolic acid and soap which is frequently used, with beneficial results, as a preventive of the apple-tree borer, *Saperda candida*, and the lepidopterous peach-tree borer, *Ægeria exitiosa ;* or, as may be still better, the carbolic wash prepared as stated in my 2d Report, p. 24. For directions for preparing the first-named wash, see page 26 of same Report.

Corythuca ciliata (Say).

The Ciliated Tingis.

(Ord. Hemiptera: Subord. Heteroptera: Fam. Tingitidæ.)

Tingis ciliata Say: Descr. N. Sp. Heterop. Hemipt. N. A., 1831; in Trans. N. Y. St. Agricul. Soc. for 1857, xvii, 1858, p. 793; Compl. Writ. Say, i, 1883, p. 349.—Walsh: in Pract. Entomol., ii, 1867, p. 47.—Glover: MS. Notes Journ.—Hemipt., 1876, p. 71 (citation), pl. 8, fig. 4 (*T. hyalina*).

Tingi shyalina Herr.-Sch.—"Fieber, 103, pl. 9, fig. 1."—Packard: Guide Stud. Ins., 1869, p. 552 (on willows).

Corythuca ciliata Uhler: in Cassino's Stand. Nat. Hist., 1884, ii, p. 285; Check-List Hemipt. Heterop. N. A., 1886, p. 22, No. 1053.

Examples of this insect were communicated to me, by Prof. D. S. Martin, of New York city, under date of August eleventh, which had been taken feeding, in their larval, pupal, and perfect stages, on the leaves of the button-wood, or sycamore, *Platanus occidentalis*.

It is quite a common species which has broad distribution over the United States. It was first described by Say in his "Descriptions of New Species of Heteropterous Hemiptera of North America," printed (or in part) in 1831. His description is as follows:

Say's Description of the Species.

Whitish, reticulate with nervures on which are short spines; widely margined; color whitish; thorax with an inflated carina before, extending over the head; sides dilated, bullate, a little elevated, lateral and anterior margins ciliate with short spines: *scutel* with the lateral margin elevated and an acute, highly elevated carina on the middle: *hemelytra* dilated, with an inflated carina before the middle of each, on which is a brown spot; edge ciliate with short spines, excepting the posterior third and tip, which are unarmed, rectilinear; beneath piceous-black: *feet* pale yellowish.

Length to tip of hemelytra, three-twentieths of an inch.

The larva is spinous, fuscous, with a large yellowish spot each side of the middle, and before the middle a broad yellowish vitta. The species is very common.

Hibernation of the Insect.

But little appears to be known of the natural history of this Hemipteran. One interesting fact therein is, the hibernation of the mature insect under the bark of trees on which it feeds. This appears from examples that were sent to Mr. Walsh for name, from Mr. J. Pettit, C. W., which had been found "in great numbers under the bark of button-wood in the winter" (Walsh, *loc. cit.*).

Compared with C. arcuata.

As closely resembling *C. ciliata*, a figure is herewith given (Figure 42) in illustration, of another common species, *Corythuca arcuata* of Say, which differs from the former in its brown bands and the arquated exterior of the hemelytra. In Figure 43, its eggs are represented on a bit of leaf. They bear so little resemblance to the eggs of insects generally, that their nature would hardly be suspected. In the same figure, an immature form of the insect is shown. They are not at all uncommon on the under side of the leaves of various species of oaks. The illustrations are from Professor Comstock's Report to the Department of Agriculture for 1879, in which an account of this "hawthorn Tingis," so designated from the food-plant on which it occurred, is given. From differences that it shows with typical forms of *C. arcuata*, Mr. Uhler regards it as a variety of that species. For a figure, habits, description, etc., of the more general form, see Cassino's "Standard Natural History," ii, p. 285, fig. 327.

FIG. 42.—CORYTHUCA ARCUATA, from oaks.

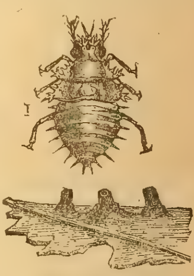

FIG. 43.—Eggs and an immature individual of CORYTHUCA ARCUATA.

Dr. Fitch (3d Report, 1859, p. 148) has described *C. juglandis*, occurring on the leaves of the butternut, and differing only in its rectilinear form and spineless veins from *C. arcuata*. Later (*Count. Gent.*, Feb. 14, 1861, p. 114), he has accepted it as probably a mere variety of *arcuata*.

Another Allied Species.

Another form, having much the general appearance of *C. arcuata,* but with a more elevated thorax, was taken by me abundantly, in all stages of development, on the leaves of the chestnut, *Castanea Americana,* at Palenville, N. Y., in August of 1884. Mr. Uhler having seen examples of it, has given it the manuscript name of *Corythuca polygrapha,* while entertaining some doubt of its specific distinctness, from "not yet having had all the links to attach it to the nearly related species." In the vicinity of Baltimore it occurs on oaks.

Injuries of Corythuca.

These harmless-looking insects which Dr. Fitch has compared to "a flake of white froth," are capable of severe injury to the vegetation that they infest. They live on the sap of different plants and trees. According to Glover, one species closely related to *C. arcuata,* has been found on the quince trees in Mississippi and Florida, where the bushes were entirely covered with them, in all the stages of larvæ, pupæ, and perfect insects. Some trees were greatly injured if not entirely destroyed by them. They are said to be able to sting severely when handled (*Report Commis. Agriculture* for 1875, p. 126, fig. 36).

Melanolestes picipes (Herrich-Schæffer).

The Black Corsair.

(Ord. Hemiptera : Subord. Heteroptera : Fam. Reduviidæ.)

Pirates picipes Her.-Sch.: Wanz. Ins., viii, 1848, p. 62, fig. 831.

Pirates picipes. Walsh: in Pract. Entomol., ii, 1867, p. 108.—Wlsh.-Ril.: in Amer. Entomol., i, 1868, p. 87; id., ii, 1870, p. 309.

Pirates picipes. Packard: Guide Stud. Ins., 1869, p. 541, fig. 545.

Melanolestes picipes Stal: Enum. Hemipt., ii, 1872, p. 107, 3.

Melanolestes picipes. Uhler: in Bull. G.-G. Surv. Terr., i, 1876, p. 330; List Hemip. West Miss. Riv., 1876, p. 64; in Cass. Stand. Nat. Hist., ii, 1884, p. 281; Ch.-List Hemip. Heterop. N. A., 1886, p. 25, No. 1236.

Melanolestes picipes. Glover: in Rept. Commis. Agricul. for 1875, p. 130, fig. 42; MS. Notes Journ.—Hemipt., 1876, p. 47, pl. ix, fig. 1.

Melanolestes picipes. Lintner: in Count. Gent., xlix, 1884, p. 877.

Reduvius pungens LeConte; in Proc. Acad. Nat. Sci. Ph., Sept. 1885, p. 404.

Melanolestes picipes. Provancher: Faun. Ent. Can.—Hemipt., 1887, p. 183.

A Stinging Plant-Bug.

A correspondent from Natchez, Miss., has sent the following communication, narrating an occasional demonstration of a species of plant-bug, which has an extensive distribution throughout the United

States. The possibility of injury from it should therefore be generally known:

I send a specimen of a fly not known to us here. A few days ago it punctured the finger of my wife, inflicting a painful sting. The swelling was rapid, and for several days the wound was quite annoying. You will observe the peculiar proboscis with which it was made. Will you be good enough to tell me something of the insect.

Its General Appearance.

The insect received was one of the bugs (order of Hemiptera), of about the size (0.65 in.) and general appearance of the "squash-bug," having a formidable jointed beak bent beneath its head and thorax, with which the wound, as above mentioned, was inflicted. Its body is black, sometimes with a reddish hue on the back and legs. Its anterior femora (thighs) are swollen, and the tibiæ (shanks) terminate in a spongy cushion. Its scientific name is *Melanolestes picipes* (Her.-Sch.). An outline figure of it is given in Packard's *Guide to the Study of Insects*, 1869, p. 541, under the name of *Pirates picipes*, by which it was formerly known, and from which a common name of "the Black Corsair" has been devised for it. Its representation in Figure 44, in natural size, is from Glover's *Manuscript Notes from my Journal—Hemiptera.*

Fig. 44.—The black corsair Melanolestes picipes. (After Glover.)

Its Geographical Distribution.

According to Uhler, it is broadly distributed throughout the United States, inhabiting California, Texas, Indian Territory, and the Atlantic region from Maine to Florida and Louisiana, and Para, Brazil. L'abbé Provancher includes it in the fauna of Canada as a rare insect. Mr. Walsh has mentioned it as common in the Western States, under stones and prostrate logs, where it feeds upon various subterranean insects (*American Entomologist*).

What is Written of its Stinging Powers.

A broken and mutilated specimen submitted to Mr. Walsh for name, taken from under a mattress in Kentucky, gorged with human blood, was thought to be this species, which was known, with its sharp and poisonous beak, to pierce and suck the blood of human beings. Glover states of it that it is capable of inflicting a severe sting with its beak, and lives on other insects. Dr. LeConte has written of it as follows: "This species is remarkable for the intense pain caused by its bite. I do not know if it ever willingly plunges its rostrum into any person, but when caught or unskillfully handled, it always stings. In this case, the pain is almost equal to that of the bite of a snake, and the swelling and irritation which result from it, will sometimes last a week. In very weak and irritable constitutions it may even prove fatal" (*Proc. Acad. Nat. Sci. Phila.*, for Sept., 1885, p. 404). In consideration of its severe sting, Dr. LeConte, believing it to be an undescribed species, gave it the appropriate name of *Reduvius pungens*.

The following is his description of the species:

REDUVIUS PUNGENS. Black, shining, wings opaque. Head a little hairy, antennæ yellowish-brown, slightly hairy, first joint shorter than the head, second, fourth and fifth much longer, sub-equal, third very small. Thorax slightly margined, strongly constricted in the middle, the anterior portion rounded and longitudinally sulcate, the posterior portion transverse. First pair of legs hairy on the under side, as are the thighs also of the second pair, but the tibiæ and tarsi of the hinder legs all over. Length 0.8 of an inch.

Stinging by others of the Reduviidæ.

There are several other species of the family *Reduviidæ* which have similar habits to the above. Although usually predaceous upon other insects, and not voluntarily, except with a few exceptions or in rare instances, attacking man, yet it is by no means safe to handle them incautiously. Under the excitement of restraint, they would not hesitate to use their powerful beak as a weapon of defense, burying it deeply in the flesh, and at the same time injecting a drop of a poisonous secretion which materially adds to the pain of the wound inflicted.

Melanolestes abdominalis (Her.-Sch.) — a congener of *M. pirates*, is said by Glover, if handled roughly, to be capable of inflicting a severe wound. Its ordinary habitat is beneath dead logs, moss, and decaying vegetable material, where it lies in wait for other insects, seizing them with its strong fore-legs and sucking their juices. Figure 45, after Glover, represents the general appearance of the insect. Its general color is red, with the tip of its body black. Stal and some other authors have regarded it as identical with *M. pirates*, from the general resemblance of the two forms and their often occurring in company under the same stone. Mr. Uhler (*loc. cit.*), however, does not deem the evidence sufficient for uniting them as one species.

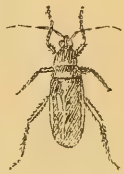

FIG. 45. — MELANOLESTES ABDOMINALIS. (After Glover.)

Of *Conorhinus sanguisugus* LeConte (shown in Figure 46), which has been styled the "big bed-bug," and by translation of its scientific name, the "blood-sucking cone-nose," it is narrated that a gentleman in Alton, Ill., was once bitten by it in three places in his arm, and the inflammation that resulted was so severe that the use of the arm was lost for three days (*American Entomologist*, i, p. 88). Dr. LeConte adds to his description of it: "This insect inflicts a most painful wound. It is remarkable, also, for sucking the blood of mammals, particularly of children. I have known its bite to be followed by very serious consequences, the patient not recovering for nearly a year" (*Proc. Acad. Nat. Sci. Phila.*, 1855, p. 404).

Mr. Uhler has described the insect as a very showy species, of a pitch-brown or black color, with red patches on the sides of the prothorax, spots of the same color at the base and apex of the wing-covers, and bands on the sides of the abdomen. It is rather bald, most of the surface is somewhat wrinkled or rough, and the end of the scutellum is long and sharp-pointed. It measures more than three-fourths of an inch in length, but specimens sometimes occur which are dwarfed to about half an inch. (*Standard Natural History*, ii, p. 280.)

Fig. 46.—Conorhinus sanguisugus; imago and pupa.

Pirates biguttatus (Say), as it has long been known, but in the recent list of Mr. Uhler has been referred to the genus *Rasahus* Amyot-Serville (from the Hebrew, meaning a "villain")—is also capable of inflicting a severe sting, but will seldom do so except from provocation, as the surroundings under which it is usually found indicates the bed-bug as its principal prey. It evidently delights in human blood, but prefers taking it at second-hand. Under the generic name of *Pirates* it has been commonly known as "the two-spotted corsair," from the two large and conspicuous spots on its elytra, It is shown in Figure 47.

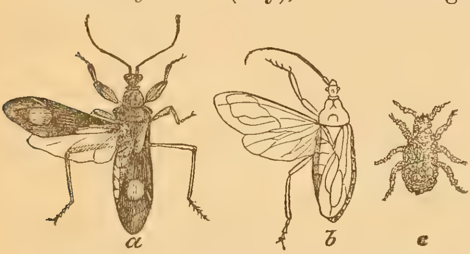

Fig. 47.—*a*, Pirates biguttatus; *b*, Reduvius personatus; *c*, its pupa.

Reduvius personatus (Linn.),—recently referred by Mr. Uhler to the genus *Opsicœtus* Klug—shown also in Figure 47, is a common insect often found hanging in spider-webs in dwellings. It also is credited with a special fondness for bed-bugs which it hunts and catches adroitly, while in its larval stage, under the disguise of a covering of dust and dirt completely investing it, as shown at *c* in the figure, and adhering to it by a glutinous secretion. The wounds which it has been known to inflict in its perfect stage with its beak, are said to be very painful, more so than those of a bee, and to be followed by numbness. Its color is black or dark brown. Its thorax in front is granular or marked transversely with fine striæ. The antennæ are brown and hairy. The eyes are quite large and almost join below. Legs the color of the body, Under side of the body, hairy.

Of *Prionotus cristatus* (Linn.), the "nine-pronged wheel-bug," or the

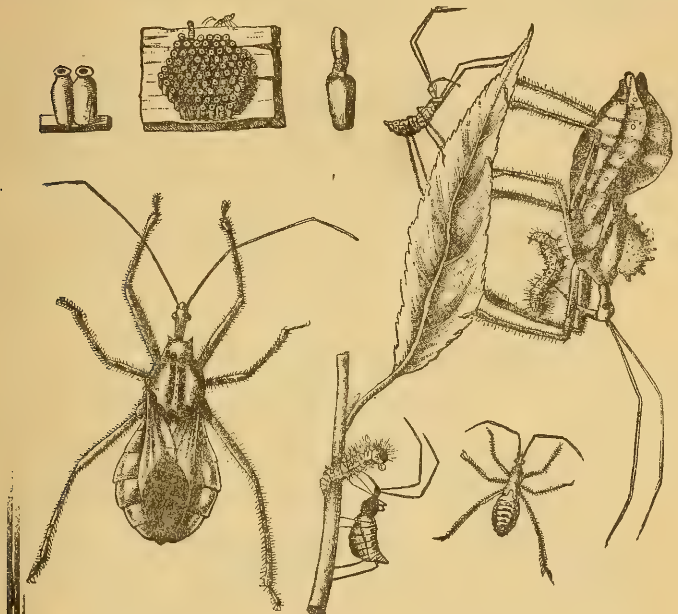

Fig. 48.—The nine-pronged wheel-bug, Prionotus cristatus, in its young and mature forms; also, its hexagonal egg-mass, eggs enlarged to show their flask-shape, and an egg giving out the larva.

"devil's horse," illustrated in figure 48, Glover states that it is very apt to sting if not handled with great care, and that the poison fluid ejected when the wound is inflicted is extremely painful. Having been stung by one of them, " the pain lasted for several hours, and was only alleviated by applications of ammonia. Several days afterwards, the flesh immediately surrounding the puncture was so poisoned that it sloughed off, leaving a small hole in the thumb injured" *MS. Notes Journ.—Hemiptera*, 1876, p. 61–2).

Sirthenea carinata (Fabr.),— of a black ground color, with a long red spot at the base of each wing-cover, the sides of the abdomen also marked with red, and the legs honey-yellow — is also charged with the infliction, at times, of painful wounds, but the authority for the statement can not be found at the present writing.

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Dr. LeConte has expressed the opinion that the many relations which we have of spider bites frequently proving fatal, have no doubt arisen from the sting of these insects or others of the same genera. Among the many United States species of *Araneidæ*, he had never seen one capable of inflicting the slightest wound. Ignorant persons might easily mistake one of the *Reduviidæ* for a spider. A physician had sent to him a fragment of a large ant, supposing it to be a spider that came out of his grandchild's head.

It would appear from the foregoing, that a certain degree of caution should always be exercised in the handling of any of the *Reduviidæ,* as the structural peculiarities which render them so formidable to many of the insect world, and so admirably adapted to preying upon them, may readily be directed, under the slightest provocation, to the serious annoyance and injury of man.

Mytilaspis pomorum (Bouché).

The Apple-tree Bark-louse.

(Ord. Hemiptera: Subord. Homoptera: Fam. Coccidæ.)

Aspidiotus conchiformis Gmel. [not of Gmel.] Curtis: in Gard. Chron., 1843, p. 735–6.

Aspidiotus pomorum Bouché: in Ent. Zeit. Stett., xii, 1851, No. 1.

Aspidiotus pomorum. Harris: Ins. N. Engl., 1852, p. 220; Ins. Inj. Veg., 1862, p. 252–3.

Coccus pyrus-malus Kellicott: in Trans. Cleveland Acad. Sci. for 1854.

Aspidiotus conchiformis Gmel. [not of Gmel.] Fitch: in Trans. N. Y. St. Agricul. Soc., xiii, 1854, pp. 735–742; 1st and 2d Repts. Ins. N. Y., 1856, pp. 31-38; 3d–5th Repts. do., 1859, p. 13.

Aspidiotus juglandis Fitch: 1st and 2d Repts. Ins. N. Y., 1856, p. 35; Trans. *cit.*, p. 739.

Aspidiotus conchiformis. Glover: in Rept. Comm. Pat. for 1860 p. 319; in Rept. Comm. Agricul. for 1867, p. 73; id. for 1870, p. 88–9, fig. 57; id. for 1876, p. 43, fig. 49.

Aspidiotus conchiformis. Walsh: in Pract. Entomol., ii, 1866, pp. 31, 47; 1st Ann. Rept. Ins. Ill., 1868, pp. 34–53 (nat. hist., habits, etc.).

Aspidiotus conchiformis. Riley: in Pract. Entomol., ii, 1867, p. 81; 1st Rept. Ins. Mo., 1869, pp. 7–18, figs. 2, 3; in Amer. Entomol., ii, 1870, p. 213, fig. 132.

Aspidiotus conchiformis. Packard: Guide Stud. Ins., 1869, p. 529.

Lepidosaphes conchiformis Shimer: in Trans. Amer. Ent. Soc., i, 1868, pp. 361–374 (habits, etc.).

Mytilaspis pomorum Signoret: in Ann. Soc. Ent. Fr., 1870, p. 98.

Mytilaspis pomorum. Le Baron: 1st Rept. Ins. Ill., 1871, pp. 24–26, figs.

Mytilaspis pomicorticis Riley: 5th Rept. Ins. Mo., 1873, pp. 73–96, figs. 31–34 (extended general account); in Amer. Entomol., iii, 1880, p. 107 (from Alabama); in Bull. 6, U. S. Ent. Comm., 1881, pp. 85, 86 (description); in Scientif. Amer., xlvi, 1882, p. 335, figs.; in Rept. Comm. Agricul. for 1884, p. 353 (distrib. by birds).

Aspidiotus conchiformis. Lintner: in Count. Gent., xlii, 1877, p. 69.

Mytilaspis pomorum. Comstock: in Rept. Comm. Agricul. for 1880, pp. 325, 326, pl. 19, fig. 2 (descr. and food-plants); 2d Rept. Dept. Entomol.—Cornell Univ. Exper. Stat., 1883, pp. 118–121, pl. 2, figs. 5, 5*a*.

Mytilaspis pomorum. Cook, M.: in Rept. Comm. Agricul. for 1881, p. 208 (resistance to insecticides).

Mytilaspis pomorum. Saunders: Ins. Inj. Fruits, 1883, pp. 40–44, figs. 28–34 (nat. hist., remedies, etc.).

Mytilàspis pomorum. Lintner: in Count. Gent., xlviii, 1883, p. 801 (on willows); id. li, 1886, p. 469; id. lii, 1887, p. 321.

Mytilaspis pomorum. Hubbard: Orange Insects, 1885, p. 15, figs. 1, 2 (showing growth of scale).

Mytilaspis pomorum. Packard: Entomol. for Begin., 1888, p. 79 (mention).

A Common and Pernicious Apple Tree Pest.

The scales of this insect upon apple tree bark were sent from Genesee county, N. Y., with the statement of its recent introduction in that vicinity, and the request for information of its nature — how it spreads from tree to tree, whether the infested trees should be destroyed, or if it were possible to arrest the attack.

The scales completely covered the piece of the branch that contained them. Similar examples had been received from time to time, for name and information, from different parts of the State of New York and other States, showing a quite general distribution of this pest of the apple tree—one of the most injurious of the large number that infests it. So common have they become in our orchards, and so destructive to the trees of which they take possession, killing large numbers of them, that they should be known by all of our apple growers.

Its Rapidity of Increase.

When this scale has been allowed to propagate itself for a few successive years without effort made to destroy it, the individuals become crowded together upon the trunk, limbs, and twigs of the tree as thickly as they can place themselves—forcing one another out of position and frequently overlying, and continuing to add to their number so long as they are able to reach with their proboscis the bark and the sap beneath.

A correspondent, writing from Newburgh, N. Y., thus describes the progress of an attack: "Immediately after the fastening of the scale, the bark beneath becomes diseased, and is ultimately found dead through to the wood. The next season these depredations are repeated, but the new scales are attached between the old ones. On the third year, on trees which are made the special point of attack, the entire bark of the tree is so spotted by the minute dead spots that a general roughness of the bark is noticed, presenting an unhealthy and unsightly appearance in the orchard, and nothing is left to be done but the removal of the trees."

Description of the Scale.

The scales of the female, which are by far the most conspicuous and abundant, are about one-twelfth of an inch long, narrow, and pointed at the apex, rounded at the other extremity and broadest centrally, and ordinarily somewhat curved. This particular form, so much like that of an oyster or mussel shell, was indicated in the specific name of *conchiformis* which it for a long time bore, and under which it was frequently written of in former years, in connection with its then generic reference of *Aspidiotus*, even so recently as during the Reports of Dr. Fitch. Its common name at that time was "the oyster-shell bark-louse"—now it is known as "the apple-tree bark-louse." Its color is brown, or ash-gray, nearly approaching that of the bark, except at the apex, where it bears two of the cast-off coverings of the young insect, which are of a dull yellowish or horn color. The scale of the male is much smaller, nearly straight, and bears but a single molted skin on its apex.

Of the Insect and its Changes.

These scales are not the insect or portions thereof, for the scale-insect may, in its earlier stages, be found beneath them, but are a thin pellicle which has been excreted by the insect for its covering and protection, and thrown out in successive layers, as may be seen under a magnifier, and built up by degrees, very much as is the shell of an oyster.

The several changes that the insect undergoes, from the time of its hatching from the eggs beneath the scale, through its brief period of free and active life, followed by its attachment to the bark where it becomes permanently fixed, its subsequent moltings, the excretion of the scale and its steady growth until it attains its full size, and the mother has placed beneath it a hundred or more minute white eggs—all these form an exceedingly interesting narration, but it has been so often given that the reader who would know the details, is referred to the reports of Harris, Fitch, Walsh, Le Baron, Riley, and others, and the pages of many of our agricultural papers.

Although so much has been written of this common insect, yet there are portions of its history which demand further study, for example, the extent to which it is double-brooded.

Is it Double-brooded in the State of New York?

Prof. J. H. Comstock, in his Report on Scale Insects, contained in his *Report of the Entomologist of the U. S. Department of Agriculture*, for the year 1880, in writing of this insect, which he regards as the *Mytilaspis pomorum* of Bouché, states that "there is but a single generation each year in the north, where the eggs hatch in the latter part of May, or early in June, and two generations in the south."

All of our entomological writers upon the insect have united, I believe, in this opinion, with the exception of Dr. Harris, who has given this as a summary of its life history:

The eggs begin to hatch about the twenty-fifth of May, and finish about the tenth of June. * * * * * In about ten days the young become stationary, and early in June throw out a quantity of bluish-white down, soon after which their transformations are completed, and the females become fertile, and deposit their eggs. These, it seems, are hatched in the course of the summer, and the young come to their growth and provide for a new brood before the ensuing winter. (*Insects Injurious to Vegetation*, 1862, p. 253.)

Prof. Riley has had the insect reported to him as double-brooded in Wright county, in the southern part of Missouri, and has written further upon this subject, as follows:

In Mississippi I know that there are two generations each year, as I have received the second brood hatching about the first of September. Dr. Harris, years ago, asserted [?, see above, "it seems"] that there were, at least [?] two broods of this apple-tree bark-louse each year, and, though he was evidently in error, so far as his own particular State (Massachusetts) was concerned, and has been severely berated for this statement by subsequent writers, yet it finally appears that his language is not so very wide of the mark. (*Fifth Report on the Insects of Missouri*, 1873, pp. 79–80.)

Not having made special study of this insect at any time, it would not be proper to say that, as a rule, it has two generations a year in the State of New York, and that Dr. Harris was probably correct in his statement regarding it in Massachusetts; but it certainly is double-brooded in New York as far north as Albany *in some seasons.* The following is the evidence upon which this assertion is based:

In a communication made by me to the *Country Gentleman* of February 1, 1877, I stated: "Some terminal twigs of a pear tree growing in a garden in Albany, were recently brought to my notice, upon which the scales of *A. conchiformis* extended to the extreme tip of the new growth of the year. Accompanying these were some pears taken from the same tree, having on them a number of the scales which had unquestionably been attached to them after the fruit had very nearly, if not entirely, attained its full size."

Upon subsequently visiting the tree, in the garden of Dr. Woolworth, at that time the Secretary of the Board of Regents of the University of the State of New York, it was found (as also others) badly infested with the scale, and the fruit upon it also infested to the extent of readily inviting attention to its condition. No minute was made of the date of this observation, but it was certainly not earlier than the month of September, and may have been in October.

A stem taken from one of the pears, bearing a dozen or more of the scales, was placed in glycerine at the time, and is now in the State collection, subject to verification, if desired.

It must be evident to all who know the habits and development of these insects, that scales found on the mature fruit can only be from a summer brood, and not from that which occurs at about the time of the blossoming of the fruit.

Is Double-brooded in Canada.

At the time of writing the above, I had no knowledge of the scale of this species having been observed on fruit, but the following notice of it has since been published, which shows a double brood for the insect even as far north as in Canada. The authority quoted is, of course, unquestionable. Mr. J. W. Douglass, of Lewisham, England, in a note dated May 12, 1888, upon *Mytilaspis pomorum*, states:

> Mr. James O'Brien has sent to me an apple, just imported from Tasmania, on which were a dozen of the scales of this Coccid, and he says he has seen some on apples from Australia. * * * I have seen the scales of this species on the fruit of apples grown in Britain, yet rarely, and also on American and Canadian fruit. (*The Entomologists' Monthly Magazine,* xxv, 1888, p. 16.)

Remedies.

If a tree has become so infested with the bark-louse that it has extended entirely over it, even planting itself on the terminal twigs, there are but two ways to deal with it: either cut the tree down and burn it, or spray it thoroughly with some liquid that will penetrate the scales and kill the insect or the eggs beneath. This, a proper kerosene oil emulsion, rightly applied, should do. It would better reach the scales when the tree is not in leaf, either in the spring or in the autumn; or if more convenient, it could be attended to in the winter. The oil will readily penetrate the scales and accomplish the desired purpose.

If the tree is small, and the scales not generally distributed over it, they may be scraped off and gathered upon a sheet spread underneath, so that the eggs may all be destroyed instead of being left on the ground to hatch and allow the young to ascend the trunk.

If the scales are confined to the trunk and lower part of the main branches, and a proper spraying apparatus is not accessible, the insects may be killed with a soft-soap solution, provided that it be used at the proper time.

The time of all others when the insect is the most vulnerable is during the early period of its existence — for about a week after hatching from the egg and previous to the time that it has attached itself to the bark and developed its scale-covering. This is usually late in May or the early part of June, and a number of observations have shown it to be contemporaneous with the opening of the apple blossoms. At this time, careful examination will show thousands of the young lice slowly moving over the bark and appearing to the naked eye as little white specks. They are so delicate at this tender age that the friction alone of a stiff brush would kill all the insects with which it came in contact.

Prof. Cook, who has had large experience with this pest, has told the story of just how he has successfully fought it in the orchards of the Michigan State Agricultural College, at Lansing. The account he gives of his method is so decidedly practical that it merits a wide publicity:

The old remedy, soft soap, or a strong solution of the same, will surely vanquish this enemy if it is applied in early June and again three weeks later. I have proved the efficacy of this treatment over and over again. The trees at once put on new vigor, and in a short time only dead lice are to be found. To apply this specific, I know of no better way than to use a cloth and scrub by hand. To be sure, we can, if dainty, use a brush like a shoe-brush, but I like to go at it with a good cloth, when, with sleeves rolled up, I make pretty sure that no louse escapes.

For the past few years I have added to the soap, crude carbolic acid, which I think improves it, especially if but one application is to be made. I heat to the boiling point one quart of soft soap to two gallons of water, and while still hot, thoroughly stir in one pint of crude carbolic acid. (*Bulletin No.* 14 *of the Agricultural College of Michigan.*

In Saunders' *Insects Injurious to Fruits*, it is recommended that after every effort has been made to destroy the insect while in the scale, in order to complete the work, the hatching should be watched, and while the larvæ are active, the twigs should be brushed with a strong solution of soft soap and washing soda, or syringed with a solution of washing soda, made by dissolving half a pound or more in a pailful of water.

Painting the twigs and branches with linseed oil has also been recommended and claimed to be harmless to the tree, and effectual for the destruction of the eggs beneath the scales; but we would not commend a resort to this heroic method until experiment shall show the season and the condition of the tree when it may be employed without fear of a harmful result.

Ptyelus lineatus (Linnæus).

The Lined Spittle-hopper.

(Ord. HEMIPTERA: Subord. HOMOPTERA: Fam. CERCOPIDÆ.)

Cicada lineata LINN.: Faun. Suec., 1761, p. 888; Syst. Nat., 1767, pt. ii, p. 709, No. 31.
Cercopis lineata FABR.: Spec. Ins., ii, 1781, p. 330, 8; Mant. Ins., ii, 1787, p. 274, 13.
Ptyelus lineatus UHLER: in Cassino's Stand. Nat. Hist., ii, 1884, p. 243.
Ptyelus lineatus. PACKARD: Entomol. for Beginn., 1888, p. 82, fig. 69.

The Insect abounds on Grass.

The pupæ of this insect were sent, June twenty-first, from Mr. Brooks Strait, of West Stockholm, St. Lawrence Co., New York, with the statement that they were found on the grass of meadows and pastures, and that "this part of the county was filled with them." They were causing considerable anxiety, and many farmers desired to know the amount of harm that they would inflict, and what remedies, if any were needed, might be employed against them.

Answer was made that it was a Hemipterous insect (order embracing the bugs), of the family of *Cercopidœ*, and that it belonged to the group of "spittle-insects," in which the larvæ and pupæ living on the sap of their food-plants, envelop and entirely conceal themselves within a mass of frothy material, sometimes called toad's spittle or frog spittle. The liquid is given out by the insect in quantity so large that portions of it break away from the mass from time to time, and drop to the ground. The group is a large one, embracing many species of the genera of *Aphrophora, Lepyronia, Clastoptera, Ptyelus,*

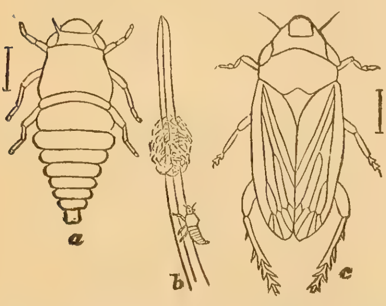

FIG. 49.—Spittle-insect, PTYELUS LINEATUS; enlarged: *a*, larva enlarged; *b*, its natural size on grass with froth-mass or "spittle."

et cet. Common species in the State of New York, are *Aphrophora parallela* Say, *A. Saratogensis* Fitch, and *A. quadrangularis* Say.

Ptyelus lineatus is a common species in low and damp meadows on grasses and some other plants over a large portion of the United States. It has never been known to occur in such numbers, where it is commonly met with, as to cause serious harm to the grasses. The insect matures during the latter part of June, when it becomes winged and feeds for a short time on the sap of the grasses, but its life in this stage is too brief to enable it to be the occasion of greater injury (if so great) than in its earlier stages. It may be recognized, among its allied species, by the narrow brown double streak on the head and prothorax, also by a slender line of the same color near the costal margin of the wing-covers, the margin itself being white (Uhler).

Figure 49, from Dr. Packard's recent publication, entitled "Entomology for Beginners," illustrates the insect in its larval and perfect stages,— their natural size being shown in the lines beside them.

Fabricius has given the habitat of *P. lineatus*, as Germany. It has quite an extended distribution throughout Europe, as well as in this country.

Ephemera natata (Walker).

(Ord. Neuroptera: Fam. Ephemeridæ.)

Palingenia natata Walker: Cat. Neurop. Br. Mus., Part iii, 1853, p. 551, 13.
Ephemera natata Hagen: Synop. Neurop. N. A., 1861, p. 39, 4.

Examples of this May-fly were received on June sixth, from Middleburgh, N. Y., where they had occurred in such immense swarms as to excite general interest, and considerable anxiety lest some injurious effects might follow their appearance. Answer was returned of their entire harmlessness, of their probable source in the Schoharie river at that place, of their brief existence in the winged stage, etc.

The species is a common one, and of broad distribution throughout the northern United States, Dominion of Canada, and Hudson Bay region.

Its general color is blackish. The antennæ are black; the abdomen is striped with two blackish lines; the caudal appendages (setæ) are three in number, of almost equal length, a little shorter than the body, reddish, banded with black; the wings are ash-gray, with black veins and four blackish spots on the front pair, of which the anterior and larger one curves upward to the front margin. The body is 0.6 of an inch long; spread of wings 1.5 inch. The setæ are 0.6 in. long.

Abundance of the May-flies.

The name of "May-fly" has been given to many species of these frail and delicate creatures, in consideration of the month in which a number of them make their appearance in early spring. The *Ephemeridæ* — the name of the family to which they belong — occur in abundance every season in the vicinity of lakes and rivers, but as their flights seldom extend to a great distance, and the time of their appearance may be limited to two or three days, they often escape observation. It is only when they appear in unusual abundance that they attract wide-spread attention. In the latter part of June, 1880, a species was observed by me, during a few days, at a summer encampment at Lake Bluff, on Sodus bay, Lake Ontario, in such numbers as almost to cover the tents and the surrounding foliage. Upon others of our lakes their dead bodies have been cast up by the waters in windrows on the shore.

Remarkable Occurrences of Ephemeridæ.

Several instances are recorded of their appearance in almost incredible numbers along the rivers in France. One account compares their flight to a snow-storm of the largest flakes, and states that they accumulated on the ground about the feet of the observer to a depth of four inches; eyes, nostrils and mouth were filled by them. At another time they were so abundant at a locality in Carniola, in June, that twenty cart-loads were drawn away for manure.

The summer of 1884, proved to be very favorable for their multiplication in unusual numbers in New York and neighboring states. Their remarkable abundance at different localities in the vicinity of the great lakes, was repeatedly made the occasion of newspaper comment. The following notice from the American Agriculturist, for October, 1884 (page 429), is deserving of record, although not surpassing in its statements a number of other accounts of similar phenomena at other places.

Sand Flies Extraordinary.— We were not a little surprised, on alighting from the carriage at nine o'clock on a last July evening, at the Leland Hotel, Chicago, located close by the lake-shore, to find the air filled with snow-flakes — so it appeared. It was certainly a phenomenon — a snow storm in midsummer! The air was filled with these apparent flakes. The porters were sweeping from the sidewalks around the hotel the two or three inches of gathered "snow." The Brush lights were flickering as if about to go wholly out, submerged by the flakes which were rapidly filling the glass globes surrounding them. One light had already been quite "suffocated," and the globe filled to the top. Rifts of "snow" swept into the passage-ways leading to the rotunda, and the verandas along the lake-side of the hotel, were fairly flecked from one end to the other with the whitening shower. It was indeed a most astonishing sight with the thermometer at eighty. But a moment, however, sufficed to dispel the illusion. These were not snow flakes which whitened and covered roof and pavement, and suffocated powerful Brush lights, but sand-flies — countless myriads of insects, appearing somewhat like young dragon-flies, coming up like the locusts of Egypt, from the sands of the lake-shore, to harmlessly fly and flutter for a day and die. The next morning, bushels of them (so the head porter informed us) had been swept up during the night and carried away. They lay dead about the rotunda, through the hallways, in the dining-hall and in guests' chambers whose windows had remained open.

The following, recounts a similar phenomenon, at St. Paul, Minn., on July of 1885 :

Chicago, July 15.—A special from St. Paul, Minn., says St. Paul was treated to a phenomenon in the form of clouds of bugs on Wednesday night. About ten o'clock a breeze sprang up from the south, and with it came countless millions of bugs which swarmed around every light, often becoming so thick around the street lamps as to almost obscure the light. Around the electric-light masts they seemed to congregate in greater numbers than elsewhere, and in the vicinity of Bridge square, Seven corners, and at the park at the head of Third street, the streets were literally covered with the pests. Along the Wabash street side of the Second National bank the sidewalk was covered to a depth of over a foot. Around the market house at whatever point an electric light was located, the sidewalk was covered with them. The Merchants' hotel received a liberal share of the bugs, the steps leading to the veranda being completely hidden from sight, and it is estimated that more than a wagon-load of bugs could have been taken from in front of the building. In Rice park was witnessed a curious sight: the trees near electric-lights were covered with bugs, giving the trees the appearance of being moving masses of life, while the electric-light wires were strung with the insects. It is probable that after striking the wire they were unable to get away on account of the current. At two o'clock yesterday morning the streets in the vicinity of Bridge square, which had been cleaned, were again covered with them, and they still continued to come. The bugs are variously called "the green bay bug," "Sunday bug," and "day bug."

A remarkable flight of a minute species of ephemera, has been related to me by Mr. Erastus Corning, Jr., of Albany, as having been witnessed by him at Murray Bay, Province of Quebec, on the St. Lawrence river, N. Lat., 47° 40′, in August of 1888. They came in such numbers that they literally covered every exposed person and object. This was the more extraordinary in consideration of their minute size, which is less than that of some of the Aphides, being only 0.33 inch in expanse of wings. The smallest known ephemerid, *Chloe pygmœa* Hagen, also from the St. Lawrence river in Canada, has 0.24 inch spread of wings.

From examples brought to me, the species has been identified by Dr. Hagen, as *Cœnis nigra,* named by him in the *Proceedings of the*

Entomological Society of Philadelphia, ii, 1863, p. 179, but its description is not yet published. The type specimens came from the upper Wisconsin river.

Early Life of the Ephemera.

Like the "dragon-flies" to which they are related, the ephemera are aquatic in their early stages, swimming about quite actively in the water, in pursuit of food. Some of the species, according to Westwood, are of a more quiet nature, and live in burrows in the mud of the banks, divided internally in two canals, each having a separate opening externally at the extremity, so that the insect can crawl in at one hole and out of the other, without being obliged to make the awkward turn it would have to do in a straight hole.

Their aquatic life may be quite long, even extending to two or three years, during which time, in one genus, they are said to undergo as many as twenty molts.

The Short Life of the Winged Insect.

FIG. 50.—HEXAGENIA BILINEATA (Say).

Their winged life is not limited to a single day, as might be inferred from a popular name sometimes given them, of "day-flies," yet it is much more brief than that of most insects. It is believed that some of the species do not live longer than a day, while others have been kept alive for weeks. Mr. B. D. Walsh has retained living examples of *Hexagenia bilineata* (Say) in his breeding cake for nearly a week* (shown in Figure 50, from an example taken by me in Schenectady, N. Y., in the month of June.) De Geer has kept *Ephemera vespertina* alive for eight days, and Stephens mentions having kept specimens of *Cloeon dipterum* alive for more than three weeks (*Westwood's Introduction,* ii, p. 27).

Their Economic Value, Distribution, etc.

The Ephemeræ have long been noted for furnishing excellent and abundant food for fishes. Swallows and other birds also feed eagerly upon them. They have a broad distribution over the world, from the tropics up to high northern latitudes. Hundreds of species have been described, while a very large number, from the difficulty attending their study, are still awaiting description. Dr. Hagen's *Synopsis of North American Neuroptera,* published in 1861, contains forty-five North American species.

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* *Practical Entomologist,* ii, 1867, p. 95.

Hairsnakes as Parasitic on Insects.

The Gordiacæa are so frequently encountered in the form of internal parasites of insects, that a brief notice of their character may be acceptable to the entomologist, as well as to the general naturalist.

The Superstition Regarding Hairsnakes.

A prevalent superstition respecting the strange looking creatures known as "hairsnakes," and when of smaller size, "hairworms," is that they are produced from horse-hairs which had found their way into ponds, pools, barrels of rain-water, etc. It should not be necessary to state that such a transformation is an utter impossibility, and that no dead organic matter can ever be thus changed into a living creature. It is a law of nature that every animal being, from the lowest to the highest, has its commencement in an egg.

What Hairworms Are.

The hairworms, of which there are a number of species known, belong to the *Entozoa* (of the class of worms — *Vermes*), which embraces a large number of small, worm-like animals (the tapeworm might with propriety be termed a large one) that pass a portion of their existence within the bodies of other animals as parasites. There are two genera of the hairworms, viz.: *Gordius* and *Mermis*, which

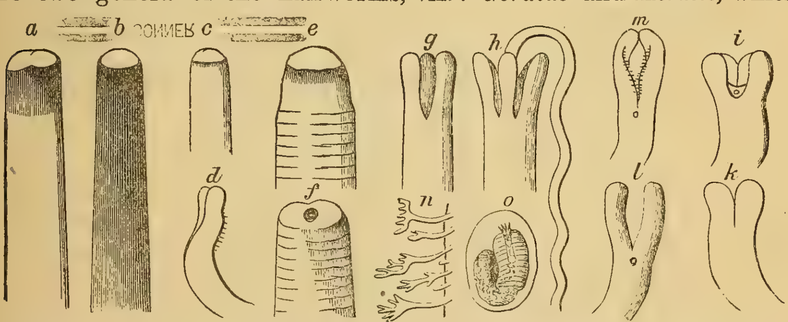

Fig. 51.— *a*, *b*, Anterior ends of female and male Gordius varius; *c*, *d*, fore and hind ends of Gordius linearis; *e*, *f*, same of Gordius robustus; *g*, hind end of Gordius varius; *h*, the same, with its three lobes more divergent, and exhibiting the extrusion of its cord of eggs; *i* and *k*, the same (two-lobed) of the male; *l*, the posterior end of the male of Gordius longolobatus; *m*, the same of the male G. linearis; *n*, portion of the fringe of the latter, highly magnified; *o*, egg of G. varius containing a fully developed embryo. (After Leidy.)

differ somewhat in structure, and ordinarily in color, the former being brown or black, and the latter white or pale yellow. They vary greatly in length as they occur to us, partly from their age, but also from their difference in species, some measuring but four inches, and the longest recorded, twenty-six inches. Their general hair-like appearance, is well-known. Their structure is apparently the same throughout, with no particular features by which the head can be distinguished from the tail by the ordinary observer — indeed by some writers the two have been confounded, even when studied microscopically. Figure 51, from a paper by Dr. Leidy, in the *American Entomologist* for May, 1870, presents enlargements under a high power of the extremities of different species of Gordius, and shows marked differences and well-defined specific characters therein.

The Gordiacæa are not rare, but are from time to time met with in turning over damp soil, perhaps in a little knot of several individuals twisted together (whence we may have the "Gordian knot"), in barrels of water, in ditches, wagon-ruts, ponds, pools, drinking troughs, wells, etc. They are sometimes discharged from water-pipes, as in the instance of a Gordius of about six inches in length, which was brought to me by a lady who had detected it in a glass of water drawn from a faucet, by the slight tingling sensation which it produced upon her lips as she was about to drink in the dark.

A Common Parasite of Insects.

As a parasite, *Gordius* occurs in the bodies of insects of nearly all the orders, as Hymenoptera, Lepidoptera, Coleoptera, Diptera and Orthoptera. Of the latter order, it is often found in katydids, crickets, cockroaches and grasshoppers — sometimes as many as five in a single grasshopper. They are met with in their parasitic stage by dissection of the insect, its accidental crushing, or in a voluntary escape when the time has come for their free existence: they have frequently been seen emerging from the heads of grasshoppers.

Some of the Characteristics of Gordius.

The Gordius is a peculiarly constructed creature: microscopic examination reveals what may be a mouth, but it seems to possess no stomach, intestinal canal, or vent. Its interior is wholly occupied by a white matter resembling the pith of a plant. Its nutrition is suggestive of that of the rootlets of plants; yet it is known to have generative organs, a nervous system, etc. It is wonderfully prolific. It eggs have been seen to be extruded in a delicate thread or cord (as at *h* in the figure) of an entire length of nearly eight feet, containing as estimated from a small section, nearly seven millions of eggs.

Its Life-History.

A brief summary of the life-history of the Gordius is as follows: Its appearance while still in the egg, is shown at *o*, in Figure 51. After emerging from the egg, it presents the successive appearances given at *p*, *q*, *r*, in Figure 52. In its earliest, or embryo stage, it lives in water. Floating about until it comes in contact with some aquatic larva, as of a species of fly or other insect, it usually enters the body through the joints of the legs, and becomes encysted, or inclosed in a small sac or bladder, as are the Trichinæ. When these larvæ are eaten by fish the cyst is broken and the Gordius passes to its second stage. After having remained free in the body for a while, it again becomes encysted in the mucous layer of the intestines. In its third stage it is again free, when it penetrates into the intestines of the fish, whence it passes with the fæces into the water, where it enters upon its final growth, undergoing other changes. Such is its history when entering into aquatic larvæ, as elaborated a few years ago by M. A. Villot, a French scientist. Its subsequent changes, when parasitic upon terrestrial insects have not been as fully observed, and just how, at maturity, it succeeds in entering their bodies, is still a mystery.

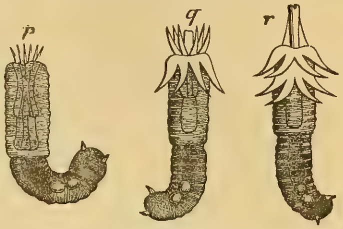

Fig. 52.— The young Gordius varius, after emerging from the egg, showing different degrees of protrusion of the oral apparatus. (After Leidy.)

Mermis Parasitic on the Apple-worm.

The other genus of hairworms, *Mermis*, has occasionally been found within apples, where it occurs as a parasite of the apple-worm, the larva of the codling moth, *Carpocapsa pomonella.* A notice of *Mermis acuminata* occurring in some apples in Orange county, N. Y., in 1875, coiled up in the fleshy part of the fruit, about midway between the skin and the core, was given by me in the *Thirtieth Annual Report on the N. Y. State Museum of Natural History* for the year 1879 (pp. 117–126); also in my *Entomological Contributions* (No. iv, pp. 5–14). It is therein mentioned that a species of *Mermis* infests the *Carpocapsa pomonella* larva, in Europe. According to Dr. Speyer, the *Gordiacœa* not unfrequently occur in larvæ which feed on tall trees, as well as those which live on plants and shrubs. Wet seasons seem to be productive of the parasitism, and Dr. Speyer recalls a number of years ago, his having met with several of such instances. From an example of *Hadena adusta,* he had a *Mermis* emerge of the length of eight and a half inches, and another from *Hesperia lineola* after it had been pinned. Prof. von Siebold suggests that a heavy dew may so moisten the trunks of trees as to enable the *Mermis* to ascend them.

Those who would know more of these interesting creatures, may find an excellent extended article upon them in the *First Report of the U. S. Entomological Commission,* 1878, pp. 326–333, from which the illustrations herewith presented have been taken.

Cermatia forceps (Rafin.).

(Class Myriapoda : Ord. Chilopoda : Fam. Scutigeridæ.)

Calista forceps Rafinesque : in Annals of Nature, 1st No., 1820, p. 7.

Cermatia coleoptrata Villiers. Say : in Journ. Acad. Nat. Sci. Phil., ii, 1821, p. 109; Compl. Writ., LeConte Edit., ii, 1883,p. 29.

Cermatia Floridana Newport : in Linn. Trans., xix, 1845, p. 353.

Scutigera Floridana Gervais : Aptera, iv, p. 225.

Cermatia forceps. Wood : in Journ. Acad. Nat. Sci. Phil., 2d ser., v, 1862, p. 9; in Trans. Amer. Philosoph. Soc., new ser., xiii, 1869, p. 145, pl. 3, figs. 1, 1a.

Cermatia forceps. Packard : Guide Stud. Ins., 1869, p. 673; in Amer. Nat., xiii, 1879, p. 527; in id., xiv, 1880, pp. 602, 603 (eyes and brain).

Cermatia forceps. Henshaw : in Amer. Nat., xiii, 1879, p. 711.

Cermatia forceps. Murray : Econom. Entomol.— Aptera, p. 29.

Cermatia forceps. Lintner : in Count. Gent., xlv, 1880, p. 311; in Brooklyn Citizen, Sept. 5, 1887, p. 3, c. 5, 6.

Cermatia forceps. Underwood : in Entomolog. Amer., i, 1885, p. 149.

Scutigera forceps. Bollman : in Entomolog. Amer., iv, 1888, p. 8.

Examples of this denizen of many Albany dwellings, have so frequently been brought to this office for name, etc., that it is believed that an account of it will prove of general interest, since its annoying intrusion is by no means limited to Albany, but is co-extensive with an already extended distribution over the Northern United States.

Does not Belong to the Class of Insects.

Its consideration does not properly come within the province of an entomological department, as it is not a member of the class of insects — characterized by having only six legs in the perfect stage, and from eight to twenty-two in the larval state, but of that of the Myriapoda, members of which are popularly known as "thousand legged worms," centipedes, etc. Among these it holds high rank — almost the highest, and it consequently approaches near to the insects in several respects, as in the character of its head, its long antennæ, the small number of its abdominal joints, and other structural features.

Is One of the Centipedes.

It may claim more than an ordinary share of interest, from its being a veritable Centiped, and from the determination that it displays of domesticating itself in our northern homes, which have hitherto been free from the intrusion of this class of unwelcome guests — so common and so seriously annoying in warmer climates. The anxiety that it has already aroused is shown by the frequent requests that are being made for some information of its nature and of its habits — whether harmful, dangerous, or otherwise.

Description.

It is about one inch in length of body: some southern individuals have measured one inch and a fourth. Its breadth at the widest part is about one-sixth of an inch. Its general color is a light olive-brown. The head is large, broader than the contiguous rings of the body, of an oval flattened outline, and is marked with two converging black lines on its front. The antennæ are quite long, many-jointed, attenuated, being thread-like at the end. The eyes are black, large, prominent, and compound; beneath them is a pair of spined palpi; and back of these, on the hinder part of the head, a pair of leg-like pointed jaws, ending in a black tip. The head and its appendages are shown in enlargement in Figure 53, in which an excellent representation of the creature is given.

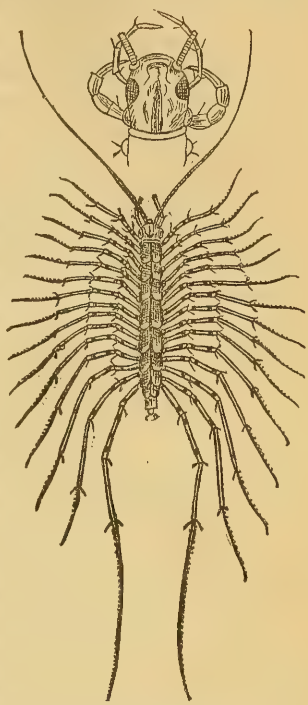

FIG. 53.— CERMATIA FORCEPS. (After Wood.)

The body has its sides nearly parallel, being but a little broader at its middle. It is traversed centrally upon the back by a sharply defined black line which commences on the head between the eyes and terminates at the last abdominal joint. Upon each side of this is a similar well-defined black line, commencing at the eyes and continuing over the entire body. The upper side of the body shows eight plates or shields, which are suboval in general outline, sharply excavated posteriorly, and thin and reflexed at the sides: under a magnifier these show granulations or spines. Underneath, the body shows fifteen rings, two of which are covered by each of the dorsal shields except the last.

There are fifteen pairs of long legs, armed with several toothed ribs, and with spines at the end of the joints. The two principal joints (tibia and tarsus) have each two incomplete black bands. The ends of the legs (metatarsal joints) are many-jointed, long, round and terminated in a short, black, acute hook. The front legs are about two-thirds the length of the body. The following ones increase in length to the terminal pair — the latter, longer than the body (in the male one-fourth longer, in the female twice as long).

Its Distribution.

It is a southern form, which seems for some time past to have been steadily extending its way northward. Say, who cites the species in his *American Entomology*, in 1871, under the name of *Cermatia coleoptrata*, gives it as an inhabitant of the Southern States, which he had observed in Georgia and Florida. The examples described by Newport as *Cermatia Floridana*, were from East Florida, where it was quite common, running about in houses at night. The examples deposited in the Smithsonian Institution at Washington are, according to Dr. Wood, author of the *Myriopoda of North America*, from Tamaulipas in Mexico, St. Louis, and Washington.

It first came under my observation in Albany, in the year 1870, in a specimen brought to the N. Y. State Museum of Natural History, which had been taken in this city. It had been observed within the State at an earlier date, for Dr. H. A. Hagen informs me that a living specimen was seen by him in his bed-room at the Prescott House, in New York, in October, 1867 — the first articulate to greet him upon his arrival in America.

In 1878, Dr. A. S. Packard found an individual hidden in some wrapping paper in his house at Providence, R. I., which he thought may have been brought in a bundle from New Jersey, as it had not, so far as he knew, been known previously to exist north of Philadelphia. Its capture was made the occasion of its notice as "A Poisonous Centipede," in the *American Naturalist* for August, 1879. The publication of this notice brought forth a note from Mr. Samuel Henshaw, of the Boston Society of Natural History, to the effect that the society's collections contained six examples taken in Massachusetts, and that three others were known to have been captured in other parts of the State. It had also been taken at Milford, in New Hampshire.

In a recently published paper entitled, *The North American Myriapoda*, by Prof. L. M. Underwood,* of the Syracuse University, it is given as having been observed by the writer at Bloomington, Ill., Philadelphia, Pa., Brooklyn, N. Y. (somewhat common in cellars), and at Utica, N. Y. (in a single example, running about the floors of the N. Y. Central Rail Road Station); and as somewhat generally distributed east of the Mississippi river.

In a *Preliminary List of the Myriapoda of Arkansas*, by Charles H. Bollman,† it is recorded as occasional in that State; " one adult was seen at Arkadelphia, and several young at Little Rock."

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* *Entomologica Americana*, i, 1885, pp. 141–151. † Id., iv, 1888, pp. 1–8.

Its Abundance in Albany, N. Y.

In a communication made by me to the *Country Gentleman*, in 1880, it was stated that "probably as many as fifty examples have come under my observation during the ten years that had elapsed since the first notice of it here." During the subsequent seven years, it has continued to increase steadily in number. It has been frequently brought to me from residents of various parts of the city, as something observed for the first time in a single example; and numerous inquiries have been made of its habits, whether or not it was a new depredator on carpets or clothing, to be added to the clothes-moth and carpet-beetle, or if it was in any way injurious, as it was occurring in such numbers as to entitle it to be ranked as a household pest. In one instance, in the pulling down of an old wooden building in Hudson avenue, a multitude of them were discovered in removing the wainscotting of the basement floor.

Its Habitat.

It has usually been reported from basements, and it is, perhaps, more frequently seen in the vicinity of the hot-water pipes — the favorite haunt of another pest of many city homes, viz., the Croton bug, *Ectobia Germanica.* It is not limited, however, to this portion of dwellings, for its long, flexible, and agile legs, in its travels for food, serve for its distribution through all the apartments. It has been seen scurrying over the parlor carpets, and while this notice is being written, it has been brought to me from the third floor of a dwelling, where it was found quietly resting upon a damp piece of linen cloth hung up for drying.

A young individual, the extended length of which was less than three-fourths of an inch (body 0.18 in., antennæ 0.33 in., hind legs 0.21 in.), was taken February second from the water of an aquarium in my office, on the fourth floor of the Capitol.

What are its Habits.

It will be a relief (in one direction, at least) to know, in consideration of its multiplication as a household pest, that the new-comer will not eat carpets, or clothing, or manufactured fabrics of any kind; nor does it emulate the roach and the Croton-bug in their attack and defilement of various articles of domestic food. Its structure has made it carnivorous, and it is believed to subsist, after the manner of its allies, upon other living creatures which its rapid movements enable it easily to catch. For this purpose, it has been provided with peculiar jaws for grasping and holding, which are probably channelled for the injection of a poisonous fluid into the body of its captives. These have been characterized as "something half-leg, half-jaw, after the fashion of the falces of spiders, with a sharp point and a hollow duct up their core, which is connected with a poison gland, as in the spider."

The Cermatians, to which this species belongs, and of which there is but one other species known in the United States, viz., *Cermatia Linceci,* from Texas (these two have the honor of constituting the family of *Scutigeridœ*), are said to be very rapacious and carnivorous in their nature, springing upon their prey after the manner of some of the spiders. Dr. Wood has written of the order to which the above family pertains (*Chilopoda*), which embraces also the poisonous centipedes of the Southern States, known in science as *Scolopendridœ,* as follows: "The whole organization of the Chilopods fits them for their predatory and carnivorous habits. The distinctness of the segments, which are not closely approximate, and the flexibility of the segments themselves, enable them to move their body in every conceivable direction. Their highly organized nervous and muscular system, and the length and power of their legs, betoken habits of great activity; whilst the formidable nature of their mandibles, and the sharp spines, both lateral and terminal, with which their feet are armed, fit them for predatory warfare."

Its Food.

We have yet to learn what are the living creatures that the Cermatia finds within our homes for its prey, and which it could not as well or better obtain elsewhere. Possibly with this knowledge acquired, we might receive it as a welcome guest whenever it appears, in the confidence that it would not obtrude except for the purpose of relieving us from greater pests. Some writer has credited it with feeding on roaches and croton-bugs, but this may be a mere supposition. In experiments made by me to test it with the latter, by confining the two together, the bugs have not been eaten, and the Cermatia has been the first to die. Perhaps it preys upon these insects only in their younger stages; or its disposition may be changed under confinement, to which it shows itself to be remarkably sensitive, for upon all the occasions when it has been brought to me alive, even when placed under a glass cover of a half-bushel capacity, it has invariable died within two days. Can it be that it succumbs so quickly to want of its proper food, or to need of moisture? The ordinary Myriapods, of the family of *Julidœ,* or "hundred-legged worms," such as are found in decaying vegetation, fruit, etc., have survived for weeks in my office, although crowded in small glass phials, almost excluded from air and entirely without food.

The bed-bug is known to have inveterate foes in two or three other members of its own order, the Hemiptera. *Reduvius personatus* (Linn.) and *Pirates biguttatus* (Say), two insects resembling the well-known squash-bug, as shown in figure 47 of page 232, feed eagerly upon it,—the former, while in its pupal state, completely enveloping itself in a mask of dust and dirt for its better concealment while lying in wait for its prey. Of another member of the bug order, *Pentatoma bidens*, it is reported that six or eight of them, shut up in a room swarming with bed-bugs, completely exterminated them in the course of a few weeks. The Cermatia, if so inclined, would prove an expert hunter of this pest: may further observations show it to be so.

Of other food that our houses might furnish, may be mentioned these: The little red ant, flies, the larva of the carpet-beetle (the clothes-moth would not be sufficiently abundant), and spiders. It will be of interest to note if any of the above-named creatures diminish or disappear when the Cermatia domesticates itself.

Is it Poisonous?

It is undoubtedly poisonous, but not to an extent that it need be the occasion of any alarm. The mosquito, when it thrusts its beak, composed of six distinct pieces, into our flesh, and draws thence the blood through the channel that they form, is supposed to instil into the wound at the same time a venomous liquid, which causes the blood to flow more freely, and occasions the subsequent irritation, so different from that resulting from the prick of a pin or needle. Spiders—house-spiders as well as others—are poisonous, and kill their prey, upon the juices of which they afterward feed, by injecting poison in them. Their mandibles are constructed after the manner of the rattlesnake's fang, the aperture for the discharge of the venom being, like that, placed on the outer curve of the mandible, and communicating through a duct with a poison sac at its base. And yet they seldom excite fear or terror, nor should they do so, for their fangs are only used on other insects that they may procure their food, or in self-defense, if molested and unable to escape. No one likes to kill a spider.

Wood states of the Chilopoda, to which Cermatia belongs: "There can be no doubt but that they are provided with poison glands, situated at the base of the mandibular teeth, and perhaps also at the bases of the terminal claws of the feet." Newport has observed in *Scolovendra* the longitudinal opening at the inner margin of the apex of the mandible communicating with a poison sac, and the gland of which it is the reservoir. Latreille, from observations on *Cermatia araneoides* of the south of France, satisfied himself of the poisonous nature of the bite of a Cermatian.

The above authorities fully attest the poisonous character of this creature, and it has also been confirmed by other writers, who might be cited. There is no record, however, of its bite ever having been inflicted upon a human being. In one instance brought to my knowledge, harm from it was surmised. A young lady pupil, occupying a dormitory of a boarding-school, discovered on her person, on awakening, a hard, swollen, inflamed and somewhat painful spot of a considerable size. While speculating on its cause, she saw one of these Cermatians resting on the sloping ceiling directly over her bed. Had it inflicted a bite during the night under the provocation of sudden pressure, or was its presence at the time merely accidental?

Life-History.

Of this, nothing appears to be recorded by our writers, and I have no access, at present, to whatever may have been written of other species of the genus occurring in Europe or elsewhere, of which Newport, in his monograph on the Myriapoda, in 1845, has recorded and described seventeen species.

From the observation given in a preceding page of this paper, it appears that the young (quite small) are to be found in the month of January. Adult forms have been brought to me, as from records at hand, in April, June, October, November and December, and they are probably to be found during every month of the year. A young individual, about one-third grown, has been taken by Mr. Erastus Corning, Jr., on September twenty-ninth, and contributed to the collections.

This creature is apparently quite cleanly in its habits, as it has, on different occasions been observed in the laborious and time-taking operation of cleaning its many legs by passing one after another, from their extreme base to the tip, through its mandibles.

Remedy.

If the Cermatia should be found to occur in large and annoying numbers in particular localities, it could readily be disposed of by a free application to the premises of fresh pyrethrum powder.

BRIEF NOTES ON VARIOUS INSECTS.

? Dolerus sp.—The saw-fly larva, noticed in my report to the Regents for 1886 (*40th Rept. N. Y. St. Museum Nat. Hist.*, pp. 87–90), as cutting off the heads of wheat in New Jersey and Pennsylvania, was again reported by Mr. J. E. Wittmer, of Hale, York county, Pa., as having made its appearance, June 16, 1887, but at that time, in no increase in number or injury over that of the preceding year. No examples were obtained for further study.

The same species, evidently, was the occasion of remark and discussion, at the Annual Meeting of the New Jersey State Board of Agriculture, at Camden, in January of 1888.

Mr. Denire stated, that the insect, the preceding year, about two or three weeks before harvest, had cut off the heads of the wheat, about half an inch below the head. In his own field, and in others in his neighborhood, about five per cent of the crop had been thus destroyed.

Mr. Nicholson remarked that a number of complaints of this injury had been received from Monmouth county. The worm, in some cases, had destroyed about twenty per cent of the crop, by cutting off the straw an inch or two from the head, a short time before harvest, and it was impossible to gather it with any machinery on the farm, for the heads fell and were lost on the ground. (*Fifteenth Annual Report of the New Jersey State Board of Agriculture*, 1888, page 164.)

Danais Archippus (*Fabr.*).—The larvæ of this butterfly were observed at Sageville (Lake Pleasant), Hamilton county, N. Y., July eighteenth, on milkweed (*Asclepias*), in various degrees of development, from its first stage (previous to its first molt) to near its full growth. The following memoranda were made of it:

As observed in its first stage, in readiness for its first molt, July twentieth, it is nearly one-fourth of an inch in length. The two black horns on the second segment are subcylindrical, about one-fourth the diameter of the body in length. The two black tubercles on top of the eleventh segment are less than one-half so long. The bands traversing the body are black on a white ground, on the middle of each segment, with yellow between, over the incisures. The head is shining black, with two brown lines on each side.

In the second stage, the front horns are straight, transversely wrinkled, moderately tapering, with a length about equal to the breadth of the body. The horns of the eleventh segment are about one-fourth as long as the anterior ones. Head, with the lateral perpendicular lines yellow, and with a yellow triangular spot centrally in front.

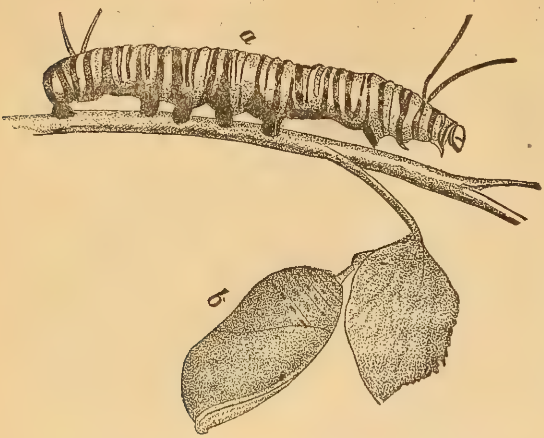

Fig. 54. — Danais Archippus: larva and chrysalis. (After Emmons.)

In the third stage, in readiness for molting, the anterior horns are curved, and have a length equal to the breadth of the body, and are twice as long as the posterior ones. No notes were made of the above features in the subsequent stages. The mature larva is represented in Figure 54.

A larva suspended for pupation on July nineteenth, and pupated on the following day. Its chrysalis is shown at *b* in the figure.

The presence of the young larvæ on the leaves may readily be detected, even when they are so small as to escape ordinary observation, through a knowledge of its habit of feeding at this stage. It probably first consumes the shell from which it emerged, as no remains of it were seen. Then, without leaving its position, and, adhering by its hinder legs, it eats through the tender leaf, and continues to feed, by simply bending its body to either side, in a large portion of a circle of less than one-fourth of an inch in diameter. Examination of the leaves will often show a crescentic hole, unmistakably the work of the larva, and, usually, its presence on its feeding ground, just within the crescent.

The following species of butterflies were observed at Sageville, Lake Pleasant (southern portion of the Adirondack region, height above tide of about 1,800 feet), during the three weeks from July sixteenth to August fifth. Some species were possibly overlooked, as no special attention was given to them — the locality not offering rare forms:

Papilio Asterias *Fabr.*	Colias Philodice *Godt.*
P. Turnus *Linn.*	Danais Archippus (*Fabr.*).
Pieris oleracea (*Harris*) form æstiva.	Argynnis Cybele *Fabr.*
P. rapæ (*Linn.*).	A. Aphrodite *Fabr.*

Argynnis Atlantis *Edw.*
A. Myrina (*Cramer*).
A. Bellona *Fabr.*
Phyciodes Tharos (*Drury*).
Grapta Faunus *Edw.* — very common.
G. comma (*Harr.*) form Dryas.
Grapta Progne (*Cramer*).
G. J. album (*Bd.-Lec.*).
Vanessa Antiopa (*Linn.*).
V. Milbertii *Godt.*
Pyrameis Atalanta (*Linn.*).
Limenitis Arthemis (*Drury*).
L. disippus (*Godt.*).
Satyrus Alope (*Fabr.*).
Feniseca Tarquinius (*Fabr.*).
Chrysophanus hypophleas *Bd.*
Lycæna Comyntas (*Godt.*).
Pamphilus Peckius (*Kirby*).
P. Metacomet (*Harris*).
Total, 27 species.

Thecla strigosa *Harris.*— A larva of this beautiful butterfly was received on June eighth, from E. Moody & Sons, of the Niagara Nurseries at Lockport, N. Y., which had burrowed into a cultivated plum and eaten out its interior after the manner of *Thecla Henrici*, in the wild plum, as described by Mr. W. H. Edwards, in *Papilio*, i, p. 151–2. It was seen to differ from that species, as it was of an uniform green color, and lacked the tuberculous dorsal ridges characterizing that form. At the request of Mr. S. H. Scudder, it was sent to him for figuring. Not reaching its destination in a healthful state, it was preserved by inflation, after it had been compared with two other examples in the possession of Mr. Scudder, which were feeding on the leaves of shad-bush (*Amelanchier*) and blueberry (*Vaccinium*), and found to agree with them "to the uttermost microscopic detail." Subsequently these examples gave *Thecla strigosa* Harris.

The note of "the larva of *Thecla Irus* Godt., burrowing in a plum," which appears in the Report of the State Entomologist to the Regents of the University S. N. Y. for the year 1886, in the *Fortieth Report of the N. Y. State Museum of Natural History*, page 140, refers to the example above noticed, and should have been so recorded : hence the above particulars.

* Nisoniades Persius *Scudder.*— Four examples of this very common Hesperian butterfly in the State of New York (two males and two females) were identified by me among the collections made by Dr. H. A. Hagen in the Northern Trans-Continental Survey in 1880, at Yakami river, La Chapples, July 16; Yakami city, July 2, and [label not legible] July 11th.

* Sphinx Canadensis *Boisd.*— An example of this rare Sphinx (the *S. plota* of Strecker) was captured at light, on a window, at Tannersville, Catskill mountains, N. Y., on August 13th, and is now in the collection of Mr. W. W. Hill, of Albany.

* The notes thus marked on this page and following ones, are from the preceding report to the Regents (for 1885) of which no copies have been printed except the regular edition of the Annual Report on the N. Y. State Museum of Natural History.

Mr. William Gray, of Kenwood, informs me that four examples of the species (one of which is in the collection of Hon. Erastus Corning, of Albany) were taken by Dr. James S. Bailey, upon the skin of a deer hung up to dry, in the Adirondack mountains. The species would seem, from the above collections, to favor high elevations.

*Melittia cucurbitæ (*Harris*).— The following memoranda on the squash-vine borer have been kindly furnished me by Mr. J. P. Devol, of Petersburg, Va., in consideration of a published request for information upon the life-history of the species:

June 24th, found two vines of Boston marrowfats dying, from which the borers had escaped and entered the ground.

July 3d, dug up a larva from two and a half inches beneath the surface of the ground, at about two inches from the root-stalk.

July 8th, a larva found in a leaf-stalk, two feet distant from the stalk.

Hyppa xylinoides *Guenée.*— A caterpillar, which proved when the moth was disclosed on July twelfth after a probable pupation of twelve days, to be this species, was taken June twenty-eighth, feeding on the leaves of raspberry. It attained a length of one inch and one-fourth. It was of a rich brown color throughout, and in shape, regularly increasing in size from its front to its eleventh segment, recalling the form of *Amphipyra pyramidoides.* After feeding heartily in confinement, mostly at night, on leaves furnished it, it spun up among some leaves in the box, as if this was its ordinary habit.

Erebus odora (*Linn.*).— As examples of this large and beautiful noctuid are of rare occurrence in the State of New York, it may be noted that a female was identified by me, which had been taken at Oxford, Chenango county. Another instance of its occurrence, somewhat remarkable from the late date of its capture, is that of a male, taken at Schoharie, N. Y., within a wood-shed on November 2, 1858, in perfect condition (now in my collection), except as it had been injured by its fluttering on the pin with which it had been roughly impaled by the small boy who captured it.

Other recorded New York captures, are: a female, at Parkville, L. I., on June 16, 1880 (*Papilio,* ii, 1882, p. 18); an example, flying about a room, at New Dorp, Staten Island, in September of 1887; and two other specimens, on Staten Island, during the last few years, one "at sugar" and the other in a barn (*Proceed. Nat. Sci. Assoc. of Staten Island,* for May 12, 1888).

Although a southern form, and question has been made of its breeding in the northern localities where it has been found, Mr.

Fletcher has reported two captures of it at Ottawa (latitude 45°), and Mr. Saunders has cited several other instances of its capture in Canada during the past few years (*Canadian Entomologist*, xii, 1880, p. 211).

We have no knowledge of the early stages of this insect beyond some brief notes upon its eggs and the first stage of the caterpillar, made at Nassau, New Providence, by Mrs. Blake, and recorded by Mr. H. T. Fernald, in *Entomologica Americana*, iv, 1888, p. 36.

Zerene catenaria *Cramer*.— Numbers of this moth were taken by Mr. Erastus Corning, Jr., on the evening of September 21st, 1887, from the windows of a drug-store, fronting Capitol Park, to which they had evidently been attracted by the lights within. Fifty or more examples, it is thought, could have been taken at the time.

It may be readily recognized by its snow-white and unusually thin wings, crossed near their middle by two black, toothed lines — sometimes broken into lines of dots upon the nervules. The head, and front of the wing-covers are ochreous-yellow. The hinder margin of the wings is dotted with black at the end of the veins. The figure represents a male with its plumose antennæ; in the female they are thread-like.

Fig. 55. — Zerene catenaria. (After Emmons.)

For an account of a remarkable flight of this moth, in October, 1880, in Lackawaxen, Pa., which, from its immense numbers, appearing in some places as a dense snow-storm, alarmed farmers who foolishly feared that it was the precursor of an army-worm attack: — see *Report of the Commissioner of Agriculture*, for 1880, p. 274.

Anisopteryx pometaria *Harris*. — Caterpillars of this species, the fall canker-worm, which is of rare occurrence compared with the spring canker-worm, *A. vernata* Peck, were received from Moriches, Suffolk county, N. Y., on June eighth, from Mr. Augustus Floyd. They had made attack upon his apple trees and were rapidly consuming the foliage. Doubtless some of the attacks ascribed to *A. vernata*, in reality belong to this species, discrimination between the two not being made by the observer.

Through an error discovered too late for its correction, figures illustrating *A. vernata* were received from the Department of Agriculture, instead of those of *A. pometaria*, desired. They will, however, serve to show the form that more commonly comes under observation. In Figure 56, *a*, is the mature larva in its natural size: *b* eggs in natural size and in enlargement; *c* and *d*, side and dorsal view of a segment of the larva enlarged. In Figure 57, *a*, is the male

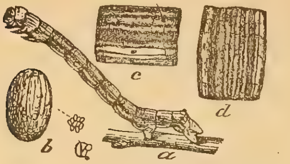

Fig. 56.— Larva and eggs of the spring canker-worm — Anisopteryx vernata. (After Riley.)

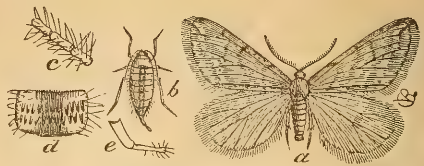

Fig. 57.— Male and female moths and enlargements of Anisopteryx vernata. (After Riley.)

moth and *b* the wingless female, each in natural size; *c*, enlargement of portion of female antennæ; *d*, joint of female abdomen, enlarged; *e*, its ovipositor, enlarged.

* Tinea pellionella *Linn.*— This notorious pest — the common clothes-moth, carpet-moth, fur-moth (different names for the same insect), etc., was first observed in flight in my office, as early as February thirteenth. During March, and especially toward the latter part of the month, the moths were not uncommon. On April twenty-third, note was made of their being quite numerous. They were also reported to me as flying in abundance, May fourteenth, from a bag with hops and pieces of flannel; the flannel was found almost entirely eaten.

The above early appearances of the insect are noted, as Professor Fernald, in his excellent paper discussing the confused synonymy of the species, states that "the moths emerge in June and July, and some even as late as August, yet there is but a single generation" (*Canadian Entomologist*, xiv, 1882, p. 167). Dr. Packard represents the moth as beginning to fly about our apartments in May (*Guide to the Study of Insects*, 1866, p. 346). Dr. Harris states that they lay their eggs in May or June, and indicates early June as the time in which the prudent housekeeper should beat up their quarters and put them to flight or destroy their eggs and young (*Insects Injurious to Vegetation*, 1862, pp. 493, 494).

Probably the nearly uniform day and night temperature of my office during the winter, maintained by the steam-heating arrangements of the Capitol, serve to shorten the period of pupation, when compared with its usual period in our dwellings.

* Mallota *sp.*— Professor L. M. Underwood, of Syracuse University, sends, January nineteenth, larvæ (3), puparium, and empty puparia (3), taken in Western New York, from between the boards

forming the walls of an out-house. They may have been of *Mallota barda*, to which they bore a resemblance, but they could not be positively identified, for unfortunately the examples sent had been put in alcohol, and none had been retained alive for rearing.

*ANTHRENUS SCROPHULARIÆ (*Linn.*).—The carpet-beetle occurred abundantly on flowers of *Spiræa*, in Washington Park, Albany, on June second. *Anthrenus varius* (Fabr.) was associated with it in about equal numbers.

June eighth, numbers were taken by Mr. William Beuttenmüller of New York city, on flowers of parsnip.

July twenty-first, twenty-five of the larvæ, of different sizes, were received from a residence in Schoharie, N. Y., where they abounded.

August ninth, Prof. H. M. Seely, of Middlebury College, Middlebury, Vt., sent what he believed to be the carpet-beetle, as it was found in large numbers associated with the *A. scrophulariæ* larvæ when searching for the latter in July. It proved, however, to be the *Otiorhynchus ligneus*, which appears of late to have domesticated itself within many dwellings (see *Second Report on the Insects of New York*, 1885, pp. 51, 52).

November second, half-grown larvæ and an imago were taken in my house, the latter from a window curtain.

ALAUS OCULATUS (*Linn.*).—As this large snapping-beetle — the largest that occurs with us of its family, is often sent for name, the accompanying figure and brief notice of it are given as aid in its recognition.

It is an inch and a half long, with ribbed wing-covers spotted with white; its thorax one-third the entire length of the insect, largely covered with white scales like a white powder, and bearing centrally on each side, a large oval, velvet-black spot ringed with white. Its specific name is given to it from the marked resemblance of the two thoracic spots to eyes, for which they are commonly mistaken. It belongs to the family of *Elateridæ*, or spring beetles — the latter name referring to a peculiar arrangement of a spine and

FIG. 58.—The owl beetle, ALAUS OCULATUS, with enlargements of antenna and tarsus. (After Emmons.)

socket upon the lower side of the thorax and abdomen, by means of which the insect is able, when laid or fallen upon its back, to spring upwards several inches, and in dropping to regain its feet. Without this provision, it would be difficult for it to recover its position if left alone to the aid of its short and rigid legs. The larva is a borer in apple trees, but as it is mainly a feeder upon decaying wood, it can not be regarded as an injurious insect, except as it may hasten the destruction of a tree in which decay has already commenced.

* Thanasimus dubius (*Fabr.*).— Numbers of this insect — one of the *Cleridæ*—were observed upon cut pine timber, at Schoharie, May thirteenth, but dropping quickly to the ground when approached. They had probably been feeding on some of the wood-eating larvæ under the bark. A species nearly allied to this, captured by me upon the summit of Mt. Marcy, at an elevation of 5,300 feet, on August 8, 1877, has recently been identified by Mr. E. A. Schwarz, as *Clerus ? analis* LeConte.

* Macrodactylus subspinosus (*Fabr.*).— Under date of July fourth, Mr. H. J. Foster, of East Palmyra, N. Y., wrote that the rose-bug had made his cherry-trees leafless the preceding year, and that this year they were eating the leaves of the wild-grape, and the apples where they occur in clusters.

Lema trilineata *Oliv.*— Larvæ of this insect in various stages of growth, some mature and building up their white cocoons of frothy matter given out from their mouth, and also the perfect beetle feeding on a species of *Physalis*, were received August twenty-sixth, from Mr. M. H. Beckwith, of the New York State Agricultural Experiment Station at Geneva.

* Chrysochus auratus (*Fabr.*).— Professor S. A. Forbes, of Champaign, Illinois, has kindly communicated to me a new food-plant for this beetle, discovered in the State of New York. He had received, under the date of July seventh, from Mr. C. Fred Johnson, of Bayport, Suffolk Co., some "potato-bugs," which he identified as this species. It had "appeared only on a dozen or so plants, in a field of two acres, but as many as thirty or forty were found on a single plant." It had never before been recorded as occurring injuriously upon any cultivated plant.

* Trirhabda Canadensis (*Kirby*).— On the twenty-second of June, at Schoharie, N. Y., a large patch of the golden rod, *Solidago Canadensis*, was observed to be infested with numbers of shining black larvæ,

about a half-inch in length, and tapering toward each end. Of a number gathered and fed upon the golden rod, a half dozen had changed to the pupa state, ten days thereafter. On the fifteenth July, the beetles were disclosed, and proved to be one of the *Chrysomelidæ*, viz., *Trirhabda Canadensis* (Kirby). The ochre-yellow stripes of the elytra, at first quite bright, gradually dulled in their drying.

Numbers of the beetle were observed, on September eighth, feeding upon the leaves of the golden rod. When approached, they drop to the ground and lie motionless. Several pairs were in copula, and all of the females had the abdomen enormously distended with eggs. *Diabrotica vittata* (Fabr.) was also very abundant in the flowers of the plant, where it was feeding upon the pollen.

T. Canadensis has also been observed, abundantly, at Keene Valley, Essex county, N. Y., on golden rods, late in July and early in August. According to Dr. LeConte, it is a common insect, extending from Lake Superior and the Mississippi river to the Pacific. It was originally described by Kirby, in his *Fauna Boreali Americana*, from collections made in Canada by Dr. Bigsby.

Galeruca xanthomelæna (*Sch.*). — Examples of this beetle, so exceedingly destructive to elm trees, were received from Poughkeepsie, N. Y., where they had recently made their appearance. It was first observed about fifty years ago, in the vicinity of Baltimore, Md., and not long thereafter, it became a serious nuisance in Washington, D. C., and in New Jersey. During the last few years it has extended its ravages to Long Island and Westchester county, N. Y., where by its complete defoliation of large and beautiful elms, and by the myriads of the disgusting larvæ swarming on the trunks of the trees, it became a common object of observation and execration. It has continued to extend itself slowly in this State (and in Massachusetts), until we have it now in Poughkeepsie, midway between New York and Albany, which is the most northern locality within the State from which it has been reported.

The beetle and its operations upon the leaves of the elm, are shown in Figure 59, taken from the *Report of the Department of Agriculture* for 1883, in which the Entomologist, Professor Riley, has given the habits and natural history of the insect, the best remedies for it, and experiments made at Washington, with insecticides for its control. The same account has been reprinted as Bulletin No. 6, of the Division of Entomology, and also in Bulletin No. 10, of the Division — " Our Shade Trees and their Insect Defoliators." Copies of this last publication are perhaps still procurable upon application to the Department of Agriculture.

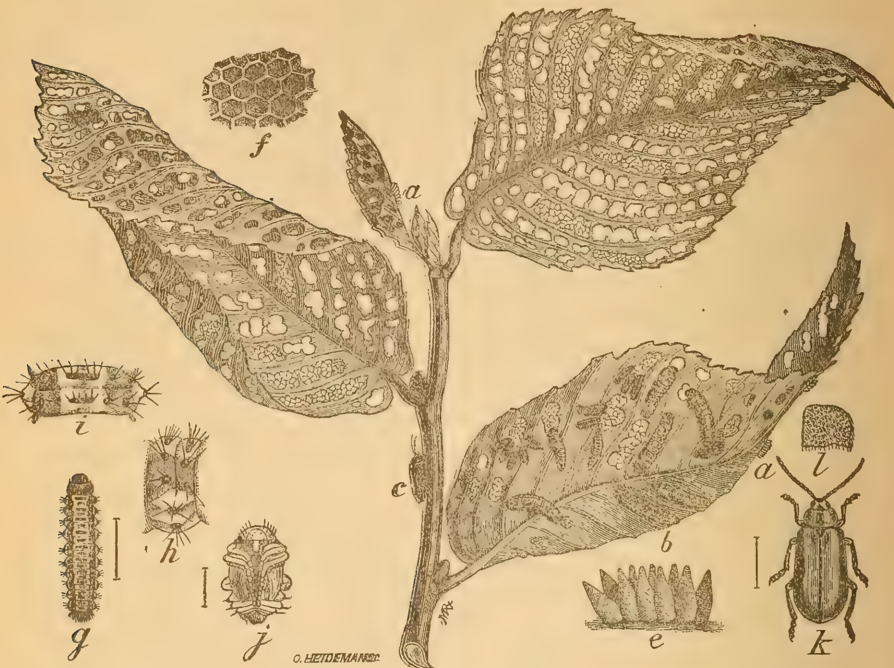

Fig. 59.—The Elm-leaf beetle, Galeruca xanthomelæna, in its different stages.

In the figure, *a*, shows the eggs as they are deposited in clusters on the leaf; *b*, the larvæ; *c*, the beetle in natural size; *e*, the eggs enlarged; *f*, the sculpture under a high magnifying power; *g*, the larva in about twice its natural size; *h*, a side view of a segment of the larva; *i*, dorsal view of the same; *j* and *k*, the pupa and the beetle enlarged; *l*, a portion of the wing-cover of the beetle enlarged.

* Hylesinus opaculus *Lec.*—This little bark-boring beetle (determined by Dr. Horn) was found by Professor C. H. Peck, State Botanist, under the bark of living, and to all appearance, healthy cedar trees (*Arbor vitæ*). They occurred May twenty-sixth, within their main galleries, with eggs laid at intervals, in niches on each side, from which, later, would run the lateral galleries of the larvæ. The beetle has hitherto been recorded only on elm and ash (*Ulmus* and *Fraxinus*).

Phlœotribus liminaris (*Harris*).—Numbers of this beetle, designated by Saunders as the elm-bark beetle, although perhaps more frequently occurring in the peach, were emerging in my office June sixth, from sections of the trunk of a young peach tree, received from Mr. G. W. Duvall, from near Annapolis, Md. The tree had, it was believed, been killed by the insect the preceding year.

The main galleries of the beetles, are usually run transversely across the trunk, but at times are inclined at various angles up to forty-five degrees. The longest are about one inch and a half in length, by one-twentieth of an inch broad, and show plainly the row of niches on each side excavated for the reception of the eggs, and from which the galleries of the young larvæ proceed. These galleries are an inch and a half, or more, in length. Those central on the main gallery, extend at right angles to it, while those on each side thereof diverge at such angles as their greater breadth, consequent on the increasing size of the larvæ, necessitate. The galleries are not strictly rectilinear, but are somewhat waved.

Dr. Harris, Dr. Fitch, and subsequent writers mention this beetle as occurring under elm bark. I have never found it in such a situation. Mr. Schwarz gives as his experience, which in the *Scolytidœ* has been so extensive as to deserve being accepted as authoritative, that it does not occur under elm bark. He thinks that it has been confounded with *Hylesinus opaculus*, which is rather common under such conditions and which resembles it so closely that without examination of the antennal structure the two can hardly be separated (*Proceed. Entomolog. Soc. of Washington;* i 1888, p. 113).

BELOSTOMA AMERICANA *Leidy.*— Mr. B. D. Skinner, of Greenport, N. Y., in sending a living specimen of this "water-bug" for name, on February twenty-second, states that he only knows the insect as seen during the winter under the ice of a certain fresh-water pond near Greenport, on the Long Island coast. On a pleasant day when the ice is free from snow and clear, a dozen or two could be noticed in a short time, moving slowly along under the ice. Boys sometimes amuse themselves by lining their course, and cutting out a block of ice a little distance in front of them, upon reaching which, they rise up to the surface and are taken by hand.

FIG. 60. — BELOSTOMA AMERICANUM.

The insect is shown in Figure 60, reduced about one-fourth in size, from the example from which it was drawn. Large examples measure about one inch and one-half in length.

From the frequency with which this insect is attracted to electric lights, it has of late in many localities become known as "the electric-light bug."

CERESA BUBALUS (*Fabr.*). — Several twigs of apple-tree from the nursery of Maxwell Brothers, at Geneva, N. Y., communicated by Mr. Goff, contained the egg-deposits of the "buffalo tree-hopper." A piece of a twig two and a half inches long showed eighteen of these deposits, averaging eighteen eggs in each. Figure 61, represents the insect, enlarged to about twice its natural size.

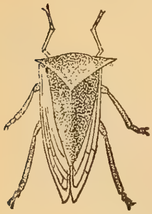

FIG. 61.—CERESA BUBALUS (Fabr.), enlarged.

As the mode of oviposition has been differently described by different writers, and in some cases erroneously, it is with pleasure that we give place to a portion of a note recently communicated to the "Industrialist," of Manhattan, Kansas, upon the method of egg-laying in this insect, by Professor Popenoe, with the figures which satisfactorily illustrate it.

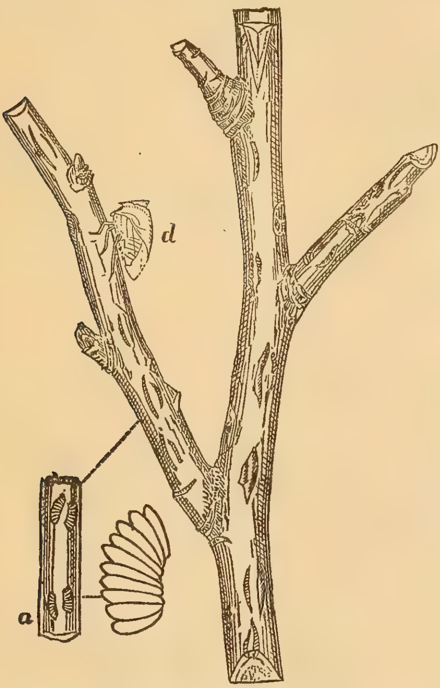

FIG. 62.—Oviposition of the Buffalo tree-hopper, CERESA BUBALUS; showing the insect at work, scars made by it in the wood, a section of a twig with bark removed with egg-clusters in place, and an enlarged egg-cluster. (After Popenoe.)

"The irregularly circular or oblong scars, resulting from the growth of the injured bark upon branches and twigs punctured by the insect in question, occur numerously on the twigs of various trees, especially upon the willow, soft maple and apple. In a young apple orchard in this vicinity, the scars were so numerous that the growth of the trees was lessened and their shape injured in consequence. The slits in the bark, made by the ovipositor of the female tree-hopper, are two in a place, slightly curved, their concave sides facing. The strip of bark between these slits is separated from the wood, as the insect thrusts the ovipositor from each slit to the bark under or beyond the opposite slit, the eggs in each row having been introduced through the slit above the opposite row. The growth of the bark is thus checked, and the incisions remain for several years as the irregular scars above noted. The wounds are made more numerously upon the upper side of the branch, and are often so abundant that the branch is deformed in growth. The insect, which is well shown in a side view at *d* in the accompanying figure, is of a bright grass-green color, and very active, flying with a buzzing noise when approached. The insect in all stages feeds upon the juices of various plants. It is very generally distributed, but does not usually appear in such numbers as to be considered injurious.

Chermes pinicorticis *Fitch.*— From branches of pine badly infested with the pine-bark Chermes, taken in Washington Park, Albany, in the early part of June, immense numbers of this minute aphis emerged, during the latter part of June, a large proportion of which were of the winged form. The branches having been placed beneath a glass shade for convenience of observation, the insects as they emerged banked up in a pile against the rim on the side toward the light. A notice of the species, with figures, may be found in the *Second Rept. Ins. N. Y.*, 1885, pp. 180–184.

Œcanthus niveus *Harris.*— Peach twigs, badly scarred through the oviposition of this insect, the white flower-cricket, were received, in April, from Mr. O. Wilson, of Keuka, Chemung county, N. Y.

APPENDIX.

(A.)

SOME EXTRA-LIMITAL INSECTS.*

Carpocapsa saltitans Westwood,

And its Jumping Seeds.

(Ord. LEPIDOPTERA: Fam. TORTRICIDÆ.)

WESTWOOD: in Proc. Ashmolean Soc., iii, 1857, pp. 137-8; in Trans. Lond. Ent. Soc., ser. 2, iv, 1858, p. 27; in Gard. Chron., 1859, p. 909.

LUCAS: in Ann. Soc. Ent. France, ser. iii, vi, 1859—Bull., pp. 10, 33, 41, 44 (as *Carpocapsa Dehaisiana*); ib., vii, pp, 561-566 (as *C. Deshaisiana*).

LINTNER: in Albany Argus, for Oct. 11, 1875; in Proc. Alb. Institute, ii, 1878, pp. 264-266. in Count. Gent., xlix, 1884, p. 757; in Bull. Brook. Entomolog. Soc., vii, 1884, p. 92.

RILEY: in Trans. St. Louis Acad. Sci., iii, 1875, p. cxc.; in Amer. Nat., x, 1876, pp. 216-218; in Proc. U. S. Nat. Mus., v, 188, pp. 632-635, fig.

DODGE: in Field and Forest, ii, 1876. p. 54-5.

FERNALD: Cat. Tortric. N. A., 1882, p. 54, No. 396; in Trans. Amer. Ent. Soc., x, 1882.

The Seeds.

The so-called "Mexican jumping seeds," whenever observed, excite so much curiosity that the following information is offered of them.

The seeds are about four-tenths of an inch long, and of about the same width, smooth on the outer surface, bisected by lines which show them to be two-valved, and of a form indicating that they had been united in a globular three-celled ovary. In shape they are sub-triangular, their two inner sides plain and meeting at an obtuse angle, and the outer side rounded. They are shown in two views in the figure, at *e* and *f*. They are known to the inhabitants of Sonora as "brincaderos," meaning jumpers.

History of the Insect.

Their peculiar jumping movements have made them objects of much interest since they were first brought to scientific notice in the year 1857, through specimens sent from Mexico by the British Chargé d'Affaires, and exhibited to the Entomological Society of London by the secretary. The seeds were said to be a species of *Euphorbia*, and they were supposed to contain a lepidopterous larva.

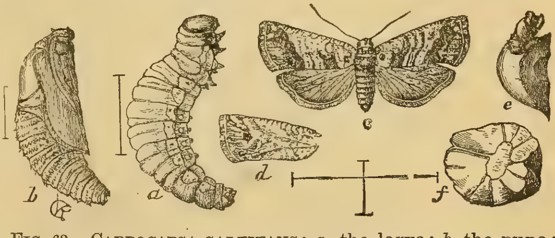

FIG. 63.—CARPOCAPSA SALTITANS; *a*, the larva; *b*, the pupa; *c*, the moth; *d*, wing of a pale variety; *e*, seed with pupa-case; *f*, seed from its lower side.

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* The insects herewith noticed are not known to the writer to occur in the State of New York, and are therefore separated from the "Injurious and other Insects of the State of New York" of the preceding pages.

In June of the following year, Professor J. O. Westwood exhibited to the society the perfect insect (a moth) which he had bred from the seeds, and in an accompanying paper described and named as *Carpocapsa saltitans*. It is shown at *c* in the figure.

A few months later, M. Lucas, in ignorance of Professor Westwood's work, in a paper entitled "Observations sur une nouvelle espèce de Carpocapsa, et remarques sur les movements que la chenille de la Lépidoptère imprime a des graines d'une Euphorbe du Mexique, dans lesquelles elle se metamorphose," published in November, of 1858, in the *Revue et Magazin de Zoōlogie* — redescribed and named the insect as *Carpocapsa Dehaisiana*. Under this latter name some examples were exhibited by me and remarked upon at a meeting of the Albany Institute, on October 5, 1875.

In the *Gardener's Chronicle* of November 12, 1859 (*l. c.*), Prof. Westwood has given an interesting paper on these seeds, in which they and the moth that they disclose are described and figured.

Its Generic Relations.

The insect belongs to the family of comparatively small moths known as *Tortricidœ*, the larvæ of which are mainly "leaf-rollers." Its generic relations are of particular interest, since it pertains to the same genus with the codling-moth, *Carpocapsa pomonella*. The larva of the codling-moth is the common and well-known apple-worm, which is so very destructive to apples in this country and in Europe, tunneling and disfiguring them with its excremental-crowded burrows and unsightly "worm-holes." It has, however, entirely different habits during its progress to maturity and subsequent transformations, nor has it ever shown any jumping propensities.

Its Jumping Movements.

The ordinary "jumps" of the *C. saltitans* are successive leaps of about one-eighth of an inch in length, repeated at intervals of a second or two. At times, however, they are more violent — turning the seed-vessel from one of its flat sides, to its concave surface, spinning it around upon one end, or projecting it, with an irregular rolling motion, to a distance of an inch or more. When held in the hand, the jumps give quite a perceptible impulse to the palm. Placed upon a small table, in a few minutes several will have thrown themselves over its edges upon the floor. If confined in a box, they in a short time become quiet, and no sound is heard from them; but upon opening and exposing them to the light, the motions are at once moderately resumed. If further disturbed by being turned out upon a table or into the hand, their more violent motions soon commence, and continue for a long time.

Their peculiar movements are said by Prof. Riley, to be produced by the larva holding fast to the silk lining of the seed-vessel with its three hinder pairs of strongly hooked abdominal legs, and in this position, with the anterior portion of its body curved upward, violently tapping the walls with its head, sometimes thrown from side to side, but more often brought directly down, as in the motion of a woodpecker's head when tapping for insects.

Another Species Reared from the Seeds.

A package of these seeds was received by me in August, 1884, from a correspondent at Garrisons, N. Y., to whom they had come by mail without any indication of their source. Soon after opening the box, and leaving its contents exposed on my table, a moth was noticed on the window of my office. It was captured, and from its general appearance, its source was naturally referred to the Euphorbia seeds; and as confirmatory, on examination, a seed was found split open in the middle and with twisted valves. The moth had evidently escaped from it. With no knowledge at the time of the appearance and structure of the *Carpocapsa saltitans*, the above example was accepted as that species, and referred to as such in a communication on "Jumping Seeds" made to the *Country Gentleman*, of September 11, 1884. The peculiar structure of its hinder legs — the tibiæ and tarsi of which were broadly dilated (it was a male) — seemed so unlike a *Carpocapsa*, that a reëxamination and study was made of it later, with the interesting result that it was the insect which Lord Walsingham had described as *Carpocapsa latiferreana*,* and for which Professor Riley, from the structural peculiarities above noticed and others, had subsequently established the genus *Mellisopus*.†

Prof. Fernald, in his *Catalogue of the Tortricidæ of North America*, has given as the habitat of *M. latiferreana*, New Hampshire, Missouri, California, and Texas, and for its food, oak acorns. If knowledge of its food is hitherto limited to this statement, the escape of an example from a Euphorbia seed, is an interesting incident. Will its larva prove to be a "jumper?" Its manner of escape, through the splitting of the seed, is quite different from that of *C. saltitans*, to be described hereafter.

Active Period of the Seeds.

In writing of these seeds, under date of September third, after the emergence of *M. latiferreana*, it was stated that the remainder (thirty-two in number) were at that time in their larval stage, as each one showed active motions, which are limited, it is believed, to this stage.

The seeds were shown and remarked upon at the meeting of the American Association for the Advancement of Science, in September, 1884, when their strange movements excited much interest in those who saw them for the first time. No note was made, unfortunately, of the time when their motions ceased. Such observation would probably have marked the approximate time of the larval change to pupation. So late as November first, all but two continued active, though not to the extent displayed in early September.

Soon after their reception one of the seed-vessels was partially crushed by accident, disclosing the larva within. The day following, the broken and separated walls were found to have been repaired and firmly united by a thick interior coating of silk.

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*Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum. Part IV,—North American Tortricidæ. London, 1879, p. 70, pl. 76, fig. 8.

† *Transactions of the St. Louis Academy of Science*, iv, 1881, p. 322; *American Naturalist*, xv, 1881, p. 480.

Emergence of the Moth from the Seed-Vessel.

The first moth made its appearance on the 13th of April, 1885, having escaped from its box and alighted on my table in the evening, where it had been attracted by the light. Of the twenty seeds that had been retained, fourteen at this time showed the small (nearly one-tenth of an inch in diameter) rounded interior larval cutting, the outer shell of which would be separated and pushed off as a lid for the escape of the imago. In each instance this mark was on the lower end of the outer surface of the seed, nearly opposite to the scar of the inner surfaces, and in all but two was so nearly central as to embrace the carina. The seeds not thus marked, without doubt, contained dead insects.

This method of preparation for the escape of the imago is quite different from that given by Prof. Riley, in the *Transactions of the St. Louis Academy of Science* (*loc. cit.*), which is as follows: "Toward the month of February the larva eats a circular hole through the hard shell of its habitation, and then closes it again with a little plug of silk so admirably adjusted that the future moth, which will have no jaws to cut with, may escape from its prison."

Examination of the lid of the aperture through which the insect has effected its escape, will show that it consists only of the outer wall of the seed — the inner wall and the thicker white connecting material between the two, having been eaten away. A slight pressure by the pupa would suffice for detaching and forcing open the lid, which frequently retains its attachment to the seed by a few fibres at one point. The empty pupa-case is often held in the opening (as represented in figure 63 at *e*), as in the *Ægeriadæ*, to those of which its abdominal bands of teeth gives it resemblance.

When the Moths are Disclosed.

Each of the fourteen seeds disclosed its imago. Their time of appearance was very unequal — the first moth emerging April thirteenth, as previously stated, and the last September twentieth. Those reared in Paris by M. Lucas were obtained between the tenth and twentieth of February, and in London, by Professor Westwood, during the same month.

Other Jumping Seeds.

In addition to the above, three other "jumping seeds," according to Dr. Hagen, are known, viz.: An Euphorbia, also of Mexico, containing a small hymenopterous insects; a Tamarix, of Algiers, containing a coleopterous larva bearing the name of *Nanophyes tamariscis;* and another, the seed of which is unknown by name, in which a hymenopterous insect undergoes its transformations.

Further information in regard to these seeds and their insect guests may be found in the *American Naturalist* for April, 1876 (*loc. cit.*), in an article entitled "Jumping Seeds and Galls," by C. V. Riley; by the same, in the *Proceedings of the U. S. National Museum* (*loc. cit.*); and in *Field and Forest*, by its editor, Mr. Charles R. Dodge, as cited.

Systena blanda Melsh.

The Broad-striped Flea-beetle.

(Ord. Coleoptera: Fam. Chrysomelidæ.)

Melsheimer: in Proc. Acad. Nat. Sci. Phila., iii, 184—, p. 164.
LeConte: in Smithson. Contrib. Knowl., xi, 1859, p. 26 (as *Systena bitæniata*).
Crotch: in Proc. Acad. Nat. Sci. Phila. [xxiv], 1873, p. 69.
Glover: in Rept. Commis. Agricul. for 1873, p. 152, fig. 1 (feeds on corn).
Le Baron: 4th Rept. Ins. Ill., 1874, p. 173.
Forbes: 13th Rept. Ins. Ill., 1884, p. 86 (on strawberry).
Henshaw: List of Coleop. of N. Amer., 1885, p. 112, No. 7003.
Hunt: in Miss. Ess. Econom. Ent., 1886, p. 105-6 (bibliog. of corn-eating insects).
Lintner: in Count. Gent., lii, 1887, p. 441 (on cotton).

Examples of this beetle were received in May, from Jackson county, Ga., accompanied with the following statement of serious injuries committed by them.

Reported as a Cotton Pest.

"I send you a small bug that is eating my cotton plants, and a few of the plants that they have been feeding on. I do not find them except where the cotton was planted on stubble land, on which the common ragweed grew after oats, last year. A portion of the field was turned last September; the balance was not plowed until March. The same little bug killed almost entirely, last year, about eight acres of cotton that was planted after ragweed. I will be greatly obliged for a suggestion of a practical remedy."

Description of the Insect.

The beetles sent with the above reported attack, are of the family of *Chrysomelidæ*, or leaf-eaters, and are known scientifically as *Systena blanda* Mels. They belong to a variety known as *bitæniata* LeConte, as kindly determined by Dr. Horn, having been described as a distinct species from some individuals of a large form and dark color, but which were subsequently found to be but varietal features. The beetles are elongate, slender, dull ochreous-yellow, with a black stripe on the inner and outer margin of each wing-cover—the two inner ones from their coalescence appearing as one; the space intermediate to the marginal black stripes presenting the appearance of a broad yellow stripe. The wing-covers have the punctures irregularly distributed instead of arranged in rows.

The beetle is figured by Mr. Glover in the Report of the Commissioner of Agriculture, for 1873.

Crops Attacked by it.

The insect has not hitherto been reported as attacking the cotton plant, and indeed no notices have appeared of extensive injuries by it to any valuable crop, except to corn.

In June, of 1873, examples of the beetle were sent for name to the Department of Agriculture at Washington, from Chambersburgh, Pa., with the statement that they had nearly devastated a field of corn, having eaten the leaves and left the bare stalks standing. They were observed to be very voracious and quite active, hopping like fleas, and hiding in the soil if there was not time to escape by flying away.

Dr. Le Baron has referred to it (*loc. cit.*) as injurious to young corn in the Middle States, but has given no particulars.

Professor Forbes, in the Thirteenth Illinois Report, states that it was especially abundant near Anna, in Southern Illinois, where it was feeding on the leaves of the strawberry, as was demonstrated by dissection of its stomach.

Professor F. M. Webster has observed it in Indiana feeding injuriously upon the potato. He states that in a locality visited by him, where the Colorado potato-beetle was common, far more damage had been done in eating the leaves by the adult *Systena blanda*, and to a less degree by *Systena frontalis* (*Report Commis. Agricul.* for 1887, p. 150).

Preventives and Remedies.

This beetle may not be expected to prove a very serious pest of the cotton. As it seems, from the communication sent, to be so associated with the ragweed [*Ambrosia*], a natural and simple preventive of its injuries should be found in the destruction of the weed on which it may be supposed to feed and develop in the autumn.

When found on the young cotton plants, relief can be obtained by sprinkling dust, fine sand, ashes, or some similar material over the leaves when wet with dew, or any other of the methods commonly resorted to for protection from the cucumber flea-beetle, *Crepidodera cucumeris*, an insect having similar habits, and to which it is nearly allied. The *Systenas* are not regarded as injurious insects usually. Their attacks are often quite local, although serious at times, as that of the red-headed Systena, *Systena frontalis* (Fabr.), has been in portions of the Province of Ontario on grapevines,* and also, on many garden plants the present year (1887), † and *Systena marginalis* (Ill.) on oaks, elms, and hickory in the same province.

The habitat of *S. blanda* is given as "Atlantic region and New Mexico." Its range seems to embrace several of the Western States. I have no knowledge of its occurrence within the State of New York.

Leptocoris trivittatus (Say).

The Box-elder Plant-bug.

(Ord. HEMIPTERA: Subord: HETEROPTERA: Fam. BERYTIDÆ.)

Lygæus trivittatus SAY: in Journ. Acad. Nat. Sci. Phil., iv, 1825, p. 322; Compl. Writ., Lec. edit., 1883, p. 246.

Leptocoris trivittatus STAL: Enum. Hemipt., i, , p. 226.

" " GLOVER: MS. Notes Journ.—Hemipt., 1876, p. 43, pl. 4, fig. 24.

" " UHLER: List Hemipt. West Miss. Riv., 1876, p. 35; in Bull. U. S. G.-G. Surv. Terr., i, 1876, p. 301; Ch. List Hemipt. N. A., 1886, p. 13, No. 606.

" " POPENOE: in Amer. Entomol., iii, 1880, p. 162.

" " LINTNER: in Count. Gent., lii, 1887, p. 69.

" " RILEY: in Bull. No. 12, Div. Entomol.—U. S. Dept. Agricul., 1886, p. 41, pl. 1, fig. 5.

Numbers Occurring on Shade Trees.

A number of examples of a hemipterous insect, belonging to the "plant bugs," were received in their living state early in January, from Sterling, Kansas. Although they had not been observed as inflicting any injury

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* Saunder's *Insects Injurious to Fruits*, 1883, p. 283.

† The *Ottawa Naturalist*, ii, 1888, page 22.

upon the trees on which they occurred, or elsewhere, they had excited much curiosity from occurring in such numbers, from their general distribution, and from their continuing so late in the winter. Their contributor, Mr. J. M. Moore, could give no particular account of them: they had been found everywhere during the autumn and winter, and had first been noticed in the early autumn. They were said to be more numerous where the box-elder tree abounded. A friend had reported to him their great abundance in the Indian Territory, during the summer, in and around the tents of his party, where they were known as the "honey-bug" [perhaps from the odor peculiar to them].

Description.

The insect, shown in Figure 64, is one-half inch long by two-tenths of an inch broad, flat upon the upper side; the thorax with a central line and the sides red; the thick portion (coriaceous) of its wing-covers margined on the sides and behind with red; the lower sides of the body is red in places. It was originally described by Say in the Journal of the Academy of Natural Sciences of Philadelphia, iv, as *Lygæus trivittatus*, the specific name being drawn from the three red thoracic stripes. It has subsequently found place in the genus *Leptocoris*. The type specimens were from Missouri. Say's description is as follows:

"Body black; eyes and stemmata sanguineous; thorax mutic; two indented transverse lines near the head, of which the anterior one is curved in the middle; three bright rufous lines, of which two are marginal; posterior edge obscurely rufous; hemelytra, coriaceous portion with a rufous exterior and posterior margin; membranaceous tip immaculate; trochanters rufous; tergum rufous with three lateral black punctures; venter, margin, and middle rufous. Length nine-twentieths of an inch."

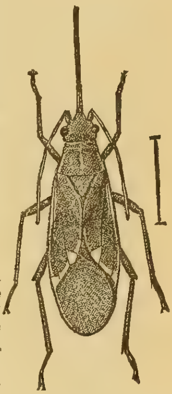

FIG. 64.—The box-elder plant-bug, LEPTOCORIS TRIVITTATUS.

Observed in Kansas.

The abundance noticed above is doubtless unusual. Our correspondent had never noticed the insect before, and it has apparently received but little attention, for the only notice of its habits that is found of it is the following communication from Prof. E. A. Popenoe, of Topeka, Kansas, in the *American Entomologist* for July, 1880, vol. iii, p. 162:

Last fall the box-elders, young soft maples and ash trees on the college grounds, were infested by a black, red-lined plant-bug — the *Leptocoris trivittatus* of Say — that punctured the bark of the trunk and limbs, feeding upon the sap. These bugs have passed the winter in sheltered situations in considerable numbers, and may prove troublesome during the coming season. The young bugs are most injurious, as they appear in much greater numbers, but may be brushed from the trees with a broom and destroyed upon the ground. This mode of operation is rendered the more successful by their habits of congregating on certain parts of the tree at this age. They are then chiefly red in color, acquiring the black with their wings in the adult state.

Its Favorite Food-plant.

The box-elder for which the bugs showed the preference, is the *Negundo aceroides*, nearly allied to the maples, and sometimes known by the common name of the ash-leaved maple. It is not, I believe, native to the State of New York, but occurs southward and westward from Pennsylvania.

Distribution.

The three-striped Leptocoris — the only U. S. species of the genus — is a western form, not occurring east of the Mississippi river. Its distribution, according to Uhler, is Colorado, Arizona, California, Kansas, Missouri and Mexico. It was observed by Prof. Uhler, at Cañon City, Cal., on August eleventh, at the roots of Cacti and Yuccas. It was found by Dr. Packard on July twenty-second, at the American Fork Cañon, Utah.

Develops a Fondness for Fruit.

The above was substantially communicated to the *Country Gentleman* for the issue of January 27, 1887 (see page 313 of this report). Since that time, the insect has been publicly presented under a more serious aspect than that of infesting shade trees — in that of a fruit depredator. As quite an interesting addition to our knowledge of its habits, the following transcription is made from Bulletin No. 12, of the Division of Entomology, U. S. Department of Agriculture, bearing date of 1886, and distributed in May, 1887. The figure given on the preceding page is from the same source.

Leptocoris trivittata injuring apples.— This bug is quite a common species and has been found in a great variety of situations. It is characteristically a plant-feeder, but has never been known to occur in such numbers as to do much damage to any cultivated crop. It has been found in large flowers like magnolia, covered with pollen, and occurs in summer on the stems and leaves of annual plants, which it probably punctures. In August of the present year, however, specimens were sent to us by Mr. A. L. Siler, of Ranch, Kane county, Utah, as injuring fruit at Kanab, the county seat of the same county. Mr. Siler's attention was called to them by the postmaster, Mr. B. L. Young, who stated that these insects were destroying their fruit crop, eating the fruit as fast as it ripened. On one tree which Mr. Siler examined, and which bore apples of a medium size, they were present in enormous numbers, and every apple that he could see was covered with the bugs. They were stated to have bred on the box-elder shade trees (*Negunda aceroides*).

Whether the bug breeds, as above stated, on the box-elder, or simply frequents it from some preference entertained for it — all the accounts associating it with that tree, its designation in popular parlance, as "the box-elder plant-bug," would be quite appropriate for it.

Mantis Carolina Linnæus.

The Carolina Mantis.

(Ord. ORTHOPTERA: Fam. MANTIDÆ.)

LINNÆUS: Syst. Nat., 12th edit., ii, 1756, p. 691.

FITCH: in Amer. Quart. Journ. Agr.-Sci., vi, 1847, p. 146 (as *Gryllus*).

THOMAS: in Trans. Ill. St. Agr. Soc., v. p. 441.

GLOVER: in Rept. Comm. Agr. for 1866, p. 40 (habits, etc.); id. for 1874, p. 133-4 (description and habits).

WALSH-RILEY: in Amer. Entomol., i, 1868, p. 59 (habits and oviposition).

RILEY: 1st Rept. Ins. Mo., 1869, pp. 169–171, figs. 94, 95 (general account); in 1st Rept. U. S. Entomolog. Comm., 1878, p. 334 (eats locusts); in 4th Rept. id., 1885, p. 99, fig. 25 (eats cotton-worms).

Packard: Guide Stud. Ins., 1869, p. 574, fig. 568; in 3d Rept. U. S. Entomolog. Comm., 1883, pp. 310-312 (anatomy).
Hubbard: Orange Insects, 1885, pp. 189, 190, figs. 90, 91.
Lintner: in Count. Gent., lii, 1887, p. 9 (eggs, etc.).

The Egg-Packet.

Two egg-packets, readily referable to *Mantis Carolina*, were received from Mr. C. M. Hedges, of Charlottsville, Va., one of which had given out the young insects which were sent with it, during the preceding April — the other, with its eggs unhatched, was taken in the month of December. Both were found on exposed board fences, and several others had been seen during the autumn. They were accompanied with a request for some information respecting them.

Fig. 65.—Egg-packets of Mantis Carolina.

These strange-looking objects would probably not have been recognized by their collector as containing eggs had not the hatched insects disclosed their nature. They are in masses of considerable size, as shown in the accompanying figure, of a gray color, over an inch long by one half-inch broad and one-fourth of an inch high, rounded at one end and pointed at the other. In general shape, they resemble a small boat turned bottom upward; and this resemblance is still more marked in the broad, flat, keel-like structure that traverses its length.

Careful examination will show from twenty to twenty-five layers in the packet, or more correctly, as many folds on each side, indicating, if each such fold contains a single egg, from forty to fifty as the usual number of eggs. From a larger cluster than the above, sent to me in February, by Mr. C. R. Moore, of Birds Nest, Va., sixty-five young Mantis subsequently emerged.

This strange-looking object is well represented in the figure, except that the "keel" does not present the *braided* appearance there shown, but could be better illustrated by corrugating in short folds a narrow strip of flexible card-board, and then pressing at the ends until the folds touch one another in the center. They are simply in contact centrally, and not interlaced, as made to appear in the figure.

How are the Eggs Deposited?

The manner in which the eggs are deposited does not appear to be positively known — whether each one is extruded singly and the entire mass built up symmetrically by successive additions, as are the egg-pods of some other members of the same order of Orthoptera, the grasshoppers (see the oviposition of the Rocky Mountain locust, in the *First Rept. of the U. S. Entomological Commission*, pp. 223–225, figs. 1–4), or if, as in other Orthopteræ, as the cockroach and Croton-bug, it is slowly extruded as a full-formed egg-case. That it is not free, but fastened by its under surface to boards or branches of trees, even adapting itself to curves in the latter, would apparently indicate that it is built up on the surface where it is placed. Prof. Riley, in his First Report, published in 1869, has written of it: "I have found the mass while it was yet quite soft and freshly laid, and have dissected the female just before she was about to deposit, and I incline to believe that it is gradually protruded in a soft, mucilaginous state, being covered at the time with a white, frothy, spittle-like substance, which soon hardens and becomes brittle upon exposure to the air." One who had witnessed the operation has rather vaguely stated of it that the eggs are "pumped out, and the entire mass elaborately shaped, with a fine instinct of construction as the process continues."

Arrangement of the Egg-Packet.

Apparently, the most reliable account of the structure of the packet and its deposit, is that given by Mr. H. G. Hubbard, in his *Insects Affecting the Orange*, which states: "The eggs occupy flattened cells, placed in two ranks, alternating with each other; the cluster of cells has a braided or woven appearance, but consists simply of a continuous ribbon of mucus, folded in close flutings, and having an egg deposited in the bight or angle of each fold. The eggs are deposited simultaneously with the deposition of this ribbon by the mother insect, and the whole mass is at first soft and flexible, but rapidly hardens by exposure to the air.

The eggs are laid during the month of September, and are hatched in June of the following year.

Egg-packets of Other Species.

Prof. Westwood, in his *Classification of Insects* (i, p. 424), has figured the egg-mass of a Brazilian Mantis, which is attached to a twig at its base, and resembles a seed-pod, being of a green color, and terminating in a long, acute point; and another case of a species from Bengal, of an oval, nearly globular form, attached to a twig by its longest diameter, with its keel upward.

Appearance of the Insect.

The insect produced from these eggs is of so peculiar and unusual an appearance, that in the Southern States where it occurs, it has received the popular names of "rear-horse," "race-horse," "praying Mantis," "camel-cricket," and even "the devil's riding-horse." In Europe they are known as sooth-sayers, diviners (*prie-Dieu* in France), from their strange attitude when at rest, as if engaged in prayer, with uplifted hands. It is a brownish or yellow-green long-legged creature, two inches or more in length, broad-bodied in the female, but narrow in the male; the many-veined thin wings resemble folded leaves; the front wings have each a brown spot centrally, and are borne rather flat over the back; the thorax is slender and almost as long as the body, looking like an elongated neck; the head is small, but much broader than it is long, triangular, and carried vertically. The two sexes — the slender male and the stouter female, are shown in Figure 66, from Professor Riley's First Missouri Report.

Its Food and Habits.

When the Mantis is disturbed, it raises its long back almost perpendicularly, with its long, stout, heavily-spined fore-legs in position for striking out at any object with which it is threatened. Its food consists entirely of living insects. In making its captures, it either lies motionless for hours at a time in wait for its prey, or else steals so slowly upon them that its motion is hardly perceptible, until it has approached within suitable distance, when its powerful prehensile legs are suddenly thrown forward, grasping its victim, which is then held securely between the two spined joints of the legs folded one on the other, and devoured while struggling for escape. The food of the young consists largely of plant-lice, but as they mature they catch and consume quite large insects. They feed upon flies eagerly; they are believed to destroy large numbers of cotton-worms in the Southern fields; and they even prey upon the Rocky Mountain locust, as appears from the First Report of the U. S. Entomological Commission, page 334. Prof. Riley states (*Report of the Entomologist* for 1883, p. 163) that they feed on the elm-leaf beetle, *Galeruca xanthomelæna.*

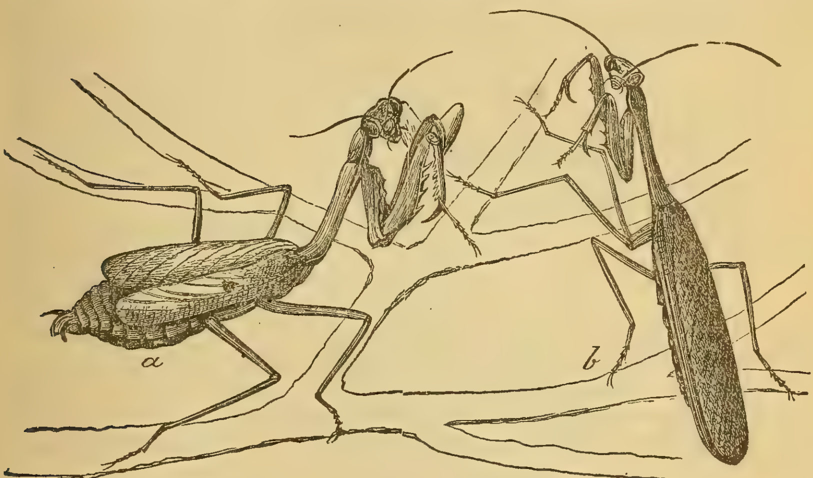

FIG. 66.—The camel cricket, MANTIS CAROLINA; *a*, female; *b*, male.

Mr. Hubbard (p. 189, *op. cit.*) records them as catching every moving insect that comes within their reach on the orange trees in Florida. Their voracity frequently leads them to devour one another, not only when just from the egg, when other food may not be convenient, but not unfrequently the amorous male falls a victim to the stronger-bodied female. A writer has stated: "The females being much larger, stronger and more rapacious than their mates, will frequently seize and kill them, and afterward make a good meal from their quivering bodies."

Its Distribution and Usefulness.

Mantis Carolina is a southern insect, abundant about Washington, D. C., but never occurring in the State of New York. Glover has stated that they have been successfully raised as far north as the Hudson river by bringing the egg-cases from the Middle States. Several cases were found fastened to the trees the next autumn, but after that they entirely disappeared. The eggs, probably, can not endure our northern winters. Could it be introduced and acclimated in our Northern States, it would be quite desirable to do so, for it certainly renders great service in the large number of noxious insects that it consumes in order to satisfy its voracity. An instance is related of a single female devouring eleven living Colorado

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potato beetles in one night, leaving only the wing-cases and parts of the legs.

It follows from the above statement of habits, that wherever this insect occurs, either in the egg or imago state, it is well deserving of being spared from the indiscriminate destruction usually extended to all of the insect world, in the mistaken idea that only harm can come from this class of animated nature. The number of beneficial insects is very large — by far too large to attempt their enumeration. There are entire families which are composed of only such species as are of eminent service to mankind.

Other Species of Mantis.

Figure 67, from Westwood, represents an European species which is quite common in the south of France—the *Mantis religiosa* Linn., commonly known as the *Prie-Dieu*. It is regarded as performing its devotions, when it has assumed its usual attitude with uplifted fore-legs, while, in reality it is lying in wait for its prey. Its conduct at such times has been thus described:

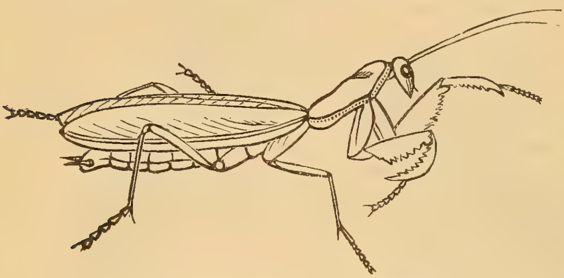

FIG. 67.—MANTIS RELIGIOSA, of Europe.

Settled on the ground, it raises its head and thorax, clasps together the joints of its front legs, and remains thus, motionless for hours together. But only let an imprudent fly come nearly within reach of our devotee, and you will see it stealthily approach it, like a cat who is watching a mouse, and with so much precaution that you can scarcely see that it is moving. Then, all of a sudden, as quick as lightning, it seizes its victim between its legs, provided with sharp spines which cross each other, conveys it to its mouth and devours it. Our make-believe nun, Preacher, Prie-Dieu, is nothing better than a patient watcher and pitiless destroyer.

Mantis oratoria Linn., is another European species, of smaller size, and less commonly met with. A South-American species, *Mantis argentina*, according to Burmeister, seizes and eats small birds.

A species of *Mantis*, not yet determined, has been sent to me, by Mr. W. E. Walsh, of Benson, Arizona, as feeding on vegetation [?]. It is a more robust form than the *M. Carolina*. Its fore-wings are leaf-green, quite broad — their breadth being nearly one-half their length. The stigma is merely defined by its elevated margin, not being marked with color as in *M. Carolina*. The hind-wings are crossed with about fifteen broken bands. The anterior legs are quite stout and more strongly and numerously spined than in *Carolina*. The prothorax is broad over the base of the fore-legs, and but slightly toothed on the sides.

In Mr. Scudder's "Catalogue of the Orthoptera of North America," four species of *Mantis* are named as occurring in the United States, of which I have no knowledge, viz.: *Mantis chlorophaca* De Haan, Watertown, N. Y.; *M. geminata* Stoll, Georgia or Virginia; *M. inquinata* Serv., South Carolina; and *M. phryganoides* Serv., New York and Cuba.

(B.)

ENTOMOLOGICAL ADDRESSES.

The republication of the following papers of the Entomologist seems desirable, in consideration of their having been printed without the opportunity of correcting, in proof, the many typographical and other errors that they present; and further, that no extra copies (of the first two) were secured by the author for distribution to those whom they would fail to reach in their original issue, and to whom they might be of value or of interest:

[From Proceedings of the 24th Convocation of the University of the State of New York.]

THE PRESENT STATE OF ENTOMOLOGICAL SCIENCE IN THE UNITED STATES.

(Read before the Convocation at its Meeting on July 7, 1886.)

It would seem proper that a paper upon the present state of entomological science in our country should be prefaced by a history of its progress. But in two attempts made by me to sketch this history very briefly, the sketches have grown to such a length as in themselves to occupy all the time allotted for this paper. I have therefore laid them aside for the present, and will only ask your indulgence for a few introductory remarks.

Early Entomological Studies.

Entomology, as a science — although its foundations were laid three hundred and fifty years B. C. by Aristotle, the father of zoölogy, the pupil of Plato, and preceptor of Alexander the Great — can only date in this country to a period within the memory of many of those now living. True, the ravages of insect pests had previously been observed by agriculturists and recorded in agricultural and scientific journals, as those of the "army-worm" (then called the black worm) in 1743, of the Hessian fly, in 1768, and of the chinch-bug in 1783: — scientific study and description had been made by Peck, afterward a professor of natural history in Harvard College, of a noted insect pest throughout New England, the canker-worm, in 1795:— collections of our insects of considerable magnitude had been made by naturalists from abroad and taken to Europe during the latter half of the eighteenth century, where they were described and named by Linnæus, Fabricius, Drury, and others:— a work upon American insects, entitled "Natural History of the Rarer Lepidoptera of Georgia," in two volumes, folio, with colored plates of insects and their early stages, which has justly been styled an "ouvrage de luxe," bears date of 1797, but of the London imprint, having been edited by a distinguished English botanist, and published through the subscriptions largely of the English nobility:— as early as 1806 a catalogue of the insects of Pennsylvania was published by Melsheimer, giving the names of 1,363 species, but they were merely traditional names, unaccompanied by descriptions, of which only 205 can now be identified.—Yet, while we bear in grateful remembrance these early entomological studies, together with others of the kind that may not now be referred to, it is without disparagement of them that we find the foundation of entomological science in the United States, in the systematic study, description and publication of our insects by Thomas Say, the author of "American Entomology," the first chapters of which were issued in 1817.

Following these studies came scores of earnest and successful workers, who have contributed in giving to our science the proud position that it now holds. The simple enumeration of their names would be too long a list for the present occasion. Their labors are held in grateful appreciation wherever natural history is cultivated, and they are the acknowledged peers of any of their European collaborators.

Special Studies of Insect Orders.

It is perhaps fortunate that the field of study presented to the entomological student is so broad, that if he would render the best service to the science — instead of frittering his labor over the entire field, he is compelled to become a specialist and confine himself to a single group of ordinal or even family value.

It is for this reason that the knowledge of our insects shows quite unequal development in the several orders in which the class is divided. The two orders that are the most advanced are the Coleoptera (beetles) and the Lepidoptera (butterflies and moths). Of these, the several families have been systematically worked and catalogued, and it is possible for the student to name most of the specimens contained in his cabinet, by the aid of synoptical tables which have been prepared; while in the other five orders (as most generally accepted), the original descriptions will have to be consulted when accessible in their scattered and perplexing distribution throughout numerous scientific journals; or the material for which name and classification is desired, must be submitted to specialists in the orders who have the disposition and the time to devote to such usually unremunerative work.

The Coleoptera, from the facility with which the collections are made and their simple preparation for the cabinet, have received the most study. About ten thousand of our species are known, described, and catalogued. A classification of them has been recently given (in 1883) in a volume entitled, "Classification of the Coleoptera of North America," by Drs. LeConte and Horn. Not only does this volume afford to the American student the needed facility for his study, but so admirably does it embody and present the fruits of the life-labor of one who was peculiarly fitted for the work — Dr. LeConte, whose recent death we mourn — that the new system of classification and order of sequence therein presented, marks so great an advance upon previous systems that it can hardly fail of being accepted by the scientific world.

The attractiveness of the butterflies and moths constituting the order of Lepidoptera, as well as the economic importance of their larvæ in their dependence for a food-supply so largely upon the crops which are deemed essential to our existence or comfort, have long made them favorite objects of study. About five thousand species have been described.

The butterflies have been carefully studied and largely illustrated in their several stages. A volume given to the public the present year, prepared by Prof. French, of the Southern Illinois Normal University, for the use of classes in zoölogy and private students, under the title of "The Butterflies of the Eastern United States" (all that region lying east of Nebraska, Kansas and Texas), enables the student, by the aid of synoptic tables, simple descriptions and excellent figures, to identify almost any butterfly pertaining to this Atlantic zoö-geographical province. Of the moths (all of the Lepidoptera not butterflies), several families, as the *Sphingidæ*, *Bombycidæ* and *Geometridæ*, have been given good illustration, and all have been advanced through the enthusiastic labors of special students.

While striving to avoid irrelevant detail in this paper, it would not be proper, even in so cursory a reference to scientific labor richly deserving many pages for its simple record, to omit mention of the debt we owe, for a very respectable knowledge of our Diptera (flies, gnats, etc.), to Baron von Osten Sacken, for a long time a member of the Russian Legation at Washington, and to his friend Dr. Loew, of Prussia. And, as we recall the "Synopsis of the Neuroptera of North America," and several other kindred publications not much less extensive, which give us about all that we know of our dragon-flies, May-flies, caddis-flies, etc., we can not forego mention of the name of Dr. Hermann Hagen, the highest living authority in this order, long distinguished in Prussia as one of the leading entomologists of Europe, but many years ago induced by Louis Agassiz to transfer his labors to this country under the temptation of an unexplored Neuropterous fauna, together with the opportunity for its study in a life-professorship at Harvard University.

Commendable progress has been made in the study of the Orthoptera, of which grasshoppers and crickets are representatives, through the attention given to the order by Mr. Scudder during a long term of years, and later by the members of the United States Entomological Commission in their investigations of the Rocky Mountain locust and allied species. A synopsis of the *Acrididæ* (grasshoppers) has been published, but some of the families have not been catalogued. To the kindness of Mr. Scudder I am indebted for an estimate of 450 described species of North American (north of Mexico) Orthoptera, of which 275 are Acridians.

In the Hemiptera (plant-lice, scale-insects, cicadas, plant-bugs, etc.), far less progress has been made than with the same order in Europe. Collections and descriptions, however, have advanced to the extent of permitting the publication of a catalogue. The first part of a catalogue, embracing the suborder of Heteroptera, of which the plant-bugs are typical, has recently been published, giving the names of 1,450 species, while the remaining suborder of Homoptera is in preparation.

Number of Described Insects.

A comprehensive idea of present acquaintance with our insect fauna, so far as relates to the forms we have to deal with, may be obtained from the following statement:

Dr. Packard, well known from his extensive writings as a leading entomologist, has estimated (although somewhat roughly) that there are within the limits of the United States 50,000 species of insects.* Of these there are at least (we can not give the precise number, as some of the orders are still uncatalogued) 25,000 described species.†

Literature of the Science.

The literature of American Entomology has become so voluminous that a good working library for a student whose studies embrace all the orders of insects, would contain at least five hundred volumes, and this would need to be supplemented by the privilege of access to some public library where would be found other works needed for occasional reference—not one so barren of scientific publications as our State library, whose catalogue (subject-index) gives but eighty-five entomological titles.

Unfortunately, much of the literature, the more recent, and, therefore, the more desirable, is scattered through the publications of scientific societies, government reports, reports of agricultural and horticultural societies and agricultural papers.

Government Publications.—The knowledge of our insects has been greatly promoted through the liberality of the general government in the large number of valuable publications that have been issued and distributed gratuitously by the Department of Agriculture, the Department of the Interior, and the Engineer Department of the Army.

Smithsonian Institution Publications.—The kindly aid extended by the Smithsonian Institution has proved of incalculable service. Several of the monographs which have contributed so largely to the advance in this department of science owe even their

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* Hayden's Ninth Annual Report of the United States Geographical and Geological Survey of the Territories for 1875. Washington, 1877, page 590.

† In the several orders as follows: Lepidoptera—Butterflies (Edwards List, 1884), 614. Moths (Grote Check List, 1882), 3,184. Tineidæ, not included by Grote (Chambers List, 1878), 779. Diptera (Osten Sacken estimate in 1878), 2,500. Coleoptera (Henshaw List of 1885), 9,507. Hemiptera-Heteroptera (Uhler Check List, 1886), 1,448. Hemip.-Homoptera (Uhler estimate), 1,200. Orthoptera (Scudder estimate), 450. Hymenoptera and Neuroptera combined, at least 5,500.

preparation to special requests made by the institution, and to material in considerable part supplied from its collections. We are indebted to it for twenty-two valuable publications on insects.

Serials.—Prompt description of new species, of observations of interest, or of special studies, obtain ready publication in the four serials* (two monthly) that are devoted to current literature. Sixty-three volumes of serials have been issued, including the Canadian Entomologist, published in London, Ontario, with contributors mainly from the United States.

BIBLIOGRAPHY.

The aid in any department of study afforded by proper bibliography is appreciated by every student. The entomological student is fortunate in having probably the most complete bibliography ever prepared of any branch of natural history, in the "Bibliotheca Entomologica" of Dr. H. A. Hagen. The labor involved in a work of this scope, may be appreciated when we state that it was eight years in compilation, involving visits to all the principal capitals and libraries in Europe, and that eight hours a day for three years was devoted to its proof-reading. It embraces all entomological books and papers issued from the earliest times to the year 1862, the time of publication—18,130 in number, by 5,617 authors. From the year 1874, an annotated biographical record of all writings upon American insects has been given in Psyche. It is now appearing in the form of title-slips which may be used as card catalogues, and has reached the current number of 3884.

A bibliography of American Economic Entomology is now in course of preparation by Mr. P. Pickman Mann, of the Entomological Division at Washington, which contains at present about twenty-eight thousand manuscript cards, with the compilation, perhaps, not over half completed.

LIFE-HISTORIES OF INSECTS.

A knowledge of the life-histories of the insects of a country, may properly be taken as a measure of its progress in the science, for such knowledge must ever afford the basis for advancement in the right direction. In the applications of the science to protection from insect injury, it is indispensable, for until we have learned the several phases that insects assume—their habits, their environments—we do not know how, when, or where they may be most effectively attacked. To our economic entomologists, therefore, particulary to Dr. Fitch and Prof. Riley, are we indebted for the possession of full life-histories of a large number of our injurious species. Some of the histories that have been given us, in their faithfulness, fullness, details and illustration, might serve as models for all similar work. Special mention deserves to be made of the admirable life-histories of our butterflies, published by Mr. W. H. Edwards, in his two quarto volumes (a third in preparation) of the "Butterflies of North America." No other country can boast of such a series, so laboriously studied, so elaborately given, and so beautifully illustrated.

But in a knowledge of the early stages of our insects, generally, we are much behind European advance. Thus, we may know the larval form of one-fifth of our lepidoptera; in Europe about four-fifths are known, together with their food-plants. Of our coleoptera, the larvæ of only about two per cent of the named species have been described, although quite a number are in collections awaiting description and proper illustration.

ANATOMICAL STUDIES.

The studies of the anatomy of insects have been numerous, and, from their ability, have added much to the biological knowledge of this class of the animal kingdom. Among the many names associated with this advancement may be mentioned those of Packard, Scudder, Hagen, Burgess, Geisler, Minot, Mark, Dimmock, Leidy, Wyman, and Chambers.

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* Transactions of the American Entomological Society, Psyche, Entomologica Americana, and the Canadian Entomologist.

In a recent paper upon the "Systematic Position of the Orthoptera in relation to other Orders of Insects," illustrated by forty plates, Dr. Packard has given an abstract of the results of the examination of the external anatomy of a larger number of forms including, also, Pseudoneuroptera and Neuroptera, than had ever before been brought together. He proposes to modify our general seven order classification by separating the Pseudoneuroptera from the Neuroptera, and Dermatoptera (consisting of a single aberrant and perplexing genus, *Forficula*) from the Orthoptera. This modification, together with a change made in the last edition of his "Guide" in the elimination of Thysanura — a low group of wingless forms showing myriapod features — would give the following sequence of orders: 1. Thysanura; 2. Dermatoptera; 3. Orthoptera; 4. Pseudo-Neuroptera; 5. Hemiptera; 6. Neuroptera; 7. Coleoptera; 8. Diptera; 9. Lepidoptera; 10. Hymenoptera.

Although the Thysanura are so degraded a group in development, it is honored by Dr. Packard with possessing a hypothetical form ("a lost type") in which he suggests that all of the million of species of insects now peopling the globe may be supposed to have had their origin.

HISTOLOGICAL STUDIES.

Histological studies, consisting of observations of the powers, peculiarities and modifications of the cells that form the tissues of the animal kingdom (as also of the vegetable), and outside of which no life exists, are no longer confined to the medical profession, but have been earnestly entered upon by the zoölogist. Until recently, histological study of our insects has been neglected, but it may now be regarded as fairly commenced, with every promise of its successful prosecution.

Some valuable studies have lately been made by Dr. Charles Sedgwick Minot, among which may be specially cited his "Histology of the Locust," as given in the Third Report of the U. S. Entomological Commission, in sixty pages and fourteen plates, seven of which are devoted to the brain of the locust.

For other contributions we are indebted to Dr. Packard and Dr. E. L. Mark.

EMBRYOLOGICAL STUDIES.

Contributions of much value to the embryological history of insects have been made in this country, which will compare favorably with those of the German schools. Among several others worthy of particular mention are those of Dr. Packard upon some species of dragon-flies, the currant-worm, the locust, and some coleoptera and hymenoptera. An incentive to these studies has been the hope that they might furnish a safe and satisfactory guide in classification, but up to the present they have failed to yield any infallible data. Another incentive should be found in the facility of study afforded in the often transparent egg-envelope of the insect, and in the rapid development of the embryo — in the house-fly, *Musca domestica*, a period of only twenty-four hours. Additional inducement is offered in the idea that has been advanced, that the embryological development of an insect should present the series of changes through which it has passed in its evolution from the first hexapod to the rank that the species now holds, *i. e.*, that the egg should furnish an epitome of ancestral history. But this has not been realized. The summary, as presented, is too condensed, and has been, it is claimed, too greatly influenced by a natural tendency to variation, and readiness of adaption to conditions. Much that is sought for is not to be seen. Missing links mar the continuity, as in the evidences of the rocks. And there will always be "missing links" in the chain of evolution with which it is sought to bind all living forms, and all that have had life, to the primordial nucleated cell — itself "evolved from inorganic matter through electro-chemical force."

ECONOMIC STUDIES.

The study of insects in their relations with man — of their character, habits, transformations, food-plants, enemies, diseases, etc., — with a view of affording protection from the excessive ravages of a large portion of their number, or of utilizing the benefits that some may subserve — is what is understood as economic entomology. In this particular department we are able to report rapid recent progress, and an advance quite beyond that attained in any other country. For this there are two reasons:

First.— The study is a necessity for us. In no other country are agricultural products subjected to depredations so great as in the United States — a condition resulting from the introduction of a large number of the most injurious insect pests of Europe unattended by their natural parasites, and from the multiplication of species and individuals through the large areas devoted to special crops, as fruit orchards of five hundred acres, and wheat fields of from twenty-five to thirty-five thousand acres.*

Second.— State and National aid extended to the study. Nearly fifty years ago (in 1837), we find unequivocal recognition of the policy of the State in providing for investigations of this nature, in the instructions by Governor Edward Everett, of Massachusetts, under which that invaluable " Treatise on Insects Injurious to Vegetation," was prepared by Dr. Harris. In them we read as follows: "It is presumed to have been a leading object of the Legislature, in authorizing this survey, to promote the agricultural benefit of the Commonwealth, and you will keep carefully in view the economical relations of every subject of your inquiry, * * * the promotion of comfort and happiness being the great human end of all science."

The example of Massachussets was followed by New York in 1853, in directing and providing for the investigations of Dr. Fitch, which were so ably continued through a long term of years. To the high estimation in which these reports were held, and the practical results attending them, we are indebted for the subsequent investigations and reports of the State entomologists of Missouri and of Illinois, which have been of a high order. Forty State reports on injurious insects have appeard.

An entomologist (Mr. Glover), had been connected with the Department of Agriculture at Washington since 1863, by whom annual reports were issued, but with his study of insects, many other official duties were connected. In 1878, in recognition of the growing importance of the study, an Entomological Division was established, organized for efficient work with a chief and assistant, and facilities for ample illustration and publication given it. From that time to the present, the work of the Division has continued to increase in magnitude and importance. Appropriations were made for it the last year, inclusive of a special appropriation for the encouragement of silk-culture in the United States, of $40,000. With such means at its command it has been able to make thorough studies of a large number of our insect pests; special scientific study of certain little known groups (as the *Coccidæ*, *Chalcididæ*, etc.); of the insect enemies of the cotton, wheat, hops, and other crops; and to publish these investigations in an annual report, having an edition of four hundred thousand copies,† and in bulletins and otherwise.

But the labors of this Division which have particularly contributed to the advancement of economic entomology have been those for the discovery of the most efficient materials for use in the destruction of insects, known as insecticides, and in mechanical devices for their application. Of the former, are arsenical poisons, pyrethrum, kerosene emulsions, and bisulphide of carbon; of the latter are various spraying pumps, nozzle-forks for under-spraying the cotton-plant, eddy-chambered nozzles, cyclone nozzle, centrifugal throwers, bamboo-hose extension pipes for spraying tall trees, and other like devices in bewildering nomenclature. At the late World's Centennial Exposition at New Orleans, 117 implements for the application of insecticides, either in powder or spray, were exhibited by the Entomological Division, ranging from the simple powder-bellows for household use, to a complicated field atomizer in which the agitating and distributing machinery is operated by the wheels of the cart upon which it is drawn as it scatters its impalpable spray over nine rows of cotton at once.

Additional appropriations have also been made by Congress of $10,000 and $15,000 a year, for the investigations by a special commission of the Rocky mountain locust, the cotton-worm, and a few other insects, whose ravages were so extended as to assume a

* First Report on the Insects of New York, 1882, pp. 8, 11. † At a cost of at least $50,000.

national importance. The commission has given us the result of its labors in four large octavo volumes (a fifth is in preparation) and in seven bulletins which more than equal another volume in size.

Entomological Societies.

The establishment of entomological societies has contributed much in stimulating the study of our insects. The first society, under the name of the Entomological Society of Pennsylvania, was established at Baltimore in 1842. It would seem to have been a premature organization, resulting in the publication of no papers, probably in the presentation of none, and with a membership that never exceeded the requirements of official duties.

At the present there are four societies in active operation in the United States, and one in Canada; established at Washington, Philadelphia, Brooklyn, Cambridge, Mass., and London, Ontario.* Each of these is issuing publications and has its library and collections. There is also an entomological club connected with the American Association for the Advancement of Science, holding an annual series of meetings for the presentation of papers and for general discussions.

It is indicative of interest and efficient labor that American entomologists are sustaining an equal number of societies with our European collaborators, there being five in Europe—of London, Belgium, France, Italy, and Russia.

Entomological Collections.

Several large collections of insects have been brought together in this country, which fully meet the purpose for which collections in natural history are made, viz.: An exhibition of the fauna, more reliable means of naming new material than from published descriptions, preservation of types, opportunity of comparison of native forms with those from other parts of the world, and access to ample material needed for monographic work.

Prominent among the general collections may be mentioned those of the National Museum at Washington, the American Entomological Society at Philadelphia, and that of the Museum of Comparative Zoölogy at Cambridge, Massachusetts. The last named is the boast and pride of the American student. In it is contained, with every possible appliance for protection from harm, the collection of Coleoptera which represents the life-labors of Dr. LeConte, and rich with its 4,000 type specimens; Baron von Osten Sacken's collection of 2,500 Diptera, including his types and those of Dr. Loew; Chambers' collection of *Tineidæ;* the collection made by the Essex Institute of Salem, Massachusetts; and types of Zeigler, Melsheimer, Say, and others. But its chief attraction is in its biological collection, in which illustration is given, more or less full, of the natural history of above 5,000 species, in their several stages of development, their characteristic depredations, food-plants, architecture, diseases, the parasites that prey upon them, etc. No other collection of the kind in the world surpasses it, if, indeed, any equals it.

A collection limited to a single order of insects, the Lepidoptera (butterflies and moths), is to be found in Reading, Pa., which is probably the largest ever brought together by a private individual. It has been made by Mr. Herman Strecker, and has attained its present magnitude and value through many years of labor, of privation, and an enthusiastic zeal which has known no limit short of full representation of all American forms, and the possession of the most rare and desirable of exotics of the several continents and islands of the sea, so far as they have been procurable, regardless of their cost. Something of an idea of its extent may be had from the statement that it occupies 600 closely packed drawers of the ordinary German museum size, 16x20, seventy of which are devoted to a single genus of butterflies—*Papilio*, of which our large yellow swallow-tail may be cited as type. The number of named and classified specimens is said by its owner to exceed 70,000.

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* Entomological Society of Washington, American Entomological Society, Brooklyn Entomological Society, Cambridge Entomological Club, and the Entomological Society of Ontario.

Entomological Libraries.

A reference to some of the entomological libraries of the United States should be of interest as showing the aid found necessary or desirable to our students in the prosecution of their studies.

The first in importance is that of the Museum of Comparative Zoölogy at Cambridge, Massachusetts, having assumed that rank from the incorporation with it of the private library of Dr. Hagen. It is rich in works on Neuroptera, in Bibliography, and in anatomical, physiological and biological papers. It is judged to contain about 2,000 volumes and 3,000 pamphlets.

Harvard College library contains about 450 volumes.

The Public Library of Boston has about 650 volumes, nearly all standard works and but few pamphlets.

The Boston Society of Natural History reports about 900 volumes and 550 pamphlets. About one-third of these formerly constituted the private library of Dr. Harris.

The Astor Library of New York has about 500 volumes.

The Buffalo Society of Natural Sciences has over 500 volumes and about as many pamphlets.

The library of the American Entomological Society at Philadelphia is said to consist of 1,728 volumes, inclusive of some general works but in part relating to entomology.

The Academy of Natural Sciences of Philadelphia, 956 volumes and 554 pamphlets.

The Peabody Institute at Baltimore, over 800 volumes.

Of private libraries may be mentioned the following: That of Mr. Scudder, of 765 volumes and nearly 2,000 pamphlets, rich in works on the Orthoptera, butterflies, fossil insects, and the anatomy and embryology of insects.

Professor Riley's library contains about 700 volumes and 3,000 pamphlets, largely of biological and economic publications.

Dr. LeConte's library, which has been scattered since his death, was mainly in Coleoptera, and contained 700 volumes and 800 pamphlets.

Dr. Packard's library, of 470 volumes and 500 pamphlets, has a special value in its embryological and morphological works.

Mr. Uhler's library, selected with special reference to his studies of the Hemiptera, contains over 300 volumes and 500 pamphlets.

The above items are drawn from a publication by Mr. Scudder in 1880, entitled "The Entomological Libraries of the United States." Since its compilation, large additions have doubtless been made to each one of the libraries.

Palæontological Entomology.

Notwithstanding the abundant wealth of our insect fauna, ever yielding discovery of previously unknown forms, while unnamed and unclassified material is an embarrassment in all of our large collections, the ancestors of these myriad forms have not been permitted to lie neglected in the beds of rock that have held their forms for countless ages. The discovery, several years ago (in 1867), in the Rocky mountains, of beds of fossil insects of unsurpassed richness, has given both the opportunity for, and the impetus to, their study. During the past twenty years Mr. S. H. Scudder has devoted much time to the fossil insects occurring in the Devonian rocks of New Brunswick, and in the carboniferous, triassic and tertiary beds of the western States and territories, as may appear from a list of sixty-four publications upon these and European forms, published by him up to 1882. Some tertiary beds of a lake basin at Florissant, in Colorado, have proved far more prolific of insect remains than any others in the world. About 12,000 specimens have been taken from them, representing each of the general seven orders of insects, while hundreds of thousands have been left behind. Among them was the first fossil butterfly ever found in America (nine were known from the tertiaries of Europe), and the most perfect one ever found. It is described as "in a wonderful state of preservation, the wings expanded as if ready for the cabinet, and absolutely perfect, with the exception of a small angle of one wing. The antennæ are nearly perfect. The markings of the wings are perfectly preserved, and in portions of the surface the form of the scales can be determined with the miscroscope."

Entomology in our Schools.

I regret that I have to report that entomology has not been given the place in our schools that it deserves. In our State, the Albany Normal School and the Oswego Normal School have given excellent instruction in it—in the latter united with laboratory work. Cornell University sustains a professorship in entomology, with courses of lectures, a laboratory, a large named and classified collection, and a library so rich in its serials that every entomological journal published in the world finds place in it. In some of our public schools occasional talks are given upon insects when teachers may chance to have a taste for the study. Elsewhere, lectures upon entomology are given in course at Harvard University, the State College of Maine, the Michigan State Agricultural College, Purdue University at Layfayette, Ind., the Illinois Industrial University, the Iowa Agricultural College and the Kansas State Agricultural College. In each of the State institutions, particular attention is paid to the economic aspect of the science. In some of the common schools of California the science is taught and collections are made by the pupils, in consideration of the interest lately aroused by the great increase of fruit insects in that State.

The above, with the exception of some academic instruction in other States, is the sum, so far as known to me, of what is being done in our institutions of learning in this department of science.

Will you pardon me if I go beyond the scope of my topic, to enter a protest against this neglect of the study? Its importance, viewed from a utilitarian standpoint alone, as might easily be shown, entitles it to a reasonable share of attention. Compare it, if you please, in practical importance, with the study of botany, which has become so popular in our schools. Some idea of its importance may be obtained from the statement that careful computations, based upon the census returns of the agricultural products of the United States, show annual losses to these products of two hundred millions of dollars, a large proportion of which are preventable. In interest, nothing in the range of natural history can equal the study of the wonderfully varied habits of insects and their marvelous transformations. As a mental discipline, it is fully equal to the study of the classics, in its stimulation of the powers of observation, comparison, discrimination, memory, while it tends to promote habits of study, industry, delicate manipulation, order, neatness, and precision, which can not but prove of service in any occupation or position in life.

Have we the text-books for school instruction, such as are found in other branches of natural history — in botany, for example? No, we have not; nor can we have, nor are they needed. The synoptic tables and brief descriptions that would be required for the identification of our United States species, with only twice the space devoted to an insect that is given to a plant, would occupy, as I have computed, forty volumes of the size of Gray's School and Field Book of Botany. But identification of species is not the end of entomological study. With "Packard's Guide to the Study of Insects" in the hands of the teacher, and with such assistance as would be suggested by it, he could soon prepare himself to give better instruction than that usually obtained from text-books alone. No branch offers such facilities for object-teaching. The objects are almost innumerable — they cost nothing — they even come to you unsought. You could take one hundred species of flies alone from your window-panes. Surely, there is no valid reason for not introducing at once this study in our schools.

Is it *right*, I would ask, in passing, and I use the word in its full import as antithetical to wrong, that the 283 academies and academical departments in our State should be able to report but fifty-one of their number as giving instruction in zoölogy — less than one-fifth? And yet this is the study that would teach of those wonderful organisms, instinct with life and intelligence, associated with us upon a globe in which the adaptations to their wants are as perfect as for our own, and each with a structure in which God is revealed as unmistakably and as clearly as in the structure of the universe.

In closing this sketch, quite imperfect from the brief time that could be devoted to it, I desire, Mr. Chancellor, to express to you and to your Honorable Board the obligations and the gratitude of American entomologists for the encouragement that for so many years you have continued to extend to this department of study. The resumption, a few years ago, of economic studies under State authority and provision, after a long intermission, was largely owing to your instrumentality, and to your recognition of their usefulness in the promotion of the agricultural interests of the commonwealth and of the country.

[From Entomologica Americana, ii, 1886, pp. 143-160.]

ANNUAL ADDRESS OF THE PRESIDENT OF THE ENTOMOLOGICAL CLUB OF THE A. A. A. S.

(Read at the Buffalo Meeting of the American Association for the Advancement of Science, August 17, 1886.)

Gentlemen.—I do not know that I can better discharge the duty devolving upon me, of the presentation of an address on this occasion, than in reference to some of the evidences of the continued progress made in our department of science, as shown in publications which have appeared since our last meeting. Little that I shall refer to, may be new to most of those present, yet a retrospect of labor satisfactorily performed and successfully prosecuted, is always agreeable to those who have had part therein, while it may prove of interest and of value to those who are not present with us, or active members of our corps, or who may not have access to our current literature.

Each of the several Orders of insects has been advanced through valuable studies and publications. While in some of the orders, the publications have been but few, yet it is gratifying to know that collections are being made in them and studies prosecuted, of which we may look for the results ere long.

Publications in the Several Orders of Insects.

In the *HYMENOPTERA*, a *Monograph of the Chrysididæ* has been published by Mr. S. F. Aaron, containing diagnostic descriptions of genera and species. Seventy-four species are described, over one-half of which are new to science: nearly all are contained in the collections of the American Entomological Society, of which Mr. Aaron is the curator. A list of the more important writings on the *Chrysididæ* is appended, and the paper is illustrated in five plates (Transactions of the American Entomological Society, xii, 1885, pp. 209-248).

Mr. Wm. H. Ashmead has given a *Biographical and Synonymical Catalogue of the North American Cynipidæ*, containing 172 species, together with a list of the trees and plants upon which they occur. It appears that these insects are so nearly confined to oaks (of the twenty species of oaks enumerated), that only thirteen species have other food-plants (Id., ib., pp. 291-304).

From the same author we also have *Studies on North American Chalcididæ*, giving descriptions of twenty-five new species from Florida and notes upon others (Month. Proc. Am. Ent. Soc., for Dec., 1885, pp. x-xix; Trans. A. E. S., xiii, pp. 125-135).

Mr. L. O. Howard, of the Entomological Division of the U. S. Department of Agriculture, who for several years past has been engaged in the study of the interesting and serviceable family of the *Chalcididæ*, is contributing to Entomologica Americana, a generic synopsis of the family, which he has divided into twenty sub-families. The European genera have been combined with our own, as many of them will doubtless be hereafter detected in this country (Ent. Amer., i, pp. 197-199, 215-219, ii, 33-39, 97-101). A list of the North American species by Mr. Howard, may be found in Bulletin No. 5 of the Division of Entomology, which also embraces the first of a series of papers descriptive of the Chalcididæ in the collection of the Department, most of which were previously undescribed.

Contributions to the knowledge of our Hymenoptera have also been made by Messrs. G. J. Bowles (Canadian Entomologist, xvii, p. 231); J. A. Guignard (id., xviii, p. 68); Wm. H. Harrington (id., pp. 30, 38, 45, and in Trans. No. 6 of Ottawa Field-Naturalists' Club, p. 244); G. W. Taylor (Canad. Ent., xvii, p. 250), and T. W. Fyles (id., xviii, p. 38).

We are greatly pleased to learn that Mr. Ezra T. Cresson, to whom we are more largely indebted than to any other person for the knowledge of our North American Hymenoptera, is engaged upon a Synopsis of the order, and that such progress has been made in its preparation that its publication may be expected before many months.

In the *LEPIDOPTERA*, a volume has been given to the public the present year, which we hope will be followed by others of the kind, in other of the orders, that greatly needed wants may be met.

The Butterflies of the Eastern United States, for the use of classes in Zoölogy and private students, by Professor G. H. French, of the Southern Illinois Normal University, will enable the intelligent student, by the aid of synoptic tables, descriptions and figures, to name almost any of the species that occur within the United States, east of Nebraska, Kansas, and Texas. Two hundred species are described, illustrated by ninety-three figures, and where known, the earlier stages are also given.

A similar work, devoted to a smaller group, is the *Sphingidæ of New England*, by Professor C. H, Fernald — a pamphlet of eighty-five pages and six plates, in which the forty-two species known to occur in the Eastern States are described and a few of them figured.

A feature in both of the above publications which deserves special commendation, is the accentuation of the binomial name of the species. The care that has been bestowed upon the preparation of these lists, entitles them to acceptance and adoption, and we hope will ensure us some degree of uniformity in pronunciation, hereafter.

Professor Fernald and Mr. Jno. B. Smith have contributed notes upon *Some of the Genera of our Sphingidæ* (Entomologica Americana, ii, p. 2).

Mr. Smith has continued his *Introduction to a Classification of the North American Lepidoptera*, in a fourth paper, devoted to the Sphingidæ (id., i, pp. 81-87), and has also given a more detailed account, with illustrations, of the scent-organs in some Bombycid Moths, than we have hitherto had (id., ii, p. 79).

The careful Life-histories of our Butterflies have been continued by Mr. W. H. Edwards (Canad. Ent., xvii, pp. 155, 181, 245), and also his Description of New Species, from the Pacific Slope (id., xviii, p. 61).

The Rev. G. D. Hulst has published during the last month, *Descriptions of New Pyralidæ*, embracing such species as are not named in the American collections and are unknown to those who have made special study of the family. Much the larger number of the species described (89 in all) are from the western portion of the United States (Trans. Amer. Ent. Soc., xiii, July, 1886, pp. 145-168). Mr. Hulst has also published two papers upon the *Geometridæ* in which several new species are described, viz., *New Species and Varieties of Geometridæ* (Ent. Amer., i, pp. 201-208) and *Notes upon Various Species of the Ennominæ* (id., ii, pp. 47-52).

Descriptions of new species of Lepidoptera have also been published by Mr. Henry Edwards (Ent. Amer., i, p. 128, ii, p. 8), Mr. J. Elwyn Bates (Can. Ent., xviii, 74, 94), Mr. Ph. Fischer (id., xvii, p. 133), Mr. B. Neumoegen (Ent. Amer., i, p. 92), and Mr. R. H. Stretch (id., ib., p. 101).

In the Proceedings of the Natural Science Association of Staten Island, for March, 1886, Mr. Davis has recorded sixty species of butterflies as found upon Staten Island, naming the recent additions to a former list.

Other contributions to the Lepidoptera have been made by Messrs. Beutenmüller, Bates, Clark, Fischer, Fletcher, French, Goodhue, Grote, Hamilton, Harrington, Kellicott, Moeschler, Smith, Stretch, Tepper, and Mrs. C. H. Fernald, and Miss Murtfeldt.

It is gratifying intelligence that the two volumes of the *Butterflies of North America*, for which we are indebted to Mr. W. H. Edwards, is to be followed by a third work upon which has been commenced. As the volumes already issued have furnished the American student with a better series of life-histories of butterflies than have ever been published elsewhere, while enriched with illustrations which in beauty and accuracy have never been surpassed, it is to be regretted that their author should be compelled to find the reward for his years of untiring labor in the honor that they may bring him, and not in a pecuniary return. A merited tribute to the high character of this work may be found in Science, for October 9, 1885 (p. 307).

The *Butterflies of New England*, which has been under the pen and pencil of Mr. S. H. Scudder for several years, and which has been so long awaited by entomologists, is, we learn, rapidly approaching completion. Having had the privilege of examination of several of the plates which are being printed at the well-known house of Sinclair & Sons, Philadelphia, by the chromo-lithographic process, I may say of them, that they are marvels of faithfulness and beauty, hardly to be distinguished from hand-coloring. They certainly mark an advance in the application of this art to insect illustration that has never before been equalled in this country or in Europe.

A *Hand-book of all the Lepidoptera described as belonging to the North American Fauna, North of Mexico*, giving brief descriptions of all the species known, to be illustrated with wood-cuts and lithographic plates, under the editorship of Mr. Henry Edwards, of New York, is announced. It will be issued in parts, by S. E. Cassino, as stated in a circular distributed. and will be commenced as soon as a sufficient number of subscribers can be obtained.

Mr. R. H. Stretch is engaged on a *Monograph of the Zygænidæ, Lithosiidæ and Arctiidæ of North America*, in which it is intended to collate all the literature relating to these families, and to illustrate all the species. About 350 figures have already been drawn for the work.

DIPTERA.— We are unable to report much progress in this Order during the year.

Dr. S. W. Williston has completed his series of three papers on the *Classification of the North American Diptera* in the families *Xylophagidæ, Stratiomyidæ, Tabanidæ, Leptidæ*, and *Syrphidæ*, published in the Bulletin of the Brooklyn Entomological Society (vii, p. 129) and in Entomologica Americana (i, pp. 10, 114, 152). In these papers some new species are described, synoptic tables of the genera and diagnoses of the tribes and families given, and structural features illustrated.

Dr. Williston has also published *Notes and Descriptions of North American Xylophagidæ and Stratiomyidæ* (Can. Ent., xvii, p. 121), in which eleven species are described as new.

Dr. Hagen has written of the *Hessian Fly in Italy*, recording its notice in that country (Can. Ent.. xvii, p. 129). He has also collated some facts relating to the food of the larva of *Scenopinus*, leading him to offer the suggestion that *S. pallipes* found beneath carpets, may be carnivorous (id., xviii, p. 73). Some observations of my own which are stated in the 2d Report on the Insects of New York, give additional reason for believing that this remarkable larva, feared as a carpet-feeder, may prey upon the larva of the clothes-moth, *Tinea pellionella* (Linn.).

The volume last referred to, contains also notices of an unknown dipterous larva feeding upon a fungus occurring on quince, the emasculating bot-fly (*Cuterabra emasculator*), *Bibio albipennis, Microdon globosus*, and *Trypeta pomonella*.

As addenda to the Scenopinus article by Dr. Hagen, Baron Osten Sacken has contributed to the Entomologist's Monthly Magazine for the present month of August (vol. xxiii, p. 51–52) *Notes toward the Life-history of Scenopinus fenestralis*, in which the literature of the species is more fully developed, and the conclusion drawn therefrom that the larva is undoubtedly carnivorous; and that it frequents fungi, hair mattresses, carpets, swallows' nests, decaying wood, animal dejections, etc., not for the sake of the animal remains or the vegetable matter, but for the larvæ or the pupæ of the moths that live in them.

Dr. Hagen has also recorded the rearing from stored sea-weeds in Harvard College Laboratory, of what is probably an addition to the small number of known marine insects — *Cœlopa frigida* Fallen. Its earlier stages are unknown, and the opportunity is taken to call attention to the absence of any collation of our knowledge of the earlier stages of the Diptera (Can. Ent., xvii, p. 140).

In a brief note from the same author to Entomologica Americana (i, p. 229), the idea is advanced that in *Cecidomyia tubicola* Osten Sacken, the larval breast-bone is a spinning organ, and homologous with the labium.

Mr. D. W. Coquillett has monographed the Lomatina of North America of the *Bombylidæ*, consisting of four genera, indicating one as new, and describing five new species (Can. Ent., xviii, p. 81).

COLEOPTERA.—Dr. G. H. Horn has continued to lay us under obligations for his valuable contributions to Coleopterology, in descriptive, classificatory, bibliographical, and critical papers, in the pages of the Transactions of the American Entomological Society, the Canadian Entomologist, and Entomologica Americana. Their titles are too numerous to permit their citation in the present paper.

Lieut. Thom. L. Casey has published *New Genera and Species of Californian Coleoptera* (Extra Bulletin, California Academy of Science, vol. i), and a *Revision of the Californian Species of Lithocharis* (Bulletin No. 5, Id., vol. ii).

Mr. Frederick Blanchard has given a careful paper *On the species of Canthon and Phanæus of the United States*, with synoptic tables of species, bibliography, and notes on some other genera (Trans. Amer. Ent. Soc., xii, pp. 163–172).

Mr. Charles W. Leng is contributing to Entomologica Americana, *Synopses of Cerambycidæ*, accompanied with illustrations (vol. i, pp. 28–35, 130–136; ii, pp. 27–32, 60–63 81–83, 102–103, 118–120, 193–200).

Other contributions to the order, which have come under my notice, are from Messrs. F. B. Caulfield, F. Clarkson, John Hamilton, S. Henshaw, A. W. Jones, Warren Knaus, C. W. Leng, A. S. Packard, E. A. Schwarz, J. B. Smith and C. W. Strumberg.

In Entomologica Americana for July and August, 1886, is a *Record of some Contributions to the Literature of North American Beetles published in* 1885, by Samuel Henshaw, which will be found very convenient for reference, and for which its compiler is entitled to sincere thanks.

The most generally acceptable contribution to this order made during the year, has been the *List of the Coleoptera of North America, North of Mexico*, by Samuel Henshaw, in which we are given the recent classification of Drs. LeConte and Horn, the large number of new species described during the preceding twelve years, together with many important synonymical corrections. Annual supplements to the List are promised by the author. The labor involved in the preparation of a work of this nature is so great, that each successive contribution of the kind, if as meritorious as the one under notice, marks an epoch in the literature of the order.

In the *HEMIPTERA*, we have had the gratification of having placed in our hands, our first Check-List. It presents a classification which has been so long needed by the student, of the Heteroptera, and the names of 1,448 species. A debt of gratitude is due to Mr. Uhler for its preparation, in consideration of the increased facility for study that it will afford, and the incentive that it will prove, to its prosecution.

We have the promise that a similar List of the Homoptera will follow as soon as time can be found for its preparation.

The chapter on Hemiptera, in the Standard Natural History recently published by S. E. Cassino & Co., of 92 pages royal octavo, is also from Mr. Uhler, and has been, I believe, generally received as advancing our knowledge of an order which has been much neglected in this country.

The Fourteenth Report on the Insects of Illinois, by Prof. S. A. Forbes, State Entomologist, treats of several Hemipterous Insects, chiefly in their economic relations.

In the Report of the Entomologist of the U. S. Department of Agriculture for 1885, Prof. Riley has presented a careful study of the two broods of the Periodical Cicada, *Cicada septendecim*—the seventeen-year *(septendecim)* and the thirteen-year race *(tredecim)* which appeared in 1885 over a large extent of the county, and came together in southern Illinois and northern Georgia. There is also a summary of distribution and future appearance of all the broods (twenty-two in number) known to occur in the United States; also a record of experiments made in transferring the eggs of the northern and southern races of the insects from one portion of the country to the other, as a test of the influence of climate upon the developmental period.

In the Fourteenth Annual Report of the Geological and Natural History Survey of Minnesota, Mr. O. W. Oestlund has contributed a *List of the Aphididæ of Minnesota*, in which seventy-one species are recorded, of which twenty-four species are described as new, and two new genera named.

Among other contributors to the order, are Mr. Wm. H. Ashmead, Prof. E. W. Claypole, and Mr. John J. Jack.

In the *NEUROPTERA*, Dr. Hagen has contributed the European literature of the *Hemerobius dipterus*, of which twenty examples are in collections in Europe, and four, so far as known taken in this country, referring to this species Dr. Fitch's type of *H. delicatulus* (Entomologica Americana, ii, p. 21).

Mr. J. A. Moffat has narrated some interesting habits of a Myrmeleon larva (Canad. Entom., xviii, p. 76).

Two elaborate papers from Dr. Hagen are additions of much importance to the literature of the Pseudoneuroptera. The first is a *Monograph of the Earlier Stages of Odonata* (in forty-three pages), in which forty-eight species in the subfamilies of Gomphina and Cordulegastrina are described (Trans. Amer. Entomol. Soc., xii, pp. 249-291). The second is a *Monograph of the Embidina*, and is apparently one of the most careful and painstaking of the erudite author's publications. Not only is each one of the seventeen species minutely described (six pages in some instances are devoted to a single species) but the history of the family is fully presented together with an extended discussion of its characters with reference to its assignment to its proper systematic position, which is held by the writer to be near the *Termitidæ* (Canad. Entom., xvii, 1885, Aug., Sept., Oct., and Nov.).

Of writings upon the *ORTHOPTERA*, I find only a *List of the Orthoptera of Kansas*, by Lawrence Bruner, and a note on the habits of *Œcanthus*, by E. W. Allis.

A resumé of our knowledge of Fossil Insects has been published by Mr. Scudder, in a volume of 113 pages, entitled *Systematische Uebersicht der Fossilen Myriopoden, Arachnoideen, und Insekten.* It presents an excellent and comprehensive view of our knowledge of these interesting forms, under a systematic arrangement, with definition of groups and abundant illustration. It is understood that it will be republished in this country.

Mr. Scudder is at present engaged upon an extensive work as it will necessarily be, descriptive of the fossil insects taken from the wonderfully prolific locality, the Tertiary Lake Basin at Florissant, in Colorado. It is thought that the first part of this work will be ready for publication the coming year.

The contributions to which we have referred in the several Orders, have been descriptive, classificatory, historical, biological, histological, anatomical, and biographical. It would perhaps have been more satisfactory if these several departments of study could have been separately reviewed, but the time has not been found for such presentation.

Publications in Economic Entomology.

In consideration of the practical importance of economic investigations, will you permit me to direct your attention to some of the work done in this direction, which has been given to us during the year:

The Fourteenth Report on the Noxious and Beneficial Insects of Illinois, by the State Entomologist, Prof. S. A. Forbes, is devoted to the consideration of various insects infesting corn, wheat, grass, clover, the maple, the elm, garden-crops, and orchards. A valuable appendix to this report is a general index to the first twelve Illinois reports — in three parts, viz., of the species of insects alphabetically and systematically arranged, their food-plants, and the remedies treated of.

The *Report of the Entomologist of the U. S. Department of Agriculture, Prof. C. V. Riley*, for the year 1885, presents us with the latest information upon progress in Silk Culture in the United States; an extended notice of *Cicada septendecim;* and notices of recent injuries by five other species of insects. Addenda to this report are the following: Report on the Locusts of the San Joaquin Valley, Cal., by D. W. Coquillett; Report on the abundance of the Rocky Mountain Locust, in 1885, by Lawrence Bruner; Notes on Locusts at and about Folsom, Cal., by Albert Koebele; Insects Infesting Fall Wheat, by F. M. Webster; Third Report on the Cause of the Destruction of the Evergreen and other Forest Trees in Northern New England, by A. S. Packard (the lepidopterous insects); and Report on Experiments in Apiculture, by N. W. McLain.

The *Second Report on the Injurious and other Insects of New York*, by the State Entomologist (279 pages), embraces notes of various insect attacks; remedies and preventives for insect attacks; miscellaneous notes; and notices of Lepidoptera, Coleoptera, Hymenoptera, Orthoptera and Neuroptera. In the Appendix is a list, with notes, of the miscellaneous publications of the Entomologist for the years 1882 and 1883, and republication of the rare paper of Dr. Fitch on the *Winter Insects of Eastern New York.*

The *Report of the Entomologist to the Department of Agriculture of the Dominion of Canada*, by James Fletcher (56 pages), is occupied with notices of the principal insect attacks during the year 1885, upon cereals, hay and clover, vegetables, fruits, and forest and shade trees.

A *Report upon Orange Insects* (227 pages) presents the investigations of Mr. H. G. Hubbard, a special agent of the Entomological Division of the U. S. Department of Agriculture, made in Florida, during the years 1881-5. The entire insect fauna of the orange, so far as known, is given, and the species discussed, together with the remedies and preventives which have been found to be the most effective in their destruction. The orange-rust is also considered, and is regarded as a condition of the fruit resulting from the attack of the rust-mite, *Typhlodromus oleivorus* Ashmead.

Bulletin No. 11, *of the U. S. Department of Agriculture, Division of Entomology* (34 pages), is devoted to Experiments on various insecticidal substances, chiefly upon insects affecting garden-crops, made under the direction of the Entomologist, by F. M. Webster, H. Osborn, and Thomas Bennett.

Bulletin No. 9, of the same Division, just issued, is entitled, *The Mulberry Silk-worm, being a Manual of Instructions in Silk Culture, by C. V. Riley, M. A., Ph. D.* It is a revised and enlarged edition of Special Report No. 4 of the Division, which had been exhausted. It contains sixty-two pages, a glossary of terms used, twenty-nine figures, two plates in chromo-lithograph showing silk-worms affected by pebrine and flacherie, and the pebrine corpuscles, after Pasteur, and an index.

Bulletin No. 12 of the same Division, also just issued, is entitled *Miscellaneous Notes on the Work of the Division of Entomology for Season of* 1885, *prepared by the Entomologist.* It is a pamphlet of 46 pages and 1 plate, and contains a Report on the Production and Manufacture of Buhach, by D. W. Coquillett, which is full and of much value; Additions to the 3d Report on the Causes of the Destruction of the Evergreen and other Forests in Northern New England, by A. S. Packard; The Periodical Cicada in Southwestern Indiana, by Amos K. Butler; and Notes of the year, of various Insects.

The *Fourth Report of the U. S. Entomological Commission, on the Cotton Worm*, by Prof. C. V. Riley, is a volume of 546 pages, carefully indexed, and illustrated by 64 plates. Of these, 48 plates and 137 pages are devoted to the mechanical devices for the destruction of the cotton-worm. The three chapters treating of the remedies and preventives employed in coping with this insect (70 pages), are especially valuable to the agriculturist, as many of them would be equally available against other insect attacks.

The four large octavo volumes of the Entomological Commission, and its seven Bulletins, of nearly 3,000 pages in the aggregate, 150 plates, several hundred wood-cuts, and a number of maps, may confidently be appealed to in justification of the action of the General Government, if its wisdom be questioned, in authorizing and providing for the work of the Commission now brought to a close in its final publication.

Prof. Riley, in his *Presidential Address before the Entomological Society of Washington*, as published in the Proceedings of the Society, has referred to some of the insect attacks which had recently come under his observation.

An *Address upon Horticultural Entomology* (23 pages), by Prof. F. M. Webster, before the Indiana Horticultural Society, very clearly presents the importance of insect studies to the horticulturist, who may not to any great extent ward off insect attack by the means successfully resorted to by the agriculturist—by rotation of crops. It also gives comprehensive notice of several of the more injurious insects with which the horticulturist must contend.

The same author has also issued a carefully prepared illustrated paper, of 36 pages, on the *Insects affecting the Corn Crop*, extracted from the Indiana Agricultural Report for 1885. Of the fifty species of corn insects noticed, several are accompanied with useful bibliographical lists.

Insects Injurious to the Apple, is the title of a paper, by Prof. B. F. Koons, extracted from the Report of the Connecticut Board of Agriculture, for 1885. The claims for the study of entomology are well presented in it.

A paper upon *Cut Worms*, read before the New York State Agricultural Society (pp. 25, figs. 20), and one entitled *Some Injurious Insects of Massachusetts*, read before the Massachusetts State Board of Agriculture, by the State Entomologist of New York, have been published in the annual reports of the societies named, and also as separates.

The Fourth Report of the New York Agricultural Experiment Station narrates (pp. 216-223) experiments made at the station with insecticides upon some of our more injurious insect pests; and contains, also, a notice of a very interesting fungus attack upon *Phytonomus punctatus* (pp. 258-262), which is believed to have been communicated through the agency of a fertilizer employed. The fungus is named by Prof. Arthur, botanist of the station, *Entomophthora Phytonomi.*

The Fourth Report of the Ohio Agricultural Experiment Station for 1885, devotes six pages to experiments with insecticides, and the best method for their application.

An Experiment in Silk Culture, by Prof. T. J. Burrill, made under the direction of the Illinois University, is published in the proceedings of the sixth meeting of the Society for the promotion of Agricultural Science. The experiment terminated in the study of a contagious disease that broke out in the larvæ that were being reared, which was believed to be identical with the *flacherie* of the silk-worm in France, observed by Pasteur. The disease had never been previously recorded as existing in this country but is now thought to have long prevailed among our native Lepidoptera, and to have been the cause of a recent epidemic in the *Pieris rapæ* larvæ. The causes that may have led to the outbreak of disease among the silk-worms attempted to be reared, are considered in the paper.

In the same publication, is an abstract of a paper by Prof. C. V. Riley, on *Grasshopper Injury.* A periodicity in wide-spread locust injuries averaging about every eleven years is accepted. It is claimed to be possible to predict the degree of destructiveness. Thus, increasing injury for the years 1886 and 1887 may be expected should the weather favor; but even under the most favoring conditions, these injuries can never again be so wide-spread, it is asserted, as between 1874 and 1877.

Prof. S. A. Forbes, who has for some time, been paying special attention to the diseases of insects with a view of their propagation for the destruction of injurious species, has published in a Bulletin of the Illinois State Laboratory of Natural History (vol. ii., pp. 257-321) an elaborate paper entitled *Studies on the Contagious Diseases of Insects.* In it he discusses *flacherie* in the cabbage-worm, *Pieris rapæ*, describing the disease minutely, its characteristic bacteria, the evidence of its contagious nature and of the ability of conveying it by an artificial culture of the Micrococcus. In the same painstaking manner, jaundice, found associated with *flacherie* in the silk-worm, by Professor Burrill, is also discussed. *Flacherie* in *Datana Angusii* is described, with its characteristic bacteria, their artificial cultures, and contagious nature. The paper concludes with a notice of the aid rendered by *muscardine* in arresting wide-spread desolation in forests and orchards, in Southern Illinois, in 1883, caused by a remarkable prevalence of the forest tent-caterpillar, *Clisiocampa sylvatica.*

The Insects of Betula in North America, by Anna Katherina Dimmock, of Cambridge, Mass., contained in Psyche, iv, pp. 239-243, 271-286, is an admirable compilation, and may justly serve as a model for similar lists. It is not a simple record of the 107 species noticed as feeding on *Betula*, but valuable notes are given upon each insect—of development, habits, history, etc., the other plants upon which it is known to feed, with references to authority and publication. Where bibliography is so extensive and of such importance as to justify it, an entire page, of small type, is devoted to a single species. It is to be hoped that this is but the first of a series of similar publications by the author.

A published abstract of a paper read by Mr. Amos W. Butler, before the American Association for the Advancement of Science at its last meeting, on *The Periodical Cicada in Southeastern Indiana*, gives the time and duration of its visitation, the mode of oviposition, abundance of the var. *cassini* Fisher in a distinct territory, the sounds produced, prevalence of a fungus attack, their destruction by mammals, birds, and fishes, and the comparatively slight damage resulting from the visitation. The paper affords evidence of well-trained habits of observation in the author.*

Dr. Hagen has communicated an interesting observation made by him of the destruction of living trees, of the red maple, *Acer rubrum*, by white ants, in Cambridge, Mass. (Canad. Ent., xvii, p. 134).

Mr. Frederick Clarkson has found, that under some circumstances at least, the development of the oak-pruner, *Elaphidion villosum*, is different from that ascribed to it by Drs. Harris and Fitch, in that the insect may mature within its burrow as early as in the month of November (id., ib., p. 188).

Mr. John J. Jack reports serious injury to a crop of beans, through the attack of an Anthomyian fly, *Anthomyia angustifrons*, the larva of which attacked and destroyed the plants before they reached the surface of the ground (Canad. Entom., xviii, 1886, p. 22).†

This form of Anthomyian attack, akin to that of the seed-corn maggot, *Anthomyia zeæ*, may afford a solution of the frequent eating out of the interior of melon and some other of the larger seeds beneath the ground, by hitherto unknown enemies, which has been brought to my notice.

Professor Riley has made an interesting communication to Science (vol. vii, p. 394), to the effect that *Feniseca Tarquinius*, one of our rarer butterflies, has been found to be carnivorous in its larval stage—the only known instance of a carnivorous butterfly, and that its food consists of plant-lice, especially of the gall-making and leaf-curling species of *Pemphiginæ*.

This publication solved what had been a mystery to me. A piece of a branch of some tree, apparently an alder, was sent to me in October last, thickly covered with the flocculent bodies of some woolly aphis, probably a *Schizoneura*. It was left in the box in which received, awaiting further notice. Upon casually opening the box early in April, to my great surprise, a newly emerged and perfect *Feniseca Tarquinius* was found therein; also, the short, stout chrysalis case from which it had escaped, and an undeveloped chrysalis, each suspended by its cremaster from the sides of the box. How and where the larva conceals itself during its growth is an interesting inquiry.

A communication made to Science (May 28, 1886, vii, pp. 481-483), by R. I. Jackson, records a New Museum Pest, in *Lepisma domestica*. It had been discovered as very injurious to labels; and it is further believed to be the author of the injury often reported, to muslin curtains, silks, etc., commonly charged upon the carpet-beetle, *Anthrenus scrophulariæ*, as similar injuries are known to have resulted from species of Lepisma in other countries, as well as to books, maps, papers, etc.

Entomology in Agricultural Journals.

Our leading Agricultural Journals are the media of no inconsiderable amount of information of the means for controlling insect depredations. They furnish convenient channels through which inquiry may be made from any portion of the Union of any unrecognized form of attack, and an intelligent reply elicited.

Professors Riley and Cook are frequent contributors to the columns of the *Rural New Yorker*.

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* The paper has been published in full, during the present month, in Bull. No. 12, of the U. S. Dept. of Agriculture, — Division of Entomology, pp. 24 to 31.

† This occurrence is subsequently noticed at greater length in Bull. No. 12, of the Division of Entomology, p. 38-39.

The *Prairie Farmer* maintains an Entomological Department, averaging two columns weekly in extent, under the editorship of Clarence M. Weed.

The same department, in the *Fruit Growers' Journal*, of Cobden, Illinois, containing weekly contributions, is edited by Professor G. H. French.

To the *American Agriculturist*, occasional contributions are made and inquiries answered by Professor Riley.

The *Spirit of the Farm*, of Nashville, Tenn., is publishing a series of entomological articles, by the entomological editor, Prof. E. W. Doran.

The *Pacific Rural Press* keeps its readers well-informed of the active entomological work being prosecuted in California, in the struggle for the preservation of the fruits of the State from the onslaught of, thus far, an invincible army of scale-insects.

The *New England Homestead*, of Springfield, Mass., encourages the observation of insect habits and injury, in the publication of much valuable information in this direction.

The *Country Gentleman*, of Albany, N. Y., receives many inquiries of insect attacks, which are answered, often at considerable length, by the State Entomologist of New York.

INTERESTING ENTOMOLOGICAL STUDIES, ABROAD.

In addition to the preceding notice of the publications of our entomologists, may I be permitted to refer to some studies of particular interest which have been given us during the year, outside of our country, to which general attention may not have been drawn.

Recent studies of Forel, Kraepelin, Hauser, and others, had placed almost beyond question, the location of the sense of smell in insects, in the antennæ. Later, the study has again been taken up by Prof. V. Graber, of the University of Czernowitz, Austria, with results that serve to reopen the question, and invite to further investigation.

In a late number of the Comptes-Rendus of the Société Entomologique de Belgique, his conclusions are summed up as follows:

1. The perception of odors is not confined to the antennæ, for ants and *Lucilia Cœsar*, deprived of their antennæ, retained the perception.

2. The antennæ are perhaps more sensitive to odors than other parts of the body. *Silpha thoracica* deprived of its antennæ, was affected by some odors but not by other weaker ones.

3. The palpi may be more sensitive to odors than the antennæ, as would appear from some experiments made with *Gryllotalpa vulgaris*.

4. In a large series of experiments with a *Lucanus* which followed the odorous material employed, sometimes the palpi and sometimes the antennæ, were the more rapidly excited.

5. The perception of odors may also lie in the anal stylets, as shown in a decapitated *Periplanata*. (This idea had been previously advanced by Dr. Packard, Amer. Nat., iv, 1870, p. 620.)

6. Insects have no special organ of smell.

The studies of Exner, communicated to the Vienna Academy in 1875, led to the rejection of the mosaic theory of vision in insects as necessarily attendant upon their compound eyes, and to its replacement by the theoretical deduction that they do not distinguish the form of objects, but that their vision consists mainly in the perception of movements and of colors. Their faceted eyes are not complete visual organs, but simple organs of orientation.

In a subsequent communication by Plateau, to the Royal Academy of Belgium, he has presented the following conclusions drawn from studies of Diptera, Hymenoptera, Lepidoptera, Odonata, and Coleoptera.

In diurnal insects with compound eyes, the simple eyes offer so little utility that it is right to consider them as rudimentary organs.

Insects with compound eyes do not notice differences of form existing between two light-orifices, and are deceived by an excess of luminous intensity as well as by the apparent excess of surface. In short, they do not distinguish the form of objects, or if they do, they distinguish them very badly (American Naturalist, xx, p. 69).

The structure of the halteres of Diptera has been studied by Mr. A. B. Lee, who finds them to embrace two distinct organs, one an auditory organ, and the other of problematical function, which may be olfactory (Entomologische Nachrichten, for August. 1885).

Sir John Lubbock records as an instance of remarkable longevity in ants, that two queens of *Formica fusca* had been kept alive by him within their nests for twelve years (Contemporary Review, for November, 1885).

The Insect Fauna of the United States.

Returning to our country, unmistakable evidence of rapid progress in our science is to be found in the explorations by private individuals, institutions, and government surveys, of almost every portion of our country for unknown species and the prompt study of the material obtained, by competent specialists.

Our lists of species are rapidly augmenting.

In a paper recently read by me, not yet published, on the *Present State of Entomological Science in the United States*,[*] I had occasion to state the number (as near as could be conveniently ascertained) of the described species of North American insects, North of Mexico. As the paper contained some estimates specially made for it, it may be of interest to present the table at the present time.

Hymenoptera (Cresson's estimate):		
Phytophaga	573	
Entomophaga	2,166	
Prædores	1,078	
Anthophila	633	
		4,450
Lepidoptera: Butterflies (Edwards List, 1884)		614
Moths (Grote Check-List, 1882)		3,184
Tineidæ, not included by Grote, (Chambers List, 1878)		779
Diptera (Osten Sacken estimate, in 1878)		2,500
Coleoptera (Henshaw List, 1885)		9,507
Hemiptera-Homoptera (Uhler estimate, 1886)		1,200
Heteroptera (Uhler Check-List, 1886)		1,448
Orthoptera (Scudder estimate, 1886)		450
Neuroptera, not estimated — perhaps		1,000
Giving a total of		25,132

Limited Knowledge of the Early Stages of Insects.

Upon former occasions when it has been my privilege to address this Club officially, I have urged the importance of the study of the earlier stages of our insects upon its members and upon all students in entomology. I beg leave to repeat the recommendation, in view of the value of such study in a scientific classification, and the necessity of it in economic investigation, for of but comparatively a small number of our insects are the earlier stages known, and of only a few do we possess full life-histories.

Although the Coleoptera have been the most thoroughly worked of any of the orders, yet it will surprise some of you to learn, as it did me, when I recently received the information from an eminent Coleopterist, of how small a proportion are the earlier stages known.

By permission of the writer, Mr. E. A. Schwarz, I give the communication addressed to me in reply to an inquiry made, in which the information above referred to is embodied. It is of so much interest and value, that it deserves publication:

"I have endeavored to keep track of the descriptions of Coleopterous larvæ from all countries. I herewith select at random a few of the larger families, and do not believe that the proportion of the known larvæ to the total number of species would be materially changed if I would go through all families. For the *Chrysomelidæ*, unfortunately, I can not get at the figures without much trouble.

[* Since published; see pages 283–292 of this Report.]

"In *Carabidæ*, including the *Cicindelidæ*, there are described, in round numbers, the larvæ of 120 species representing forty genera, out of a total of 9,300 species.

"In *Dytiscidæ*, there are described 22 species representing 13 genera, out of a total of 950 species and 35 genera.

"In *Hydrophilidæ*, there are described 30 species representing 14 genera, out of a total of 570 species and 30 genera.

"In *Staphylinidæ* are described 75 species with 37 genera, out of a total of 4,130 species and 270 genera.

"In *Silphidæ* are described 25 species with 9 genera, out of 460 species.

"In *Scarabæidæ* are described 85 species in 40 genera, out of 6,550 species.

"In *Buprestidæ* are described 70 species in 20 genera, out of about 2,700 species.

"In *Elateridæ*, about 60 larvæ described out of a total of 3,100 species.

"In *Curculionidæ*, about 260 larvæ described in 65 genera, out of a total of 10,150 species.

"In *Cerambycidæ*, about 150 species of larvæ described in about 70 genera, out of a total of 7,600 species.

"A summing up of the above shows that there are about 900 species of larvæ described out of a total of 45,600 species, giving a proportion of 1 to 50. Since the publication of the Munich Catalogue, the description of new species has gone on with unabated activity, while, at the same time comparatively very few larvæ have been made known. Thus the proportion will be now somewhat below *two per cent.* This refers to the whole world. For the European fauna alone, the proportion is of course considerably higher, while for the North American fauna, the proportion is but little above the average, and hardly reaches 1 to 40, even including all of the unpublished larvæ which are in our collections. Of the 83 families of the North American Coleoptera, the larvæ of no less than 20 families are entirely unknown."

The Bureau of Entomology at Washington.

In consideration of the contributions made toward the advancement of entomological science through the investigations and publications of the Division of Entomology of the U. S. Department of Agriculture, it must be a source of gratification to us all, that at no time since the establishment of the bureau, has it been in position to render more efficient service than at the present. The recognition of its value and importance has drawn to it the aid and the support that it needs for its successful operations. It is much to be regretted that just at this time, its activity should be somewhat impaired, by the ill health of its Chief Officer, compelling a temporary respite from official duties. I know that you will unite with me in the earnest desire that the restoration of health which he is seeking in rest abroad, may be speedy and complete.

Valuable aid to economic entomology may be confidently expected from the "Division of Economic Ornithology and Mammalogy," recently established in Washington, under charge of Dr. C. Hart Merriam, in the investigations that are being conducted by it in the food-habits of our insectivorous birds.

Insects of the National Museum, etc.

The appointment of one of the active members and an officer of our own club, to the assistant curatorship of the Department of Entomology of the National Museum, under provisions that will permit of the proper care and increase of the collections, is a gratifying event of the past year. This Department now contains the Riley collection recently donated to it of 15,000 species and 115,000 specimens; the collection of the Department of Agriculture of 50,000 specimens, and probably 5,000 species not in the Riley collection; the collection of the National Museum proper, estimated at 20,000 specimens, and 2,000 species not in the other collections; and the New Orleans Exposition exhibited collection of economic entomology, of which a catalogue has been printed and distributed. The aggregate may be given as 200,000 mounted specimens, and 26,000 distinct species. (*Science*, November 20, 1885, vi, p. 445.)

The admirably prepared collection of Lepidoptera of Mr. Otto Meske, of Albany, N. Y., embracing a fine exhibit of the New York fauna, rare material from Texas and other

Western States, together with an excellent representation of the European fauna, received through the exchanges conducted for many years with Dr. A. Speyer, of Austria, has recently been purchased by the National Museum, and is now in its possession.

The collection of Insects of the Peabody Academy of Science, at Salem, has been deposited in the Museum of Comparative Zoölogy at Cambridge. It had mainly been brought together by Dr. A. S. Packard, and contained a large proportion of his types, including all those (except four belonging to other entomologists) of his Monograph of Geometrid Moths. It also contained types of other eminent entomologists.

I feel that an apology is due for the length of my paper. Its excuse must be found in the activity that has characterized entomological study for the past year. Even in the time that I have occupied, I have only been able to refer to some of the work done, while omitting much that is equally — perhaps more — worthy of notice.

[From the Report of the American Pomological Society, for 1887.]

SOME PESTS OF THE POMOLOGIST.

(Read before the American Pomological Society, at its Boston meeting, September 15, 1887.)

The large attendance at this convention, the several States of the Union represented, the distinguished men participating in it, the high order of the discussions and papers that have been presented, the exhibit of fruit that is made — all bear testimony to the widespread interest of the present day in fruit-culture and the great advance that has been attained therein.

Progress in Pomology.

It is not my province to do more than mention the progress made in fruit-culture within a few years past. This privilege belongs to those who have been active participants and agents in its stimulation and remarkable growth. We can not but recognize its results in the many fruits it has given us previously unknown in our markets — varieties far surpassing those which we formerly enjoyed, and an abundance such as we had never dreamed of, brought within reach of all.

Evils Attending Progress in Pomology.

Yet this has not been attained without attendant evils. Here, as elsewhere, in all that pertains to the advancement of our race — at every step of progress, a penalty has been incurred and exacted. It is patent to all that the development of Pomology into a science and an important industry of our country, has only been accomplished through a great increase of plant diseases and a remarkable multiplication of insect pests. These two evils follow as a necessary consequence of the advance made: They are connected therewith as inseparably as cause and effect. And what part they are to play in the future in retarding, arresting or ruining fruit-culture, must depend upon the manner in which they are met by the enlightened fruit-grower.

Need of Scientific Study.

You do well, gentlemen, in calling to your aid whatever science is able to do for you in the investigation of the serious evils to which I have referred. It is of the utmost importance that you should know each one of your enemies, whether it be a soil constituent, a vegetable, or an animal — its character or nature, whence it proceeds, how it acts, and above all, the most economical and efficient means for overcoming it. You particularly need the best skill of the chemist, of the botanist, the mycologist, and the entomologist. Their services are freely at your command, whether asked for of our Scientific Schools, Agricultural Colleges, State Experiment Stations, the United States Department of Agriculture at Washington, or of our State Entomologists.

Demands of Science on the Pomologist.

But let me remind you that you too have an important part to perform in this needed observation, study and investigation of plant diseases and insect injuries. You are brought face to face with them, day after day, more intimately, more continuously, and I may add, more advantageously than is possible for the scientist to be. Your trained eyes are quick to detect the first indication of disease or injury; and you should be able to discern its nature, to the extent, at least, that you may promptly summon to your aid, if aid be needed, that particular scientific investigation which the occasion demands. And what a broad field of coöperation with the specialist is open, if, when through the aid extended, you have been led in the proper direction, you not only faithfully follow the course marked out for your guidance, but also test the value of experiments that will naturally be suggested by the failure or partial success that meets your efforts.

The sciences that are lending you their cordial coöperation have a claim upon you — yes, have a right to demand this at your hands. Upon you is chargeable the curse that surely is hanging over, if not already fallen upon, fruit-culture in our country—"in the sweat of thy face shalt thou eat" fruit! I do not overstate when I say, that the great increase of plant diseases and insect ravages that you are experiencing is the direct result of the enormously increased production of fruit, and the large area in which fruit crops are massed.

Immense Fruit Production — No Over Production.

Compare the production of fruit to-day with what it was in the childhood of any here present, both in variety and quantity. To go back farther than many of you are able — in my childhood, an orange was a rarity; a peach was seen at intervals of years. I only knew one variety of cherry; our apples did not exceed a score, and pears a half score. Now, freight trains of fruits of almost countless varieties are rolling over our country, carrying the delicious and healthful products to central marts, whence they may be distributed to every home in our land, and even find their way beyond the oceans that bound our continent. No wonder, it may be remarked in passing, that under such production, prices may, at times, become very low, and the cry is heard, "raising fruit does not pay!" A prominent member of one of our horticultural societies recently made this remark in a public address: "There is such an over-production of these fruits (referring to a certain class) that they will no longer pay, unless some insect pests will come and relieve us of half the crop." What a ridiculous, pitiable, senseless statement to make! Markets that will yield remunerative prices are, and will continue, to be found to enterprising, energetic, sagacious business men. If not already existing, they may be built up, and the demand will surely follow. There can be no over-production, for the retarding houses, canneries and evaporators, springing up in all our fruit regions, will keep pace with production. The desire for, the need of, wholesome fruit will ever be in excess of its growth. As its price falls—to quote the words of a fruit dealer in Philadelphia, who last September received and sold in three days 665,000 pounds of grapes—"everybody wants it." Should an unusually favorable season give a yield beyond the possibility of gathering, transportation, or preservation, why not try the experiment of giving the freedom of your orchards to "the poor whom ye have always with you," and see if it is not almost as good to give as to receive.

It does not appear to be known what the aggregate value of the fruit crop in the United States amounts to, but surely that must be a safe estimate that places it at between two hundred and three hundred millions of dollars annually.

Large Areas Devoted to Fruit Crops.

This enormous production which is but the natural outgrowth of the discovery of the peculiar adaptation of the soil and climate of many portions of our country to fruit-culture, has compelled its cultivation in larger areas than anywhere else in the world. An apple orchard on the Hudson river, at Greenport, N. Y., covers 300 acres. At Orchard Hill, in Georgia, is a peach orchard of 790 acres, and 84,000 bearing trees. The vineyard of Leland Stanford, at Vina, California, has 4,000 acres in vines in a tract of six miles long by two wide.

How does this massing of crops tend to promote an increase of insect ravages? Let me illustrate it by what I have elsewhere written of our apple insects:

"Two hundred years ago not even the wild crab, the earliest representative of the apple existed in this country, and consequently there were no apple insects. Later, when a few apple trees became the adjunct of the simple homes of the early settlers, those of our insects to which they offered more desirable food than that on which they had previously subsisted, were obliged to wing their way often for many miles in search of a tree upon which to deposit their eggs. If birds were then abundant, how few of the insects could safely accomplish such extended flights. But in the apple orchards of the present day—some of them spreading in an almost unbroken mass of foliage over hundreds of acres—our numerous apple insects may find the thrifty root, the vigorous trunk, the succulent twig, the tender bud, the juicy leaf, the fragrant blossom, and the crisp or mellow fruit spread out before them in broad array, as if it were a special offering to insect voracity, or a banquet purposely extending an irresistible invitation to the tent-caterpillar, the codling-moth, the canker-worm, the striped-borer, the bark-beetle, the twig-borer, the leaf-aphis, the bark-louse, the root-louse, and every other of our two hundred species of apple insects. Here they may luxuriate as nowhere else. The required food is greatly in excess of insect need. Careful cultivation has made it the best of its kind; appetite is stimulated; development is hastened; broods are increased in number; individuals are multiplied beyond the conservation of parasitic destruction; facilities of distribution are afforded with hardly a proper exercise of locomotive organs, and when these almost useless members have become aborted, as in the wingless females of the bark-louse (*Mytilaspis pomicorticis*) and the canker-worms (*Anisopteryx vernata* and *A. pometaria*), the interlocking branches afford convenient passage from tree to tree."

Increase in Plant Diseases.

The same causes, viz., high culture, enormous production, and massing in large areas, inevitably promote plant diseases. Let me, in passing, simply name a few of these, since they are so intimately connected with insect attack, being often its precursor or its sequence—and then leave them to be discussed by those to whom their study properly belongs.

Of the more than two hundred species of fungi known to infest the grapevine, special attention has been called within the last few years, to the following, from the serious losses that they have occasioned: The Downy mildew (*Peronospora viticola*); the Powdery mildew (*Uncinula spiralis*); the black-rot (*Physalospora Bidwellii*); Anthracnose (*Sphaceloma ampelinum*), a comparatively new grape disease in this country, but one long known in Europe, which attacks the vine, the leaf and the fruit.

Of other well-known and destructive diseases, are the peach yellows (no satisfactory cause or cure for which has yet been discovered); the peach-leaf curl (*Exoascus deformans*); the plum-rot (*Monilia fructigena*); the black-knot (*Plowrightia morbosa*) of the plum and cherry; the plum-leaf fungus (*Septoria cerasina*), affecting also the cherry and the apricot, and peach slightly, causing often one-half of the leaf to die and fall away in rounded holes, as in examples recently received by me from an orchard in Canada; the apple rust (*Rœstelia penicillata*); the apple and pear scab (*Fusicladium dendriticum* and *F. pyrinum*); the pear-blight, so extensively written of and but lately shown to be caused by the bacteria which has been named *Micrococcus amylovorus*, also infesting the apple and several other fruits; the tomato-rot in green fruit (probably *Cladosporium fulvum*); the gooseberry blight; the raspberry rust (*Cœoma nitens*); and the spot disease or leaf-blight of the strawberry (*Ramularia Tulasnei*). The causes and cures of these and of many others associated with them, are deserving, from their great economic importance, of all the study that is being given to them. Valuable results are expected from the establishment about a year ago of a mycological section in the Department of Agriculture at Washington, specially charged with the study of the fungus diseases of plants; and it was very fitting that this section should have received the cordial indorsement of your society so promptly given it.

New diseases are being discovered from time to time. A very remarkable one has lately been reported to the State Horticultural Society of California. The writer names it, "Paralysis of Apricot Trees." It had been observed by him in three different cases in three years, in apricot and apple trees that had been grafted on other stock. They were of exuberant growth, in healthy foliage and were bearing, abundantly, normally developed fruit. It is described as follows:

"In the morning the trees appeared to be in full health; shortly after 10 o'clock the leaves suddenly became weak and every leaf, without exception, hung lifeless on the tree. In the afternoon the fruit and bark began to shrink, and in forty-eight hours all the leaves and young shoots were entirely withered and the fruit shrunken and nearly dried up. Two trees were tested with the knife, and it was found that the paralysis and death had taken place from the grafting-point upward."

Increase of Insect Ravages.

Passing now to insect pests — it is surely evident to every fruit grower that, with each successive year, the difficulty of growing choice and perfect fruit is becoming greater. He can no longer ignore the insect as an insignificant object in nature, almost unworthy of regard. The myriad hosts confront him on every side and demand his attention. They claim the choicest products of his labor — not a tithe of them, which might, perhaps, be granted, but the entirety. It is a struggle for mastery, in which he must conquer the insect, or the insect will conquer him.

The primary causes that have necessitated this warfare have been given you in general terms, but the consequences of these might not extend much beyond a multiplication of the individuals of a species. But beyond this, another serious element is forced upon us, viz., a continual increase in the number of species preying upon fruits.

Food-habits of Insects.

You all know that our noxious insects are divisible into many groups, indicated by the food-plants upon which they subsist. Thus we have our grass insects, our grain insects, insects infesting our forest trees, those infesting our flowering plants, those attacking garden vegetables, a long list of household pests, those that live upon our domestic animals, etc., etc. Insects are more or less particular in their food. There are those that confine themselves to a certain species of plant and will starve rather than change to another. Very many will feed upon allied plants as associated by structure and character in a genus or a family; while others, polyphagous species, as they are termed, extend their range through different and often dissimilar orders of the vegetable world.

Change of Food-plants.

Thus it is that the fruit grower not unfrequently has to contend with some insect depredator quite new to him and to his locality. He submits it, as he should, to some authority in entomology, and it is found to be a species previously known as subsisting on some other food-plant. Chance, it may be, has brought it to an apple tree, and it at once finds in its material, food more agreeable and attractive to it than that on which it had hitherto fed. It becomes an apple tree insect, and displays under the stimulating effect of its changed diet, far more destructive habits than those that before pertained to it. To illustrate: A little bark-boring beetle (*Scolytus rugulosus*), which for several years had been known to us only as destroying cherry, peach, and plum trees, has been discovered by me the present year as working in large numbers beneath the bark of apple trees and quickly killing them by running its galleries over and around the trunk until it is completely girdled.

Introduction from Abroad.

Again, the new pest proves to be an introduced species, brought over from Europe through some commercial avenue, readily planting itself in its new home, and spreading from thence over the country as broadly as the area of its food-plant or suitable climatal conditions will permit. And almost without exception, a species thus introduced from abroad, unattended by its natural parasites and freed from other enemies that had learned to prey upon and control it, is at once transformed into a pest of such magnitude, that its harmlessness in the old world is in marked contrast with its ravages in the new.

SPREAD OF SCALE INSECTS.

In illustration of the evils often attendant upon a change of food-plants and extention of range, and also the increased destructiveness of introduced species, we may refer to the struggle which the fruit growers of California are at the present time undergoing with insect pests, and notably with scale-insects, which have followed the recent extended culture of the citrus fruits, particularly the orange, in that State.

Attack by the members of this family, known as the *Coccidæ*, is always dreaded, as they multiply with amazing rapidity, and are protected during nearly all of their life by a shield-like covering which is impervious to such applications as ordinarily suffice to destroy more exposed forms. They are not even amenable to the poison of arsenical preparations, which are our best insecticides wherever they may be safely employed, as they find their food in the juices of plants, extracted by means of a needle-like proboscis driven through the bark, or epidermis of the leaf.

The scale-insect, which is especially enlisting wide-spread attention in California, receiving the most careful study, and, from the difficulty of its control, exciting great alarm, is known as "the fluted scale," or "the cottony-cushion scale," from the peculiar and conspicuous cotton-like mass attached to it and sheltering its eggs. Scientifically it is known as *Icerya Purchasi* Maskell. Australia, South Africa, New Zealand and California are its only localities, so far as known to us. Its original food-plant is believed to have been an Acacia—thorny trees or shrubs belonging to the *Leguminosæ*, of which we have no native species north of Texas. On an Acacia imported from Australia it was in all probability introduced into California in 1868 or 1869. From this plant it spread to various orchard and ornamental trees, garden plants, weeds, etc. A few of these may be enumerated as showing the possible range of some of these pernicious scales: Orange, lemon, quince, pomegranate, apple, pear, peach, apricot, fig, strawberry, grape, hawthorn, walnut, oak, pine, cypress, laurel, locust, elm, willow, ivy, rose, verbena, and box. According to a writer in New Zealand, "it attacks all sorts of plants." It is proving particularly destructive to the orange, entire plantations of which have been completely destroyed. Not yet overspreading the entire State, the most earnest efforts are being made to arrest its distribution. Laws have been enacted, under which fruit inspectors have been appointed, whose duty it is to enforce the laws, and even to search out the infested trees and compel their destruction.

The interest taken in this crusade against insect pests in California, and the desire to conduct it in the most efficient manner, is shown in the following extract from an address recently made by the Secretary of the California Horticultural Society:

"Every effort is being made by horticulturists to resist the spread of fruit-pests. Every method suggested by reliable scientists and fruitmen is being thoroughly tested. Usually not much urging is required to induce the owners of pest-ridden orchards to try the latest discoveries, as they are only too willing to attempt the eradication of their insect enemies. In this way many new applications are being discovered. If we can succeed in checking the ravages of the pests, this State is bound to become the orchard of the world." (*Pacific Rural Press*, August 20, 1887, p. 145.)

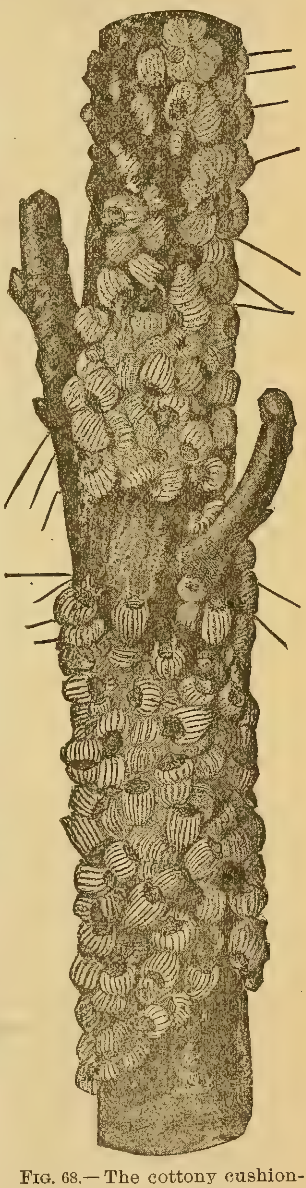

FIG. 68.—The cottony cushion-scale, ICERYA PURCHASI, on orange.

It is devoutly to be hoped that the "Australian bug," as it is sometimes called, together with the Red Scale (*Aspidiotus aurantii*) also introduced from Australia, and others of its associates, may not become distributed over the United States, to add to the already almost overwhelming number of our fruit insects.

There is little danger of the introduction this side of the Rocky mountains of the larger number of the California scale-insects, through the fruit which is being brought eastward, for nearly all of them are fixed to the plant upon which they subsist during their entire life except a brief period following their hatching from the egg. The Icerya, or Fluted Scale, unfortunately possesses habits more favorable to its spread, for it remains free and travels about during the greater part of its existence. In its last stage — according to Professor Riley, to whom we are indebted for the elaborate study of this insect as given in his last annual report,* — and just before the production of its eggs, it shows a disposition to travel in search of some place of concealment, as beneath rough bark. Under this impulse, it might leave the tree and find a convenient hiding-place in some fruit package, and there be conveyed by rail to a distant locality. The common mode of distribution of scale-insects is through the sale of scions and nursery stock. I do not know if these are being brought from California eastward. If such a business has been inaugurated (of which there would seem to be no need), every effort should be made to suppress it, as it would not be possible to institute such a system of inspection for the detection and destruction of infested stock, as has been adopted by several of the countries of Europe to protect them from the introduction of the terrible Phylloxera pest.

I have dwelt at some length on these scale-insects, in consideration of their extreme virulence and the harm that will attend their spread. When they have been allowed to gain the footing that they now have in California, it is not possible to exterminate them. The most that can then be accomplished is to reduce their numbers, and to exclude them from localities now free from their presence. I believe that the Icerya has not yet shown itself in the orange groves of Florida. Whenever it shall do so, unless it be met as promptly as we are accustomed to deal with a rabid animal, it is safe to predict that the orange culture of that State is doomed. Arizona is just giving promise of becoming a wonderful fruit region. As yet, it is almost free from fruit pests. Peaches, it is claimed, can there be eaten from the tree from June to December. If so, with proper railroad facilities, we in our Eastern cities could enjoy the delicious fruit during one-half of the year. How desirable it is that such prospects should not be blighted by permitting an influx into Arizona of the scale and other pests which it is possible to exclude, for years, at least.

Number of Insect Pests.

I have referred to the large number of our fruit-pests, in species, of perhaps equal importance with the number of individuals, since each one of the species requires separate study that its particular life-history and habits may be learned, and thereby a knowledge obtained of the best method of dealing with it. If a noxious form, then the most efficient means for its destruction is to be sought; if beneficial, in the great service that it renders in preying upon injurious species, as are entire families, as those of the Ichneumons, Lady-birds, and others — in that case study must be made of how it may best be protected, and its multiplication promoted.

Of the 325,000 species of insects known to science through name and description, as existing in the world, 25,000 belong to the United States. Of these 15,000, at least, would be regarded as injurious, from preying upon material serviceable to man. The amount of harm inflicted by many of these is inconsiderable; and probably not exceeding one-half of the number, or from 7,000 to 8,000 may justly be regarded as insect pests.

The number of fruit insects can not be definitely stated. Four years ago I published a list of 176 species of insects depredating on the apple. Since then I have enlarged the

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* *Report of the Commissioner of Agriculture* for 1886, pp. 465–492, plates i–v. See, also: Icerya or Fluted Scale *Bulletin* 15, *U. S. Dept. Agricul.*, *Division of Entomology*, 1887, pp. 40.

list one-fifth, making it to contain at present, 210 species. Doubtless a thorough examination of published and manuscript records of food-plants, and direct observations in the orchard, would extend the number to nearly if not quite 300. With this as a basis, we may safely conclude that the number of fruit insects in the United States is at least 1,000. And every year is adding to the number. Several new ones have come under my observation the present year.

An Unknown Currant Insect.

To one of these new fruit pests, of more than ordinary interest to me, I will ask your attention, in the hope that if its operations are widespread, the unknown insect inflicting the injury may be discovered while engaged in its oviposition, by some one of you, as otherwise its identification may elude us for years.

During the latter part of May and early in June the tips of the new and more vigorous shoots of both the black and the red currant were observed, in gardens at Albany and vicinity, to be girdled, drop over, wither and finally to break off and fall to the ground. The girdling is done by five or six sharp, deep and rather long incisions in the same plane, nearly surrounding and severing the stalk, and seeming as if made by strong mandibles. It is entirely different from the two circles of punctures made by the well-known raspberry-cane girdler, *Oberea bimaculata* Oliv., and moreover, the oviposition is within the tip that falls to the ground — not in the standing cane. It would, therefore, be difficult to rear the insect from the egg, deprived, as it would be, in confinement, of its natural conditions. The girdling is probably done during the night.

How Insect Ravages are to be Met.

And now, to proceed to the more practical part of my paper: What must the nurseryman and the fruit grower do, that they may effectually meet these annually increasing insect ravages. The plant diseases of rust, smut, blight, mildew, etc., to which I have referred, belong to, and are left for, others to discuss.

I need not urge upon the members of this Society the importance of their recognition of the amount of harm to which they are exposed from insect injury. Individual experience has taught the absolute necessity of such recognition. Certain it is that he who will hereafter achieve the best success in the growth of fruit or fruit trees, will be he who has best informed himself of insects and how to deal with them. In the hands of such, the business will continue to be profitable, while the thriftless, careless, and ignorant will have to seek other occupation, more congenial to his quiet tastes and easy-going nature.

While the fruit grower has not the opportunity for becoming a technical entomologist, he may at least acquire such a general knowledge of the elements and applications of economic entomology as are taught and explained in scores of publications issued gratuitously during the last few years by several of the States and the General Government, for the sole and only purpose of diffusing, broadcast, knowledge so important to individual and national prosperity.

May I venture to offer what seems to me, from my stand-point, some reasonable requisites of the successful fruit grower of the future?

1. He should be acquainted with all of the more common insects that occur, or are liable to occur in his vicinity — their names (not necessarily their scientific ones), the nature of their injuries (if injurious), their more important habits, and be able to identify them in their different stages.

2. He should be so familiar with his ordinary visitants that he would detect the advent of an unusual or new form, so that it could be promptly submitted for such study as it might need.

3. He should be able to distinguish between his insect friends and foes, that he might not unwittingly destroy the former, or employ such remedies against the latter as to involve both classes in a common destruction, accomplishing thereby more harm than good.

4. He should be able to refer them to the Orders to which they belong in classification, that he might speak or write of them understandingly and properly — not grouping all under the name of "bugs." The commonly accepted Orders are but seven and may be easily learned. They are these:

1. Hymenoptera — Bees, wasps, hornets, ants, saw-flies, etc.
2. Lepidoptera — Butterflies and moths.
3. Diptera — Flies, mosquitoes, gnats, etc.
4. Coleoptera — Beetles.
5. Hemiptera — Plant-lice, scale-insects, tree-hoppers, etc.
6. Orthoptera — Crickets, grasshoppers, etc.
7. Neuroptera — Dragon-flies, May-flies, caddis-worms, etc.

5. He should know the manner of insect feeding, so as to be able to employ the proper class of insecticides.

6. He should be informed of the method of preparation and of application of the best insecticides.

7. He should experiment with such remedies and preventives as his own observation and experience may suggest.

8. He should avail himself of the publications in economic entomology relating to fruit pests. These have become numerous and can not fail of proving of great service.

The first three of what I have named as requisites of the successful fruit grower, viz.: Names of insects, recognition of new forms and discrimination between foes and friends — may be largely met by the use, in connection with observation of the living insects, of the volume entitled, "Insects Injurious to Fruits," by William Saunders. It is an exceedingly valuable compilation of most that is desirable to be known, for practical uses, of our fruit insects, and has been prepared by a gentleman, whose long experience as a fruit culturist, together with a high reputation as an entomologist, had in every way fitted him for the work which has been so successfully accomplished. The volume — an octavo of over 400 pages, with illustrations on almost every page — is published by the well-known publishing house of J. B. Lippincott, Philadelphia, of whom it may be ordered.

For the fourth requisite — for some knowledge of the orders in which insects are grouped, and in addition, a comprehensive idea of the families in which the orders are divided, I would recommend the purchase of Dr. Packard's "Guide to the Study of Insects." It is a large octavo of over 700 pages, abounding in illustrations; and is well adapted to the wants of those who desire some accurate and general knowledge of the insect world. The eighth edition was published in 1883, by H. Holt & Co., 29 W. Twenty-third street, New York city; price, five dollars.

For the fifth requisite — a knowledge of the manner of feeding, it is necessary, in the employment of remedies, to be able to distinguish between biting insects, the Mandibulata, which are provided with mandibles or jaws, and sucking insects, and the Suctoria, furnished with a proboscis for extracting the sap of plants. The former are killed by the application of poisonous substances to the surface of the leaves or other parts of the plants on which they feed, while the latter, living only on the interior juices, are entirely unaffected by such applications. Of this last class, are all of the plant-lice, or Aphides, the scale-insects, bugs proper, and, in short, all comprising the extensive order of Hemiptera. Against these the strongest arsenical preparations are of no avail, but they are vulnerable to applications that will affect them through their breathing pores, as, for example, kerosene, which closes these pores and produces suffocation.

INSECTICIDES.

The sixth requisite named, is a knowledge of insecticides, and of the means for applying them.

Not many years ago the only known methods of combating insect pests were hand-picking, beating from shrubs or jarring from trees on sheets spread underneath, attracting to lights or fires, and taking up and burning the infested plants. As insects multiplied and more ample means for their control were required, insecticides, so-called, were discovered. Twenty years ago, when a beetle, whose home was in the Rocky mountains, had, at the approach of civilization, abandoned its wild Solanum food-plant for the more nutritious cultivated one, and was rolling eastward over the Western States as steadily and irresistibly as a tidal wave, the timely discovery by a citizen of Illinois that Paris green was an effectual remedy for it, at once brought under control the ravages of the devouring pest, and made the continued cultivation of the potato a possibility. Ten years thereafter, London purple, a residuum in the manufacture of analine dyes, was found to be almost equally efficacious against the Colorado beetle, and, as the fruit of experiments since conducted, we have now in these two arsenical compounds, insecticides effective against nearly all of the mandibulate insects which feed exposed on such vegetable substances as we or our domestic animals do not require for food.

The need of reaching the large order of suctorial insects which are not affected by the arsenites, led to the discovery of kerosene as a destroyer of insect life. It was found to be fatal to every insect to which it could be applied. As in its undiluted state it is also fatal to vegetation, means were sought, and were speedily found, for reducing it to any desired degree. Often as the methods of preparation of what are known as "kerosene emulsions" have been published in our agricultural and horticultural journals, it may be of service to you to give the most approved method, in a single short sentence:

The best emulsion for general use is produced by violently agitating through the rose of a force-pump until emulsified in a homogeneous mass, two gallons of kerosene to one gallon of a hot soap solution, made by dissolving a half-pound of common soap in a gallon of water.

The ordinary dilution of the above emulsion for use, is with nine gallons of cold water.

Of the various other insecticides with which the fruit grower will find it to his advantage to be familiar, as hellebore, pyrethrum, carbolic acid, coal-tar, tobacco, etc., I will not speak, but will refer you to publications in which they are fully discussed, and which constitute a part of that literature of economic entomology which should find place in the library of each one of you.

Publications Relating to Fruit Insects.

The advance made in our knowledge of dealing with insect pests, is largely due to the investigations and discoveries of the Entomological Division of the Department of Agriculture, at Washington, of which Professor Riley is chief. The publications of this division present full reports of experiments in testing almost every material that has from time to time been recommended as an insecticide, even to ice water and buckwheat flour; descriptions of various devices, implements, and machines for applying insecticides; descriptions, figures, and life-histories of our most formidable pests, with the best remedies or preventives against them, and much other valuable matter on entomological subjects.

Of these publications — of primary value are the *Annual Reports of the Entomologist* (by Professors Riley and Comstock), of the series commencing with the establishment of the Division in 1878. In addition to a limited number of these reports issued as separates, they are included in the *Annual Report of the Commissioner of Agriculture;* and as the immense edition of four hundred thousand copies of this report is printed by Congress each year, certainly every one desirous of obtaining a copy should have no difficulty in procuring it through application to his representative in Congress or to the Commissioner of Agriculture. The same volume will also contain hereafter the annual report of the Pomologist, the Mycologist, and the Botanist, of the Department.

The Entomological Division has also issued, from time to time, *Bulletins*, containing observations and experiments in its practical work, and studies and reports on special insects of exceptional importance. Bulletin No. 1 was published in 1883; No. 15, the last, in August of the present year. Application for these should be made to the Department of Agriculture.

The four *Reports of the United States Entomological Commission*, containing, in the aggregate, over 3,000 octavo pages and 150 plates and numerous figures, are mainly devoted to consideration of the Rocky Mountain locust and the Cotton-worm, while space is given (in vol. 3) to the Canker-worm — a notorious apple tree pest in some localities. In the fourth Report of the Commission, published by the Department of Agriculture (volumes 1 and 2 are from the Department of the Interior), no less than sixty-four pages are devoted to the interesting subject of insecticides, and 132 pages to machines and devices for their application to various crops under different conditions.

Of the *Bulletins* that have been issued by the Entomological Commission, No. 7, entitled *Insects Injurious to Forest and Shade Trees* (published by the Department of the Interior, in 275 pages), contains descriptions and figures of quite a number of pests which also extend their ravages to fruit trees, and would therefore be of value to the fruit grower. An enlarged and revised edition of this valuable volume is being prepared, and may be expected to appear during the coming year. As indicating the advance made in this promised revision, and also, in our general knowledge of insects, since the issue of the first edition in 1881, I will state, that while in that edition, 214 oak insects are enumerated, its author, Dr. Packard, informed me some months ago, that his manuscript then contained 425 determined species living on oak, and about 100 undetermined.

Of the valuable series of Reports of Dr. Asa Fitch, on the *Noxious and Other Insects of the State of New York*, published in the Transactions of the New York State Agricultural Society for the years 1854-1870, the first three are mainly devoted to fruit insects. Reports one and two, forming a bound volume, may be procured of the secretary of the State Agricultural Society, at Albany; report three is out of print. For information relating to the other eleven, my first report on the *Injurious and Other Insects of the State of New York*, pp. 294-296, may be consulted.

The nine *Reports on the Insects of Missouri*, by Prof. C. V. Riley, replete as they are with admirable life-histories and illustrations of notable excellence, are desirable to all who have occasion to study insect lives and insect habits; as are also the fourteen *Reports on the Insects of Illinois*, by the State Entomologists, Walsh, Le Baron, Thomas, and Forbes. It is hardly possible to obtain full series of these, but inquiries in relation to them may be addressed to Prof. Riley, at Washington, and to Prof. S. A. Forbes, State Entomologist of Illinois, at Champaign, Ill.

The American Entomologist — three volumes, of from 250 to 350 pages each, contains much material of pomological importance. The first volume is difficult to obtain, and consequently commands a high price (seven dollars) when offered for sale. Inquiries for these may be made of Prof. Riley.

A Monthly Bulletin, under the name of the *Practical Entomologist*, forming two volumes — pages 128 and 122 — was published in 1865-1867 by the American Entomological Society "for the dissemination of valuable knowledge among agriculturists and horticulturists." Possibly a few copies are still procurable of the secretary of the society, Mr. E. T. Cresson, P. O. box 1,577, Philadelphia, Pa.

To a number of other publications I would be glad to invite your attention, but it would too greatly extend my paper.

Conclusion.

I have attempted to show how the pomologist can hope to attain success in the insect warfare in which he must engage, and the panoply in which he should be clothed for the fight. The requirements that I have made are not very exacting, or are they difficult to meet. Compliance with them will not only yield a pecuniary reward, but at the same time add to mental wealth, enlarging and enriching the mind, by opening up to it sources of pleasure and continually increasing interest, as one is led from the simple contemplation of these curious, beautiful, and wonderful forms, to the remarkable transformations that they undergo, the various habits that characterize them, and the surprising instincts or the shadowing of reasoning powers that they not unfrequently display.

The study of the myriad insect world, even apart from its utility, can not fail of being a fascinating adjunct to the pleasurable pursuit of fruit growing. As such, I commend it to each member of the American Pomological Society.

(C.)

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST.

The following is a list of the principal publications of the Entomologist during the year (1887), giving title, place and time of publication, and a summary of contents:

The Praying Mantis and its Eggs. (Country Gentleman, for January 6, 1887, lii, p. 9, c. 3–4, figure — 62 cm.)

Egg-cases from Charlottesville, Va., where they occur on fences, are identified as of this insect and described. The mode of deposit of the eggs is not known, but probably the entire mass is extruded in its case. The perfect insect, *Mantis Carolina* Linn., is described and figured, and its habits, food, manner of feeding, etc., stated, together with its occasional cannibalism. It is a Southern form, not occurring in New York. Its consumption of injurious insects entitles it to protection and cultivation. [See revision and extension of above in pages 158–162 of this Report.]

A Bug Injurious to Shade Trees. (Country Gentleman, for January 27, 1887, lii, p. 69, c. 2–3 — 18 cm.)

Leptocoris trivittatus (Say) — one of the Hemiptera, received from Sterling, Kansas, where it has abounded during the autumn and winter, is described, and its habits in Topeka, Kansas, as narrated by Prof. Popenoe, quoted, together with its food-plants there observed, viz., box elder (*Negundo aceroides*) and soft maples. [See revision and extension of above in pages 156–158 of this Report.]

Fuller's Rose-Beetle — Aramigus Fulleri *Horn.* (Country Gentleman, for February 3, 1887, lii, p. 89, c. 1 — 21 cm.)

A grub sent from Bucksport, Maine, as destructive to the roots of rose-bushes, is Fuller's rose-beetle — known as being quite injurious to roses grown in greenhouses and to some other plants. Dr. Horn's remarks upon its rapid spread over the country following its first notice in 1874, are quoted. The grubs eat the roots and the beetles the foliage of the plants. The latter often abound in greenhouses in November and December, when they should be collected and destroyed. By carefully hand-picking the beetles as they mature, they may be exterminated. A bush badly infested at the roots should be taken up with proper care and burned. See Second Report on the Insects of New York, 1883, p. 142.

Harmlessness of the Lady-bird, Adalia bipunctata. (The Owl [Glens Falls, N. Y.], February, 1887, ii. p. 15—8 cm.)

The cause of the unusual abundance of this harmless insect in dwellings during the past winter, is its entrance for hibernation after its great abundance last year as a destroyer of the innumerable aphides which infested the hop and other crops. It deserves protection wherever met with.

The Aphididæ, or Plant Lice. (Proceedings of the Western New York Horticultural Society at its thirty-second annual meeting, January 26 and 27, 1887, pp. 85–97.) Issued in March, 1887.

The paper is arranged under the following headings: Systematic Position of the Aphididæ — Features of the Aphididæ — Distribution of the Aphididæ — Injuries from the Aphididæ — Propagation of the Aphididæ—Imperfect knowledge of the Aphididæ—Recent Discoveries.

A Wood-eating Insect. (Country Gentleman, for March 31, 1887, lii, p. 257, c. 1—18 cm.)

Inquiry made of a long-horned beetle which had recently appeared in a dwelling in Albany, in numbers, is answered by its identification as *Xylotrechus colonus* (Fabr.). Nothing is known of its life-history, except that it has been bred from oak and maple. It may have been carried within doors in the larval stage in fuel, or it may have emerged from furniture recently manufactured. Instances are recorded where beetles have escaped from furniture after their imprisonment for fifteen years. They may have come from the hickory wood stored (as stated) in the basement. [See revision and extension of the above in pages 93–96 of this Report.]

How to Prevent the Cabbage-maggot. (New England Homestead, for April 9, 1887, xxi, p. 136, c. 5—35 cm.)

No general preventive or remedy is known, as the materials used are variously affected by the character of the soil where applied. The following are discussed: Tobacco-dust sprinkled on the plants to prevent egg-deposit. Dressing the ground before planting with 150 bushels of shell-lime to the acre. Gas-lime worked into the soil. Ammoniacal liquor applied to the roots. Decoction of burdock stems and leaves. Decoction of tansy. Puddling the plants with a mixture of earth and cow-dung or night-soil. Dipping in soot and water. Dipping in hellebore solution. Avoid use of fresh barn-yard manure.—Reports of experiments with the above are requested.

Currant Worm Remedy. (Popular Gardening, for April, 1887, ii, p. 120–121 —8 cm.)

An effectual remedy may be had in sprinkling powdered hellebore on the lower leaves of currant bushes when they first show the small holes eaten by the larvæ of the first brood; or the leaves may be picked off and crushed. Will distribute the egg-parasite, *Trichogramma pretiosa*, if the parasitized eggs can be obtained.

Life-history of Hemileuca Maia *Drury.* (The Swiss Cross, for April, 1887, i, pp. 135–139, figs. 1–3.)

Presents the life-history of this Bombycid moth under the following heads: The Egg-belt; Egg cement; Oviposition; Hibernation of the eggs; Hatching; Egg-shell; The young larva; First moult; Second moulting; Third moulting; Stinging power of the larva; Fourth moulting; Fifth moulting; Mature larva; Food-plants; Parasites; Pupation; The pupa; The Imago; Metamorphic periods; Prolonged pupation; Habits of the moth; Rarity; Geographical range.

The Apple-tree Bark-louse. (Country Gentleman, for April 21, 1887, lii, p. 321, c. 1–3 — 60 cm.)

Scales on apple bark from Batavia, N. Y., are those of *Mytilaspis pomicorticis* Riley. They often entirely cover the bark, giving it a characteristic blistered appearance. Description of them. Interest pertaining to the life-history of the insect. Is not fitted for rapid spreading, as the female is wingless, but may be conveyed by other insects, birds [and spiders]. The brief period of their free existence. Reference to scale-insects of the orange in Florida and California. For remedies, cut down and burn the trees infested throughout, or spray thoroughly with a kerosene emulsion. Small trees may be scraped. The most vulnerable time of the insect, is just after hatching, or at the time of the blossoming of the tree. Prof. Cook's method of scouring by hand with a soft-soap and carbolic acid solution. Soft-soap and washing soda also recommended; also, linseed oil.

Remarks, in answer to inquiry, on the two-spotted lady-bird, *Adalia bipunctata,* found frequently hibernating in houses, and mistaken for the carpet-beetle, *Anthrenus scrophulariæ.*

Borers in Timber. (Country Gentleman, for April 28, 1887, lii, p. 341, c. 3 — 17 cm.)

A correspondent asks for a method for protecting timber from borers. The inquiry is of too general a nature to admit of satisfactory reply. Means for protecting certain timber from specified insects could be given. The ship-timber in the royal dock-yards of Sweden, was, by the direction of Linnæus, preserved from *Lymexylon navale,* by submerging it at a specified time. Some felled timber may be protected by peeling the bark. Creosote has been used for protection of timber, with satisfactory result.

Honey-dew Eaten by Bees. (Country Gentleman, for April 28, 1887, lii, p. 341, c. 3–4 — 44 cm.)

The extent to which honey-dew is eaten by bees, is of entomological, botanical, and economical importance. A correspondent states that the aphis secretions on fruit trees and the elm is not eaten by bees. Prof. Cook is quoted on some honey-dews that are eaten. "Honey-dew," too general a name, as it includes both aphis and plant secretions. Sometimes difficult to determine the source of a secretion observed. An extract from "Science" is given, on the rich nectar and excellent bee-food secreted by the larch plant-louse, *Lachnus laricifex* Fitch, which is corroborated by Prof. Cook.

The Seventeen-year Locust — Cicada septendecim. (The Owl, Organ of Agassiz Association, No. 711, Glens Falls, N. Y., May, 1887, ii, pp. 17–19, figs. 1–5.)

The interest attaching to this insect from its long period of development, noticed; also, a thirteen-year Southern race; number of broods in the United States, and the number occurring in the State of New York; the next appearance of the New York broods. A résumé of the life-history of the insect is given, and reference made to *Cicada tibicen.*

[A Root Aphis of the Hop-vine.] (The Waterville [N. Y.] Times, for May 6, 1887, p. 2, c. 3 — 32 cm.)

Some insects sent in soil from a hop-vine hill in Waterville, are recognized as belonging to the group of *Rhizobiinæ*, or underground aphids, which feed on the roots of plants. They can not be referred to any described U. S. species, as they differ from all such. A description of them is given. They are viviparous females, and are now producing living young. As these develop, it may be possible to identify them with some known above-ground species.

Lady-birds, Leaf and Carpet Beetles. (Country Gentleman, for May 12, 1887, lii, p. 381, c. 1–3, figs. 1–6 — 80 cm.)

Importance of such a knowledge of lady-birds as should prevent such destruction as they have been recently subjected to from having been mistaken for the carpet-beetle; the regard for them in Europe; how their form and markings may serve for their recognition; the specific names that indicate their usual spotted ornamentation; figures of some species; how the *Chrysomelidæ* with which they are liable to be confounded, may be distinguished, particularly the "tortoise beetle;" the *tarsi* as separating and distinguishing the two families; description and figures of the carpet-beetle, *Anthrenus scrophulariæ.*

The Little Winged Pest. (The Albany Argus, for May 16, 1887, p. 2.)

An abstract from a paper read before the Dana Natural History Society of Albany, on the Mosquito, treating of the numerous species; their distribution; means of protection against them; the bite; palliatives of the bite; only the female bites; the biting organs; use of the mosquito; the mosquito as a host for filariæ; perhaps one of the ten plagues of Egypt; the life-history and transformation of the insect.

Another Apple-Tree Pest. (Country Gentleman, for May 19, 1887, lii, p. 398, c. 4 — 10 cm.)

A flea-beetle sent from Coleman's Falls, Va., where "it caused the apple-trees to look as if the buds had been burned out with a hot iron," is *Crepidodera rufipes* (Linn.). Although *C. Helxines* has been reported as injurious to apple leaves in Illinois, this has not previously been so reported. The reasons are given why neither of these may be expected to prove serious pests of the apple. [See revision and extension of the above in pages 221–223 of this Report.]

A New (?) Aphis on Hop Roots. (Country Gentleman, for May 19, 1887, lii, p. 401, c. 3-4 — 45 cm.)

Aphides received from Waterville, N. Y., are sent as probably the hop-louse. Importance of ascertaining the hibernation of *Phorodon humuli*, which is believed to be on plum trees. Our limited knowledge of the root-feeding *Rhizobiinæ*. Description of the mature and young aphis from hop hills in Waterville.

The Currant-worm Parasite. (Albany Express, for May 23, 1887, xli, p. 2, c. 5 — 10 cm.)

The attack of the egg-parasite [*Trichogramma pretiosa*] on the eggs of the currant saw-fly — not hitherto recorded out of the State of New York, is discovered in some of the eggs received from a fruit farm in Galena, Ill. In picking off for destruction the egg-bearing leaves of currant bushes, those on which the eggs have turned black, indicate parasitization, and therefore should not be crushed, but preserved for the development of the parasite.

The Leather Beetle. (Boots and Shoes Weekly, for May 25, 1887, xi, p. 473, c. 1-2 — 36 cm.)

To inquiry received from Scott Co., Ky., of an insect that burrows in shoes and perforates them in all directions (no examples sent), reply is made that it is probably *Dermestes vulpinus*, or "the leather beetle," which has seriously injured boots and shoes in some wholesale houses in St. Louis, Mo., and elsewhere. Its operations are described and remedies given. Another beetle occasionally injuring boots and shoes is *Sitodrepa panicea*. [See pages 208-213 of this Report.]

A Saw-fly on Apple-trees. (Country Gentleman, for May 26, 1887, lii, p. 421, c. 3 — 21 cm.)

Insects occurring in large numbers on apple-trees in Chester county, Pa., and thought to be the occasion of the blighting of the trees, are *Dolerus sericeus* (Say). They could not have caused the injury reported. *Dolerus arvensis* (Say) has been sent from Ohio as having injured the fruit-buds of pear-trees, but it is not credited, for none of the *Tenthridinæ* are known to feed injuriously on vegetation in their perfect stage. Reference is made to food-plants of the larva of *D. arvensis*.

Elm-leaf Beetle Going Northward. (Country Gentleman, for May 26, 1887, lii. p. 421, c. 3-4 — 20 cm.)

Galeruca xanthomelæna (Schr.) received from Poughkeepsie, N. Y.— the most northern locality in the State from which it has been reported. Its progress, since its introduction fifty years ago, is sketched. Importance of efforts to arrest its spread. Reference to literature upon the insect.

A New Cotton Pest. (Country Gentleman, for June 2, 1887, lii. p. 441, c. 4 — 19 cm.)

A small beetle reported from Jackson county, Ga., as destroying young cotton plants where ragweed had grown the preceding year, is identified as *Systena blanda* var. *bitæniata* LeConte. This Chrysomelid beetle had not been known to injure cotton. It has been reported as injurious to corn in Pennsylvania. The Systenas (species cited) are not usually injurious to vegetation. For preventives, destroy the ragweed, or sprinkle the young cotton plants with any dust-like substance. [See pp. 275, 276 of this Report.]

Thrips in Strawberry Blossoms. (Country Gentleman, for June 9, 1887, lii, p. 459, c. 1–2 — 50 cm.)

Strawberry blossoms from Geneva, N. Y., contained thrips, averaging perhaps twelve to a blossom. Difference between the true thrips and the so-called thrips of the grape leaves; their appearance; where they occur; have not been much studied; conflicting statements of their habits; deemed by some to be mainly insectivorous and therefore beneficial; by others, injurious to vegetation; known feeding habits of some species quoted; the species undoubtedly differ in habits. No injuries evident in the Geneva blossoms. The strawberry thrips has been very abundant and injurious to the blossoms in Illinois, and is being studied by Professor Forbes.

The Leather Beetle again. (Boots and Shoes Weekly, for June 15, 1887, xi, p. 608, c. 1–3—50 cm.)

The beetle boring into shoes (see preceding page) has been reared from an infested shoe, and found to be *Sitodrepa panicea.* Its operations in the leather are described, and some of the large number of substances on which it feeds, given. It will not probably prove a very serious leather pest. In addition to the remedies suggested for *Dermestes vulpinus*, this may be killed in any of its stages by treating the infested shoes with kerosene.

The Apple Pest. (Oswego Daily Times, June 18, 1887, p. 4, c. 6–7—48 cm.)

Insects reported as entirely destroying the foliage of apple trees in Granby, Oswego county, N. Y., and eating the young fruit, are identified as the rose-bug, *Macrodactylus subspinosus.* This beetle is described, its occasional ravages referred to, and the difficulties in dealing with it, pointed out. The best methods for its control, are beating from low plants into a pan of water and kerosene, and jarring from trees on sheets spread beneath; also dusting the foliage with oak ashes (highly recommended), air-slacked lime, plaster of Paris, or even with road-dust. The insects will disappear about the first of July.

Cockscomb Elm-gall. (Country Gentleman, for June 23, 1887, lii, p. 491, c. 2 — 12 cm.)

Galls on young elm trees in Coffee, Va., are the above species, *Glyphina ulmicola* (Fitch); description of them; are confined to the white elm, *Ulmus Americanus.* For remedy, when the insects are distributed over the leaves, spray with soapsuds and quassia water, or a kerosene emulsion. Reference to literature of the gall.

The Ox Warble-fly. (Country Gentleman, for June 23, 1887, lii, p. 493, c. 1–3 — 106 cm.)

What warbles are; different species of warble-flies; figure and description of the ox warble-fly and its life-history; habits of the larva and figures. The best method of dealing with this insect is to kill the maggot in March and April by applying to the opening in the warble a little mercurial ointment. Reference to the old method of forcing out. The ointment sometimes applied before openings appear. Other thick adhesive material that may be applied to arrest respiration. Natural history of the insect. Applications for prevention need to be long continued, and are, therefore, not as simple as killing. Some preventives named. Reference to, and figure of, the ox gad-fly, *Tabanus bovinus* Linn.

Grape-vine Leaf-hopper. (Country Gentleman, for June 23, 1887, lii, p. 493, c. 4 — 33 cm.)

Insects destroying grapevines in Clearfield, Pa., are not "thrips" as commonly named, but species of *Erythroneura*, of the Hemiptera; the general appearance and operations of these leaf-hoppers; a common one is the *Tettigonia vitis* of Harris, which is described. The young leaf-hopper may be killed with soapsuds, or tobacco water, or the kerosene emulsion. When winged, they may be driven on a piece of building-paper coated with gas-tar stretched between the rows of the vineyard.

The Rose-Bug. (Country Gentleman, for June 30, 1887, lii, p. 511, c. 1–2 — 35 cm.)

Rose-bugs from Onondaga county, N. Y., and Cumberland county, N. J., attacking peach, corn, grape, and blackberry are identified. No means for fully controlling it yet known; is a local insect, and believed to breed in sandy soil. Beating and jarring from plants and trees has long been practiced successfully. When on corn might be poisoned with Paris green or London purple. Dusting the foliage with some dry powdery substance is a good preventive. Lures for concentrating attack are the Clinton grapevine and valerian. Account of the success of the last-named lure.

The Hop-Louse. (Country Gentleman, for June 30, 1887, lii, p. 511, c. 2–3 — 23 cm.)

In answer to request for remedies for *Phorodon humuli*, reply is made that none will probably be needed this year. In years of its abundance, the English custom of hop-washing will have to be adopted in this country, to insure remunerative crops. The machine used in England for this purpose is described, and the wash of quassia extract, soft-soap and water given. Reference made to present investigations in the life-history of this insect by the Division of Entomology at Washington.

Report of the State Entomologist to the Regents of the University of the State of New York, for the year 1885. (Thirty-ninth Annual Report of the State Museum of Natural History, for the year 1885, pp. 77–125.) [Published, July 6, 1887.]

The contents are, Introduction. Publications by the Entomologist. Contributions to the Department. Collections of the entomologist. Insect Attacks and Miscellaneous Observations [as follows]: Eggs of a Cut-worm on an apple-tree: The Canker-worm: The Apple-leaf Bucculatrix: The Clover-seed Midge: Sciara sp? on wheat: Helophilus similis: The Cabbage Fly: The Hessian Fly: A Lady-bug attack on scale insects: Oviposition of Saperda candida: The Clover-leaf weevil destroyed by a Fungus attack: The Pear-blight Beetle: Attack on young pears by a Plant-bug: Pœcilocapsus lineatus: An Experiment with the 13-year Cicada: A Scale-insect attack on Ivy: The Cheese-mite infesting Smoked Meats: A Parasitic Mite infesting a beetle: A Mite attack on Garden plants: The Black Knot of the Plum tree and its Guests. Notes upon various Insects [as follows — reprinted in present report]: Nisoniades Persius — Sphinx Canadensis — Melittia cucurbitæ—Tinea pellionella—Mallota sp.—Anthrenus scrophulariæ—Thanasimus dubius — Macrodactylus subspinosus — Chrysochus auratus — Trirhabda Canadensis — Hylesinus opaculus — Phlœotribus liminaris— Œcanthus niveus — Ephemera natata.

The Meal Worm in Salt. (Country Gentleman, for July 7, 1887, lii, p. 530, c. 3–4 — 8 cm.)

Examples of twenty-five larvæ and of some beetles found in a sack of salt which had stood unopened in a meal-room for two months, in Newark Valley, N. Y., are *Tenebrio molitor* Linn. It is probable that the larvæ entered the sack for pupation, and in this manner only could the salt have served any purpose in the development of the beetle from the matured larvæ.

Four-lined Leaf-bug on the Currant. (Country Gentleman for July 14, 1887, lii, p. 547, c. 2–3 — 21 cm.)

Insects infesting currant bushes at Fairmount, N. Y., are *Pœcilocapsus lineatus* (Fabr.). Description of it is given and of its method of injury. It can not be killed by application to the leaves, as it is not a suctorial insect. Remedies mentioned, are, burning refuse garden material where it hibernates, killing the hibernating female when returning to the bushes in early spring for oviposition, and beating the larvæ and pupæ into a pan of water and kerosene.

The Elm-leaf Beetle. (Country Gentleman for July 21, 1887, lii, p. 565, c. 3 — 25 cm.)

Larvæ sent from Scarsdale, N. Y., as destroying the foliage of elms, are those of *Galeruca xanthomelæna*. References to former notices of it in the Count. Gent. The best liquid preparation for its destruction is made with one-half pound of London purple, and three quarts of flour to a 40-gallon barrel of water. The method of mixing it is given, and the time for its application.

The Curculio on the Apple. (Country Gentleman, for July 21, 1887, lii, p. 565, c. 3-4 — 23 cm.)

Apples from Moosehead City, N. C., submitted for examination, are gnarled and distorted from the numerous blackened pits that they bear, which are particularly described No insects are found in the fruit. The punctures were probably made by the plum curculio, *Conotrachelus nenuphar*, for feeding purposes. The apple curculio, *Anthonomus quadrigibbus*, is described. Curculio attack is to be met by jarring the insects from the trees on sheets spread underneath.

An Ichneumonized Caterpillar. (Country Gentleman, for September 1, 1887, lii, p. 673, c. 3-4 — 13 cm.)

Darapsa Myron larva, from a grapevine at Nassau, N. Y., has its body covered with the cocoons of a small ichneumon fly, which is *Apanteles congregatus*. The history of this common parasite of *D. Myron* is given, with reference to an error that is often made of mistaking its cocoons for insect eggs and destroying them.

Milkweed Beetle with Bad Habits. (Country Gentleman, for September 1, 1887, lii, p. 673, c. 4 — 27 cm.)

Larvæ sent from Chenango Co., N. Y., as feeding commonly on the morning-glory, but also on barley, corn, cabbage, and some weeds are identified as those of *Chelymorpha Argus* Licht. The beetle is described. The literature of its food-habits is given, showing that it had not hitherto been observed as a corn depredator. It does not promise to be destructive to valuable crops. When numerous it may be controlled by hand-picking or shaking from the plants.

Blister Beetle Attack. (Country Gentleman, for September 1, 1887, lii, p. 674, c. 2 — 6 cm.)

A beetle from Morton, Pa., charged with having devoured in one night the leaves of a *Clematis flammula*, is identified as *Epicauta cinerea* (Forst.), the *marginata* of Fabricius. Remedy, spraying with Paris green in water.

Mites on Arbor Vitæ. (Country Gentleman, for September 1, 1887, lii, p. 674, c. 3 — 9 cm.)

The blackened appearance of a twig of Siberian arbor vitæ, sent with inquiry from Pittsburgh, Pa., is due to an attack of a minute mite, the egg-shells and exuviæ of which are discernable under a magnifier. The attack can be arrested by spraying with pyrethrum water, or if on small trees by sulphur burned underneath with sheets spread over them to confine the fumes.

Harvest Fly. (Country Gentleman, for September 1, 1887, lii, p. 674, c. 3 — 5 cm.)

Identification of *Cicada tibicen* — the common harvest-fly, improperly known as a locust, with brief notice of its distribution from New York to Brazil; its annual appearance about the commencement of the dog-days; its shrilling noise, and the apparatus by which produced; its transformations, occupying two or three years, unlike the *Cicada septendecim* which requires seventeen years; its split pupal-cases often met with on the trunks of the trees.

Elm-leaf Spraying. (Country Gentleman, for September 8, 1887, lii, p. 694, c. 2–3—10 cm.)

In reply to an inquiry for a force pump for spraying elm trees, statement is made that a powerful pump is desirable that the liquid may be taken from a tank, and distributed through a rubber hose of suitable length and a "bamboo extension rod," as recommended in the U. S. Agricultural Report of 1881–82. The best nozzle to apply to the rod would be the "Nixon;" made at Dayton, Ohio, by A. H. Nixon. Bulletin No. 10, of the Division of Entomology, is referred to as giving method of elm-tree spraying practiced in Washington, D. C.

Pests of the Pomologist. (The Boston Herald, for September 16, 1887, p. 3—1¼ cols.)

Abstract of an address delivered before the American Pomological Society, at its meeting at Boston, September 15, 1887, treating of plant diseases and insect ravages, as the result of the present extended cultivation of fruit; great increase of fruit-pests from importation and changed food-habits, as shown in the fruit pests of California, and notably the "fluted scale;" the number of insect pests; importance of their study; some requisites of the successful fruit grower. The same in the Albany Sunday Express for October 2, 1887, p. 2, c. 4–5—1½ cols.

A Queer Foe to the Caterpillar. (New England Homestead, for October 1, 1887, p. 354, c. 3—13 cm.)

A Sphinx caterpillar having its body nearly covered with small, white parasitic cocoons, is the *Darapsa Myron* of the grapevine. The method of attack of the hymenopterous parasite, *Apanteles congregatus* is described, together with the development of the grubs within the body of the caterpillar, and externally within their cocoons. The cocoons are often mistaken for eggs. Caterpillars ichneumonized in this manner often have their larval stage considerably prolonged.

The Value of Crustaceans as Food for Fishes. (The American Angler for October 8, 1887, p. 235 — 31cm.)

In addition to the species and families of Crustacea named,— among the insects, May-flies, Phryganid larvæ and other aquatic larvæ are noticed, as very desirable food for fishes.

The Two-marked Tree-hopper. (Country Gentleman, for October 13, 1887, lii, p. 783, c. 2–3 — 22 cm.)

Insects described, sent from Glen Cove, Long Island, N. Y., as occurring only on *Juglans rupestris*, are a variety of *Enchenopa binotata* (Say). Comparison is made with typical examples of this species, and if the differences are constant, the form sent will at least merit a varietal name. They resemble examples of *Enchenopa* taken from a honey locust at Bennington, Vt. *Juglans rupestris* is native to Texas, Arizona, and New Mexico. Remedies for this insect are, removing and burning the twigs bearing the egg-deposits, indicated by the conspicuous white egg-coverings, and driving away the timid winged forms.

Mites on Arbor Vitæ. (Country Gentleman, for October 20, 1887, lii, p. 800, c. 2—8 cm.)

The mite infesting an arbor vitæ as noticed in the Country Gentleman for September first, is believed to be *Tetranychus telarius*, "the red spider," or a nearly allied species. Its occurrence on this food-plant is new.

Asparagus and Pear-Blight Beetles. (Country Gentleman, for October 27, 1887, lii, p. 817, c. 3–4 — 35 cm.)

Beetles appearing, for the first, this year at Annapolis, Md., are identified as *Crioceris asparagi*. Its distribution in this country is stated, and for remedies air-slacked lime, and chickens as collectors, recommended.

The beetles taken while commencing to bore in the trunk of a young apple tree, are *Xyleborus pyri* (Peck). Its two forms of attack — the burrowing of the larva near and into the bud, and by the mature beetle in the spring, into the trunk, are described. Remedies: cutting off and burning infested twigs, and poisonous or repellant washes.

White Grub Attack on Wheat. (Country Gentleman, for October 27 1887, lii, p. 817, c. 4 — 24 cm.)

A white grub sent from Abingdon, Va., where in October, it is destructive to young wheat, seems not to be that of *Lachnosterna fusca*, but of some allied species. Description of the grub is given, and of its method of traveling on its back. No remedy is known for an attack of this kind. The grubs should have been destroyed when the meadow was broken up for wheat, by methods mentioned. Should the grubs, after heavy rains, show themselves above ground, poultry would reduce their number materially.

The Bag-Worm. (Country Gentleman, for November 3, 1887, lii, p. 837, c. 2–4 — 54 cm.)

An insect destroying an arbor vitæ hedge in Plainfield, N. J., is the bag-worm, *Thyridopteryx ephemeræformis*, of which the habits are given, and reference to its bag; also, the degraded habits of the female;

reference to publications on it; the life-history; conflicting statements of transformations, etc., by Mrs. King; evidences opposed to those, and showing an autumnal maturity. Remedies are, poisoning with the arsenites, and collecting the bags in January for burning.

Insects and Yellows in the Peach. (Country Gentleman, for November 3, 1887, lii, p. 837, c. 4—22 cm.)

The beetle which "inspectors for peach-yellows" find in peach-trees in Ringwood, Ontario, and claim to be reason for condemning the trees as affected with yellows, is identified as *Phlœotribus liminaris* (Harris). It was many years ago thought to be associated with, if not the cause of, the yellows. It is not evidence of the disease. It is said to infest elms, and is known as the "elm-bark beetle." It occurs on peach-trees where yellows is unknown. Prof. Penhallow's studies of the disease show that it is not even induced by *Scolytidæ* presence. Reliable indications of the yellows, drawn from foliage, growth, and fruit, are cited.

Grape Insects in Manure. (The American Garden, for December, 1887, viii, p. 396, c. 2—7 cm.)

A recent statement attributing the increase of grape insects in the vicinity of New York city, to the use of city stable manure, is unworthy of consideration. Larvæ living on excremental material, would not feed on living plants. *Ligyrus relictus* larvæ which occur in manure beds have been mistaken for the white grub of *Lachnosterna fusca*, and excited fear that its distribution in manure would endanger field-crops. Such fears are groundless.

Report of the State Entomologist to the Regents of the University of the State of New York, for the year 1886. (Fortieth Report of the N. Y. State Museum of Natural History, 1887, pp. 79–154. Also, separate, with cover and title-page: same paging.) [Published January 20, 1888.]

The contents are: Introductory: A new Attack on Wheat by a Saw-fly larva: The Red-humped Apple-tree Caterpillar and Parasite: The Forest-tent Caterpillar: The Spring Canker-worm: An Unknown Grass Pest: A New Strawberry Insect: A Meal Insect: A Grass-burrowing Insect: A Dung Beetle: The Sugar Maple Borer: The Potato-stalk Weevil: An Ugly Bee-Slayer: Melon Vines Attacked by the Squash-bug: The Grain Aphis: The Hop-vine Aphis: The Apple-tree Aphis: Potato Plants Attacked by Aphides: Aphis Attack on Carrots and Parsnips: The Beech-tree Blight: The Cockscomb Elm-gall: An Unrecognized Insect Attack: A Grass-Infesting Mite: A Mite Infesting Smoked Meats: Myriapod Attack on Potatoes: Notes on Various Insects: Contributions to the Department: List of Publications of the Entomologist during the Year.

(D.)

CONTRIBUTIONS TO THE DEPARTMENT.

The following are the contributions that have been made to the Department collections during the year:

IN HYMENOPTERA.

Pelopœus cœmentarius (Drury), *Pelopœus cœruleus* (Drury), and *Ophion bilineatus* Say. From Mrs. E. B. SMITH, Coeymans, N. Y.

Isosoma hordei (Harris) — the larvæ in wheat straw, September 7th. From C. H. BOYD, Johnson's Creek, Niagara county, N. Y.

Undetermined species of the Chalcid genera of *Torymus, Tetastrichus,* and *Entedon,* obtained from galls of *Cecidomyia betulœ,* contributed by PETER INCHBALD, Fulwith Grange, Harrowgate, Eng.

Rhyssa (*Thalessa*) *lunator* (Fabr.). From MONROE CRANNELL, Albany, N. Y.

The Oak plum-gall, containing larvæ of *Cynips q. prunus* Walsh, on the acorn cup of *Quercus rubra,* October 26. From AUGUSTUS FLOYD, Moriches, N. Y.

Woolly-galls on scrub oak, *Quercus nigra,* disclosing *Cynips q. operator* O. S. From Dr. M. G. PLANCK, Schenectady, N. Y.

Larvæ of the larch saw-fly, *Nematus Erichsonii* Hartig, from tamaracs at De Kalb Junction, St. Lawrence county, N. Y., June 29th. From C. PHELPS, De Kalb. Larvæ of the same, and cocoons spun en route, July 9th. From Rev. HENRY U. SWINNERTON, Cherry Valley, Otsego county, N. Y.

Dolerus sericeus Say, from apple tree blossoms. From JOHN L. BALDERSTON, Kennett Square, Pa.

Eggs of *Nematus ventricosus* Klug, parasitized by *Trichogramma pretiosa* Riley, May 16th. From HALLETT & SON, Galena, Ill.

Tips of currant twigs girdled and broken down, and found to contain young larvæ of an insect apparently belonging to the Hymenoptera, May 30th. From Prof. CHARLES H. PECK, Menands, N. Y.

IN LEPIDOPTERA.

Sphinx quinquemaculata Haworth — a female specimen captured September 28th. From Mrs. JOHN BLAIR, Albany, N. Y.

Spilosoma virginica (Fabr.); *Hyperchiria Io* (Fabr.); *Leucania pallens* Guen.; *Angerona crocotaria* (Fabr.); *Nematocampa filamentaria* Guen.; *Bleptina* sp.; *Rivula propinqualis* Guen.; *Acidalia* sp.; *Penthina nimbatana* (Clem.); *Carpocapsa pomonella* (Linn.); *Ephestia interpunctella* Zeller. From Mrs. E. B. SMITH, Coeymans, N. Y.

Larvæ of *Lagoa opercularis* (Sm.-Abb.), from an apple tree, with cocoons spun en route, August 19th. From C. R. MOORE, Birds Nest, Va.

Limacodes pithecium (Sm.-Abb.) — larvæ from apple tree and cocoon, August 24th. From HENRY C. GETTER, Middleburgh, N. Y. The same larva from a pear tree, with a cocoon, August 6th. From JOHN CORBETT, Watkins, N. Y.

Eggs of *Callosamia angulifera* (Walker). From Miss EMILY L. MORTON, Newburgh, N. Y.

Young larvæ of *Mamestra picta* Harris, feeding in company on currant leaves. From GEORGE T. POWELL, Chatham, N. Y.

Larvæ of *Nephelodes violans* Guen., collected alive from the surface of snow, near Montreal, Can., March 18th. From Prof. D. P. PENHALLOW, McGill University, Montreal.

Aletia xylina (Say), the cotton-worm moth, from large numbers abounding about electric lights and in windows in Watertown, N. Y., on October 10th. From J. Q. ADAMS and from J. M. ADAMS, of Watertown.

Zerene catenaria (Cramer), in several examples, captured at light on windows in Albany, September 21st. From ERASTUS CORNING, Jr., Albany, N. Y.

Larvæ of *Anisopteryx pometaria* Harris, from apple-trees. From AUGUSTUS FLOYD. Moriches, N. Y.

Larvæ of the eye-spotted bud-moth, *Tmetocera ocellana* (Schiff.), feeding within the buds and blossoms of apple twigs. From W. J. BABCOCK, Rochester, N. Y.

Larvæ of *Crambus* sp.? taken from roots of corn, June 23d. From W. E. HARDING, Bethany, N. Y.

IN DIPTERA.

Galls of *Cecidomyia betulæ* Winn., in the seeds of white birch, *Betula alba*. From PETER INCHBALD, of Fulwith Grange, Harrowgate, England.

Lasioptera vitis O. S., emerging from galls on tips and leaves of seedling grape, June 7th. From HENRY LEE, Middlehope, Orange county, N. Y.

Sarcophaga sp.? and other undetermined *Muscidæ*. From Mrs. E. B. SMITH, Coeymans, N. Y.

Chloropisca prolifica Ost. Sack., in many examples, infesting a dwelling during the winter. From Warren F. Daniell, Franklin, N. H. The same species, September 18, from Dr. H. C. Coon, Alfred Centre, N. Y.

Pupæ of a leaf-miner within the leaves of daisies (*Chrysanthemum*) in a green-house at Glen Cove, N. Y., disclosing *Phytomyza lateralis* Fallen. From Dr. James A. Cooley, Glen Cove.

In Coleoptera.

Tenebrioides Mauritanica (Linn.), in larva, pupa, and imago, June 30, From J. M. Adams, Watertown, N. Y.

Alaus oculatus (Linn.) and *Lucanus dama* Thung. From Mrs. E. B. Smith, Coeymans, N. Y.

Larvæ of *Agriotes mancus* (Say), from corn. From D. A. A. Nichols, Cleveland, O.

Sitodrepa panicea (Linn.), boring and breeding in shoes. From Wm. Smith, Louisville, Ky. The same insect, from a drug store, from J. M. Adams, Watertown, N. Y.

Phanæus carnifex (Linn.), collected at Columbus, O. From Frank Phisterer, Albany, N. Y.

Macrodactylus subspinosus (Fabr.), from peaches and corn. From Charles E. Daboll, Memphis, N. Y.

Larvæ of *Lachnosterna* sp., allied to *L. fusca*, from roots of wheat. From R. P. Carson, Abingdon, Va.

Monohammus confusor Kirby, from Mt. Desert, Maine. From Miss A. McNaughton, Albany, N. Y.

Saperda vestata Say. From Harry L. Peck, Menands, N. Y.

Oberea bimaculata Oliv., the raspberry-cane borer — the imago, and the pupæ and the larvæ in their burrows, and girdled tips of the canes. From J. E. Blodgett, Oswego, N. Y.

Lema trilineata (Oliv.), in larvæ in various stages, and the beetle, feeding on *Physalis*. From E. S. Goff, and from M. H. Beckwith, of the State Agricultural Experiment Station, at Geneva, N. Y.

Galeruca xanthomelæna Schr.— the elm-leaf beetle. From Isaac Coles, Glen Cove, N. Y.; from E. S. Grove, New York city ; and from D. J. Garth, Scarsdale, Westchester county, N. Y.

Eggs of *Galeruca xanthomelæna* Schr. From Mrs. E. W. K. Lasell, Orange, N. J.

Systena blanda var. *bitæniata* Lec., from cotton plants. From W. L. Williamson, Harmony Grove, Ga.

Pupæ and imago of *Chelymorpha Argus* Licht., from corn, July 15. From C. L. Landers, Afton, N. Y.

Tenebrio molitor (Linn.). From J. M. ADAMS, Watertown, N. Y.

Epicauta cinerea (Forst.), from *Clematis flammula.* From E. RAMSDEN, Morton, Pa.

Larvæ of *Conotrachelus cratægi* Walsh, in quinces. From MAXWELL and BROTHERS, Geneva, N. Y.

Scolytus rugulosus Ratz., in bark of peach trees. From GEORGE O. TOMPKINS, White Plains, N. Y.

Phlœotribus liminaris (Harris), in bark of peach trees. From E. F. OATES, Ringwood, Ontario.

IN HEMIPTERA.

Leptocoris trivittatus (Say), from Sterling, Kansas. From J. MILTON MOORE, Sterling, K.

Corythuca ciliata (Say), in larva, pupa, and imago, on *Platanus occidentalis.* From Prof. D. S. MARTIN, New York city.

Belostoma Americana Leidy. From C. A. RICHARDSON, Canandaigua, N. Y.; from A. G. RICHMOND, Canajoharie, N, Y., June 28; from J. M. ADAMS, Watertown, N. Y.; from Dr. B. D. SKINNER, taken from under ice in fresh water, February 22, at Greenport, N. Y.

Apple twigs with inserted eggs of the buffalo tree-hopper, *Ceresa bubalus* Fabr. From E. L. GOFF, N. Y. Agricultural Experiment Station, at Geneva, N. Y.

Schizoneura sp., probably *tessellata* Fitch. From JOHN B. JOHNSTONE, Belmont, N. Y.

Galls of *Glyphina ulmicola* (Fitch), the cockscomb elm-gall. From S. H. HUBBARD, Coffee, Bradford county, Va.

Chionaspis furfurus (Fitch), the scurfy bark-louse, from apple trees. From C. R. MOORE, Birds Nest, Va.

IN ORTHOPTERA.

Egg-packet of *Mantis Carolina* Linn. From C. R. MOORE, Birds Nest, Va.

IN NEUROPTERA.

Larvæ of the "Hellgrammite fly," *Corydalis cornutus* Linn., September 23. From SELWYN A. RUSSELL, M. D., Albany, N. Y.

Diplax obtusa Hagen, from Round Lake, Saratoga county, N. Y. From S. C. BRADT, Albany, N. Y.

IN MYRIAPODA.

Cermatia forceps Raf., young, September 29. From ERASTUS CORNING, Jr., Albany, N. Y. From W. W. HILL, Albany, N. Y.

Lithobius Americanus Newport, and *Cermatia forceps* Raf., from the Industrial School Building. From Miss L. A. MARSHALL, Albany.

Iulus cœruleocinctus Wood. From Mrs. IRA HARRIS, Loudonville, N. Y.

(E.)

ERRATA IN FORMER REPORTS.

The following Errata in the First and Second Reports on the Injurious and other Insects of the State of New York, were not noted in a number of the copies that were first distributed. They may be cut from this page and inserted in the volumes:

[OF FIRST REPORT.]

Page 42, line 34, and page 247, line 15, *dele* the comma after *cerasi* and *opimus*.
Page 81, lines 5, 6, 7, 17, *dele* the period after the specific name.
Page 81, line 27, for ii, read iii, 1883.
Page 87, line 3 from bottom, for ii, read iii, 1883.
Page 160, line 28, for BUCCULATRIX read BUCCULATRICIS, and correct in Index.
Page 215, line 34, change the comma to a period.
Page 226, line 35, after different insert class of the.
Page 296, line 21, read two of the three bound volumes.
Page 349, *dele* the comma from Bucculatrix, pomifoliella.

[OF SECOND REPORT.]

Page xii, line 15, for *ræus* read *reus*.
Page 31, line 3 from bottom, for *Pscyche* read *Psyche*.
Page 46, line 15, for Mille read Miller.
Page 57, line 2, for Harris read (Harris).
Page 74, line 31, for *Thyriodopteryx* read *Thyridopteryx*.
Page 77, line 4, for *Cupili-* read *Cupuli-*.
Page 94, line 1, for **Grote** read Grote.
Page 98, line 35, for honey-locust read common locust.
Page 101, line 2, same as the above.
Page 101, line 4, for *Spiraœ* read *Spirœa*.
Page 102, line 30, for 169 read 171.
Page 119, line 13, for on read in.
Page 119, line 17, for where read when.
Page 140, line 4, for Rhynchoporid read Rhynchophorid.
Page 140, line 25, for pora read phora.
Page 142, line 1, for (Horn) read Horn.
Page 182, line 9, for longer read shorter.
Page 199, line 8, for *Pscocidœ* read *Psocidœ*.
Page 223, line 9, for *aurichalchea* read *aurichalcea*, and correct in Index.
Page 235, line 6, *dele* the first with.
Page 264, line 15, *dele* 98.

GENERAL INDEX.

B.

D.

E.

I.

N.

PLANT INDEX.

ERRATA.

Page 134, line 13 from bottom, for J. W. read W. J.

Page 159, last line for (Dade.) read (Gade.)

Page 172, line 9, for *Quercus vaccinium* read *Quercus, Vaccinium.*

Page 193, first line, for (Fallen) read Fallen.

Page 227, line 27, for *Tingi shyalina* read *Tingis hyalina.*

Page 233, line 6 from bottom, for *MS.* read (*MS.*

Page 239, line 6 from bottom, for *Michigan* read *Michigan.*)

Page 265, line 18 from bottom, for *Americana* read *Americanum.*

Page 276, first foot-note, for Saunder's read Saunders'.

Page 286, line 18, for biographical read bibliographical.

Page 318, line 3 from bottom, for *Americanus* read *Americana.*

Page 320, line 10 from bottom, for is not a read is a.

Page 320, line 12 from bottom, for *Pœcilocap-* read *Pœcilocap-.*

REPORT

OF THE

STATE GEOLOGIST,

FOR THE YEAR 1887.

REPORT OF THE STATE GEOLOGIST.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN.— For several years past, the duties of the State Geologist have been almost entirely restricted to the preparation and publication of the volumes upon the Palæontology of the State, provided for by the law of 1883. This work, which had been for many years conducted in the private buildings of the State Geologist, was interrupted in the spring of 1886 by the necessity for the removal of the accumulated collections of more than thirty years, to a public building. These collections have now been transferred to the State Hall, and the writer was able to occupy the offices prepared for this work only in the latter part of January of the present year, and some weeks longer were required to put ourselves in working order to go on with the printing of the volumes.

I have already reported the completion of the second volume on the Lamellibranchiata in my communication of last year.

The printing of volume VI on the Corals and Bryozoa was begun in August 1886, but it became necessary to suspend this part of the work in order to remove the material and collections in use, to the State Hall, causing a delay of several months.

This volume (VI) consisting of 298+xxvi pages, with sixty-seven plates was completed and published in the early part of September of this year.

Owing however, to the restriction in number of pages of text and of plates of illustration, much material, which had been partially or entirely prepared for publication was necessarily omitted from the volume. I have appended a memorandum of the nature and amount of this material, and would earnestly recommend that some steps be taken to secure its proper publication as an appendix or supplement to the volume already issued. It will be far easier to complete this work at the present time than at any future period, and if once allowed to drop out of the line of work in progress it will be extremely difficult to revise it, and it can never again be continued under so favorable conditions as the present, when everything is forwarded and the subject fully occupying the minds of those engaged in the work. The number of species described in volume VI is 385, and the number of genera 72.

The following synoptical table presents the names of genera and species therein contained, and will also serve to show their geological relations.

Both for want of space and time, the author has made no attempt to present a classification of the compact, massive or branching forms of the so-termed Bryozoa. Such a work can only be satisfactorily presented after much more careful study of the interior structure, the mode of growth, and the conditions supervening from origin to maturity. Such a classification however is very important, and until that be done the descriptive portion of the work can only be regarded as a step in the progress of research, which may serve a useful purpose — the final presentation of our results.

SYNOPTICAL TABLE OF THE GENERA AND SPECIES DESCRIBED IN VOLUME VI OF THE PALÆONTOLOGY OF NEW YORK.
PREPARED BY MR. CHARLES E. BEECHER.

Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
	1	Streptelasma, Hall, 1847.							
1	1	S. strictum, Hall	*	.	.	.	.	1	i. figs. 1-10.
	2	Zaphrentis, Rafinesque, 1820.							
2	1	Z. Roemeri, Edwards and Haime	*	.	.	.	.	2	i. figs. 11-21.
	3	Aulopora, Goldfuss, 1826.							
3	1	A. Schohariæ, Hall	*	.	.	.	.	3	ii. figs. 1-6.
4	2	A. tubula, Hall	*	.	.	.	.	3	ii. figs. 7, 8.
5	3	A. subtenuis, Hall	*	.	.	.	.	4	ii. figs. 9-13, 15-18.
6	4	A. elongata, Hall	*	.	.	.	.	5	ii. figs. 14, 19, 20.
	4	Vermipora, Hall, 1874.							
7	1	V. serpuloides, Hall	*	.	.	.	.	5	ii. figs. 24-31.
8	2	V. robusta, Hall	*	.	.	.	.	6	ii. figs. 32, 33.
9	3	V.? tortuosa, Hall	*	.	.	.	.	6	ii. fig. 23.
	5	Striatopora, Hall, 1852.							
10	1	S. Issa, Hall	*	.	.	.	.	6	iii. figs. 14, 15.
	6	Michelinia, De Koninck, 1842.							
11	1	M. lenticularis, Hall	*	.	.	.	.	7	iii. figs. 1, 2, 3, 5.
	7	Favosites, Lamark, 1812.							
12	1	F. Helderbergiæ, Hall	*	.	.	.	.	8	iv. figs. 1, 2; v. figs. 1-3; vi. figs. 1-8.
13	2	F. conicus, Hall	*	.	.	.	.	9	iii. figs. 4, 6-13.
14	3	F. sphericus, Hall	*	.	.	.	.	9	vii. figs. 1-12; viii. fig. 8.
15	4	F. proximus, Hall	*	.	.	.	.	10	vii. figs. 13-15.
	8	Alveolites, Lamarck, 1801.							
16	1	A. explanatus, Hall.	*	.	.	.	.	11	xiii. figs. 15, 16.
	9	Chætetes, Fischer, 1837.							
17	1	C. colliculatus, Hall	*	.	.	.	.	11	viii. figs. 1-4.
18	2	C. monticulatus, Hall	*	.	.	.	.	12	viii. figs. 5-7.

SYNOPTICAL TABLE OF THE GENERA AND SPECIES, ETC.—(*Continued*).

Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
	10	Monotrypa, Nicholson, 1879.							
19	1	M.? spinulosa, Hall	*	.	.	.	.	67	xvi. fig. 25.
	11	Monotrypella, Ulrich, 1882.							
20	1	Chætetes (M.) arbusculus, Hall	*	.	.	.	.	12	ix. figs. 1-3, 6-8 (4, 5)?
21	2	C. (M.) abruptus, Hall	*	.	.	.	.	13	ix. figs. 9-11.
22	3	C. (M.) densus, Hall	*	.	.	.	.	14	x. figs. 11-13.
	12	Ptychonema, s. g., Hall, 1887.							
23	1	Chaetetes (T.) tabulatus, Hall	*	.	.	.	.	14	ix. figs. 12-15.
24	2	C. (T.) Helderbergiæ, Hall	*	.	.	.	.	15	ix. figs. 16, 17.
	13	Trematopora, Hall, 1852						xiv	
	14	Trematella, s. g., Hall, 1886.							
25	1	Trematopora ? (T. ?) corticosa, Hall	*	.	.	.	.	15	x. figs. 1-10; xiii. fig. 4; xxiii. fig 20.
26	2	T. (T.) arborea, Hall	.	.	*	.	.	69	xxv. figs. 16-21.
27	3	T. (T.) glomerata, Hall	.	.	*	.	.	70	xxv. figs. 4, 5.
28	4	T. (T.) perspinulata, Hall	.	.	.	*	.	175	Not figured.
29	5	T. (T.) nodosa, Hall	.	.	.	*	.	176	Not figured.
	15	Orthopora, s. g., Hall, 1886.							
30	1	Trematopora (O.) regularis, Hall	*	.	.	.	.	16	xi. figs. 1-8; xiii. figs. 1-3; xxiii. fig. 1.
		Trematopora (O.) regularis, Hall	.	.	*	.	.	71	xxv. figs. 27, 28; xxvi. figs. 5, 6.
31	2	T. (O.) ovatipora, Hall	*	.	.	.	.	17	xi. figs. 9-11; xxiii. fig. 5,
32	3	T. (O.) canaliculata, Hall	*	.	.	.	.	17	xi. fig. 12; xxiii. fig. 9.
33	4	T. (O.) rhombifera, Hall	*	.	.	.	.	18	xi. figs. 15, 17-20; xxiii. figs. 11. 12.
		T. (O.) rhombifera, Hall	.	.	*	.	.	71	xxv. fig. 29; xxvi. figs. 3, 4.
34	5	T. (O.) parellela, Hall	*	.	.	.	.	19	xi. figs. 13, 14; xxiii. figs 7, 8.
35	6	T. (O.) granilinea, Hall	*	.	.	.	.	....	Expl. xxiii. fig. 2.
36	7	T. (O.) nodosa, Hall	*	.	.	.	.	....	Expl. xxiii. fig. 10.
37	8	T. (O.) scutulata, Hall	.	.	*	.	.	70	xxvi. figs. 7, 8.
38	9	T. (O.) polygona, Hall	.	.	.	*	.	176	Not figured.
39	10	T. (O.) subquadrata, Hall	.	.	.	*	.	177	lv. fig. 10; lvi. figs. 1, 6.
40	11	T. (O.) hexagona, Hall	.	.	.	*	.	178	lv. fig. 8; lvi. fig. 2.
41	12	T. (O.) reticulata, Hall	.	.	.	*	.	179	lv. fig. 9; lvi. fig 5.
42	13	T. (O.) carinata, Hall	.	.	.	*	.	179	lv. fig. 2; lvi. fig. 3.

43	14	T. (O.) tortalinea, Hall	.	.	.	*	.	180	lvi. fig. 9.
44	15	T. (O.) lineata, Hall	.	.	.	*	.	181	lv. figs. 3-6; lvi. fig. 19.
45	16	T. (O.) bispinulata, Hall	.	.	.	*	.	182	lv. figs. 27-30; lvi. figs. 16-18.
46	17	T. (O.) elongata, Hall	.	.	.	*	.	183	lv. fig. 11; lvi. fig. 15.
47	18	T. (O.) ornata, Hall	.	.	.	*	.	184	lv. fig 1; lvi. fig 4.
48	19	T. (O.) immersa, Hall	.	.	.	*	.	185	lvi. fig. 11.
49	20	T. (O.) interplana, Hall	.	.	.	*	.	186	lvi. fig. 12.
50	21	T. (O.) granifera, Hall	.	.	.	*	.	186	Not figured.
51	22	T. (O.?) transversa, Hall	.	.	.	*	.	187	lv. fig. 12; lvi. figs. 13, 14.
52	23	T. (O.?) orbipora, Hall	.	.	.	*	.	188	lv. figs. 13, 14; lvi. fig. 8.
	16	Tropidopora, Hall, 1886.							
53	1	T. nana, Hall	.	.	*	.	.	71	xxv. figs. 25, 26.
	17	Diamesopora, Hall, 1852.							
54	1	D. constricta, Hall	*	.	.	.	.	19	x. figs. 14-19; xxiii. a, fig. 7.
55	2	D. dispersa, Hall	*	.	.	.	.	20	x. figs. 20, 21.
59	3	D. camerata, Hall	.	.	*	.	.	72	xxvi. figs 9, 10.
	18	Acanthoclema, Hall, 1886.							
57	1	A. alternatum, Hall	.	.	*	.	.	72	xxv. figs. 8-10.
58	2	A. ovatum, Hall	.	.	*	.	.	73	xxviii. fig. 3.
59	3	A. divergens, Hall	.	.	*	.	.	73	xxviii. fig. 2.
60	4	A. triseriale, Hall	.	.	*	.	.	74	xxviii. figs. 6, 7.
61	5	A. scutulatum, Hall	.	.	.	*	.	190	lv. figs. 15-17; lvi. figs. 19, 20.
62	6	A. Hamiltonense, Nicholson	.	.	.	*	.	191	lv. figs. 18-26.
63	7	A. sulcatum, Hall	.	.	.	*	.	192	lv. fig. 7; lvi. fig. 7.
	19	Bactropora, Hall, 1887.							
64	1	B. granistriata, Hall	.	.	.	*	.	193	lxvi. figs. 20-22.
65	2	B. curvata, Hall	.	.	.	*	.	194	lxvi. figs. 14-16.
	20	Nemataxis, Hall, 1886.							
66	1	N. fibrosus, Hall	.	.	*	.	.	74	xxv. figs. 30-36.
67	2	N. simplex, Hall	.	.	.	*	.	193	lxvi. figs. 17-19.
	21	Callopora, Hall, 1852.							
68	1	C. oppleta, Hall	*	.	.	.	.	21	xi. figs. 23, 24.
69	2	C. cellulosa, Hall	*	.	.	.	.	21	xii. figs. 1-9; xiii. fig. 9; xxiii. a, fig. 6.
70	3	C. perelegans, Hall	*	.	.	.	.	22	xii. figs. 10-17; xxiii. a, fig. 14.
71	4	C. multiseriata, Hall	.	.	*	.	.	75	xxv. figs. 6, 7; xxvi. figs. 18, 19.
72	5	C. geniculata, Hall	.	.	*	.	.	75	xxv. figs. 1-3.
	22	Callotrypa, s. g., Hall, 1887.							
73	1	Callopora (C.) macropora, Hall	*	.	.	.	.	24	xi. figs. 25-29; xxiii. figs. 15-19.
74	2	C. (C.) macropora var. signata, Hall	*	.	.	.	.	25	xi. figs. 30, 31.
75	3	C. (C.) heteropora, Hall	*	.	.	.	.	25	xi. figs. 32-34; xiii. figs. 5-8; xxiii. fig. 3.
76	4	C. (C.) unispina, Hall	*	.	.	.	.	26	xi. figs. 35-37.
77	5	C. (C.) striata, Hall	*	.	.	.	.	26	xi. figs. 38-41; xxiii. figs. 13, 14.
78	6	C. (C.) coulifera, Hall	*	.	.	.	.	27	xiii. fig. 10; xxiii. fig. 6.

SYNOPTICAL TABLE OF THE GENERA AND SPECIES, ETC. — (*Continued*).

Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
		Callotrypa — (*Continued*).							
79	7	C. (C.) paucipora, Hall	*	.	.	.	.	....	Expl. xxiii. fig. 21.
80	8	C. (C.) internodata, Hall	.	.	.	*	.	189	Not figured.
	23	Cœlocaulis, s. g., Hall, 1887.							
81	1	Callopora (C.) venusta, Hall	*	.	.	.	.	23	xii. figs. 20-24; xxiii. a, figs. 1-3, 4 (?), 5.
82	2	C. (C.) mediopora, Hall	*	.	.	.	.	23	xiv. fig. 18; xxiii. a, figs. 11-13.
83	3	C. (C.) aculeolata, Hall	.	.	*	.	.	76	xvi. figs. 16, 17.
84	4	C. (C.) irregularis, Hall	.	.	*	.	.	76	xxvi. figs. 11-15.
85	5	C. (C.) Hyale, Hall	.	.	*	.	.	76	xii. figs. 18, 19.
	24	Lichenalia, Hall, 1852.							
86	1	L. crassa, Hall	*	.	.	.	.	30	xi. figs. 21, 22.
87	2	L. maculosa, Hall	*	.	.	.	.	30	xiv. figs. 1-8.
88	3	L. torta, Hall	*	.	.	.	.	31	xv. figs. 1-5, 7.
89	4	L. serialis, Hall	*	.	.	.	.	32	xiii. figs. 17, 18; xv. fig. 6.
90	5	L. distans, Hall	*	.	.	.	.	32	xv. figs. 8, 9.
91	6	L. lunata Rominger	.	.	*	.	.	77	xxxi. figs. 1-9.
92	7	L. lunata, var, tubulata, Hall	.	.	*	.	.	78	xxxi. figs. 28, 29.
93	8	L. substellata, Hall	.	.	*	.	.	78	xxvi. fig. 26; xxx. figs. 1-11.
94	9	L. bistriata, Hall	.	.	*	.	.	79	xxxii. figs. 6-14.
95	10	L. geometrica, Hall	.	.	*	.	.	79	xxxii. figs. 21-23.
96	11	L. ovata, Hall	.	.	*	.	.	80	xxxii. figs. 1-5.
97	12	L. alternata, Hall	.	.	*	.	.	80	xxxi. figs. 39-41.
98	13	L. conulata, Hall	.	.	*	.	.	81	xxxi. figs. 10-14.
99	14	L. subcava, Hall	.	.	*	.	.	81	xxvi. figs. 23-25.
100	15	L. permarginata, Hall	.	.	*	.	.	82	xxvi. fig. 20.
101	16	L. stellata, Hall	.	.	.	*	.	195	lviii. figs. 15, 16.
102	17	L. subtrigona, Hall	.	.	.	*	.	196	Not figured.
103	18	L. distans, Hall	.	.	.	*	.	197	Not figured.
104	19	L. vesiculata, Hall	.	.	.	*	.	198	lvii. figs. 14-19; lix. figs. 1, 14.
105	20	L. ramosa, Hall	.	.	.	*	.	199	Not figured.
106	21	L. colliculata, Hall	.	.	.	*	.	200	Not figured.
107	22	L. cultellata, Hall	.	.	.	*	.	202	lxiv. figs. 1, 2.
108	23	L. cornuta, Hall	.	.	.	*	.	203	Not figured.
109	24	L. confusa, Hall	.	.	.	*	.	204	Not figured.
110	25	L. bullata, Hall	.	.	.	*	.	205	lvii. figs. 12, 13.

111	26	L. operculata, Hall	.	.	.	*	.	205	Not figured.
112	27	L. pustulosa, Hall	.	.	.	*	.	206	Not figured.
113	28	L. tessellata, Hall	.	.	.	*	.	207	Not figured.
	25	Pileotrypa, s. g., Hall, 1886.							
114	1	Lichenalia (P.) pyriformis, Hall	.	.	*	.	.	82	xxxi. figs. 21-27.
115	2	L. (P.) clivulata, Hall	.	.	*	.	.	83	xxxi. figs. 30-33.
116	3	L. (P.) granifera, Hall	.	.	*	.	.	84	xxx. figs. 28-31.
117	4	L. (P.) denticulata, Hall	.	.	*	.	.	84	xxvi. figs. 21, 22, 27; **xxx. figs. 12-20.**
	26	Odontotrypa, s. g., Hall, 1886.							
118	1	Lichenalia (O.) alveata, Hall	.	.	*	.	.	85	xxx. figs. 24-27.
	27	Lichenotrypa, s. g., Ulrich, 1886.							
119	1	Lichenalia (L.) longispina, Hall	.	.	*	.	.	287	xxv. figs. 11, 12.
	28	Selenopora, s. g., Hall, 1886.							
120	1	Lichenalia (S.) circincta, Hall	.	.	*	.	.	86	xxv. figs. 13-15.
121	2	L. (S.) complexa, Hall	.	.	*	.	.	87	xxxi. figs. 19, 20.
	29	Glossotrypa, s. g., Hall, 1887.							
122	1	Lichenalia? (G.) paliformis, Hall	.	.	*	.	.	85	xxxi. figs. 15-18.
	30	Phractopora, Hall, 1881.							
123	1	P. cristata, Hall	.	.	*	.	.	99	xxxi. figs. 36, 37.
124	2	P. cristata, var. lineata, Hall	.	.	*	.	.	99	xxxi. figs. 34, 35.
	31	Fistulipora, McCoy, 1849.							
125	1	F. ponderosa, Hall	*	.	.	.	.	27	xiv. figs. 9-12; xxiii. a, figs. 8-10.
126	2	F. parasitica, Hall	*	.	.	.	.	28	xiv. figs. 13, 14; xxiii. fig. 4.
127	3	F. triloba, Hall	*	.	.	.	.	29	Not figured.
128	4	F. lamellata, Hall	.	.	*	.	.	87	xxx. figs. 21-23.
129	5	F. intercellata, Hall	.	.	*	.	.	87	xxxii. figs. 15-20.
130	6	F. longimacula, Hall	.	.	.	*	.	209	Not figured.
131	7	F. variopora, Hall	.	.	.	*	.	210	lviii. figs. 9-14.
132	8	F. confertipora, Hall	.	.	.	*	.	211	lviii. figs. 1-5.
133	9	F. scrobiculata, Hall	.	.	.	*	.	212	lviii. figs. 17, 18.
134	10	F. umbilicata, Hall	.	.	.	*	.	213	Not figured.
135	11	F. serrulata, Hall	.	.	.	*	.	214	lviii. figs. 6-8.
136	12	F. plana, Hall	.	.	.	*	.	215	lviii. figs. 19, 20.
137	13	F. unilinea, Hall	.	.	.	*	.	217	lvii. figs. 1, 2, 5.
138	14	F. interaspera, Hall	.	.	.	*	.	218	Not figured.
139	15	F. segregata, Hall	.	.	.	*	.	219	lix. fig. 4.
140	16	F. micropora, Hall	.	.	.	*	.	220	lvii. fig. 20; lix. fig. 3.
141	17	F. involvens, Hall	.	.	.	*	.	221	lix. fig. 2.
142	18	F. trifaria, Hall	.	.	.	*	.	222	Not figured.
143	19	F. triangularis, Hall	.	.	.	*	.	222	Not figured.
144	20	F. minuta (?), Rominger	.	.	.	*	.	223	lix. figs. 5-8.
145	21	F. spheroidea, Hall	.	.	.	*	.	225	lvii. figs. 3, 4.
146	22	F. hemispherica, Hall	.	.	.	*	.	226	lvii. figs. 8-11.

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Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
		Fistulipora—(*Continued*).							
147	23	F. constricta, Hall	.	.	.	*	.	227	Not figured.
148	24	F. multaculeata, Hall	.	.	.	*	.	228	lix. figs. 10, 11.
149	25	F. digitata, Hall	.	.	.	*	.	229	lix. figs. 12, 13.
150	26	F. densa, Hall	.	.	.	*	.	231	Not figured.
151	27	F. decipiens, Hall	.	.	.	*	.	232	lix. fig. 9.
152	28	F? subtilis, Hall	.	.	.	*	.	233	Not figured.
	32	Favicella, Hall, 1887.							
153	1	F. inclusa, Hall	.	.	.	*	.	234	lviii. figs. 21, 22.
	33	Ceramopora, Hall, 1852.							
154	1	C. maculata, Hall	*	.	.	.	.	33	xvi. figs. 5-11.
155	2	C. labeculoidea, Hall	*	.	.	.	.	33	xvi. figs. 1, 2.
156	3	C.? parvicella, Hall	*	.	.	.	.	34	xvi. figs. 3, 4.
157	4	C. imbricella, Hall	.	.	.	*	.	236	Not figured.
158	5	C. (Berenicea) maxima, Hall	*	.	.	.	.	34	xvi. fig. 12.
159	6	C.? (Lichenalia) foliacea, Hall	.	.	.	*	.	235	lvii. figs. 6, 7.
	34	Paleschara, Hall, 1874.							
160	1	P. incrustans, Hall	*	.	.	.	.	35	xvi. figs. 15–21.
161	2	P. radiata, Hall	*	.	.	.	.	35	xvi. figs. 13, 14.
162	3	P.? dissimilis, Hall	*	.	.	.	.	35	xv. figs. 10–13.
163	4	P.? tenuis, Hall	*	.	.	.	.	36	Not figured.
164	5	P.? (Lichenalia?) bilateralis, Hall	*	.	.	.	.	36	xvi. figs. 22, 23.
165	6	P. concentrica, Hall	*	.	.	.	.	67	xvi. fig. 24.
166	7	P. pertenius, Hall	.	.	.	*	.	237	Not figured.
167	8	P. intercella, Hall	.	.	.	*	.	237	Not figured.
168	9	P. reticulata, Hall	.	.	.	*	.	237	Not figured.
169	10	P. variacella, Hall	.	.	.	*	.	237	Not figured.
170	11	P. amplectens, Hall	.	.	.	*	.	237	Not figured.
	35	Coscinium, Keyserling, 1846.							
171	1	C. striaturum, Hall	.	.	*	.	.	88	xxxiii. figs. 20, 21.
172	2	C. striatum, Hall	.	.	.	*	.	238	lxiv. figs. 13-16.

	36	Coscinotrypa, Hall, 1886.							
173	1	C. cribriformis, Prout, var. carinata, Hall	.	.	*	.	.	89	xxix. figs. 29-35; xxxiii. figs. 22-25.
	37	Coscinella, Hall, 1887.							
174	1	C. elegantula, Hall	.	.	.	*	.	239	lxiv. figs. 9-12.
	38	Ceramella, Hall, 1887.							
175	1	C. scidacea, Hall	.	.	.	*	.	240	lxiv. figs. 5-8.
	39	Ptilodictya, Lonsdale, 1839.							
176	1	P. lirata, Hall	.	.	.	.	.	38	xvii. figs. 1-4; xxiii. a, fig. 20.
177	2	P. tenuis, Hall	*	.	.	.	.	39	xiii. fig. 14; xvii. 7-12; xxiii. a, fig. 15.
178	3	P. nebulosa, Hall	*	.	.	.	.	40	xvii. figs. 13-18.
179	4	P. parallela, Hall	*	.	.	*	.	270	lxi. figs. 7, 8.
180	5	P. plumea, Hall	.	.	.	*	.	271	lxi. figs. 9-12.
181	6	P. retiformis, Hall	.	.	.	*	.	272	lxi. fig. 13.
182	7	P. scutulata, Hall	.	.	.	*	.	272	Not figured.
	40	Acrogenia, Hall, 1881.							
183	1	A. prolifera, Hall	.	.	..	*	.	267	lxiii. figs. 17-15.
	41	Stictoporina, s. g., Hall, 1887.							
184	1	Stictopora (S.) claviformis, Hall	.	.	.	*	.	269	Not figured.
	42	Rhinidictya, Ulrich, 1882.							
185	1	R.? granulosa, Hall	*	.	.	.	.	40	xvii. figs. 5, 6; xxiii. a, figs. 18, 19.
	43	Stictopora, Hall, 1847.							
186	1	S. papillosa, Hall	*	.	.	.	.	37	xiii. figs. 12, 13; xxiii. a, fig. 16.
187	2	S. obsoleta, Hall	*	.	.	.	.	37	xxiii. a, fig. 22.
188	3	S. granatula, Hall	*	.	.	.	.	38	xi. fig. 16; xxiii. a, fig. 17.
189	4	S. alternata, Hall	*	.	.	.	.	....	Expl. xxiii. a, fig. 21.
190	5	S. Gilberti, Meek	.	.	*	.	.	90	xxvii. figs. 20-35; xxviii. figs. 21, 22.
191	6	S. crescens, Hall	.	.	*	.	.	91	xxvii. figs. 5-11.
192	7	S. rigida, Hall	.	.	*	.	.	91	xxviii. figs. 15, 16.
193	8	S. fruticosa, Hall	.	.	*	.	.	92	xxviii. figs. 12-14.
194	9	S. ovatipora, Hall	.	.	*	.	.	93	xxvii. figs. 12-19; xxviii. figs. 23, 23 a.
195	10	S. vermicula, Hall	.	.	*	.	.	93	xxvii. figs. 2-4.
196	11	S. invertis, Hall	.	.	*	.	.	94	xxviii. figs. 24-26.
197	12	S. semistriata, Hall	.	.	*	.	.	95	xxviii. figs. 17-20.
198	13	S. rhomboidea, Hall	.	.	*	.	.	95	xxix. figs. 27, 28.
199	14	S. perarcta, Hall	.	.	*	.	.	96	xxix. figs. 36, 27.
200	15	S. linearis, Hall	.	.	*	.	.	96	xxviii. figs. 4, 5; xxvii. fig. 1.
201	16	S. incisurata, Hall	.	.	.	*	.	241	lx. figs. 1-18.
202	17	S. trilineata, Hall	.	.	.	*	.	243	lxi. figs. 26, 27.
203	18	S. rectalinea, Hall	.	.	.	*	.	245	lxiii. fig. 23.
204	19	S. tumulosa, Hall	.	.	.	*	.	246	lxi. figs. 18-22.
205	20	S. striata, Hall	.	.	.	*	.	246	lxiii. fig. 22.
206	21	S. sinuosa, Hall	.	.	.	*	.	247	lxi. fig. 17.
207	22	S. ovata, Hall	.	.	.	*	.	248	lxiii. fig. 24.

SYNOPTICAL TABLE OF THE GENERA AND SPECIES, ETC.—(*Continued*).

Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
		Stictopora—(*Continued*).							
208	23	S. incrassata, Hall	.	.	.	*	.	246	lxii. figs. 1-6.
209	24	S. limata, Hall	.	.	.	*	.	250	lxi. figs. 14-16.
210	25	S. subrigida, Hall	.	.	.	*	.	251	lx. fig. 21.
211	26	S. crenulata, Hall	.	.	.	*	.	252	lx. fig. 22.
212	27	S. angularis, Hall	.	.	.	*	.	252	lxi. fig. 23.
213	28	S. recta, Hall	.	.	.	*	.	253	Not figured.
214	29	S. bifurcata, Hall	.	.	.	*	.	254	lxiii. fig. 17,
215	30	S. palmipes, Hall	.	.	.	*	.	255	lx. figs. 19, 20.
216	31	S. lobata Hall	.	.	.	*	,	256	Not figured.
217	32	S. granifera, Hall	.	.	.	*	.	257	lxi. figs. 1-6.
218	33	S. divergens, Hall	.	.	.	*	.	257	lxiii. figs. 18, 19.
219	34	S. permarginata, Hall	.	.	.	*	.	258	lxiii. fig. 16.
220	35	S. interstriata, Hall,	.	.	.	*	.	259	lxii. figs. 7-12.
221	36	S. recubans, Hall	.	.	.	*	.	260	lxiii. figs. 20, 21.
222	37	S. subcarinata, Hall	.	.	.	*	.	261	lxiii. figs. 1-6.
	44	Thamnotrypa, Hall, 1887.							
223	1	T. divaricata, Hall	.	.	*	.	.	101	xxxiii. figs. 9, 10.
	45	Tæniopora, Nicholson, 1874.							
224	1	T. exigua, Nicholson	.	.	.	*	.	263	lxii. figs. 15-26.
	46	Prismopora, Hall, 1881.							
225	1	P. triquetra, Hall	.	.	*	.	.	97	xxviii. figs. 8-10; xxix. figs. 9-15.
226	2	P. paucirama, Hall	.	.	*	.	.	98	xxviii. fig. 11; xxix. figs. 16, 17.
227	3	P. sparsipora, Hall	.	.	*	.	.	288	xxxii. figs. 24-28.
228	4	P. dilatata, Hall	.	.	.	*	.	265	lxii. figs. 13, 14.
229	5	P. lata, Hall	.	.	.	*	.	266	Not figured.
	47	Scalaripora, Hall, 1881.							
230	1	S. scalariformis, Hall	.	.	*	.	.	100	xxix. figs. 4-8.
231	2	S. subconcava, Hall	.	.	*	.	.	100	xxix. figs. 1-3.
	48	Semiopora, Hall, 1881,							
232	1	S. bistigmata, Hall	.	.	.	*	.	262	lxii. figs. 27-29.

	49	Intrapora, Hall, 1881.							
233	1	I. puteolata, Hall	.	.	*	.	.	97	xxix. figs. 18-26.
	50	Thamniscus, King, 1849.							
234	1	T. variolata, Hall	*	.	.	.	.	41	xxii. figs. 34-46.
235	2	T. fruticella, Hall	*	.	.	.	.	42	xxii. fig. 33.
236	3	T. ? Cisseis, Hall	*	.	.	.	.	42	xxii. figs. 24-30.
237	4	T. ? Nysa, Hall	*	.	.	.	.	43	xxii. figs. 31, 32, 47, 48.
238	5	T. multiramus, Hall	.	.	*	.	.	104	xxxiii. figs. 1-5.
239	6	T. pauciramus, Hall	.	.	.	*	.	274	Not figured.
240	7	T. nanus, Hall	.	.	*	.	.	292	lxvi. figs. 11-13.
	51	Fenestella, Lonsdale, 1839.							
241	1	F. crebripora, Hall	*	.	.	.	.	43	xx. figs. 1-3.
242	2	F. junceus, Hall	*	.	.	.	.	44	xx. figs. 16-18.
243	3	F. Cleia, Hall	*	.	.	.	.	45	xx. figs. 14, 15.
244	4	F. Hestia, Hall	*	.	.	.	.	45	xx. 12, 13.
245	5	F. Æsyle, Hall	*	.	.	.	.	46	xix. figs. 11-13.
246	6	F. Noe, Hall	*	.	.	.	.	47	xiii. figs. 19-22.
247	7	F. Spio, Hall	*	.	.	.	.	47	xix. fig. 16.
248	8	F. Althæa, Hall	*	.	.	.	.	48	xix. figs. 17-19.
249	9	F. Adraste, Hall	*	.	.	.	.	48	xx. figs. 19-22.
250	10	F. Sylvia, Hall	*	.	.	.	.	49	xx. figs. 4-7.
251	11	F. Philia, Hall	*	.	.	.	.	50	xx. figs. 9-11.
252	12	F. Thyene, Hall	*	.	.	.	.	50	xxi. figs. 1-5.
253	13	F. Coronis, Hall	*	.	.	.	.	51	xxi. figs. 10-13.
254	14	F. Idalia, Hall	*	.	.	.	.	52	xxi. figs. 6-9.
255	15	F. quadrula, Hall	*	.	.	.	.	53	xxi. figs. 19-22.
256	16	F. adornata, Hall	*	.	.	.	.	66	xxii. figs. 7, 8.
257	17	F. variapora, Hall	.	.	*	.	.	104	xxxv. fig. 17; xlv. figs. 1-13.
258	18	F. tenella, Hall	.	.	*	.	.	105	xlv. figs. 18, 19.
259	19	F. pertenuis, Hall	.	.	*	.	.	106	xlv. figs. 22, 23.
260	20	F. parallela, Hall	.	.	*	.	.	107	vliv. figs. 8-18.
261	21	F. curvijunctura, Hall	.	.	*	.	.	107	xlvi. figs. 1-5.
262	22	F. confertipora, Hall	.	.	*	.	.	108	xlvi. figs. 7-11, 17-21.
263	23	F. stellata, Hall	.	.	*	.	.	109	xlv. figs. 14, 15; xlvii. figs. 20-36.
264	24	F. serrata, Hall	.	.	*	.	.	110	xlvii. figs. 11-19.
265	25	F. verrucosa, Hall	.	.	*	.	.	110	xlii. fig. 11; xlvi. figs. 22-24.
266	26	F. depressa, Hall	.	.	*	.	.	111	xlv. figs. 16-17.
267	27	F. æqualis, Hall	.	.	*	.	.	112	xlvi. figs. 27-31.
268	28	F. biseriata, Hall	.	.	*	.	.	113	xlii. figs. 16-18.
269	29	F. peculiaris, Hall	.	.	*	.	.	113	xlii. figs. 19-21.
270	30	F. dispanda, Hall	.	.	*	.	.	114	xliv. figs. 1-4.
271	31	F. singularitas, Hall	.	.	*	.	.	114	xlvi. figs. 12-16.
272	32	F. proceritas, Hall	.	.	*	.	.	115	xlvi. figs. 32, 35, 36.
273	33	F. sinuosa, Hall	.	.	*	.	.	116	xliv. figs. 5, 6.
274	34	F. tuberculata, Hall	.	.	*	.	.	116	xlvi. figs. 25, 26, 33, 34.
275	35	F. clathrata, Hall	.	.	*	.	.	117	Not figured.
276	36	F. erectipora, Hall	.	.	*	,	.	118	l. figs. 15, 16.

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		Fenestella — (*Continued*).							
277	37	F. cultrata, Hall	.	.	*	.	.	119	l. figs. 1-5.
278	38	F. lunulata, Hall	.	.	*	.	.	121	xlvii. figs. 1-10.
279	39	F. bi-imbricata, Hall	.	.	*	.	.	122	xlviii. figs. 6-11.
280	40	F. interrupta, Hall	.	.	*	.	.	123	xlviii. figs. 12-17.
211	41	F. granifera, Hall	.	.	*	.	.	125	l. figs. 12-14, 16.
282	42	F. semirotunda, Hall	.	.	*	.	.	125	xlix. figs. 11-22.
287	43	F. permarginata, Hall	.	.	*	.	.	127	xlix. figs. 1-10.
284	44	F. biserrulata, Hall	.	.	*	.	.	128	l. figs. 6-11.
285	45	F. latijunctura, Hall	.	.	*	.	.	128	xlviii. figs. 1-5.
286	46	F. perplexa, Hall	.	.	*	.	.	130	Not figured.
	52	Reteporina, s. g., D'Orbigny.							
287	1	Fenestella (R.) rhombifera, Hall	.	.	*	.	.	120	l. figs. 18,19.
288	2	F. (R.) coalescens, Hall	.	.	*	.	.	120	Not figured.
	53	Fenestrapora, s. g., Hall, 1884.							
289	1	Fenestella (F.) biperforata), Hall	.	.	.	*	.	286	lxvi. figs. 34-39.
	54	Unitrypa, s. g., Hall, 1885.							
290	1	Fenestella (U.) præcursor, Hall	*	.	.	.	.	54	xxi. figs. 14-18.
291	2	F. (U.) Nervia, Hall	*	.	.	.	.	55	xxii. figs. 1-3, 6, (9,10.)?
292	3	F. (U.) Nervia, var. constricta, Hall	*	.	.	.	.	56	xxii. figs. 11, 12.
293	4	F. (U.) acaulis, Hall	.	.	*	.	.	131	li. figs. 1-6.
294	5	F. (U.) acaulis, var. inclinis, Hall	.	.	*	.	.	132	Not figured.
285	6	F. (U.) projecta, Hall	.	.	*	.	.	132	Not figured.
296	7	F. (U.) transversa, Hall	.	.	*	.	.	132	Not figured.
297	8	F. (U.) nana, Hall	.	.	*	.	.	133	Not figured.
298	9	F. (U.) stipata, Hall	.	.	*	.	.	134	li. figs. 7-14.
299	10	F. (U.) tegulata, Hall	.	.	*	.	.	135	li. figs. 15-23.
300	11	F. (U.) lata, Hall	.	.	*	.	.	136	lii. figs. 1-10.
301	12	F. (U.) ficticius, Hall	.	.	*	.	.	137	lii. figs. 11-15.
302	13	F. (U.) acclivis, Hall	.	.	*	.	.	138	lii. figs. 16-23.
303	14	F. (U.) pernodosa, Hall	.	.	*	.	.	139	liii. figs. 1-11.
304	15	F. (U.) elegantissima, Hall	.	.	*	.	.	140	liii. figs. 12-17.
305	16	F. (U.) fastigata, Hall	.	.	*	.	.	141	liv. figs. 1-6.
306	17	F. (U.?) consimilis, Hall	.	.	*	.	.	142	liv. figs. 7-9.

	55	Isotrypa, s. g., Hall, 1885.							
307	1	Fenestella (I.) conjunctiva, Hall	.	.	*	.	.	143	liv. figs. 10-21.
	56	Loculipora, s. g. Rominger, M. S.							
308	1	Fenestella (L.) circumstata, Hall	.	.	*	.	.	144	liv. figs. 22-25.
	57	Hemitrypa, s. g. Phillips. 1841.							
309	1	Fenestella (H.) biserialis, Hall	*	.	.	.	.	57	xxii. figs. 13, 16-18.
310	2	F. (H.) biserialis, var. exilis, Hall	*	.	.	.	.	57	xxii. figs. 14, 15.
311	3	F. (H.) cribrosa, Hall	.	.	*	.	.	145	Not figured.
312	4	F. (H.) columellata, Hall	.	.	*	.	.	146	Not figured.
313	5	F. (H.) favosa, Hall	.	.	*	.	.	148	Not figured.
314	6	F. (H.) biordo, Hall	.	.	*	.	.	149	Not figured.
	58	Polypora, s. g. McCoy, 1845.							
315	1	Fenestella (P.) Eudora, Hall	*	.	.	.	.	58	xix. figs. 3, 4, 5, ? 6-10.
316	2	F. (P.) stricta, Hall	*	.	.	.	.	59	xix. figs. 1, 2.
317	3	F. (P.) Idothea, Hall	*	.	.	.	.	60	xix. figs. 14, 15.
318	4	F. (P.) compressa, Hall	*	.	.	.	.	61	xviii. figs. 14-18.
319	5	F. (P.) Lilæa, Hall	*	.	.	.	.	62	xviii. figs. 19-22.
320	6	F. (P.) compacta, Hall	*	.	.	.	.	63	xviii. figs. 1-3; xxii. figs. 4, 5.
321	7	F. (P.) Arta, Hall	*	.	.	.	.	63	xviii. figs. 4-7.
322	8	F. (P.) obliqua, Hall	*	.	.	.	.	64	xviii. figs. 8, 9.
323	9	F. (P.) paxillata, Hall	*	.	.	.	.	65	xviii. figs. 10-12.
324	10	F. (P.) celsipora, Hall	.	.	*	.	.	150	xli. figs. 16-22; xlii. figs. 5-10.
325	11	F. (P.) celsipora, var. minor, Hall	.	.	*	.	.	151	xli. figs. 14, 15.
326	12	F. (P.) celsipora, var. minima, Hall	.	.	*	.	.	151	xxxv. figs. 1-4; xli. figs. 11-13.
327	13	F. (P.) adnata, Hall	.	.	*	.	.	152	xli. figs. 1-8, 10.
328	14	F. (P.) elongata, Hall	.	.	*	.	.	153	xlii. figs. 3, 4.
329	15	F. (P.) carinella, Hall	.	.	*	.	.	153	xlii. figs. 1-2.
330	16	F. (P.) granilinea, Hall	.	.	*	.	.	154	xl. figs. 20-23.
331	17	F. (P.) rigida, Hall	.	.	*	.	.	155	xxxiv. figs. 1-3.
332	18	F. (P.) robusta, Hall	.	.	*	.	.	156	xxxiv. figs. 4-7; xxxvii. fig. 1; xxxix. figs. 1-3; xliii. fig. 1; lxvi. fig. 6.
333	19	F. (P.) largissima, Hall	.	.	*	.	.	156	xxxiv. figs. 8, 9.
334	20	F. (P.) propria, Hall	.	.	*	.	.	157	xxxiv. figs. 10-13.
335	21	F. (P.) aculeata, Hall	.	.	*	.	.	157	xxxv. figs. 5-7; xl. figs. 6-11.
336	22	F. (P.) quadrangularis, Hall	.	.	*	.	.	158	xxxv. figs. 8-13; xxxvi. figs. 23, 24; xl. figs. 1, 2.
337	23	F. (P.) lævistriata, Hall	.	.	*	.	.	159	xxxv. figs. 14-16.
338	24	F. (P.) cultellata, Hall	.	.	*	.	.	160	xxxvi. figs. 3-22; xli. fig. 9.
339	25	F. (P.) distans, Hall	,	.	*	.	.	161	xxxvii. figs. 2-10, 15, 16; xliv. fig. 7.
340	26	F. (P.) flabelliformis, Hall	.	.	*	.	.	161	xxxvii. figs. 11, 12.
341	27	F. (P.) perangulata, Hall	.	.	*	.	.	162	xxxvii. figs. 13, 14.
342	28	F. (P.) porosa, Hall	.	.	*	.	.	163	xxxviii. figs. 1-6.
343	29	F. (P.) perundata, Hall	.	.	*	.	.	163	xxxviii. figs. 7-13.
344	30	F. (P.) hexagonalis, Hall	.	.	*	.	.	164	xxxviii. figs. 14-20.
345	31	F. (P.) hexagonalis, var. foraminulosa, Hall	.	.	*	.	.	165	xxxix. figs. 16-20.
346	32	F. (P.) nexa, Hall	.	.	*	.	.	165	xxxix. figs. 4-9.
347	33	F. (P.) separata, Hall	.	.	*	.	.	166	xxxix. figs. 10, 11.
348	34	F. (P.) mutabilis, Hall	.	.	*	.	.	166	xxxix. figs. 12-15.

SYNOPTICAL TABLE OF THE GENERA AND SPECIES, ETC.— (*Continued*).

Serial number.	Species number.	NAME AND AUTHOR.	Lower Helderberg.	Schoharie grit.	Corniferous.	Hamilton.		Page.	Plates and Figures.
		Polypora—(*Continued*).							
349	35	F. (P.) submutans, Hall	.	.	*	.	.	167	xl. figs. 3-5.
350	36	F. (P.) brevisulcata, Hall	.	.	*	.	.	168	xl, figs. 12-15.
351	37	F. (P.) striatopora, Hall	.	.	*	.	.	168	xl. figs. 16-19.
352	38	F. (P.) lævinodata, Hall	.	.	*	.	.	169	xlii. figs. 12-15.
353	39	F. (P.) rustica, Hall	.	.	*	.	.	169	xliii. figs. 10-13.
354	40	F. (P.) crebescens, Hall	.	.	*	.	.	170	xlv. figs. 20, 21.
	59	Ptiloporella, s. g., Hall, 1885.							
355	1	Fenestella (P.) laticrescens, Hall	.	.	*	.	.	171	Not figured.
356	2	F. (P.) inequalis, Hall	.	.	*	.	.	171	Not figured.
	60	Ptiloporina, s. g., Hall, 1885.							
357	1	Fenestella (P.) conica, Hall	.	.	*	.	.	172	xliii. figs. 2-4.
358	2	F. (P.) pinnata, Hall	.	.	*	.	.	172	xliii. figs. 5, 6.
359	3	F. (P.) disparilis, Hall	.	.	*	.	.	173	xliii. figs. 7, 8.
360	4	F. (P.) sinistralis, Hall	.	*	.	.	.	174	xliii. fig. 9.
	61	Ptilopora, McCoy, 1849.							
361	1	P. striata, Hall	.	.	.	*	.	283	lxvi. figs. 30-33.
362	2	P. infrequens, Hall	.	.	.	*	.	284	lxvi. figs. 26-29.
363	3	P. nodosa, Hall	.	.	.	*	.	285	lxvi. fig. 25.
	62	Glauconome, Goldfuss, 1826.							
364	1	G. sinuosa, Hall	.	.	*	.	.	101	xxxiii. figs. 11, 12.
365	2	G. tenuistriata, Hall	.	.	*	.	.	102	xxxiii. figs. 15-19.
366	3	G. nodata, Hall	.	.	*	.	.	102	xxxiii. figs. 13, 14,
367	4	G. carinata, Hall	.	.	.	*	.	273	lxvi. figs. 23, 24.
	63	Ichthyorachis, McCoy, 1844.							
368	1	I. Nereis, Hall	*	.	.	.	.	66	xxii. figs. 19-21.
	64	Criscinella, Hall, 1883.							
369	1	C. scrobiculata, Hall	.	.	*	.	.	103	xxxiii. figs. 6-8.
	65	Cystopora, Hall, 1881.							
370	1	C. geniculata, Hall	.	.	*	.	.	103	lxvi. figs. 7-10.

	66	Clonopora, Hall, 1881.							
371	1	C. fasciculata, Hall	.	.	*	.	.	289	lxvi. figs. 1, 2.
372	2	C. semireducta, Hall	.	.	*	.	.	289	lxvi. figs. 3, 4.
373	3	C. incurva, Hall	.	.	*	.	.	289	lxvi. figs. 5, 6.
	67	Reptaria, Rolle, 1851.							
374	1	R. stolonifera, Rolle	.	.	.	*	.	274	lxv. figs. 17-19.
375	2	R. nodata, Hall	.	.	.	*	.	276	Not figured.
	68	Hederella, Hall, 1881.							
376	1	H. cirrhosa, Hall	.	.	.	*	.	277	lxv. figs. 12, 13.
377	2	H. Canadensis, Nicholson	.	.	.	*	.	277	lxv. figs. 1-8, 14, 16 ?
378	3	H. filiformis, Billings	.	.	.	*	.	278	lxv. figs. 9-11.
379	4	H. conferta, Hall	.	.	.	*	.	279	Not figured.
380	5	H. magna, Hall	.	.	.	*	.	280	lxv. fig. 15.
	69	Hernodia, Hall, 1871.							
381	1	H. hemifusa, Hall	.	.	.	*	.	281	lxv. figs. 20, 21.
	70	Botryllopora, Nicholson.							
382	1	B. socialis, Nicholson	.	.	.	*	.	282	lxiv. figs. 3, 4.
			107	1	158	118			
		Addenda.							
	71	Receptaculites, De France, 1827.							
383	1	R. infundibuliformis, Eaton	*	.	.	.	.	290	xxiv. figs. 3-11.
	72	Ischadites, Murchison.							
384	1	I. squamifer, Hall	*	.	.	.	.	291	xxiv. figs. 1, 2.
385	2	I. bursiformis, Hall	.	*	.	.	.	291	xxiv. figs. 12-14.
			109	2	158	118			

The preceding synoptical table presents a list of the genera and species, actually described in Volume VI of the Palæontology of New York. Of this number fifty species are not illustrated upon the plates, though described in the text of the volume. This omission has arisen from the limitation as to the number of plates and figures to be included in the volume, by the contract of 1883.

This contract was made after the work had been commenced and thirty-three plates already lithographed, the restriction being necessary in order to give each class of objects to be represented in the several volumes its proper proportion, without exceeding the entire appropriation for the final publication of volumes V, VI, VII and VIII.

In the beginning of this work for volume VI there was no actual or anticipated restriction in the amount of text or number of plates and the drawings were begun and continued with a view of making the result as complete as the material at our command would permit. With this object in view and having abundant material in some of the groups or families, these were very fully illustrated. When, however, the restriction was imposed it became necessary to make such a selection of the illustrations as would give a fair expression of each group, and including as many of the genera as practicable in our descriptions and illustrations.

In furtherance of this plan it became necessary to omit all the Fenestellidæ of the Hamilton Group, besides many from the Upper Helderberg Group, as already noticed. Many of the original drawings made under the earlier conditions of the work named above, still remain unutilized, but are at any time available for further illustrations of the Bryozoa.

There now remain available for such further use as may be considered desirable about 290 figures, representing about seventy-two species, chiefly of the Fenestellidæ. To illustrate these species fully would require about one hundred more figures, chiefly of the celluliferous faces of these fossils. These species are neither named nor described and the collection is of little scientific value in its present condition. Were these forms named and described the collection would become of much scientific value as containing the type specimens of the species. There are also about seventy figures of specimens described in the text of volume VI, for which there was no room upon the plates. For the same reason there were from sixty to eighty drawings left off from the lithographed plates, for want of room, the species being represented by fewer figures than would have been desirable, could the space have been allowed. All these drawings could be arranged on plates and published in the annual reports; or they can be arranged on plates corresponding with those of the volumes and published as a supplement or arranged as part of a museum bulletin to be published with a classification of the Bryozoa.

The best and most satisfactory disposition of this material would be the publication of a supplemental volume of about twenty plates with text of 150 pages to include a synopsis and classification of the genera with the proper illustrations, together with descriptions of the new species. This would serve to give a completeness to the work which it now lacks, and which, from the great amount of new material that would be presented in the volume, we should feel it a duty to publish.

In order to have this material more immediately available for use, should it be required for publication, I propose to arrange these drawings upon cards in the form of the plates of the volume and to have the necessary drawings made for their completion; to write out the descriptions, and explanations of plates and to leave all this, together with the specimens properly labeled and arranged in a series of drawers, so that the entire material will be available for use.

The Corals and Bryozoa of the Lower Helderberg Group and the Bryozoa of the Upper Helderberg Group which have been used in the descriptions and illustrations of the volume have been arranged in drawers in the rooms of the upper story of the State Hall. All the duplicate collections of specimens have likewise been similarly arranged preparatory to labeling the whole (a work already begun). To complete the labeling will require several months of careful labor by Mr. Simpson the assistant and draughtsman in this department. At the end of February, 1888, Mr. Simpson's services were discontinued, and the material mentioned above, as practically prepared for publication, still remains in the same condition as when this report was written, with a large number of specimens remaining unlabelled and consequently of little value to science or to the Museum.

In this connection I beg leave again to urge upon the committee of the State Museum the great importance of having selected from the very large collection of fossil corals a series of specimens for their special study, leaving the remainder for disposition as duplicate collections. Until such selection is fully made it becomes impracticable to distribute any part of this collection which now occupies twenty-five large boxes, which are piled in the rotunda, four large tables of five shelves each, and 608 drawers, of which nine are filled with cut and polished specimens, and also a long wall-case in the corridor containing about 500 large specimens. I may likewise mention the fact that all the drawers of the large room appropriated to the duplicate collection are filled with specimens while there remain many boxes filled with specimens which it is very desirable to have taken out and arranged.

PALÆONTOLOGY.

Volume VII.

The printing upon Volume VII Palæontology of New York was begun in September; the first proofs coming to hand early in October of the present year. At the time of the present writing more than one-half of the manuscript has been delivered to the printer and more than one-third of the matter is in type.

Of the proposed number of fifty-five plates, forty-five have already been lithographed, leaving ten plates in preparation and progress.

The accompanying synopsis of the contents of the volume, together with the list of plates will serve to give some more definite idea of the nature of the work in progress.

CRUSTACEA.

Subclass: ENTOMOSTRACA.
Order: TRILOBITA.
Family: **Calymenidæ.**
Genus: Calymene.
" Homalonotus.
Family: **Bronteidæ.**
Genus: Bronteus.
Family: **Phacopidæ.**
Genus: Phacops.
" Dalmanites.
Subgenus: Hausmannia.
" Coronura.
" Cryphæus.
" Corycephalus.
" Odontocephalus.
" Chasmops.
Family: **Acidaspidæ.**
Genus: Acidaspis.
Family: **Lichadæ.**
Genus: Lichas.
Subgenus: Terataspis.
" Ceratolichas.
" Conolichas.
" Hoplolichas.
" Arges.
" Dicranogmus.
Family: **Proëtidæ.**
Genus: Proëtus.
" Phaëthonides.
" Cyphaspis.
Order: CIRRIPEDIA.
Family: **Lepadidæ.**
Genus: Plumulites.
" Strobilepis.
Family: **Balanidæ.**
Genus: Protobalanus.
Order: PHYLLOPODA.
Family: **Limniadiadæ.**
Genus: Estheria.
" Schizodiscus.
Subclass: MEROSTOMATA.
Order: XIPHOSURA.
Family: **Limulidæ.**
Genus: Protolimulus.
Order: EURYPTERIDA.
Family: **Eurypteridæ.**
Genus: Eurypterus.
" Stylonurus.
Subclass: MALACOSTRACA.
Order: PHYLLOCARIDA.
Family: **Ceratiocaridæ.**
Genus: Ceratiocaris.
" Echinocaris.
" Dithyrocaris.
" Elymocaris.
" Tropidocaris.
Family: **Rhinocaridæ.**
Genus: Rhinocaris.
Family: **Discinocaridæ.**
Genus: Spathiocaris.
" Dipterocaris.
Order: DECAPODA.
Family: **Carididæ.**
Genus: Palæopalæmon.

PLATES OF CRUSTACEA.

OCTOBER 1, 1887.

VI.	Phacops	Engraved.
VII.	Phacops	Engraved.
VIII.	Phacops	Engraved.
VIIIA.	Phacops	Engraved.
IX.	Dal. anchiops	Engraved.
X.	Dal. anchiops	Engraved.
XI.	Dal. regalis	Engraved.
XIA.	Dal. species	Engraved.
XIB.	Dal. selenurus	Engraved.
XII.	Dal. selenurus	Engraved.
XIII.	Dal. aspectans	Engraved.
XIV.	Dal. myrmecophorus	Engraved.
XV.	Dal. myrmecophorus	Engraved.
XVI.	Dal. Boothi	Engraved.
XVIA.	Dal. Boothi	Engraved.
XVIB.	Acidaspis	Engraved.
XVII.	Lichas grandis	Engraved.
XVIII.	Lichas grandis	Engraved.
XIX.	Lichas	Engraved.
XIXA.	Lichas	Engraved.
XIXB.	Lichas	Engraved.
XX.	Proëtus	Engraved.
XXI.	Proëtus	Engraved.
XXII.	Proëtus	Engraved.
XXIII.	Proëtus	Engraved.
XXIV.	Cyphaspis	Engraved.
XXV.	Miscellaneous trilobites.	
XXVI.	Stylonurus.	
XXVIA.	Stylonurus	Engraved.
XXVIII.	Protolimulus and Echinocaris.	
XXIX.	Echinocaris.	
XXX.	Echinocaris.	
XXXI.	Echinocaris, Tropidocaris, etc.	
XXXII.	Mesothyra.	
XXXIII.	Mesothyra	Engraved.
XXXIV.	Mesothyra	Engraved.
XXXV.	Dipterocaris.	
XXXVI.	Turrilepis and Protobalanus.	

For the plates yet incomplete there are about fifty original drawings to be made.

Besides the Crustacea this volume will contain a supplement to volume V, part II, including plates cxiv to cxxix, of which five are given to illustrations of Pteropoda and Annelida and the remainder to Cephalopoda of the genera Orthoceras, Gomphoceras, Cyrtoceras, Nautilus and Goniatites.

PALÆONTOLOGY.

Volume VIII.

Since the completion of volume V, part I, on the Lamellibranchiata the Museum collections and material prepared for this volume have been in the care and custody of Mr. C. E. Beecher, whose services I expected would be given in the final revision of the work.

He has, however, found it necessary to give most of his time to special Museum work and therefore little progress has been made in the study of Brachiopoda.

He had already, prior to 1886, prepared about 250 microscropic slides for illustrating the shell structure of nearly eighty species and about sixty photographic negatives have been taken. Unfortunately for our progress in this work no field collections in this direction have been made in many years, and the material now available in the Museum collection is entirely insufficient for any satisfactory progress in the work and quite inadequate for the purposes of the volume.

The work in preparation for a revision of the Brachiopoda was begun in 1867, after the completion of the fourth volume of the Palæontology.and was continued with interruptions until 1878, at which period twenty-eight plates had already been lithographed.

In the original plan of this volume no especial limitation was considered, but it was proposed to illustrate fully all the Palæozoic genera of Brachiopoda irrespective of geographical limitation. The plates were to embrace illustrations of the external form, hinge structure, the interior of the valve with its muscular and vascular impressions together with the miscroscopic structure of the shell.

Since 1878, little progress has been made in the work, for this volume, except in the preparation of sections for microscopic study, little or almost no new material has been accumulated, and we are not now as well prepared to go on as we were at that date. Since the commencement of this work several important monographs have been issued in England, France, Belgium, Germany and Bohemia, the most important of these being the monographs of Mr. Davidson upon the Silurian, Devonian and Carboniferous Brachiopoda. It follows without further argument or explanation that a work planned and partially executed more than ten years ago can not be creditably published at the present time without a modification in its scope and illustration.

Moreover, while the law of 1883 proposed and enacted a restriction upon the extent of the work as originally planned, the subject has in the meantime expanded far beyond what was known in 1867 or in 1878, and to meet these conditions the work should have been extended instead of curtailed.

In the twenty-eight plates already lithographed very full illustrations have been given of the families Orthidæ, Strophomenidæ, Productidæ and Spiriferidæ, embracing twenty-one genera. The species have been illustrated in their external form, hinge structure, muscular and vascular markings, leaving the microscopic structure to be illustrated in subsequent plates.

There remain according to the provisions of the contract but twenty-nine (30?) plates to be made up and lithographed. In order to make the work complete these twenty-nine plates should embrace the illustration of eleven families and almost eighty genera.

This would require the illustration of nearly three genera upon each plate, besides the illustrations of microscopic structure. It is scarcely necessary to say that this space is entirely inadequate for the proper presentation of this class of fossils.

It becomes important to consider this subject in view of the approach to completion of volume VII. Not only is it necessary to consider the question of the procuring of material for study and illustration, but the question as to whether a work begun in 1867 shall, after a lapse of twenty years, be continued and published upon the basis of the knowledge then possessed, or whether we will recognize the great progress made during that period and adapt our work to the existing state of our knowledge.

In conclusion, I beg leave to call your attention to the accompanying list of genera of Lamellibranchiata published and illustrated in volume V, part I, of the Palæontology of New York, together with a list of other Palæozoic genera which it has been proposed to illustrate in a bulletin of the State Museum of Natural History. Should the board remain of the same opinion as formerly it becomes very desirable to take some steps to procure specimens for illustration and to keep in view the plan of final publication.

I am very respectfully, your obedient servant.

JAMES HALL.

Statement of the Condition of the Work on the Brachiopoda. Palæontology of New York, Volume VIII. Communicated by C. E. Beecher.

December 3, 1887.

The condition of the volume on the Brachiopoda has remained unchanged since the date of the last report of the State Geologist.

Work was begun upon this volume, on the completion of the fourth volume of the Palæontology in 1867, and was continued with some lapses until 1878. About one-fourth of the labor may be considered as finished. Twenty-eight plates are lithographed and printed, illustrating three families and comprising twenty-one genera of Brachiopoda. The remaining twenty-nine plates yet to be done, should embrace eleven families, comprising about eighty genera.

Besides the illustration of the general form and characters of the genera, some work has been undertaken towards a study and illustration of the microscopic structure of the shell in the numerous species of this class of organisms. About two hundred and fifty microscope slides have been prepared, comprising the shells of nearly eighty species and about sixty photographic negatives, illustrating shell structure, have been taken.

Very little additional material for the completion of this volume, exists in the collections belonging to the State, and considerable field-work must be undertaken before systematic work can be commenced. The very full illustration already given of the twenty-one genera now on the printed plates, will make a disproportionate presentation of the remaining eighty genera, if presented according to the restricted limits determined by the law and contracts of 1883. It should be borne in mind also that since the inception of this work, several important monographs have been issued in England, France, Belgium, Germany and Bohemia, and the original plan will require radical modification before any creditable work can be published.

BRACHIOPODA.

I.		XVIII.	Productidæ.*
II.		XIX.	Productidæ.*
III.		XXI.	Spiriferidæ.*
IV.		XXII.	Spiriferidæ.*
AV.	Orthidæ. *	XXIII.	Spiriferidæ.*
V.	Orthidæ. *	XXIV.	Spiriferidæ.*
VI.	Orthidæ. *	XXV.	
VII.	Orthidæ. *	XXVI.	
VIII.	Strophomenidæ.*	XXVII.	
IX.	Strophomenidæ.*	XXVIII.	
X.	Strophomenidæ.*	XXIX.	
XI.	Strophomenidæ.*	XXX.	Spiriferidæ.*
XIA.	Strophomenidæ.*	XXXI.	Spiriferidæ.*
XII.	Strophomenidæ.*	XXXII.	Spiriferidæ.*
XIII.	Strophomenidæ.*	XXXIII.	Spiriferidæ.*
XIV.	Strophomenidæ.*	XXXIV.	Spiriferidæ.*
XV.	Strophomenidæ.*	XXXV.	Spiriferidæ.*
XVI.	Productidæ.*	XXXVI.	Spiriferidæ.*
XVII.	Productidæ.*		

CLASSIFICATION OF THE BRACHIOPODA [AFTER ZITTEL] (PALÆOZOIC).

A. Order Pleuropygia, Bronn.

Family.	Genera.
1st. Lingulidæ, King	4
2d. Obodidæ, King	10
3d. Discinidæ, Davidson	3
4th. Trimerellidæ, Davidson and King	4
5th. Craniadæ, D'Orbigny	3

B. Order Apygia.

1st. Productidæ, D'Orbigny	4
2d. Strophomenidæ, King	20
3d. Koninckinidæ, Davidson	1
4th. Spiriferidæ, D'Orbigny	23
5th. Atrypidæ, Dall	5
6th. Rhynchonellidæ, D'Orbigny	13
7th. Stringocephalidæ, Davidson	2
8th. Thecideidæ, King	1
9th. Terebratulidæ, King (emend. Davidson)	6
14 families.	99

* Plates lithographed.

LAMELLIBRANCHIATA.

LIST OF GENERA ILLUSTRATED ON THE PLATES OF THE REPORT OF THE STATE GEOLOGIST FOR 1882, PREPARED BY MR. C. E. BEECHER.

1. Pernopecten.
2. Crenipecten.
3. Euchondria.
4. Pterinopecten.
5. Aviculopecten.
6. Lyriopecten.
7. Pterinea.
8. Limoptera.
9. Ectenodesma.
10. Actinopteria.
11. Ptychopteria.
12. Glyptodesma.
13. Leiopteria.
14. Leptodesma.
15. Pteronites.
16. Gosselettia.
17. Mytilarca.
18. s. g. Plethomytilus.
19. Modiola, s. g., Mytilops.
20. Palæopinna.
21. Byssopteria.
22. Microdon.
23. Modiomorpha.
24. Goniophora.
25. Sphenotus.
26. Leda.
27. Nucula.
28. Nuculites.
29. Palæoneilo.
30. Ptychodesma.
31. Macrodon.
32. Nyassa.
33. Dystactella.
34. Schizodus.
35. Cytherodon.
36. Conocardium.
37. Paracyclas.
38. Megambonia.
39. Solemya.
40. Amnigenia.
41. Megalomus.
42. Lunulicardium.
43. Panenka.
44. Glyptocardia.
45. Euthydesma.
46. Grammysia.
47. (Sphenomya.)
48. (Leptodomus.)
49. Modiella.
50. Palæanatina.
51. Prorhynchus.
52. Prothyris.
53. Tellinopsis.
54. Cypricardinia.
55. Orthonota.
56. Palæosolen.
57. Phthonia.
58. Pholadella.
59. Cimitaria.

LIST OF GENERA NOT ILLUSTRATED ON THE PLATES OF THE GEOLOGIST'S REPORT OF 1882, TOGETHER WITH THE AUTHOR'S NAME AND REFERENCES TO THE EARLIEST PUBLICATION OF THE SAME.

1. *Entolium*, Meek. Geol. of California, vol. 1, app. B, p. 478. Jurassic.
2. *Streblopteria*, McCoy, Am. Mag. Nat, Hist., 2d ser., vol. 7, for figure, see Syn. Carb. Foss., Ireland, pl. 12, fig. 5.
3. *Vertumnia*, s. g., Hall. Pal. N. Y., vol. v., pt. ii., pl. 24, fig. 12. *Vertumnia avis.*
4. *Avicula*, Klein, 1753. Ostreæ.
5. *Actinodesma*, Sandberger. Nassau, Pl. 29, figs. 17, 17a. *A. malleiforme*, Sand.
6. *Pteronitella*, Billings. Pal. Foss, vol. 2, 1874. Pl. 9, fig. 5.

7. *Pseudomonotis*, Beyrich, 1862. Deutsch Geol. Gesell., vol. 14.
8. *Ambonychia*, Hall, 1847. Pal. N. Y., vol. 1, p. 523. Pal. Ohio, vol. 2, pl. 2.
9. *Modiolopsis*, Hall, 1847. Pal. N. Y., vol. 1. Pal. Ohio, vol. 2, pl. 2, fig. 17.
10. *Pyrenomœus*, Hall, 1852. Pal. N. Y., vol. 2, pl. 27, fig. 12.
11. *Tellinomya*, Hall, 1847. Pal. N. Y., vol. 1. Pal. Ohio, vol. 2, pl. 2, fig. 24.
12. *Cardiopsis*, Meek and Worthen, 1861. Proc. Acad. Nat. Sci. Phila.
13. *Cleidophorus*, Hall, 1847. Pal. N. Y., vol. 1.
14. *Astartella*, Hall, 1858. Geol. Rept. Iowa. Pl. 29, fig. 1.
15. *Lyrodesma*, Conrad, 1841. An. Geol. Rept. N. Y. Pal. Ohio, vol. 2, pl. 1, fig. 25.
16. *Cuneamya*, Hall and Whitfield, 1875. Pal. Ohio, vol. 2, pl. 2, figs. 9, 10.
17. *Palæocardia*, Hall, 1867. 20th Rept. N. Y. State Cab., pl. 14, figs. 11, 12.
18. *Amphicœlia*, Hall, 1867. 20th Rept. N. Y. State Cab., pl. 14, fig. 15.
19. *Orthodesma*, Hall and Whitfield, 1875. Pal. Ohio, vol. 2, pl. 2, fig. 7.
20. *Anomalodonta*, S. A. Miller, 1874. Cin. Jour. Nat. Hist. Soc., vol. 1, p. 17, fig. 8.
21. *Eopteria*, Billings, 1865. Pal. Foss., vol. 1, p. 306, fig. 298.
22. *Euchasma*, Billings, 1865. Pal. Foss., vol. 1, p. 361, fig. 348.
23. *Allorisma*, King, 1844. Am. Mag. Nat. Hist., vol. 14.
24. *Anatina*, Lamarck, 1809. Phil. Zool.
25. *Chœnomya*, Meek., 1864. Pal. of Upper Missouri, p. 43, pl. 2, fig. 1.
26. *Chœnocardia*, Meek and Worthen, 1869. Proc. Acad. Nat. Sci., Phila.
27. *Clinopistha*, Meek and Worthen, 1870. Proc. Acad. Nat. Sci., Phila.
28. *Dexiobia*, Winchell, 1863. Proc. Acad. Nat. Sci., Phila. (*Dualina* Barrande.)
29. *Ilionia*, Billings, 1875. Can. Nat. and Geol., p. 301, fig. 1.
30. *Promacrus*, Meek., 1871. Am. Jour. Conch, vol. 7.
31. *Sedgwickia*, McCoy, 1844. Synop. Carb. Foss., Ireland, pl. 11, fig. 39.
32. *Carbonarca*, Meek and Worthen, 1870. Proc. Acad. Nat. Sci. Phila.
33. *Solenomya*, Lam., 1818. Hist. Nat. Anim. sans Vert., vol. 5.
34. *Aviculopinna*, Meek., 1867. Am. Jour. Sci., vol. 44. Dyas. Geinitz, pl. 2, fig. 13.
35. *Bakevellia*, King, 1849. Permian Fossils, pl. 14, figs. 29, 30, 33.
36. *Monopteria*, M. & W., 1866. Proc. Chicago Acad. Nat. Sci.
37. *Monotis*, Bronn, 1824. System Urweltlicher Konchylien.
38. *Posidonia*, Bronn, 1824. System Urweltlicher Konchylien.
39. *Posidonomya*, Bronn, 1837. Leth. Geogn.
40. *Cardium*, Linn., 1758. Syst. Nat. 10th ed. (probably not found in palæozoic rocks).
41. *Astarte*, Sowerby, 1818. Min. Conch., vol. 2, (probably not found in palæozoic rocks).
42. *Cardinia*, Agassiz, 1838. In Societ. Basil.
43. *Cycloconcha*, S. A. Miller, 1874. Cin. Quar. Jour., vol. 1, p. 231, figs. 21, 22.
44. *Cypricardella*, Hall, 1858. Trans. Alb. Inst., vol. 4.
45. *Cypricardia*, Lamarck, 1801. Syst. An. sans Vert., (probably not found in palæozoic rocks).
46. *Cypricardites*, Conrad, 1841. An. Geol. Rept., N. Y.
47. *Isocardia*, Klein, 1753. Tent. Meth. Ostr.

48. *Matheria,* Billings, 1858. Can. Nat. and Geol. vol. 3, p. 440, fig. 18.
49. *Pleurophorus,* King, 1844. Ann. Mag. Nat. Hist. vol. 14.
50. *Lucina,* Bruguiere, 1792. Ency. Meth.
51. *Anthraconya.* Salter, 1861. Mem. Geol. Survey of Gt. Britain.
52. *Anodontopsis,* McCoy, 1851. Ann. Mag. Nat. Hist. vol. 7, 2d series.
53. *Anthracoptera.* Salter, 1862. Mem. Geol. Survey of Gt. Britain.
54. *Lithophaga,* Lamarck, 1812. Hist. An. sans Vert.
55. *Myalina,* De Koninck, 1844. Desc. Anim. Foss. Carb. Belg.
56. *Mytilus,* Linn. (Unknown in palæozoic rocks).
57. *Lima,* Bruguiere. (Unknown in palæozoic rocks).
58. *Ostrea,* Linn. (Unknown in palæozoic rocks).
59. *Pinna,* Linn., 1758. Syst. Nat.
60. *Pinnopsis,* Hall, 1843. Geol. Rep. 4th Dist. p. 243, fig. 106, 7. Syn. for *Lunulicardium,* Pal. N. Y., vol. v., pt. 1, pl. 71.
61. *Solen,* Linn., 1858. Syst. Nat. (Probably not found in palæozoic rocks.)
62. *Solenopsis,* McCoy, 1844. Carb. Foss., Ireland, p. 47, pl. 8, fig. 2.
63. *Sanguinolaria,* Lamarck, 1801. Syst. An. sans. Vert. (Probably not found in palæozoic rocks.)
64. *Dolabra,* McCoy. Syn. Carb. Foss., Ireland, p. 64, pl. 11, fig. 10.
65. *Ægilops,* Hall, 1850. 3d Rept. State Cab., p. 171, pl. 4, fig. 1.
66. *Ischyrinia,* Billings, 1866. Catal. Sil. Foss. Anticosti.
67. *Anthracosia,* King, 1844. Ann. Mag. Nat. Hist.
68. *Angellum,* S. A. Miller, 1878. Jour. Cin. Soc., vol. 1.
69. *Orthonotella,* S. A. Miller, 1882. Jour. Cin. Soc.
70. *Prisconara,* Conrad, 1867. Am. Jour. Conch., vol. 3.
71. *Pyanomya,* S. A. Miller, 1881. Jour. Cin. Soc., vol. 4, p. 318, pl. 8, fig. 4.
72. *Vanuxemia,* Billings, 1858. Can. Nat. and Geol., vol. 3, p. 439, fig. 17.
73. *Euthydesma,* Hall, 1885. Pal. N. Y., vol. v, pt. 1. Lam. II.
74. *Spathella,* Hall, 1885. Pal. N. Y., vol. v., pt. 1. Lam. II.
75. *Cardiola,* Broderip, 1834. Trans. Geol. Society.
76. *Yoldia,* Muller, 1842. Kroyer's Nat. Tid. (Probably not found in palæozoic rocks.)
77. *Præcardium,* Barrande, 1881. Syst. Sil de Bohéme.
78. *Paracardium,* Barrande, 1881. Syst. Sil de Bohéme.
79. *Pararca,* Hall, 1885. Pal. N. Y., vol. v., pt. 1. Lam. II.
80. *Glossites,* Hall, 1885. Pal. N. Y., vol. v., pt. 1. Lam. II.
81. *Elymella,* Hall, 1885. Pal. N. Y., vol. v., pt. 1. Lam. II.
82. *Protomya,* Hall, 1885. Pal. N. Y., vol. v., pt. 1. Lam. II.
83. *Allocardium,* Hall, 1884. Pal. N. Y. vol. v., pt. 1. Lam. I.
84. *Sanguinolites,* McCoy, 1844. Carb. Foss. of Ireland, p. 47.

59 Genera are illustrated on the plates of the Geologist Report.
84 Genera which are not there illustrated.

143 total number of genera of Lamellibranchiata which have been referred to American Palæozoic formations.

REPORT ON THE BONES OF MASTODON OR ELEPHAS FOUND ASSOCIATED WITH CHARCOAL AND POTTERY AT ATTICA, WYOMING COUNTY, N. Y.

James Hall, LL.D., *State Geologist:*

Sir.—Late in the autumn of 1886 my attention was called to the discovery of some mastodon bones in the village of Attica, Wyoming county, N. Y., and shortly thereafter, under your direction, I visited the place for the purpose of determining if the discovery merited the attention of the State Museum. The visit elicited the fact that some workmen, while engaged during the month of September or October of that year in digging a trench for a water-main alongside the road-bed of Genesee street in that village, partly uncovered a tusk, at a depth of about three feet from the surface. The tip of the tusk was left projecting for about six inches into the trench, and being regarded by the workmen as a hemlock root, no especial attention was paid to it until it was hacked in two with a pickax, in order to get the obstruction out of the way of the water-pipes. Its nature was thereupon recognized by some of the lookers-on. The tusk was removed, and the excavation widened over an area of about twenty-five square feet, in a search for other bones of the skeleton. This search resulted in finding two ribs and a portion of the zygomatic arch, which lay four or five feet away from the position of the tusk, and a foot or more further down. Finding nothing more, the hole was filled up, and the bones found came into the hands of Mr. W. F Cogswell, of Attica. At the time of my first visit to the place the tusk was found to be in an unusually well preserved condition, considering the harsh treatment it had received at the hands of the workmen, and is of exceptional interest, as its small size indicates a quite young animal. As far as could be judged at that time, with the ground covered with snow, the spot where the bones lay appeared to be in a narrow sink-hole extending beneath the bed of the road-way and apparently connected with a somewhat larger sink-hole lying back of the first range of lots on the west side of the street.

In a brief report of these observations made to yourself soon after this visit (Sixth Rept. State Geologist, p. 34, 1887), it was suggested that, on account of the limited area of these sink-holes, the probability of finding the remainder of the skeleton was such as to justify a reasonable expenditure by the State Museum. An appropriation was accordingly made for this purpose, and, acting under your directions, I took charge of the excavations which were undertaken early in the month of August, 1887.

The topographical character of the ground investigated is shown in the accompaying map. It was found that, as at first reported, there were two small bog-holes, the smaller lying mostly within the boundaries of Genesee street, and, as the excavation proved, very narrow. The work of excavation was begun at the point where the tusk had been found, and was carried in all directions until the muck or mucky clay petered out. This gave the hole a diameter of about thirty feet north and south, and somewhat more east and west, the vertical section through its deepest point being:

Made ground (road-bed, etc.)	2 ft.	10 in.
Loam	0	5
Clayey muck	1	2
Clay (unlaminated)	1	5
Clay (laminated)	0	0
	5 ft.	10 in.

A few bones only were found; these being fragments of ribs taken from the unlaminated clay at a depth of two feet six inches from the *natural surface* of the ground, a little west of the deepest point in the hole; several ribs, nearly entire, from the unlaminated clay, at a depth of three feet from the natural surface; and in the muck above these, one foot below the natural surface, the ankle bones of some large ruminant, probably the elk. Excavation was then begun in the large bog-hole lying in a pasture lot belonging to the Messrs. Smith and Cogswell, 297 feet west of the west line of Genesee street. A series of trenches were put down in various directions, which showed that this hole was circular, measuring seventy-five feet in diameter, and was filled by a very shallow accumulation of black muck and mucky clay. This material reached a thickness of from twelve to fifteen inches, except at a single point where over a surface twelve feet square it extended to a depth of four feet. All of this vegetable earth was underlain by compact laminated clay. At the bottom of the deep accumulation of muck, and four feet from the natural surface of the ground, was found a fragment of pottery, and from beneath and around it were taken about thirty fragments of thoroughly burned charcoal. These traces of ancient man were found fully twelve inches further down from the natural surface of the ground than the deepest of the bones taken from the other sink-hole.

The connection of the two sink-holes, and their former drainage from one to the other, was established by a series of excavations between them, which showed the vegetable mold to be continuous between the two, with a thickness of from three to six inches, though rapidly thinning out to the north and south, giving the drainage way a width of only a few feet. No bones were found in the larger sink-hole, but four small fragments of charcoal were subsequently found in the clayey muck of the smaller hole from which the ribs were taken. These, it would appear, had been washed out of the sink-hole above. Indeed, the finding of so few of the bones of the skeleton of this mastodon or elephant, and the ankle-joint bones of the undetermined ruminant, which were evidently deposited when held together by the ligamental tissue, and all these in so small a bog-hole, indicate that in probability the hole had been flushed at times of high water, and the remnants of the skeletons carried away.

The fragment of pottery found is made of coarse, angular (crushed?) fragments of quartz and feldspar (orthoclase), mixed with clay. Its greatest thickness is five-eighths of an inch. A portion of the upper edge of the pot to which it belonged is retained. The curvature of the lower portion of the fragment, if carried out in a circle, indicates a vessel having a diameter of slightly more than eight inches, flaring a little toward the mouth. The outer surface is marked by low, somewhat irregular, transverse ridges, perhaps from wear being less conspicuous than those upon the inner surface, where, instead of being transverse, they are longitudinal. The fragments of charcoal vary in size from two inches in diameter down, and appear, with one exception, to have been thoroughly burned.

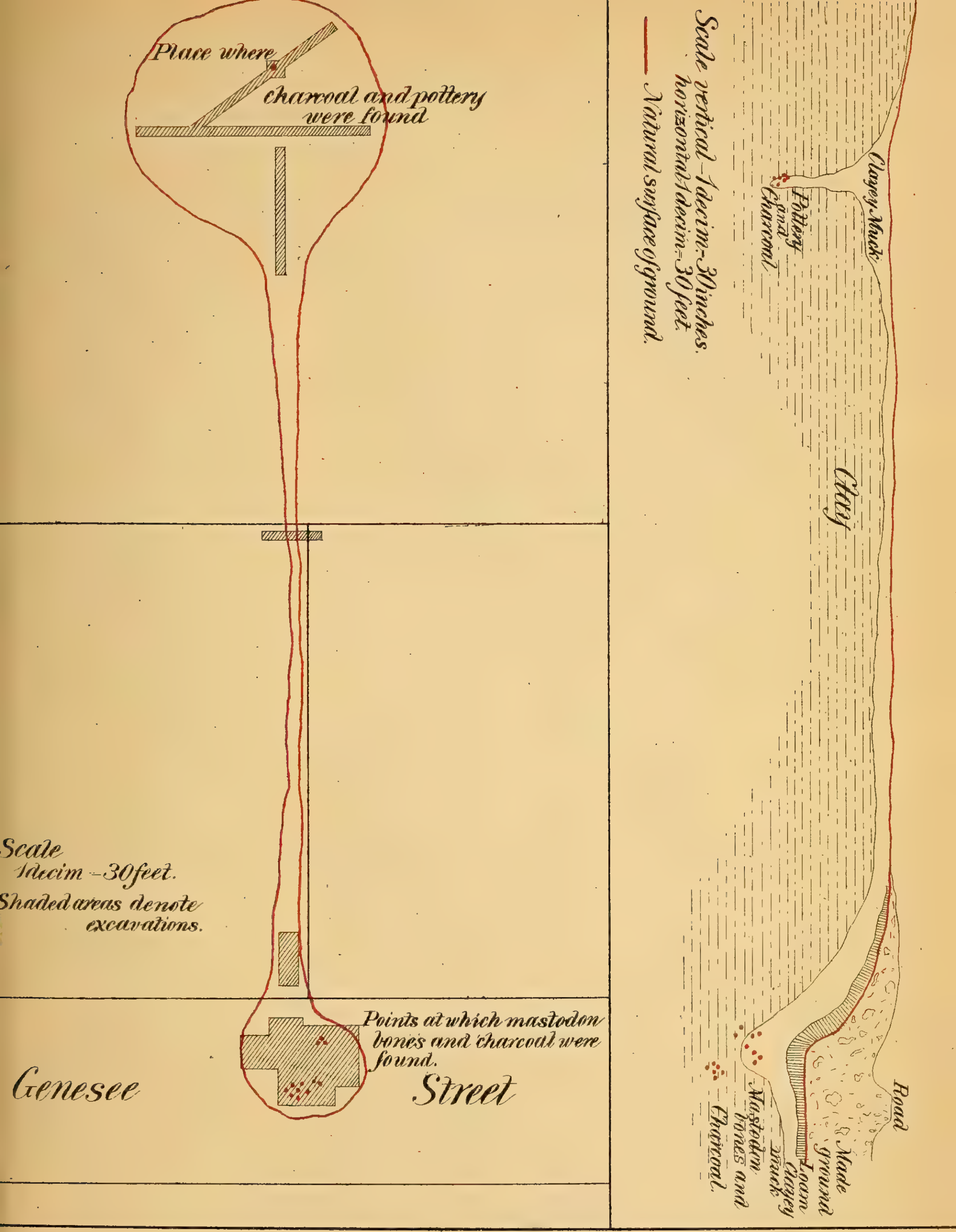
The peculiar occurrence of the pottery and charcoal at the bottom of this deep hole in the clay of the larger bog is difficult to explain. No evidence was apparent, in the course of the excavation, that this hole in the clay had been artificially dug out or filled. The area over which the relics were scattered, was not more than four feet in diameter, through a depth of eight or ten inches. To assume that these relics had sunk to this depth when the black earth was in a semi-fluid condition, asks too much of chance, for though so ponderable a substance as a piece of pottery might work its way through the soft mud to a considerable depth, the numerous pieces of charcoal would hardly and in unison do this.

As to whether the bones (tusk, ribs and zygoma) found are those of the mastodon or elephant it is difficult to decide, none of them showing distinctive characters. The probabilities are, however, undoubtedly, that they are mastodonic.

I am, sir, very respectfully yours,

J. M. CLARKE.

October 1, 1887.



Ground Plan and Vertical Section

of the sink holes at Attica, Wyoming county, N.Y. in which were found

Mastodon bones and Human relics.

DESCRIPTION OF NEW SPECIES

OF

FENESTELLIDÆ

OF THE

LOWER HELDERBERG,

WITH EXPLANATIONS OF PLATES ILLUSTRATING

SPECIES OF THE HAMILTON GROUP,

DESCRIBED IN THE REPORT OF THE

STATE GEOLOGIST FOR 1886.

TECTULIPORA *nov. sub. gen.*

FENESTELLA (TECTULIPORA) LOCULATA n. sp.

Bryozoum consisting of infundibuliform fronds of compact appearance. Thickness of frond about .60 mm. Branches moderately slender, width just above a bifurcation .30 mm., regularly increasing to .55 mm., subangular or rounded, with from three to five distinct longitudinal striations; opposite the dissepiments the branches are slightly elevated. On the specimens observed the bifurcations occur at intervals of from 10 to 20 mm.

Dissepiments comparatively slender, width about .15 to .18 mm., rounded, depressed below the plane of the branches, and expanding at their junction; about eleven in the space of 5 mm.

Fenestrules regularly oval, length from .32 to .38 mm., width about two-thirds the length.

On the celluliferous face the branches are angular. Dissepiments very slender, angular, much depressed. Fenestrules narrower than on the opposite face. Cell apertures in two ranges, opening directly outward, very closely disposed, and often in contact; about thirty in the space of 5 mm. Margins elevated, and distinctly indenting the borders of the fenestrules.

Branches between the ranges of apertures and along the middle of the dissepiments carinated; carina .30 mm. high, for half the height very thin, then rapidly expanding, those of the branches to a width of about .25 mm., and those of the dissepiments to .15 mm., the expanded portions having the appearance of the non-celluliferous face of some form of Fenestella. These pseudo-branches and dissepiments are broadly angular, with a slight carina along the middle. The fenestrules are a little larger than on the non-celluliferous face.

This subgenus differs from Loculipora, which it closely resembles, in having the cell apertures in straight lines along the branches and not surrounding the fenestrules, there being no apertures on the dissepiments. The apertures on each side of the carina of the dissepiments at its juncture with the branch are separated but slightly, if any more than the others.

Of the forms resembling *Fenestella* (*Unitrypa ?*) *unsinalis* a new subgenus should be made. It would differ from this one in having no carinæ on the dissepiments, and in the pseudo-dissepiments not being equal in number to the true dissepiments.

Formation and Locality.—Lower Helderberg group, near Clarksville, Albany county, N. Y.

Fenestella frequens n. sp.

Plate ix, Figs. 12–15.

Bryozoum consisting of infundibuliform fronds. Branches moderately strong, width just above a bifurcation .25 to .35 mm., increasing to .50 or .60 mm., and sometimes more, rounded or angular, occasionally granulose.

Interstices sometimes narrower, at other times wider than the branches.

Dissepiments moderately strong, width .25 to .30 mm., rounded or subangular, on a plane, with the branches frequently extending upon them, sometimes nearly to the middle, causing the branches to appear much narrower than they really are; very closely disposed, about twelve in the space of 5 mm.

Fenestrules usually oval or broadly lenticular, sometimes very irregular, length transversely about .40 or .45 mm., width from one-half to two-thirds the length.

On the celluliferous face the branches are angular. Dissepiments angular and much depressed, fenestrules of about the same appearance as on the opposite face.

Cell apertures in two ranges, opening laterally, separated by about the diameter of an aperture; twenty in the space of 5 mm.; margins thin; slightly elevated. Surface between the ranges of apertures carinated; carina moderately strong, elevated about .40 or .45 mm., more or less expanded at the summit, smooth.

This species is regularly distinguished from any other at present known, by the closely disposed dissepiments, the branches and dissepiments of the non-celluliferous face having precisely the appearance of the carinæ and scalæ of a *Unitrypa*. On the celluliferous face it is distinguished by the closely disposed dissepiments and the elevated carinæ.

Formation and Locality.— Lower Helderberg group, near Clarksville, Albany county, N. Y.

PLATE 8.

Fenestella angustata.

Figs. 1–8.

Fenestella angustata, Hall. Report of State Geologist for 1886, page 54.

Fig. 1. An enlargement from the non-celluliferous face, showing straight rigid branches and elongate fenestrules. 6 x.

Fig. 2. An enlargement from another frond showing more broadly oval fenestrules and nodose branches. 6 x.

Fig. 3. A still further enlargement from fig. 2, showing more distinctly the ornamentation of the surface. 18 x.

Fig. 4. An enlargement showing slender branches and subquadrangular fenestrules. 6 x.

Fig. 5. An enlargement from the celluliferous face showing the form and disposition of the cell apertures. 6 x.

Fig. 6. An enlargement showing the branches covered with minute nodes. 6 x.

Fig. 7. A transverse section of the branches. 6 x.

Fig. 8. An enlargement of a lateral view, showing a transverse section of the dissepiments and the position of the cell apertures. 6 x.

Fenestella emaciata.

Figs. 9–13.

Fenestella emaciata, Hall. Report of State Geologist for 1886, page 57.

Fig. 9. A fragment, natural size.

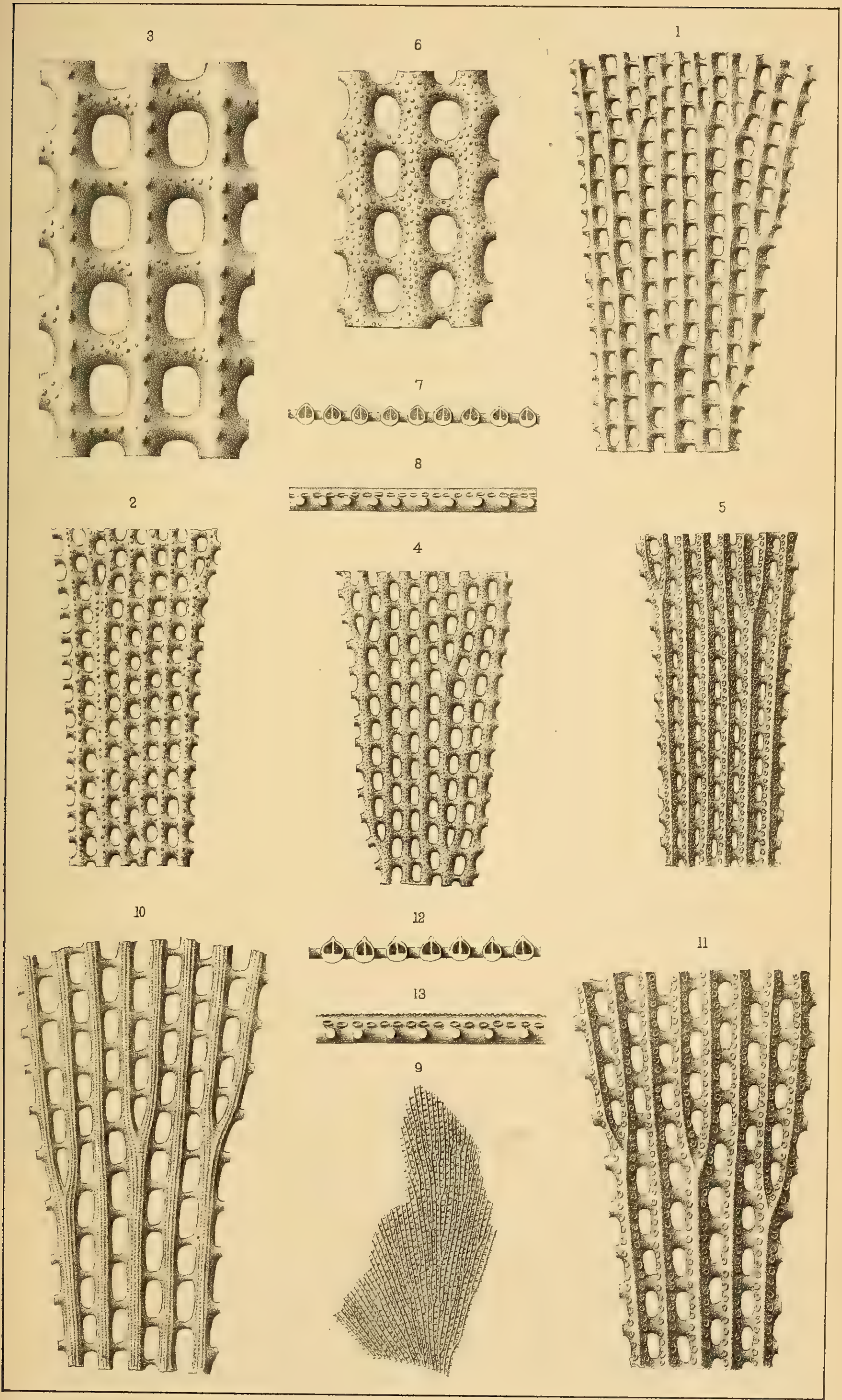
Fig. 10. An enlargement from the non-celluliferous face, showing the striated granulose branches and the oblique dissepiments.

Fig. 11. An enlargement from the celluliferous face, showing the form and disposition of the cell apertures. 6 x.

Fig. 12. A transverse section of the branches. 6 x.

Fig. 13. A lateral view of the branches, showing the dissepiments and position of the apertures. 6 x.

FENESTELLIDÆ.



G.B. Simpson del. Phil. Ast lith.

PLATE 9.

FENESTELLA SUBTORTILIS.

FIGS. 1–5.

Fenestella subtortilis, HALL. Report of State Geologist for 1886, page 52.

Fig. 1. A fragment, natural size.

Fig. 2. An enlargement from the non-celluliferous face showing the form of the branches and dissepiments and large fenestrules. 6 x.

Fig. 3. An enlargement from the celluliferous face, showing the narrow fenestrules, the form and disposition of the cell apertures, and one or two of the branches with the carina. 6 x.

Fig. 4. A transverse section of the branches. 6 x.

Fig. 5. A lateral view of the branch showing a transverse section of the dissepiments, the position of the cell apertures and the carina. 6 x.

FENESTELLA PARALLELA.

FIGS. 6–11.

Fenestella parallela, Hall. Pal. N. Y., Vol. VI, p. 107.

Fig. 6. A fragment showing the expanded carina, natural size.

Fig. 7. An enlargement from the non-celluliferous face showing the form of the branches and dissepiments, and the granulose surface. 18 x.

Fig. 8. An enlargement from the celluliferous face showing the form and arrangement of the cell apertures and the basal portion of the carinæ of the branches and dissepiments. 18 x.

Fig. 9. An enlargement of the expanded summits of the carinæ. 18 x.

Fig. 10. A lateral view of a branch, showing a transverse section of the dissepiments, and their carinæ much expanded at the summit, the position of the cell apertures, and the carina of the branch. 18 x.

Fig. 11. A transverse section showing the form of the branches, the expansion of their carinæ at the summit and the dissepiments with their carina. 18 x.

FENESTELLA FREQUENS, n. sp..

FIGS. 12–15.

Fig. 12. An enlargement from the non-celluliferous face showing the frequent dissepiments.

Fig. 13. An enlargement from the celluliferous face showing the form and disposition of the cell apertures. 6 x.

Fig. 14. A transverse section of the branches. 6 x.

Fig. 15. A lateral view of a branch showing the position of the dissepiments and the high carina. 6 x.

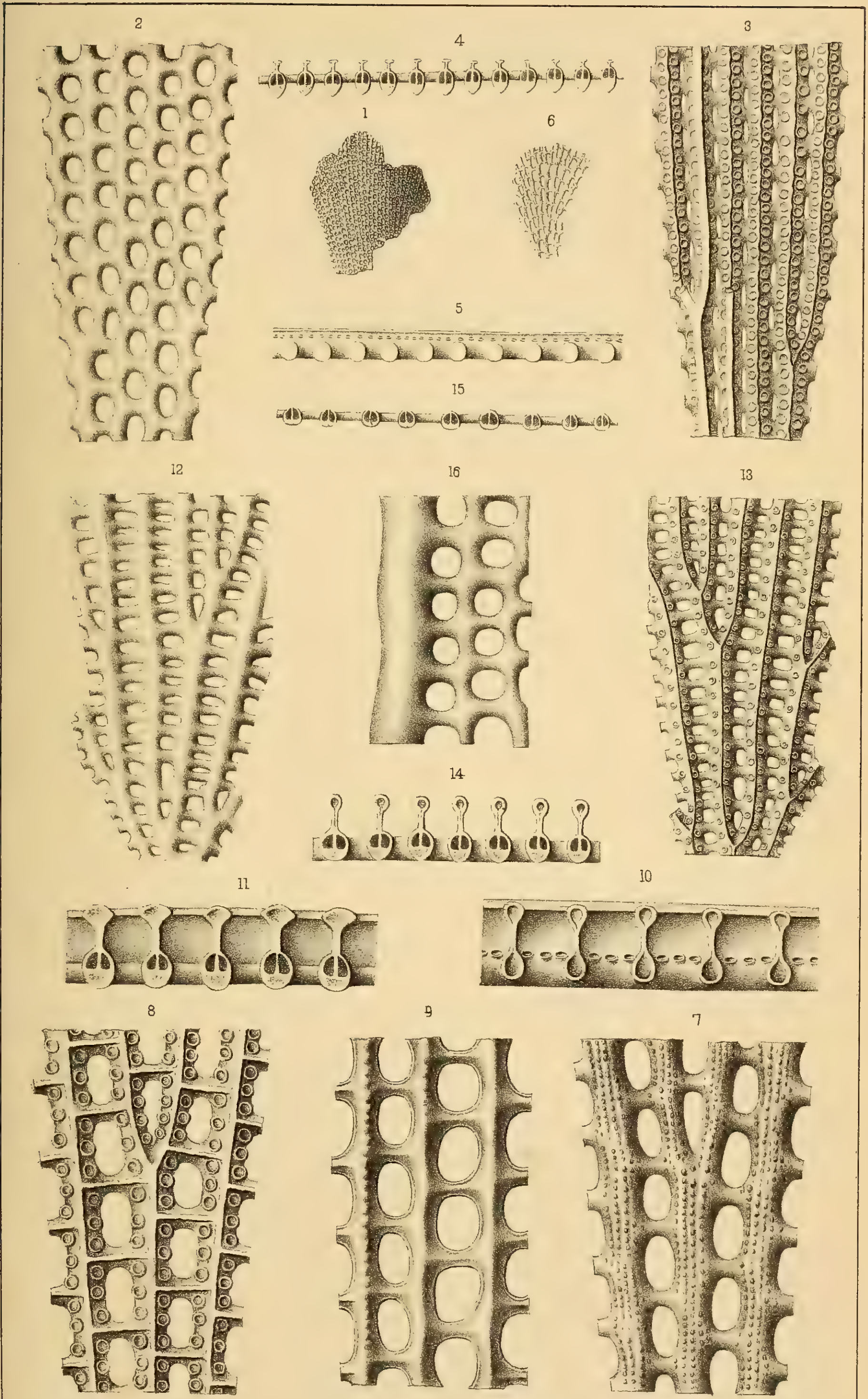
FENESTELLA (LYROPORA) CINCTUTA.

FIG. 16.

Fenestella (Lyropora) cinctuta, HALL. Report of State Geologist for 1886, page 69.

Fig. 16. An enlargement from the non-celluliferous face showing the strong thickened border and the rounded or somewhat transversely oval fenestrules. 6 x.

FENESTELLIDÆ.



G.B. Simpson del. Phil. Ast. lith.

PLATE 10.

FENESTELLA (LOCULIPORA) PERFORATA.

FIGS. 1–13.

Fenestella (Loculipora) perforata, HALL. Report of State Geologist for 1886, page 62.

Fig. 1. A large fragment, showing the general appearance and manner of growth, natural size.

Fig. 2. An enlargement from the non-celluliferous face, showing the angular, slightly carinated branches connected by dissepiments. 6 x.

Fig. 3. Rock deposit, showing the impressions of a portion of the non-celluliferous face of a frond. 6 x.

Fig. 4. A translucent longitudinal section. 6 x.

Fig. 5. An enlargement of the celluliferous face, showing the angular branches and the disposition of the cell apertures around the fenestrules. 6 x.

Fig. 6. An enlargement showing the summit of the carina or pseudo-non-celluliferous face. 6 x.

Fig. 7. A transverse section showing the elongate rhomboidal section of branches and carinæ. 6 x.

Fig. 8. A transverse section of the branches, showing the broadly rhomboidal form of the branches and summit of the carinæ. 6 x.

Fig. 9. An enlargement showing distinctly the appearance of the branches and carina of the dissepiments. 18 x.

Fig. 10. A transverse section of a frond embedded in the rock. 6 x.

Fig. 11. The appearance of a translucent, longitudinal section, greatly magnified.

Fig. 12. A lateral view of a branch, showing the form of the dissepiments, and pseudo-dissepiments, the carina, and the position of the cell apertures.

Fig. 13. A transluscent, longitudinal section, on glass, greatly magnified.

Formation and Locality.—Hamilton group, near Canandaigua lake, N. Y.

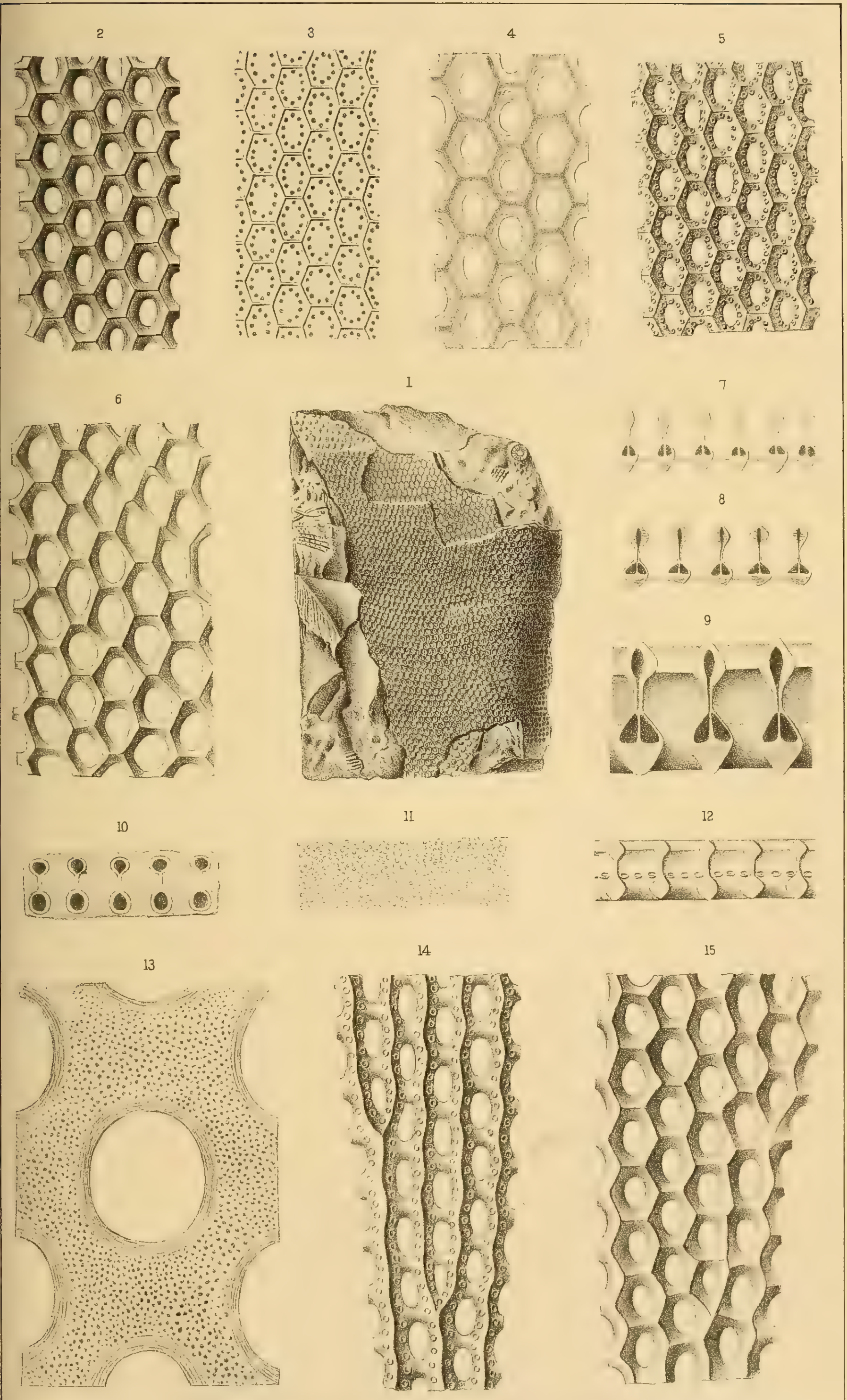
FENESTELLA NEXILIS, n. sp.

FIGS. 14–15.

Fig. 14. An enlargement of a portion of the celluliferous face, showing the form and disposition of the cell apertures and the sinuous carinæ. 6 x.

Fig. 15. An enlargement from the non-celluliferous face, showing the angular carinated branches and dissepiments.

Formation and Locality.—Corniferous limestone.



G.B. Simpson del. Phil. Ast. lith.

PLATE 11.

Fenestella (Unitrypa) scalaris.

Figs. 1–11.

Fig. 1. A fragment of the carinæ and scalæ; natural size.

Fig. 2. An enlargement showing a row of prominent nodes along the middle of the branch and a row of granules on each side. 6 x.

Fig. 3. An enlargement showing the lateral rows of nodes much stronger than in fig. 2. 6 x.

Fig. 4. An enlargement showing two rows of nodes on each branch, the middle of the branch a little depressed. 6 x.

Fig. 5. An enlargement of the summits of the carinæ and scalæ, showing nodes on the carinæ. 6 x.

Fig. 6. An enlargement showing very thin carinæ and scalæ. 6 x.

Fig. 7. An enlargement showing the under side of the carinæ and scalæ. 6 x.

Figs. 8 and 9. Transverse sections of different fronds. 6 x.

Fig. 10. A transverse section further enlarged, showing the rhomboidal form of the branches, their structure, the dissepiments and scalæ, and the form of the expanded portion of the carina. 18 x.

Fig. 11. A translucent longitudinal section on glass, showing the structure of the branches and dissepiments, greatly enlarged.

Formation and locality.—Hamilton group; Bellona, Yates county, N. Y.

Fenestella (Polypora) multiplex.

Figs. 12–16.

Fenestella (Polypora) multiplex, Hall. Report of State Geologist for 1886, page 66.

Fig. 12. A fragment, showing the celluliferous face, natural size.

Fig. 13. An enlargement from the celluliferous face, showing the form and disposition of the cell apertures, and the striæ or ridges between the ranges of apertures. 6 x.

Fig. 14. An enlargement, showing the angular branches of the non-celluliferous face, connected by slender depressed dissepiments.

Figs. 15, 16. Transverse sections from different fronds, showing the variation in the form of the branches. 6 x.

Formation and locality.—Hamilton group; Moscow, Livingston county, N. Y.

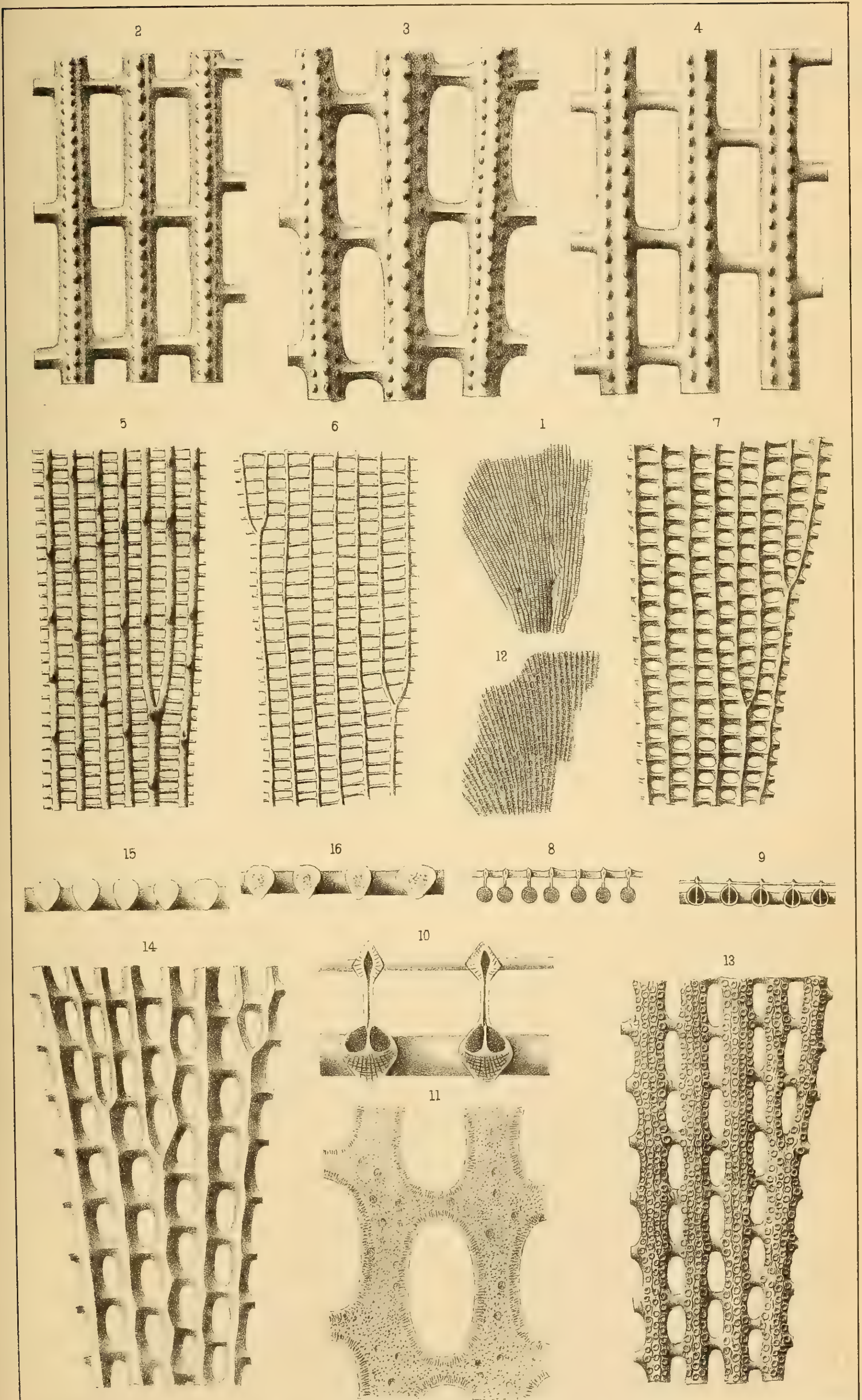


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PLATE 12.

FENESTELLA (POLYPORA) FISTULATA.

FIGS. 1–16.

Fenestella (Polypora) fistulata, HALL. Report of State Geologist for 1886, page 64.

Fig. 1. A fragment of the celluliferous face, natural size.

Fig. 2. A fragment of the non-celluliferous face, natural size.

Fig. 3. An enlargement, showing straight, regular, angular branches and dissepiments. 6 x.

Fig. 4. An enlargement, showing more slender, rounded branches and dissepiments.

Fig. 5. Enlargements from different portions of the same frond, one portion showing very strong regular branches, the other portion more slender, sinuous branches. 6 x.

Fig. 6. An enlargement, showing flattened branches with a carina along the middle. 6 x.

Fig. 7. An enlargement from a frond partially covered by a rock deposit, causing the branches to appear very slender. 6 x.

Fig. 8. An enlargement, showing slender branches and very nearly circular fenestrules. 6 x.

Fig. 9. An enlargement, showing somewhat irregular branches connected by very slender branches. 6 x.

Fig. 10. An enlargement, showing decidedly angular carinated branches and dissepiments. 6 x.

Fig. 11. An enlargement from the celluliferous face, showing the narrow fenestrules, wide branches, and form and disposition of the cell apertures. 6 x.

Fig. 12. A still further enlargement, showing more distinctly the form of the cell apertures. 18 x.

Fig. 13. An enlargement of a portion of a branch having only two ranges of cell apertures. 18 x.

Fig. 14. A lateral view of a portion of a branch. 18 x.

Fig. 15. A further enlargement of the preceding, showing the form of the branches and the thickness of the dissepiments. 18 x.

Fig. 16. A transverse section of a frond. 6 x.

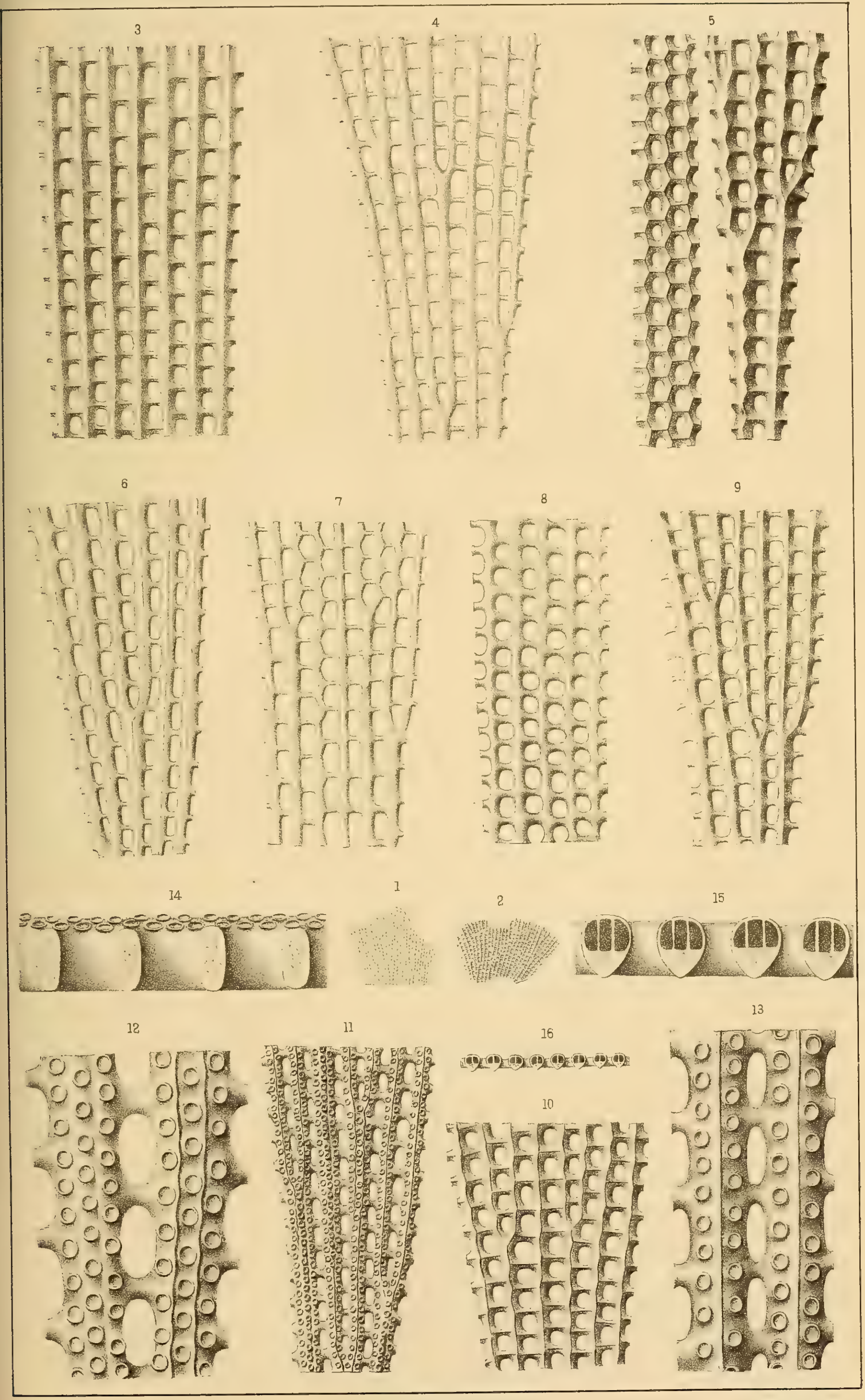

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PLATE 13.

FENESTELLA (POLYPORA) LATITRUNCATA.

FIGS. 1–9.

Fenestella (Polypora) latitruncata, HALL. Report of State Geologist for 1886, page 68.

Fig. 1. A fragment of the non-celluliferous face, natural size.
Fig. 2. A fragment of the celluliferous face, natural size.
Fig. 3. A fragment from another specimen, natural size.
Fig. 4. An enlargement from the non-celluliferous face, showing somewhat distorted branches. 6 x.
Fig. 5. An enlargement showing slender branches and irregularly formed fenestrules. 6 x.
Fig. 6. An enlargement showing stronger branches and more irregularly formed fenestrules. 6 x.
Fig. 7. An enlargement from the celluliferous face, showing the form and disposition of the cell apertures. 6 x.
Fig. 8. An enlargement, showing twisted striations. 6 x.
Fig. 9. An enlargement, showing very thin branches and large variable fenestrules. 6 x.

FENESTELLA (POLYPORA) ASPECTANS.

FIGS. 10–14.

Fenestella (Polypora) aspectans, HALL. Report of State Geologist for 1886, page 65.

Fig. 10. A fragment, natural size.
Fig. 11. An enlargement from the non-celluliferous face, showing nearly circular fenestrules. 6 x.
Fig. 12. An enlargement from the celluliferous face, showing the form and disposition of the cell apertures and the extremely narrow fenestrules. 6 x.
Fig. 13. A transverse section of the branches, showing their cuneiform shape. 6 x.
Fig. 14. An enlargement of a lateral view of a branch, showing the form of the dissepiments and the position of the cell apertures.

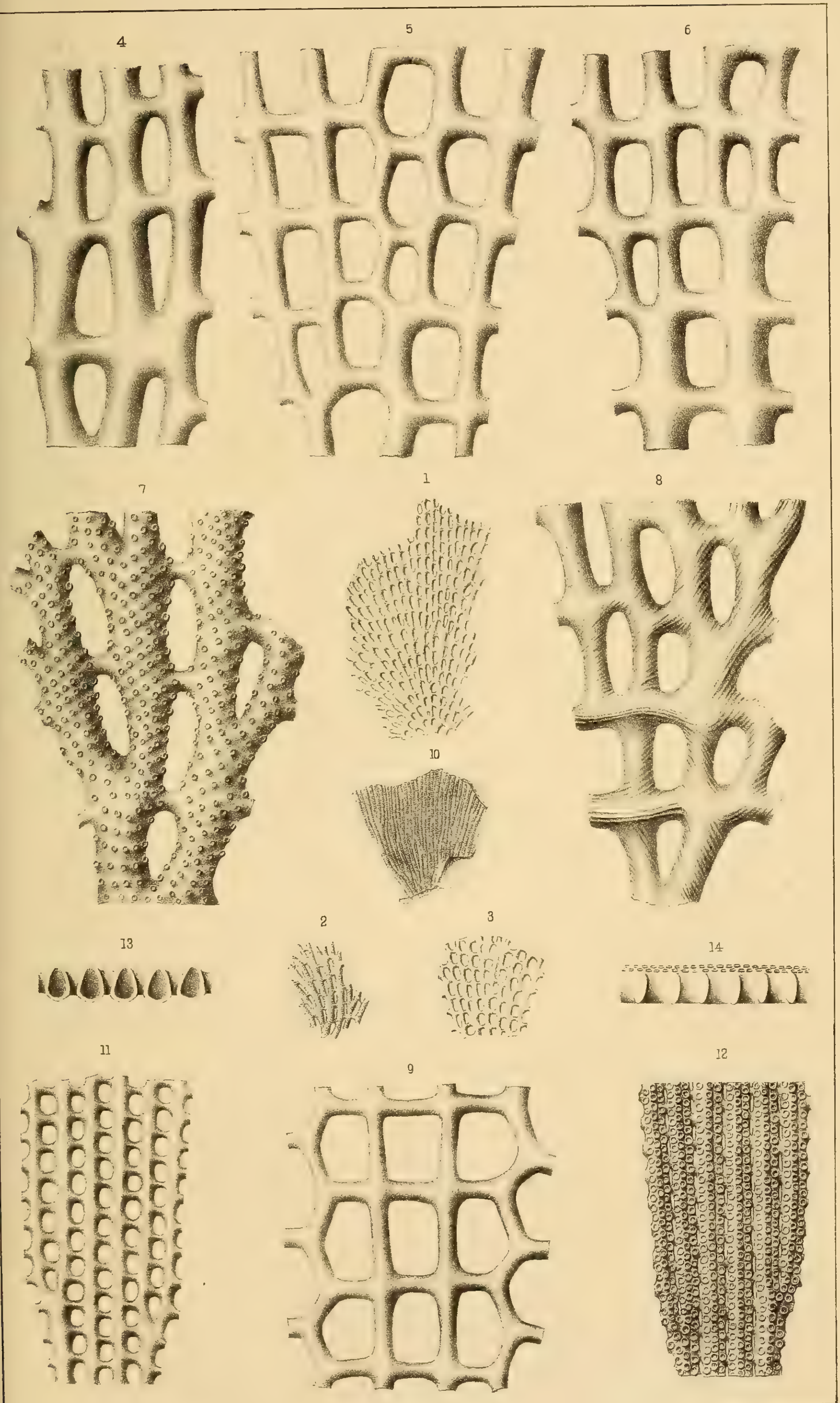

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PLATE 14.

FENESTELLA (POLYPORA) ARTA.

FIGS. 1–3.

Fenestella (*Polypora*) *Arta*, HALL. Pal. N. Y., Vol. VI, page 63.

Fig. 1. An enlargement from the non-celluliferous face of a frond with rigid, rounded branches, and nearly uniform fenestrules.

Fig. 2. An enlargement from the non-celluliferous face of a frond, where the branches are somewhat flattened and bifurcating above.

Fig. 3. An enlargement of two adjacent branches; the one with three ranges of cell apertures, and the other with two ranges of cell apertures and a central carina. 18 x.

This figure is given to compare with *Fenestella obliqua*, fig. 4.

FENESTELLA OBLIQUA.

FIG. 4.

Fenestella (*Polypora*) *obliqua*, HALL. Pal. N. Y., Vol. VI, page 64.

Fig. 4. An enlargement of the celluliferous face of two branches with connecting dissepiments; showing the oblique arrangement of the outer ranges of cell apertures. 18 x.

FENESTELLA PERPLEXA.

FIG. 5.

Fenestella perplexa, HALL. Pal. N. Y., Vol. VI, page 130 (not figured).

Fig. 5. An enlargement of three branches from the celluliferous face, showing the strong carina with prominent transverse bars.

Upper Helderberg group.

FENESTELLA (UNITRYPA) PROJECTA.

FIGS. 6–8.

Fenestella (*Unitrypa*) *projecta*, HALL. Pal. N. Y., Vol. VI, page 132 (not figured).

Fig. 6. A portion of the non-celluliferous face of a frond, showing the projections on the upper margins of the dissepiments.

Fig. 7. An enlargement of three branches and the connecting dissepiments, showing the characteristic features of the non-celluliferous face.

Fig. 8. A lateral view of a branch enlarged, showing sections of the dissepiments, the cell aperture with projecting cell margins, and the curving scalæ above.

Fenestella (Unitrypa) transversa.

Fig. 9.

Fenestella (*Unitrypa*) *transversa*, Hall. Pal. N. Y., Vol. VI, page 132 (not figured).

Fig. 9. An enlargement from the non-celluliferous face of a frond, showing the prominently carinate dissepiments which extend over the branches on the right hand portion of the figure, and becoming depressed and merged on the left side.

Fenestella varia, *n. sp.*

Figs. 10–12.

Fig. 10. An enlargement of two branches with the connecting dissepiments, showing the arrangement of cell apertures with thin margins. On the left side the central range of apertures is interrupted, and a row of pustules continued in the same line.

Fig. 11. A lateral view of a branch with transverse sections of the dissepiments, and showing the projecting cell margins. 18 x.

Fig. 12. A transverse section of branches showing those with two and those with three ranges of cells.

This species resembles *F. arta*, but is a smaller form.

Lower Helderberg group. Clarkesville, N. Y.

Report State Geologist, 1887.

Plate XIV.

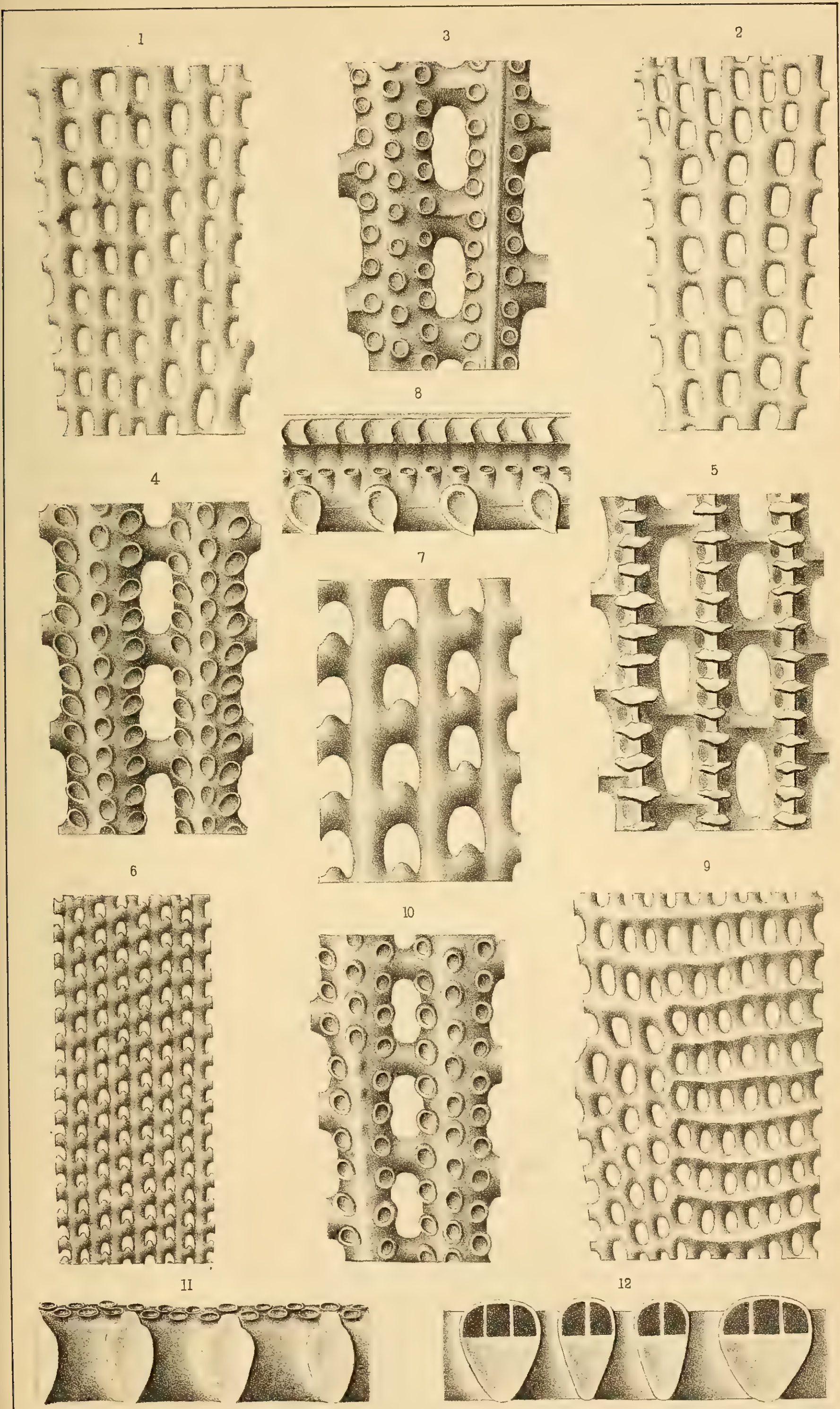

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PLATE 15.

Fistulipora triloba.

Figs. 1, 2.

Fistulipora triloba, Hall. Pal. N. Y., Vol. VI, page 29 (not figured).

Fig. 1. An enlargement of the surface, in its natural condition, showing the form and arrangement of the cell apertures and the openings of the septate intercellular tubuli.

Fig. 2. A vertical section of the frond enlarged, showing the striated interior cellwalls, and the intercellular tubuli, which are in part irregularly vesiculose below and regularly septate above.

Lower Helderberg group.

Lichenalia subtrigona.

Figs. 3, 4.

Lichenalia subtrigona, Hall. Pal. N. Y., Vol. VI, page 196 (not figured).

Fig. 3. A portion of the surface in its natural condition, enlarged to show more distinctly the form and arrangement of the cell apertures, and the absence of intercellular pits.

Fig. 4. A vertical section of the preceding enlarged, showing the open tubular cells and the intermediate septate tubuli, with vesicular texture at the base, which, on one side, extends nearly to the surface of the mass.

Lichenalia distensa.

Fig. 5.

Lichenalia distans, in error; Pal. N. Y., Vol. VI, page 197; also Index page 297, reference to *L. distans*, page 197, to be *Lichenalia distensa*. Not *Lichenalia distans*, Pal. N. Y., Vol. VI, page 32.

Fig. 5. A portion of the surface enlarged, to show the form and arrangement of the cell apertures and the smooth intercellular surface.

Lichenalia cornuta.

Fig. 6.

Lichenalia cornuta, Hall. Pal. N. Y., Vol. VI, page 203 (not figured).

Fig. 6. A portion of the surface enlarged, to show the regular form and arrangement of the cell apertures, the thickening and crescentiform projection upon the margin of the aperture. The intercellular surface is minutely pustulose.

LICHENALIA OPERCULATA.

FIG. 7.

Lichenalia operculata, HALL. Pal. N. Y., Vol. VI, page 205 (not figured),

Fig. 7. An enlargement of the surface, showing the pustuliform apertures with operculæ, and the intercellular surface, which is sometimes strongly striated or ridged towards the cell apertures, with the intermediate space showing an uneven vesiculiform surface.

LICHENALIA TESSELLATA.

FIGS. 8–10.

Lichenalia tessellata, HALL. Pal. N. Y., Vol. VI, page 207 (not figured).

Fig. 8. An enlargement from the surface, showing the peculiar character of the cell apertures and intercellular spaces.

Fig. 9. A transverse section of the same, showing the distinctly circular form of the cell-tubes and the intercellular tissue.

Fig. 10. A vertical section, showing the cylindrical cell-tubes, the septate intercellular space and the basal vesicular tissue.

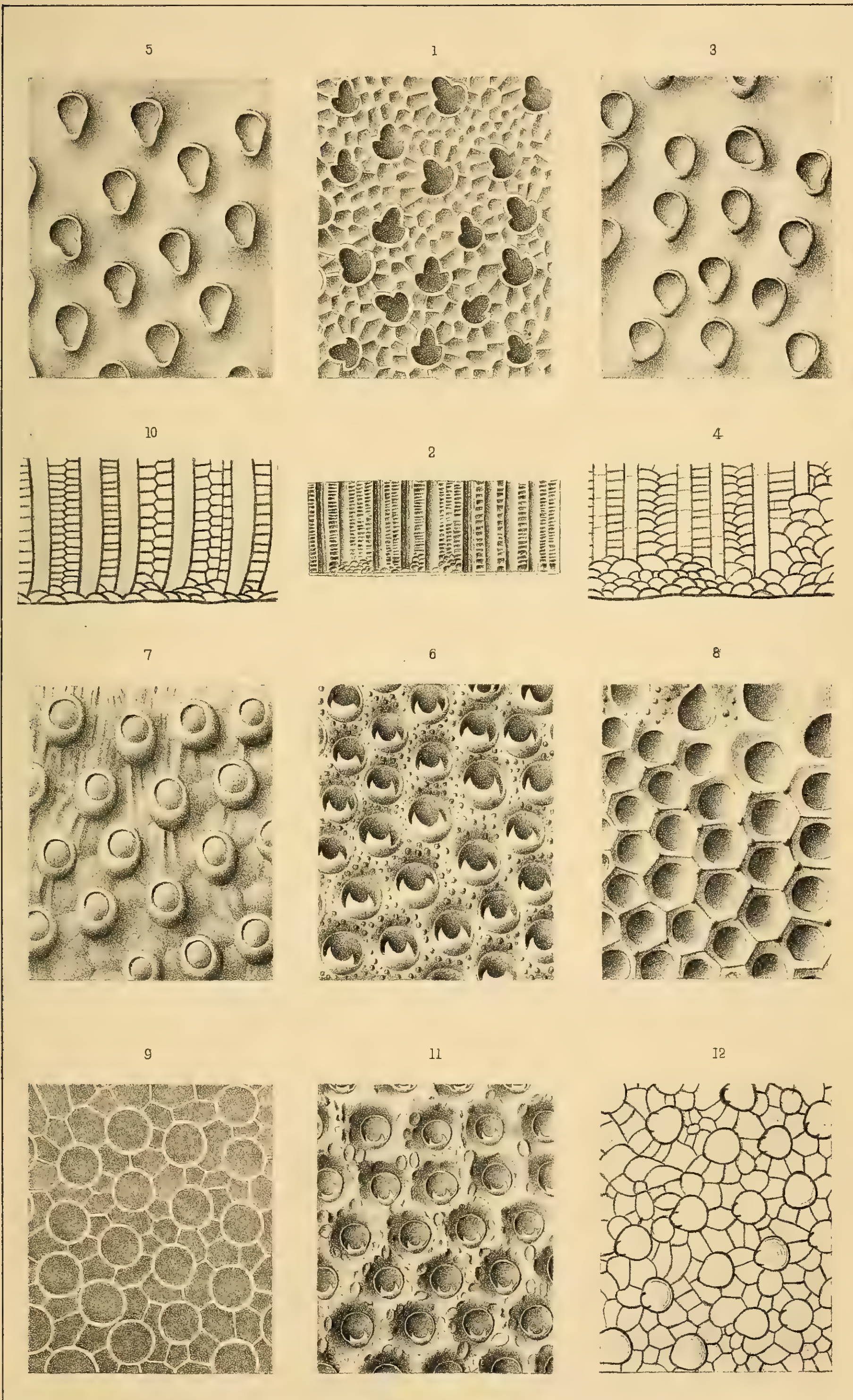
FISTULIPORA CONSTRICTA.

FIGS. 11, 12.

Fistulipora constricta, HALL. Pal. N. Y., Vol. VI, page 227.

Fig. 11. An enlargement from the surface, showing the form of the cell apertures and their constriction by the crescentic projection. The intercellular space is irregularly pustulose and pitted.

Fig. 12. A transverse section of the same species, showing the form of cell-tubes with the irregular intercellular tissue,



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