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VOLUME XIII.

PAPERS READ BEFORE THE ACADEMY.

TRANSACTIONS

OF THE

NEW YORK ACADEMY OF SCIENCES.

Regular Business Meeting.

October 2nd, 1893.

President Bolton in the chair, and fourteen persons present.

The following Amendment to Chapter XII., of the By-Laws, proposed at the meeting of May 1, 1893, was adopted :

To follow Section 3 and be numbered "4," the present Section 4 to be changed to "5."

4. The following shall be considered the order of procedure at meetings assigned to Sections :

1. Reading the minutes.

2. Reports of committees.

3. Exhibition of specimens.

4. Session of the section under the direction of the Chairman and Secretary of the Section.

(*a.*) Reading minutes of the last meeting of the Section.

(*b.*) Presentation and discussion of papers previously announced.

(*c.*) Any other Scientific communications relating to the work of the Section.

5. Adjournment of the Section and resumption of the chair by the President.

The Secretary announced the completion of Vol. XII. of the Transactions during the summer.

The President exhibited the newly engraved seal of the Academy, adopted by the Council.

The following papers were read by title :

" Coleopterological Notices—V." by Thomas L. Casey. [To be published in Vol. VII. ofthe Annals.]

AN INTERNATIONAL INDEX TO CHEMICAL LITERATURE.*

By H. Carrington Bolton.

During one of my bibliographical tours in Europe, an eminent librarian of a German University remarked: "You Americans are doing more and better work in bibliography than all the nations of Europe taken together." And this he said not in flattery, but as the expression of an earnest conviction. Later I expressed surprise that Germans with such splendid collections of books and other advantages should leave it to Americans to cross the Atlantic and wrest from Europe materials for general and special bibliographies. To this he promptly replied: "Ach, mein Freund, das Geld fehlt."

I shall not attempt to demonstrate the accuracy of the gentleman's statements, as it would involve comparisons, and these are said to be odious. A basis for his enthusiasm is, however, found in such monumental works as Poole's Index, Fletcher's Index, Billings' Index-Catalogue of the Medical Library of the Surgeon General's Office, the Index-Medicus edited by Dr. Robert Fletcher, the Catalogue of the Boston Athenæum, as well as the bibliographies of science published by the Smithsonian Institution, by the United States Department of Agriculture, and in independent journals. Many other notable works will suggest themselves to the chemists present who will understand that this is only a passing reference.

The production of special and general bibliographies in the United States goes forward with the multiplication of public and endowed libraries, now increasing in number and value with gratifying rapidity throughout the land. Some of these are publishing bibliographies of specific subjects in addition to their Library-Catalogues; in this direction Harvard University takes the lead.

Unfortunately much good work done by institutions does not get beyond the manuscript stage, as for example the Subject-Index in preparation at the Scientific Library of the United States Patent Office; and the chemical bibliographies compiled by the students of the University of Michigan, as appendages to theses in science.

There are at least three organizations in the United States, which promote the preparation of bibliographies; these are the

* Opening Address to the Section of Bibliography, Congress on Chemistry held at Chicago, August 21-26, 1893.

American Library Association, the Committee on the Bibliography of Geology appointed at the International Congress of Geologists, and the Committee on Indexing Chemical Literature, of the American Association for the Advancement of Science. The work of the American Library Association is familiar to every one; through the journal it reaches all librarians and bibliographers in sympathy with its enterprises. Its scope is, however, almost entirely literary, and science finds little place in its admirable plans.

The Secretary of the Committee on the Bibliography of Geology appointed at the International Congress of Geologists, held September 1, 1891, at Washington, has issued a circular dated November 20, 1891, which sets forth its plans for work. These comprise the preparation of (1) a list of geologic bibliographies already in existence, (2) new bibliographies of special topics, and (3) the periodic registration of the bibliography of geology. Their work has been so recently begun that no great results can as yet be expected.

The work of the Committee on Indexing Chemical Literature, of the American Association for the Advancement of Science, now in the eleventh year of its existence, is familiar to most persons present. This committee has endeavored to direct attention to the importance of compiling bibliographies, catalogues and indexes to the voluminous literature of chemistry. While little systematic work has been undertaken, duplication of labor has been prevented and independent efforts have accomplished much. Thus a collection of special bibliographies has been gradually forming, which now number more than fifty; the list was printed in the tenth annual report of the Committee, published in the proceedings of the A. A. A. S., for 1892, as well as in the *Chemical News* (London). While the Committee feels that their labors have not been vain, the proportion of the completed bibliographies to the number of authors publishing chemical papers is still unhappily small, and the average of five bibliographies per annum is rather lower than expected. The committee expresses the hope that the number will grow much faster in the future.

In England the British Association for the Advancement of Science has done something towards fostering the object under consideration by appointing Committees on Indexing Solutions and other topics, but their work progresses slowly.

The Chemical Societies of Berlin, Paris and London give to their members and subscribers laboriously prepared abstracts of papers published in countries other than their own. For persons whose linguistic attainments are limited to their mother tongue these abstracts are undoubtedly useful, perhaps invaluable; but it rarely happens that they can be entirely relied upon for the details needed by chemists practically interested, and the originals must eventually be consulted. It has seemed to me that if the same amount of energy expended by abstractors of the societies named could be exerted in indexing, greater practical results would be obtained and at far greater economy of space. Moreover, these societies generally confine their abstracts to publications issued in other countries than their own, and consequently a large amount of good material published at home in Government reports, transactions of learned societies, and periodicals devoted to general science, escapes the eyes of all except a few industrious readers.

It has further occurred to me that the Chemical Societies of Germany, France, Italy, Russia, England and the United States, instead of filling their official organs with abstracts of papers foreign to each, might well devote their energy to indexing the wealth of material produced each in its own nation.

And this brings me to the statement of a plan which I have the honor to propose to this Congress for a Coöperative International Index.

I suggest that this Congress, in which are representatives of the six leading Chemical Societies of the world, recommend to these societies the preparation of an annual index to current chemical literature, each society to care for the productions of the country in which it is situated. These annual indexes to chemical literature could be published in the journals (*Berichte*, *Bulletin*, *Journal*, etc.) of the respective societies, which, fortunately for our purpose, are all in octavo form; and when all the indexes are issued for a given year, they could be bound together for convenience. The bibliographies would, of course, be compiled on the same or similar plans, this uniformity being secured by conference between the Index-Committees of the several societies. This plan would necessitate the consultation of six alphabets at least in each annual volume, but this inconvenience would be counterbalanced by the greater accuracy and fullness attained by the subdivision of labor proposed.

What reception this plan may receive by the several societies is uncertain, but I believe that no more important work can be undertaken by the American Chemical Society. This newly reorganized association now numbers over 700 members and is a truly national society. The *Journal* could not present to its members and subscribers a more welcome contribution than a subject-index to the publications of American chemists. This might be done half yearly, or better quarterly, and should embrace the widest range of pure and applied chemistry. Perhaps the American Chemical Society will lead in this enterprise, and then the older and more conservative societies of Europe might follow. One stimulus that would eventually influence them is national pride.

So far this plan relates only to current literature, and some provision must be made for indexing the enormous accumulation of material already in print. Probably there is no better way to attack this problem than to prepare a subject-index to the chemistry contained in the Catalogue of Scientific Papers published under the auspices of the Royal Society. This monumental work loses much of its value owing to the lack of a subject-index, and it is deeply to be regretted that there is no prospect of one being compiled, if at least one may judge from the correspondence on this subject printed in the pages of *Nature.*

And here allow me to place on record a fact bearing on the question; a few years ago a member of the Committee on Indexing Chemical Literature of the American Association for the Advancement of Science, already known to the scientific world by his labors in bibliography, decided to undertake the preparation of a subject-index to the chemistry and physics in the eight quarto volumes of the work named, but before doing so wrote a courteous letter to the Secretary of the Royal Society announcing his scheme. In that letter the gentleman explained that he planned to compile the subject-index and to print it entirely without expense or liability on the part of the Royal Society. After a long lapse of time the gentleman received a note from the Secretary of the Royal Society stating that the matter had been laid before the Council and they had refused permission to have such an index prepared! Thus rebuffed, my friend abandoned his scheme and turned his attention to another task.

In spite of this attitude of the Council of the Royal Society, I believe a regularly constituted committee of chemists could secure permission, if, indeed, any be necessary.

Details of methods to be pursued cannot here be considered; they could be formulated by a committee.

A general bibliography of chemistry has been recently attempted by the writer of this communication; the results form a volume of over twelve hundred pages just issued by the Smithsonian Institution as No. 850 of the series entitled Miscellaneous Collections. This "Select Bibliography of Chemistry, 1492–1892" embraces about twelve thousand titles in twenty-four languages, yet makes no claim to completeness; it is, moreover, a bibliography, not an index.

In conclusion, I have the honor to propose the appointment of an International Committee on Chemical Bibliography, to consist of one member from each country represented in this Congress. That this committee have unlimited power to add to its number, provided, however, that no country have more than two representatives. That this committee, through the European and American Chemical Societies, report a scheme for an International Coöperative Index to Chemical Literature.

UNIVERSITY CLUB, NEW YORK CITY, August, 1893.

STATED MEETING.

October 9th, 1893.

Prof. JOHN K. REES in the chair, and twenty-seven persons present.

SECTION OF ASTRONOMY AND PHYSICS.

The following papers were read :

"The Iced-Bar and the Long-Tape Base Apparatus of the United States Coast and Geodetic Survey," by Prof. R. S. Woodward.

"Some Observations on Deep-Well Temperatures made during the Summer of 1893, at Wheeling, West Virginia," by Prof. Wm. Hallock.

Prof. Rees exhibited two positives taken by Prof. Schaeberle in Chili, at an altitude of 6,600 feet, during the total solar eclipse of April 16, 1893. He also reported on the progress of the variation of latitude work at the new Columbia College Observatory, in connection with the Naples Observatory. Four observers, Prof. Rees and Messrs. Jacoby, Monell and Davis have made observations of 873 pairs of stars on 86 nights, from May 6 to October 7.

Prof. Rees also announced the receipt of photographs from retouched enlargements of the moon's surface taken with a 36 inch refractor at the Lick Observatory. They were retouched by Prof. Weineck, of Prague, and presented by him.

Stated Meeting.

October 16th, 1893.

Vice President Osborn in the chair and twenty-eight persons present.

Prof. Osborn stated that the Committee on Public Lectures had secured the hall of the New York Academy of Medicine for this season's course.

Section of Biology.

Professor Osborn took the Chair, and after a short address, called upon members of the section for brief reports of summer's researches.

Mr. F. M. Chapman spoke of the revision of his collections of birds and mammals from the Island of Trinidad; Dr. F. S. Lee of his continued investigation of the functions of the internal ear; Prof. E. B. Wilson of his recent visit to the Pacific coast, undertaken in behalf of the University of California, with the view of determining a locality best suited for the proposed Marine Laboratory; Dr. Bashford Dean gave a brief account of his experiments in the Delaware in the artificial culture of sturgeon carried on in the interests of the United States Fish Commission; Prof. N. L. Britton reported on his summer researches at Pocono, Pa., noting some of the results of himself and of his students in studies of the altitudinal distribution of Eastern plants; Prof. Osborn, in conclusion, spoke of his visits to the collecting ground in the "Bad Lands," and reported briefly upon recent discoveries of new forms of fossil Titanotheres in the Upper Bridger.

The following officers of the section were elected for the ensuing year:

Chairman: Prof. H. F. Osborn.
Secretary: Dr. Bashford Dean.

Stated Meeting.

October 23d, 1893.

Prof. Jas. F. Kemp in the Chair and thirteen persons present.

The following paper was read:

OBSERVATIONS ON THE GEOLOGY AND BOTANY OF MARTHA'S VINEYARD.

By Arthur Hollick.

PART Ia.

In a recent communication* I expressed regret at not having had an opportunity to visit Martha's Vineyard. Previous observations on Staten Island and Long Island had led me to infer that certain conditions which exist on these two islands must also prevail on Martha's Vineyard. Subsequent explorations on Long Island confirmed my ideas and emphasized the necessity for a personal knowledge of the facts. Through the liberality of the Trustees of Columbia College, a trip with this end in view was made to Martha's Vineyard during the early part of last July, and the observations then made form the basis of this paper.

As is well known, Martha's Vineyard is merely part of the fringe of morainal hills which extend from the mainland of northern New Jersey through Staten Island, Long Island and the islands to the eastward, reappearing on the mainland again in Massachusetts, on Cape Cod.

The inroads of the sea, combined with the gradual depression of the coast, has resulted in a submergence of portions of this fringe, leaving the higher parts in the form of islands, one of which is Martha's Vineyard.

The only essential difference of opinion in regard to the geological history of this island, on the part of recent observers, is, apparently, whether it has been subjected to mountain building forces, by reason of which it has been subjected to distortion and raised disproportionately above the surrounding levels of the sea bottom, or whether it may be accounted for upon the same hypothesis by which we may account for the formation

*"Plant Distribution as a Factor in the Interpretation of Geological Phenomena, with Special Reference to Long Island and Vicinity." (Trans. N. Y. Acad. Sci. XII. (1893) 189-202).

and structure of the other islands which yet remain as the remnants of the gradually vanishing morainal fringe.

In the first instance it would be necessary to consider Martha's Vineyard either as having little or nothing in common, so far as its geological history is concerned, with the other parts of the moraine, or else to suppose that the theory in regard to the geological history of these other parts is at fault and must be altered to conform to that regarding Martha's Vineyard. In the second instance, we should be able to invoke the same series of cause and effect to account for the formation and structure of the entire moraine, based upon extensive observations and investigations over a much larger extent of country than is available in the limited area of Martha's Vineyard alone.

A brief history of the views of different observers will therefore be of interest in this connection, as a prelude to what is to follow.

In the early documentary history of this country numerous references may be found to Martha's Vineyard. In 1602 Bartholomew Gosnold sailed from England in the bark "Concord," stopped at "No Man's Land" on May 24th, and subsequently passed Gay Head, which they named "Dover Cliff," and entered Buzzard's Bay, or, as they called it, "Gosnold's Hope." In 1603, Martin Pring,* having heard of Gosnold's voyage, set sail, and after stopping at several points on the New England coast, finally anchored in Old Town Harbor, Martha's Vineyard.

In 1614 another expedition was fitted out and commanded by Capt. Hobson. A captive American Indian, who had been carried to England, was taken along, on his promise that he would show where gold was to be found on "Capawicke," or Martha's Vineyard. The expedition arrived there in good time, but the Indian made his escape without making good his promise. The gold was doubtless the pyrite which is so common in the clays of Gay Head.

In 1786 Samuel West and William Baylies, with three others, formed a party to visit the island, and the account of their visit is embodied in two communications to Gov. Jas. Bowdoin of Massachusetts.† As these communications contain perhaps the earliest published descriptions of the island and are exceedingly quaint, the following extracts from them may not be out of place.

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*I have been informed by one of the descendants of an old Martha's Vineyard family that the name is generally supposed to be a corruption of "Martin's Vineyard," the latter part of the name having reference to the great abundance of native grapes which were and are yet to be found there.

† Mem. Am. Acad. Arts and Sci. II., Part I. 147–150 (1793) and 150–155 (1797).

Mr. West says :

"* * * The inhabitants presented us with a petrified bone said to be one of the vertebrae of the whale, which they told us they found in the cliff; it is very heavy, owing, I apprehend, to a metallick impregnation. They also brought us two shell-fish which were petrified; these were taken out of the cliff. * * * The doctor and I dug out some pieces of charcoal at the bottom of the cliff. * * * Some of the vitriolick springs are very strongly impregnated with the taste of copperas. * * * In addition to what the doctor has observed, that there must formerly have been a volcano on the Gay Head, I would inform your excellency, that an elderly man, who was in company with us, told me that his mother had informed him that she could remember when it was common to see a light upon Gay Head in the night time. Others informed me that their ancestors have told them that whalemen used to guide themselves in the night by the lights that were seen upon Gay Head."

Mr. Baylies says :

"I have at length executed the design, which I had formed, in consequence of an invitation from the Reverend Mr. West, of visiting Gay Head. In company with him, Col. Pope, and two others, I sailed from Bedford, in an open two-mast boat. * * * A northerly wind carried us down the river into the midst of the bay, in an easy, agreeable manner. A calm then coming on with a hot sun, and a constant rolling of the boat, I grew exceedingly sick. Nothing could alleviate my disagreeable feelings, but a view of Gay Head, through Quick's Hole, at the distance of about fifteen miles. A variety of colours, such as red, yellow and white, differently shaded and combined, exhibited a scene, sufficient to captivate the mind, however, distressed. * * * We beckoned to two young Indians whom we saw on the hills above us. They immediately came ; and, by the promise of a little rum, our boat was hauled up on the beach. * * * In one way we found the soil to be good. * * * It manifests to the taste a strong impregnation of vitriolick acid; and contains many bright shining particles. * * * After our arrival at the cliffs, we looked round for a place of descent. This, in a little time, we found. But, I must confess, I proceeded on with great caution and some fear; knowing that one false step would bring me to the bottom much sooner than I could wish. On one side we had a red, unctuous, argillaceous earth; on the other a blue, white and yellow one, variegated with grey, black and green spots and masses of charcoal under our feet. When we had descended, on looking back, the idea of a volcano struck us at once. In fact it had all the appearance of having blown out but a few days. That it was formerly a volcano, was confirmed by a further examination. Large stones, whose surfaces were vitrified; great numbers of small ones, cemented together by melted sand, and also cinders were to be seen in many places. A black, sooty powder, similar to lamp black, and made use of by painters to serve the same purposes, under which a whitish matter resembling the gypseous earth calcined, intermixed with the same kind of earth uncalcined, were to be found in great quantities. Besides there are very plain marks of four or five different craters. * * * Add to this a tradition prevalent among the natives : in former times, the Indian God, Moiship, resided in this part of the island; and made the crater described above his principal feat. To keep up his fires he pulled up the largest trees by the roots ; on which, to satisfy his hunger, he broiled the whale and the great fish of the sea, throwing out the refuse sufficient to cover several acres. * * * To facilitate the catching these fish, he threw many large stones, at proper distances into the sea, on which he might walk with greater ease to himself. * * * On a time an offering was made to him of all the tobacco on Martha's Vineyard, which having smoked, he knocked the snuff out of his pipe, which formed Nantucket. When the Christian religion took place in the island, he told them as light had come among them, and he belonged to the kingdom of darkness, he must take his leave ; which to their great sorrow he accordingly did ; and has never been heard of since. Had this been a Grecian or Egyptian fable, how many volumes of explanations, resolutions, and comments, it would have given rise to !"

"We tarried on the island * * * examining the cliffs. * * * They appeared to be composed principally of clays, of all colours, and unctuous to the touch. The red, used as a paint, undoubtedly derives its colour from the calx of iron. The blue shoots out copperas in considerable plenty, and we found hard, heavy pieces of matter, sparkling with small granulated particles of a white colour, imbedded therein. This, it is probable, will afford something of the metallick kind. * * * Small streams of water ran down the sides of the cliffs ; * * * every one of these had more or less of the vitriolick taste.

"The bones of whales, sharks' teeth, and petrified shell fish, are frequently picked up, scattered up and down the cliff, at a considerable distance above the surface of the water.

"The sea, it is said, has made considerable encroachments on this part of Gay Head. Within thirty years it has swept off fifteen or twenty rods. Had Neptune thus demolished part of Vesuvius or Ætna up to their very craters and laid open all their secrets, how would the curious in Europe have flocked from all quarters to behold a scene so full of wonders ! But Gay Head is scarcely mentioned in America."

PART I b.

Reports upon and accounts of the geology of the island by subsequent observers are abundant, references to which will be given wherever occasion may arise in this paper, and such as are not quoted in the discussion will be appended at the end.

One of the latest, and by far the most complete of these, is by Prof. N. S. Shaler,* to which special attention is now called, not only because it may be considered as containing the views most likely to carry with them the greatest weight of authority, but also because it was used as my guide and work of reference while on the island, and because it is indispensable to those who may wish an exhaustive and clear statement of the facts concerning the island's geology, irrespective of any interpretation which may be deduced from them.

It has already been noted that the earliest writers ascribed a volcanic origin to that part of the island in the vicinity of Gay

* "Report on the Geology of Martha's Vineyard."—7th Ann. Rept. U. S. G. S. 1885-86) 297–363.

Head, and it is of interest to note that Prof. Shaler, one of the latest observers, likewise argues for a somewhat similar idea, viz., mountain-building forces, in order to account for the dislocations and elevations of the strata.

Doubtless recognizing the substantial agreement between these widely separated sources of information, we find, in the International Encyclopedia, which bears the imprint 1892, under the caption "Martha's Vineyard," the statement that " * * * At the w. end of the island, is Gayhead, an abrupt and bold coast-line eminence, which is said to be of volcanic origin."

Under the above circumstances, it therefore becomes of importance, in case any other interpretations of the facts are warranted, that they should be made known, together with any material and observations upon which they may be based.

My own investigations on Staten Island and Long Island,* continued through many years, satisfied me that a single series of cause and effect had produced the phenomena of folding, elevation, dislocation and transportation of the cretaceous and post-cretaceous material which we find there in connection with the terminal moraine.

If we examine the moraine throughout Long Island and in that portion of it on Staten Island, which is to the south of former cretaceous or post-cretaceous areas, we find that the clays and other incoherent strata have not only been eroded but plowed up in masses, or the strata frequently folded or squeezed up and shoved ahead by the advancing ice sheet, which, upon melting, left them as hills or ridges of dislocated, contorted material, covered to a greater or less extent by the englacial and superglacial till. In some instances the clays are interbedded with the till, forming a part of it and just as erratic in their distribution as are the accompanying bowlders. In other instances the till appears merely as a mantle over the distorted clays below. The northern flanks of the hills are usually deeply covered with the till, which thins out to a feather edge on top, merging into more or less modified and stratified material on the southern flanks. A miniature ideal section of this description may be seen at Arrochar, Staten Island, in the new cut made for the

* "The Palæontology of the Cretaceous Formation on Staten Island." (Trans. N. Y. Acad. Sci. XI. 96–104.)

"Additions to the Palæobotany of the Cretaceous Formation on Staten Island." (Trans. N. Y. Acad. Sci. XII. 1–12.)

"Plant Distribution as a Factor in the Interpretation of Geological Phenomena, with Special Reference to Long Island and Vicinity." (Trans. N. Y. Acad. Sci. XII. 189–202.)

"Preliminary Contribution to Our Knowledge of the Cretaceous Formation on Long Island and Eastward." (Trans. N. Y. Acad. Sci. XII. 222–237.)

Staten Island Rapid Transit Railroad during the present year. There are also scattered through the till and in the modified drift beyond, fragments and concretions of ferruginous sandstone or shale, which represent the smaller pieces of clay, marl or sand hardened by oxidation of included ferruginous waters or by the accumulation of limonite around the exterior in the form of a shell. These fragments are exceedingly characteristic constituents of the drift material wherever it occurs to the south of former cretaceous areas, and once recognized could afterwards hardly be mistaken for anything else, and as they frequently contain well-known cretaceous leaves and mollusks their derivation cannot be doubted. Thus far I have failed to find any of these on Staten Island or Long Island which could be referred to the tertiary.

Such, in brief, are the facts as they occur on these islands, and the interpretations which have been applied to them.

On Martha's Vineyard I found the conditions to be similar in all respects, but in a more clearly defined and concentrated form. The description of these conditions is so graphically and exhaustively given in Prof. Shaler's report that it would be superfluous for me to reiterate them. It is sufficient to say that there is a similar ridge of hills, consisting of a superstructure of contorted clay strata, capped and flanked to the north with till, while to the south there is a similar region of modified, water assorted drift. The escarpment of Gay Head is unique inasmuch as it is the only portion of the moraine where we have an almost sheer section exposed from summit to tide level. The elevation is no greater and in fact not so great as that of many of the morainal hills on Long Island, and we need merely to imagine Long Island separated into isolated portions, by north and south erosion channels, in order to reproduce Gay Head indefinitely. In fact, at several localities, Glen Cove in particular, it may be actually seen in miniature at the present time.

Under the circumstances I fail to see that any other explanation to account for the structure of the entire morainal fringe throughout the coastal region is as consistent with the facts as the one here advanced. Further than this an examination of the Martha's Vineyard rocks shows them to have been derived largely from cretaceous and post-cretaceous strata. Aside from the clays themselves, everywhere the characteristic ferruginous sandstone and shale fragments and concretions may be found, many of them containing fossils which can be readily identified. The majority of these are of cretaceous origin, in fact all which I collected, representing both flora and fauna, are of this formation, although the palæontological material collected by other observers shows that both the tertiary and quaternary formations are also represented.* This fact is to be expected if we suppose the material which now forms the island to have been largely derived from the strata which formerly occupied the present basin of the Sound to the north. In fact the almost entire absence of tertiary fossils throughout Long Island has always been more or less of a puzzle, unless we suppose that the cretaceous belt of New Jersey, which averages about 18 miles in width, continued in about the same width for a considerable distance eastward, in which case it would have occupied practically the whole of the area of the coastal plain subject to glacial erosion north of Long Island, and the tertiary strata would have been south of the limit of furthest ice advancement, and therefore not only not subject to erosion, but their former outcrops covered with the debris of the moraine at the present time.

As there seems to be undoubted evidence of both cretaceous and post-cretaceous fossils on Martha's Vineyard we must conclude that the cretaceous belt became narrower from Long Island eastward, and that tertiary and later strata as well were subject to erosion in the area north of Martha's Vineyard.

PART I C.

The portion of the island personally investigated was from Vineyard Haven to Gay Head, and the palæontological material collected consists of mollusks in a poor state of preservation, and dicotyledonous plant remains in excellent condition. I also found a bone which I took to be a section of the vertebral column of a *Zeuglodon*, but it was unfortunately lost before my return home, and was therefore merely subjected to a hasty examination in the field.

This latter specimen and the plant remains were collected on the side or at the base of the Gay Head escarpment. The plant remains consist of leaves, fruits, seeds and other fragments,

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* Hitchcock, Edward. Final Rept. on the Geol. of Mass., II. (1841) 422-434, Pl. XIX. Figs. 1-19. [Cretaceous and Tertiary flora and fauna.]

Lyell, Charles. Quart. Journ. Geol. Soc. London, IV. No. 92. Review in Am. Journ. Sci. XLVI. (1844) 318-320. [Tertiary fauna.]

Shaler, N. S. Bull. Mus. Comp. Zool. XVI. No. 5 (1889) 89-97. [Cretaceous fauna.]

Merrill, Fredk. J. H. Discussion of David White's paper on "Cretaceous Plants from Martha's Vineyard." Bull. Geol. Soc. Am. I. (1890) 554-555. [Tertiary and Quaternary fauna.]

White, David. See above reference and also Am. Journ. Sci. XXXIX. (1890) 93-101. [Cretaceous flora.]

The above references contain definite facts in regard to the palæontological proof of the ages of the strata. References in regard to stratigraphy and general geology, etc., will be given further on.

many of them readily recognizable as cretaceous species, and there seems to be no reason to doubt that the entire collection is to be referred to that horizon. They were found in fragments and concretions of ferruginous sandstone, indistinguishable in their mode of occurrence and lithological characters from the material already described by me from Long Island and Staten Island. As, however, the collections by Mr. David White, previously referred to, were much more extensive and have been already partially described, I have thought it best that some one person should study and describe the combined collections, and hence shall do no more on this occasion than to exhibit the specimens, in order that they may be compared with those from Long Island, Staten Island and New Jersey and their identity noted, leaving their elaboration for some future occasion.

The molluscs were found at Indian Hill, where they occur in drift material of a ferruginous character, almost identical with similar specimens from Arrochar, Staten Island. In connection with the material in which the molluscs occur there is quite a mass of sandy clay, evidently due to glacial transportation "en masse," and the ordinary sand, gravel and bowlders of the moraine. Comparing this material with the Gay Head, Long Island and Staten Island specimens, and the conditions under which it occurs, we can not doubt an identical derivation for all, from former cretaceous or post-cretaceous strata to the north, and transported to their present locations through the agency of the ice sheet.

Professor Shaler, in his report, mentions the Indian Hill locality and the "small angular fragments of a reddish sandstone, which contain six or eight well marked species of cretaceous mollusca." He is, however, unable to accept any other theory to account for their presence there than "that the cretaceous beds whence these fragments were derived are in place at some little depth beneath the surface, within a few hundred feet of the locality where the cretaceous waste now lies." If we are to consider "in place" as comprehending strata which have been moved from their original position, while retaining in a large part their integrity, this theory is entirely in accord with the present condition of our knowledge. Even this interpretation, however, is not a necessary one, and I should be more inclined to attribute the origin and present distribution of this material to transportation of incoherent material and its subsequent hardening, without necessarily inferring the immediate proximity of the strata from which it was derived.

I am also led to this conclusion from the fact that similar fragments, identical lithologically, are to be found throughout the entire morainal region of the island, just as they may be found in the other regions examined, although not always containing any palæontological evidence of their origin.

A few pieces which I picked up on the road between Menemsha and Squipnocket Ponds seemed to promise some results, but they were too fragmentary for determination.

In a subsequent communication * Prof. Shaler describes the results obtained from a study of the molluscs contained in this material. The conclusion seems to be irresistible as to its Cretaceous age, and the discussion in regard to its origin and distribution is more nearly in accord with my own, but he is still unable to accept all the interpretations here advanced.

Prof. R. P. Whitfield has kindly subjected the specimens in my possession to careful examination, without however reaching very satisfactory results, owing to their poor preservation. I quote as follows from his communication to me on the subject:

> "The box of fossils sent I have examined, but can make but little of the contents. * * * The *Camptonectes* is the best thing among them. * * * The *Ostrea* might be identified with *O. congesta*, Conrad, but I am not by any means certain that it is that shell. * * * There are one or two other shells—an *Exogyra*, a Solen, and Shaler's new genus. [See his Fig. 1.] * * * But I would not say unequivocally that they are Cretaceous."

Following is the list:

1. *Camptonectes Burlingtonensis*, Gabb.? (*Not C. parvus*, Whitf.)
2. *Exogyra ostracina*, Lam.? (Shaler, Fig. 19.)
3. *Exogyra* sp? (Looks like *E. arietina*, Roem.)
4. *Ostrea congesta*, Conrad?
5. *Ostrea* sp?
6. *Lyonsia?* (Same as Shaler's f. 11, but *not Lucina.*)
7. *Mytilus* sp?
8. *Corbula* sp?
9. Some fragments of a Solen (*not Leptosolen biplicata*, Conrad).
10. Shaler's new genus, probably. (Shaler's f. 1–1b. "Compare *Myoconcha.*")
11. A gasteropod, indeterminate.

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3. Crosby, W. O. Rept. on the geological map of Massachusetts for the Centennial Commission (1876).

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* "On the occurrence of fossils of the Cretaceous age on the island of Martha's Vineyard." Bull. Mus. Comp. Zool. XVI. No. 5, pp. 89–97. Pl. 1, 2 (1889).

5. Hitchcock, Edward. "Notices of the geology of Marthas's Vineyard and the Elizabeth Islands." Am. Journ. Sci. VII. (1824), 240–248.

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Rept. Re-exam. Econom. Geol. Mass. (1838), 130–131.

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8. Merrill, Fredk. J. H. "Geological structure and age of the deposits at Gay Head, Mass." Trans. N. Y. Acad. Sci. IV. (1885), 78, 79.

9. Morton, S. G. / Vanuxem, L. "Geological observations on the secondary, tertiary and alluvial formations on the Atlantic coast of the United States of America." Journ. Acad. Nat. Sci. Phil. VI. Part I. (1827), 59–71.

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11. Rogers, H. D. Address, Am. Assn. Geol. and Nat. Washington, D. C., May, 1844, in Am. Journ. Sci. XLVII. (1844), 137-160, 247-278.

12. Shaler, N. S. "Tertiary and cretaceous deposits of eastern Massachusetts." Bull. Geol. Soc. Am. I. (1890), 443–452.

13. Stimpson, Wm. "Cretaceous strata at Gay Head, Mass." Am. Journ. Sci. XXIX. (1860), 145.

"On the fossil crab of Gay Head." Bost. Journ. Nat. Hist. VII. (1863), 583–859, Pl. XII.

14. White, C. A. "Correlation papers—Cretaceous." Bull. No. 82, U. S. G. S. (1891), pp. 86, 87.

15. Whiting, H. L. In 7th Ann. Rept. Harbor Commissioners, Boston (1872), p. 112, and Appendix p. 361.

PART II.

While engaged in making the observations previously described I also took advantage of the opportunity, to note and collect, without special search, such specimens of the flora as attracted, or rather forced themselves upon my attention.

The most conspicuous element in the vegetation is the large number of oaks, which in places form many square miles of dense low woods. *Quercus ilicifolia* is the most abundant species, but *Q. stellata*, *Q. tinctoria*, *Q. palustris* and *Q. alba* are also plentiful, besides several peculiar forms having the characteristics of both *Q. tinctoria* and *Q. ilicifolia.* As no fruit was available for study I merely mention the fact in the hope that other collectors may be fortunate enough to gather more and better material for comparison. It is possible that there is here represented another of the many hybrid oaks. All are stunted in stature, although this may be due to the fact that the timber throughout the island is second growth, and possibly the original trees may have been much larger.

Dense thickets of *Rosa Carolina* and *R. humilis*, besides almost a continuous hedge of the same for miles along the road to Gay Head, were just in full blossom, and never before had I seen them in any such profusion. Wild grapes also, which are very plentiful there, were in blossom, so that between the two the atmosphere in places was fairly heavy with perfume.

The soil of the region traversed, between Vineyard Haven and Gay Head, is composed of sand and boulders, with clay in limited localities only, so that streams and ponds are very rare, the porous soil absorbing the rain almost as soon as it falls. There are several little sandy sphagnum swamps, however, and a lake (Lake Tashmoo) of some size close to tide-water, besides sand beaches and salt water inlets. In general, it is a typical scrub-oak region, strikingly like many parts of the eastern end of Long Island.

In the sphagnum swamps *Drosera rotundifolia*, *Galium trifidum*, *Schoblera macrocarpa*, *Limodorum tuberosum*, *Pogonia ophioglossoides* and *Eriophorum gracile* were specially noted.

In Lake Tashmoo *Potamogeton perfoliatus* and *Ruppia maritima* form masses of vegetation, and along the borders the most abundant plants are *Dryopteris Thelypteris*, *Juncus Greenii*, *Iris versicolor*, *Scutellaria galericulata*, *Gratiola Virginiana*, *Lysimachia terrestris*, *Ptilimnium capillaceum*, *Nesæa verticillata*, *Potentilla Anserina*, *Rubus hispidus* and *Sagina decumbens* (?).

On the high dry ground there are large patches of *Hudsonia tomentosa* with *Lechea minor*, *L. maritima* and *Helianthemum majus*. This latter plant occurs in the two very distinct forms—one perfectly smooth, the other villous and hoary, in close contact with each other. The sand barren plants are also represented by *Viola sagittata*, var. *ovata*, *Polygala polygama*. *Trifolium arvense*, *Cracca Virginiana*, *Prunus maritima*, *Chrysopsis falcata*, *Sericocarpus asteroides*, *Diplopappus linariifolius* *Arctostophylos Uva-Ursi*, *Kalmia angustifolia*, *Asclepias obtusifolia*, *Salix tristis* and *Cypripedium acaule*. *Pinus rigida* was the only pine noted.

The bulk of the underbrush consists of *Gaylussacia frondosa*, *G. resinosa*, *Vaccinium corymbosum*, *V. vacillans*, *V. Pennsylvanicum*, *Andromeda ligustrina*, *Rhododendron viscosum*, *Myrica cerifera*, *M. Gale*, *Viburnum dentatum*, *Amelanchier Canadensis*, *Pyrus arbutifolia*, *Rhus copallina* and the roses previously mentioned, while on the ground is an abundant growth of *Epigæa repens*, *Gaultheria procumbens*, *Trientalis Americana* and *Potentilla argentea*. *Smilax glauca* and *Smilax rotundifolia*, although both were occasionally met with, are surprisingly uncommon, and their complete absence from large tracts of the woodland is in striking contrast to nearly every other such locality in this region.

Apparently the most abundant weed on the island is *Hypericum perforatum.* Other species which might be mentioned in the same category are *Lepidium ruderale*, *Potentilla Norvegica*, *Daucus Carota*, *Erigeron Canadensis*, *Achillea Millefolium*, *Ambrosia artemisiæfolia*, *Carduus spinosissimus*, *Chrysanthemum Leucanthemum*, and *Rudbeckia hirta.*

Usnea barbata hangs thickly from the trees in many localities.

Some of the introduced plants perhaps merit special mention. A tree of *Æsculus Hippocastanum* was found on the shore of Lake Tashmoo, so remote from any habitation as to appear truly native there. *Dianthus barbatus* and *Sedum acre* are not uncommon along the roadsides, with the very common *Silene inflata* and *Saponaria officinale.* A bright orange-red flower attracted my attention in the middle of a field, which I thought at some distance was *Asclepias tuberosus*, but which turned out to be *Lychnis chalcedonica.*

Following is a complete list of the species noted during the brief period of my visit. It was made up from such as were observed without effort, some species in flower, some in fruit, and may therefore be considered merely as representing the commonest or most conspicuous species of the midsummer flora of the island, in that part of it between Vineyard Haven and Gay Head.

1. *Castalia odorata* (Dryand) Greene.
2. *Lepidium ruderale*, L.
3. *Helianthemum majus* (L.) B. S. P.
4. *Hudsonia tomentosa*, Nutt.
5. *Lechea maritima*, Leggett.
6. *Lechea minor*, L.
7. *Viola sagitata*, Ait., var. *ovata*, Nutt.
8. *Polygala polygama*, Walt.
9. *Silene vulgaris* (Moench) Garcke.
10. *Saponaria officinalis*, L.
11. *Dianthus barbatus*, L.
12. *Lychnis chalcedonica.* L.
13. *Sagina decumbens* (Ell.) T. & G.
14. *Hypericum perforatum*, L.
15. *Oxalis stricta*, L.
16. *Ilex verticillata* (L.) Gray.
17. *Vitis æstivalis*, Michx.
18. *Rhus copallina*, L.
19. *Rhus Toxicodendron*, L.
20. *Rhus Vernix*, L.
21. *Trifolium arvense*, L.
22. *Cracca Virginiana*, L.
23. *Lathyrus maritimus* (L.) Bigel.
24. *Prunus serotina*, Ehrh.

25. *Prunus maritima*, Wang. (Several bushes in both flower and fruit.)
26. *Rubus hispidus*, L.
27. *Fragaria Virginiana*, Mill.
28. *Potentilla Anserina*. L.
29. *Potentilla argentea*, L.
30. *Potentilla Norvegica*, L.
31. *Rosa Carolina*, L.
32. *Rasa humilis*, Marsh.
33. *Pyrus arbutifolia* (L.) L. f.
34. *Crataegus Crus-galli*, L.
35. *Amelanchier Canadensis*, T. and G., var. *obovalis* (Michx.) B. S. P.
36. *Ribes oxyacanthoides*, L.
37. *Sedum acre*, L.
38. *Drosera rotundifolia*, L.
39. *Nesæa verticillata* (L.) H. B. K.
40. *Epilobium spicatum*, Lam.
41. *Mollugo verticillata*, L.
42. *Ptilimnium capillaceum* (Michx.)=*Discopleura capillacea*, D. C.
43. *Heracleum lanatum*, Michx.
44. *Daucus Carota*, L.
45. *Aralia nudicaulis*, L.
46. *Nyssa aquatica*, L.
47. *Viburnum dentatum*, L.
48. *Galium trifidum*, L.
49. *Chrysopsis falcata* (Pursh) Ell.
50. *Sericocarpus asteroides* (L.) B. S. P.
51. *Aster linariifolius*, L.
52. *Erigeron Canadensis*, L.
53. *Anaphalis margaritacea* (L.) Benth. & Hook.
54. *Ambrosia artemisæfolia*, L.
55. *Rudbeckia hirta*, L.
56. *Achillea Millefolium*, L.
57. *Chrysanthemum Leucanthemum*, L.
58. *Erechtites hieracifolia* (L.) Raf.
59. *Carduus spinosissimus*, Walt.
60. *Carduus odoratus* (Muhl.)=*Cnicus odoratus*, Muhl.
61. *Hieracium venosum*, L.
62. *Gaylussacia frondosa* (L.) T. & G.
63. *Gaylussacia resinosa* (Ait.) T. & G.
64. *Vaccinium Pennsylvanicum*, Lam.
65. *Vaccinium vacillans*, Soland.
66. *Vaccinium corymbosum*, L.
67. *Schollera macrocarpa* (Ait.)=*Vaccinium macrocarpon*, Ait.
68. *Arctostaphylos Uva-Ursi* (L.) Spreng.
69. *Gaultheria procumbens*, L.
70. *Epigæa repens*, L.
71. *Andromeda ligustrina* (L.) Muhl.
72. *Kalmia angustifolia*, L.
73. *Rhododendron viscosum* (L.) Torrey.
74. *Pyrola rotundifolia*, L.
75. *Clethra alnifolia*, L.
76. *Monotropa uniflora*, L.
77. *Lysimachia terrestris* (L.) B. S. P.
78. *Trientalis Americana* (Pers.) Pursh.
79. *Anagallis arvensis*, L.

80. *Diospyros Virginiana*, L.
81. *Apocynum cannabinum*, L.
82. *Asclepias exaltata* (L.) Muhl.
83. *Asclepias pulchra*, Ehrh.
84. *Asclepias obtusifolia*, Michx.
85. *Convolvulus Sepium*, L.
86. *Gratiola Virginiana*, L.
87. *Melampyrum lineare*, Lam.
88. *Scutellaria galericulata*, L.
89. *Plantago lanceolata*, L.
90. *Plantago major*, L.
91. *Polygonum punctatum*, Ell.
92. *Sassafras Sassafras* (L.) Karst.
93. *Broussonettia papryifera* (L.), Vent.
94. *Myrica cerifera*, L.
95. *Myrica Gale*, L.
96. *Quercus alba*, L.
97. *Quercus coccinea*, Wang.
98. *Quercus ilicifolia*, Wang.
99. *Quercus palustris*, Du Roi.
100. *Quercus rubra*, L.
101. *Quercus minor* (Marsh.) Sarg.
102. *Quercus tinctoria*, Bart.
103. *Fagus atropunicea* (Marsh.) Sudw.
104. *Salix tristis*, Ait.
105. *Limodorum tuberosum*, L.
106. *Pogonia ophioglossoides* (L.) Ker.
107. *Cypripedium acaule*, Ait.
108. *Iris versicolor*, L.
109. *Sisyrinchium angustifolium*, Mill.
110. *Smilax glauca*, Walt.
111. *Smilax rotundifolia*, L.
112. *Lilium Philadelphicum*, L.
113. *Juncus Greenii*, Oakes & Tuck.
114. *Juncus tenuis*, Willd.
115. *Juncoides campestris* (L.) Kuntze.
116. *Potamogeton perfoliatus*, L.
117. *Ruppia maritima*, L.
118. *Cyperus filiculmis*, Vahl.
119. *Eriophorum gracile*, Koch.
120. *Carex fœna*, Willd.
121. *Panicum depauperatum*, Muhl.
122. *Panicum dichotomum*, L.
123. *Deschampsia flexuosa* (L.) Griseb.
124. *Dactylis glomerata*, L.
125. *Pinus rigida*, Mill.
126. *Pteris aquilina*, L.
127. *Dryopteris acrostichoides* (Sw.) Kuntze.
128. *Dryopteris Thelypteris* (Sw.) A. Gray.

SPECIMENS SHOWN.

Ferruginous sandstone and concretions containing dicotyledonous leaves and fruit. Gay Head.

Variegated clays and objects made from them. Gay Head.

Ferruginous sandstone fragments, containing molluscs. Indian Hill.

Ferruginous sandstone and concretions, containing cretaceous leaves and molluscs. Long Island and Staten Island.

Variegated clays. Long Island and Staten Island.

Mounted plants, representing part of the summer flora of Martha's Vineyard.

Stated Meeting.

October 30th, 1893.

Prof. R. P. Whitfield in the chair, and thirty-six persons present.

Dr. E. S. F. Arnold exhibited specimens of limonite from St. John's River, Florida; he stated that the deposit is about five feet below the surface, and from one to four feet thick.

Prof. A. H. Chester exhibited a specimen of rhodonite from Franklin Furnace, N. J.

Section of Geology and Mineralogy.

Prof. Whitfield in the chair.

The following papers were read:

"The Ore-bodies at Franklin Furnace and Ogdensburg, N. J.," by Jas. F. Kemp.

The paper was discussed by Prof. A. H. Chester, who called attention to the discovery there by F. L. Nason of a new mineral, apparently a manganese mica, near manganophyllite.

By Bashford Dean, "On the Fin-structures of *Diplurus.*" The general homologies of the structures of Coelacanthids were briefly noted, and the evidence was considered for regarding these as descendants of forms possessing *Ceratodus*-like paired and unpaired fins. The character of notochordal sheath may be determined in the types of *Diplurus longicaudatus*, Newberry.

Regular Business Meeting.

November 5th, 1893.

Dr. A. A. Julien in the Chair, and eleven persons present.

The following persons were elected resident members:

Prof. R. S. Woodward,
Prof. W. H. Burr,
Mr. Morris K. Jemp,
Mr. Harrison G. Dyer,
Mr. Mark Samuel.

Mr. J. P. Thomson, of Brisbane, Australia, was elected a corresponding member.

The Audubon Monument Committee,* appointed October 3d, 1887, presented the following report, which was accepted:

The public proceedings looking forward to the erection of a monument over the grave of the distinguished ornithologist, John James Audubon, first found expression at a special meeting of the New York Academy of Sciences held at Columbia College, on the evening of August 15th, 1887, the American Association for the Advancement of Science then being in session in New York. At that meeting Prof. D. S. Martin, at the suggestion of Prof. Thomas Egleston, who was then in Europe, stated the desirability of commemmorating the services rendered to Science by Audubon, and urged action by the Academy and the American Association. No action was taken by either body at that time. (See minutes of the Academy, August 15th, 1887.)

At the Regular Business Meeting of the Academy held October 3d, 1887, Prof. Martin made a statement regarding the presentation of the subject on August 15th. On motion of Dr. N. L. Britton, seconded and carried, the Chairman, Prof. W. P. Trowbridge, appointed Professors Egleston and Martin,

* See minutes of the Academy, April 26th, 1893, and Transactions, xii. 217, 218.

and Dr. Britton, a committee to solicit and receive subscriptions for a monument to be placed over the remains of Audubon in Trinity Cemetery. (See minutes of the Academy, October 3d, 1887.)

The Committee held several meetings during the autumn of 1887. Prof. Egleston was elected Chairman and Dr. Britton Secretary and Treasurer. It was decided to ask the coöperation of other scientific organizations in the work with which they had been charged. As the result of this action, the following associate committees were appointed by their respective organizations:

From the American Ornithologists' Union.
Dr. Geo. Bird Grinnell,
Mr. Wm. Dutcher,
Mr. G. B. Sennett.

From the Torrey Botanical Club.
Dr. J. A. Allen.

From the Linnæan Society of New York.
Mr. L. S. Foster,
Dr. C. S. Allen,
Mr. Jonathan Dwight, Jr.

From the Natural Science Association of Staten Island.
Mr. W. T. Davis,
Mr. Jas. Raymond,
Mr. Arthur Hollick.

From the Manhattan Chapter of the Agassiz Association.
Mr. E. B. Miller.

From the Audubon Society.
Mr. C. F. Amery.

On December 27th, 1887, the first circular letter of the Committee was sent to all members of the Academy, and at the same time the Committee decided on the general plan of the monument, a runic cross with decorations drawn from animals and plants. The cost was estimated at from $6,000 to $10.000. (See minutes of the Academy, January 30th, 1888.)

The first meeting of the joint committees was held at the University of the City of New York, February 2d, 1888. The design for the monument adopted by the Academy's Committee was approved, and a subcommittee, consisting of Dr. J. A. Allen, Mr. Sennett and Dr. Britton, was appointed to select the figures of birds, mammals and plants for the ornamentation of the shaft. At this time the Treasurer reported receipts of $323.75.

The committees next met at Columbia College on April 3d, 1888. The Chairman reported satisfactory progress in the work, calling attention to the many favorable magazine and newspaper notices which it had received. Representatives of the associate committees reported that considerable money had been received by them. The Secretary and Treasurer reported receipts as $358.75 and expenses as about $55.00.

The committees next met at Columbia College on May 22d, 1888. The Secretary and Treasurer reported a balance of $583.17. It was resolved to request a number of persons prominent in Science, Literature and Politics to favor the committees with letters expressing their opinions of the movement, to be used in calling attention to it and in influencing subscriptions.

It was also resolved that a committee be appointed to ask for the use of the steel plate portrait of Audubon in the possession of Mr. Tyler and reproduce therefrom or from electrotypes, prints for sale. Mr. Foster, Mr. Grinnell and Dr. Britton were appointed as this committee.

The next meeting of the committees was held at Columbia College November 21st, 1888. The Secretary and Treasurer reported receipts as $837.81 and a balance of $710.00. Letters were presented from a number of prominent men approving the project.

The committee appointed to request the use of Mr. Tyler's steel plate reported failure. The Chairman exhibited a proof of a photographic reproduction of an engraving by Turnure from a painting of the naturalist by Cruikshank; the engraving had been loaned for the purpose by Mr. J. M. Wade, of Boston.

It was resolved that a large edition of this be printed and distributed to all subscribers to the fund who had contributed $1.00 or more.

The next meeting of the Committees was held at the residence of Professor Egleston, January 2, 1889, several meetings of the Academy's Committee having intervened. The Secretary and Treasurer reported that the prints authorized at the last meeting had been executed in two sizes, one suitable for binding in an octavo publication, the other for framing. The larger one was being sent to subscribers, accompanied by a circular letter renewing attention to the work. He also presented the draft of a circular letter to be sent to the secretaries of all American scientific societies asking their coöperation.

At the annual meeting of the Academy, February 24th, 1890, the Secretary and Treasurer reported a balance of about $1,000. (See minutes of Academy, February 24th, 1890.)

The slow progress in securing funds discouraged the members of the committees, and from this time on the members of the Academy's Committee determined that personal solicitation was the only method that promised a successful consummation of the enterprise. The Chairman of the Committee took the matter in hand, after it having been determined to make subscriptions conditional on $10,000 being raised. On February 23d, 1891, at the Annual Meeting of the Academy for that year, the Secretary and Treasurer reported a balance on hand of $1,818.50 and a total subscription of $3,218.50. (See minutes of Academy, February 23d, 1891.)

Additional sums in large amounts were obtained during the next year. At a meeting of the Academy in February, 1892, Dr. J. A. Allen was added to the Academy's Committee (See minutes of Academy, February 1st, 1892), and on March 15th, 1892, the Committee adopted the following resolutions:

I. There shall be a ceremony of unveiling the monument in Trinity Cemetery during the fall of 1892.

II. This ceremony shall consist of:

1. The transferral of the completed monument from the New York Academy of Sciences to a representative of Trinity Church, by the Chairman of the Committee.

2. The unveiling of the monument by a representative of the Audubon family.

3. The acceptance of the monument by a representative or representatives of Trinity Church, who shall furnish the New York Academy of Sciences with a receipt therefor.

III. Subsequently on the evening of the same day as the unveiling there shall be a public meeting at the American Museum of Natural History, if the hall of that institution can be obtained for the purpose, at which meeting a eulogy of Audubon shall be delivered.

IV. The President of the American Ornithologists' Union shall be invited to deliver this address.

V. The details of the arrangements for this meeting shall be referred to the Joint Committees.

On March 22d, 1892, the Committee met at Columbia College, and examined and approved the sketches of the ornamentation of the monument drawn from the figures of animals and plants, which had been selected by the sub-committee on ornamentation of the shaft appointed February 2d, 1888. The following proposition for the construction and erection of the monument was accepted:

97 East Houston street, New York.
JANUARY 26th, 1892.

Dr. Thomas Egleston, 35 West Washington Square, City.

DEAR SIR: We hereby confirm our verbal offer made to you last evening, namely, to build the Audubon Monument of North River Blue Stone, in New York City, in accordance with original design and proposition for the sum of seventy-six hundred dollars ($7,600).

The drawing is perspective, drawn to a 1″ scale, making the total height over all from grade line 25.′0.

Yours truly,
R. C. FISHER & Co.

At a meeting of the Joint Committees held March 29th, 1892, the following resolutions were adopted:

I. That all members of the Scientific Alliance of New York, all contributors to the fund, all subscribers to the "Auk," the organ of the American Ornithologists' Union, representatives of each of the educational institutions of the City of New York, representatives of the New York press, and 500 or more representative citizens of New York, be invited to attend the ceremonies attending the unveiling of the monument.

II. That a committee of three be appointed, of which the Chairman shall be one, to prepare and distribute the invitations and tickets to the ceremonies. Mr. Foster and Dr. Britton were appointed to serve with the Chairman on this committee.

The Committee met October 17th, 1892, and the Chairman stated that failure by the stonecutters to procure a perfect stone for the die of the monument had caused delay in its construction. Also that the corporation of Trinity Church had agreed to grade and rearrange the ground about the base of the monument without expense to the Committee. Professors Egleston and Britton were appointed a sub-committee to submit a plan for the disposal of funds remaining after the monument is erected, paid for, and the expenses of the Committee met.

On November 30th, 1892, the Chairman reported to the Committee that two other stones selected for the die of the monument had proved defective, and it was resolved to postpone the unveiling until the spring of 1893.

On February 28th, 1893, a supposed perfect stone for the die having meanwhile been secured, it was resolved to hold the ceremonies of unveiling at some time during the last two weeks of April, and Professors Egleston and Britton were appointed a sub-committee with power to arrange the details and select the day.

Wednesday, April 26th, was chosen, and the programme determined on on March 15th, 1892, was carried out, as the accompanying report of the proceedings describes.

The Committee met at Columbia College, May 1st, 1893, all the members present.

It was resolved that framed copies of the card of invitation printed on large paper, and of photographs of the monument be presented to the corporation of Trinity Church and to the New York Academy of Sciences, and that similar copies of the card of invitation and photographs be presented to each member of the Committee; also that similar copies of the card be presented to members of the Audubon family.

Two lantern-slides of the monument shown at the meeting at the American Museum of Natural History were presented to the Museum.

The thanks of the Committee were extended to Mr. Otto Meurer, keeper of Trinity Church Cemetery, for efficient aid at the ceremony of unveiling. It was resolved to request the Academy to extend a vote of thanks to the Trustees of the American Museum of Natural History for the use of the lecture hall of that institution, for the meeting held on the evening of the unveiling.

It was resolved to request the Academy to extend a vote of thanks to the corporation of Trinity Church for hearty coöperation in the work of the Committee.*

It was resolved that the report of the Committee, including the addresses delivered at the Cemetery and at the American Museum of Natural History, be submitted to the Academy on June 5th, 1893.*

It was resolved to have 500 reprints made of the report, and that one of these be sent to each subscriber to the fund, one to each member of the Committee, others to members of the Audubon family and others to persons to be selected by the Secretary.

It was resolved that after all bills incurred by the Committee shall have been paid, the Secretary and Treasurer shall pay over

* There being no quorum for the transaction of business at the meeting held June 5th, 1893, the report of the Committee was deferred until the autumn.

the balance to the Treasurer of the Academy under the title "The Audubon Publication Fund," the interest on which shall be annually devoted to the publication of a Memoir on some zoölogical or botanical topic, if a paper suitable for such a Memoir shall be presented. If no such paper shall be presented during any one year the interest shall be allowed to accumulate until one is presented. Memoirs published by this fund shall be so designated.

The Secretary and Treasurer was directed to reserve $100 of the balance to meet the expense of the reprints of the report and of their distribution, and to account for this sum to the Academy at a subsequent time.

The Committee met at Columbia College, October 16th, 1893.

The Secretary stated that owing to the failure of a quorum at the meeting of the Academy on June 5th the report could not then be presented.

The Chairman reported that cracks having appeared on the die of the monument subsequent to the unveiling, it had been determined to be unsafe and that the builders had agreed to replace the stone by a new one.

The Secretary stated that owing to this defect he had not paid the full bill for the monument, but that on May 22d he had paid R. C. Fisher & Co. $5,000 on account. It was resolved that the report of the Committee be presented to the Academy at the Regular Business Meeting in November, 1893.

The report was accompanied by the following documents:

Presentation of the Monument to the Corporation of Trinity Church, by Prof. Thomas Egleston, Chairman of the Committee.

Rev. Dr. Dix, as Chairman of the Audubon Monument Committee, and as such representing the Academy of Sciences of the city of New York, I am here to present to you, the head of the venerable corporation of Trinity Church, this monument to the illustrious ornithologist, Audubon, whose remains were interred in this cemetery when he died in the year 1851, and have since been in your care and keeping.

It is owing to the thoughtful generosity of Trinity Church that the Audubon Monument Committee has been able to set up a monument on this spot, for when, in 1888, they represented to Trinity Church that the monument ought to be erected in a more conspicuous place than that where his remains were then buried, you not only agreed to it and exchanged the old plot in the southwest part of the cemetery for a new and larger one in this beautiful location, overlooking his old homestead, and constructed a new vault, but when you were informed that the weight of the monument might endanger the vault, you gave additional ground on which to erect it. It is, therefore, largely owing to your generosity that the Academy of Sciences has been able to erect so stately a monument.

The dimensions of the monument are:

Granite base, 1 ft. 6 in. high, 8 ft. by 6 ft. 4 in. square.

Bluestone die, 5 ft. 6 in. high, 5 ft. by 4 ft. at the base, 3 ft. 5½ in. by 2 ft. 10 in. at top.

Cross, 18 ft. 10 in. high, 2 ft. 4¼ in. by 1 ft. 7½ in. at the bottom.

Total height 25 ft. 10 in.

The arm of the cross is 5 ft. 3 in.

The weight is:

Granite base	7 tons.
Die	8 "
Cross	6 "
Total weight	21 tons.

The contributions for it have been received from almost every part of the United States. Boston has been very liberal; Philadelphia and Baltimore have made some subscriptions; but by far the largest part has been contributed by the citizens of of this city, which he honored by having lived in it.

This cross is a monument to science, to manhood, to persevering and patient endeavor under discouraging circumstances, to unselfish generosity, and, highest and best of all, to that unbounded faith in his Heavenly Father's wisdom and guidance which characterized, in adversity as well as prosperity, every act of Audubon's life. This beautiful cross, with its ornamentation of the birds and animals which he loved so well, and its inscriptions, cannot fail to be both a reminder and an incentive to young men to strive to attain the eminence to which he arrived.

It is proper that monuments of stone should be raised to the nation's distinguished dead. They serve the double purpose of recalling those whose memories should not be forgotten, and of arousing the spirit of the living to emulate the virtues of the dead. Their erection honors both the dead and the living. This monument serves not only to perpetuate the name of Audubon in this city, where he lived and died, but recalls those virtues, both religious, civic and scientific, which so characterized the man. The honor we pay to such men is a measure of our appreciation of the benefits of scientific culture. As a scholar he was modest; as an artist, without depreciating his own merit, he never vaunted it. It was this modesty, combined with real worth, which made him socially a most attractive man and publicly one of the most distinguished naturalists this country has ever produced. The history of his life will be fully detailed by a distinguished ornithologist this evening. I do not therefore propose to dwell on his history, but only to refer to some of those traits which characterized him as an artist, a scientist, and a useful citizen.

John James Audubon was the son of a French naval officer, who came to this country during the Revolution to help us in our struggle for liberty. He was born near New Orleans, and as a boy spent all his leisure hours in studying the habits of birds and animals. His fondness for nature and natural objects was the prominent characteristic of his early as well as of his later years. He loved out-door life and was always sketching what he saw, not at first as an adept in drawing, but the more inadequate the sketches to convey to his mind the beauty of the natural objects, and the more he endeavored to acquire greater skill, the more fully did he appreciate the beauty of the details of the objects of his sketches.

Sent to Paris to be educated, he could only see one thing worthy to be attained, and that was the ability to represent the peculiarities and beauties of the animal creation, either with the pencil or the brush. The pupil of the great artist David, he put him into despair, because the young man could see nothing worth representing on the canvass except birds and beasts. Having inherited a fortune from a relative, he returned to this country and married his wife near Philadelphia. He was shortly afterwards ruined by the war of 1812, and was obliged to give up his beautiful place, and, returning to Paris, found his sister, who had married a nobleman, in destitute circumstances. and at once made over to her what remained of his fortune and became himself a poor man. It was then that he determined to make his love of natural history and the skill that he had acquired with his pencil and brush the pursuit of his life. He sent his family to Louisiana, where they would be cared for, and spent three years in the forests, studying the plumage of the birds and the habits and peculiarities of the animals he met with. When he returned, his portfolio was full of some of the most famous sketches of his life. He had drawn them at first dead, but afterwards was persuaded to sketch them as they appeared living. His wife in the meantime had supported herself and educated her family, so that when he returned she was able to help him. Not, however, to be dependent upon his wife, he supported himself during one winter as a dancing master, and then started with a few of his drawings to obtain subscriptions for his great work. He interested the wealthy men here. He then went to Europe and attracted the notice of kings and nobles and rich men by the beauty of his work. The larger part of his drawings and sketches he left in New York. When he had secured subscriptions for 100 sets at $1,000 each, he returned to New York to find that during his absence the whole of his work had been destroyed. "I spent," he says, "the morning of that day in walking to the upper end of the island, where I gave way to vain regrets. That afternoon I began the work over again." What he achieved by that resolution, his great work shows. This disaster, instead of crippling him, made him a great man. Instead of being overwhelmed by his misfortune and allowing himself to be overcome by vain regrets, he called his manliness to his aid, and in the full trust in his Heavenly Father which was so characteristic of every step of his life, commenced his life over again, only to rise at the end of the struggle to fame and wealth, and he has left behind him not only the record of a man who rose above great losses and unlooked-for misfortunes, but that of a great naturalist whose whole life was one of humble faith. Misfortune only interrupted his work. It intensified and developed his talents, and in his life we can plainly see how that what sometimes seem to us to be hindrances and obstacles which cannot be surmounted, may be turned into the greatest blessings of our lives. He says of himself that, in the midst of his misfortunes, "Many a time at the sound of the wood-thrush's melodies have I fallen on my knees and there prayed earnestly to our God."

Audubon's facility for describing the birds was as great as his artistic method of painting them. He also loved all inanimate nature, and was fond of flowers and trees. The great Scotch ornithologist, Wilson, says of him that "He was, without contradiction, the greatest artist in his own walk that ever lived."

He came to New York in 1833. He settled in this vicinity in 1841. He was proud of his citizenship of the United States, and also of this city, which he honored while making his own name famous.

This monument is in sight of his old homestead, at what will be the foot of Audubon avenue when the two blocks between it and its present terminus are cut through. It will be in the sight of every one who walks or rides in this beautiful part of the city, and must recall to all who see it how great and conscientious endeavor may influence the lives of people not only of their own but of future generations. Few military heroes who have fought to redress great wrongs more truly deserve such a memorial.

Audubon was first the rich dilettante, then the unsuccessful merchant, then the dancing master, the portrait painter, the curator of a museum, and in all these occupations, which he dignified, he never forgot his love of birds. So great was his love for all animated nature that he relates of himself that in one of his journeys with merchndise, while watching the motions of a warbler he lost sight of his pack-horses, which carried the most of his valuables and his money.

Audubon was a great artist. Cuvier said of his work that "it was the most magnificent monument that art had ever made to ornithology." He was so thoroughly in sympathy with all living things that he not only saw their beauties, but detected peculiarities which others failed to see. America is indebted to him for his accurate observations and for the encouragement and elevation of the study of natural history, as much as the English people are to White of Selbourne.

What are some of the benefits which the patient and careful labors of this man for science have rendered to the world? They are many in number, and among them is the habit of careful and accurate observation of the habits of birds and animals. It does not at first sight seem quite clear how such a study be considered as a benefit to mankind, but the habit of careful and accurate observation and study in one branch naturally leads to the habit of mind which involuntarily applies the same principle to any and every other walk in life. It is impossible to exercise the great care and attention required to distinguish the various parts of the anatomical and plumage structure of birds, their habits of life, the choice of their food, the methods of rearing their young, their calls in danger or in pleasure, the differences in the structure of their feathers and wings to adapt them to the various conditions of life by which they gain their food or rear their young, without acquiring at the same time the general habit of care and accuracy in all the other occupations. This applies to the whole range of the study of natural history. How few people there are who use their eyes as they might, and how blind are many of us to the beauties with which we are constantly surrounded, which we do not see and cannot appreciate because our eyes are not educated to see and our minds have not been cultivated to appreciate these things.

The constant association with nature leads to a more natural life and a better appreciation of the beauties and wonders of nature itself, and consequently must of necessity elevate and raise the man. The continued contemplation of works which are in themselves perfect, leads to the cultivation of a higher tone of mental and moral development and the desire to reach to the same perfection which characterizes all the works of the Creator. They necessarily raise the individual above what is petty and low to longings for higher aims in life. The contemplation of what is always beautiful leads to a higher aspiration for what is in itself beautiful. All that one finds in nature is beautiful and true and well adapted for the purposes for which it is designed. Where is it possible to find more striking evidences of design than in the formation of the feet of animals to adapt them to the various conditions of climate and of environment? If you study mechanism, what better example can you find than the construction of the wings of birds and their adaptation to the laws of flight? The balancing of the wings in front by the body behind, so that the centre of gravity is retained in all positions, is one of the most remarkable adaptations of means to an end that can be found in animated nature.

Will you study construction? What better illustration of it can you find than the light, hollow bones, so filled with air ducts and channels that the air can be forced into or extracted from them according to the needs of the animal? Look at the feathers, always so arranged that in the necessity of rapid flight each part will interlock, so as to allow no air to pass, but so constructed that in some species that the flapping of the wings produces no noise, so that the animals upon which it preys for food may have no warning of its appreach. Look at the adaptation of means to an end in the beak, generally used as an instrument for obtaining food, straight, blunt, crooked, and so arranged that it can cut, tear or break, as it is needed, and sometimes even used as a hand in climbing. Look at the combination of sand and muscle in the gizzard, which is adapted to the maceration of the food. What grinding mill made by human hands is better contrived? What better adaptation of energy and skill can we find than the shortening of the tendons of the legs, so that when the bird perches, the bending of the leg contracts the toes around the perch, and so the bird rests securely without muscular effort? Will you study pneumatics? See the heavy condor floating in the air with outspread wings, or almost without motion, keeping the hollow bones exhausted of air and the cells heated, and then when it sees its prey, opening the valves and filling the cavities with cold air, so that it drops like a stone, and with unerring certainty, on its food.

Will you further study? Notice the arrangement of the eye, which by constant change in the focal length of the lenses expands or contracts the range of vision. Look at the adaptation of the feathers to keep the body warm and prevent evaporation, which, from their rapid flight in high regions would inevitably freeze their bodies, and to make this covering more perfect, it not only protects the bird from cold, but it is waterproof. If it was heavy, the bird could not carry it. All the feathers of some large birds do not weigh more than 1½ ounces. Will you study color? Where will you find more splendid colors or more beautiful contrasts of color than in the plumage of birds? Will you study music? What can be more harmonious than the song of birds? What church organ or other musical instrument is so beautifully contrived as those air channels, which the bird fills and then uses with its double larynx, so that it seems as if the volume of air emitted must be ten times the volume of the body of the bird, and so intense that the songs of some of them can be heard four or five times the distance that the voice of a man can be distinguished.

Religion and story take their examples of maternal devotion and affection from the birds. No better mental or moral training can be had than that which results from the study and contemplation of such phenomena as these. No wonder we are called on to sing in thanksgiving, "O all ye fowls of the air, bless ye the Lord; praise Him and magnify Him forever." It is well and fitting that we should have raised a monument in the form of a cross to the memory of a man who at the sound of the voice of a warbler should have found occasion for praise and thanksgiving to his Heavenly Father, and that we should have ornamented it with the beasts and the birds which he loved and with whom his name will always be associated.

It is therefore with profound satisfaction that I, as the representative of the Academy of Sciences, present to you as the head of the venerable corporation of Trinity Church for its care and keeping this monument to Audubon.

Acceptance of the Monument by the Rev. Morgan Dix, D. D., Rector of Trinity Church.

PROFESSOR EGLESTON: In the name of the Venerable Corporation of Trinity Church I accept at your hands, as Chairman of the Audubon Monument Committee and representing as such Chairman the Academy of Sciences, the gift of this stately and noble monument erected to the memory of one who has been described, by a high authority, as the greatest of American ornithologists; and in doing so I promise you, in the name of the present members of the Corporation and of their successors, that we will do all in our power to preserve it intact, and keep it uuinjured on its present site. Among the most precious and honorable of the trusts of Trinity Corporation is that of guarding the remains of the dead and the monuments erected to their memory by grateful and admiring friends. No one knows this better than yourself, an active member of the Cemetery Committee. The ancient churchyard of Trinity, which has been in our keeping since the year 1702, contains many notable memorials. There may be seen the monument upon the grave of the illustrious Alexander Hamilton; the monument under which rest the bones of the not less illustrious James Lawrence, who died fighting his ship against a foe superior in force; the tomb of Albert Gallatin, statesman and diplomatist; the headstone of William Bradford, who introduced the Art of Printing into the Middle Colonies of British America; and that lofty and appropriate structure erected by the Vestry of Trinity Church to commemorate the martyrs who died in the British prison ships during the Revolutionary War; with other stones of which I have not time to speak particularly. In the almost equally ancient churchyard of St. Paul's Chapel may be seen the shafts sacred to the memory of Robert Emmett and Dr. McNeven; the monument of the gallant Montgomery who fell at Qnebec; the monument of the Sieur de Roche Fontaine, a distinguised officer of the French force under Count Rochambeau, which aided us in the establishment of our independence; and that of the eminent actor Geo. Frederick Cook, erected by the elder Kean, and recently restored by our distinguished townsman, Edwin Booth. This cemetery in which we are now assembled contains already many treasures of this class, to which others are added year by year; and I wish I could say that they shall always remain in our care unmolested and undisturbed; but unfortunately we are reminded by recent occurrences that men are powerless against the aggressive force of injurious statutes and unfriendly influences. The old Clarkson Street Burial Ground has been recently taken from us by the City authorities, though not till we had resisted to the last point in our power the act of spoliation. Let me express the earnest hope that as this is the first, so it will be the last, instance in which we may be defeated in our honest wish and endeavor to do our duty as custodians of the remains of the dead and of those monuments of whatever kind which keep their names alive from generation to generation.

The duty of representing your Committee and the Academy of Sciences on this occasion belonged of right to you; for without your interest in this matter and your unwearying efforts, I am inclined to think the result which we see would not have been accomplished; and so this moment must be to you one of deep satisfaction, your conscience bearing witness to the sincerity of your intention, and your zeal in a worthy cause.

As for the monument now before us, none could have been selected more appropriate to one who united in himself the devotion of an enthusiastic student of nature, the skill of the draughtsman and painter, and the reverence of the Christian. In your remarks, which anticipate the fuller discourse to be delivered by the learned and distinguished gentleman who is to address us this evening, you have touched on the points in Audubon's life and character most deserving of consideration. I listened with special interest to what you said relating to his deeply religious character. Scientific pursuits are among the highest that can occupy the attention of men; to the students of nature in her several kingdoms the human race owes a debt of which the imagination can hardly estimate the value. But when our teacher leads us, as we follow his direction, from the consideration of the works of nature to a reverent and loving appreciation of the glorious God of Nature, Possessor of Heaven and Earth, the life of the student seems to assume an almost ideal character. Of such was the man whom we commemorate to-day.

Again, sir, I thank you, and through you the Audubon Monument Committee, the Academy of Sciences, and all who have had part in raising this beautiful and sacred monolith, for making us its custodians; and I assure you that no efforts shall be spared on our part to preserve it from harm, and to keep it where it stands, an object to cheer the eyes of all beholders, in this place where "the sacred calm that breathes around bids every fierce tumultuous passion cease."

Proceedings of the Special Meeting of the Academy held at the American Museum of Natural History in the Evening of April 26, 1893.*

President H. Carrington Bolton in the chair.

Mr. Morris K. Jesup, President of the Board of Trustees of the Museum, spoke as follows:

Ladies and Gentlemen: It is a great pleasure to me, as President of the American Museum of Natural History, to ask you to join with us in bidding welcome this evening to our honored guests, the New York Academy of Sciences, the oldest organization of its kind in this city, and which has done so much for the cause of science throughout the world. They have come here at our invitation to do honor to the memory of the great naturalist, Audubon, whose statue was unveiled this afternoon at Trinity Cemetery. Any one who was fortunate enough like myself to be present on the occasion referred to, and to hear the eloquent words of Dr. Egleston and Dr. Dix, must conclude that the age of civic pride in this city is not dead, but lives. It has been said that the people of this city were given over to money making and money worshipping, that science and art had no place here. I am sure we can give the denial to such statements when we look about us and see the monuments, statues, museums and hospital buildings that exist, and see also to what other uses the money made in this city is consecrated to in our public buildings, such as the Cooper Institute, Lenox Library, United Charities Building and others. No, New Yorkers do consecrate their time and give their money as no other city in this country. I am glad to see this Museum able to extend its hospitality to such honored institutions as the one, Dr. Bolton, which you represent, and I now take pleasure in asking you to take the chair, and to preside over this meeting, and to consider yourself, sir, and your friends, as entirely at home.

President Bolton read the following extracts from unpublished letters of Audubon:

Washington City, Nov. 8, 1836.

1. We left Baltimore yesterday afternoon at ¼ past 5—having paid $13.31 for our bill at Page's Hotel. We came here by the railway in 3 hours and paid for this $5. We are at Fuller's this evening, and at this moment in the same parlor where John and I spent some days when on our way last to England.

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* See minutes of the Academy, and Transactions, 12: 217, 218.

This morning I called on Col. John James Abert, whom I found at his office of the Topographical Bureau ; he received me with his wonted cordiality, promised to assist me in all my desires, gave me a letter received by him from I. Bachman, and another from Mr. Coleman, the bookseller of New York ; and after chatting a while on different subjects we walked together towards the President's house, to present my letters. Here we found Colonels Donaldson, ——— and Earle, both nephews of General Jackson, and the next moment I was in the presence of the famous man and had shaken his hand ; he read Mr. Swartwart's letter twice with apparent care, and, having finished, said, "Mr. Audubon, I will do all in my power to serve you, but the Seminole war, I fear, will prevent you having a cutter. However, as we will have a committee at 12 o'clock this day, we will talk of this and will give you an answer tomorrow." The General looked well, he was smoking his pipe, and I thought was more complaisant to me than ever. I then gave my letters to Col. Donaldson, who read them attentively, and as I left the room he followed us, and we talked to him respecting the subscriptions of the different Departments to our work. I like this man and his manners. I gave him the Duke of Sussex's letter and maps from the Governor of the Hudson Bay Fur Co , and went in to see Col. Earle, who is engaged in painting General Jackson's portrait full length, etc. My opinion of this man and of his talents I intend to speak of elsewhere. Col. Abert then took me to Mr. Woodbury, Secretary of the Treasurer—received me very politely, and after my letters to him being read, he promised me the use of the cutter and said that he would find me a letter to-morrow morning. The subscription was broached upon, but nothing decisive transpiring, we left him for Mr. Butler's office. Mr. Butler is a young man, he read Washington Irving's letter, laid it down and opened with a long digression on the latter's talents, etc. ; at last my business was brought forward, but I found that the Government affords so little money as contingent that he did not believe it likely that I could succeed in obtaining subscriptions from the different Departments without a law to that effect from Congress. This opinion was all but gratifying, however as he promised to present the matter before next Congres with many courteous promises I bid him adieu, hoping for the best.

2. Our country is becoming more wealthy every day, science is looked upon with more congeniality every year—subscribers in this dear country of ours do not drop off unless they die—they pay punctually on demand, and to have more of them in this land than in Europe is a thing which I think may prove of the greatest importance to us—When I visited our woods on my first return from England, I was absent for 12 months ; Mr. Rathburn and Mr. Children wrote to me many times to return or expect my work to fail—I then went back to Europe before I was ready or willing to go, and on my arrival there to my surprise I found everything going on as well as could have been wished ; but I was again obliged to come to our country to renew my research and improve my head as well as my collections and drawings. I had left no one like you in England. Now you my dear son are there (thank God for it) ; you proved to be a better man at carrying this publication than myself, and to tell you more, I doubt much if I could procure there more subscribers than yourself can or have done. I am truly desirous for your sake, and those of your dear brother and most excellently kind mother, to do all in my power for the completion of this great work, than ever I have felt before. I wish to finish all here that is to be, or

can be done, both in the way of drawing and accumulation of knowledge in black and white, and also in augmenting the number of our subscribers. I return to Europe, where I must remain several years at least, if not until the completion of the engraving of the last plate. I am growing old very fast, in three or four years my career as a traveler will be ended, and should I be obliged to renew my field labors, it is very doubtful if my present constitution of body would allow the attempt; one year now is equal to three in three years hence. I received much assistance from our Government; I have John to accompany me, I am still able to undergo some fatigue, and as I have said I am anxious, very anxious, to do all that can be done ere I return to Europe. Now the whole time which I conceive necessary to enable me to perform these desiderata cannot exceed 12 or 15 months. What pleasure it would be to us all if when I take you by the hand and press you to my breast I could also hand you a list of 100 new subscribers in America, and all the drawing and manuscripts wanted for the completion of our great and wonderful undertaking.

Professor Thomas Egleston addressed the meeting as follows:

Mr. Chairman, Ladies and Gentlemen: The idea of erecting a monument to Audubon originated in 1885, when I noticed in Trinity Cemetery a vault with the name of Audubon, very much out of repair, and endeavored to have it put in good order. To this there seemed to be some objection and it was not done. In the year 1886, when 153d street was to be cut through, thinking that some accident might possibly happen to the Audubon vault, which was very near to the line of the street, and it was to be opened, I proposed to the corporation of Trinity Church to remove the vault to a more prominent site, and suggested that I would endeavor to have a suitable monument raised to Audubon's memory if this was done. It was agreed to at once, and the present site of the monument at the foot of Audubon Avenue was selected. It was hoped at first that the funds for the monument could be raised by a national subscription, and to that end Prof. Martin was asked to bring the matter before the American Association for the Advancement of Science, which met in August, 1887, which he did. It excited a great deal of interest, but nothing was done. In October, 1887, Prof. Martin presented the matter to the Academy of Sciences and a committee was appointed, consisting of Dr. Egleston, Chairman, Dr. Britton and Prof. Martin. This committee met at once and appointed Dr. Britton as Secretary and Treasurer. It was decided to make the subscription as far as possible a national one, and for that purpose letters were sent out to nearly all the scientific societies of the United States. Replies were received from the Torrey Botanical Club, the Linnæan Society of New York, the American Ornithological Union, the Agassiz Association, and the Natural Science Association of Staten Island.

These Societies appointed committees, who acted for a short time with the Committee of the Academy of Sciences. Designs for the monument were submitted and discussed. It was decided after some discussion that the runic cross was the most suitable form, and a design was asked for from R. C. Fisher & Co., of East Houston street. On the presentation of the design, it was modified by the Committee of the Academy of Sciences, who decided that it should be ornamented with the birds and animals which Audubon has described. The work of raising the funds was commenced at once. At first, school children took a great interest in it individually, and many subscriptions were received from schools as the collections of the children. Some subscriptions were sent in postage stamps, others as low as ten cents were received from every part of the United States. After a number of months it was found that by this method a sufficient sum for the erection of the monument could not be raised. It was then proposed to ask 100 gentlemen in the cities near New York in which Audubon had been especially interested to give $100 each, and this plan succeeded so well that in the fall of 1891 the amount was raised. In 1891 Dr. Allen was added to the committee and has acted with us since that time. The details of the monument were then drawn in charcoal, full size, and discussed by the committee. When this had been done, a committee was appointed for the mammals and one for the birds, to see that the drawings were accurate and were those of the animals and birds in which Audubon was specially interested. They were then modeled by Mr. Eugene Pfister, of R. Fisher & Co., and the models carefully examined by the committee. When this had been done, the best portrait of Audubon that had been made was sought, and this was modeled in clay, heroic size, and afterwards accepted by the committee. The order for the monument was then given to R. Fisher & Co., and it was hoped and expected that it would have been finished in November, 1892. The stone for the cross was gotten out without accident. Three stones which were to be used for the die proved defective. The fourth one fortunately proved to be sound. This delayed the construction of the monument several months. Much assistance was received from the New York Society for the Preservation of Game and from the newspapers generally, but Forest and Stream threw itself with great interest into the work and has been of great service to the committee. Philadelphia and Baltimore have contributed somewhat, and Boston has been extremely liberal, but by far the larger part of the subscriptions have come from the citizens of New York. Now that New York has begun to honor scientific men, it is to be hoped that it will be continued. This is, we believe, the first instance of a monument being erected to a scientific man in this city.

The committee had another plan which they had hoped to carry out, which was to raise a fund sufficient for the founding of an Audubon scholarship for the prosecution of researches in natural history in this Museum of Natural History. It was found impracticable to carry out the plan, but it is hoped that some one, either within the reach of my voice, or at this suggestion, may found a scholarship for the prosecution of original studies in natural history in connection with this museum, and that in this way a large amount of research may be made in both the living and fossil animals of which this country is so full. What remains of the fund, after paying all the expenses, will be devoted to the founding of an Audubon publication fund in the New York Academy of Sciences.

The following address was then delivered:

The Life and Services of John James Audubon.

BY DANIEL G. ELLIOT, F. R. S. E.

Mr. President, Ladies and Gentlemen—Should we desire to seek for the beginnings of Ornithology, we must look for them in the period when our old earth was yet young; when that strange creature, more bird than reptile, more reptile than bird, according to the impressions received by those who have studied its remains in the slab of Solenhofen, the Archaeopteryx, winged its feeble flight above the landscape of the Jurrassic Age. Evolved from its wholly reptilian ancestors, this, so far as we know, was the first creature provided with wings composed of feathers to bear it onward and upward in the atmosphere.

There were no artists upon the earth in those days to transmit to us the portraits of animals then living, but nature has carefully wrapped this creature in the stone to remain forever an object of our wonder and our admiration.

Unknown ages rolled along, and man appeared upon the scene, but in the evidences of their existence that the pre-historic races have left behind them, no incised stone, or bone, or ivory, contains any representation of birds.

It is only when we reach what may be deemed modern times, in comparison to the periods of which I have referred, that we meet with colored pictures of birds, and although it is now more than three thousand years since the artist painted their portraits, yet the fresco of six geese, taken from a tomb at Maydoom, in Egypt, and now deposited in the museum at Boolak, is so fresh, and depicted with such marvelous fidelity of form and coloring, that four of these figures, can without hesitation be referred to two species living in the Old World to-day, one of which, the white fronted goose, has a very near relative in our own land, and known to many as the Brant of our Western prairies. There were probably most excellent and learned naturalists among that wonderful people living on the banks of the old Nile, but their names have been lost in the overthrow of their nation, and it was not until the fourth century before Christ that the first serious ornithological author appeared in the person of Aristotle. He was followed in the first century of our era by Pliny the Elder, and then we come to the sixteenth century before we find a name at all familiar to us. The seventeenth and eighteenth centuries produced a host of naturalists, some preëminent in ornithology; and it was towards the close of this century that he appeared upon the scene, in honor of whose memory we are assembled here this evening.

In the resurrection period, the most beautiful season of the year, when all the groves were echoing with melody issuing from countless feathered throats, singing a natal song to him who was to be ever the birds' lover and friend, and the air was redolent with the fragrant breath of opening buds and flowers, on the 4th May, 1780, in the then French province, now the State of Louisiana, on his father's plantation, John James Audubon was born. His mother's maiden name was Anne Moynette. She was a lady of Spanish extraction, possessed both of wealth and beauty. A few years after the birth of her youngest son Mrs. Audubon accompanied her husband to St. Domingo, and there perished during an insurrection of the negroes. The elder Audubon then returned to France with his family, and the future naturalist was sent to school, and was instructed in mathematics, geography, drawing, music and fencing, and in the last three he became proficient. He played well upon the violin, flageolet and guitar, and was a graceful dancer, an accomplishment that in after years he was to have more opportunities of practicing with bears and other wild denizens of the forest than with the fairer sex of his own species. During his school days, at every opportunity that offered, young Audubon would wander away to the woods and fields to collect objects of natural history, and he also made about two hundred drawings of the birds he procured. Declining to join the armies of Napoleon, his father sent him to America to look after some property called Mill Grove, which he had purchased on Perkiomen Creek, near Philadelphia.

Here he led an ideal existence from his view of life. He had ample means, was gay and fond of dress and all his time was occupied in hunting, fishing and drawing, and he was without any care. His own description of himself, given at this time, illustrates the frank, open, simple character of the man, one which he was never to lose throughout all his career so full of vicissitudes, discouragements and trials. He says: "I had no vices, but was thoughtless, pensive, loving; fond of shooting, fishing and riding, and had a passion for raising all sorts of fowls, which sources of interest and amusement occupied all my time. It was one of my fancies to be ridiculously fond of dress, to hunt in black satin breeches, wear pumps when shooting, and dress in the finest ruffled shirts I could obtain in France." What a contrast to the backwoodsman of the years to come, wandering over little known portions of the land, clad in plainest garments, often all the worse for wear, totally unmindful of his personal appearance, intent only upon the discovery of some new species, or the capture of one already known, but not yet added to his collection. His mode of life at this time was as abstemious as his dress was extravagant. He ate no meat, lived chiefly on fruits, vegetables and fish, and never drank a glass of spirits or wine until his wedding day. To this he attributed his continual good health, endurance and iron constitution. When, in after years, he looked back upon this happy period of his youth, he exclaims: "And why, have I often thought, should I not have kept to this delicious mode of living." But it was not to be; he had his special part in life to play. He was to be no idle dreamer, no beruffled dandy, fritting away his days in fruitless pastimes, but even as he was penning the description of himself at Mill Grove, the day was dawning that should usher to him a new existence, one of happiness, indeed, yet full of trials, suffering, discouragments, of long-continued struggles against adversity, often of penury, and of manifold disappointments, to be finished at last with a complete success, an immortal name and an everlasting peace.

And the chief cause for all this change in his life was nigh at hand. It is the old, old story. Within sight of his house, at Flatland Ford, lived William Blakewell and his family. He was an English gentleman, a descendant of the Peverills, rendered famous by Sir Walter Scott in his novel of "Peveril of the Peak." Descending from the Norman Count Basquelle, the name had been corrupted into Baskiel, and then Blakewell. Audubon raised in the Napoleonic atmosphere which made everything English abhorrent to a Frenchman was so uncivil as to delay for a long time to return the visit his neighbor had paid him. But it was of no avail to struggle against his fate, and one morning he entered the Blakewell residence. He was shown into a drawing-room, when a young lady rose to welcome him and to assure him of the pleasure her father would have in receiving him. This was his introduction to Miss Lucy Blakewell, his future wife, who proved to be a most fitting mate for such a man as Audubon. Affectionate, patient, sympathetic, entering with her whole heart into her husband's pursuits, self-sacrificing, ever ready to encourage him when depressed by disappointments, jealous of his reputation, cheerfully submitting to any privation in order that his immortal work should be carried to a successful completion, enduring without a murmur long separations from husband and children, and accepting at times the uncongenial labor of teaching to gain means to advance the publication of his book; she was a type of that woman of whom it is written, "her children shall rise up and call her blesssed," and whatever wreath shall be twined for the brows of the naturalist, sprays from it must be taken to form a similar crown to adorn the head of his faithful, devoted wife.

The acquaintance thus formed ripened into intimacy, and in due course of time on expressing to Mr. Blakewell his desire to unite himself with his daughter, he was advised before marriage to gain some knowledge of mercantile pursuits, which, with his characteristic impulsiveness, Audubon at once put into practice by going to New York, entering the counting house of Mr. Benjamin Blakewell, and beginning his acquaintance with business methods by losing several thousand dollars in speculation. It was not long before Mr. Blakewell discovered that it was impossible to make a merchant of Audubon, and he returned to Mill Grove. During all this time he kept adding to his collections, visiting constantly the woods and fields, and his rooms were turned into a museum filled with all manner of specimens in Natural History. He has given a sketch of himself at this time, which brings him vividly before us. "I measured," he writes, "five feet ten and a half inches, was of a fair mien, and quite a handsome figure, large dark and rather sunken eyes, light colored eye-brows, aquiline nose, and a fine set of teeth; hair, fine texture and luxuriant, divided and passing down behind each ear in luxuriant ringlets as far as the shoulders."

After his return to Mill Grove, he decided to go to Louisville, Kentucky, and having sold his place he invested the proceeds in goods, and was married to Miss Blakewell on the 8th of April, 1808.

It was while residing at Louisville a memorable occurrence took place. One morning a man with two volumes under his arm entered his counting room. Audubon describes him as having a long, rather hooked nose, keen eyes and prominent cheek-bones, stamping his countenance with a peculiar character. He was dressed in a short coat, waistcoat and trousers, of grey cloth. This man was Alexander Wilson, the pioneer in the field Audubon was destined to enter, the Father of American Ornithology. He walked up to the table at which Audubon was working, opened his books, explained his occupation, and requested his subscription, thus illustrating in a measure the method which in after years Audubon himself was obliged to adopt in order to bring his own work before the world and accomplish its publication. Surprised and pleased at the sight of the plates, Audubon took his pen to write his name among those of the subscribers, when his partner said to him in French, " My dear Audubon what induces you to subscribe to this work; Your drawings are certainly far better, and again you must know as much of the habits of American birds as this gentleman." " Vanity and the ecomiums of my friend prevented me from subscribing," is his frank, though sad statement. Wilson probably understood French, for he asked Audubon if he had many drawings of birds. Taking down a large portfolio, its contents were exhibited much to the surprise of Wilson, who said he had no idea that anyone besides himself was engaged in making such a collection, but was still more astonished when asking if it was Audubon's intentions to publish, he was answered in the negative. They met but once again during one of Audubon's visits to Philadelphia, when he called on Wilson and found him engaged in drawing the white headed Eagle. Audubon says he was received with civility and taken to the exhibition rooms of Rembrandt Peale, but they spoke not of birds, and shortly afterwards the two men whose names are more closely interwoven with American ornithology than any others ever can be, and whose tastes and pursuits should have proved the magnet to draw them most closely together, parted never to meet again. The melancholy reserve of the quiet, shrinking Scotchman could not be conquered even by the vivacity of the enthusiastic Franco-American, and their brief acquaintance brought no profit to either. Business at Louisville did not prosper, and Audubon sold his interest to his partners and went to Henderson. While traversing the country between these places, and also during his residence in them, most of his time was given to roaming the woods, hunting with the Indians, studying wild animals and drawing their portraits. He now entered into a partnership with his brother-in-law,under the firm name of Audubon & Co., to carry on business in New Orleans, and embarked in this enterprise all his fortune. But as usual, instead of attending to business, he passed his days hunting and fishing, and was soon informed that all his means had been lost.

He was now nearly at the end of his resources, but gathering together a few hundred dollars, he invested them in goods and commenced business again at Henderson. Strangely enough, he prospered, purchased land and a log cabin to which a family of negroes was attached as part of the property, and began to be pretty comfortable.

This state of affairs, however, was not long to continue, for he was soon joined by a former partner, whose alliance always brought disaster, and who now persuaded him to erect a steam mill, which brought all interested in it to ruin. His troubles increased daily, and he was assailed by all manner of difficulties. Giving up to his creditors all he possessed, he departed with his family, dog, gun and precious drawings, from which he never allowed himself to be separated, and went to Louisville, and then to Cincinnati, where he was engaged as a kind of curator in the museum, his work being chiefly that of a taxidermist.

From Cincinnati he went to Natchez and was engaged to teach drawing in the college at Washington, near that town. His work interfered greatly with his ornithological pursuits and depressed his spirits, and although he prospered he says, "the hope of completing my book upon the Birds of America [which he now desired to publish] became less clear, and, full of despair, I feared my hopes of becoming known to Europe as a naturalist were destined to be blasted." Throughout his writings there is found these constant expressions of this desire to become known and to leave a name upon the roll of naturalists, but it was not a representation of "Fame blowing out from her golden trumpet a jubilant challenge to Time and to Fate" that appeared to his despairing eyes, for he seemed always to perceive a quiescent goddess with trumpet idle in her hand, and to hear no resonant note blown in recognition of himself, and in frank and simple language he expressed his fears that he should die unheralded and unknown.

Mrs. Audubon wished her husband to go to Europe to receive instruction in oil painting, and to aid him in accomplishing this, engaged herself as governess in a family at Bayou Sara. Audubon having, exhausted his patronage at Natchez resolved to start with an artist named Stein in a wagon and make a trip through the Southwestern States as perambulating portrait painters, having, as he says, resolved "to break through all bounds and follow his ornithological pursuits." His friends regarded him as crazy, his wife and family alone gave him encouragement. His wife, he writes, "determined that my genius should prevail, and that my final success as an ornithologist should be triumphant." Always his wife,—wherever throughout his career, we learn of trouble, disappointments, vexation of all kinds, and monetary difficulties innumerable overtaking him, it is always his wife who encourages the despairing heart, strengthens the weakening faith and points him onward to the distant goal, which her woman's trust in his abilities shall surely help him to obtain.

His trip with Stein was a failure financially, and returning to Natchez he went to Philadelphia. There he met the artist Sully, who gave him valuable lessons in oil painting, and he worked hard to complete his drawings of birds. His friends and the engravers of Wilson's plates all recommended him to visit Europe, and he decided to follow their advice, and left Philadelphia to return to Bayou Sara. In New York he was introduced by Dr. DeKay to the members of the Lyceum of Natural History, now the Academy of Sciences, which has been instrumental in raising the monument this day unveiled, and under whose auspices we meet this evening. His drawings were exhibited to the members, "among whom," he says, "I felt awkward and uncomfortable. After living among such people I feel clouded and depressed; remember I have done nothing, and fear I may die unknown. I feel I am strange to all but the birds of America. In a few days I shall be in the woods and quite forgotten."

On arriving at Bayou Sara he began to consider what he could do to hasten the publication of his drawings. His wife was receiving a large income for those days, nearly $3,000, which she offered to give him, and he resolved on an effort to increase the amount. From Woodville came a special invitation to teach dancing, and a class of sixty pupils was formed. "The dancing speculation," he says, "fetched $2,000, and with this capital and my wife's savings I was now able to foresee a successful issue to my great ornithological work."

On 26th April, 1826, he sailed from New Orleans for Liverpool in the ship Delos, provided with numerous letters of introduction, and reached his destination on the 20th July. In Edinburgh he met Mr. Lizars, the engraver of Selby's great work on British Birds, who offered to bring out the first number of the Birds of America, and on the 28th November he was presented with a proof of the first plate.

He was well received here, and on December 10th writes:

"My success in Edinburgh borders on the miraculous. I am féted, feasted, elected honorary member of societies, making money by my exhibition and my paintings. It is Mr. Audubon here, and Mr. Audubon there, and I can only hope that Mr. Audubon will not be made a conceited fool at last."

He continued to wear his hair long and flowing on his shoulders, which made him very conspicuous wherever he went; and once a stranger suggested to him to paint an Osage Indian hunting wild turkeys, as likely to prove an attraction. On which he comments: "No doubt it would, for whatever is most strange is most taking now. But so long as my hair floats over my shoulders I shall probably attract attention enough, and if it hung to my heels it would attract more."

He was elected a Fellow of the Royal Society, and commenting on it in a letter to his wife, he says: "So, poor Audubon, if not rich, thou wilt be honored at least and held in esteem among men.'

He now issued his Prospectus for the Birds of America, arranged his affairs, and under the importunities of his friends, cut off his hair which he had so long worn in ringlets, and started for London. Here he worked very hard and painted many pictures, a number of which, by the help of Sir Thomas Lawrence, he was able to dispose of at various prices from £10 to £30. Without the sale of them he was, as he says, bankrupt when his work was scarcely begun, and all his hopes blasted, for he had actually to borrow five pounds to purchase materials for his pictures. When he had completed one of these, he would go out in the evening and visit the shops of the Jews and others, and take any price he could get for it. In this way he sold a large number, and when in after years he sought to find these pictures he was unable to trace a single one.

Up to this time there was no text to his book, the plates alone having been issued without any accompanying explanation. He now commenced to prepare the Ornithological Biography, which eventually filled five volumes. He felt himself unfitted for this literary work, and applied to Mr. James Wilson of Edinburgh to recommend some one who, to use his own words, "would undertake to correct my ungrammatical manuscript, and assist me in arranging the more scientific part of the Biography of Birds," and was referred to Mr. William McGillivray. No better or more fortunate choice could have been made, and whatever scientific value there is in Audubon's biography is derived largely from McGillivray's coöperation. Audubon worked incessantly at this book, McGillivray keeping abreast of him, and Mrs. Audubon re-wrote the entire manuscript to send to America and secure the copyright there.

In three months the first volume was finished and offered to some publishers, none of whom would give a shilling for it, and the author issued it himself. In his search for subscribers he relates his experience with Baron Rothschild. He called at the banking house, and soon the Baron entered and, he says, "dropped his fat body into a comfortable chair as if caring for no one in the world but himself." Audubon presented his letter of introduction and was met with the question, "Pray, sir, is this a letter of business, or is it a mere letter of introduction?" As he had not read it, Audubon could not say; the Baron opened it, glanced at the contents and said, "This is only a letter of introduction, and I expect from its contents you are the publisher of some work or other, and need my subscription." "Had a man the size of a mountain," says Audubon, "spoken to me in that arrogant style in America, I should have indignantly resented it, but where I then was it seemed best to swallow and digest it as best I could." The Baron then said, "I never sign my name to any subscription list, but you may send in your work, and I will pay for a copy of it." The numbers were regularly delivered, and in about a year's time Victor Audubon made out the account and sent it by Mr. Havel to the banking house. The Baron looked at it with amazement: "What! a hundred pounds for birds! Why, sir, I will give you five pounds and not a farthing more." Explanations were unavailing, and the work was actually returned to Mr. Havel's shop from the Baron's residence, and Audubon remarks, "I kept the work, and sold it afterwards to a man with less money, but a nobler heart."

Leaving his wife and son in London, Audubon again visited America, and went to Texas, where he passed most of the winter in search of material for his work, and in May returned to England, and in the autumn of 1839 the Birds of America, the most magnificent ornithological work the world has ever seen, and the Ornithological Biography being both finished, he came back to America and settled in New York, not, however, to be idle, that was impossible for a nature like Audubon's, but he immediately began an edition of his large work in 4to size. This was completed in seven volumes in 1843.

In the spring of this year he started on his last expedition, to visit the Yellowstone river, and procure material for a work on the Quadrupeds of North America, and he went as far as Fort Union on the Missouri, at that time an outpost on the borders of civilization. Two years afterwards appeared the first volume of this great work, the other two were prepared mostly by his sons, Victor and John, the last one appearing the year Audubon died. In this work the naturalist associated with himself as co-author, the Rev. Dr. John Bachman, of Charleston, South Carolina, who is responsible for the scientific portion, and, like McGillivray in the Birds of America, proved to be of the greatest possible assistance in the construction of the text, and scientific arrangement.

In this hasty sketch of the naturalist's life, I have touched upon some of the most important or interesting incidents of his career, exhibiting in various lights the impulsive, mercurial disposition of the man, which urged him often to enter upon impracticable and unwise undertakings, and yet permitted him never to remain steadfast in the pursuit of material advantages, even though the necessity for close application to gain them was paramount. He was born to accomplish a certain task, and no matter what the condition of his life may have been, nothing could divert his mind from the subject with which his whole nature was imbued, nor any privation discourage him from following the pursuit and study of his beloved birds.

He was a woodsman, not a scientific naturalist, according to the ideas prevalent to-day. He loved to go into the forests and watch the creatures that dwelt among the leafy lanes and thickets; to study the birds in their time of love-making, nesting and migration, and to draw their forms upon the canvas. But of books he was no student; of the intricate scientific details of his mighty subject he was unconcerned and indifferent; sufficient for him it was, to learn where and how his feathered friends lived and moved, and to produce their portraits.

He was possessed of a most indomitable resolution and perseverance in following his life work. It is almost sublime the courage he displayed, and the indifference to those things which are generally first considered by his fellow-men, as exemplified by him at the commencement of the publication of the Birds of America. He was on the verge of failure, with but one sovereign in his pocket, and knew not a single individual from whom he could borrow another, and yet he extracted himself from his difficulties by rising at four in the morning, working hard all day, and disposing of his pictures, "at a price that a common laborer would have thought little more than a sufficient remuneration for his work." And yet, during the publication of his first volume, about forty thousand dollars passed through his hands. While the book was in progress, no less than fifty subscribers abandoned him, representing a total sum of fifty-six thousand dollars and to replace them he was obliged to tramp through the provinces in quest of others.

From his French extraction he inherited the impulsive character of the race, which at times influenced his judgment, and led him into wild and unprofitable pursuits. But his many severe and oft recurring pecuniary embarrassments in time sobered him, and in his maturer years he exhibited little of the fanciful vagaries of his earlier life. As an artist, and a pupil of David, we must judge him, and the master's influence is frequently seen in the composition of his plates. While the grouping is well considered and the figures spirited, they often partake of the theatrical in their attitudes and occasionally are anatomically impossible. Yet the effect is almost always pleasing and apt to evoke admiration.

As a naturalist, we must not judge him by the standard of to-day, achieved in the severe and exacting curriculum of modern scientific teaching. The ornithologist of the close of the nineteenth century is altogether another savant from the one Audubon understood by the term, nor does he quite answer to the description I once heard given by a lady, as one who was "always fussing over little fluffy birds." He must not only know the habits and economy of birds as Audubon did, but also very much more. And first, he must be thoroughly versed in the bibliography of his subject, a mighty task, in which few are thoroughly proficient; he must be conversant with at least five languages, French, English, German, Italian and Latin, for in all of these and more, are the memoirs of his science published throughout the world. He must be acquainted with anatomy and osteology to understand not only the comparative relationship of the animals, comprised in the orders and families of his own especial branch, but also their affinity to those in other departments of zoölogy; he must understand pterylography, the growth and structure of feathers, and the distribution of feather tracts, and be able to see the significance of these, and what they imply; he must be skilled in the theory and facts of geographical distribution, and be able to give a probable reason for the cause of the various habitats and dispersion of the animals on our globe; he must have knowledge of geology and paleontology, so as to be able to study intelligently the fossil remains of extinct forms, and read aright the lessons that they teach; in fact, because the various sciences are so intimately connected, to be fully equipped for his work, he must be not only an ornithologist, but also a zoölogist and if possible a biologist as well.

It is no small thing to be a graduate in such a school, and few, indeed, are they who by their works have proved themselves fitted to take a place in the front rank of the science. One must begin early in life, work hard all the time, passing gradually from one degree of proficiency to another (for ornithology is a science with ever-opening vistas of continued possibilities of progress) until, after a life passed in diligent and honest labor, so brief is our allotted time here, that one finds himself only upon the threshold of his subject, with vast sources of knowledge lying just beyond. Such, in brief, is the ornithologist of to-day, an expert in no mean branch of scientific pursuit, and yet mindful of what is required to constitute such a savant, so little is the science appreciated and its acquirements understood, it is sad, indeed, to know that even in this late day there are those who believe that a man requires little or no training to become a naturalist, and that almost any one is competent to give instruction in the mysteries of zoölogy.

The ornithologist is not made, but born to fill his role in life as is the poet; and as you cannot construct a naturalist, neither can you destroy that irresistible impulse which compels him to follow his allotted part, and which was implanted into his very nature by the Great Ruler of Events with the first breath he drew.

You may instal him in places of profit, and where material advancement is certain, and though he may honestly do all he can while so situated, it is not the best he can do, for his abilities have not their legitimate scope and his efforts are hampered by uncongenial surroundings. Like Audubon, it is rare that a man possessed with talents which enable him to succeed in any branch of natural science, even though it be of one apparently the least important, can command success in any business pursuit. The heart is not in it; unwise and foolish as it may seem to the vast majority of mankind, material gain, such as wealth for itself alone, and the vain fictitious rank it gives to its possessor, presents no attractions to the man of science. To work to gather up money for itself allures him not; his heart and soul is with higher things, to seek and learn the truth, to strive and find out how God works, to study the creatures that, like himself, owe their existence to the Divine First Cause, and have been, through countless ages, progressing ever onward and upward from a lower to a higher degree of physical and mental attainments.

As in the youthful age of the old earth the ungainly reptile, with its leathery skin and tooth-armed jaws, keeping down from undue expansion the equally unattractive creatures which formed its prey, has gradually through multifold evolutions during the changing ages been transformed into the graceful, fairy-like beauteous creature, the bird of our own time, fitted to fill a higher destiny in a more perfect world, so has the naturalist advanced with his subject,—from the first debased creature, seemingly unworthy of the name of Man, with eager eyes watching the animals about him, actuated solely with the desire for food, until, having kept step and time with the march of the progressive ages, at length materially and mentally equipped, he is able with the eye of faith and finger of instinct to perceive and point out the ways and methods of Creative Power. For the entire universe is ever moving onward and upward; there is no cessation in the march of development; advance! "Go forward!" is and has ever been the divine command. To hesitate, to pause, means death, and there can be no retrogression. Type breeding only unto type ends surely in annihilation. To stand still is to cease to exist, to go ever forward from one height to another still higher is the only method for a continued life. Such is the manifest law of Omnipotence, and only that which is capable of a higher development can survive.

Man—that highest of earthly types—is no exception to this law, but in himself exemplifies its truth and force in the evidences of his own existence. The races incapable of farther advancement become extinct, only those survive which contain within themselves the seeds of continued progress, and which, on looking on their history, can say,

"I have climbed the snows of Age, and I gazed at a field in the Past,
Where I sank with the body at times, in the sloughs of a low desire,
But I hear no yelp of the beast, and the Man is quiet at last,
As he stands on the height of his life, with a glimpse of a height that is higher."

We may not, therefore, as I have already said, judge Audubon by the standard of to-day, any more than we ourselves shall be measured by that employed by naturalists half a century hence. He was an ornithological artist, not a scientific naturalist, and no one appreciated this fact, and was more ready to acknowledge it than the simple, frank and enthusiastic author of the Birds of America. He never made pretence to be more than he really was; he never claimed to anything higher than to be a lover of animals, their faithful illustrator, and the historian of their lives, but in this role he occupies a formost place, and has gained an imperishable name. We must consider him as he struggled and worked in the dawn of the scientific period, in the blaze of whose noonday sun we ourselves live.

He is most remarkable for his energy and indomitable perseverance in battling against the difficulties presented in the exploration of a little known, wild and for the most part uncivilized land, permitting few opportunities, even if he had the desire, for the study and careful investigation of that scientific portion of his subject, of which he frankly declared himself to have been ignorant.

But we admire in him the painstaking observer, the field naturalist, who, daunted by no difficulties, penetrated the unknown forests, living with the Indians, or in the midst of scarcely less savage beasts, encountering with cheerful courage unnumbered privations, hunger, cold, storms and oppressive heat, to secure specimens which afterwards were made to live again in the pages of his immortal work.

He was the type of that class of naturalists whose labors provide the means by which his more scientific brothers are enabled to reach definite conclusions, demonstrate Nature's problems and explain the laws by which her kingdom is governed.

There is not now left much for me to tell. Audubon returned from his last expedition in October, 1843, and immediately began to work upon his Quadrupeds of America, the first volume of which appeared two years afterwards. He lived on his place, now known as Audubon Park, at that time far removed from the bricks, dust and grime of the great city, which he could never tolerate. "Ah," he once said, "how often when I have been abroad on the mountains, has my heart risen in grateful praise to God, that it was not my destiny to waste and pine among the noisome congregations of the city."

The first volume of the Quadrupeds was his last work. He retained his simple habits, passed much of his time in the woods or at his easel; but he was now verging towards three score and ten, and while the love of his pursuit was as great as ever, the number of his accomplished years had tempered the ardor of his energetic spirit, and the fire of his youthful passion was gradually lapsing into a fitful glow.

His life was peaceful and happy, surrounded, as he writes "by all the members of my dear family, enjoying the affection of numerous friends, who have never abandoned me, and possessing a sufficient share of all that contributes to make life agreeable. I lift my grateful eyes towards the Supreme Being and feel that I am happy."

One day he discovered that he could not adjust his glasses so as to find a focus upon his canvas, and from that moment he began to fail. The devoted wife, who had always been his mainstay throughout his chequered career, now never left him, reading to him, and during his walks about the grounds that surrounded the house and which stretched to the banks of the Hudson, was always at his side. But the once erect, lithe and agile figure was now lost in the feeble form of a weak old man.

"Waning life and weary,
Fainting heart and limb,
Darkening road and dreary,
Flashing eye grown dim,
All betokening nightfall near,
Day is done and rest is dear."

Towards the last another shadow fell upon him and his mind failed, and his eye, noted for its brightness, became dim, and during the remainder of his stay on earth like a little child he was led by the hand.

On the 27th of January, 1851, the summons came, and as he lay upon his bed, surrounded by his family, his eyes regained their lustre, as though they penetrated the veil and looked beyond the river into that land that is "very far off," and with his hands clasped in those of his wife he passed peacefully away.

He sleeps by the side of our noble river, which in its fair and full proportions with stately sweep moves calmly onward to its own rest in the bosom of the great deep, so nigh at hand, while above him, bearing upon its chiseled sides reproductions from his own drawings, rises the splendid monument this day unveiled in honor of his memory and to commemorate his work.

His labors accomplished, his vocation fulfilled, how can I more fittingly express it all than by those lines so full of music, which tell of a life well lived from its rising to its setting sun; of the contemplation of a peaceful passing hence that no alarms can stir, and of the possession of a steadfast unfaltering trust when standing on the borders and looking out upon the glassy surface of the vast, unknown eternal sea?

"Sunset and evening star,
And one clear call for me,
And may there be no moaning of the bar
When I put out to sea,
But such a tide as moving seems asleep,
Too full for sound or foam,
When that which drew from out the boundless deep
Turns again home.
Twilight and evening bell
And after that the dark,
And may there be no sadness of farewell
When I embark.
For tho' from out our bourne of Time and Place
The flood may bear me far,
I hope to see my Pilot face to face
When I have crossed the bar."

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May 12,	Clerical assistance,	4.00
" 12,	Postage	.50
" 12,	Bill of Eleanor W. Rose, addressing circulars (15),	8.56
" 17,	L. R. Purdee, collector,	2.00
" 20,	Bill of L. S. Foster, envelopes (16),	.90
" 18,	Bill of Jeremiah Titus, postage,	5.87
" 29,	Clerical assistance,	1.23
June 20,	A. A. Gifford, copying (18),	2.10
July 2,	Postage,	2.00
Nov. 25,	Postage,	1.75
Dec. 5,	Expressage,	.60
" 13,	Bill of Holt Bros., postal cards (19),	1.25
" 13,	Bill of Holt Bros., circulars (20),	4.50
1889.		
Jan. 5,	Bill of Photo-Engraving Co., electrotypes and printing (21),	49.00
" 5,	Clerical assistance,	1.00
" 7,	Bill of Forest and Stream Pub. Co., electrotypes (22),	.95
" 28,	Postage,	2.00
Feb. 25,	Bill of Holt Bros., envelopes and circulars (23),	15.50
Mar. 14,	Postage,	1.00
" 23,	Bill of Holt Bros., postal cards, circulars and envelopes (24),	10.50
" 23,	Paid Fannie Thompson for addressing (25),	3.00
1890.		
May 19,	Bill of M. A. Driffill, envelopes, printing and addressing (26),	25.80
1891.		
Feb. 26,	Bill of W. J. Terwilliger, copying (27),	2.00
Mar. 3,	Bill of Trow City Directory, distributing circulars (28),	8.00
" 10,	Bill of George Crouch, copying (29),	6.00
" 10,	Bill of Anna L. Altherr, writing letters (30),	19.10
" 10,	Bill of M. A. Drifill, printing, postage and addressing (31),	83.70
" 17,	Clerical assistance and messengers,	5.00
" 27,	Bill of Charlotte E. Driffill, writing letters (32),	26.50
" 27,	Bill of Ettie Schüllinger, copying (33),	22.00
" 27,	Bill of A. & L. Braddick, writing letters (34),	4.45
Apr. 15,	Bill of Ettie Schüllinger, copying (35),	26.42
" 15,	Bill of S. W. Gaylord, copying (36),	18.31
May 11,	Bill of Ettie Schüllinger, copying (37),	9.45
" 11,	Bill of M. A. Driffill, printing, copying and postage (38),	205.66

May 11,	Bill of O. E. Norton, writing letters (39),	$5.31
Dec. 8,	Bill of Gregory Bros., printing and envelopes (40),	12.25
1892.		
Feb. 4,	Bill of Ettie Schüllinger, copying (41),	17.10
" 24,	Bill of Stephen T. Smith, envelopes, and printing (42),	14.00
Apr. 13,	E. A. Darling, superintendent, janitor's services,	1.00
May 3,	Bill of Ettie Schüllinger, copying (43),	16.00
" 7,	Bill of L. S. Foster, envelopes, postage and writing (44),	32.00
June 6,	Bill of M. A. Driffill, writing letters (45),	65.20
Sept. 8,	Paid L. S. Foster, on account (46),	300.00
" 22,	Postage, expressage and messengers,	2.00
1893.		
Mar. 4,	Bill of M. A. Driffill, clerical work (47),	4.50
Apr. 11,	Bill of L. S. Foster, balance for tickets and invitations (48),	425.00
" 13,	Postage and messengers,	5.00
May 1,	Bill of L. S. Foster, extra cards for unveiling ceremonies (49),	18.75
1,	F. W. Erb, typewriting Treasurer's Report (50),	2.75
15,	Bill of M. A. Driffill (51),	11.36
22,	Paid Robert C. Fisher & Co., on account of construction and erection of monument (52),	5000.00
June 3,	F. W. Erb, typewriting (53),	4.00
Nov. 6,	Postage and stationery,	2.00
	Total,	$6645.07

STATEMENT.

Total receipts from subscriptions,	$10,525.21
Approximate amount of interest,	420.72
Total receipts,	$10,945.93
Expended by the Committee to date,	6,645.07
Approximate balance,	$4,300.86
Due R. C. Fisher & Co., on account monument,	2,600.00
Approximate amount unappropriated,	$1,700.86

AS TO THE APPROXIMATE BALANCE.

In New York Life Insurance and Trust Co.,	$4,135.66
In the hands of the Treasurer,	165.20
	$4,300.86

ACCOUNT WITH NEW YORK LIFE INSURANCE AND TRUST CO.

Deposit June 2, 1891,	$3,900.00
" Feb. 2, 1892,	1,400.00
" May 12, 1892,	500.00
" May 26, 1892,	3,000.00
" Apr. 11, 1893,	339.94
	$9,139.94
Drawn Apr. 11, 1893,	425.00
	$8,714.94
Drawn May 22, 1893,	5,000.00
	$3,714.94
Interest to June 30, 1893,	379.72
Balance, June 30, 1893,	$4,094.66
Approximate interest on balance for four months, at 3 per cent.	41.00
Approximate balance,	$4,135.66

N. L. BRITTON,

Nov. 3, 1893. *Secretary and Treasurer.*

STATED MEETING.

November 13th, 1893.

MR. CHAS. F. COX in the chair and thirty-five persons present.

The following paper was read by title:

"Recent Experiments in Sturgeon Hatching on the Delaware."

BY DR. BASHFORD DEAN.

The region of the Delaware River near its mouth has long been the seat of an extensive sturgeon (*Acipenser sturio*) fishery. At Delaware City, Delaware, the great number of fish brought in daily to the wharfs during spawning time provide a locality especially favorable for experiments in artificial propagation. The studies by Prof. Ryder (published in the U. S. Fish Commission Bulletin) were here carried on in 1888, and during the present season this station was again selected for experiments to be made in behalf of the United States Commission of Fisheries.

At the time of the writer's visit the fishermen were bringing daily to the slaughtering wharfs from fifty to one hundred fish; and among these (May 16, 17, 18, 1893), a number of spawners were taken. There was thus abundant material for purposes of experiment. In the following paper the results of these test studies, in their bearing upon practical sturgeon culture, are briefly reviewed:

Fertilization.—The fertilization of the eggs, as known from former experiments,* is easily accomplished. The milt and roe even appear to retain their capability of fertilization under most unfavorable conditions. Ripe fish when brought into the docks had been out of water at least several hours; no precautions had been taken to insure their careful transportation, and they were usually near the point of death. In one case eggs were successfully fertilized which were taken from a fish apparently lifeless. The milt was found to remain active as long as a quarter of an hour after the fish had been slaughtered.

In the mode of fertilization, care in details appears to be needless. Eggs from ripe fish are readily fertilized, whether extruded by pressure or obtained by excision. In the latter case there is apparently no preference to be given to eggs from different ovarian regions. Excision is certainly the more speedy and convenient method. The eggs may be received with equal success in vessels, earthen, metal or wooden. Especial cleanliness is not vitally essential; in one case eggs were fertilized in an earthen bowl, from which a fixing solution of concentrated acetic-sublimate had been hastily rinsed.

Milt may likewise be taken as well by excision as extrusion. In case the fish be not actually "ripe," sufficient milt for a fertilization may often be obtained in a pipette after repeated body pressure. Milt may be collected in vessels, clean, soiled or rusted, and will retain its activity (out of water) for at least six minutes. Obtained by excision the milt may be separated from the fragments of cut testes by coarsely straining through cloth. For convenience in handling, it was found that the milt might best be secured and retained in a long rubber bulbed pipette.

If untouched by water, the eggs remain capable of fertilization for several (5) minutes. Details in the mode of introducing the milt seem of little importance. No better results followed the introduction of milt directly from the living fish than of that strained from cut testes and retained several minutes in

* In the United States those for example of Seth Green (New Hamburg, N. Y., 1875), Ryder (Del. City, 1888), Lotz (Ohio, F. C. Rep. 1890).

pipette. A few drops of milt were found to fertilize about two litres of eggs. In the experiments running water was in some cases added to the egg mass at the time of fertilization, in others as long as ten minutes afterwards; in all cases were results approximately the same. Within from twenty to thirty minutes the eggs have become viscid and "set." Under conditions of natural spawning, it seems probable that the eggs are fertilized at extrusion, since experiment failed to fertilize eggs that had been immersed in water about half a minute. This spawning condition is further attested by the scratches and abrasions noted on the abdomens of spent fish, both male and female.

Difficulties in sturgeon culture have usually been reduced to three—(1) those of obtaining ripe eggs and milt simultaneously, (2) of imperfect means of aëration of eggs, and (3) of inroads of fungus. It is evident that by careful experimental study the dangers of malaëration and fungus growth might be reduced, if not largely obviated. To these problems the attention of the writer was especially directed.

Difficulty of Aeration.—Sturgeon eggs have proven difficult to handle on account of their viscid character. Shortly after artificial fertilization the eggs stick together in a glue-like mass; this, speedily hardening, forms a compact egg mass, whose dense jelly-like matrix the culturist finds does not permit the inner and innermost eggs to be sufficiently aërated. Dying in consequence, these become the cause of the loss of the intimately connected surrounding although better aërated eggs.

On the natural spawning grounds this harmful condition does not, apparently, maintain. The eggs, fertilized and becoming viscid, appear to be drawn out into stringy clusters or ribbons, attaching at all points to submerged objects. Sticks, water weeds, fish nets and especially brush, spread over with a thin layer of sturgeon eggs, are well known to the fishermen. Egg-attached objects, it is generally noted, are found only in deeper, usually channel waters.

Favorable aëration, as suggested by natural conditions, seems accordingly to be insured by the disposition of the eggs in thin layers, and by a plentiful water supply.

To imitate these natural hatching conditions in a way practicable for large numbers of eggs is clearly the bourne of the culturist. To attain this, however, is not his easiest task. The eggs becoming viscid speedily must be attached to the hatching devices with the greatest promptness. The hatching trays must be prepared for immediate use, and the eggs must be spread over them simultaneously in a single layer. Otherwise all eggs becoming "set" at the same moment those that remain unspread must, in their clustered condition, be inevitably lost.

Aëration seems to be especially concerned with three cultural details—(1) the character of the egg trays, (2) the mode of egg attachment, and (3) the means of securing water circulation.

1. The shallow trays to which the eggs are affixed have, as far as the writer can find, been constructed either of fine metal gauze or of cheese cloth. In the present experiments the use of a coarse-meshed "mosquito netting" was found to give most satisfactory results. Of a tray bottom of this material the perforations are sufficiently large to admit an egg, but not so large as to permit it to pass through. A tray bottom thus prepared retains a single layer of eggs which may be aërated as conveniently on the under as on the upper side.

2. In former experiments the eggs, becoming viscid, appear to have been lifted from the water, spread upon the trays and retained thus until their attachment. In trials made at the suggestion of Mr. Pancost, of Delaware City, the eggs were spread upon immersed trays. Under water the eggs are easily handled, flowing smoothly over the netting tray, and by careful tapping of the tray frame may be made to assume a single layer. If placed on the tray ten minutes after fertilization they become firmly attached in about twenty minutes.

3. To assure the free circulation of water necessary to the hatching process, the egg trays are arranged in stout wooden cases, which float in the current or are sunk in deep water. Bottom and two sides of the cases covered with metal gauze permit a free passage of water current. In the present experiments the floating hatching case differed from any of which the writer is aware in the following regards: It was nearly as deep as wide. By this means the hatching trays might be placed almost vertically, to thus take advantage of the water current and at the same time to economize space. As many as four trays to a case were successfully employed; these, held in position by cleats, were directed slightly downward to guard against deposits of sediment. The incoming current was directed against the under side of the tray.

The problems of aëration seem closely connected with those of fungus growth, as may be seen in the following paragraphs.

Inroads of Fish Fungus, Achlya.—The greatest difficulty encountered by Prof. Ryder in his experiments at Delaware City (1888) appeared to have been due to fungus growth. This was found to arise at various points of the hatching tray during the first forty-eight hours of hatching, and to gradually spread its velvety encasing over and stifle the entire egg mass. For success in hatching the means then suggested was water sterilization, the fungus spores to be removed by use of either filters or heat.

The effect upon fungus growth of more perfect aëration and increased salinity of water, however, had not been positively determined. And in the following experiment the writer aimed to reconsider these matters, hoping that favorable results might suggest a simpler and less costly means of evading fungus growth.

The results of Prof. Ryder had been obtained in a small fresh water pond emptying through the river bank directly into the Delaware; the hatching cases had been placed in a sluiceway through which water was constantly escaping; yet in spite of this current fungus inroads had here destroyed all but a few of the fertilized eggs. It was the plan of the writer to array a line of hatching cases from this shore point near the mark of low water out as far as the edge of the channel in deep water. By this means (the cases to contain eggs in every way similarly conditioned) the effects of difference of salinity, aëration and silt deposit upon fungus growth seemed most likely to be understood. Surface waters of mid stream, stronger in current, would naturally be better aërated and more devoid of silt than marginal waters. In channel, moreover, the water density was noted at 1.007 (sp. gr.).

The success of the experiment seems clearly to indicate the means that may be here taken to obtain practical results. The eggs in strong current, in salter and less silty waters, were practically exempt from attacks of fungus; those in marginal waters speedily perished (see accompanying table). It would in fact seem to the writer that the fungus is rather a consequent than a prime cause of egg destruction. That it is lacking under the natural conditions of sturgeon hatching is a fact not the most remarkable, and that it may be obviated in artificial processes by imitation of the natural hatching conditions seems the simplest and wisest plan of cultural procedure.

Number of Case.	Location.	Percentage of Eggs Destroyed by Fungus.			
		2d Day.	3d Day.	4th Day.	5th Day.
I.	At outlet of fresh pond, as in experiments of Prof. Ryder, ...	100	...	...	...
II.	At stake near line of low water, ...	60	100	...	...

Number of Case.	Location.	Percentage of Eggs Destroyed by Fungus.			
		2d Day.	3d Day.	4th Day.	5th Day.
III.	At wharf sluice, a rod further out,.........	20	80	100	...
IV.	At wharf end, a rod further out,............	0	20	50	60
V.	In deep water in current at break water,......	0	5	5	5

It would appear from the above results that the problem of hatching sturgeon eggs is intimately conditioned by water current, by silt deposits, by salinity of water. To determine to what degree each of these factors is contributive to success would be granted most difficult. In the particular case of the common anadromous sturgeon (*A. sturio*) a slight degree of brackishness of water might be regarded as a favorable, if not a necesssary condition, were it not that the eggs of this species have been repeatedly hatched in water absolutely fresh. Current, on the other hand, could not have been alone an essential condition; since in the fresh sluice-way at Delaware City in the experiments of Prof. Ryder a circulation maintained stronger undoubtedly than in channel waters. Nor could the effect of silt be regarded as alone the unfavorable element; quantitatively in mid-stream—especially in sturgeon waters—an amount of sediment might be expected greater, doubtless, than of a neighboring spring-fed pond. Mode of temperature variations might, again, be looked upon as of problematic value. To what degree, then, is each of these conditions to be regarded as essential for success in sturgeon hatching? This problem, it cannot be doubted, is more troublesome in theory than in practice.

As to obtaining simultaneously the spawning fishes, male and female. In the event of extensive culture this difficulty is one that in the opinion of the writer could not be regarded as of serious weight. In a favorable locality each season brings a number of spawners to the wharfs of the fishermen, and with a regularity of occurrence that appears remarkable. In a letter to the writer Mr. Reuben Anderson, of Delaware City, well known as a most careful observer of the habits of the sturgeon, predicted *to a day* the appearance of spawners. He afterward stated that the "run" of fish,* though brief—often not longer than a

* A breeding habit of the sturgeon Mr. Anderson discussed with the writer seems for cultural purposes of the utmost significance The earliest fish in their passage up the stream spawn furthest from the river mouth, the next school in a locality not as distant, and the later fish in the lower stream regions. This zonal distribution in spawning seems attested by the character of fish as taken in their journey past a single shore front; the earliest are uniformly "cavaire fish" (i. e. of immature ovaries); later are taken "runners" (i. e., ripe fish); and at the close of the spawning season none but "slunkers" (i. e. those having spawned).

single day—might, in his long experience, with every possibility be depended on.

SECTION OF ASTRONOMY AND PHYSICS.

Professor REES in the chair. The secretary read a paper by Mr. Herman S. Davis, Fellow in Astronomy at Columbia College, entitled "Note on Bessel's determination of the relative parallaxes of μ and θ Cassiopeiæ." Mr. Davis had re-reduced the observations of right ascension difference of the two stars made by Bessel in the years 1814 to 1816, and printed in Engelmann's "Abhandlungen von F. W. Bessel," vol. 2, p. 215. Employing the Auwers, proper motions of the two stars and introducing into the Besselian equations a term to allow for differential proper motion, Mr. Davis arrives at the value:

Parallax of μ relative to θ Cassiopeiæ $= + 0.''02 \pm 0''.24$.
Where Bessel had obtained $- 0''.12 \pm 0''.29$.

It will be seen that the new reduction diminishes materially the probable error of the result, in spite of the fact that the introduction of the proper motion term into the parallax equations has lessened the weight of the determination of the parallax itself. Mr. Davis' result is in very close though perhaps accidental accord with that derived from Mr. Rutherfurd's photographic measures, which was $+ 0''.04$ (Annals N. Y. Academy, vol. viii., p. 11).

Professor William Hallock read a paper on "The Theory of Geysers," in which he described his researches upon the geysers of the Yellowstone Park, and explained their action. A glass model geyser was exhibited, in which the internal arrangement and action was plainly shown. Steam was supplied to the model from a small copper boiler, and it reproduced very successfully the remarkably regular periodical eruptions which in nature are caused by the supply of steam from the interior heated strata of the earth.

STATED MEETING.

November 20th, 1893.

Vice-President OSBORN in the chair, and twenty persons present.

The following paper was read by title:

"The Ore-Deposits at Franklin Furnace and Ogdensburg, New Jersey."

BY J. F. KEMP.

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Additional references on the minerals will be found at the close of the paper. Important papers are marked Rec. i. e. recommended.

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Berthier. Describes and names Franklinite, Annales des Mines, Vol. IV., 1819.

N. L. Britton. Annual Report of the State Geologist, N. J., 1886, p. 89. An excellent cross-section of Mine Hill is given.

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G. H. Cook. On the probable age of the white limestone at the Sussex and Franklin Zinc Mines, Amer. Jour. Sci., ii,. XXXII. 208.

G. H. Cook. Geology of New Jersey, 669, 1868, with map, Rec.

H. Credner. On the Franklinite Beds, Berg-u. Hütt. Zeitung, 1866, 1866, 29 ; 1871, 369, Rec.

B. K. Emerson. On the Dykes of Micaceous Diabase, penetrating the bed of Zinc Ore at Franklin Furnace, Sussex Co., N. J., Amer. Jour. Sci., May 1882, 376.

Aug. F. Foerste. New fossil localities in the early Paleozoics of Penn., N. J. and Vt., etc. Amer. Jour. Sci.,iii., XLVI., 435. Discusses the local stratigraphy with a map.

S. Fowler. An account of the Sapphire and other minerals in Newton Township, Sussex Co., N. J., Amer. Jour. Sci. i. XXI., 319.

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Gibbs. Alger refers to a paper by Gibbs, which has not been found by J. F. K.

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J. F. Kemp. Ore Deposits of the United States.—p. 175–1893.

*In the removal of the library of the late Professor Newberry, in 1891, this thesis was mislaid and has not been as yet found. It was, however, read by J. F. Kemp and the substance is here mentioned.

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General Geography.

The zinc mines at Ogdensburgh and Franklin Furnace, N. J., are in the northwestern part of the State, in the valley of the Walkill River, a small stream. They are about forty miles in a direct line from New York City, but are sixty miles by rail, and on a latitude some twenty-five miles north. The New York State line is twelve or fifteen miles north of them. Three railways pass through Franklin—the New York, Susquehanna and Western; the Sussex Railway, a branch of the Delaware, Lackawanna and Western; and the Lehigh and Hudson. Ogdensburgh is two miles south 20° west from Franklin. The mines at Ogdensburgh are on the eastern slope of a hill, known as Stirling Hill, while those at Franklin are on the western and northwestern crest of another which is called Mine Hill. These names are often used by writers instead of the names of the towns. Stirling Hill is a portion of the ridge called the Pimple Hills. The valley of the Walkill is spoken of by the older writers as the valley of Sparta.

HISTORY.

The outcroppings of these great ore bodies must have been early noticed. It is recorded by Alger that at Franklin the portion of the bed or vein that was rich in zincite and willemite projected originally as a slight ridge, because of its greater resistance to erosion as compared with the neighboring franklinite. The discovery of the ore doubtless, therefore, dates back to the early settlement of the valley. Even to this day the few croppings that remain seem unfavorable to vegetation. The first mining that I find recorded was done by Lord Stirling, after whom Stirling Hill was named, and whose career, before the Revolutionary war, in which he was a general on the American side, was closely identified with the iron industry of New Jersey. He resided at Baskenridge, N. J., from 1774–1776 *and devoted his time to these iron developments. He acquired the title to the Stirling Hill, and dug some test pits on the ore, thinking that the red zincite was cuprite. Large trees had grown on the dumps in 1844 (Alger) and in the 70 years of interval nothing further seems to have been done. It was somewhat different at Franklin, because small bodies of magnetite are found near the franklinite and the latter itself was taken for an iron ore. A furnace was erected at least early in the present century, for Nuttall, writing in 1822, refers to it as a well established works and mentions the salamanders that were formed by the franklinite and the trouble that ensued. It is not surprising that dealing with a new and hitherto unknown mineral which looked exactly like magnetite, these primitive furnace men, without the help of chemistry, got into difficulties. All of Mine Hill and indeed much of the valley to the north belonged to Dr. Samuel Fowler of Franklin, whose name is attached to the mineral Fowlerite.

Regarding zinc, nothing very serious was done until after 1840, and then for ten years or so various enterprises were more or less unsuccessful. The ores could more easily be turned into zinc white for a pigment than into metallic zinc, for which latter there was then but a limited demand. In 1848 Dr. Fowler sold to the Sussex Zinc and Copper Mining and Manufacturing Company,† " all the zinc, copper, lead, silver and gold ores, and also all other metals or ores containing metals (except the metal or ore called Franklinite and iron ores, where it exists separate from the zinc) existing, found or to be found on Mine

*See Life of William Alexander, Earl of Stirling, by W. A Duer New Jersey Hist. Soc. 1847.

† See paper by J. C. Platt, Jr., cited above, from whom these quotations are taken.

Hill." He also further conveyed "all the metal, mineral or iron ore usually known and designated by the name of Franklinite found or to be found" on the northern portion of the bed, the exact boundaries matter little for our purposes. From this rather obscure, badly worded and unfortunate reservation, it appears evident that Dr. Fowler regarded the franklinite as an ore of iron or at least not a profitable source of zinc, for in 1850 he conveyed to other parties "all the reserved ore called franklinite and all other reserved ores and metals not granted or conveyed to the Sussex Co."

Undoubtedly the impression which prevailed at this time and before, that there were two distinct veins, one rich in zincite and willemite next the foot-wall, and the other in franklinite next the hanging, contributed to this result. Ultimately this latter reservation came into the possession of Moses Taylor. Meantime the New Jersey Zinc Company had become possessed of the first conveyance, and had set up the manufacture of zinc white and zinc. J. D. Whitney, writing in 1854,* speaks in high terms of their plant and calls it the only important metallurgical improvement that had up to that time been made in America. Naturally, in mining the zincite and silicate (willemite is generally called sillicate and zincite, oxide among the miners), much franklinite was also removed, and this led to a famous mining suit between Moses Taylor, plaintiff, and the New Jersey Zinc Company, defendant. A decision was finally rendered in favor of the former by the United States Circuit Court, sitting at Trenton in 1876. A consolidation of the two interests followed, and they have since operated as one, under the name of the New Jersey Zinc and Iron Company. The stimulating motive of the suit was, without doubt, the availabilty of franklinite as a source of spiegeleisen in the Bessemer steel process. Moses Taylor was one of the chief owners in the Lackawanna Iron and Steel Company of Scranton, by which company the New Jersey Zinc and Iron Company is practically owned. The northern central portion of the great bed is operated by the Lehigh Zinc Company, at the so-called Trotter Mine. The Lehigh Company have developed by borings, the continuation of the back vein, and are now sinking a shaft that will tap it at about 1,000 feet. A law suit is at present pending between them and the New Jersey Company, the latter being the plaintiff. At Ogdensburgh the New Jersey Company owns the northern end, but the works are closed, and have been for some years. The southern end, the bend and the back vein are operated by the Passaic Zinc Company.

* Metallic Wealth of the United States, p. 346.

General Geological Relations.

In both Stirling Hill and Mine Hill, the ores form a bed which is in each case, so far as one can see, parallel to the bedding of the containing limestone. The limestone is coarsely crystalline and is white. It outcrops as a continuous belt of varying width and somewhat over 30 miles in length. At Ogdensburgh, which is near its southern end it is a half mile wide, and at Franklin rather less. In the area with which we are concerned the white limestone rests on the west against the gneiss, which forms the Pimple Hills and which is parallel with the white limestone in strike and dip. Nevertheless the strike and dip of the latter are often obscure, on account of its massive habit. The white limestone is closely involved throughout all of its extent with a blue variety, which is of Cambrian or Cambro-Silurian age. It has been a much argued question for many years as to whether the white is altered blue or is a member of the gneiss series and therefore Archæan. A full historical review of this question is given by F. L. Nason in the American Geologist, VII. 241, April, 1891, and an important contribution in the New Jersey Report for 1890. The point at issue is briefly this: The white limestone is pierced in countless places by granitic dikes, which now appear in more or less detached masses, apparently stretched out thus by foldings and disturbances. More basic varieties, seeming to be altered gabbros, are also recorded by Nason, and some extremely interesting trap dikes. The white limestone, it may be added, is also charged with curious bunches of silicates, especially near the mines, which, if they are originally igneous rock, are now much metamorphosed. They contain well crystallized orthoclase, biotite, pyroxene, hornblende, garnet, etc. It is a very important point that the white limestone is penetrated by the intrusions noted above, and much stress will be laid on it later.

The terms bed and vein are used somewhat interchangeably in the subsequent description. Locally the ore body is always spoken of as a vein, and the parts are called the front vein, the back vein, etc. But as the ore is parallel to the bedding it may also be called a bed, and is so by Credner. In using this latter term, which I prefer, I would not mean thereby that the ore is necessarily older than the hanging and later than the foot, and thus deposited in the regular sedimentary series, although this definition of bed is insisted on by many writers. It is merely intended to convey the idea that the ore is interbedded.

The Ogdensburgh Ore Body.

As shown on the map, which is reproduced from a topographical map on a large scale (8 in. to the mile) that accompanies the N. J., Rep., for 1868, the white limestone forms a belt about ½ mile across. On its western side it rises in a hill some 260 ft. above the river. The ore body appears as a great hook, affording two so-called veins (or beds) known as the front vein and the back vein, and connected by a bend (see fig. 1). Beginning at the north end of the front vein the ore runs 1100 feet S. 30° W., then curves around for 300 feet and continues parrallel with the

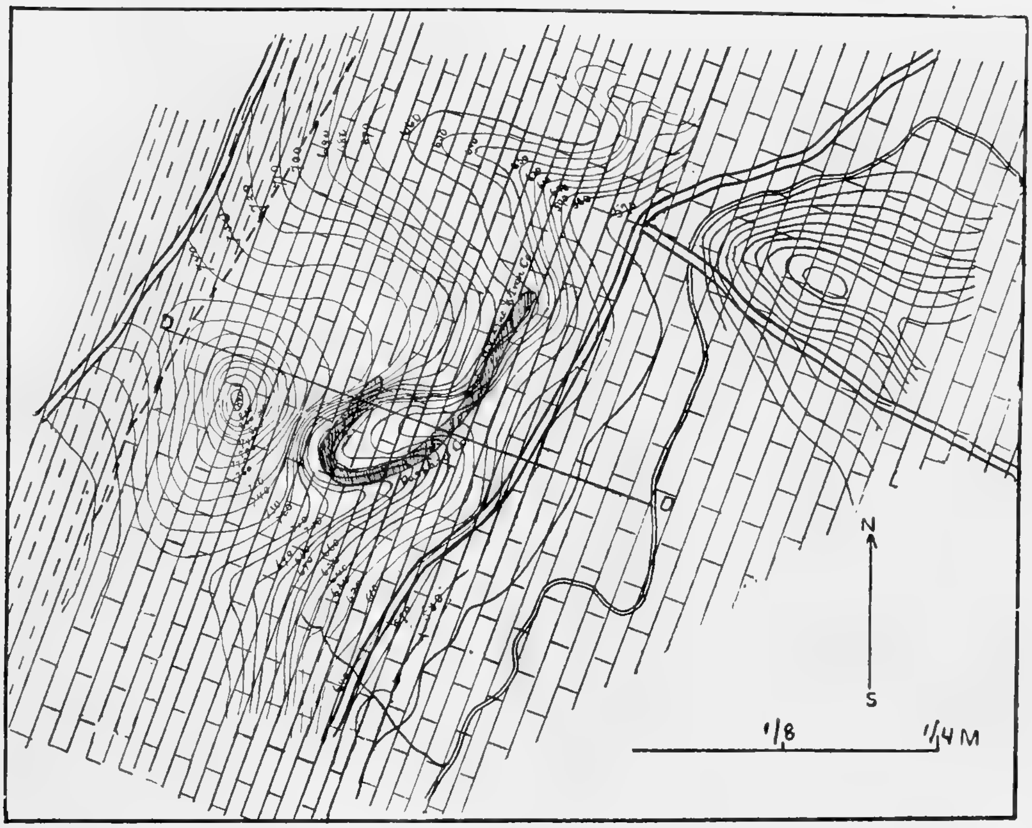

FIG. 1. MAP OF THE ORE-BODY AT OGDENSBURGH.
For Explanation of Signs, see Fig. 4.

front vein about 475 feet until it ends. The ore body dips eastward at about 60° near the surface, but in the Passaic Mine, the only one accessible to me, it soon flattens to about 45° at 150 feet in depth, and then at about 250 shows an even steeper dip than at the surface (see section D D fig. 2). In the front vein the portion near the foot shows a band richer in zincite and willemite than that near the roof, but it is hardly enough to justify speaking of two veins, a zincite vein and a franklinite vein. Both are irregular, and pinch from the coming in of the foot wall. The ore body is an impregnation of the limestone along this horizon with the ore bearing minerals in greater or less degree, and with a richer streak in zinc, next the hanging. As much as twenty feet in width have been taken out, the walls then being too lean to work. Along the back vein at the bend, the rock is very complicated and far from a simple limestone. The outline of the bend we are obliged to take from the Report of the N. J. Survey for 1868. At present only a great pit appears, entirely mined out as an open cut, and about 50 ft. deep by 100 ft. or more east and west, and 75 ft. north and south. The walls show masses of silicates, often beautifully crystallized, including augite, jeffersonite, hornblende, garnet, apatite, ga-

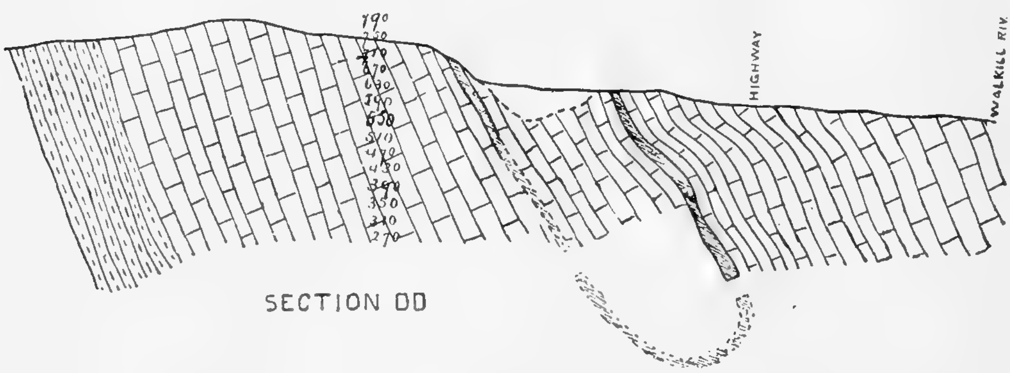

FIG. 2. CROSS-SECTION OF THE ORE-BODY AT OGDENSBURGH.
For Explanation of Signs, see Fig. 4.

lena, enormous crystals of franklinite, etc. There are also bunches of dark syenitic rock, that are quite certainly intrusive in their nature and contain orthoclase, a little plagioclase, green hornblende, some augite and garnet. Somewhat northeast of this great open cut, and directly between the front and back veins, is another open cut. This formerly contained a deposit of calamine that was worked out in 1876, and that is described by Mr. Marshall, superintendent of the mine, as terminating in a bowl-shaped end. Much decomposed limestone thickly charged with franklinite is here, so that it would seem as if the intervening rock between the two veins was impregnated with franklinite, that it suffered surface alteration and that in a cavity secondary calamine formed.

The report of 1868 states that the ore pitches downward at an angle of 65° to the north. Coupling this with the fold, the necessary data are afforded for the interpretation to a certain degree of the geological relations. The foundations for this interpretation may be briefly summed up as follows, and in the summary the reliability of the several statements is indicated.

1. The ore is interbedded in the limestone.

2. The deposit is a continuous and single bed (or vein) which is bent into a fold. (This statement rests on the authority of the report for 1868, and is corroborated by the mining operations and such observations as can be made to-day.)

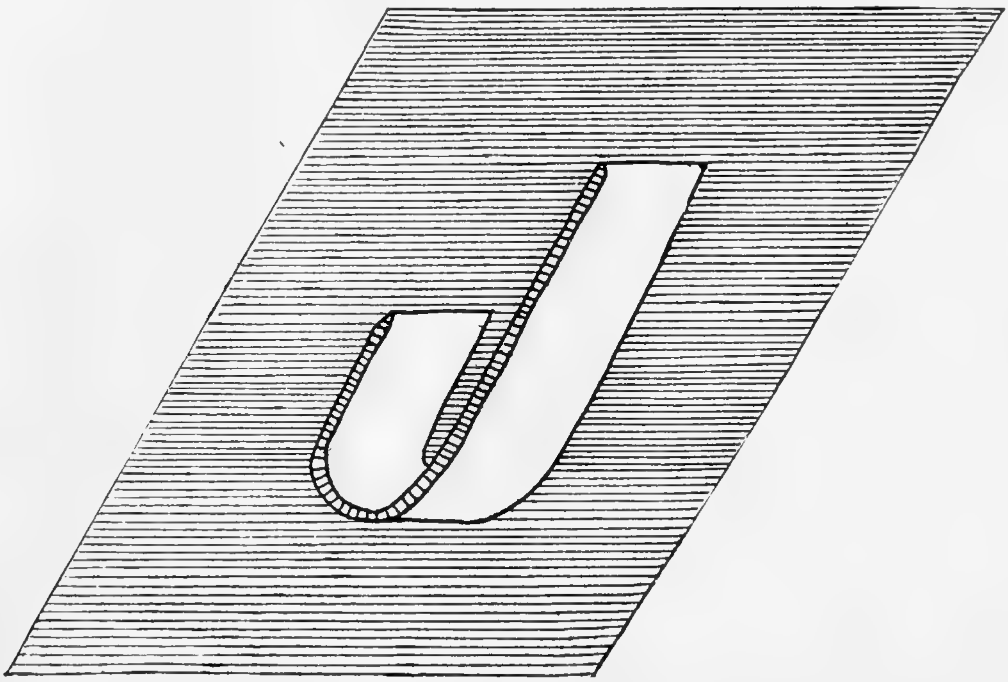

FIG. 3. STEREOGRAM OF THE OGDENSBURGH ORE-BODY.

3. The wall rock is widely impregnated at the bend with franklinite and other minerals, and is pierced by intrusions of rather basic syenite.

4. The ends of the bed and the axis of the fold pitch to the north at an angle of about 65°, as recorded in the report for 1868. The old mines where this might be verified are abandoned.

5. There is a somewhat variable dip to the ore of from 65° to 45° southeast, but mostly the former.

Picturing to ourselves the limestones as once flat, they have been folded by pressure operating in a northwest and southeast line, i. e., normal to the general strike and trend of the country, and this fold has then been tilted to a very steep pitch to the north and doubtless broken by a great fault somewhere in this direction. The broken condition of the igneous rock and its appearance as stretched and isolated masses argues its intrusion before this excessive folding and disturbance.

How much of this fold and ore has been eroded, we have no means of knowing, but if the above statement (4) is true, as there seems reason to believe, and the pitch holds for some considerable depth, the point at which the workings of the Passaic Company will meet the pitching trough of the fold, can be approximately plotted. The foot-wall will come in not so much from the west as from the south. Fig. 3 is an attempt to sketch the general shape of the ore, without attendant walls.

The questions that at once suggest themselves as to whether the ore was formed before the folding occurred, and as to its source can be best treated in connection with Franklin Furnace, to whose description we now pass.

The Franklin Furnace Ore Body.

The relations at Mine Hill are somewhat analogous to those at Stirling Hill, and yet are more complicated. The ore bed shows a similar northerly pitching fold, but with a much less steep pitch. There is also reason to think that on the east a small anticline comes in. In the front or west bed the ore is much nearer the contact with the gneiss than at Ogdensburgh, and seems clearly to be at a different horizon in the limestone. It begins on the north, as shown on the map. Fig. 4, in the "front vein," near the Hamburg road, and runs south 30° west for about 2,500 feet. It then bends around in a sharp fold forming the back vein and strikes to the east, at an angle of about 30°, and after running some 600 feet, pitches below the surface at an angle of 27° or 28°. The borings for the new shaft of the Lehigh Company have proved it to continue for about 2,000 feet further, and when the pitch of the bed as shown in the Buckwheat Mine is plotted, and an allowance made for topographical differences of level, the known depth of the borings to ore (1,000 feet) checks very well with a pitch of 28°. The line of the ore underground is indicated on Fig. 4 by a heavy broken line. How much further it runs will be an interesting thing for future workings to determine.

The old mine at the north end of the front vein is called the Hamburg, or the Hamburg Road Mine. In it the interesting mineral sussexite was discovered. The workings south of this belong to the Lehigh Company, but the mine is commonly called the Trotter. It is the great source of rare minerals. The New Jersey Company, no longer operate the front vein, but

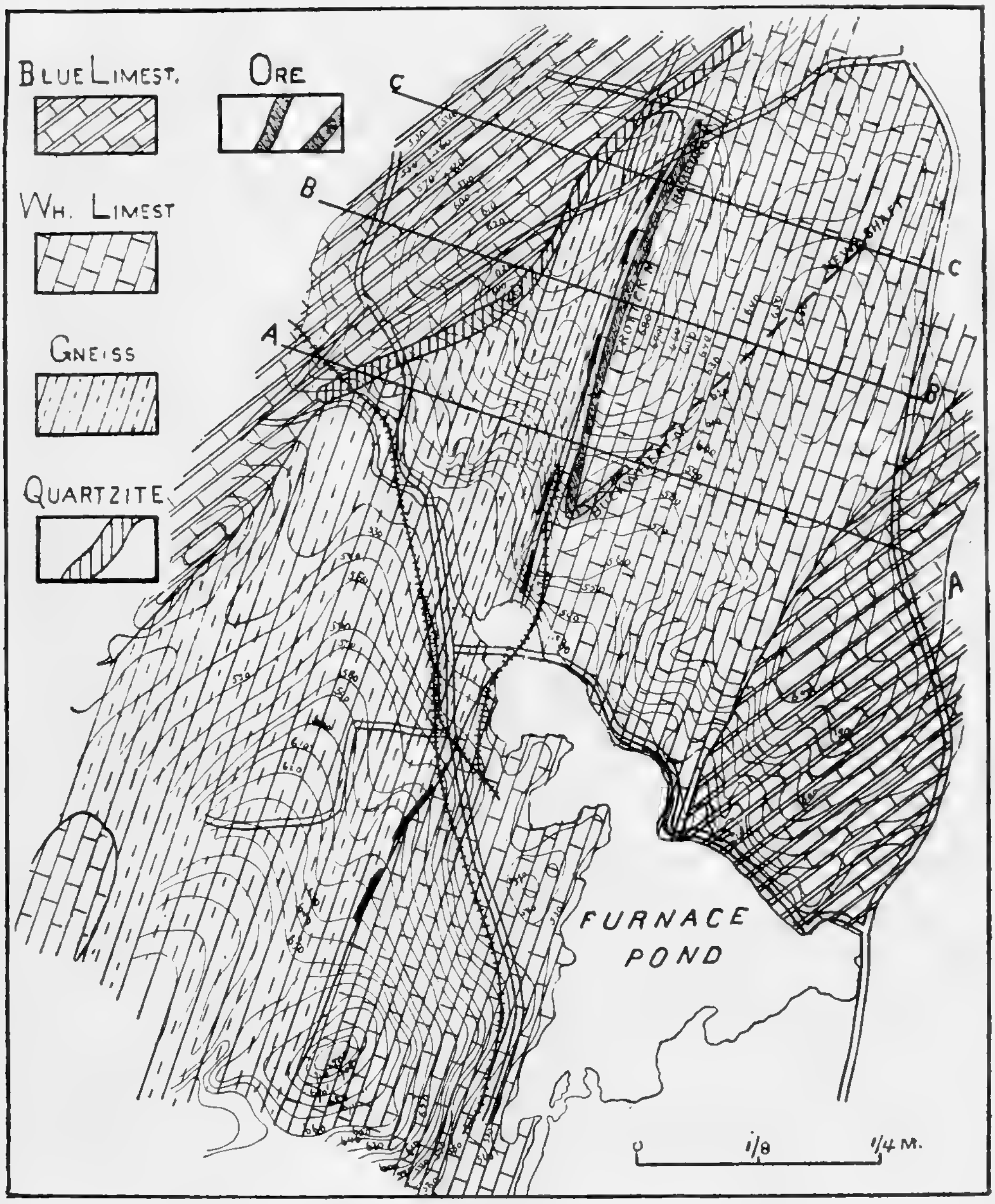

FIG. 4. MAP OF FRANKLIN FURNACE.

mine only the back one. This mine is called the Buckwheat or Taylor, and is far the largest and richest of all. Just as the ore pitches below the surface it is cut by an interesting trap dike, about 20 feet thick, of such mineralogical character as to stamp it as an associate of the great elæolite-syenite dike, which outcrops 14 miles northwest.*

This basic dike has no connection with the ore, which appears as inclusions in it. There seems also every reason to think that

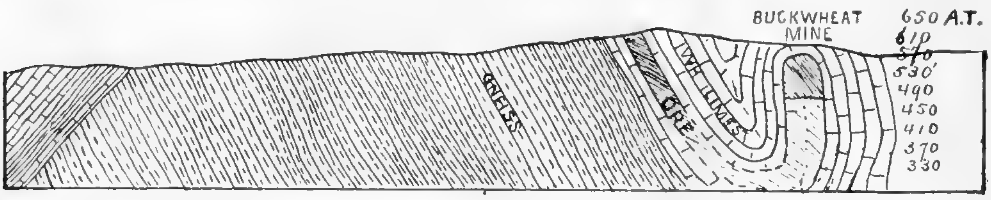

FIG. 5. SECTION AA. OF FIG. 4.

the rocks and ore have not been much disturbed since the dike was intruded.

Along the contact between the white limestone and the gneiss and granite on the west, there is a series of small magnetite ore bodies that have furnished considerable ore, and in the New

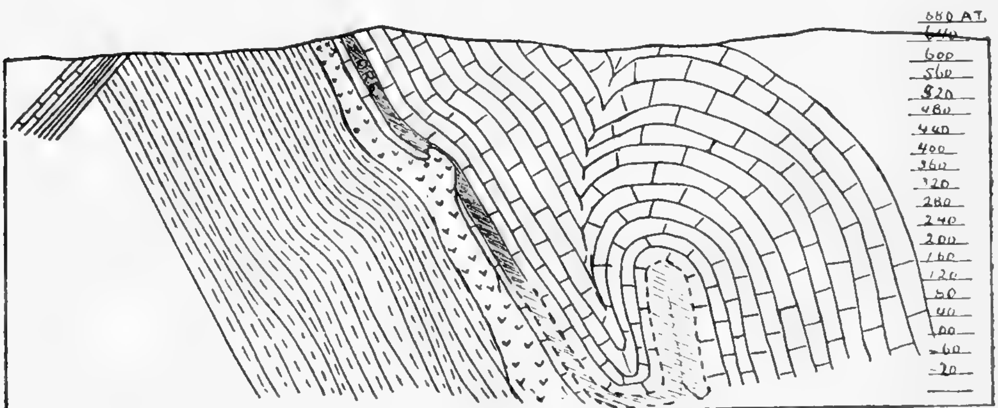

FIG. 6. SECTION BB. OF FIG. 4.

Jersey Report for 1868, p. 658, it is recorded that one has been mined out from the limestone beneath the bend of the zinc ore bed. This iron ore has received most attention to the south of the zinc outcrops, for while in the surface cuts of the Hamburg mine it also shows, it is not over 2 feet thick.

* J. F. Kemp, Trans. N. Y. Acad. XI. 60.

Igneous granite or related rocks outcrop at many points in the white limestone near Franklin. A great intrusoin was cut some years ago in the Trotter Mine, and it lies on one of the dumps still. It is a green granite with finely bounded crystals of amazon stone in great aboundance. In thin section it exhibits, microcline, orthoclase, considerable hornblende and at times is very rich in allanite. It is a basic granite and is poor in quartz. The earlier descriptions speak of outcrops of "sienitic" granite near the vein and in the limestone to the eastward of this point (Nuttall, p. 243) and on the large map of the report of the New Jersey Survey, 1868, a pink gneissic or granitic mass is colored in just east of the location of the Trotter Mine.

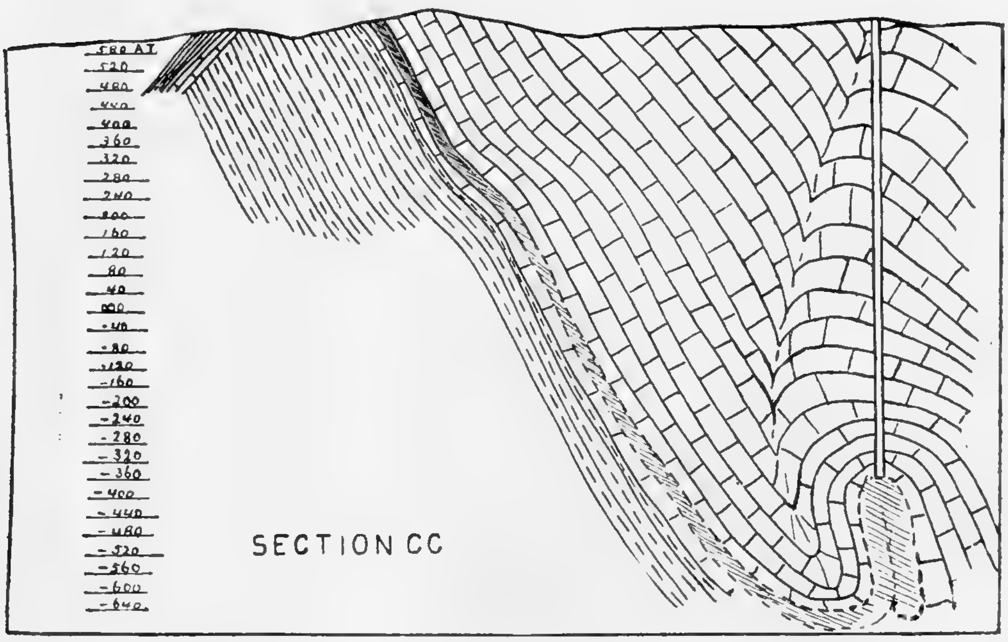

FIG. 7. SECTION CC. OF FIG. 4.

This still can be seen and is a well known locality for garnets although the character of the rock is less clear than the granite in the mine. A great dike of granite appears in the quarry, just southwest of the furnace. It consists of quartz, microcline biotite and a little plagioclase. Still further south at the abandoned iron mines, dioritic facies appear and coarse pegmatites, with masses of colophonite, coccolite, and other interesting minerals that led Prof. Groth, of Munich, whom I had the honor to conduct over the region, to call it at once, "klein Arendal," so close is the parallel with the famous Norwegian locality.

From all this it appears that igneous intrusions of acidic rocks are abundant along the contact with the gneiss, and indeed by the early observers they were one of the first things noted and commented on.

In discussing the structural relations of the ore, it will perhaps be clearest to again summarize the facts which have the strongest significance, as was done under Ogdensburgh.

1. The ore is interbedded in the limestone.

2. The deposit is a continuous and single bed (or vein) which is bent into a synclinal fold, and also on the east apparently into a small collapsed anticlinal. The ore fades out qu.te gradually into the walls. These contain much manganese and weather brown.

3. The wall rock is widely impregnated at the bend with franklinite and other minerals, and in at least one place (the Trotter Mine) is pierced by intrusive granite of a basic type. Other granite appears between it and the gneiss.

4. The crest of the probable eastern anticlinal in the Buckwheat Mine, and presumably also the trough of the syncline pitch northeast at an angle of about 28°.

5. The ore dips southeastward with an inclination in the western (or front vein) of from 60°–37°, but in the eastern portion it is nearly vertical.

The first of these statements is the universal testimony of all who have written of the ore, but it is true here, as at Ogdensburgh, that the dip and strike of these massive, crystalline limestones are often very obscure. Whether the apparent laminations in so disturbed and metamorphosed an area represent original planes of deposition is not absolurely beyond question, although I think in general that they do.

The second of these statements is proved by the excavations at the south end. In the south end of the second level of the Buckwheat Mine a cross drift has been run to the front vein. It is very evident that along this drift the ore flattens to the horizontal and then rises again to an inclination beyond the vertical, so that a slightly collapsed fold is indicated. The layers or bands of ore that are next the hanging of the front vein are next the foot of the back. The synclinal fold is beyond question, but whether the back vein is a crushed anticline is less certain, although I think it is and have so drawn it. This anticlinal structure was suggested by Bemis and Woolson in the thesis cited at the outset. In favor of such interpretation, it may be said, that

1. The ore is of double or even greater width.

2. After it has pitched below the surface, the roof is a marked

arch, and where mined out beyond the trap dike this arching crest is very strongly suggested.

3. In the earlier mining (1885), when the roof was accessible to Bemis and Woolson, they noted radiating and tapering veinlets of willemite which penetrated it.

4. If a collapsed anticline be *not* supposed, we have a bed-like body of ore, terminating in a rounded and swollen mass, more than three times the average thickness elsewhere, and extending in a practically straight line on the pitch over 2,000 feet. According to this supposition we would naturally expect the ore

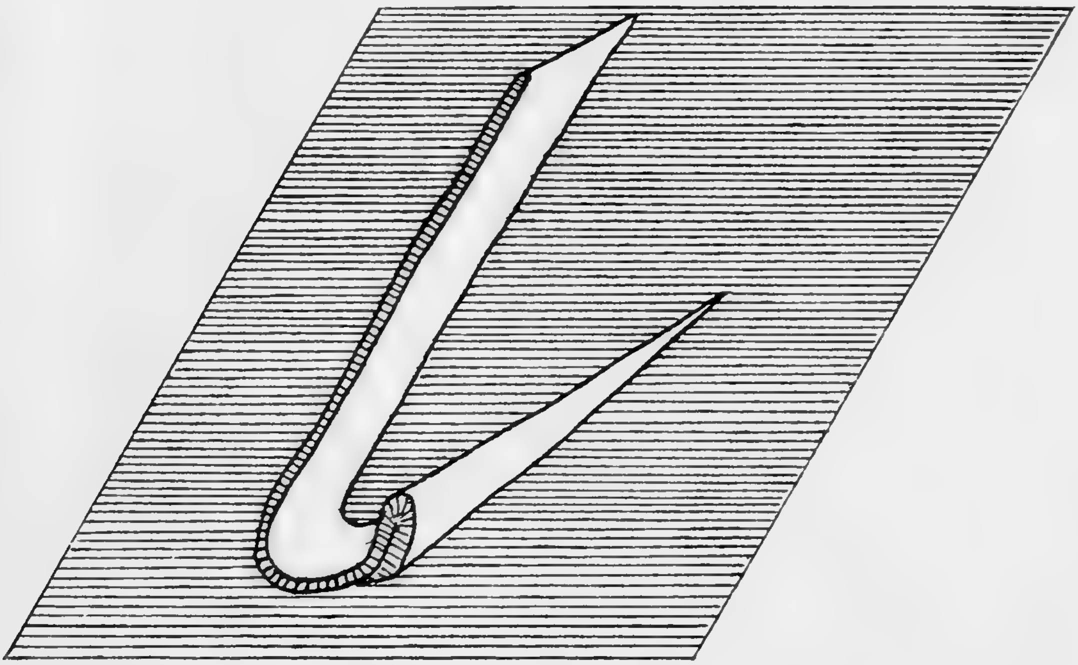

FIG. 8. STEREOGRAM OF THE FRANKLIN FURNACE ORE-BODY.

to gradually pinch out, or to end in ramifications, or in a leaner and leaner wall rock.

Granting the collapsed anticline the lengths of the flanks can be plotted to scale from the known pitch, the outcrop and the inclined section of it on the surface. This has been done in the sections. The original bed of ore only sufficed to form the anticline, else a further outcrop would be found, tailing out southeast of the point where the trough of the syncline intersects the surface. The accompanying figure (Fig. 8.) gives an idea of the shape of the ore, stripped of its walls. On the sections, AA., BB. and CC., it can also be traced. They indicate, with a fairly close approximation to scale, the vertical extent of the collapsed anticline, and the depth along each section, at which the front vein may be expected to fold upward into the back. It will be interesting to see if future mining establishes these inferences, and if when the indicated bottom of the back vein or collapsed anticline is reached the ore ends, or whether it separates into two beds (the flanks of the anticline), one joining the front vein, and the other dipping off downward or eastward from it.

On the Origin of the Ore.

Having the structural features before us, we may discuss the probable form of origin. This is a puzzling problem, the more because the minerals so abundant here, franklinite, zincite and willemite, are either unknown or extremely rare elsewhere in the world. Evidently the general method of origin for the ore-bodies of both Stirling Hill and Mine Hill is the same. I do not think they were ever continuous because they appear at different horizons in the limestone, with reference to the gneiss. In throwing what light we can on the origin, it is important to note—

1. That of the ores franklinite is much the most abundant mineral, and that this contains much more iron than anything else. Mr. Stone's four analyses (cited at outset), show from 56.57 to 67.38 per cent. Fe_2O_3. Mr. Van Dyck (N. J. Rep. for 1868. p. 673) found 74.8 Fe_2O_3. The deposit is essentially one of iron oxide, with extraordinary amounts of manganese and zinc. The same chemists found from 7.8 to over 15 per cent. oxide of manganese, and from 15.91 to over 21 per cent. oxide of zinc. Oxides of manganese are frequent associates of iron ores, and zinc blende is also known, but always as an unimportant mineral.* In distinctively zinc mines iron oxides are widespread, although manganese is a rarity.

2. That it is a remarkable and exceptional thing not to find more lead with so much zinc, for where zinc is found in limestone as it usually is, we almost always meet lead and conversely. Although galena is found in these mines, it is a rare and insignificant mineral.

3. From experience with oxidized ore bodies of zinc and iron (manganese as stated is unusual) elsewhere (Southwest Virginia, Belgium, Raibl in Karinthia, Silesia, Laurium in Greece) the

*Zinc oxide has been caught at the tunnel head of furnaces smeltiug Virginia limonites. E. C. Means, "Dust of the Furnaces at Low Moor, Va. Amer. Inst. Min. Eng. Oct. 1888. Cadmium was also found years ago in an old furnace at Ancram, N. Y.

conclusion has usually been drawn that they have been derived from blende and pyrite, by oxidation. If this ever were the case in the ore bodies here considered, oxidation must have been extraordinarily thorough, before the period of metamorphism, for blende and pyrite are both extremely rare minerals in the mines and do not occur with the ore proper, but with the horses of silicates. If, however, such an oxidized mass of limonite, smithsonite and calamine had been present, metamorphism could much more readily bring about the chemical compounds that we find to-day. We cannot readily conceive of metamorphism changing the sulphides directly to the present minerals. The absence of the sulphides increases the difficulty.

4. Although the ore is in a disturbed region, no faults have been met in the mines which might serve as a source of the original ore bearing solutions, nor do any fissures cross them so far as known. There is no evidence to show that the ores themselves have filled a fissure parallel with the bedding, although it is possible that they may have been directed by one, or better yet by a set of bedding planes and spreading thence have replaced the walls. But as they are in a narrow belt of rock, which probably is, as Mr. Nason strongly argues, blue Cambrian limestone, locally altered by granite intrusions, I think the causes cited under 5, have greater weight, than main supply fissures.

5. If we do not admit, and indeed it seems unreasonable to me to do so, that the bodies of iron-zinc-manganese compounds have been deposited along with the limestone and at a certain stage in its growth, there is but one stimulating cause for ore solutions left, and that is the intrusive rocks, already referred to. While this cause cannot be *demonstrated* to be without question the true one, these dikes and intrusions might have naturally started circulations, which, spreading from their contacts with the limestone, along a favorable bed, surcharged the limestone with the ores and attendant minerals. In just what form they were originally precipitated we cannot well say, although as stated general experience the world over would suggest sulphides. It is possible as Mr. Nason suggests (N. J. Rep. 1890, p. 47–49) that the sulphides with the magnetite at Andover and Oxford Furnace to the south represent such originals in a less altered form. If they were originally sulphides, they were doubtless oxidized by atmospheric agents, to the usual secondary minerals, and then metamorphosed.

6. The small bodies of magnetite along the contact of the limestones with granite, and the larger manganiferous one under the fold of the zinc ore at Franklin (see New Jersey Report,

1868, 658) are probably of the same general form of origin with the zinc ores. It is significant that they lack sulphur entirely.

7. It may occur to some that the metals have been disseminated through the limestone and have been segregated or concentrated along the ore horizon by the oft mentioned tendency of ore thus to collect together. The possibility of such a process cannot well be denied, although it seems to the writer far less likely than one on which special confidence is here placed. It would require an enormous extent of wall rock to yield the amount of ore here visible, and the migration of material through a great amount of rock favorable to its precipitation.

8. The ore bodies have been said to be analogous to the ordinary magnetite in the gneisses of New Jersey. This throws very little if any light on the method of origin.

9. Some additional probability is given to the reference of the ores to the stimulating action of the granite, because refined analysis of the zinc-white reveals the presence of small traces of tin, as well as other metals. Tin is a characteristic associate of granite.

In this instance, as so often in the case of ore deposits, we are unable to go beyond the fixing of the most probable cause of formation, but bearing in mind the above points, in the statement of which the attempt has been made to be as fair and judicial as possible, the following outline of the process may be traced:

The ores were most probably deposited from solutions, set in circulation by the intrusive rocks. These solutions spread through a particular bed, as along a particular set of bedding planes in each locality, replacing and impregnating the walls with ore. The kind of minerals which were first deposited is obscure. We would expect sulphides, but can find no trace of them. The present character of ore is probably in no small degree the result of metamorphism. After deposition, walls and ore were folded by mountain-making pressure, operating along a northwest and southeast line and metamorphosed. An unknown but doubtless considerable amount was eroded. At some period subsequent to the folding, the great trap dike of the Buckwheat Mine was intruded, and since then there seems to have been slight, if any, disturbance.

THE MINERALOGY.

The mineralogy of this limited region is almost synonymous with the mineralogy of the State, and its contributions of new species to the science are not few. The locality became well known at the beginning of the century, and has been a prolific source ever since. Lists of minerals have been published from time to time as follows: Vanuxem and Keating in 1822 (Jour. Phila. Acad. of Sci., ii. 287) mention twenty-nine, in which list, dysluite, automalite and "spinelle" figure as three. Samuel Robinson in his catalogue of American Minerals, etc., 1825, pp. 162–173 mentions forty-nine, of which ten are worthless or repetitions, and four others are varieties of the spinel group, involving but two species (gahnite, automalite, spinelle, dysluite), three others, augite coccolite, and jeffersonite are closely akin, as are tremolite, actinolite, and hornblende. This leaves about 35 admissible ones. Dana's Manual of Mineralogy, first edition 1848, p. 370, gives 34, of which about 4 are repetitions. Dana's System of Mineralogy, 1868, mentions but 38, of which 8 are varieties and one is doubtful, leaving 29. F. A. Canfield 1889 (N. J. Geol. Surv. Final Rep. Vol. ii. p. 3), gives 77 of which 19 are varieties and 3 are doubtful species, leaving 55. One or two others are mentioned elsewhere which are not in his list, such as barite, niccolite, chloanthite, desaulesite, axinite. Dana's System of Mineralogy 1893, p. 1066, mentions 56, of which 11 are varieties or doubtful. To the above list I am able to add Thorite. This occurs in the granitic dike of the Trotter Mine with allanite and zircon. It forms small masses, a half inch across, of irregular outline. It is dark brown, translucent in thin splinters, infusible, gelatinizes, and yields micro-tests for thoria. It is isotropic under the microscope, probably from alteration. The mineral was found while in company with Prof. P. Groth.

The accompanying list contains all those mentioned above with the first authority by whom they were cited, and in case of a new species, or variety, or of a special description the paper is cited. The species are numbered, but varieties and doubtful species are not. The standard test of species is the late edition (1893) of Dana's incomparable System of Mineralogy, in which those receiving separate numbers in the text and printed in full faced type in the index are estimated species, while all others are grouped as varieties or as doubtful.

C stands for F. A. Canfield, N. J. Geol. Surv. Final. Rep. Vol. ii. 3, 1889. D 1848 for Dana's Manual 1848. D 1868 for Dana's System of Min. 1868. D 1893 for Dana's System of Min. 1893. R for S. Robinson, Catalogue of Amer. Minerals, 1825. V and K for Vanuxem and Keating, Jour. Phila. Acad. Sci., ii. 287, 1822. F means Franklin Furnace, O Ogdensburgh.

Actinolite, see under Amphibole.

Algerite, doubtful species, being altered scapolite. T. S. Hunt, Amer. Jour. Sci. ii. VIII. 103, 1849.

1. ALLANITE, F, in feldspar of iron mines. C. T. Jackson, Descr. and Anals. Amer. Assoc. Adv. Sci., 1850, p. 323. From granite of Trotter Mine. A. S. Eakle, Trans. N. Y. Acad. Sci. Nov., 1893. Occurs also in the "Mud Mine" at O.
Amethyst, see under Quartz.
2. AMPHIBOLE, F., O. V. & K , 1822. Actinolite, R. Tremolite, R. Hornblende. Asbestus, F., D 1848.
Anomalite, O., doubtful species. Altered Jeffersonite, G. A. Koenig. The reference Trans. Amer. Inst. Min. Eng. Phila. Meeting, 1876, is given for this, but no published record appears.
3. ANORTHITE, F. C. Pseudomorphs after anorthite, described by W. T. Roepper, Amer. Jour. Sci. iii. XVI. 364.
4. APATITE, F., O. R.
5. ARAGONITE, F., D., 1868, p. 776.
6. ARSENOPYRITE. V. & K., 1822.
Asbestus, see under Amphibole.
Augite, see under Pyroxene.
Automolite, see under Gahnite.
7. AXINITE, F., Trotter Mine. F. A. Genth and Penfield and Pirsson, Amer. Jour. Sci., May, 1891, 394.
8. AZURITE, F., O. V. & K., 1822.
9. BARITE, D., 1848.
10. BEMENTITE, F., Trotter Mine. G. A. Koenig, Proc. Acad. Nat. Sci. Phila., 1887, 311.
11. BERYL, F. G. Troost, Jour. Phila. Acad. Sci., III. 224, 1823.
12. BIOTITE, F., O. Called mica by V. & K., 1822.
Blende. See Sphalerite.
13. CALAMINE, O. D. 1868, 776.
Calcimangite. Manganiferous calcite C. U. Shepard.
14. CALCITE, F., O. V. and K. 1822, but of course much earlier. Var. Spartaite, Breithaupt Berg. u. Huet. Zeit. XVII. 58, 1858.
Calcozincite, O. Doubtful identity. C. U. Shepard, Amer. Jour. Sci., iii. XII. 231, 1876.
Chalcedony. See under Quartz.
15. CHALCOPHANITE, O. G. E. Moore, Amer. Chem. July 1875.
16. CHALCOPYRITE, F., O. C. 1889.
17. CHLOANTHITE, F. Trotter Mine. G. A. Koenig, Proc. Phila. Acad. Sci., 1889, 184.
18. CHONDRODITE, F. Called Brucite by the older writers. Bruce. Min. Jour. 1810, V. & K. 1822. Nuttall. Amer. Jour. Sci., i. V. 245, 1822. Maclureite is a variety. See Nuttall, Amer. Jour. Sci. i. V. 246. Seybert do. 336.
Cleiophane, see Sphalerite.
Coccolite, see Pyroxene.
19. CORUNDUM, F., O. V. & K. 1822.
20. CUPRITE, F. C. 1889.
Desaulesite, F. Trotter Mine. Not fully described. G. A. Koenig, Proc. Phila. Acad. Sci., 1889, 185.
Diallage, see under Pyroxene.
Dysluite, see under Gahnite.
21. EPIDOTE, F., O. V. & K. 1822.
22. FLUORITE, F. A. Bruce Amer. Min. Jour. 1810, p. 32.
Fowlerite, see under Rhodonite.
23. FRANKLINITE. F. & O. Noted very early, named by Berthier, Ann. des Mines, IV. 489, 1819.

24. Gahnite, F., O. Var. Automolite, V. & K. 1822. Var. Dysluite, Keating, Jour. Acad. Sci. Phila. ii. 287, 1822.
25. Galenite, F., O. D., 1848, p. 270.
26. Garnet, F., O. V. & K., 1822. Var. Polyadelphite, Thomson's Mineralogy, I. 154, 1836.
27. Graphite, F., O. V. & K., 1822.
28. Greenockite, F., O. C., 1889.
29. Hematite, F. C. 1889.
 Hetærolite, O. With Chalcophanite. Of doubtful value. G. E. Moore, Amer. Jour. Sci. iii. XIV., 423.
 Hornblende, see Amphibole.
 Hydrofranklinite, O. Named by W. T. Roepper; poorly identified. D. 1893, 259.
 Idocrase, see Vesuvianite.
 Jeffersonite, see Pyroxene.
 Keatingine, see Rhodonite.
 Leucopyrite, not certainly discovered. G. J. Brush, Amer. Jour. Sci. iii. I., 29.
30. Limonite, F. C., 1889.
 Maclureite, see under Chondrodite.
31. Magnetite, F. V. & K., 1822.
 Magnofranklinite, mentioned by Canfield but original authority not found by J. F. K.
32. Malachite, F., O. V. & K., 1822.
33. Menaccanite, F. C., 1889.
34. Microcline, F. Trotter Mine in granite dike. The green "orthoclase" is microcline as shown by the microscope.
35. Molybdanite, D. 1848, p. 270.
36. Niccolite, F. G. A. Koenig, Proc. Phila. Acad. Nat. Sci., 1889, 185.
37. Oligoclase, O. C., 1889.
38. Orthoclase, F. H. Credner, Berg. u. Huet. Zeitung,, 1866, 29. Probably called feldspar, by V. &. K., 1822, and green feldspar, by R., 1825.
39. Phlogopite, F., O. Mentioned by B. Silliman, Jr., Amer. Jour. Sci. ii. X., 372.
 Polyadelphite, see Garnet.
40. Pyrite, F., O. V. & K., 1822.
41. Pyrochroite, F., O. C., 1889.
42. Pyroxene, F., O., var Augite, R., 1825; var. Coccelite, R,, 1825; var. Diallage, V. & K., 1822; var. Jeffersonite. Keating and Vanuxem, Jour. Phila. Acad. Sci. II., 194, 287, 1822; var. Sahlite, D., 1848.
43. Rammelsbergite, F., D., 1893.
44. Quartz, F., O. V. & K., 1822; var. Amethyst, D., 1848, p. 270; var Chalcedony, D., 1848.
45. Rhodochrosite, F., O. D., 1868. p. 198.
46. Rhodonite, F., O. var, Fowlerite, C. U. Shepard. Treatise on Mineralogy, 1832, 186. See especially L. V. Pirsson, Amer. Jour. Sci. iii. XL., 484, 1890. Keatingine is Fowlerite. C. U. Shepard, Amer. Jour. Sci. iii. XII., 1876.
47. Rutile, C., 18$9.
48. Rœpperite, O. W. T. Roepper, Amer. Jour. Sci. ii. L., 35. Name given by G. J. Brush, idem. iii. I., 28, 1870. The same name was

applied to a variety of rhodochrosite, by Kenngott, Neues Jahrb., 1872, 188.

Sahlite, see Pyroxene.

Scapolite, see Wernerite.

49. SERPENTINE, F. D., 1848.
50. SIDERITE, R., 1825.
51. SMALTITE, F. D. 1893.
52. SMITHSONITE, F., O. V. &. K., 1822.

Spartaite, see Calcite.

53. SPHALERITE, F., O. R., 1825. The name Cleiophane (Prof. A. H. Chester informs the writer), was given by Nuttall in some private way. It is first noticed by T. H. Henry, Phil. Mag. 4th Series, I. 23, 1851. It merely refers to a white, very pure variety. Yellow blende also occurs.
54. SPINEL, F. Green variety (ceylonite), V. & K., 1822. R., 1825. Gray spinel also occurs one-half mile southwest of Franklin.
55. SUSSEXITE, F. G. J. Brush, Amer. Jour. Sci. ii. XLV., 140, 240, 1868. Penfield and Sperry, idem. iii. XXXVI., 323.
56. TALC, F. C., 1889.
57. TEPHROITE, F., O. Named by Breithaupt, 1823. Vollständige Charak, etc., Dresden, 1823.

Tephrowillemite, see Willemite.

58. THORITE, F. Trotter Mine, J. F. Kemp, this contribution.
59. TITANITE, F., O. V. & K., 1822, who call it "silico-calcareous oxide of titanium."
60. TOURMALINE, F., O. V. & K., 1822.

Tremolite, see Amphibole.

Troostite, see Willemite.

Vanuxemite, of no value. C. U. Shepard, Amer. Jour. Sci. iii. XII., 231, 1876.

61. VESUVIANITE, V. & K., 1822.
62. VIVIANITE. Dana, 1893.
63. WERNERITE, F. Called Scapolite by V. & K., 1822. See Algerite, which is altered Wernerite.
64. WILLEMITE, F., O. V. & K., 1822, who call it "Silicious oxide of Zinc." Var. Troostite. C. U. Shepard. Mineralogy, 1832. Tephrowillemite is a variety of Troostite. G. A. Koenig, Proc. Phila. Acad. Nat. Sci., 1889, 187.

YTTROCERITE was announced by Gibbs in Amer. Jour. Sci., i. VI., 379, 1823, but appears in no subsequent list.

65. ZINCITE, F., O. Called "red oxide of zinc," in Bruce's Amer. Jour. Min. Vol. i. 96, 1810. Must have been long known. V. & K., 1822.
66. ZIRCON, F. V. & K., 1822.

The above list embraces six good species named from this occurrence, nine good varieties, one species desaulesite that needs a complete description, and nine worthless creations.

As the appended discussion indicates, Prof. F. L. Nason has probably discovered something new and interesting that is now under investigation by Prof. A. H. Chester.

Discussion.

Professor A. H. Chester made the following remarks :

Another mineral has recently been found at Franklin, which Prof. Kemp has not mentioned, though he knows of it. It is a micaceous mineral, resulting from the alteration of biotite, and resembles clintonite very closely, so that it has had that name applied to it. As far as I can learn, it was first noticed by Prof. F. L. Nason in January, 1893. During the last summer he collected a considerable amount of it, which is now under examination at the laboratory of the New Jersey Geological Survey at Rutgers College. At my request Prof. Nason has given me some account of its occurrence and association, which I will read, with your permission.

"The limestone formation of Orange County, New York, extends southward into Sussex County, New Jersey, includes the zinc deposits at Franklin Furnace and Stirling Hill, and as a continuous deposit terminates a little north of the village of Sparta.

"At Franklin Furnace the white limestone is injected with numerous dikes of granite. These granites can be seen to good advantage in the furnace quarry at Franklin and in the Trotter Mine at the north end of Mine Hill. At the furnace quarry the eruptive origin of the granite is shown (a) by its thin tongues reaching out into the inclosing limestone from the main body; (b) by its cutting across the strike of the limestone; and (c) by the large development of contact minerals, among the most prominent of which are tourmaline and chondrodite.

"The granite here is peculiar in that the mineral allanite is so prominent that it may properly be called an allanite granite.

"As might be expected, when this granite cuts the zinc vein, which it does, as proved by mining, interesting contact minerals are developed. On the surface the dike appears at a point known as Double Rock. Great masses of garnet here are found on the surface. In the limestone adjoining, the garnets appear abundantly in beautiful clusters of crystals. In the mine two hundred feet from the surface and from the surface down to this point the granite is encountered. In connection with this dike the rarer minerals found at Franklin occur. Allanite is found in large crystals usually in the coarse granite in contact with either the limestone or with the vein matter.

"Axinite, usually massive, but frequently in pockets, lined with small but brilliant crystals occurs.

"Large crystals of Amazon stone very perfect in form also occur. One large crystal formerly in the possession of Mr. W. W. Pierce weighed about twenty pounds.

"Rhodonite, both massive and in beautiful large crystals:

"Zircon, a specimen in the cabinet of Mr. Thos. Long. of Ogdensburgh, $\frac{1}{4}$ inch across the prism face, and $1\frac{1}{2}$ inches long;

"Zincite; massive tephroite; tephrowillemite in fine crystals; sussexite, rarely found; desaullesite; niccolite, in crystals occasionally; rammelsbergite, in crystals; rhodocrosite; fluorite; asbestos.

"The most abundant minerals are, however, massive rhodonite and polyadelphite. It is in immediate connection with this latter mineral that the recently observed mineral is found. It occurs in thick plates and scales with biotite, into which this passes or from which it is apparently derived by alteration.

"The writer has been at the mines frequently during the past five years, and this is the first time that this mineral has been known to be observed, and it can thus probably be safely recorded as a new mineral from this locality." (End of Nason's Notes.)

The examination, as far as it has proceeded, shows conclusively that it is not clintonite. It contains considerable manganese and is perhaps the alteration of biotite known as manganophyllite. As far as I know, this variety has not been noted from this country. It may be an altogether new species, for it does not correspond exactly with manganophyllite. I hope to make a full report in this matter a little later. (A. H. Chester.)

SECTION OF BIOLOGY.

DR. N. L. BRITTON remarked on species of the genera *Dracocephalum*, L., and *Cedronella*, Moench.

The following papers were read:

"On the Scope of Modern Physiology," by Dr. F. S. Lee.

ADDITIONAL NOTES ON RECENTLY DISCOVERED DEPOSITS OF DIATOMACEOUS EARTH IN THE ADIRONDACKS.

BY CHAS. F. COX.

Since the presentation of my previous paper upon this subject I have caused an exploration to be made of the ponds and lakes in Township 43, Herkimer county, N. Y., by Mr. D. C. Wood, Topographical Engineer of Dr. W. S. Webb's Na-ha-sa-ne Park, under the general direction of Mr. Edward M. Burns, the manager of the park, within the limits of which lie all the deposits to be described. The result is to increase considerably the area over which diatomaceous earth is known to exist, but to discredit the earlier estimates of the quantity of pure or commercial material existing in any one of these deposits. It will be seen, however, from the details which I shall present, that there are in this region at least eight deposits of considerable extent and of some scientific interest.

I give below the physical characteristics of each deposit, as described by Mr. Wood:

1. *Roilly Pond.*—In this body of water the diatomaceous earth can be traced with the naked eye over an area of about two acres. According to soundings and borings made by Mr. Wood it extends to a depth of from one to seven feet, averaging probably about two and one-half feet. The pond has two outlets, both of which are rapid, and which carry off enough of the earth to color the water of the streams for about a half a mile a milky white. The water of the pond itself also holds the material in suspension to some extent, from which fact the pond has derived its name. I have received no evidence, however, that the pond abounds in living forms, or that the stratum of their shells is now being added to to any appreciable extent.

2. *Big Crooked Lake.*—In this body of water the diatomaceous deposit has been recognized at its west end over an area estimated to contain between four and five acres, and Mr. Wood thinks he has proven that it extends to an average depth of seven feet. The water in this lake, which is a good fishing ground, is of coniderable depth, reaching in some places to fifty and even seventy-five feet. It is, therefore, impossible to say whether or not the diatomaceous earth extends beyond the limits already named.

3. *Beaver Meadow*, west of and close to Big Crooked Lake. This meadow seems to be improperly named, as Mr. Wood thinks that it was formerly a veritable lake which has been filled up, but which exhibits no evidence of having been dammed by beavers. The meadow contains from fifteen to twenty acres, and water still exists in the centre. The purer diatomaceous earth is recognizable over an area of at least five acres, though it is found more or less mixed with mud in many other parts. From Mr. Wood's examination the deposit appears to run from two to twelve feet in depth, and he thinks that over the five acres already referred to it extends to an average depth of three feet. On top of it, however, there is about a foot of

soil covered by weeds, etc., but after this is removed the earth can be spaded out in a condition of great purity.

4. *Chub Pond.*—This is a body of water covering about five acres and located at a distance of a little over a mile southeast of Big Crooked Lake. The water is about two and one-half feet deep and has a mud bottom, but upon probing this mud Mr. Wood found that it was underlain by a rather impure diatomaceous earth which he was able to trace to a depth of twenty feet. He thinks, however, that he had not reached the bottom of it, as he had not the means at hand of going deeper, but he reports that the lower he probed the purer the earth became, the last of the twenty feet being almost white.

5. *Pond North of Big Crooked Lake*, about a quarter of a mile long, contains diatomaceous earth recognizable over an area of about one acre. Mr. Wood estimates that this earth in a comparatively pure condition extends to an average depth of about three and one-half feet, but mixed with mud and other foreign matter it is traceable over a much larger area than that mentioned above.

6. *Hawk Lake* contains, according to Mr. Wood's estimate, about one and one-half acres of diatomaceous earth of from four to five feet in depth, but it has not the appearance to the naked eye of being very pure, as it seems to have some dark substance mixed with it. Beyond the one and one-half acres mentioned, Mr. Wood found extensive traces of it more or less contaminated with mud and muck.

7. *The Lower of Five Ponds*, the size of which has not been given me, is said by Mr. Wood to be entirely underlain by diatomaceous earth ranging from one to eight feet in depth, averaging as he thinks about three feet.

8. *Clear Lake.*—This appears to be another of the Five Ponds which constitute the head waters of Cranberry Lake, and in this Mr. Wood thinks there are about three and one-quarter acres of diatomaceous earth whose depth he has not determined.

Besides the deposits specifically described, Mr. Wood has examined several small ponds containing more or less of the same formation, but not in sufficient quantity or of such purity as to make it valuable in his eyes; and, as he conducted his explorations with a view to the commercial value of the material for which he was searching, he did not think these ponds worth the trouble of measurement or other detailed examination.

The samples sent me by Mr. Wood from the several deposits which he examined are all of exceptional purity and capable of being prepared for the microscope by the most superficial method of cleaning. Under the lens they appear much alike as regards the remains of Diatomaceæ which they contain, although they differ somewhat in the assembly of genera and species, as is the case with all the lacustrine sedimentary deposits of the post-glacial area of the Middle and Eastern States.

In my previous paper I described more particularly the deposit existing near Hinckley, in the southern part of Herkimer county, in which the most prominent forms had been identified. The probability is that a complete list of the forms distributed over an area as large as the one we have now under consideration would include practically all of the species which have been found in the many deposits scattered over the surface of New York and the New England States. The main difference observable in comparing the earths from the northern part of Herkimer county with the one from Hinckley is, that the Hinckley deposit contains very few individuals of the genus *Surirella*, while the Northern deposits are generally quite rich in this genus. This is especially the case with the specimens from Hawk Lake and the lake north of Big Crooked. In these the Surirellæ appear to make up the bulk of the material and are crowded in the field of view. They are less conspicuous, however, in the specimens from Roilly Pond and Beaver Meadow, and still less so in the others. In all of the deposits the free forms of diatoms are predominent, which is, of course, to be expected in specimens from a still water habitat. As I mentioned in my previous paper, these are mostly of the genera *Navicula*, *Stauroneis*, *Cymbella* and *Eunotia*, to which I may now add *Surirella*. I then spoke of these as solitary and motile, when it would have been sufficient to designate them merely as free, by which is meant entirely unattached to rocks, weeds, etc. Along with these free forms we find a scattering of those which are classed as filamentous, stipitate and adnate, such as *Melosira*, *Gomphonema* and *Epithemia*, all of which are, during their adult period at least, anchored or attached, and which, therefore, belong in moving water. This association of free and fixed forms is an indication that while the deposits were in the main laid down in still water, they were, nevertheless, contributed to by streams which fed the lakes or wandered through them.

I submit herewith samples of all the earths referred to in this paper in the condition in which they have come to me, and also slides for examination under the microscope, showing each earth in its natural state and also after the usual treatment to separate the diatoms from the amorphous matter.

November 27th, 1893.

STATED MEETING.

PROF. R. P. WHITFIELD in the chair, and twenty-seven persons present.

SECTION OF GEOLOGY AND MINERALOGY.

The following papers were read:

ON ALLANITE CRYSTALS FROM FRANKLIN FURNACE, N. J.

BY A. S. EAKLE, CORNELL UNIVERSITY.

Much has been written concerning the widespread occurrence of allanite as a rock constituent, and many analyses have also been published. The present article deals entirely with the crystallography of the mineral, and is the result of an examination of a large number of crystals coming from the Trotter Mine, Franklin Furnace, N. J.

Allanite was first reported from this locality by C. T. Jackson in 1850.* He gave a short description of its occurrence and an analysis, but nothing concerning the forms. His crystals came from a different locality, being in the feldspar of the old magnetite mines, while those described here occur with the zinc ores, in a great granite dyke.† The crystals are coal-black in color, very brittle, and occur in the common flat, tabulra forms, elongated in the direction of the ortho-axis. They contain many inclusions of the associated feldspar. The faces of the crystals are, in general, dull, and when magnified appear to be much pitted, so that reflections with the Fuess goniometer are poor. Cleavage occurs parallel to the basal- and ortho-pinacoid faces and also in the direction of the prism face, but varying about 6°30′ from parallelism. An average of several readings gives an angle of 47°56′ between the ortho-pinacoid and this cleavage face.

In all, fourteen forms occur on the crystals, none of them, however, being new. The forms are the following:

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* Allanite from Franklin Furnace, N. J., C. T. Jackson, Proc. A. A. A. S., 1850, 323.

† J. F. Kemp—These transactions, Oct. 30, 1893.

$a = \infty P \bar{\infty}$ (100).	$n = P$ ($\bar{1}11$).
$c = 0P$ (001).	$o = P \grave{\infty}$ (011).
$d = -P$ (111).	$r = P \bar{\infty}$ ($\bar{1}01$).
$e = -P\bar{\infty}$ (101).	$u = \infty P \bar{2}$ (210).
$i = \frac{1}{2}P\bar{\infty}$ ($1\bar{0}2$).	$w = -2P\bar{2}$ (211).
$l = 2P\bar{\infty}$ ($2\bar{0}1$).	$\boldsymbol{o} = \frac{1}{3}P \bar{\infty}$ ($\bar{1}03$).
$\boldsymbol{m} = \infty P$ (110)	$\boldsymbol{m} = -\frac{1}{2}P\bar{\infty}$ (102).

Forms ***m***, *i* and *o* are less common, and *u* and ***o*** are rare. The remaining faces are quite common to the species, not alone in this locality, but in general. On the "bucklandite" (allanite) of the Laacher See,* and later on the allanite from Vesuvius,† Dr. G. vom Rath has described a large series of forms, most of them being common on the Franklin crystals.

W. C. Bröggér‡ has determined the faces which occur on the allanite crystals of southern Norway.

In the drawings accompanying this paper are shown the various combinations. They are all drawn from the actual crystal, and, as near as possible, in the same relative dimensions.

Fig. 1.

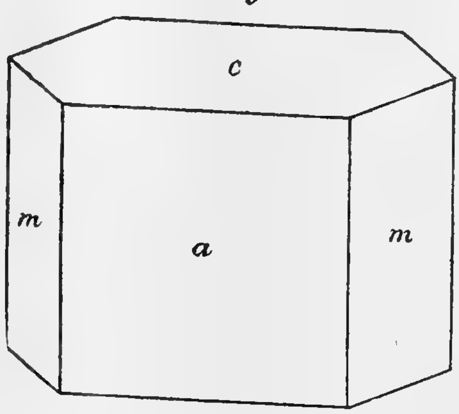

Fig. 1 shows the simplest form, consisting merely of the basal pinacoid (*c*) 0P (001), the ortho-pinacoid (*a*) $\infty P \bar{\infty}$ (100) and the prism (*m*) ∞ P (110). This combination is rare.

* G. vom Rath, Ueber die Krystallform des Bucklandits vom Laacher See,—Pogg. Ann. Phys. and Ch., Vol. 113, p. 281.

† G. vom Rath, ibid., Vol. 138, p. 492.

‡ W. C. Brogger, Mineralien der sudnorweg. Augitsyenit. Zeit. fur Krys. xvi., 95, 1890.

Fig. 2.

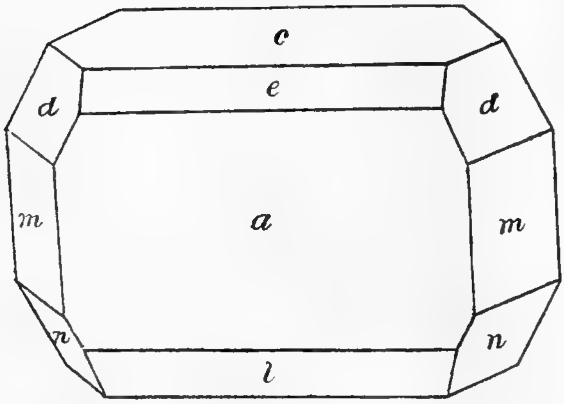

Fig. 2 is a combination showing forms (*e*) — P $\bar{\infty}$ (101), (*d*) — P (111), (*n*) + P ($\bar{1}$11) and (*l*) 2 P $\bar{\infty}$ ($\bar{2}$01) in addition to those in Fig. 1. This crystal is the largest terminated one in the lot examined, and the angles were measured with a contact goniometer.

Fig. 3.

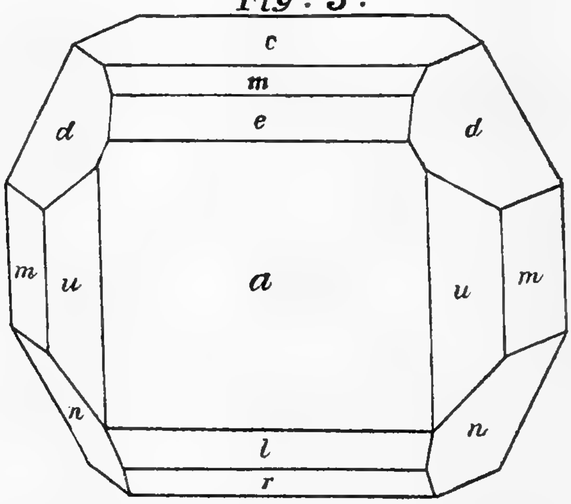

Fig. 3 shows a much more general combination. The forms occurring are (*c*) 0P (001); (*m*) — $\frac{1}{2}$ P $\bar{\infty}$ (102); (*e*) — P$\bar{\infty}$ (101); (*a*) ∞ P $\bar{\infty}$ (100); (*d*) — P (111); (*n*) + P ($\bar{1}$11); (*u*) ∞ P $\bar{2}$ (210); (*m*) ∞ P (110); (*b*) 2 P $\bar{\infty}$ ($\bar{2}$01); (*r*) P $\bar{\infty}$ ($\bar{1}$01). This combination is similar to the one on the large allanite crystal from Moriah, N. Y., described by E. S. Dana,* lacking only the clino-dome P$\grave{\infty}$ (010).

* E. S. Dana. Allanite, Min. Notes. Amer. Jour. Sci. iii. XXVII. 479.

Fig. 4.

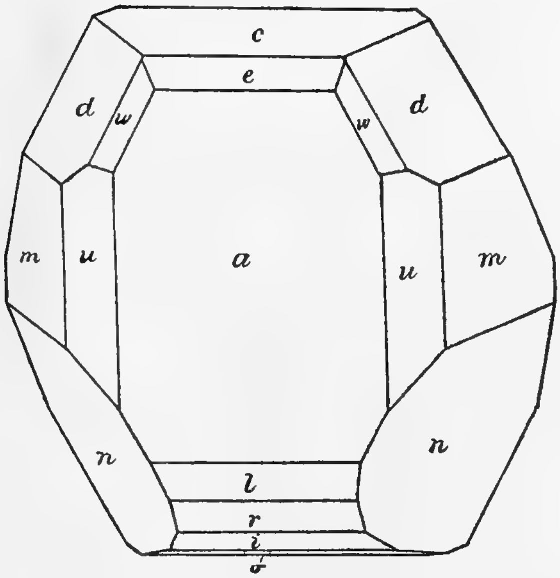

Fig. 4 is a drawing of a crystal showing the largest number of forms in combination. All of the forms shown on Fig. 3, with the exception of $-\frac{1}{2} P \bar{\infty}$ (102), occur and in addition (*i*) $\frac{1}{2} P \bar{\infty}$ ($\bar{1}02$) and the rarer forms (*o*) $\frac{1}{3} P \bar{\infty}$ ($\bar{1}03$) and (*w*) $-2 P \bar{2}$ (211).

Fig. 5.

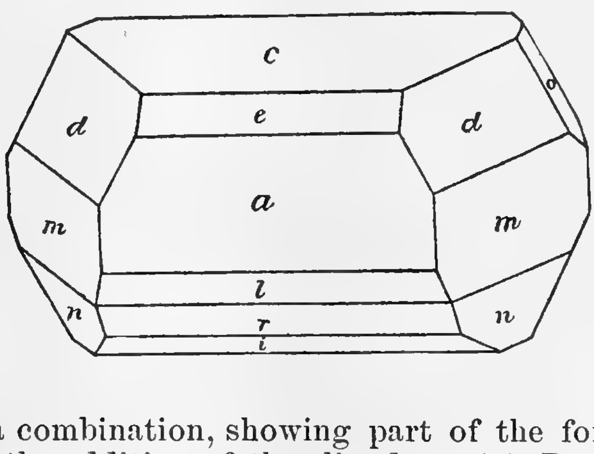

Fig. 5 is a combination, showing part of the forms shown in Fig. 4, with the addition of the clinodome (*o*), $P \grave{\infty}$ (010).

The following is a list of the angles measured and calculated:*

Faces.	Angles meas.	Angles calc.
001 : 100	65°2′	64°59′
001 : 101	34°50′	34°53′
001 : 102	22°36′	22°36½′
001 : $\bar{2}$01	89°2′	89°1′
001 : $\bar{1}$01	63°26′	63°24′
001 : $\bar{1}$02	34°15′	34°15½′
001 : $\bar{1}$03	21°22′	22°10′
001 : 011	58°5′	58°2⅔′
011 : 111	52°8½′	52°9′
001 : $\bar{1}$11	74°50′	74°49′
100 : 101	29°56′	30°6′
100 : 210	35°42′	35°5¾′
100 : 111	49°35′	49°40′
100 : 211	34°9′	34°15′
100 : 110	54°26′	54°34′
100 : $\bar{2}$01	25°59′	26°
210 : 110	19°23′	19°28¼′
111 : $\bar{1}$11	61°41′	61°38′
102 : 101	12°18′	12°16½′
$\bar{2}$01 : $\bar{1}$01	25°27½′	25°37′
$\bar{1}$01 : $\bar{1}$02	28°13′	28°8½′
$\bar{1}$02 : $\bar{1}$03	12°27′	11°56½′
211 : 111	15°8′	15°25′

Reflections were so poor in some cases that only approximate readings could be made, but a sufficient number of these readings were taken to establish with certainty the identity of all the forms.

Much assistance has been rendered by Prof. J. F. Kemp, of Columbia College, by suggestions and by the loan of crystals

* E. S. Dana, New System of Mineralogy, 1892, Allanite, p. 522.

which he collected. The writer takes this opportunity to express his acknowledgments.

Discussion.

Prof. Kemp remarked on the general presence of this mineral containing the rare earths of the cerium group, along the white limestone belt of Sussex county, N. J., and Orange county, N. Y., in association with granite intrusions.

A Pleistocene Lake-Bed at Elizabethtown, Essex County, New York.*

By Heinrich Ries.

The drift deposited by the ice sheet in its passage over New York formed in many instances dams across the valleys, causing an interruption of the drainage, with the consequent formation of lakes. Some of these still remain, but the majority of them have been obliterated by sedimentation or the lowering of their outlets, so that at the present day Pleistocene lake-beds may be seen in many of the valleys of the State. They are very numerous in Southern New York and also in the Adirondacks.

While engaged at field work in Essex county with Prof. Kemp last September, I was most forcibly impressed with the large number of these lakes of obstruction, as well as the beds of previously existing ones. Emmons [Geol. of N. Y., Part IV., p. 212] says: "There are about one hundred lakes in Essex county, most of which are small. They diversify the surface of the country, and impart a great variety to its scenery, but contribute considerably to diminish its temperature. They are not evenly distributed over the country, but are collected in small clusters about the different summit levels in different portions of the county. Most of them are small and narrow, and instead of occupying shallow basins scooped out of the softer materials as earths or ordinary slates and shales, they lie in chasms formed by the uplifts and fractures in the primary rocks."

On account of the narrowness of these fault valleys, which Emmons mentions, a comparative small amount of drift was necessary to form an obstruction across them, backing up the water of the stream and forming a lake. If the lake thus formed is small and shallow, a section of its bed simply shows successive layers of sand or silt, but if it be of considerable size

* Published by permission of Prof. James Hall, State Geologist.

and depth we find the lake-bed proper composed of layers of fine clay and sand while at the shore line the tributary streams have built their deltas.

One of the best examples of lake-beds that I noticed was at Elizabethtown, Essex county, N. Y. The town is situated in the broad, flat valley of the Bouquet River, or Russian Valley, as it is called, seven miles from Westport and five hundred feet above the level of Lake Champlain. About three and one-half miles south of Elizabethtown is New Russia, and one mile south of it the valley broadens and continues so until just north of Elizabethtown, where it narrows suddenly, the river flowing northward between Raven's Peak and Wood's Hill. It is at this point that the dam of drift probably was which caused the lake, but, on account of the steep sides of the valley, little or none remains. The outlet of the lake must also have been through this valley.

The present bottom of the valley between Elizabethtown and New Russia is from half a mile to a mile across, so that the lake must have been at least this wide, while its depth in places was one hundred feet or even more, as the level of the valley is 540 feet, while the shore line is 660 feet. The clay forming much of the lake-bed is exposed in the gullies by the roadside near Elizabethtown, and also at the base of the delta sections.

Emmons had noticed the character of the deposits in this valley, for he says:* "Upon the bouquet is a wide and level plain which has received the name of the valley; it might be called the Beautiful Valley of the Bouquet. It is truly one of great beauty when taken in connection with the high and alpine range, which bounds it on the west, and which forms the main chain of mountains of the northern counties. This valley is bottomed upon thick beds of clay, gravel and sand. The clay appears to be the same as that upon the lake, and I have been told that shells or fossils have been found in it. I am not able to verify this statement, but still have some confidence in it." No shells were found by the writer in the clay. It is also hardly possible to consider it as belonging to the estuary deposits of the Champlain Valley, for this would indicate a post-glacial submergence of 540 feet, a far greater one than we have any record of in this region.

The deltas formed by the tributary streams are quite extensive. There are two a mile south of Elizabethtown, one on either side of the valley. The largest delta terrace, however, is that on which Elizabethtown stands. It was formed by the Branch

* Geol. of N. Y., Part IV., p. 212.

which enters the valley from the west. The thickness of the delta deposit is about forty feet, and the materials composing it are sand and cobbles up to six inches in diameter, these latter being mostly the different forms of norites and gabbros. At the base of this section is reddish clay. Barton Brook, which enters the extreme northwest corner of the valley, has also deposited considerable coarse material about its mouth.

To sum up there was in Russian Valley a lake five miles long and one-half to one mile wide, and one hundred feet deep. The lake was caused by the formation of a dam of drift between Raven's Peak and Wood's Hill, which was gradually cut down by the Bouquet River, the outlet of the lake.

We can at the present day see all the stages of transition from the lake, as originally caused by the dam of drift, to the flat-bottomed meadow or vly, the old lake bed. Lake Placid may be instanced as a lake formed by a wall of drift. Another is Long Pond, four miles south of North Elba. It is about one thousand feet long, and lies in a narrow fault valley, its outlet being over a wall of drift at the north end. The first step in the obliteration would be either the filling of the pond with sediment brought in by tributary streams or the cutting down of the outlet. These causes may be acting singly or at the same time. Lake-filling is going on actively in many localities, and has been described in detail by Prof. Smyth,* of Hamilton College, who has observed the filling of lakes in Hamilton county.

Little Pond two miles northeast of New Russia is decreasing in size due to the formation of a swamp around its outlet. The streams flowing into Lincoln Pond two miles farther south have brought in so much sediment that the pond is now only one-third its former size. Finally we have the lake completely destroyed and only a flat, swampy meadow is left, as in the case of Russian Valley and many others.

Columbia College, November, 1893.

The paper was illustrated by lantern views.

"On the Stratigraphical Relations of the Bed which yields the *Triarthrus Beckii* with appendages," by W. S. Valiant. Read by G. Van Ingen.

"Notes on the Fossil Fish in the State Museum at Frankfort, Ky.," by Dr Bashford Dean.

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*Amer. Geol., February, 1893.

December 4th, 1893.

REGULAR BUSINESS MEETING.

PROF. H. F. OSBORN in the chair and twenty-two persons present.

SECTION OF BIOLOGY.

The following papers were presented:

"Restorations of the Lower Miocene Mammals," by Prof. H. F. Osborn.

"An Improvement of the Golgi Staining Method," by O. S. Strong.

"PROF. E. B. WILSON gave an account of his method of preparing sections of the testis of the common lobster.

The following papers were read by title:

"A Revision of the North American Cichlidæ," by Carl H. Eigenmann and William L. Bray.

"Notes on some South American Fishes," by Carl H. Eigenmann.

December 11th, 1893.

STATED MEETING.

PROF. O. P. HUBBARD in the chair and twenty-four persons present.

The following paper was read by title:

The Gross Anatomy of the Kidney of Elephas Indicus.*

BY GEO. S. HUNTINGTON.

The specimen recently dissected at the anatomical laboratory of the College of Physicians and Surgeons was a young female, about five feet high, affording excellent opportunity for comparison with the specimen dissected by Miall and Greenwood,

* First presented before Section of Biology, May 8, 1893.

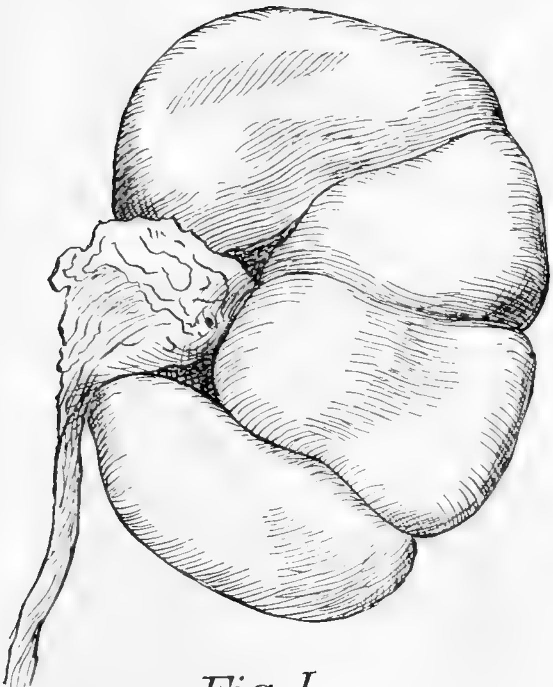

Fig. I

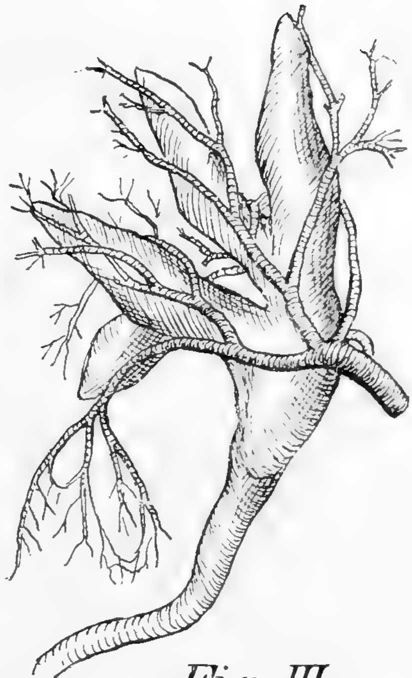

Fig. III.

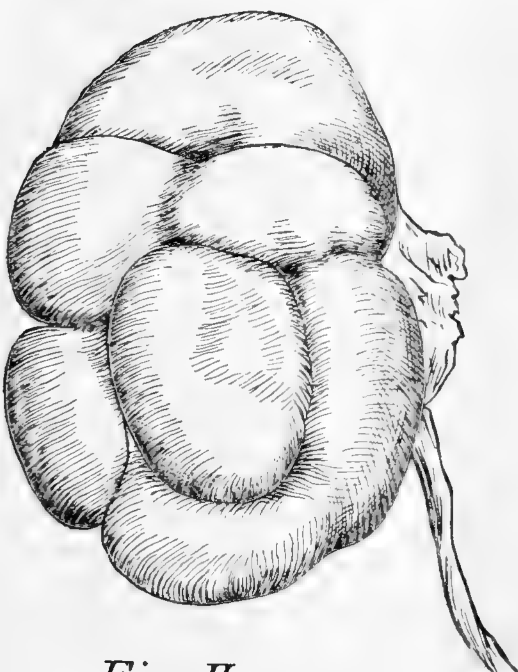

Fig. II

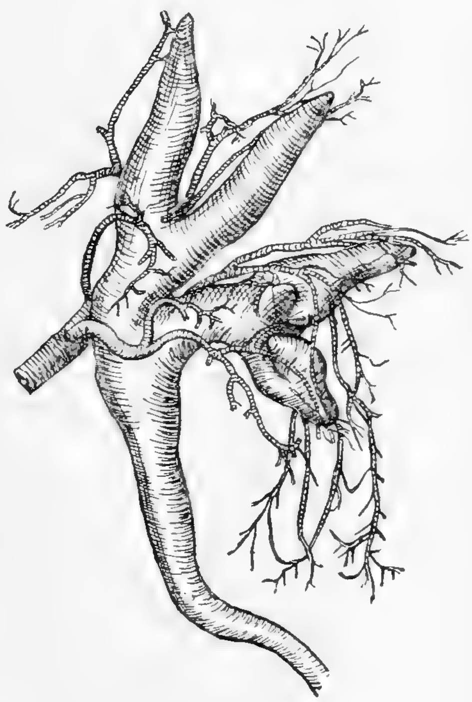

Fig. IV.

ANATOMY OF THE KIDNEY OF ELEPHAS INDICUS.

of the same sex, and about of the same age and size, which these authors have described in their memoir on "The Anatomy of the Indian Elephant."*

Such comparison of results obtained by the examination of similar individuals is all the more desirable, as the published accounts reveal much discrepancy in reference to a number of structures. More especially does this apply to the gross anatomy of the urinary organs. I beg, therefore, to present to the Section this evening the results of our observations on the kidneys of our specimen, and to demonstrate the preparations consisting of a corrosion of the right ureter and renal artery, and of the alcoholic preparation of the left kidney.

The kidneys of the Indian elephant occupy a marked retro-peritoneal position opposite the thirteenth to the sixteenth rib, bearing vertebræ. After removal of the other abdominal contents, the surface of the posterior abdominal wall at the site of the kidneys is entirely smooth, and even slightly concave forwards, in conformity with the curve of the surrounding abdominal parietes on each side of the vertebral prominence.

The firm, thick and dense peritoneum stretches across the anterior surface of the organs, separated from them by a quantity of exceedingly firm and tough sub-peritoneal connective tissue, in which they lie imbedded, and which forms a prominent and characteristic feature of all the serous cavities of this species.

The kidneys are placed nearly parallel with the vertebral column. The abdominal surfaces are turned slightly outwards, and the long axes converge somewhat at their anterior or cephalic extremities.

The two kidneys were of nearly equal size, and presented a similar number and arrangement of lobes. The left kidney weighed 1066 gms., and measured 23.2 cm. in the greatest cephalo-caudal or antero-posterior,† 14 cm. in the greatest transverse, and of 7.3 cm. in the greatest dorso-ventral or verticaldiameter. The caudal pole of the organ is somewhat greater in transverse and dorso-ventral measurement than the cephalic extremity. The hilus is at the centre of the vertebral border, occupying the medial one-quarter of the central third of the ventral surface of the kidney.

The main renal vein is placed dorsally, together with some smaller arterial branches. The main artery is situated ven-

* L. C. Miall and F. Greenwood, "Anatomy of the Indian Elephant." Studies in Comparative Anatomy, No. II., London, 1878.

† Measurements and directions refer to the site of the organs in the normal quadruped position.

trally, with the ureter between and somewhat caudad of the two vessels.

The kidney presents a lobulated appearance (Figs. I. and II.), being divided into six lobes which are arranged as follows: Two large lobes form respectively the cephalic and caudal extremities of the organ; of these the cephalic lobe occupies nearly the same area on the ventral and dorsal surfaces, while the caudal lobe extends with a tongue-like process further cephalad on the dorsal than on the ventral surface, along the vertebral border of the kidney. Of the remaining lobes two are placed centrally on the ventral surface (Fig. I.), corresponding to nearly two-thirds of the caudo-cephalic measurement of the organ, and constituting the entire ventral surface of this portion, but extending around the lateral convex border only sufficiently to form about the lateral one-third of the dorsal surface between the polar lobes. The remaining two-thirds of this intermediate or central segment of the dorsal surface is formed by two smaller, somewhat pentagonal lobes, and, along the medial border, by the tongue-like extension cephalad of the caudal polar lobe.

This arrangement of the lobes, the position of the hilus, etc., is exhibited in Figs. I. and II., Fig. I representing the ventral and Fig. II. the dorsal view of the left kidney.

The sulci separating the lobes are bridged over by the same firm areolar tissue which forms the superficial investment of the entire organ. A number of small capsular vessels, imbedded in this same tissue, leave and enter the substance of the organ in the sulci.

The published accounts of the gross anatomy of the Elephant's kidney differ much as to the number and distinctness of the lobes, from two to eight or nine having been reported. Inasmuch as these differences depend in all probability upon the differences in the age of the animals examined, fusion of the lobes occurring in the older specimens, it is interesting to note that Miall and Greenwood* describe five lobes, which practically corresponds to what we find in our specimen of approximately the same age, as the sulcus which upon the dorsal surface separates the smaller (cephalic) pentagonal intermediate lobe from the dorsal extension of the ventral cephalic intermediate lobe is but slightly developed (Fig. II.) and apparently in process of obliteration, which would reduce, when completed, the number of lobes in our specimen to five, the number which Miall and Greenwood describe.

In regard to the number and arrangement of the calyces and

* Loc. cit., p. 67.

their mode of connection with the ureter, another point where much discrepancy exists in the published accounts, the corrosion preparation of the right kidney (Figs. III. and IV.) gives the best information. Fig. III. shows the corrosion of the ureter and renal artery in the ventral and Fig. IV. in the dorsal view.

The ureter, after dilating into a moderate sized pyriform pelvis, divides dichotomously at an angle of about 35° into two main branches, or primary calyces, each of which again subdivides into two at about the same angle as in the primary bifurcation of the ureter (35°). The upper primary calyx carries on its superior subdivision two closely united secondary or terminal calyces, the lower subdivision presenting also two secondary calyces, one apical, the other lateral.

The inferior and somewhat larger primary calyx divides into two short branches, each of these again subdividing into two secondary terminal calyces.

The entire number of terminal calyces is therefore eight, arranged in conformity with the fact that the greatest bulk of the organ is placed at the caudal pole, as indicated by the close apposition of the calyces in the two cephalic pair, compared with the wider separation of the calyces forming the two caudal pair.

Miall and Greenwood describe a separate calyx for each of their five lobes, and state* that "the calices of the three anterior lobes united to form a common canal, which, after a course of about three inches was joined by a similar tube formed by the union of the two posterior calices. Here the ureter was much dilated."

An examination of our specimens shows that without resort to the demonstration by corrosion, it would be extremely difficult to determine the actual number of terminal calyces on account of their close juxtaposition and the small size of the fornix. Especially is this true of the calyces attached to the cephalic primary division of the ureter. It is possible, that Miall and Greenwood's examination, after the ordinary method, failed to reveal quite accurately the actual number of calyces. The eight secondary calyces of our six-lobed specimen were arranged in such a manner that the close opposition of the calyces in the two cephalic pair would, perhaps, without examination by corrosion, have led to the erroneous counting of six secondary calyces, by regarding the two cephalic pair as single calyces, thus agreeing with the surface division into lobes. The actual condition, however, indicates the original eight-lobed composition of the kidney, the surface markings being reduced in the usual manner in the course of further development to six.

* Loc. cit. p. 67.

SECTION OF GEOLOGY AND MINERALOGY.

The following papers were read:

"Notice of an ancient Beaver Pond at Plainfield, N. H.," by O. P. Hubbard.

"Notes on the Trenton Limestones in the Lake Champlain Valley," by Gilbert Van Ingen.

A NEW CLADODONT FROM THE OHIO WAVERLY CLADOSELACHE* NEWBERRYI, N. SP.

BY BASHFORD DEAN.

(PLATE 1.)

Among the fossil sharks secured by Prof. Newberry, now in the possession of Columbia College, the writer finds an undescribed specimen which proves of considerable interest. It appears to have been collected by Rev. Dr. Kepler, near Linton, Ohio, about 1890, and when received together with other and better material was regarded by Dr. Newberry as an immature specimen of "*Cladodus*" (*Cladoselache**) *fyleri*. It is lacking in counterpart.

The fossil presents for examination the following parts: Visceral (?) aspect from near the tip of snout to hinder region of trunk (cf. in accompanying Fig. III.); a well preserved pectoral fin, muscle plates, the basal cartilages of a ventral fin, and in visceral region a well marked coprolite. The specimen measures in its widest part three, and in axial length thirteen inches. The length of the pectoral fin is two inches, its breadth one and one-half.

This fin, accordingly, is but about one-third (in linear measurement) the size of the pectoral of *Cladoselache fyleri*, but differing but slightly in its structures, the fossil might readily be assigned to this species. General proportions of the body, prove, however, to be widely unlike those of *fyleri*, and these together with the minor differences in fin structure might reasonably be taken as characteristic of a new species. The specific name the writer would dedicate to Dr. Newberry as the first describer of *Cladodonts*.

* Cf. in current number of American Journal of Morphology the characters of this genus, as discussed by the writer, also, Trans. N. Y. Acad. of Sci. Vol. XII., p. 121, 1893.

Cladoselache newberryi proves of interest in its relation to Acanthodian, and in this regard will later be discussed.

It differs from *Cladoselache fyleri* in proportions, and in fin characters. In the former regard the fossil permits the following body distances to be taken for contrast: (a) length and breadth of pectoral; (b) distance of pectoral from centre of orbital ring; (c) distance of ventral from pectoral; and (d) body breadth. To establish this contrast the proportions of *fyleri* were first determined. These proportions, drawn to scale in the accompanying figures, I. and II., were taken in the first instance from a perfect example of this species whose structures have been figured in the current number of the Journal of Morphology. The tabular measurements, then compared with those taken from the type specimens of *fyleri*, were found to be remarkably uniform. Slight allowance, however, is doubtless to be made for distortion of body breadth. Axial percentages and fin proportions are constant.

In the following table the proportions are expressed:

CLADOSELACHE FYLERI.

Position and proportion of body parts expressed in percentage of axial length:

(Total length, axial, snout to tail tip,	100)
From snout to centre of orbit,	5
" hind end of mandible,	12
" origin of pectoral,	22
" tip of pectoral (measured axially),	26
" caudad margin of pectoral,	36
" origin of ventral,	57
" tip of ventral,	61
" caudad margin of ventral,	67
" anterior margin of caudal,	92
Span of pectorals,	35
" ventrals,	14
Height of caudal,	24
Greatest apparent width of trunk,	15
Proximo-distad length of pectoral,	14
" " ventral,	4

In contrasting *newberryi* with *fyleri* the distance from orbit centre to origin of pectoral fin may conveniently be taken as a unit of proportional measurement. In terms of this unit of proportion the percentage distances of both species may first be determined.

The proportions of *newberryi*, when reduced, may then be expressed in the terms of the former species, thus:

	fyleri.	*newberryi.*
Distance from centre of orbit to origin of pectoral (unit of comparison),	1	1
Length of pectoral, measured axially	1	$\frac{3}{5}$
" " proximo-distad,	1	$\frac{3}{5}$
Distance from hinder margin of pectoral to origin of ventral,	1	$\frac{9}{5}$
Greatest apparent breadth of trunk,	1	1

It will accordingly be seen that Cladoselache newberryi was proportioned not unlike the recent eel-like frilled shark, Chlamydoselache. It differed from other known Cladodonts in the smaller size of the pectoral fins and the greater interval between the paired fins (cf. Fig. III.). The snout, only in part preserved in the fossil, seems to have been longer than that of *fyleri.* The head at eye region appears notably broad.

In addition to these differences in proportions, *newberryi* is readily distinguished by the structure of its pectoral fin (see Fig. IV.). Although the fin rays agree substantially in number and relative sizes, their mode of arrangement is clearly different from that of *fyleri;* the rays are notably compacted antero-posteriorly, and have lost to some degree the graceful curve in their placement. They have thus become set rigidly almost at right angles to the fish's axis, and in their straightness and compactness, their row of graded sizes appears clearly suggestive of the fin spine of Acanthodian. The entire fin is narrower and more acutely pointed than that of *fyleri.*

Circum orbital plates, although not perfectly preserved in the fossil, are relatively larger than those of *fyleri*, and appear less numerous, doubtful in this character perhaps on account of imperfect preservation (Fig. VIII.).

The basalia of the left ventral fin are imperfectly preserved (Fig. V.). Their number and position, however, vary but little from the conditions of *fyleri.* Six basalia are to be determined.

Near by, anteriorly, is the impression of what must be regarded as a coprolite, while still further forward (Fig. III., A) is an entire coprolite well preserved. The latter (Fig. VII.) is especially interesting since it furnishes a cast of the intestinal wall and gives definite evidence as to the presence of a spiral valve. This structure, accordingly, maintained in the generalized Cladodont; and that the intestinal septa were here low and numerous is most significant phylogenetically. Its condition in this form, as the nearest known ancestor of Selachians, would, moreover, give an additional reason for emphasizing the most ancient origin of Dipnoan, Teleostome, and even Chimaeroid. The coprolite seems remarkably small in comparison with the total body width of the specimen; its striæ are six in number, and are somewhat irregularly disposed, the hindmost one notably furthest from its fellows.

Myomeres are well shown in the fossil in the regions indicated (Fig. III., C. C. C.); a figure here given illustrates their coarse longitudinal striation (Fig. VI.).

The especial interest which Cladoselache newberryi presents is in its Acanthodian features. It advances clearly from the known Cladodont forms along the line of specialization. It is in the first place a form of smaller size, of but somewhat more than half the length of *fyleri* and less than one-third that of *kepleri*. Its pectoral fin is narrower and more acutely pointed, better adapted to a more specialized function; its radials becoming straighter and more compressed are strongly suggestive of the elements of the fin spine of Parexus. Enlargement in size of the circum-orbital plates (with probable decrease in their number) is finally to be noted in its Acanthodian bearing.

Mr. Arthur Hollick made the following remarks on the paper:

One part of Dr. Dean's investigations throw an unexpected flood of light upon a matter in which I am much interested, and in regard to which there has always been a great diversity of opinion.

I refer to certain peculiar screw-like fossils which have been described from time to time, both from this country and abroad, under the names *Spiraxis*, *Spirangium*, *Palæoxyris*, *Palæo bromelia*, *Fayolia*, etc. It may, perhaps, be remembered that Dr. Newberry described two species from the Chemung sandstone, under the names *Spiraxis major* and *Spiraxis Randalli*, in the Annals of the Academy (Vol. III. (1855) 217–220, Pl. XVIII.). His descriptions and figures and the type specimens upon which they were founded are here for comparison, and we can hardly doubt that they are identical with the coprolite figured by Dr. Dean from the intestine of the shark.

These fossils have been referred by different investigators to *Xyris*, *Bromelia*, *Chara*, stems of algæ, etc. Dr. Newberry did not venture any positive opinion as to their affinities, but mentioned incidentally their possible reference to algæ or sponges.

Upon examining Dr. Dean's drawing I was at once struck by the remarkable likeness between the coprolite and *Spiraxis*, and comparison of the specimens satisfied us both they represented similar fossils.

Of course we can not say that all the fossils mentioned may be referred to the same source, but in regard to the specimens from the Chemung there can hardly be any doubt, and as all or nearly all the others are likewise from rocks representing geological horizons in which sharks were plentiful, we may at least assume the probability of a similar origin for all. The matter, however, was only called to my attention two days ago, so that there has been no opportunity for anything like careful research, and we must leave any extended dissertation upon the subject until some future time, merely placing the fact of the comparison upon record.

Explanation of Figures.

Fig. I. *Cladoselache fyleri*, Newb. A restoration drawn to scale according to measurements of type specimens ($x\frac{1}{7}$). The number of gill clefts, of which seven are figured, is here at the best approximate. Eight or nine may well have been present. The horizontal keel at the base of the caudal is represented by shading. The dorsal (?) fin is not definitely known.

Fig. II. *C. fyleri*, Newb. Ventral aspect. The condition of the gill clefts ventrally has not been determined; there is reason to believe that the anterior isthmus-flap was considerably larger than here indicated, and like that of the recent *Chlamydoselache*, may have extended caudad so as to protect the hinder clefts. The body width, if allowance be made for distortion in fossilization, is perhaps more accurately expressed by the maginal dotted lines. In ventral aspect the horizontal caudal keel is indicated by shading.

Fig. III. *C. newberryi*, n. s. Ventral aspect. The right pectoral fin, together with outlines of ventrals, has been added. The left mandibular ramus and the hinder margin of the isthmus-flap are visible in the fossil. ($x\frac{1}{4}$).

A. Coprolite (cf. Fig. VII.).

B. Basalia of left ventral (cf. Fig. V.).

C. Myomeres (cf. Fig. VI.).

Fig. IV. *C. newberryi*. Pectoral fin (x1). Radialia straighter and more compressed antero-posteriorally than in *fyleri*: fin's body-length shorter.

Fig. V. *C. newberryi*. Basalia of ventral fin. These, although poorly preserved in the present specimen, agree in position with similar structures in *fyleri*.

Fig. VI. *C. newberryi*. Myomeres (x1).

Fig. VII. *C. newberryi*. Coprolite (x1) showing well marked impression of spiral valve.

Fig. VIII. *C. newberryi*. Circum-orbital derm plates (x1).

Professor J. F. Kemp exhibited a series of thin sections of typical rocks by the lantern with polarized light.

December 18, 1893.

STATED MEETING.

Professor D. S. MARTIN in the chair, and ten persons present.

SECTION OF ASTRONOMY AND PHYSICS.

Mr. Harold Jacoby presented the following:

Report on the Meeting of the National Academy of Sciences.

The National Academy of Sciences met in the Capitol at Albany, November 7–9. The papers presented included one by Dr. S. C. Chandler, entitled "Additional researches on the motion of the earth's pole." Dr. Chandler finds that the most recent observations obtainable (some still unpublished) confirm the doubly periodic law deduced by him. He showed that the two separate motions of the pole both take place from west to east. Dr. Chandler's paper was discussed by Professors Hall, Newcomb and Boss. They all expressed themselves as now favoring the truth of Dr. Chandler's law of variation. Professor C. S. Hastings read a paper on "A new form of telescopic objective, as applied to the twelve-inch equatorial of the Dudley Observatory." The principal characteristics of this instrument are: First, that one of the "ghosts" is made to coincide with the focal plane, thus rendering it harmless; and second, that the transformation from a visual to a photographic telescope is accomplished by substituting a second glass for one of the lenses of the visual combination, instead of adding a third lens. Professor Asaph Hall read a short paper on "Double stars." Professor Charles L. Doolittle (introduced by Professor Boss) communicated a paper, "Latitude determinations at the Sayre Observatory," but was unable to be present in person.

During the afternoon of November 8 the members of the Academy visited the new Dudley Observatory by invitation. The completed observatory was opened for inspection, and an address was made by Professor Simon Newcomb.

Notice Concerning the Motion of 61 Cygni.

The Sitzungsberichte of the Berlin Academy of October 26 contain the announcement by Dr. J. Wilsing of an observed variation of short period in the distance of the components of 61 Cygni. A series of photographic plates for the determination of the parallax of this star was begun at Potsdam in the autumn of 1890. In the course of the reduction of these measures it was found that certain discordances existed between the parallaxes derived from different comparison stars. These discordances could not be accounted for on the ground of errors of observation, nor did the measures of the comparison stars themselves show evidence of a difference between their own respective parallaxes. Dr. Wilsing was, therefore, led to suspect the presence of one or more unknown bodies in the system, and to investigate by observation the effect upon the distance between the two visible components. Great care was taken to eliminate from the results all sources of error known to affect photographic observations, and the reductions were carried out with all necessary precision. The series of observations extended from 1890, October, to 1893, September. A table is given showing the results suitably grouped in means. They have all been corrected to 1891 .0 for proper motion by assuming that the continuous yearly increase of the distance is 0. ″10.

A comparison of the numbers in the table shows that the systematic differences are too large in comparison with their probable errors to be taken as the result of errors of observation. Dr. Wilsing gives also a graphical representation of the observations by means of a curve. He concludes finally that the distance of the two visible components of 61 Cygni is subject to a fluctuation as great as 0. ″3, and having a period not far from 22 months. Systems of this kind, he thinks, offer a connecting link between the spectroscopic and visual binary systems.

Mr. Harold Jacoby also read:

"Some recent papers on the reduction of astronomical photographs."

This paper will be contributed to the Astronomical Journal.

Professor Rees gave a brief account of the work now being carried on for making a photographic catalogue and a chart of the heavens. His remarks were illustrated by lantern slides showing the photographic telescopes and the measuring micrometers used for the purpose.

Mr. Post exhibited a number of plates of the Pleiades and β Cygni which he had made at his observatory at Bayport, L. I. He intended to measure these plates, in order to compare their accuracy with that attained by Rutherfurd and other astronomers.

Regular Business Meeting.

January 8th, 1894.

There was no quorum present for the transaction of business.

Prof. D. S. Martin remarked on the present rates of postage on natural history specimens, and the earnest desire of students for their modification.

Stated Meeting.

January 15th, 1894.

Prof. J. K. Rees in the chair and twenty-four persons present

Section of Astronomy and Physics.

Prof. M. I. Pupin read a paper on "Electrical Resonance," illustrated by experiments.

Stated Meeting.

January 22d, 1894.

Dr. E. S. F. Arnold in the chair and twenty-seven persons present.

Section of Geology and Mineralogy.

The following papers were read:

"Observations on an Auriferous Deposit in Buckingham county, Va.," by Prof. P. deP. Ricketts.

"Account of the American Museum of Natural History Field Expedition of 1893," by Mr. J. L. Wortman.

Some Further Notes on the Geology of the North Shore of Long Island.

BY ARTHUR HOLLICK.

In two previous contributions* I gave accounts of what was known or inferred in regard to the geological history of Long

*"Plant Distribution as a Factor in the Interpretation of Geological Phenomena, with Special Reference to Long Island and Vicinity." Trans. N. Y. Acad. Sci. 12: 189-202 (1893). "Preliminary Contribution to Our Knowledge of the Cretaceous Formation on Long Island and Eastward." Trans. N. Y. Acad. Sci. 12: 222-237, *pl. 5-7* (1893).

Island and the occurrence there of material representing the cretaceous formation. Accompanying the latter of these were descriptions and figures of several well recognized cretaceous leaves, selected from a large amount of material collected by me and others at Lloyd's Neck, in the vicinity of Glen Cove and in Brooklyn.

Since these were published I have been enabled, in connection with the summer school of geology of Columbia College, to extend the investigation further eastward along the north shore of Long Island and on to Martha's Vineyard. The results obtained at this latter locality have already been published* and all the palæobotanical material from Long Island has been described and discussed, either in the second contribution previously mentioned or in the Bulletin of the Torrey Botanical Club. †

The present paper is designed to further discuss some of the geological problems previously outlined, in the light of some new facts observed.

I shall assume that the existence of cretaceous material on Long Island can no longer be questioned, in view of the facts already brought to light, and that we may now confine ourselves to the discussion of phenomena in connection with it, such as distribution, method of occurrence, associated rocks and their derivation, etc.

Briefly stated, the hypothesis previously advanced is that the entire area now occupied by Long Island Sound, was, until the advent of the Ice Age, dry land, representing a portion of the Atlantic coastal plain, composed of cretaceous and post-cretaceous strata. The continental glacier, upon reaching this easily eroded material, plowed it up and pushed it forward, leaving it as part of the terminal moraine, while the area eroded remained as a great trough, which, becoming filled with water, we now know as Long Island Sound. The material pushed forward exists to-day as the contorted clays, sands and gravels, buried beneath the bowlder till, while the fragmentary eroded material is represented by the more or less hardened ferruginous conglomerates, sandstones, shales and concretions which are scattered through the moraine and in which have been found the evidence of their cretaceous origin.

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* "Observations on the Geology and Botany of Martha's Vineyard." Trans. N. Y. Acad. Sci. **13**: 8–22 (1893).

† 1. "A New Fossil Palm from the Cretaceous Formation at Glen Cove, Long Island." Bull. Torr. Bot. Club, **20** : 168, 169, *pl. 149* (1893).

2. "Some Further Notes upon Serenopsis Kempii." Bull. Torr. Bot. Club, **20**: 334, 335, *pl. 166* (1893).

3. "Additions to the Palæobotany of the Cretaceous Formation on Long Island." Bull. Torr. Bot Club, **21** : 49-65, *pl. 174-180* (1894).

The region traversed was along the shore from Northville, near Jamesport, to Glen Cove, a distance of about fifty miles, following the curve of the Sound. The actual distance covered, however, was much greater, on account of the numerous inlets, which often necessitated long detours of five or ten miles in order to visit localities perhaps not more than a mile or so apart, on the extremities of the long projecting necks of land.

The principal object in view was to ascertain, if possible, the limits within which cretaceous material could be found. I had previously traced such material from New Jersey through Staten Island and along the north shore of Long Island to as far east as Dosoris Island, in the vicinity of Glen Cove, and the fact that such material was also found on Martha's Vineyard and that the accompanying geological phenomena were identical throughout, led me to infer that similar conditions must prevail in the intermediate area.

I shall begin with an account of the facts noted and follow it with a discussion of their significance.

So far as the clays are concerned we may dispose of them in a few words. Absolutely no palæontologic evidence of their age was obtained, except at Glen Cove, as previously described. Leaf fragments have however been obtained from them at Northport, by Mr. Heinrich Ries, and from Cold Spring, according to specimens in the collection of the Long Island Historical Society, but they are too fragmentary to serve as criteria for the determination of the age of the clays in which they were found. The fact of their occurrence at these localities however should encourage further search.

The material previously mentioned, consisting of ferruginous sandstones, shales, &c., scattered through the moraine, was the special subject to which I directed my attention, as it had heretofore proved to be of the greatest value. At Northville not a fragment of it was found, and indeed it does not seem to enter to any extent into the composition of the moraine along the Sound shore, until, proceeding westward, the vicinity of Port Jefferson is reached. At this locality I found numerous fragments which were lithologically similar to the material in question, but they were mostly very coarse sandstones or conglomerates, and I failed to find any definite plant remains in them.

The first locality in which well defined fossil leaves began to appear was on Eaton's Neck, and from thence westward they constantly increased in abundance, until the maximum was reached in the vicinity of Glen Cove.

The general character of the moraine was also found to vary from place to place in a most striking manner. At Northville there is little true bowlder till, large bowlders are scarce and clay is absent. Most of the morainal material is more like coarse water-worn gravel, quartzose and granitic in composition, with numerous fragments of triassic sandstone. Further westward both the amount of till and the number and variety of the large bowlders increases. Shales and limestones begin to be represented among them and calcareous pebbles enter into the composition of the gravels. On Oak Neck I found a bowlder, containing *Spirifera macropleura* and *Strophomena radiata*, referable to the Helderberg.

As a rule the cretaceous drift material seems to accompany the bowlder till and where the latter is absent the former is absent also. Or perhaps it would be better to say that where bowlder till is well represented is where we may expect to find the cretaceous drift material in greatest abundance.

One other element remains to be considered, viz: The gravels which presumably represented the pliocene or pleistocene deposits of the coastal plain. These are recognized as the "yellow gravel" or "pre-glacial drift" of New Jersey, and they occur mixed up in the moraine both there and on Staten Island. The determination of their occurrence on Long Island would largely depend of course upon the ability to recognize and differentiate them from other gravels, and this is not always an easy matter to accomplish. Lithological characteristics are of little value, and color can not be depended upon, as the prevailing yellow color is dependent upon the action of ferruginous waters, which gives them a more or less superficial coloring of the oxide, and this may be, and often is, reduced by the action of decaying vegetation, so that the gravels again appear colorless.

Practically the only characteristic which can be relied upon is the presence of silicified palæozoic fossils. These have served as criteria for the identification of the "yellow gravel" wherever found, and hence I maintained a close search for them in all the gravel accumulations, whether stratified or unstratified.

Proceeding westward from Northville I first found these fossils on Lloyd's Neck. From thence to Glen Cove, however, they were quite abundant. Many of them are not thoroughly silicified, and their origin from former calcareous rocks is quite apparent. At times they are white, again they are characteristically yellow, the color or its absence seeming to be merely incidental and dependent upon the causes previously indicated. At Glen Cove there are great accumulations of white sand and gravel accompanying the cretaceous clays, the whole series much contorted by glacial action; but as many of the pebbles contain the characteristic silicified fossils we can but consider them as identical, at least in part, with the typical "yellow gravel" of the plains on the south side of the island and with that of Staten Island and New Jersey. Such being the facts let us now endeavor to understand their significance and the inferences which we may be justified in drawing from them.

Bearing in mind the hypothesis previously outlined, suppose we hypothetically extend the present clay belt of New Jersey, averaging some 6–7 miles in width, eastward, parallel with the present New England coast, which we must assume was the old shore line of the former coastal plain. The southern limits of such a belt would curve through Raritan Bay and reach the south shore of Long Island near Rockaway Inlet. From here it would cross the island diagonally to the vicinity of Lloyd's Neck and from thence would curve into the Sound, after which the indications are that it became narrower,* and hence would not again be represented on the island. South of this would be the marl belt and south of this the tertiary, the limits of both of which might be extended in the same way.

We ought therefore to find the evidences of the cretaceous clay belt on Long Island from the vicinity of Lloyd's Neck westward, and such as we have seen is the fact. Practically all the cretaceous material collected was found in this region, only a single well defined specimen having been found beyond, on Eaton's Neck. Further than this we know that the clays in New Jersey incline towards the southeast with a uniform dip of about 50 feet per mile, so that if the same conditions prevailed throughout all the area formerly occupied by them they could only be represented to a very limited extent on Long Island and would be there profoundly modified by glacial action, that is either contorted and twisted as we find to be the case in the vicinity of Glen Cove, or else buried under subsequent deposits. Their occurrence in connection with the moraine has been amply proven, and we may also here note the fact that clays containing lignite are invariably struck in all deep well borings south of the moraine, although no palæontologic proof of the age of these latter clays has yet been brought to light. From what we know of the stratigraphy of the coastal plain they might be either tertiary or cretaceous, according to the depth at which they

* The indications of such narrowing are to be found in the fact that on Martha's Vineyard both cretaceous and tertiary material is represented in the moraine, while on Nantucket tertiary material only has been identified. This seems to indicate that the cretaceous belt was so narrowed in the vicinity of the present Vineyard Sound that the tertiary outcrop occupied part of the area, and that it was practically the only formation exposed further eastward. This hypothesis would be still further strengthened if the reported existence of cretaceous marls on the eastern coast of Massachusetts could be proven. The relative positions of the clay and marl belts being such that if the marl belt is represented there the clay belt would not be.

were struck. Assuming the inclination to be the same throughout, however, it may be readily calculated at what depth the cretaceous clays ought to be reached. Thus at Hempsted, seven miles from the theoretical southern limit of the clay outcrop, this outcrop should be at a depth of 350 feet; at Patchogue, 1,000 feet; at East New York, 50–100 feet, &c. It is probable, however, that close to the margin of the moraine the erosion was so great that the original outcrops were removed to a considerable depth and the place formerly occupied by them filled up with water assorted material from the moraine. In this connection the record of a deep well section at East New York, which I am fortunately able to show in miniature, is of great significance. For the first 149 feet only superficial sands and gravels, colored with oxide of iron, were encountered; below that, clay with lignite and white sand began to appear. As no material representing the marl belt was met with, we must assume that this was either normally absent or else had been entirely eroded and replaced by the superficial sands and gravels.

Following a similar course of reasoning the cretaceous clays would not be found outcropping east of Lloyd's Neck and whatever clays might be found in place to the eastward of that locality ought to represent tertiary or post-tertiary horizons. As far east as this locality the cretaceous age of the clays or the material derived from them has been proven; further east than this the proof of their age yet remains to be discovered. Theoretically the moraine from here eastward ought to contain eroded material representing cretaceous, tertiary and post-tertiary strata, and eventually proof of the presence of such material ought to be forthcoming.

Suppose we next consider the significance of the moraina material in general.

As is well known, there are two forks or branches to the moraine on Long Island. The one farthest south forms Montauk Point, and its vanishing remains further eastward are represented by Block Island, Martha's Vineyard and Nantucket. The one farthest north forms Orient Point and extends similarly to Plum Island, Gull Islands and Fisher's Island. They join at about the vicinity of Port Jefferson and from thence westward form a single range of hills. The north branch was considered by Upham* to represent a second terminal moraine, and it may be seen that this supposition is strongly emphasized by some of the facts which I have noted. Thus the bulk of the material which formed the old coastal plain would have been eroded

* Upham.—Warren. "Terminal Moraines of the North American Ice-Sheet." Am. Journ. Sci. 18: pp. 200–209 (1879).

by the first advance of the ice, and would, therefore, be included in the first or southern branch of the moraine. In other words, it should be looked for along the north shore only as far east as Port Jefferson, after which its occurrence would reasonably be expected in the southern or Montauk Point branch. The Orient Point branch ought to consist, following the same course of reasoning, very largely of material left behind in the first retreat of the ice, which would be pushed forward or transported by the second advance. That is, it ought to consist largely of previously eroded and transported material. As I have not traced the southern branch I have had no opportunity to examine the material composing it, but in regard to the northern branch the facts may be seen to be of considerable significance. It consists of water-worn and assorted quartzose and granitic sands and gravels, with but little till and few bowlders, and apparently not a trace of the characteristic ferruginous sandstones, shales and concretions derived from the material of the coastal plain, which are such prominent constituents of the moraine west of Port Jefferson. We have, in other words, just the conditions which would be inferred on the hypothesis of a second advance of the ice sheet. Further than this the rarity of bowlders and till might be expected from the probability that the trough eroded by the first advance of the ice had become filled with water and that in its second advance it would lose part of its load in passing over this body of water. A similar hypothesis, on a more extended scale, was advanced by Merrill* in order to account for the increasing rarity of bowlders and till throughout the entire morainal area east of Roslyn. This, however, involves a discussion of the composition of the southern branch of the moraine, which is not included in this paper.

We may next consider the facts in connection with the "preglacial" or "yellow gravel."

The principal difference of opinion between those who have studied this formation has arisen from the difficulty of determining whence the material was derived which forms the gravel. Without entering into a discussion of the different views which have been advanced, it is sufficient to say that the general consensus of opinion at the present day is that we must look to eroded areas towards the northwest for the origin of this material. Should this hypothesis be correct, we ought to find the pebbles containing Silurian and Devonian fossils more abundant in the vicinity of areas of these rocks, in other words, in New Jersey, on Staten Island, and on the western end of

* Merrill.—F. J. H. "On the Geology of Long Island." Ann. N. Y. Acad. Sci. 3: p. 359 (1885).

Long Island. Such we have seen to be the case, and the gradual disappearance of the fossils eastward is exactly what might be expected. The composition of the gravel changes from Devonian and Silurian pebbles to pebbles of the older crystalline rocks, such as are represented in Southern New York and New England.

The only weak point in the hypothesis is the almost total absence of any triassic pebbles in the gravel. If its origin was from the palæozoic and crystalline rocks of New York and New England, it must have crossed the triassic area in order to reach its present position, and the absence of triassic material in its composition yet needs a satisfactory explanation, especially as well defined deposits of "yellow gravel" are to be found in New Jersey right up to and extending for some distance into the triassic area.

Every new fact recorded is, therefore, of importance, and definite proof that the "yellow gravel" is represented on Long Island is of value in itself, irrespective of the extent of its distribution there, inasmuch as its identity with the "yellow gravel" of New Jersey has been questioned, mostly because of the previous absence of just such evidence. Personally I think that there is no doubt of the identity of the "yellow gravel" throughout Long Island, even where it does not contain the characteristic palæozoic fossils. The conditions under which it occurs are identical, and I am even inclined to refer some of the gravels on Martha's Vineyard to the same horizon. The entire subject, however, is under investigation by me at the present time, and will probably form the basis for a separate contribution in the future.

In conclusion, I have decided to append a list of the cretaceous plants thus far described from the island, together with a table of distribution.

An analysis of the 50 species determined shows that 7 have been found on Staten Island, 22 in New Jersey, 4 on Martha's Vineyard, 23 in the Dakota group and 1 in the Laramie group of the West, 16 in the Lower Atane and 7 in the Patoot beds of Greenland, while 4 are reported from Gelinden and 3 from Moletein, in Europe. Further than this I have not carried the distribution.

With the small amount of material at present available it is not safe as yet to draw any positive conclusion, but the comparison at least serves to closely correlate the Long Island cretaceous with the Amboy clays of New Jersey, the Dakota group of the West and the Lower Atane beds of Greenland.

These species are included in at least 28 genera and 19 orders of dicotyledons, and 1 genus and 1 order of monocotyledons, and several genera are undoubtedly to be added in the mono-cotyledons and gymnosperms, but these latter are not included in the enumeration, and are merely designated provisionally in the list.

The species of widest general distribution is *Myrtophyllum* (*Eucalyptus?*) *Geinitzi* Heer, which is reported from Long Island, two localities on Staten Island, three in New Jersey, Martha's Vineyard, the Dakota group of the West, the Lower Atane beds of Greenland and Moletein in Europe.

The species of widest distribution in America is *Liriodendron simplex* Newb., which is reported from Long Island, two localities on Staten Island, one in New Jersey, Martha's Vineyard, the Dakota group of the West and the Lower Atane and Patoot beds of Greenland.

Andromeda Parlatorii Heer, and *Protæoides daphnogenoides* Heer, also merit attention in this connection.

MAPS, PLATES, DIAGRAMS AND SPECIMENS SHOWN.

Geological Map of the United States. 5th Ann. Rept. U. S. Geol. Survey.

Geological Map of New Jersey. Geol. Survey of N. J. 1882.

U. S. Coast Survey, Chart No. viii. Approaches to New York, Gay Head to Cape Henlopen.

Map of Long Island and Southern New England, by the writer.

Diagrams, showing ideal sections across New Jersey and Long Island, by the writer.

Plates, representing the cretaceous flora of Long Island. Trans. N. Y. Acad. Sci. **12** : *pl. 5–7* (1893), and Bull. Torr. Bot. Club, **21** : *pl. 174–180* (1894).

Ferruginous shale and sandstone, containing cretaceous leaves, from Eaton's Neck, Lloyd's Neck, Glen Cove, Sea Cliff and Brooklyn, Long Island.

Morainal gravel, quartzose and granitic, from the vicinity of Northville, Long Island.

"Yellow gravel," containing silicified palæozoic fossils, from Lloyd's Neck, Glen Cove, etc., Long Island.

Miniature section of a driven well at East New York.

STATED MEETING.

January 29th, 1894.

Vice-President OSBORN in the chair and fourteen persons present.

SECTION OF BIOLOGY.

The following paper was read by title: "A Case of Reversed Cleavage in a Sinistral Gasteropod," by Mr. H. E. Crampton, Jr.

LONG ISLAND CRETACEOUS FLORA.

Table of Distribution.

Orders.	Species.	Long Island.						Staten Island.			New Jersey.				West'n U. S.	Green-land.		Europe.	
		Eaton's Neck.	Lloyd's Neck.	Oak Neck	Glen Cove.	Sea Cliff.	Brooklyn.	Prince's Bay.	Tottenville.	Kreischerville.	Woodbridge.	Sayerville.	South Amboy.	Gay Head, Martha's Vineyard.	D. = Dakota Group. L. = Laramie.	Lower Atane.	Patoot.	Gelinden.	Moletein.
Palmæ	*Serenopsis Kempii* Hollick				+														
Salicaceæ	*Salix proteæfolia* var. *flexuosa* Lesq.					+					?				D				
	Salix purpuroides Hollick					+													
Juglandaceæ	*Juglans crassipes* Heer						+								D		+		+
	Juglans arctica Heer. (?)				+						+				D	+			
Urticaceæ	*Ficus protogæa* Heer. (?)				+										D ?	+			
	Ficus Willisiana Hollick				+	+													
Proteaceæ	*Protæoides daphnogenoides* Heer					+			+	+	+	+	?		D				
	Laurus Plutonia Heer				+				+		?				D	+	+		
	Laurus Omalii Sap. et Mar.				+	+													
Lauraceæ	*Laurus Newberryana* Hollick				+														
	Sassafras progenitor Newb. mss (?)			+							+								
	Sassafras acutilobum Lesq				+						+				D				
	Cinnamomum Sezannense Wat.				+	+									D	+	+	+	
Ebenaceæ	*Diospyros rotundifolia* Lesq.				+										D				
	Diospyros primæva Heer				+				+				+		D	+	+		
Myrsinaceæ	*Myrsine elongata* Newb. mss.		+										+						
Ericaceæ	*Andromeda Parlatorii* Heer					+					+	?	?	+	D	+	+		
Caprifoliaceæ	*Viburnum integrifolium* Newb. mss.				+						+								
	Aralia transversinervia Sap. et Mar.			+														+	
Araliaceæ	*Aralia patens* Newb. mss. (?)				+						+								
	Aralia Nassauensis Hollick						+												
Myrtaceæ	*Myrtophyllum* (*Eucalyptus?*) *Geinitzi* Heer.				+				+	+	+	+	?	+	D	+			+
	Eucalyptus? nervosa Newb. mss. (?)					+							+						
	Dalbergia Rinkiana Heer		+				+									+			
	Hymenæa Dakotana Lesq. (?)					+					?				D				
Leguminosæ	*Colutea primordialis* Heer	+									+				D				
	Leguminosites convolutus Lesq. (?)				+										D				
	Leguminosites constrictus Lesq. (?)			+											D				
Sapindaceæ	*Sapindus Morrisoni* Lesq.				+				+					+	D	+	+		
Ampelidaceæ	*Cissites formosus* Heer. (?)											+			D	+			
	Paliurus integrifolius Hollick		+	+	+														
Rhamnaceæ	*Zizyphus elegans* Hollick				+														
	Zizyphus Lewisiana Hollick			+															
	Rhamnus? acuta Heer		+													+			
Celastraceæ	*Celastrophyllum Benedeni* Sap. et Mar.				+													+	
	Celastrophyllum decurrens Lesq. (?)				+										D				
Tiliaceæ	*Grewiopsis viburnifolia* Ward		+												L				
Menispermaceæ	*Menispermites Brysoniana* Hollick				+														
	Magnolia speciosa Heer.				+										D				
	Magnolia Capellini Heer				+										D				
	Magnolia Isbergiana Heer															+			
	Magnolia longipes Newb. mss.				+						+								
Magnoliaceæ	*Magnolia glaucoides* Newb. mss.				+	+													
	Magnolia auriculata Newb. mss.										+								
	Magnolia Van Ingeni Hollick					+													
	Liriodendron primævum Newb.								+						D				
	Liriodendron simplex Newb														D				
	Liriodendron oblongifolium Newb. mss.																		
?	*Tricalycites papyraceus* Newb. mss.		+								+								
	Podozamites?																		
	Poacites?				+														
	Cyperites?				+														
	Typha?		+																
20 +	50 +	1	7	5	33	11	3	1	7	2	19	4	7	4	D. 23 L. 1.	16	7	4	3

Dr. Bashford Dean exhibited drawings of original restorations of *Dipterus valenciennesi* S. & M. and *Cælacanthus elegans* Newb.

Dr. J. L. Wortman exhibited an almost entire skeleton of *Patriofelis*, recently acquired by the American Museum of Natural History, and discussed its probable relationships. From structural characters of limbs he regards this Creodont as nearest the ancestral form of the seals. Its spreading digits appear to have been webbed, and its coprolites show that its food included turtles.

Dr. A. A. Julien read a paper on a newly-discovered fossil fungus in silicified wood from the petrified forest near Cairo, Egypt, probably of the genus *Peronosporites*.

Professor Osborn showed a water color restoration of a Miocene landscape, including characteristic animals and plants of the western lake basins.

Regular Business Meeting.

February 5th, 1894.

No quorum present.

Stated Meeting.

February 12th, 1894.

Vice-President Osborn in the chair and eighteen persons present.

A letter was received from Mr. M. Huss, of Brooklyn, N. Y., calling the attention of the Academy to the coming celebration of the sixtieth birthday of Prof. Ernest Haeckel, to be held at Jena, Germany, on February 17th.

Prof. Geo. S. Huntington, Prof. E. B. Wilson, Mr. C. F. Cox, Prof. N. L. Britton and Prof. H. F. Osborn were appointed a committee to prepare an address of congratulation and forward it to Jena.

SECTION OF BIOLOGY.

The following papers were read:

"The Morphology and Significance of the variations of the Biceps flexor cubiti," by Geo. S. Huntington.

Our Conception of "Species" as Modified by the Doctrine of Evolution.

BY N. L. BRITTON.

One of the most familiar axioms laid down in modern writings is to the effect that the word "species" is most difficult to define. This difficulty is, indeed, cumulative, as the number of different living organisms known increases, each "new species" brought to light showing some peculiarity of structure or form in which it differs from all others, but also indicating by some other characters its genetic relationship to its kin. Thus, as our knowledge of living things increases, our notions of their relationships undergo modification, in groups of lower rank as well as in those of higher. It is clear that the naturalists of the early part of the century had far less difficulty with the "species" question than we of to-day, and the disrepute which it has been sought by some narrow-minded writers to shroud the whole sciences of Systematic Botany and Zoölogy has been largely initiated by the inherent difficulty of the subject. Indeed, at the present day it is only the very broadest kind of training coupled with acute faculties for observation and intimate acquaintance with an enormous number of different organisms that equip a student as a really successful systematist. What wonder is it then that so few attempt these lines of research?

The difficulty surrounding the delimitation of species has for its origin, according to modern scientific thought, the past condition of organisms as well as their present. Believing, as we do, that the now-existing plants and animals are descended from preëxistent ancestors, more or less different, and recognizing the effects, though we are as yet unacquainted with the cause of the phenomena which we designate as atavism and reversion, we understand, imperfectly, to be sure, but more and more accurately, how it is that organisms present so much variation within rather a limited field, for we realize that they are only showing some indications of their ancestral condition. It is my opinon, based on a considerable amount of observation on living plants, that the atavistic tendency has not been given the prominence it deserves in the study of the complex phenomena which we know under the general name of variation.

The life history of almost any plant one takes up illustrates atavism in its vegetative organs; this is perhaps most readily observed in the first-developing leaves of Dicotyledons. Take the poplars and aspen for example (*Populus*). In these the leaves of young trees, and to a less marked degree the first-appearing ones of older trees, are radically different from those of subsequent appearance. The same is true of many of the oaks. In the Australian genus *Eucalyptus* the leaves of the lower and therefore earlier branches are dissimilar to those of the upper in at least several species. The North American Tulip-tree (*Liriodendron*) occasionally shows leaf-forms very different from the normal, and these were recognized by Dr. Newberry as characteristic of Cretaceous ancestral "species." Doubtless all these phenomena are susceptable of the same explanation.

Examples of such occurrences might be almost indefinitely multiplied. From this series of facts we are led to suspect that many divergences from what we recognize as the most usual characters of an organism may be merely some features of its ancestors, perhaps of some exceedingly remote generation, brought out again by this most wonderful tendency, sometimes to be transmitted to its immediate offspring, sometimes to perish with it, sometimes to appear again only after centuries. Now, inasmuch as we understand that the groups of similar organisms which we term species, inhabiting the same general area of the earth, have descended from common ancestors, we must expect that any individual or generation of them will be susceptible to this tendency, and may exhibit characters which will ally them more closely than usual with their relatives of what we commonly understand to be another species. When this happens to be observed, and it is my belief that it is, perhaps unwittingly, very frequently observed, it has generally been disposed of by concluding that the two organisms hitherto regarded as different are really but forms of the same thing, or that the two "species" are one, notwithstanding the fact that the great bulk of individuals forming the two groups may be entirely distinct, even to casual observation. Does it not appear, however, that this method of treatment is open to grave philosophical objection in the light of facts as set forth above? Is it not better to regard such cases as distinct species and recognize the occurrence of what the ornithologists have termed "intergrades?"

While I have given atavism the place of honor in this discussion, I would not have it supposed that I maintain it to be the chief cause of variation in living organisms. I have taken it first, because, in Botany at least, it has not been much considered. Other assigned causes, environment, modifications within the germ-cell, the "survival of the fittest," have all in my opinion more or less to do with this most intricate problem. Their consideration, however, does not come within the scope of my present communication.

From the conditions thus surrounding the philosophical consideration of species, it is by no means strange that widely different opinions as to the relationships of different groups should be maintained by different authors working from different material. We cannot hope to alter these conditions, nor would there be any gain in unifying scientific opinion, for then there would be little progress in knowledge.

It seems probable that some advantage may be drawn from a method which, though empirical, has still a considerable scientific basis, and which has been more or less employed by many systematists. I refer to the known geographical distribution of closely related or "intergrading" species. It has been found quite possible to divide the surface of the earth into biological areas and subareas, variously designated, these areas being characterized by different climates and inhabited by floras and faunas of a different general facies, and their outlines can be so drawn as to include the natural geographical range of many species, which thus become characteristic of the areas. Now if we have two closely related organisms, each inhabiting its own area, the conclusion that they are distinct species is strengthened by giving us an artificial aid in their delimitation.

The explanation of the occurrence of identical or closely related species in widely separated geographical areas affords another most interesting problem. It is, I believe, in many instances, to be solved by reference to their origin in remote geological epochs rather than by migration in comparatively recent time. The basis for this explanation lies not so much in the inherent improbability of extensive migrations of plants in a body, which would have to be invoked for instance to satisfy the fact of the occurrence of numerous circum-boreal species in the extreme southern part of South America or the presence of numerous Texano-Mexican types in Southern Brazil and Paraguay, or the similarity of the Eastern North American flora to that of Japan, or that of the East Indian and West Indian Archipelagos, as in the uniformity of the floras of ancient geological epochs over the entire earth's surface before the great differentiation into climatic areas took place in the Cretaceous and Tertiary. This general uniformity is clearly indicated by our present knowledge of palæobotany, and has repeatedly been made the subject of remark. Indeed, up to the middle Cretaceous we find the recurrence of much the same forms in Greenland, in Central North America, along our Atlantic seaboard and in Western Europe. As I have elsewhere maintained, it appears to me that in this wide early diffusion of similar or identical organisms we have a more philosophical basis for the explanation of occurrences, such as above cited, than in the widely accepted hypothesis that any given species has originated in a limited area, and thence "migrated." And if my position in this is tenable it has an important bearing on the subject in hand.

I have confined my remarks to the consideration of present-existing plants. If we find the "species problem" so intricate in these, how much more difficult must it be in the study of fossils? For in these, if our modern pet theory be true, we will sooner or later accumulate material which will invalidate all palæontological "species." The "lines of descent" already worked out foreshadow this result very clearly. What then shall we do with these organisms? It is necessary to recognize them as autonomous in order to study them at all, and in order to study them to any advantage we have to apply to them designations of some kind. It appears as though our present methods of nomenclature would prove insufficient to meet the necessities of this new biological era, so rapidly opening before us, but what will be substituted for them is not yet clear. It is to be hoped that when another method comes into vogue it will be so constituted as to be applicable to all organisms both past and present.

On the History of the Archoplasm Mass in the Spermatogenesis of Lumbricus.

By Gary N. Calkins.

The history of the reproductive cells in *Lumbricus* offers many interesting and perhaps some unique problems. Of these probably the most striking is that which relates to the origin and fate of a body which acts like an attraction center in the early germ cells, and which finally becomes the middle piece of the mature spermatozoan. This body, which appears in diverse forms in the different stages of sexual development of *Lumbricus*, may be called the archoplasm mass.

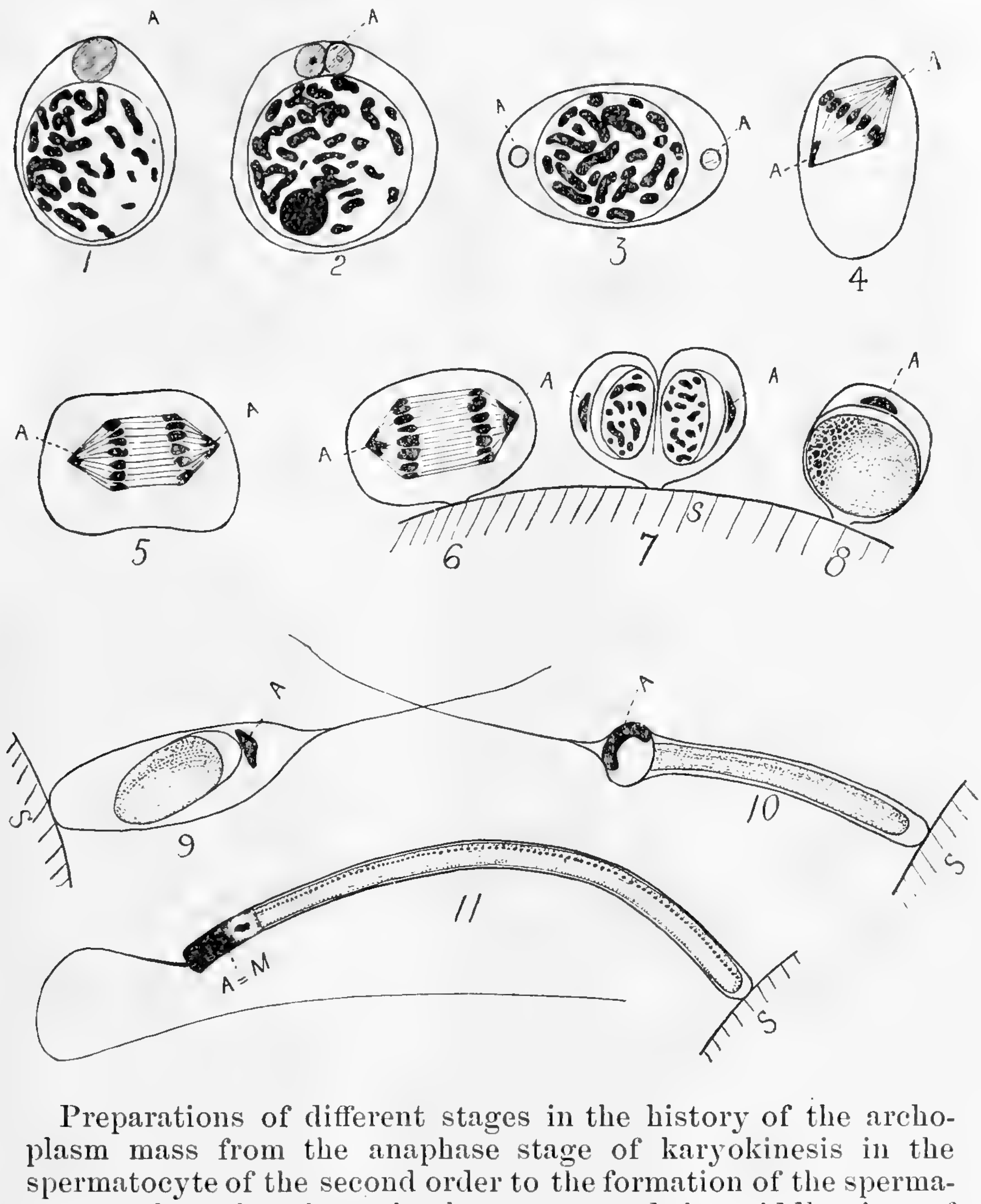
The archoplasm mass in some cases is elongated and flattened and lies closely applied to the exterior of the nuclear membrane.

In other cases it is divided into finger-like processes closely resembling certain stages of the "Nebenkern," as figured and described by Gustav Platner in the cases of *Limax agrestis* and *Helix pomatia.* Again, it is in the form of a sphere; but in all forms it is apparently one and the same substance and can be observed in all of the male reproductive cells until finally it is found in the mature spermatozoan.

Cytologists are at present by no means agreed in regard to the origin of the male attraction sphere in fertilized ova of different animals. Fol, Hertwig, Field and others assert, on the one hand, that it originates from a centrosome lying at the extreme tip of the mature spermatozoan (e. g. in Echinoderms). Fick and other investigators have shown, on the other hand, that the male attraction sphere is, in some cases, formed from the middle piece of the spermatozoan (as in *Axolotl*). Here in the one case there is a certain portion of the spermatozoan—the centrosome—which performs a certain function in fertilization. In the other case there is, apparently, an entirely different portion of the spermatozoan—the middle piece—which performs the same function. In view of this contradiction and as illustrating the identity, in some cases, of centrosome and middle piece, the history of the archoplasm mass in *Lumbricus* is interesting and important.

The spermatogenesis of Lumbricus offers exceptional material for demonstration of the final distribution of the cytoplasmic and nuclear elements. The developing sexual cells, as is well known, are here attached to a central mass or spermatosphere by means of which the cells can be oriented at a glance. Also the archoplasm mass is quite conspicuous and not difficult to demonstrate, provided the proper stains are employed. Almost any nuclear stain is sufficient to reveal its presence, but Kleinenberg's haematoxylin and the iron haematoxylin of Heidenhain give the best results.

Platner, in his work on the spermatogenesis of the butterfly, shows that the middle piece of the mature spermatozoan is formed from the achromatic *verbindungsfäden* of the spindle after division of the spermatocyte of the second order. The centrosome is thus in position at the head of the spermatozoan, while the tail is developed from the opposite end. In *Lumbricus* the development of the spermatid is quite different. Here the spermatid is attached at one end to the spermatosphere, and the division plane by which it is formed is radial. That is, the long axis of the spindle in the spermatocyte of the second order is tangential to the spermatosphere (see figure 6), and, as a result, the centrosomes, if present, must lie at the side of the spermatids, as shown at A in figure 7. The elongation of the spermatid takes place in a direction radial to the center of the sphere, hence the centrosome must necessarily move around through an angle of 90° towards either the future tail end of the spermatozoan or the future head end. As a matter of fact it invariably moves towards the tail end. (See figure 8.)



Preparations of different stages in the history of the archoplasm mass from the anaphase stage of karyokinesis in the spermatocyte of the second order to the formation of the spermatozoan, show that the archoplasm mass and the middle piece of the spermatozoan are one and the same substance (see figures 6–11). Furthermore, similar preparations show that the archoplasm mass can be uninterruptedly followed from its position in the resting stage of the early germ cell to its position at the poles of the spindle during the prophase of karyokinesis (see figures 1–4). I am unable to state as yet, however, whether the archoplasm mass disappears or not in the stages between the prophase, as in figure 4 and the anaphase of karyokinesis, as in figure 5.

In the early stages of spermatogenesis the archoplasm mass apparently plays an important part in cell division where its actions are extremely suggestive, to say the least, of those of an attraction center.

In its first phase of activity it appears as a homogeneous sphere at the extremity of the cell furthest from the center of the spermatosphere and rests against the nuclear membrane (figure 1, A=archoplasm mass). It then divides into two equal parts, and in some cases a minute black dot is visible in the center of each part. I take this to be the true centrosome (figure 2). Both halves then pass around the nucleus through an angle of 90° and the spindle is formed with its long axis tangential to the periphery of the ball (figure 3). When the spindle is nearly completed the archoplasm masses can be seen, in many cases, to extend part way up the spindle fibres (figure 4). In the later stages of karyokinesis the same masses can be seen collecting at the poles (figure 5). One is almost tempted to conclude from these phenomena that the achromatic spindle fibres come from and are retracted into the archoplasm masses at the two poles. After formation of the daughter cells the archoplasm masses are in the form of more or less flattened plates closely applied to the new nuclear membranes. (Figures 6, 7 and 8, which represent the spermatid development, may apply equally well to the earlier germ cells, so far as the archoplasm masses are concerned.) These masses are next seen in this same shape at the farther extremity of the cell. Whether they move to these positions or are so placed by rotation of the nuclei, I am unable to state.

In the spermatid the archoplasm mass occupies a position in the cell as shown in figure 8. In form it is a concave disc lying closely applied to the nuclear membrane. From its position here, it is a comparatively simple matter to trace the formation of the middle piece.

The spermatozoan is formed from the spermatid by elongation of the latter cell in the direction of its radial axis. The nucleus of the spermatid, which has the appearance of a compact and homogeneous mass, elongates, and a tail begins to form at the distal extremity of the cell—*i. e.*, that which lies farthest from the center of the spermatosphere (figure 9). This elongation of the nucleus continues until the spermatid becomes a long columnar cell with a filament growing out from one end, the other end remaining attached to the spermatosphere. The archoplasm mass now lies in a vesicle between the tail and the nucleus (figure 10). The further history is briefly as follows: The nucleus and tail elongate still more; the vesicle disappears by elongation of the archoplasm mass, and the spermatozoan finally assumes the shape of a long rod with a much longer filamentous tail (figure 11). This rod consists of middle piece and nucleus which can be differentiated only by careful staining.

The history of the archoplasm mass has now been traced from its position in the spermatid to the mature spermatozoan, where it forms the middle piece. It has also been shown that the same substance (archoplasm mass) acts in a manner suggestive, at least, of an attraction center. This identity of archoplasm mass and middle piece of the spermatozoan furnishes a clue to the solution of the apparent contradiction between such cases as the echinoderms on the one hand and *Axolotl* on the other. I shall reserve for a future paper, however, the conclusions which may be drawn from the facts here recorded.

Stated Meeting.

February 19th, 1894.

Professor A. H. Chester in the chair and thirty-seven persons present.

Section of Geology and Mineralogy.

Professor Chester exhibited some fine crystals of Monticellite and Perofskite from Magnet Cove, Ark.

Professor Kemp exhibited a nugget of native antimony from Kern Co., Cal.

The following papers were read:

"Preliminary Notice of Sodalite from three new Localities" (Hastings, Ont., the Ural Mountains and the Congo Region), by L. McI. Luquer.

"The Advantages of standard or society Sizes for the Drawers, Trays and Boxes of Cabinets for Minerals and Microscopical Specimens;" "On a portable Mineral Cabinet;" "On Trays for Cabinets, moulded from aluminum, celluloid, papiermaché or wood-pulp," by W. G. Levison.

An orbicular Granite from Quonochontogue Beach, Rhode Island.

By J. F. Kemp.

(Plate II.)

For many years it has been known that granite occasionally displays a very peculiar spheroidal structure, which is called "orbicular granite," "ball granite" and "spheroidal granite" in English, and "Kugel-granit" in German. Such have been recorded from various places abroad, but are especially well known from Swedish and Sardinian localities. Almost all museums contain also the related phase of diorite, known as corsite and napoleonite, that comes from Corsica. Allied phenomena have already been four times reported in America. In 1861 Pres. Edw. Hitchcock* recorded the well known "pudding" or "prune" granite of Craftsbury, Vt., and it was, afterwards, in 1878, described with microscopic sections by G. W. Hawes,† and again by de Chroustchoff in 1885.‡ The nodules seem to the eye to be entirely formed of biotite, in concentric layers, but under the microscope it is seen that much quartz occurs between the laminae, that muscovite occasionally appears, and that there is faint suggestion of a core. G. P. Merrill§ has also recorded in a number of Maine granites, employed for building purposes, various dark segregations that mar the stone. They are both angular and rounded, and in most cases show no sharp line of demarcation from the matrix. They manifest no tendency to separate from the granite when broken. While in mineralogical composition they are much the same as the nodules described here, the paper of Mr. Merrill does not indicate the beautiful concentric and radiating structures of the Rhode Island example as being present in the specimens yet met in Maine.

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* Geol. of Vermont, II. 564, 1861.

† Geol. of New Hampshire, III. Part 4, p. 203, and Pl. XI. Fig. 4, 1878.

‡ Bull. Soc. Min. de France, VIII. 137, 1885.

§ On the black Nodules or so-called Inclusions in the Maine Granites. Proc. U. S. National Museum, 1883, 137.

The late Prof. G. vom Rath,* to whose travels in this country in 1884 we owe many acute and interesting observations on western localities and mines, noted at Rattlesnake Bar, El Dorado Co., Cal., an orbicular diorite, which he describes as of exceptional perfection. It is much the same thing as the Corsican occurrence but has the radiating structure less prominently formed. Zirkel† also records a tendency of quartz, feldspar and muscovite to form minute zones around magnetite crystals, in a granite from Clark's Peak, Medicine Bow Range, Colorado.

Four years ago, the writer obtained some fragments of orbicular granite of exceptional perfection, while visiting the quarries at Westerly, Rhode Island, but did not ascertain until last summer the exact locality. It was then learned that they were taken from a boulder at Quonochontogue Beach. This is situated in southwestern Rhode Island, about eight miles east of Watch Hill, and five miles south of the nearest railway station, Niantic, on the shore line for Boston. The place is thus quite inaccessible, but nevertheless a few cottages and a small hotel have sprung up. On visiting the locality the boulder was found to be about 6 feet by 5 feet by 4 feet, and to be one of a number making up an old glacial dump. Half of it is orbicular and half normal biotite-granite or granitite of rather coarsely crystalline structure. The granitite is, however, just the same as is found in neighboring ledges, and is only a coarser variety of the one which is so extensively wrought at Westerly and Niantic. The boulder has not been transported far, but in all the outcrops seen, no orbicular structures have been met in place. This whole coast is formed of drift, mostly coarse morainic material, and except for the ledge referred to no other exposure appears for several miles to the north. The surface consists of morainic hills, with great sandy or gravelly stretches, which mask the underlying geology. It is possible that the parent ledge of the boulder may yet be discovered, but it is hardly probable.

The normal granite is mainly composed of quartz, orthoclase, and biotite, with considerable plagioclase as well. It is a very pure biotite granite or granitite. A few stray magnetite grains appear, and a zircon or two in each slide.

The nodules run from 2–3 inches (5–7 cm.) in diameter and are rudely elliptical in outline. The center consists quite entirely of plagioclase, but a few quartzes may be recognized

* Sitzungsberichte der Niederrhein. Gesellsch. f. Natur. und. Heilk. zu Bonn., December 1, 1884.

† Fortieth Parallel Survey, Vol. VI., p. 54, 1876.

especially in a polished slab. In the nodule figured in Pl. II. these are exceptionally large. In others they are less pronounced.

Toward the rim the biotite in irregular shreds begins to be noticeable, and the nodule is more finely crystalline. Still further the biotite begins to assume a concentric arrangement, which is very pronounced, and much magnetite is associated with it in rather rough octahedral crystals. After a very decidedly darker zone the inner part of the nodule ceases abruptly. It is this portion that separates easily when the rock is broken up. There remains, however, outside of each core a marked rim or outer zone. This is $\frac{1}{8}$ to $\frac{1}{4}$ inch (3–6 mm.) wide, and is formed of plagioclase crystals with their twin lamellæ radiating from the inner portion. *All* the crystals, it should be stated, have not the lamellæ sharply radial, for the twin sections show at times some irregularity, but as a rule they are in this position and in sufficient numbers to give a strong impression of radial arrangement. The effect is heightened by a fine dust of magnetite that is sprinkled through them, but with suggestions also of the same concentric alignment so pronounced in the internal, dark zone. The rim ends sharply against the granite of the matrix, which is in all respects normal. In one portion, the outer rim of the nodule in the upper right hand corner of the plate is interfered with by a group of rather coarser crystals than the general matrix, but in all other cases seen it is entire. The coarser group is probably an incipient nodule. Some nodules are more thickly sprinkled throughout with dark minerals than others, and such are shown in the half tone plate of a large block.

In this curious structural anomaly we evidently can observe the following facts: (A.) A much more basic aggregate of minerals is present in the spheroids than in the normal granite. (B.) In the individual spheroid the innermost core is most acidic; it shades into the most basic portion of all next the outer rim; the outer rim is of medium basicity. It is equally clear that in the still fluid magma centers of crystallization began, consisting of plagioclase (*i. e.* oligoclose), with subordinate quartz and orthoclase. The expanding centers occasionally involved with themselves biotite and magnetite, which were doubtless already formed in the magma. As the nuclei grew increasing amounts of biotite and magnetite were entangled or drawn in by a concretionary action until they were nearly exhausted in those portions of the magma neighboring to the nuclei. Finally the rim formed. While yet soft the spheroids were more or less flattened, probably by movements in the magma. Much the same process has been outlined for the other occurrences abroad; but whether differential cooling or greater basicity in this portion of the magma perhaps developed according to Soret's principle, or whether some more obscure cause primarily brought about the beginnings of the spheroids, are difficult questions.

Search through the literature developed the following facts: Typical (*i. e.* biotite-muscovite) granites seldom develop spheroids. The Sardinian occurrence at Fonni, described by vom Rath* and Fouqué† is almost the only one yet noted. Several fine examples of these are in the Columbia College collections. They are larger than the Rhode Island nodules, but in general structure strongly resemble them.

The usual spheroid bearing granite is either a biotite-granite (granitite) or a hornblende-granite. The former occurs in the Riesengebirge of Silesia‡ (described by Rose) and at Wirvik in Finland, as described by Frosterus§; the latter at Mullaghderg, in County Donegal, Ireland, as described by Hatch‖ and at Slättmossa in Sweden, as best and most recently set forth by Brögger and Bäckstrom¶. The Wirvik spheroids resemble those described in this paper very closely, and the illustrative plates which accompany the descriptions are very like the one here given; but the outer radiating rim, so well developed in Rhode Island, is lacking. This radiating character also fails in almost all the Scandinavian examples, but at Mullaghderg it is even more pronounced than at Quonochontogue. Judging from the figure (Plate XVI., Fig. 1) of Dr. Hatch's admirable paper, it forms a much larger portion of the nodule in the former case than in the latter. The radiating structure in a spheroid is most prominently shown in the orbicular diorite or corsite of Corsica. The spheroids are constructed of crystals of anorthite, which radiate from a center, and which are separated into concentric shells by layers of hornblende crystals. The parallel which they afford in a plutonic rock, to the spherulites of glassy rocks, so well discussed by Iddings** and Cross,†† is much closer than can be drawn from the granitic nodules here discussed.

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* Sitzungsberichte d. Niederrhein. Gesellsch. in Bonn, June, 1885, p. 201. (As quoted by Hatch, whose paper is later cited. The original is not accessible to J. F. Kemp.)

† Bull. Soc. Min. de France, x., p. 57, 1887.

‡ G. Rose, Pogg. Annalen, Vol. LXI., p. 624.

§ Tschermaks Min. und Pet. Mitth. XIII. 177, 1893—Plates VI. and VII.

‖ Quart. Journ. Geo. Soc., XLIV., 548, 1888.

¶ Geol. Fören. i Stockholm, Förhandl. IX. 351.

** J. P. Iddings—Spherulitic Crystallization. Bull. Phil. Soc. of Wash. XI. 445, 1891.

†† Whitman Cross. Constitution and Origin of Spherulites in acid Eruptive Rocks. Idem, p. 411.

Spheroidal granites, on the whole, are much more basic than the general magma from which they have been segregated. It is quite possible that this segregation may have been brought about in accordance with Soret's principle, but it is hardly justifiable to base inferences of this sort upon a boulder which is not in place.

ADDITIONAL NOTE ON THE OCCURRENCE OF LEUCITE IN NEW JERSEY.

By J. F. Kemp.

(ABSTRACT.)

Prof. Kemp reported the discovery of fresher material than was used in his previous paper* on leucite in New Jersey, and the fact that the mineral fulfils the microscopic, optical and chemical tests for leucite. The specimens were derived from a dike in the limestone quarries at Rudeville, some three and one-half miles northeast of Franklin Furnace. The full note is to appear in the American Journal of Science for April or May, 1894.

Mineralogical Notes.

By George F. Kunz.

TOPAZ FROM NEAR PALESTINE, TEXAS.

Five crystals, all more or less rolled, showing that they had been taken from the bed of some stream or brook, were lately sent to Messrs. Tiffany & Company, of New York, on the supposition that they might be diamonds. Four of these proved on examination to be topaz crystals. The largest one, of a faint pale green color, with dull rubbed surfaces, somewhat rolled and fractured, and with slightly etched faces, resembled the more highly modified crystals of this species from Alabashka, in the Urals, and from Colorado. Its size was 17 by 16 by 12 mm. The following faces have been identified and verified by measurements with the hand goniometer; the base, (001), domes (021) and (041), pyramids (111) and (221) and prisms (110) and (120). It is very similar in habit to some of the topaz crystals found in Colorado.

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* On a basic dike in Northwestern New Jersey that has been thought to contain Leucite, Amer. Jour. Sci., April, 1893, p 298.

Two crystals were white, with almost no faces, save that the strong basal cleavage was very apparent. One of the smaller ones was about 10 mm. in diameter, and very much etched. It resembled the etched wine-colored crystals from Cheyenne mountain, Colorado. No other information was given about them than that they came from near Palestine, Texas, evidently from granitic rocks.

This is the first occurrence of topaz noted in Texas; and its presence suggests that it may probably be found in connection with other minerals associated with topaz and peculiar to the Urals, Madagascar, Ceylon, and Oxford county, Maine. The crystals are believed to have been transported from some northeastern point.

DIAMONDS FROM WISCONSIN.

In December, 1893, my attention was called by Dr. William H. Hobbs, professor of mineralogy and metallurgy in the University of Wisconsin, at Madison, to a diamond that had been found in Oregon township, two and one-half miles southwest of Oregon village, in Dane county, Wisconsin. Through his courtesy, the stone was sent to me by the finder, Mr. Charles Devine, of the place just named. The diamond was discovered by him while husking corn, in October, 1893, in a rough, stony field which had been under the plough for forty years. The bank of clayey earth in which it occurred contained a large number of rounded pebbles of quartz, but no other of the associated minerals of the diamond; and as the entire district consists of glacial drift coming from the north, a diamond-bed is not likely to exist in the immediate vicinity, but is rather to be looked for in the direction from which the drift came. The diamond is a rhombic dodecahedron, deeply pitted with circular, elongated, reniform markings. In color it is slightly grayish-green. It is one of those diamonds, however, whose color often proves to be but superficial, and it would probably cut into a rounded stone. Its weight is 3.34 karats. This is the second authentic occurrence of diamond in Oregon, Wis., the other being that of three small stones, the largest of which weighed 25.32 karats, and was noticed in the report on the Mineral Resources of the United States for 1892, page 759. A 16-karat diamond was reported to have been found, also in the glacial drift, at Waukesha, Wis., in 1884. Some litigation resulted from its finding, and considerable doubt was expressed at the time as to the genuineness of the discovery.

Discussion by Prof. Kemp. Tin ores have been known for some years as occurring in Llano Co., and in the Trans-Pecos region, Texas (Texas Geol. Surv. Second Ann. Rep., p. 595, 690 and 713). It is interesting to have their invariable associate, topaz, also brought to light.

On Some New Forms of Wollastonite from New York State.

By Heinrich Ries.

The specimens described in this paper were obtained six miles from Harrisville, N. Y., along the stage road to Fine, on the land of H. Johnson. The wollastonite is said not to be abundant at this locality. Some of the crystals are of large size, and all are more or less weathered, so that a hand goniometer had to be used in measuring the angles, but the readings were sufficiently close to determine the different faces with certainty.

A noteworthy feature of all the specimens examined is the presence of grains or lumps of unaltered green pyroxene scattered through them. This, together with the fact that many of the crystals examined resembled those of the Pitcairn pyroxene in form, led to the opinion at first that the specimens might be altered pyroxene. Measurements of the various angles, however, soon dispelled this idea. The grains and lumps of pyroxene, so far as observed, always occur near the surface of the wollastonite crystals, and wherever the former showed recognizable faces it was found to be simply an intergrowth and not a parallel growth of the two minerals.

Like the Pitcairn pyroxene, the wollastonite is intergrown with calcite and microcline, and the latter often extends some distance into the wollastonite crystal. All of the wollastonite crystals show a distinct basal cleavage, and a less perfect one parallel to i–ī, and 1–ī. There is also a prismatic parting parallel to I, which is not mentioned by Dana. Owing to the splintery nature of the wollastonite it was impossible to section it and determine the optical properties. The simplest and commonest form of the crystals examined is a combination of the basal pinacoid [*c*], 0P [001], the orthopinacoid [*a*], i–ī [100], the positive unit orthodome (*t*), 1–i [101], and the negative unit orthodome (*v*),—1–ī [101].

Fig. 1 shows a common combination, which has, in addition to the faces mentioned in the previous form, the orthodome [*b*], $\frac{3}{5}$-ī [305], the unit prism[*m*], I [110], the orthoprism[*z*], i-$\frac{3}{2}$

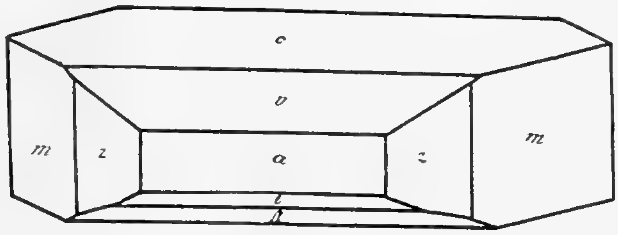


Fig. I.

[320] These three faces, so far as I have been able to find out, have not been recorded from New York State.

Fig. 2 shows an elongated form which somewhat resembles the Pitcairn pyroxene crystals in shape. The faces present are the basal pinacoid (*c*), 0P [001], the positive orthopinacoid (*t*),

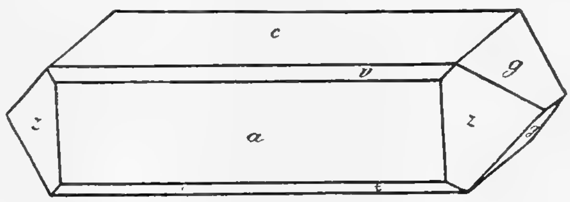


Fig. II

1-ī [101], the negative orthopinacoid (*v*),—1-ī [101], the orthoprism[*z*], i-$\frac{3}{2}$ [320], and the clinodome [*g*], 1-ĭ [011]. The latter face is also a new one for this State.

The following is a list of the angles measured and calculated :

Faces.	Angles measured.	Angles calculated.*
001 : 100	84° 30′	84° 30′
100 : 101	43° 56′	44° 27
100 : $\bar{1}$01	49°	50° 25′
001 : $\bar{3}$05	28° 30′	30° 5′
001 : 101	41° 30′	40° 3′
320 : 320	70° 00	69° 54′
110 : 110	92° 00	92° 42′

The writer wishes to express his thanks to Prof. A. J. Moses, who kindly loaned him the specimens for examination, and gave him other aid.

Mineralogical Laboratory, Columbia College, Feb., 1894.

* E. S. Dana, System of Mineralogy, 1893. Wollastonite, p. 371.

A Visit to the Falls of Bassasseachic.

By Edward D. Self, M. E.

The falls of Bassasseachic are located in the state of Chihuahua, in Northern Mexico. Wide, sloping plains cover part of the state, and form the first portion of an ascent, graphically, but incorrectly, described by Humboldt, as so gradual that it makes a natural wagon road from the United States to the city of Mexico.

Much of the state, therefore, is a high plateau, but it is broken occasionally by isolated ranges of mountains that are often almost destitute of trees or, indeed, of any vegetation. They are large masses of rock that stand apart from the Sierra Madre Mountains that cross the western part of this State and the eastern part of Sonora.

The point from which journeys to the interior begin is the city of Chihuahua. The city is situated in an open valley between 4,000 and 5,000 feet above the sea. The table-land is often subject to long continued drouth. Not unfrequently a year passes without rain, and famine ensues from the failure of the crops. When a storm does reach the interior the dry ground is so quickly washed away that the surface is cut by deep fissures or barrancas. These are usually dry, but sometimes the bed of swollen streams.

In this way the process of erosion and degradation has been carried on with great rapidity on the plain and in the mountains. The softer rocks have been worn down, leaving the harder ones in sharp, broken outlines, or sometimes standing alone as solitary pillars of remarkable size and height.

The action of the winds must also be noted in this country of topographical surprises. The walls of a ravine not far from Jesus Maria have been cut into fantastic shapes by the combined action of wind and sand. Castles and spires about 200 feet high and of remarkable symmetry line one side for a mile or more. Occasionally window-like openings are seen in the buttresses of rock that justify the name, Tierra Agujarada, or "needled earth," given to the country by the natives. The rocks are far more curious than those in the well known "Garden of the Gods," near Pike's Peak, Col.

One morning I was one of the passengers in the stage that leaves Chihuahua twice a week for Cusihuriachic. We were drawn by ten mules over the roughest roads from about three o'clock in the morning until after six at night before the stage rolled into Cusihuriachic, where we spent the night. The following day the journey was resumed in another stage that brought us to Guerrero, at the foot of the mountains. Here began a journey of about 100 miles on mule back. The ride takes about three days. After climbing innumerable hills, we at last came to the highest ridge, called the Cumbre of Jesus Maria, and descended a steep cañon to the town.

The following day we set out for the falls. The trail wound over a high range of hills, whose vertical cliffs form one side of the cañon of Jesus Maria. A long circuitous path led up to the top of the cliffs, beyond which easier slopes rose much higher.

Before reaching the stream above the falls, the trail crosses a gorge several hundred feet deep, with nearly vertical sides. Climbing the intervening hill, we came to the Bassasseachic River above the fall.

My visit being in the dry season, the bed of the river seemed dry, but on reaching the bottom of the ravine the water was found flowing in tortuous channels, 10 to 20 feet deep, worn in the bare rock by the passage of sand. In some places the rock was pitted as though by the removal of phenocrysts, leaving a cellular ground mass. Other parts of the ravine seemed to be silicious limestone; near the crest of the fall the rock is probably porphyry, but there are no sharp dividing lines as one shades into the other insensibly.

The bed of exposed rock covered by flood in the rainy season is 50 to 100 feet wide. The cutting action of sand and gravel is also illustrated, just above the fall, for at this point there is a natural arch of rock formed by the destruction of a pot-hole, under which the water passes before taking its final leap. There are several pot-holes, 3 to 5 feet in diameter and 10 to 20 feet deep, near the deep channel, in which the water is now flowing.

It is not until actually at the crest of the fall that the visitor realizes that there is any break in the bed of the river. Only by leaning over the precipice and looking down nearly 900 feet, can the bottom be seen, or even the water after it leaves the edge.

The amphitheatre below the falls is surrounded by vertical cliffs that rise 800 to perhaps 2,000 feet above the bed of the stream. From the fall to the cliff opposite is about 3,000 feet, and the extreme width of the cañon is about 1,500 feet. On the bottom there are piles of debris fallen from above, and over all is a dense forest of pine and cedar. The cañon turns to the right, and a further view is shut off by the high cliffs beyond.

On looking down from the edge of the fall the task of getting to the bottom seems an impossible one. But there is a trail on the left that is hidden by a knifelike spur of rock that forms part of one side of the cañon, so we have to go back a few hundred feet and climb over a hill to the trail, down which we can make our way by an equal use of hands and feet.

Halfway down there is a break in the narrow ridge of rock, whose vertical side is one wall of the amphitheatre, and from this narrow opening, called La Ventana, or window, the first view of the falls is obtained during the descent.

This is, perhaps, the most striking view of all; for the height of the fall, over 400 feet above and the depth of over 400 feet to the pool below, are brought in close comparison. The fall is hidden from sight as the trail winds down the debris at the foot of the cliffs. When at the bottom it is still a work of some difficulty to make one's way around the huge boulders to the pool, for what appeared from above to be heaps of gravel now proves to be masses of large boulders difficult to pass. There are large accumulations of rock in the bottom of the cañon, and one of the hills formed by the debris is several hundred feet in height. The stream below the falls is so filled with boulders and falls 10 to 20 feet in altitude that it is almost impassable. Ropes and scaling ladders would be required should one attempt to follow the actual course of the water.

The height of the fall above the pool is 871 feet in a single perpendicular drop, and by going down the stream about 1,500 feet sufficient additional fall is obtained to give a total head of nearly 1,200 feet. The quantity of water flowing at the time of my visit, which was in the dry season, was 125 cubic feet per minute, which would produce about 250 horse-power. The amount of water passing during the rainy season has not been measured, but the quantity is very great, as it comes from the rapid drainage of about 75 square miles above the falls. About 6 miles down the cañon there is another fall several hundred feet high which I did not see.

It would be interesting to attempt to discuss the causes that produced this cañon, but further than to suggest that it is the result of the gradual extension of a barranca or ravine, caused by surface washing that began on the Pacific Slope and slowly cut its way into the heart of the Sierras, until stopped by a porphyry dike at the falls, I can advance no theory at present.

The difficulty of making consecutive geological observations is very great, as may be inferred from the preceding and no data are obtainable upon which to base a more comprehensive explanation. The topography now shows the results of erosion by surface waters more strongly than the presence of faults or upheavals.

A glance at the colored geological chart, made by the Mexican Government, will show many white or unexamined areas in this part of the Sierras. A few reports of isolated mines indicate that the surface of the country is generally limestone pierced by igneous dikes.

A careful gelogical study of this district, so long known and yet still so unknown, might yield much valuable information.

NOTE.—A description of the proposed method of utilizing this water-power appears in the *School of Mines Quarterly* for April, 1894; also by Mr. Self.

ANNUAL MEETING.

February 26th, 1894.

Vice-President OSBORN in the chair, and fourteen persons present.

The following persons were elected resident members:

Theodore G. White, Walter C. Kerr, Christian A. Herter, M. D., Ernest E. Smith, Fred. J. Brockway, M. D.

The following report of the Audubon Monument Committee was received, accepted, and the committee continued.

The committee appointed October 3d, 1887, to solicit and receive subscriptions for a monument to be erected over the grave of John James Audubon in Trinity Cemetery, presented a report to the Academy at the Regular Business Meeting of November 5th, 1893, announcing the successful completion of the enterprise. This report, including a financial statement, has been printed in the current volume of the Transactions (Vol. XIII., pp. 23–69). As therein stated, certain imperfections which have been discovered in the die of the monument subsequent to its erection, have made necessary the replacement of this stone by a new one. This replacement is now in progress, and to insure its proper completion the committtee respectfully asks to be continued.

N. L. BRITTON,
Secretary of the Committee.

Reports of officers for the year 1893–94 were presented as follows:

Prof. H. F. OSBORN, Second Vice-President, reported on the evident increase of interest in science in New York, remarked on the success of the Public Lecture Course, and alluded to the First Annual Reception and Exhibition of the Academy arranged for March 12th, 1894.

REPORT OF THE CORRESPONDING SECRETARY.

During the past year two corresponding members have been elected, viz.: Prof. C. H. Smyth, Jr., on March 6th, and J. P. Thomson, November 6th. These members were duly notified of their election. Several corresponding members have died during the year, among whom we must deplore the loss of Dr. H. A. Hagen, of Cambridge, Mass.

As editor of the Annals, I have to report that Vol. VII. is practically completed, and that the index and title-page of Vol. VI. will be issued with the concluding parts of Vol. VII.

Respectfully submitted,

THOS. L. CASEY,
Corresponding Secretary.

REPORT OF THE RECORDING SECRETARY.

During the year 1893–94, there have been held:

Eight meetings of the Council.

Eight Business Meetings of the Academy, of which three have failed of a quorum.

Twenty-seven Stated Meetings of the Academy.

One Special Meeting of the Academy.

Eight Public Lectures have been delivered.

The Three Sections of Astronomy and Physics, Geology and Mineralogy, and Biology, have each held eight meetings.

The number of formal papers presented before the Academy was eighty-one, of which eight have been read by title only. This is an increase of twenty-five over the year preceding.

These eighty-one papers may be classified as follows:

Astronomy,	12	Histology,	1
Biography,	2	Human Anatomy,	2
Botany,	6	Mineralogy,	4
Chemistry,	2	Petrography,	6
General Biology,	3	Palæontology,	10
General Information,	2	Physiology,	1
Geodesy,	1	Physics,	4
Geology,	11	Zöology,	14

The average attendance, exclusive of public lectures and special meetings, was twenty-seven as against twenty-one during the year preceding. The largest attendance was 110, the smallest 5.

There have been eight Resident Members elected, making the total number now on the Secretary's list 215, of which sixty-two are Fellows. This is a net loss over the number reported by the Secretary for the year 1892–1893 of eighteen.

Two Corresponding Members have been elected.

No fellows have been elected.

Seven signatures of Transactions, Vol. XIII. (112 pages), have been printed, including proceedings and papers read at the meeting of December 11th, 1893, signature 7 bearing date January 3d, 1894. The proceedings up to and including those of the meeting of January 22d, are in type, and everything up to the last meeting (February 19th) is in the hands of the printer. The failure to print a signature since January 3d, has been primarily due to lack of matter to complete it, but this is now at hand, and the printing can be brought approximately up to date in a few days. Respectfully submitted,

N. L. Britton,
Recording Secretary.

Report of the Treasurer.

RECEIPTS.

Cash received March 9, 1893, from Henry Dudley, Treasurer.

Current Account,	$258.53	
Savings Bank Account,	1,081.16	$1,339.69
Interest on Investments and Deposits,		197.66
Initiation Fees,		65.00

Fellowship Fees,		$10.00
Life Membership Fees,		200.00
Membership Dues for 1891,	$10.00	
" " " 1892,	60.00	
" " " 1893,	1,555.00	
" " " 1894,	20.00	$1,645.00
Sales of Lecture Tickets,		111.00
Gift,		18.00

EXPENDITURES.

Expenses of Publishing Annals,		$1,152.40	
" " " Transactions,		749.69	
" " Recording Secretary's Office,		338 32	
" " Treasurer's Office,		20.73	
" " Librarian's Office,		109.60	
" " Lecture Committee, 1892 and 1893,		34.00	
" " " " 1893 and 1894,		237.19	
Janitorial Services,		91.50	
Insurance, 1 year on $5,000,		20 00	
Half Dues to Scientific Alliance,		61.88	
		$2,815.31	
Cash on Hand, Current Account,	$156 22		
Savings Bank Account,	614.82	771.04	
		$3,586.35	$3,586 35

PUBLICATION FUND.

Amount Rceived March 9, 1893, from Henry Dudley, Treasurer,	$1,620.45
Interest allowed by Savings Bank,	64.42
Balance on hand,	$1,684.87

INVESTMENTS.

United States Four Per Cents of 1907, $4,100 worth @ 114	$4,674.00

C. F. COX,
Treasurer.

MARCH 5, 1894.

Report vouchers and securities examined and found correct.

HENRY DUDLEY,
Chairman Finance Committee,

Reports were also received from the Librarian and from the Sections of Astronomy and Physics, Geology and Mineralogy, and Biology.

The Academy then proceeded to the election of officers for the year 1894–1895, a list of nominations constituting the regular ticket having been prepared by the Council in the manner prescribed by Chapter XIII., Section 1, of the By-Laws, and mailed to every Resident Member and Fellow two weeks in advance of the Annual Meeting.

Prof. George S. Huntingdon and Dr. J. L. Wortman were appointed tellers. The ballot having been taken and the report of the tellers presented to the presiding officer, the following were declared elected:

President—J. K. Rees.
1st Vice-President—R. P. Whitfield.
2d Vice-President—Henry F. Osborn.
Corresponding Secretary—Thomas L. Casey.
Recording Secretary—J. F. Kemp.
Treasurer—Chas. F. Cox.
Librarian—Arthur Hollick.
Councilors—J. A. Allen, H. Carrington Bolton, N. L. Britton, O. P. Hubbard, Harold Jacoby, R. S. Woodward.
Curators—Bashford Dean, G. F. Kunz, Daniel S. Martin, Heinrich Ries, W. D. Schoonmaker.
Finance Committee—Henry Dudley, J. H. Hinton, Seth Low.

Stated Meeting.

March 5th, 1894.

President Rees in the chair. About sixty persons present.

The reading of the minutes was, by motion, deferred until the following meeting.

Prof. Ernst Haeckel was elected by the society an honorary member, and Prof. J. McK. Cattell a resident member.

As corresponding members were nominated: Prof. Edward B. Poulton, Oxford University, England; Prof. W. T. Sedgwick, Boston Institute of Technology; Prof. William Libbey, Princeton College. These names were referred to the Council.

The Section of Biology then organized. In the absence of its chairman, Prof. Osborn, Prof. Britton was elected temporary chairman. The discussion of the evening was devoted to the modern doctrine of evolution, especially as to the transmission of acquired characters.

Prof. Poulton introduced the discussion in favor of natural selection. He noted that individual variation, however produced, was the requirement of selection, and that the Neo-Lamarckians had as yet failed to demonstrate the inheritance of acquired characters. Their objection to the development of structures to the degree when they became useful, was one rarely to be applied. Nature is adaptive oftener than originative. But even where these structures first develop, they are probably to some degree useful. Palæontology should provide records of selective failures, but with its fragmentary records this would be difficult to expect. If, however, evidence of survival of individuals is lacking, such evidence is retained for groups. The Lamarckian objection is that no cause is a true cause which merely selects; that origin of the fittest is not thereby explained. But this interpretation must be a faulty one; selection selects the minutest variations, it builds and does not merely pick. Offspring are the mean product of parents and of the tendency to reversion, but selection may overcome the reversion. It operates on the entire organism, not on one of its parts, as Spencer had objected.

Natural selection is demonstrated in the known evolution of breeds, as of domestic animals, and negatively by the lack of transmission of acquired characters. Mutilations are not transmitted even, as in the flat-head Indians where their recurrence is long existing. Inheritance of proneness to disease is interpretable as inheritance of constitutional inability to resist it. Selection employs its two factors, use and disease, to produce certain effects, and they do not militate against it. A lobster shedding its claw or a lizard its tail, to divert the enemy, are cases too complex to be interpreted as the effects solely of use and disease. The ventricle by combined use grows no thicker than requisite, because it selects the thickness best suited to survive. Use and disuse should have affected external structures best, yet the skin retains tenaciously its ancestral characters; the oldest birds were feathered, the oldest mammals possessed hair.

The direct action of cold, serving in higher animals as a heat stimulus, is interpretable alone as a result of selection.

Instinct, if the hereditary memory of experience, can only maintain in the higher animals. In the lower animals to avoid experience is the only chance of survival. Mimicry is alone explained by selection, for it is always the rarer form that assumes the characters of distasteful or otherwise protected forms.

Prof. Cope, replying to the discussion of Prof. Poulton, maintained that selection did not explain the origin of variations. It required conditions which could not be obtained; for its purpose there must fortuitously be found two varying indidividuals of either sex, whose progeny, if at all varying, would have to maintain themselves against the entire species. Use and disuse (or movement and lack of movement) is the directive power towards variation, pressing its physical necessity upon the plastic animal form, not merely in one individual but in a race. As in the reduction of digits in horses, the effect was not transitory but constant—for all individuals and at all times. Physiogenesis expresses the immediate influence of environment, stimulated by direct physical causes. Kinetogenesis by the animals' movements gives rise to organic changes. Joint formation is directly kinetogenetic, as the formation of new joints after dislocations tends to demonstrate. External stimuli should affect simultaneously both the body and the germ plasm. Selection can but operate with existing structures, but the origin of these is to be explained by direct needs of environment. In the case of the lower animals' inability to acquire personal experience, was it not possible that this might be acquired by the observation of the experience of others?

Prof. E. B. Wilson noted briefly the lack of evidence on the side of embryology, as to the transmission of acquired characters. Complex structures occur in early stages, which entirely disappear in later development before the development of a nervous system. Can these structures of one stage be transmitted by another? That the germ plasm is not to be directly operated upon by external stimuli seems proven experimentally. The removal of the hypoblast of Echinoderm gastrula does not prevent the remaining germ layers from producing characteristic structures. These appear in no way modified by the loss of the tissue which contains the germ plasm.

Dr. Wortman, continuing the arguments of Prof. Cope, referred to structures of the human foot, which come to be evolved because of pressure, as sesamoid bones, keels and ridges of the great toe. These structures he had found invariably present on examining 150 specimens of foetuses, while in no case was there a tendency to their formation in the lateral toes, where pressure causes were wanting. This evidence would militate strongly against the doctrine of fortuitous variation. The plasticity of the harder animal tissue was emphasized—bone and teeth. Enamel is a living substance, partly regenerative, and capable of being impressed by mechanical causes. Degeneration is hardly to be explained from the standpoint of selection, especially under conditions of civilization, where selection should be inactive, e. g., as loss of wisdom teeth or of terminal phalanx of little toe.

Prof. E. S. Morse emphasized the failure of evidence as to the transmission of acquired characters. He referred to the recent experiments of A. Agassiz, which showed that larval flounders preserve their symmetry when precluded from their normal living conditions.

In concluding the discussion, Prof. Poulton explained that the variations upon which natural selection operated were at the beginning often most minute, and hence it would not seem amiss to regard selection as creative. On the other hand, he could not admit with Prof. Cope that selection regarded the causes of variation as unimportant. But it was not necessary to find variations in both sexes, as the establishment of a well-marked breed of sheep was known to have originated in but a single individual. Intercrossing is unquestionably swamping in its effects, but natural, as well as artificial selection, could overcome its results. Physiogenesis would in the end be often injurious, since in another generation other combinations of colors, etc., might be more valuable for protection.

The action of environment is only valuable as the shock or jar which produces variation in an already predisposed organism Tooth enamel could hardly be regarded as sufficiently plastic to be mechanically modified at certain points to meet necessary wear; if slightly plastic the case is one, not of mechanical origin, but of organic growth.

In the absence of Prof. J. A. Allen, his paper on the "Direct Action of Physical Conditions as a Factor in Evolution" was submitted by the Secretary.

After a brief note by Prof. Cope the meeting adjourned.

BASHFORD DEAN,
Recording Secretary of Biological Section.
J. F. KEMP,
Recording Secretary.

March 12th, 1894.

The regular meeting took the form of a reception and exhibition of apparatus, etc., to illustrate the recent progress of science. The following departments were represented and were under the charge of the chairmen whose names appear opposite:

Anatomy, Prof. Huntington.
Mineralogy, Prof. Moses, Mr. Kunz.
Astronomy, Prof. Rees.
Palæontology, Dr. J. L. Wortman.
Botany, Judge Addison Brown.
Photography, Mr. Van Brunt.
Chemistry, Prof. Chandler.
Physics, Prof. Hallock.

Electricity, Prof. Pupin.
Physiology, Prof. Curtis.
Geology, Prof. Kemp.
Psychophysics, Prof. Cattell.
Zoölogy, Prof. Allen.

Cards of invitation were sent out upon which appeared, as a reception committee, the names of Henry L. Osborn, N. L. Britton, George L. Huntington, George F. Kunz, Charles F. Cox.

These same gentlemen constituted, also, the committee of arrangements. The honorary committee of members comprised Seth Low, Morris K. Jessup, William E. Dodge, F. A. Schermmerhorn, J. Pierpont Morgan, Rutherford Stuyvesant, Samuel Sloan, Oswald Ottendorfer, Henry G. Marquand, Charles P. Daly.

An elaborate catalogue of exhibits was also issued. Copies of the preliminary circulars and invitations are preserved in the book of Academy Memorabilia in the charge of the Librarian. Duplicate copies of the catalogue of specimens will be bound in at the end of this volume of the Transactions.

The reception was largely attended and was in every respect a success. Although on the evening of a regular meeting no organization was effected.

J. F. KEMP, *Recording Secretary.*

STATED MEETING.

March 19th, 1894.

The meeting was called to order by the Recording Secretary, and on nomination PROF. D. S. MARTIN was elected to the chair. Thirty persons present.

Minutes of the last meeting were read and approved.

The following papers were read by title and referred to the Publication Committee.

Harrison G. Dyar, "A Classification of Lepidopterous Larvæ.

Harwood Huntington, "Certain New Derivatives in the Aromatic Series."

The Section of Geology and Mineralogy then organized, Prof. Martin continuing in the chair.

The following papers were read:

O. P. Hubbard, "On the Discovery of basaltic Boulders containing large Nodules of Olivine, at Thetford, Vt." Dr. Hubbard outlined the discovery of the famous Thetford boulders in the early fifties, while he was in the faculty of Dartmouth College. He discussed their probable derivation from basaltic areas in Canada.

NOTE ON THE PETROGRAPHY OF CERTAIN BASALTIC BOULDERS FROM THETFORD, VT.

By E. O. Hovey, Ph. D.

More than forty years ago Dr. O. P. Hubbard, of New York, then of Hanover, N. H., noted the peculiar appearance of a large boulder lying in the road as he was driving through the town of Thetford, Vt., and some time afterward had the rock taken to his home, where it lay for some years before material from it was sent to the Sheffield Scientific School in New Haven. The feature that attracted Dr. Hubbard's attention was the large rounded masses of olivine that gave the rock somewhat the appearance of a conglomerate. Many other boulders of the same character lay scattered over a pasture near the place where the first was found, and several years after their discovery Dr. Hubbard bought some of these, which the owner of the pasture had removed to a neighboring fence, and sent them to several museums as a curiosity, but particularly in the hope that their origin might be discovered. As is well known, the region in which they were found is one of extensive glaciation, and, in all probability, the boulders were brought from the northward to Thetford by the ice. That they were not transported very far is attested especially by the fact that they seem to have been confined to a very limited area of deposition and to thin out in numbers toward the north, according to Prof. C.

H. Hitchcock. If the parent ledge is ever discovered, it will readily be recognized from the peculiar character of the rock.

The boulder donated to the American Museum of Natural History by Dr. Hubbard was originally an irregular ovoid, about two and a half feet in each of two directions and rather less than two feet in the third. It weighed more than 1,200 pounds. It has been broken longitudinally so as to expose a fresh surface to view. The most conspicuous feature of the rock is the numerous rounded masses of granular olivine scattered through it, more than fifty of which, one inch in diameter and upwards, were counted on the freshly fractured surface alone, to say nothing of the numerous small nodules. The largest masses measured were $5\frac{1}{2}$ inches by $6\frac{1}{2}$ inches, $3\frac{3}{8}$ inches in diameter, $4\frac{1}{4}$ inches by $3\frac{1}{2}$ inches and $4\frac{1}{2}$ inches by $2\frac{1}{2}$ inches in dimensions. In appearance these nodules somewhat resemble the bombs of olivine found in several areas of basaltic eruption, notably the Eifel of Rhenish Prussia. The Thetford olivine sent to the Sheffield Scientific School was analyzed there by E. A. Manice, with the following result: *

SiO_2	40.75
FeO	9.36
MgO	50.28
Total	100.39

This corresponds almost exactly to the theoretic composition of an olivine (chrysolite) in which the Mg is to the Fe in the ratio of 10 to 1. The granular masses, while they contain many particles of apparently unaltered material, show the usual tendency toward alteration, and the small nodules have for the most part already gone over into serpentine.

The other striking constituent of the rock is the large rounded crystalline masses of grayish green, glassy pyroxene. Some of the largest of these measured 3 inches by $2\frac{1}{8}$ inches, 3 inches by $2\frac{3}{4}$ inches, $2\frac{1}{2}$ inches by $1\frac{1}{4}$ inches and $1\frac{1}{2}$ by $\frac{3}{4}$ inches on the sections exposed. They may be gotten out whole or nearly whole from the matrix, and, when isolated, they present the appearance of waterworn pebbles with pitted surfaces. Each seems to be a single crystal and they may best be explained as the remains of great crystals of augite, which have been rounded by extensive magmatic re-absorption. Under the microscope this pyroxene is seen to be an augite with its angle of extinction not less than 44°. It is very pale green in the thin section and consists of broad areas of bright, fresh material

*Am. Jour. Sci., II., xxxi., 359, 1861. Also: Syst. Mineralogy, Dana, 5th Ed., p. 257.

intersected by bands and frequently surrounded by a zone of augite of like orientation with the main mass, but possessing lines of parting tranverse to the cleavage. The zone and bands show a greater tendency toward alteration than does the rest of the crystal, and are therefore noticeable on a weathered surface of the boulder.

These large, rounded masses of olivine and augite are imbedded in a very fine grained matrix or ground mass which consists of augite as its main constituent with a basic plagioclase feldspar (labradorite?) in lath-shaped twins with wide angle of extinction and larger irregular masses as a very secondary component. The following were noted as accessory constituents: olivine in small grains; magnetite in numerous small crystals; titanic iron (ilmenite) in lath-shaped crystals, networks and arborescent forms; pyrite; apatite in the usual needles; brown hornblende in lath-shaped crystals, usually associated with the augite of the groundmass, but sometimes in the feldspar. The alteration products seem to be serpentine, chlorite and calcite. The specific gravity of the matrix as determined on three pieces was 2.98, 3.11, 3.13, giving an average of 3.07.

The augite of this groundmass is of the regular basaltic type. Its color is brownish violet, showing the presence of titanium in its composition. It has distinct pleochroism to brownish yellow, and its scheme is, rays ∥ ($\mathfrak{b}$) violet, ∥ ($\mathfrak{a}$) & ($\mathfrak{c}$) yellow. The angle of extinction of this also is at least 44°. The larger crystals have almost complete crystallographic outlines and are strongly idiomorphic, though they are not strictly phenocrysts, as occasionally a small crystal of the same indents one. All the augite is idiomorphic with reference to the feldspar.

The larger crystals and areas contain inclusions of undetermined character and spots which may have been glass originally, but now are considerably altered. Around many of the large masses of pale green augite there is a more or less complete zone of violet augite arranged in minute crystals in parallel position to each other, but not to the pale augite. These crystals are sharply bounded toward the groundmass, but not toward the crystal on which they occur.

The other constituents of the rock do not demand further mention than what is given in the list above. The amount of glass present seems to be very small and has been largely, if not entirely, devitrified.

The rock would be classed as an olivine basalt, very poor in in feldspar, and therefore inclining toward the limburgite division of the family.

AM. MUS. NAT. HIST., NEW YORK CITY, March 19, 1894.

EXPLANATION OF THE FIGURE.

The microdrawing herewith presented shows a portion of the rock which does not happen to contain any olivine and has rather more feldspar than the average. It brings out the salient features of the slide, but cannot pretend to the accuracy of a photograph. The needles of apatite are not represented. The areas of augite are represented by single series of parallel lines; those of hornblende by intersecting lines; those of magnetite and ilmenite by solid black; those of feldspar were left blank. The dotted areas are those of most marked decomposition. Ordinary light. X 115.

J. F. Kemp, "On Some Camptonite Dikes in the Town of Queechee, Vt., near Thetford." Prof. Kemp gave a general review of the camptonite dikes of the Green Mountain region, and cited in particular several from Queechee Gulf, specimens of which had been sent him by Prof. C. H. Hitchcock. These latter comprised true camptonite, diabase and olivine diabase. A series entirely parallel with the typical ones at Campton in the Pemigewassett valley. Prof. Kemp commented on the resemblance of the olivine diabase to the boulders and advocated the derivation of the latter from some undiscovered but extraordinary and abnormal dike. A meteoric source does not seem probable.

G. Van Ingen, "Notes on the Geology of Ulster County, N. Y." The author described several interesting sections along Esopus Creek, west of Rondout, and indicated with the aid of the lantern their geological relations.

MICROSCOPIC ORGANISMS IN THE CLAYS OF NEW YORK STATE.

By Heinrich Ries.

The occurrence af organic remains in the clays of New York State has always been of great interest, not only as a means of determining the age of the more extensive beds, but also as an indication of the conditions under which the clays were deposited.

It was the great scarcity of macroscopic fossils which led me to search the clays for microscopic organisms and the results, while not extensive, are interesting and suggestive.

The clays of New York may be separated into three groups:

1. Quaternary clays, which include the many local deposits scattered over the State and the estuary clays of the Hudson and Champlain Valleys.†
2. Tertiary clays, which probably occur on Long Island.*
3. Cretaceous clays, which occur on Staten Island, and on Long Island at Glen Cove and possibly other localities.

Before describing the results of my observations it may be well to note briefly what organic remains have already been recorded from the clays. The estuary clays along Lake Champlain and at Madrid, St. Lawrence County, contain numbers of marine shells belonging chiefly to the genera *Macoma* and *Tellina*. The skeleton of a whale has also been found in the clay of the Champlain Valley. In the Hudson River clays the only

*Geology of Long Island. F. J. H. Merrill. Ann. N. Y. Acad. Sci., Nov., 1884.

fossils thus far found are some small elliptical leaves, presumably those of a water plant, discovered in the blue clay behind the Medical College in Albany.*

On Staten Island an abundance of plant and molluscan remains have been discovered and described by Mr. Arthur Hollick; they all confirm the cretaceous age of these deposits.†

A list of fossils found in the Long Island clays up to 1884 has been given by Dr. Merrill in his paper on the Geology of Long Island. Since then a number of cretaceous plant remains imbedded in concretions have been found along the north shore of the island between Glen Cove and Northport, but they have been found in the clay only at the former locality. The writer has found leaves [referable to Eucalyptus] in the clays at Northport, and in the summer of 1892 yellow gravel fossils were discovered by him at Cold Spring.‡ Additional specimens were noted the following summer by Mr. Hollick.

Several years ago while making an examination of the Hudson River clays I searched very carefully for fossils, but the only things met were some regular markings which Prof. James Hall declared to be worm-tracks. This absence of organic remains seemed rather unexplainable when we consider the abundance of fossils found in the estuary deposits of the Champlain Valley, which are of the same age.

In order to make my search complete specimens of the clay from many localities between New York and Albany were examined microscopically, and in those from Croton Point were found a number of sponge spicules shown in Pl. III., Fig. 1–13. They are probably referable to *Hyalonema* or some closely allied genus. The following diatoms, all fresh water species, and known to occur at the present day were also discovered in this clay.

Navicula Gruendleri, A. S. Pl. III., Fig. 15.
Navicula permagna, Edw. [fragments]. Pl. III., Fig. 18.
Melosira granulata [Ehr.] Ralfs. Pl. III., Fig. 14.
Nitzschia granulata, Grun. Pl. III., Fig. 25.

Figs. 17, 21, 22, 23 and 24 are fragments found in the clay from Verplank. Fig. 22 is of a yellowish color and resembles the scale of an insect.

In the Champlain clay at Plattsburg one species of diatom belonging to the genus Diatoma was noted. Pl. III., Fig. 16.

The Long Island clays were next examined with interesting results. At Wyandance is a bed of black clay overlain by a

*Mather. Geol. 1st Dist., N. Y., 1843, p. 125.
† Trans. N. Y. Acad. Sci., Vol. XI., No. 5, & Vol. XII.
‡Trans. N. Y. Acad. Sci., Vol. XII. December, 1892.

yellow clay which in turn is covered by yellow gravel. A number of specimens of the black clay were examined, and in nearly every one was found a curious jointed hair of a yellowish brown color. [Pl. IV., Figs. 1 and 2.] I have not been able to identify it thus far and can simply note its resemblance to a crustacean hair. Frustules of *Melosira Granulata* [Ehr.] Ralfs. Pl. IV., Fig. 26 and 27 were also discovered in this clay. Fig. 9, Pl. IV., is the fragment of a spicule from the clay at Farmingdale.

Nothing was noticed in the clays from Fisher Island or Fresh Pond, but in that from Northport which greatly resembles some of the State Island clays and may prove to be of the same age; three species of diatoms were met, viz.:

Melosira granulata [Ehr.] Ralfs. Pl. IV., Figs. 26 and 27.

Diatoma hyemale, K. B.

Cocconema parvum, W. Smith. Pl. IV., Fig. 14.

All three are fresh water species. In the clay from Centre Island in Oyster Bay, one species of diatom is thus far known to occur, viz:

Stephanodiscus niagaræ, Pl. IV., Fig. 28, Ehr., and in addition there was noticed a brown bristly hair, Pl. IV., Fig. 29.

The most interesting discovery, however, was the finding of diatoms in the stoneware clay at Glen Cove. The species are

Melosira granulata [Ehr.] Ralfs. Pl. IV., Fig. 27.

Stephanodiscus niagaræ, Ehr. Pl. IV., Fig. 28, and a frustule, which according to Prof. C. H. Kain, who has very kindly identified many of my specimens, is possibly *Diatoma hyemale*, Pl. IV., Fig. 10. The *Melosira* is fairly common.

While diatoms have not been observed in abundance in any deposits older than the Tertiary, the first undoubted proof of their occurrence is in the Chalk, which is upper cretaceous. The clay at Glen Cove, in which the diatoms occur, is considered to be middle cretaceous, and if this is true it extends the known geological range of diatoms. Let us see what evidence we have of its age. In appearance and chemical composition the stoneware clay closely resembles many of the New Jersey cretaceous clays. It outcrops on the south shore of Mosquito Inlet, near its mouth. The bluff in which the clay containing the cretaceous fossils is exposed, is on the north shore of the inlet and at its mouth. The concretions containing the leaves are distributed all along the shore of the inlet from one outcrop to the other, but none have been met in the stoneware clay. On this evidence the stoneware clay is considered middle cretaceous. It may be added that all the diatoms found in the stoneware clay, are species which are living at the present day. No diatoms were found in the clay bearing the concretions, but fragments of spicules were common in it, as well as in the clay from Dosoris Islands, Pl. IV., Figs. 4 and 5.

The last Long Island clay examined was that from Lloyd's Neck, near Cold Spring. There is in the upper portion of Hammond's clay bank a bed of diatomaceous earth, and its position is shown in the following section given by Merrill : (l. c.)

"Till" and stratified drift,...........................	10 feet.
Quartz gravel,.....................................	45 "
Red and blue "loam" or sandy clay,................	20 "
Diatomaceous earth,................................	3 "
Yellow and red stratified sand,......................	20 "
Red plastic clay,...................................	20 "
Brown plastic clay, ...	25 "
Total,....................................	143 feet.

"The bed of diatomaceous earth is of undetermined extent, and appears to be replaced a little to the east by a blue clay, which, however, contains some diatoms. It is undoubtedly equivalent to the bed of ochre which overlies the sand throughout the remainder of the section."

The following diatoms, all fresh water species, occur in it:

Melosira granulata [Ehr.] Ralfs. Pl. IV., Figs. 26 and 27.
Stephanodiscus niagaræ Ehr. Pl. IV., Fig. 28.
Epithemia turgida [Ehr.] Kutz. Pl. IV., Fig, 22.
Encyonema ventricosum, Kutz. Pl. IV., Fig. 18.
Cymbella delicatula, Kutz.
Cymbella cuspidata, Kutz. Pl. IV., Fig. 12.
Navicula viridis, Kutz. Pl. IV., Fig. 11.
" *cocconeiformis*, Greg. Pl. IV., Fig. 23.
" *major*, Kutz.
" *varians*, Greg.
" *lata*, Breb. Pl. IV., Fig. 17.
Eunotia monodon, Ehr. Pl. IV., Fig. 16.
Gomphonema capitatum, Fhr. Pl. IV., Fig. 21.
Stauroneis Phœnecenteron, Ehr. Pl. IV., Fig. 24.
Fragilaria construans, Grun. Pl. IV., Fig. 20.
Synedra affinis, K. B. Pl. IV., Fig. 19.
Campyloneis Grevillei var *Regalis.* Pl. IV., Fig. 13.
Triceratium trifoliatium. Pl. IV., Fig. 15.

The *Melosira* and *Stephanodiscus* are present in countless numbers. Only two specimens were found of the *Triceratium*, and Dr. D. B. Ward, of Poughkeepsie, who has also given me much aid in the identification of my material, informs me that this species is very common in the diatomaceous earth from

Wellington, New Zealand, but he has never heard of its occurrence before in America. Sponge spicules are not uncommon in Lloyd's Neck diatomaceous earth, and several forms are figured. [Pl. IV., Figs. 6, 7 and 8.] Samples of the red and brown clay from the section given above were examined, but no organic remains were found in them.

Pl. III., Figs. 19 and 20, are spicules from the fireclay at Kreischerville, Staten Island. In the Kaolin found near Kreischerville were discovered a number of diatoms, which Dr. Ward informs me are either *Cocconeis placentula*, Ehr., or *Cocconeis pediculus*, Ehr. Their occurrence is also of great interest, as these kaolins are known to be middle cretaceous beyond doubt.

It seems to me that the results obtained from this hasty examination of the clays are sufficiently encouraging to warrant a further and detailed search. The correlation of strata by means of their microscopic organisms has been successfully tried elsewhere, and further work might prove it applicable to the clays of Long Island, whose age and stratigraphical relations need much further elucidation.

Columbia College, March 19th, 1894.

The Section adjourned at 9:55.

J. F. Kemp,
Secretary of Section and Recording Secretary.

Stated Meeting.

March 26th, 1894.

The meeting organized with President J. K. Rees in the chair. In the absence of the Recording Secretary, the minutes were read by Prof. Hallock and were approved. Eighteen persons present.

A paper by O. F. and A. C. Cook, entitled "A Monograph of Scyonotus," was read by title and referred to the Publication Committee.

The Section of Astronomy and Physics then organized with Prof. Rees as Chairman and Prof. Hallock as Secretary *pro tempore.*

In the absence of Mr. Jacoby, the paper on 61 Cygni was read by Professor Rees. This paper has been published recently in full in the *Monthly Notices* (No. 2, Vol. LIV., Dec., 1893) of the Royal Astronomical Society of London. Professor Rees called attention to the importance of all observations showing changes in the relative positions of the components of 61 Cygni. He remarked on the present uncertainty as to whether the pair formed a true binary system or not. Calculations had given such differing orbits as are indicated by periods of 1159 and 462 years. The observations of S. W. Burnham lead him to conclude that the members of the pair are separating, and Professor Hall, from his observations extending over a period of 12 years, favors the view of physical connection of these stars (Astr. Journal, No. 258, page 140).

Prof. Hallock read a paper on a method of defining standard colors, and showed many samples of colors and the five discs of standard color used. The methods of defining standard color with them were illustrated.

Prof. Rees remarked upon the importance of the work.

Dr. T. J. J. See, of the University of Chicago, read a paper on the "Origin of the Heavenly Bodies," illustrated with lantern slides. He believes that the double stars originated by the swinging apart of one nebula through a process of splitting.

The paper was discussed by President Rees and others.

The Academy then adjourned.

WM. HALLOCK,
Secretary pro tem.
J. F. KEMP,
Recording Secretary.

REGULAR BUSINESS MEETING.

April 2d, 1894.

The meeting was called to order with President Rees in the chair. Fifteen persons present.

The minutes of the last meeting were read and approved.

The Secretary submitted from the Council the nominations of Prof. Wm. Libbey, Jr., of Princeton, N. J., Edward Poulton, of Oxford, England, and W. T. Sedgwick, of Boston, as corresponding members, all of whom were elected.

Messrs. S. G. Bayne and Henry S. Curtis were nominated and elected as resident members.

The Secretary offered for distribution a number of cards of admission to the Fifteenth Annual Exhibition of the New York Microscopical Society for April 17th.

The Section of Astronomy and Physics then organized, and proceeded to the election of a Chairman and Secretary.

Prof. Rees was elected to succeed himself as Chairman, and Prof. Hallock was elected Secretary.

Prof. Hallock read a note on a "New Method of making very fine Bolometers." It consists in constructing the bolometer with a "Wollaston wire," *i. e.*, a wire of very fine platinum surrounded by a coat of silver. This wire being of appreciable size can be easily inserted in the bolometer, after which the silver is dissolved off with nitric acid, leaving the platinum exposed. The paper was discussed by Prof. Pupin.

The next paper was by N. D. C. Hodges, editor of *Science*, on a "New Method of protecting Houses from Lightning."

The paper was discussed by Professors Rees and Pupin.

Professor Rees presented the following notes in regard to the Auroræ of February 23d, 1894, and March 30th. 1894:

"The aurora of February 23d was observed by me from the latitude observatory of Columbia College at 118th Street and Amsterdam Avenue, New York City.

"In the early part of the evening between 6:30 and 9:40 the aurora was noticed but attracted no special attention as I passed from the observing room to the chronograph room, which are separated by an open space 150 feet wide. At about 9:40 I had finished observing a 'star group' and proceeded to the chronograph room to make the final records and computations. I came out at 10 o'clock and was at once surprised by the rapid wave-like motions of the auroral light. I stood watching the phenomena for fifteen minutes and then walked away keeping face to the north. By 10:20 I could see no more motion, nor in fact any aurora. I continued to look for the aurora until 11 o'clock. I was again at the observatory from 2:20 to 5 o'clock the next morning and saw no aurora.

"This aurora was to me the most remarkable one I have ever seen in respect to the wave motion. Great masses of banded light were distributed from the west to the east extending to and beyond the zenith. In the west there was quite a dull red color. All the time there was a rapid wave-like pulsation which passed from the horizon to the zenith in a couple of seconds. These waves were, it seemed to me, about 8 to 10 degrees in vertical extension and about 16 to 20 degrees in east and west direction. The motion made me imagine the resemblance to great white flags that were moved by a stiff breeze. Such flags seemed to be distributed so as to cover about 180 degrees at the horizon from the east point to the west point and to contract toward the zenith.

"The aurora of March 30th, 1894, was observed by me from the roof of 'The Dakota,' from which a clear view, not very badly interrupted by the city lights, could be had of the horizon except toward the south.

"I began my observations at 8:20 o'clock, and continued them till about 10. Three things were especially noteworthy: 1. The beautiful rosy and pink colors in the east and west at times. 2. The radiation of the aurora from the zenith in all directions, the remarkable southern extension being greater than I have ever previously beheld it. 3. The very peculiar zenithal development, which showed a ring formation. A cloud-like ring some 3 degrees wide and having an inner radius of about 10 degrees showed itself whenever the light pulsations spread to the zenith, and from this ring the radiated streamers extended in all directions. The ring did not always keep the same place, but appeared to my eye to occupy a slightly different place at each illumination, but always kept near to the zenith. The appearance suggested a current of electricity passing through a thin cloud of ring-like formation.

"When I first saw the aurora there were cloud masses of very dark gray color ranged from the west point of the horizon around to the east. The upper edge of this bank was irregular. At the west it rose highest, reaching some 35 degrees from the horizon at times. Its height was not always the same. This western bank of clouds was the focus of the greatest display. Here were to be seen the most exquisite rosy tints, which spread with radiated bands to the zenithal ring, and thence seemed to pass out in all directions. Later the western focus was dimmed and there appeared a vivid display of red light in the east, which sent up shafts to the zenith, and there again the ring appeared and seemed to distribute the silvery blue light in all directions. At various times this answering of the east display to the west was finely seen.

"At about 8:45 the finest of the display was over, and there appeared in the north about 20 degrees west a curtain aurora having an extension east and west of about 35 degrees and rising toward the zenith with its peculiar folds about 45 degrees.

"Later in the evening, at the observatory at 118th street, between 1 and 3 o'clock, I again at times looked at the aurora, and I could see wave-like pulsations moving from horizon to zenith, as in the aurora of February 23d, previously described, but this motion was faint compared with the motions of the aurora of February 23d.

"During my observations early in the evening the light was intense enough to enable me to read readily the time from my watch, and when I went up to 118th streets, I looked at some of the light masses with a small direct vision spectroscope, but obtained only a very faint continuous spectrum. I am inclined to believe that had I the spectroscope when the display was most brilliant, I would have obtained the characteristic spectrum of the aurora.

"The intensity of the light and the peculiar display at the zenith giving the ring formation suggests to my mind the possibility of taking photographs of the auroral displays of like intensity and persistency of form.

" In closing this account I am pleased to present a letter received from our fellow member, Mr. C. A. Post."

NEW YORK, March 31st, 1894.

Professor J. K. Rees,

DEAR SIR.—I send you some notes of the aurora, observed at Bayport on the evening of March 30th.

At 7:45 Eastern time I noticed a distinct greenish light, due west, which extended to the zenith. To my surprise I found another band in the east meeting the western one at the zenith. At this point it soon attained its greatest brilliancy and breadth, while the northern and southern sky both remained dark.

At 8 p. m. this band, broadest at the zenith and narrowing down at each horizon, was so brilliant that I could read the seconds hand on my watch. Below Jupiter and in the region of Taurus streamers of greenish white light appeared, followed by frequent and very brilliant white flashes. Next a very bright red streak shot from nearly due west to the zenith. This was followed by streamers spreading from the eastern and western skies to the north and converging at the zenith, where the sky was brilliantly red. These streaks, of which some were red and others green, formed a half dome with the apex in the zenith. The southern sky now became also illuminated until the stripes formed a perfect dome, suggesting to my mind the frame of an open umbrella with a hole in the centre for the handle, for at the zenith there was a distinct condensation with a sharply defined black centre.

At 8:10 the southern side of the dome extended below Rigel, Sirius and the constellation of Corvus.

At 8:15 the region of Taurus became bright red, fringed with very bright wisps of green. At this time the northern sky was very feebly illuminated with light greenish white streaks. At about this time waves of luminous mist rolled from the southern horizon to the zenith. The southern sky was otherwise clear and there a was strong breeze from the north.

At 8:17 the light suddenly faded away, leaving a red glow due west, from which there were constant flashes like distant lightning.

At 8:20 waves of light shot up from the south, looking like reflections from a bull's-eye lantern thrown on the southern sky, and moved rapidly upwards. During all of this time the northern sky was dull and inactive and almost without light.

At 8:22 the red glow became very brilliant about west-northwest. In the northeast a moderately brilliant green streamer next appeared, accompanied by a red streak, which soon developed into a band from east to west, passing in the east some 5° north of Virgo and through Auriga in the west.

At 8:32 the northern sky became very brilliant, and at 8:37 the umbrella-like formation again showed itself, but in a less marked degree than before.

Shortly after this the light faded away, and before 8:40 the display practically ceased, but an aurora of no very extraordinary character remained in the northern sky until about 9:30, when, although it was still visible, I ceased to note its changes.

The marked peculiarity of this aurora seems to have been its extremely vivid red and green light, and the fact that it commenced in the west and east, was very brilliant in the south, and, except for a few moments, the northern sky was a comparatively insignificant factor in the phenomenon. The zenith, at all times of great activity, was the apparent centre of brilliancy. Very truly yours,

CHAS. A. POST.

The second paper, by Prof. Rees on the "Solar Faculæ in the Rutherfurd Photographs," was postponed on account of the lateness of the hour.

Prof. Rees announced the receipt of some very beautiful negatives from the Lick Observatory, including one of the eclipse taken by Schaeberle in South America.

The Section then adjourned at 10:30.

WM. HALLOCK, *Secretary of Section.*
J. F. KEMP, *Recording Secretary.*

STATED MEETING.

April 9th, 1894.

In the absence of regular business, the Biological Section immediately organized; Prof. H. F. OSBORN in the chair; about thirty persons present.

The following papers were read:

H. F. Osborn, "A division of the Eutherian Mammalia into the Mesoplacentalia and the Cænoplacentalia."

Paul Gibier, "Glycosuria produced experimentally in animals by psychical causes."

Albert C. Mathews, "The morphology and physiology of the pancreas cell."

J. L. Wortman exhibited three new specimens of mammals from the White River deposits of Dakota, two of *Anthracotherium* and one of *Hyopotamus.*

The following names were nominated and referred to the council: Prof. Mitchell T. Prudden, Dr. Ira Van Gieson, Dr. Edward Freeborn.

The following titles were presented for publication :

O. S. Strong, M. A., "The Origin and Distribution of the Cranial Nerves of Amphibia; a contribution to the Morphology of the Vertebrate Nervous System."

Bashford Dean, Ph. D., "New forms of Coccosteids; and the relations of Arthrodiran fishes." Meeting adjourned.

BASHFORD DEAN,
Secretary of Biological Section.

J. F. KEMP,
Recording Secretary.

STATED MEETING.

April 16th, 1894.

The meeting organized with Vice-President WHITFIELD in the chair. Twenty-three persons present. The minutes of the last meeting were read by the Secretary and were approved.

The following paper was read by title and referred to the Publication Committee :

ACCOUNT OF AN ANCIENT BEAVER POND AND OF CUT STICKS FOUND THEREIN.

BY PROFESSOR OLIVER P. HUBBARD.

About 1860 Mr. Wm. H. Daniels, of Plainfield, Sullivan County, N. H., requested me to examine some localities on his ancestral farm that had been occupied by his family for 60 years. This was a hill farm of 300 to 400 acres, a mile from the Connecticut River, and with a southwesterly drainage to it. One spot of 12 acres lying in a side hill valley, sometimes wet, and partially cultivated, was covered with heavy grass mowed annually. There stood on it a stump of a pine tree, over 4 feet in diameter, which was cut between 1840 and 1850, when the clearing was begun. On the lower or drainage side was a compact earthy barrier of true "glacial drift."

"The original forest contained the usual varieties that grow in this climate on wet land, and you counted on the stump over 600 grains" (rings?).*

To bring this fertile area most easily under cultivation, Mr. Daniels cut, by my advice, two trenches. One was 30 to 40 rods long and was intersected by the other at its middle point. The latter was 40 to 50 rods long, and each was 4 feet wide at the top, and 4 or 5 feet deep. They penetrated for nearly their entire depth, a deposit of dark, peaty, vegetable matter to the bottom of a basin. The immediate bottom was thickly covered with short sticks of hard and soft woods, of a peaty color, from 6 to 18 inches long, and from 1 to 6 inches in diameter. Some of these resembled poplar, hemlock and iron-wood. The ends were marked as if gnawed by incisor teeth, as is seen in trees and fragments taken from beaver dams. An inspection suggests this as the only agency in their production.† Two fragments of bone 4 inches long have been submitted to Prof. Scott, of Princeton, for examination.

Admitting the agency of beavers we have here a curious succession of facts after the end of the glacial period. (1) A natural basin holding water and a young forest covering the country. (2) A migration of companies of beavers from the South taking possession and occupying it for a long time, covering the entire bottom with sticks. (3) The rodents at some time departed voluntarily or were driven out by some change in the physical condition, whereby (4) There was an influx of sedi-

* Letter of Mr. Daniels, Dec. 7, 1874.

† This was the united opinion of the Academy on viewing the specimens.

mentary matter and vegetable growth that completely filled the basin and it became a wet swamp. (5) A forest growth succeeded of great size and age. (6) This probably was, according to custom, cut in the winter when the surface was frozen. (7) The country being cleared the bog dried and gradually shrunk to five feet in thickness, leaving the roots of the stump exposed. We may estimate the age of the pine at least 300 years?* ; this added to the fifty years since it was cut, equals 350 years, the only *unit of time* we have, and we must, therefore, fall back on geological periods.

NOTE.—Mr. Daniels wrote me, December 7, 1874: "A geologist who has seen the specimens of the sticks you left in the cabinet of Dartmouth College, visited me and said he had discovered that they had been cut by two different animals—those cut round and round the stick were the work of beavers, and many cut lengthwise, with tooth marks an inch or more wide and sharp angles between them, were done by mastodons, and that *the same cuttings* were met where the remains of a mastodon were found at Cohoes Falls, N. Y., September, 1866." In the "Report of the Regents of the University of New York, 1871," p. 79, is "Prof. James Hall's account of the Cohoes Mastodon." He says, p. 100: "Among the fragments of wood taken from the peaty swamp—of several species—with pine and hemlock cones, were many which had been gnawed by beavers, the marks of (their) teeth remaining distinctly visible." There is nothing said of marks of mastodon teeth. We know his food was similar to that of the modern elephant (vegetable), but there is no reason to suppose *he ever gnawed trees, if it were possible.*

To this end portions of the earth have been referred to Mr. Charles F. Cox, of the Academy, for microscopical examination, and he has kindly prepared the following report:

I have made microscopical examination of the earth obtained by Prof. Hubbard, at Plainfield, New Hampshire, and find that it is to be classed with the rich diatomaceous deposits which are common in almost every part of the State. In 1874, Dr. Arthur Mead Edwards was employed by Prof. C. H. Hitchcock as microscopist to the Geological Survey of New Hampshire, and in his report gave a list of fifteen localities from which specimens, of diatomaceous earths had been sent to him. In this list every one of the ten counties was represented, excepting Rockingham and Sullivan. Since that report was published other similar deposits have been made known, but, as far as I am informed, this specimen is the first to come from Sullivan county.

* A pine tree (*P. strobus*) was cut in 1770 on Hanover, N. H., plain, 270 feet long, and another a few years since in Whitefield, N. H., seven feet in diameter.

These deposits, old and new, are now generally described as "Lacustrine sedimentary," but their exact age is a matter of constant discussion, because of the fact that almost every quiet body of water is to-day laying down a stratum of diatom shells of the same general character as that of the strata, which compose the relatively ancient and semi-fossil beds, which are found either dry or beneath existing lakes and ponds. As these beds are usually located in hollows, produced by glacial action, the earliest of them are doubtless to be referred to the Quaternary period (probably to the Champlain epoch), while the rest are of every possible age, down to the actually contemporaneous. It is likely, however, that the process of deposition is at present proceeding at a much slower rate than that at which the earlier beds were formed, and this difference seems to be due, mainly, to a change of temperature, the climate towards the middle and close of the Champlain epoch being most favorable to diatom growth and multiplication.

The extensive marine deposits of diatomaceous material in Maryland and Virginia, as well as the vast lacustrine and fluviatile strata of Nevada, Utah and other Western States, are probably correctly referred to the Tertiary period.

The fresh-water deposits of our Northern and Eastern States are divided into two classes, the sub-peat and the lacustrine proper. Deposits of the first-named class were laid down in bogs and marshes, or in bodies of water which subsequently became partially dried up, were then buried beneath gradually accumulating beds of vegetable debris, and were finally often grown over by trees and shrubs. Deposits of the second class, as a rule, were formed in ponds and lakes which have ever since continued to be such, or which were at some time suddenly drained by the destruction of their barriers or dams.

In the specimen submitted to me I have thus far identified, as I think, eight genera and twenty-two species of what are known as free forms; but the individuals of these species are so exceedingly numerous that they may be said to make up the great mass of the material. This fact leads to the conclusion that in the main the deposit was formed in a placid body of water. There are, however, to be found in it diatoms belonging to at least five genera and eight species which are either filamentous, stipitate or adnate in their methods of growth, which seems to indicate that a stream or streams flowed into or through the pond or bog from which the specimen came, by which these forms were introduced and mixed with the prevailing species.

I have no information as to what proportion of the five feet of peaty matter, which Prof. Hubbard says overlay the sticks and bones exhibited by him, was composed of material like that submitted to me. But even if we knew that the whole of it was of the same character we could not make any trustworthy estimate of the time consumed in its formation. It must suffice that we can with some certainty trace these sticks and bones well back into the Quaternary period, because of their position beneath this diatomaceous deposit in a post-glacial basin."

CHARLES F. COX.

Professor Scott, of Princeton College, sends the following report in regard to the cannon bones: " *They consist of two fragments of the metatarsus* of deer, which probably represent two species. Neither one agrees altogether with any deer with which I have been able to compare them, (e. g. *Cervalces*, *Megaceros*. *Alces*, *Cervus Canadensis*), though the larger one is not unlike the elk or wapiti. The material is, however, *too scanty for the formation of new species.*

When the opportunity was offered for the exhibition of specimens, Mr. C. L. Pollard presented some fossil leaves of Cretaceous age, from Eaton's Neck, L. I., with the following notes:

In his paper on "The Clays of New York State and their economic Value," printed in the Transactions of the Academy for December, 1892, Vol. XII., Mr. Heinrich Ries mentions among other clay outcrops on Long Island, a bed of stoneware clay on Elm Point. This clay pit is between 30 and 40 feet deep, overlaid with 15 to 20 feet of yellow gravel and drift. At the base of it, along the shore, detached fragments of shaly sandstone have been discovered, containing plant remains similar to those found hitherto at Glen Cove. This is the first instance in which fossil leaves have been found so far west on the north shore of the island. The fragments are water-worn, with smooth edges, showing that they have not been broken off from any underlying fossiliferous stratum. Moreover, as we penetrate into the clay itself, no trace of these fragments can be found, neither do they seem to occur at a greater distance than 300 yards along the beach on either side of the clay pit. While the remains are somewhat fragmentary, the following species have been recognized: *Liriodendron simplex*, Newb.; *Diospyros* *primæva*, Heer; *Magnolia alternans*, Heer; *Platanus Newberriana*, Heer.

As to the origin of these sandstones, which are not concretionary in their structure, or as to their probable connection with the clay outcrop in question, it would be useless to speculate until the matter has been further investigated, and other portions of the shore searched for new material.

The Section of Geology and Mineralogy then organized. The following papers were presented :

ON CASWELLITE, AN ALTERED BIOTITE FROM FRANKLIN FURNACE, N. J.* QUARTZ CRYSTALS FROM ELLENVILLE, N. Y.

BY ALBERT H. CHESTER.

The mineral now under consideration is the one alluded to by the author at the meeting of the Academy, held October 30, 1893.† At that time a short account of its discovery was given, as well as a statement from Mr. F. L. Nason, as to its occurrence and associations. Since then it has been examined at the laboratory of the New Jersey State Geological Survey, with the results given below.

The new mineral is of a peculiar flesh, or light copper-red color, with a bronzy lustre and micaceous structure, closely resembling light-colored clintonite, for which it was at first mistaken. Its hardness is 2.5—3, and its specific gravity is 3.54. It is completely decomposed by hydrochloric acid, with the separation of gelatinous silica. It has entirely lost the elasticity of the original biotite and is quite brittle, so that while it still cleaves easily it has not the eminent cleavage of mica. It occurs in most intimate association with massive yellow garnet (polyadelphite), granular rhodonite and a somewhat altered dark brown biotite, with which last it is most closely connected, in many instances the same plate of mica showing a gradual change from nearly black biotite at one end to caswellite at the other. It therefore is found in all stages of alteration, and varying in color from almost black to the bronze-red or pink described above.

* By permission of Prof. John C. Smock, State Geologist of New Jersey.
† Trans. N. Y. Acad. Sci. xiii. 97.

Our analyses result as follows:

	1.	2.	Average.
Ignition loss,	4.64	(4.64)	4.64
SiO_2	38.68	38.80	38.74
Fe_2O_3	6.85	(6.85)	6.85
Al_2O_3	6.45	6.71	6.58
Mn_2O_3	15.80	16.11	15.95
CaO	22.68	21.92	22.30
MgO	5.43	5.60	5.52
	100.53	100.63	100.58

The molecular ratios, calculated from the average of these analyses, are:

SiO_2	.643	.643	3.09
Fe_2O_3	.043		
Al_2O_3	.064	.208	1.00
Mn_2O_3	.101		
CaO	.398	.536	2.57
MgO	.138		
H_2O	.258	.258	1.24

showing ratio, of $SiO_2 : R_2O_3 : RO : H_2O = 6 : 2 : 5 : 2.5$. This does not suggest any very probable formula, a result to be expected from the way in which the mineral was produced.

Mr. Heinrich Ries, Fellow in Mineralogy at Columbia College, who made optical examinations of this mineral and of the associated biotite, writes as follows: "The new mineral is very feebly doubly refracting, and shows apparently no pleochroism in a section at right angles to the base. It is more strongly biaxial than the biotite from which it has altered, but it is so feebly refractive that only poor images could be obtained. With the gypsum plate, showing red of the first order, it acts like an isotropic mineral, so that the character of the double refraction could not be determined. The biotite with it shows a slight divergence of the optic axis probably not more than 5°. A flake was struck with a sharp point to obtain the percussion figure, and the leading ray of the latter was parallel to a line joining the loci of the optic axes, proving it to be a mica of the same order as biotite." A very dark red mica with brilliant lustre, from the same mine, and associated with similar minerals, was also examined optically, and proved to be a fresh, unaltered biotite. Chemical examination showed the presence of potash in considerable proportion in this unaltered biotite, while it is found in slight amount in the biotite occurring with the caswellite, from which latter it has wholly disappeared, as shown by the analyses quoted. The fresh biotite also shows much magnesia and little or no lime, differing thus from the caswellite.

These facts show that there is an unaltered manganesian biotite among the minerals found at the Trotter mine, which at least at one place has been altered by the loss of its alkalies, and probably by other changes in its composition, so that it has practically become a new mineral. This idea is strengthened by the fact that the mineral has been found only at one place in the mine. Though nothing is on record of its occurrence, its position and distribution in the dump shows that it was of local occurrence. It seems to indicate an influx at some point of water carrying with it manganese and calcium compounds, and perhaps helps to explain the finding of such a variety of minerals at this most prolific locality.

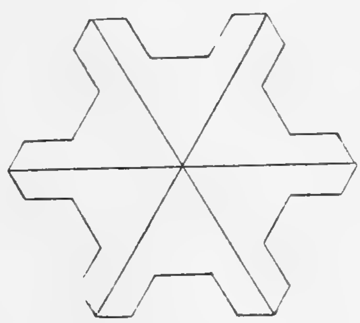
Inasmuch as these results seem to justify the view that it is a new mineral species, I propose for it the name *Caswellite*, after Mr. John H. Caswell, of New York, well-known among the mineralogists of this vicinity.

QUARTZ CRYSTALS FROM ELLENVILLE, N. Y.

The quartz crystals which are the subjects of this communication are from the mineral collection of Rutgers College. There is no record to show their exact source, but they came from the lead mine at Ellenville, Ulster county, N. Y.,

FIG. 1

FIG 2.



and have evidently been in the College collection for a long time. The first specimen is noticeable on account of the peculiar prolongation of its pyramid faces as shown in the accompanying figures, which represent the crystal as it would appear if what was evidently attempted had been completely carried out. In the actual specimen the projection is found on but five of the six angles, another large crystal having grown on in such a way as to prevent it on the sixth. This crystal has something of the same shape, however. Whether this is a sort of skeleton growth, with the intervening spaces not yet filled out, or a case of twining, is not quite clear. The former idea is rendered probable from the fact that these spaces are partially filled up by a large number of small crystals, all of which have their faces parallel with the corresponding faces of the large central crystal.

The other specimen is a doubly terminated crystal of quartz of the ordinary shape, but interesting from the fact that one termination is more or less coated with a layer of native copper. As far as I know, this is the first occurrence noted of native copper from the state of New York. It is not at all strange that it should occur at Ellenville, for a considerable amount of chalcopyrite has been found there, at times in very large and beautiful crystals, affording some of the finest known specimens of this mineral.

Another very interesting specimen from the same locality to be seen in the Rutgers collection, but too large to be easily taken away for exhibition, is a slab covered with quartz crystals upon which are implanted more than fifty crystals of brookite of the tabular form and red color so well known as occurring there.

These three specimens have been considered unique enough to deserve mention and description here.

RUTGERS COLLEGE, April 14, 1894.

The papers were discussed by Profs. Moses, Whitfield and Kemp.

2. A. J. Moses, Mineralogical Notes. Prof. Moses gave as the results of recent measurements made on some crystals of zincite, from Franklin Furnace, and stated that, referred to Rinne's crystal of artificial oxide of zinc, the natural crystals are either $\frac{5}{4}$ P. or $\frac{3}{4}$ P.

Dr. Moses mentioned Atacamite from Globe Arizona, and exhibited the crystals, which are of unusual excellence. The notes concluded with a reference to the curious cavities in quartz and chalcedony, apparently left by definite monoclinic crystals, which are found at McDowell Quarry, Upper Montclair, N. J. The angles are very constant and are near those of orthoclase, but the speaker was unable to suggest the original numeral. The papers were discussed by Prof. Chester and Kemp.

3. A. S. Eakle; Tourmaline Crystals from Rudeville, N. J. In the absence of the author the paper was read by J. F. Kemp.

Large crystals of brown tourmaline from the limestone quarries north of Franklin Furnace were described, which are remarkable for the extended development of the basal pinacoid. In addition the other faces present are $P2$, $P\frac{5}{4}$, R—$2R$, R^5 and R^3.

Prof. Kemp, who had collected the crystals, remarked on their occurrence near the basic dike, which contains leucite, and which probably occasioned their formation. (See Amer. Jour. Sci., May, 1894.)

The next paper was—

THE INTRUSIVE ROCKS NEAR ST. JOHN, N. B.

(Plate V.)

By W. D. Matthew.

Southern New Brunswick is in large part underlain by a complicated series of rocks, sharply folded and much faulted and metamorphosed. These have been referred for the most part to Pre-Cambrian time, and appear to be a continuation of the great metamorphic belt of the Eastern United States. They have been very fully described as regards stratigraphy and general character in various Reports of the Canadian Geological Survey and elsewhere, and, as far as their limited exposures and complex folding and faulting permitted, their succession has been carefully determined. The work on this area, however, was done without the aid of modern petrographic methods, and in view of the great advance which these have effected in our understanding of the character and origin of igneous, and especially of metamorphic rocks, it would seem that some new light might be thrown on the Pre-Cambrian formations of this region by a study of thin sections of the various rocks composing them.

In the publications of the Survey, two main groups have always been distinguished. They differ markedly in lithological character, and are unconformable to each other and to the overlying Cambrian sediments, so that they have been compared to the Laurentian and Huronian series of Quebec and Ontario, and named accordingly.

These names are open to considerable objection when applied to the New Brunswick Pre-Cambrian on account of the restricted sense in which they are now used. Further, they are liable to be understood as implying a time-equivalence which is by no means certain, even in the former broader sense of the terms; and they were replaced in the later Survey Reports by numbers to indicate the divisions. But as this article deals with the petrography rather than the stratigraphy of the country mapped, it seems best to retain the old and well-established names, with the understanding that they imply merely a convenient and natural division of its Pre-Cambrian strata, corresponding to that found elsewhere. Whether this correspondence implies any real equivalence, or merely a similar succession of conditions, is unproved, if indeed it be provable. Within the area mapped, no rocks which can well be compared with the "Archean complex" are seen;* it may be present elsewhere in the province. As a matter of convenience, then, the terms Laurentian and Huronian will here be used for the two divisions of the New Brunswick Pre-Cambrian.

The earlier series or Laurentian consists chiefly of granitic and gneissic rocks, limestones and quartzites, the two last confined to the upper beds. It appears to have been considered, in the time of the earlier reports at least, as almost all sedimentary, though eruptive granites are occasionally noted. The strata lie steeply inclined in a succession of ridges and folds with a general northeast and southwest direction.

Overlying this more crystalline series, at a generally lower dip, are fine-grained flinty rocks, interbedded with various schists, porphyries, ash-rocks and sandstones, and with great masses and dykes of trap. These have been called Huronian, and with them have been coupled other rocks of similar character, but doubtful relations. This series has been considered as in part sedimentary, in part surface volcanic products, more or

* Prof. Van Hise, in Bulletin 86, United States Geological Survey, suggests separating the upper (limestone) beds of the "Laurentian" of New Brunswick, from the lower (gneiss) and calling the latter, Archean, while the former is added to the Algonkian. But in the neighborhood of St. John, the first described and typical area of the southern New Brunswick rocks, the true gneisses are conformable with, and in their upper part interbedded with, the limestones and quartzites, while the latter are unconformably overlain by the volcanic clastic "Huronian" group. The unconformity between the upper and lower "Laurentian" described in the early reports is an intrusion contact; aside from these intrusives, the gneisses are closely connected with the limestones.

less worked over by water and subsequently altered by metamorphic action.

The present paper deals only with the lower series of rocks, the so called Laurentian, in the vicinity of the city of St. John. This area has been taken as a type, as it is well exposed, and affords good opportunities for study. A great extent of country both east and west of it is occupied by the same formation, but is largely wooded, the rocks deeply buried by surface deposits, and roads are few and far between.

The lower part of the Laurentian series, just north of the city, is made up of massive crystalline rocks, both acid and basic, which have been described as syenites, gneisses and diorites. The first of these is a coarse-grained quartzose granitic rock, with large porphyritic crystals of pink-weathering feldspar. Although its resemblance to an eruptive granite was noted by the officers of the survey, yet it appears to have been considered a highly metamorphic sedimentary gneiss.* Microscopic study has shown it to be an intrusive quartz diorite or hornblende-granite. The gneisses proper are of variable character, at times quite massive, but generally schistose, granular, banded with alternate light and dark beds, and in the upper part of the series interbedded with the limestones and quartzites. They are accompanied by hornblende and mica schists, into which they sometimes grade. Thin sections show no trace of igneous origin. The diorites included a variety of rocks, some of which seem to be altered sediments, while others are altered igneous rocks, gabbros, quartz-diorites and diabases. Associated with the less crystalline limestones are numerous thin beds of a fine grained black pyritous rock, which has been generally called argillite; it is wanting in any noticeable bedding or slaty cleavage.

Microscopic study shows that much of this lower Laurentian series is of igneous origin, and that its exact age is very doubtful, though it is probably Pre-Cambrian. The intrusive rocks of the series, which it is the purpose of this paper to describe, are of two classes, one a very quartzose acid rock varying from a quartz-diorite to a hornblende-granitite; the other quite basic, and varying from anorthosite to peridotite. These may be called respectively *granite-diorite* and *gabbro*. The first occurs as long ridges and more or less detached remnants covering altogether a considerable area. Of the second the exposures are quite limited, being confined to two small bosses, each only a few hundred feet long and wide, in the " North End " of the city, commonly known as Indiantown. Other exposures are

* Report of 1871.

known to occur outside the limits of the accompanying map, but the rock is not a common one in New Brunswick.

1. GRANITE-DIORITE.

The typical locality for this rock is a band which rises from under surface deposits about a mile and a half west of Indiantown, thence, crossing the river, stretches northeast for three miles, when it thins out and disappears. It is $\frac{3}{8}$ mile wide at its western end, but narrows considerably toward the other. The rock is pretty uniform throughout, though coarser to the west of the river, and is, as already noted, coarse grained, with porphyritic feldspar crystals.

Besides the main band, there are several other areas within the limits of the map. A narrower band lies about $\frac{1}{4}$ to $\frac{1}{2}$ mile to the north and another a mile or more further, the last being an interrupted one along the edge of Kennebecasis Bay, and forming for the most part a mere facing for the steep shore cliff. At the eastern end it thins out so as to be not wider than a heavy dike. These two northern bands are finer grained than the southern one, and the porphyritic feldspars are wanting. At Poverty Hall Point, on Kennebecasis Bay, is a little area of the same rock, apparently a remnant of a much larger mass. It is in part quite coarse and porphyritic. To the east of the southern band, another wider intrusion comes in, of which only the western end is known to the writer. It is coarser than any of the others, and contains enough orthoclase to make it a true hornblende-granitite.

MICROSTRUCTURE. It is largely on internal evidence that the granite-diorite has been set down as intrusive, for with exceptions to be described later, the contacts between it and the surrounding rocks are invariably faulted.

Fig. 1 represents the appearance of a nearly typical thin section from a little quarry on the Sand Point Road, in the southern band. The rock may be described as follows:

Quartz is present in large amount, forming $\frac{1}{3}$ to $\frac{2}{5}$ of the whole mass. It occurs in large grains and is always allotriomorphic.

Plagioclase is in more or less well-defined crystals, rarely entirely allotriomorphic, except near the edge of the intrusion. The crystals sometimes show a zonal structure, but this is not very pronounced.

Orthoclase is much less abundant than plagioclase, with the exception noted above. It is almost all in the form of strongly zonal crystals, often broken or corroded, averaging $\frac{1}{4}$ to $\frac{1}{2}$ inch long. A little orthoclase occurs in small irregular grains, especially near the edge of the mass, where the phenocrysts are mostly wanting. The orthoclase of the phenocrysts appears to be older than the plagioclase, that in the ground mass younger.

Hornblende, when original, occurs either in well-defined crystals or irregular masses of deep green color and strong pleochroism. It is sometimes very difficult to get it thin enough to be translucent. The secondary hornblende is uralitic, with light green and yellow pleochroism, and is found paramorphic after biotite and also after the dark-green hornblende, instances of the progressive alteration of either being not infrequently seen.

Biotite is mostly in well bounded crystals, and is almost as abundant as the hornblende in unaltered material, but tends

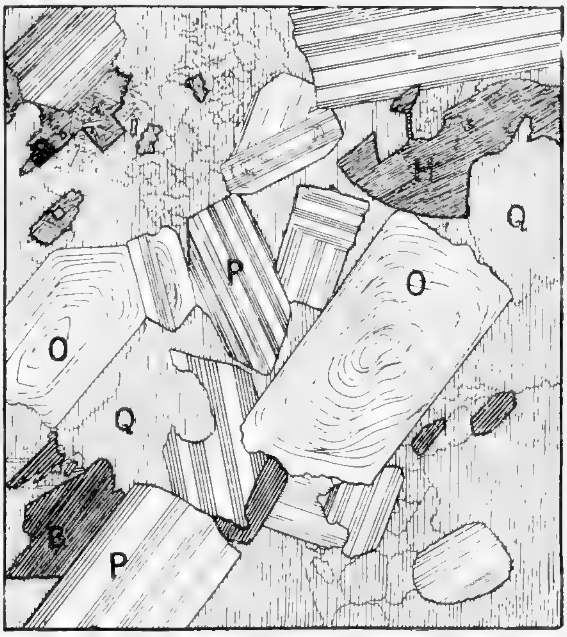


FIG. 1, QUARTZ-DIORITE.

Enlarged 5 diam. Spec. 113 Q=quartz; P=plagioclase; O=orthoclase; H=hornblende; B=biotite.

strongly to alter to secondary hornblende interleaved with epidote.

Apatite is unusually abundant for this kind of rock, and forms a good characteristic whereby to make sure of the identity of any part of the intrusion. It is in the usual small crystals and mostly included in or associated with the ferromagnesian silicates.

Zircon is likewise quite abundant, especially in connection with abundance of orthoclase. It occurs in remarkably well bounded crystals which have, besides the ordinary prism, pinacoid and pyramid, apparently i-3, and perhaps other faces.

Magnetite is not common, though occasionally associated with the dark silicates. It appears to be in part titaniferous.

Titanite has been observed in several sections from near the edges of the intrusion, in large, sharply defined crystals.

Monazite?—In the heavy concentrates from the crushed rock were found one or two crystals of a clear yellow color and high refractive index, showing an abundance of faces referable to orthorhombic or inclined axes. These may be referred to this mineral, which Derby has shown to be accessory in many granitic rocks.

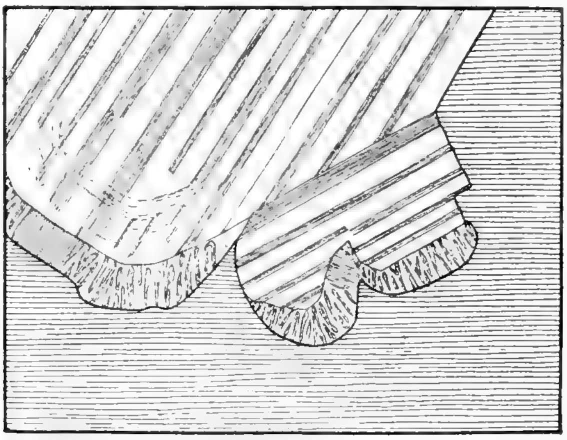


FIG. 2, MICROPERTHITE.

On crystal of plagioclase in quartz-diorite. Enlarged 25 diam.

Secondary products.—*Epidote* is the most noticeable of these. It is very faintly pleochroic from colorless to pale yellow and occurs accompanied by a smaller proportion of other minerals, replacing the plagioclase, or interleaved with biotite or hornblende. When it replaces plagioclase, an odd-looking rock is sometimes produced, composed of opaque green and pink crystals in a background of glassy quartz, the pink crystals being weathered orthoclase. In other cases the original structure is almost obliterated by crushing and epidotization, so that the rock is scarcely recognizable.

Microcline is often seen, and is regarded as being here a secondary structure, developed in orthoclase by paramorphic

* Proc. Rochester Acad. Sci., Vol. I., p. 198: Amer. Journ. Sci., Vol. XLI., p. 309.

change, since it has been observed only in those slides which show evidence of shearing and strain, and is abundant in such specimens as have a marked gneissic structure. What look like transitions between orthoclase and microcline are sometimes seen.

Microperthite is not uncommon, sometimes forming a partial ring around plagioclase crystals at their contact with quartz (Fig. 2), more often scattered in small masses between the other constituents. In the former case it looks rather like a reaction rim, and may be produced in a similar way.

The specific gravity varies from 2.69 in the coarse porphyritic granite to 2.75 in the fine dark grey quartz-diorite. A partial analysis of a specimen as nearly typical as could be obtained gave the following results:

$Si\,O_2$	65.8
$Al_2\,O_3$	13.1
$Fe\,O.\,Fe_2\,O_3$	7.7
$Ca\,O$	3.5
$Mg\,O$	0.9
$K_2\,O, Na_2\,O$	6.6

Loss on ignition not determined.

The high percentage of iron is rather remarkable. In this respect it agrees well with the analysis published by Vom Rath of the original Tonalite from the Alps.

VARIATION. The most striking change in the character of the rock is the greater or less abundance of orthoclase phenocrysts, which are in largest amount in the widest intrusions, while in the narrower ones they become smaller and fewer and finally disappear, being only partly replaced by an increase in the amount of orthoclase in the ground-mass. As the orthoclase decreases, the rock becomes finer in grain and darker in color, hornblende coming in in larger proportion and biotite almost disappearing. The amount of quartz does not seem to vary to any extent. Here and there are seen small dark patches, composed of the same constituents as the surrounding rock, but with hornblende in excess. These occasionally take the form of dikes, apparently due to extravasation into fissures in the half-solidified magma; the common rounded patches being more probably segregations at an earlier stage. True dikes, of quite different character and appearance, are abundant near the edges of the intrusion; most of these are porphyritic diabase.

REGIONAL METAMORPHISM. This is confined to the edges of the quartz-diorite and the vicinity of faults, the main mass being little affected. A well defined gneissic structure is seen in several small patches, only a few yards in extent and fading out into the unaltered massive rock. Over considerably larger areas, as at Sandy Point in the northern strip, and on the Sandy Point road in the southern, the rock is much shattered by jointing, and somewhat crushed, so that its structure is not easily seen in the hand specimens. In several places along the edges of faults there is a considerable amount of breccia, consisting of rounded quartz grains in a fine green paste. But in general the intrusion is little affected, except for the development of secondary minerals mentioned above. Uralite and epidote are present in all the sections.

CONTACT EFFECTS. The edge of the intrusion, where not hidden by surface deposits, is usually faulted. The actual contact can be seen only at two localities on the southern band: one just to the east of the river St. John, on the south side of the mass; the other west of the river, on the north side.

The first mentioned contact is with a mass of olivine-gabbro which will be described later on. Here the junction can be plainly seen on the bare rocks on which the suburb of Indiantown is built. It forms a jagged, irregular line, the quartz-diorite sending out small dikes and stringers into the gabbro, and a large tongue along its eastern edge. Numerous included blocks, up to a foot in diameter, are seen near the edge in the later rock. The gabbro near the edge is changed to a rock composed of more or less granular hornblende, with a greater or smaller amount of plagioclase. Receding from the granite, this hornblende is more uralitic, and the various stages between it and the scarcely altered gabbro can be traced. At a distance of one hundred feet there is very little change. The quartz-diorite near the contact is likewise altered; it becomes very fine grained and entirely allotriomorphic, composed of an evenly granular mixture of plagioclase, quartz and orthoclase, with small irregular grains and shreds of hornblende and biotite. No trace of porphyritic structure can be seen even in the small dykes. Several veins of coarse feldspathic pegmatite are seen cutting indifferently through both gabbro and quartz-diorite, their straightness and clean cut walls distinguishing them sharply from the true dykes, aside from the character of the filling.

The larger offshoot mentioned is somewhat differentiated from the main mass, being uniformly darker, finer grained and with fewer and smaller phenocrysts. It contains about ten per cent. less silica. Its contact with the coarser rock is rather peculiar, suggesting the effect produced by stirring two thick liquids together, and showing the strong disinclination of the two magmas to mix completely. The contact effects are much more marked in respect to the character of the granitic rock here than elsewhere. At no other point have small dykes been seen, nor does the granite become finer grained at the edges in other places. The pegmatite veins, too, are exceptional.

The second contact, on the western side of the St. John River, stretches from near Pleasant Point, opposite Indiantown, to where the intrusion sinks under the overlying drift; but it is by no means as well exposed as the first. Its existence is, perhaps, owing to the fault-line along the northern edge of the main band, having here departed a little from the contact, and occupying the present bed of the St. John River. A narrow interrupted strip of sedimentary rocks is thus left along the

FIG. 3, PYROXENE-GNEISS WITH TITANITE.

From quartz-diorite contract. Enlarged 45 diam. P=green pyroxene ; F=plagioclase feldspar; T=titanite.

northern side of the intrusion, and is considerably metamorphosed. Massive micaceous and pyroxenic gneisses, which are not found elsewhere in the neighborhood, but appear to correspond with the mica and hornblende schists of the upper Laurentian, are found in small quantity. In some of these, small rounded, spindle-shaped crystals of titanite are quite abundant and may be due to contact influence. A figure is given of the appearance in thin section of a pyroxenic gneiss from close to the granite, chiefly to show the resemblance between this extreme phase of our contact-metamorphism and the extreme regional metamorphism as seen in the Adirondack gneisses, some of which, as seen in Prof. Kemp's collections, this specimen very much resembles.

The contact is mostly with Laurentian limestone, which is considerably altered, though scarcely as much as one would expect in view of the change in the accompanying acid rocks. It is harder, whiter and coarser in grain, and shows in thin section an abundance of pyroxene crystals, now mostly serpentinized on the surface. Near King's Mill several small marble quarries have been opened in the limestones next the granite, but they were soon abandoned. In one of these, close to the intrusive mass, garnet is largely developed, in crystals or irregular masses, forming nearly half the rock, and separating the pure limestone from the granite. It again is separated from the granite by a thin layer of pyroxenic gneiss and a still thinner one of pegmatitic material, the last composed of quite large crystals of dull green, rusty, weathering augite scattered through a granophyric mixture of quartz, orthoclase and microcline. At another part of the contact, near Pleasant Point, a rock composed of nearly pure garnet separates the limestone and granite.

Passing northwest, away from the edge of the granite, the limestone is less and less altered, till at Green Head it is dark colored, fine grained and well stratified.

Although elsewhere the edges of the intrusion are faulted or concealed, yet it appears that the limestones in the neighborhood are whiter, harder and coarser than those at some distance away. The band next the contact on the south side of the main mass of granite has given the name of Marble Point to a part of Indiantown, and is traceable by its whiteness and coarse grain, as well as by its purity, for some distance in either direction.

On the whole, the contact effects here are quite small in view of the size and character of the intrusion, and it is not surprising that the granite was considered sedimentary, with the views as to metamorphism then prevailing,* and the array of negative evidence as to its influence on the surrounding rock. The inclusions were thought to be pebbles or boulders; the gneissic structure to show a sedimentary origin, and the different bands were placed in the Laurentian series, as an unconformable lower member.

CHARACTER OF THE INTRUDED MAGMA. From the foregoing description and figure, it can be seen that the granite-diorite has not exactly a normal granite structure, though its composition is within the limits of normal granites, except for the excess of iron present. It seems rather to simulate the intrusive rocks of medium composition, which are thought to be due to true igne-

*1871.

ous fusion, than those more acid ones whose production requires the presence of a considerable amount of water in the magma. That some water was present in the St. John intrusion must follow from the minerals present. But that it was less than ordinary, and scarcely in excess of what was needed for the mineral formation, seems probable from the following evidence:

1. Veins, granite veins and pegmatite masses, due presumably to the action of highly heated water under heavy pressure, are usually very prominent and abundant around the edges of granites intruded into crystalline rocks. This is notably the case, as Prof. Kemp informs me, with the intrusive granites of western Rhode Island. The pegmatite veins of eastern Connecticut, so well known as localities for rare minerals, are certainly in part, and probably all, connected with intrusive granites. These features are not common in the St. John area.

2. Contact influence on the surrounding rocks is limited, and consists chiefly in their higher crystallization. None of the characteristic contact minerals, such as scapolite, sillimanite tourmaline, chondrodite, etc., are to be seen; garnet, titanite and green pyroxene occur close to the contact, and the two former, at least, were very probably caused by mineral-bearing solutions spreading out from the edge of the granite into the surrounding rocks. But these are found only for a few feet from the junction of the two. In contrast with this may be placed a granite from Orange county, N. Y., recently described by Prof. Kemp and Mr. Hollick.* This is a basic granite, probably very near the St. John rock in composition, and comes up through limestones not much less crystalline. But the neighboring rock is greatly changed, becoming very coarse, with great bunches of silicate minerals, and abundant development of scapolite and fluoric and boracic acid compounds.

3. The granite-diorite is generally nearly uniform throughout any one band. But, where differentiated parts of the magma have come in contact, they show a great disinclination to mix or grade one into the other. This, along with the rarity of dykes or apophyses branching out from the main body, seems to indicate a very viscid magma. The characters of the Indiantown contact would in this case lead us to suppose that there may have been an unusual supply of water at the edge at that point, causing a differentiation of the mass, its granular character and the presence of pegmatite.

4. The structural resemblance to intrusives of medium composition has been already noted.

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* The granite at Mts. Adam and Eve, Warwick, Orange Co., N. Y. By J. F Kemp and Arthur Hollick. Trans. N. Y. Acad. Sci., Vol. VII., p. 638, Feb , 1894.

COMPARISONS. Typically this rock is a tonalite or very quartzose hornblende biotite diorite, and in chemical composition is very like the original tonalite described by Vom Rath.* Structurally there is no special likeness. Both chemically and structurally it resembles an intrusive mass described by Dakyns and Teall from near Loch Lomond, Scotland.† This is of very similar composition, and differentiated in the same way as the St. John rocks, but to a much greater extent. Porphyritic orthoclases appear only in the most acid varieties, and are not usually zonal. They seem to be intermediate in size and character between the small zonal crystals which one may ascribe to cooling from fusion in which water is subordinate, and the enormous twinned non-zonal orthoclases, usually granophyric in structure, such as those lately described by Dr. Lawson from California granites.‡ The latter variety is perhaps allied to the feldspars of the pegmatite veins, as being due to the presence of a large amount of water in the magma.

AGE OF THE INTRUSION.—The resemblance of parts of the St. John granitic areas to the great belts of Devonian granites stretching across central New Brunswick, is noted in the Survey Report for 1871. Whether this comparison holds good also with regard to microscopic peculiarities, I do not know, as I have not seen any sections or microscopic descriptions of Devonian granites. It is not at all impossible that the intrusive granites of the southern hills may prove to be of this age; but their relations to the Cambrian slates seem to be against this view. They are certainly post-Laurentian, for as already described, they break through the limestones, altering them along the contact. They are as certainly pre-Carboniferous, for they are unconformably overlain by flat lying Lower Carboniferous conglomerates. The relations to the Cambrian slates are doubtful, the only contacts being on Kennebecasis Bay, one a little northeast of Drury's Cove; the other at Sandy Point, to the southwest of it, and both these are faulted. Unless these faults are heavy, the granite would appear to be pre-Cambrian, for not the slightest evidence of contact alteration can be seen, even in the seams of fossiliferons limestone. But it must be admitted that there is no evidence of the extent of the fault, and that the granite diorite has not had a great influence on the earlier Laurentian limestone. No Cambrian conglomerates are exposed here. The relative abundance of diabase dykes in the granite and in the

* Zeit. d. d. geolog. Gesell, 1864, XVI., p. 249.

† "Plutonic rocks of Garabal Hill and Meall Breac." Quart. Jour. Geol. Soc. XLVIII., p. 104, May, 1892.

‡ "Geology of Carmelo Bay." Geol. Dep. Univ. of Cal., Bull. No. 1.

Cambrian and later rocks, may be taken as some evidence as to the age of the former. The granite, as well as the Laurentian series, is traversed by innumerable dykes, while in the Palaeozoic rocks they are very rare, the only ones I have seen being in the Lower Carboniferous shales near Poverty Hall Point, and these are of a different character from the ordinary. In the Huronian there are a good many dykes in places, but the diabase is mostly interbedded. If, then, the diabase dykes approximate the Huronian in age, as seems not unlikely, the granite must be earlier than this, and belong to the interval between the Laurentian and Huronian. Again, the pre-Carboniferous rocks, though much folded and considerably faulted, are hardly so much changed as to suggest an igneous intrusion of such prevalence as this, being connected with their metamorphism. Altogether it seems more probable that the granite is pre-Cambrian, and very likely pre-Huronian, for the great unconformity here is between the Laurentian and Huronian, not between the Huronian and Cambrian.

II. GABBRO.

Within the area as yet studied, the gabbroitic rocks are confined to two small knobs at Indiantown, where they are mostly well exposed. Another larger body occurs north of Dolin's Lake, some seven or eight miles northeast of the city, and has been described in the Canadian Survey Reports,* as a norite of basic, but very variable character. About half-way between these two localities, but outside the accompanying map, is a little exposure of an altered gabbro, surrounded and almost buried by drift. The Indiantown gabbro was described, but not recognized in the survey reports, the unaltered rock being not very accessible, and was called "diorite" and "feldspathic diorite."

The knob fronting on the river, which gives the best exposures, varies from anorthosite at the southern end to peridotite at the other. The anorthosite is moderately coarse, the grains averaging $\frac{1}{3}$ to $\frac{1}{2}$ inch diameter, seldom much more. The amount of dark silicate present is sometimes almost nil; where it is a little more abundant, the rock sometimes appears strongly porphyritic, the feldspar being in well-developed thick tabular crystals in a matrix now composed of pale green actinolite. Towards the northern part of the exposure, more dark silicate comes in, mostly aggregated in irregular masses, which, decaying much more easily than the feldspar, give the weathered surface a characteristic pitted appearance, like that noted by Prof.

* Can. Geol. Sur., 1871, p. 41. In Amer. Nat., Nov., 1885, Prof. Adams, having examined thin sections of this rock, states that it is an olivine-gabbro.

Williams in the Baltimore gabbros.* Near the northern end the proportion of dark silicates. and especially of olivine, rapidly increases, grading finally into a peridotite. It is not easy here to get good exposures, the ground being mostly built over and the rock much altered, but sufficient material can be had to determine with fair accuracy its limits and character. When unaltered it is heavy, massive and black, with a marked bronzy lustre from plates of hypersthene, and with irregular white aggregates of feldspar more or less abundant. When the latter are moderately common and regularly distributed, a remarkable looking rock is produced, the contrast of color being very strong.

MICRO-CHARACTERS. In thin sections of specimens from near the northern end *olivine* is seen to compose nearly half the mass, occurring in regular crystals and irregular grains, and apparently the first formed constituent of the rock. *Hypersthene* is next in amount, of a rather pale color as compared with that in the Cortland peridotites, and often full of minute inclusions. It is seldom or never at all idiomorphic, and usually tends to collect around the olivine. A nearly colorless *monoclinic pyroxene* is almost equally abundant, with habit like that of the hypersthene. It does not show any diallagic cleavage; this character, however, is found in the pyroxene of the small isolated exposure half-way between Indiantown and Dolin's Lake. *Triclinic feldspar* is seldom entirely absent from a slide, but is sometimes quite subordinate. The remaining constituents of any importance are *spinel* and *magnetite*. The former is a very abundant accessory, occuring in irregular grains and minute vermiform shapes, and is probably largely secondary. Magnetite, too, appears to be chiefly an alteration product occurring in minute granules and irregular aggregates; but a few larger grains may be seen in unaltered parts of the slide. *Apatite* is very rarely seen.

REACTION RIMS. A very marked character in the thin sections is the invariable presence of reaction rims, surrounding the olivine crystals where they come in contact with the feldspar. These are composed of two zones:

1. The inner zone is very narrow, composed of a series of small highly refracting grains with green and pink pleochroism, and is continuous with the larger grains of hypersthene.

2. A zone of fine radiating needles of a faint green color and pleochroism which seem to be uralitic amphibole. The outer part of this zone is filled with minute vermicular grains of a very high refracting, deep green non-pleochroic mineral, prob-

* U. S. G. S. Bull. 28, p. 27.

ably spinel, as it is similar in color and refraction to the larger spinel grains, and, when coarse enough, which is not usual, appears isotropic under crossed nicols.

The hypersthene zone is often wanting; the spinel is variable in amount and often disappears. But the actinolite seems to be very constant. The outer zone often surrounds the large hypersthene grains, and sometimes, also, the monoclinic pyroxene. Its actinolite cannot be distinguished in appearance from the same mineral occurring as an undoubted secondary product, replacing the dark silicates and also in part the feldspar of the rock. Further, as spinel is abundant in the dioritic rock to which

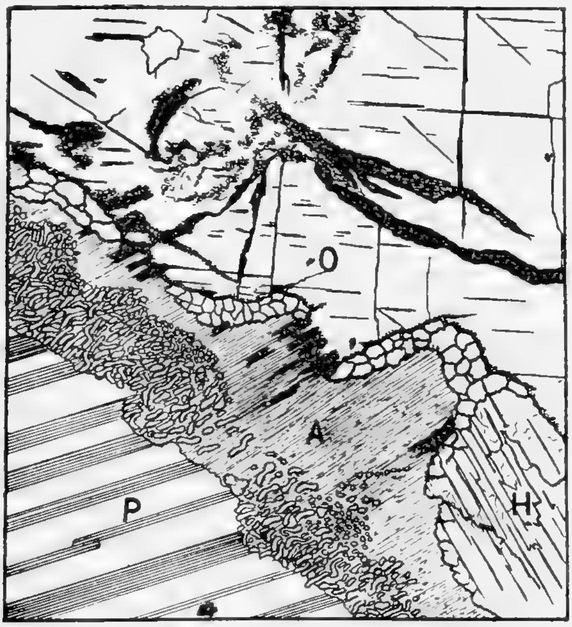

FIG. 4. REACTION RIM IN OLIVINE GABBRO.

Spec. 155⅔. Enlarged 43 diam. O=olivine; P=plagioclase; A=actinolite; H=hypersthene.

much of the gabbro has been altered, and is comparatively rare in the freshest gabbro, and associated always with the actinolite, it is probably mostly, if not all, secondary, and that of the reaction rims has presumably the same origin. The actinolite rim follows the outline of the olivine, often running up into cracks traversing the mineral, where the hypersthene zone is not seen. Small plates and needles of magnetite, very like the secondary magnetite between the alteration cracks in the olivine, occur commonly between the actinolite fibres, their shape being conditioned by that of the interspace which they fill. The spinel granules are separated from the feldspar by a sharp line; on the other side they usually become gradually less numerous till they disappear. The evidence seems strongly in favor of the secondary nature of the outer zone, and I believe that in the case of the St. John gabbros, at least, it is formed by the same influences that caused the uralitization of the rock. Supposing those conditions to be present which favor the formation of uralitic hornblende, it would form first and most easily on the contact of a magnesia-iron silicate with a lime-alumina silicate, because here all the materials necessary to make an average amphibole would be furnished with a minimum of transportation. In a less basic rock the diallage might be of the required composition, and thus be uralitized before any reaction rims formed; but in the St. John gabbro, apparently, this was not so. In the formation of the uralite, the surplus magnesia and iron from the olivine and hypersthene would combine with the surplus alumina from the feldspar to make spinel, the position of the spinel being perhaps determined by the relative solubility of its acid and base, the more soluble magnesia and iron being more easily transported.

With regard to the inner zone, I have seen no evidence that it is secondary; on the contrary its continuity with the large hypersthene grains, its refusal to follow the outer zone into secondary cracks, and its fresh and granular character, lead one to believe that like most other occurrences of hypersthene it is an original mineral, which collected around the olivine crystals on account of their attractive influence, partly chemical, partly physical, on the molten magma.

Dr. Adams * has described rims very similar to these surrounding the olivine in the saguenay anorthosites, and also mentions them as occurring in the Dolin's Lake gabbro. He regards them as original, and the same view is taken by Dr. G. H. Williams † as to the pyroxene-actinolite rims in the peridotites of the Cortland series. On the other hand Dr. Vogt ‡ and Dr. Patton § speak of hypersthene-actinolite rims as produced by metamorphic action while Dr. Becke ‖ and Prof. Teall ¶ consider the somewhat similar anthophyllite-actinolite rims as

* Amer. Nat., Nov., 1885, p. 1087; Neues Jahrb., B. B. VIII., p. 466.

† Amer. Jour. Sci., Jan., 1886, p. 35.

‡ Zeit. f. prakt. Geol., April, 1893, p. 132. These rims, as well as some of those described by Lacroix (Soc. Franc. de Min., 1889, p. 223), are very like ours in composition and structure.

§ Rep. Mich. State Board of Geol. Survey for 1891–2, p. 183.

‖ Min u Pet. Mitth. IV., p. 450.

¶ Min. Mag., 1888, p. 116.

secondary, and Prof. Judd * enumerates among instances of chemical change induced in rocks by the combined influence of pressure and high temperature, the production of pyroxene-actinolite rims between olivine and feldspar.

Dr. Adams states that the reaction rims are independent of the cataclastic and gneissic structure developed in the rock. But the metamorphism due to crushing at great depths may be considerably different in character and effects from the paramorphism due to chemical and molecular action at less depth and with perhaps the assistance of water. The two are, it is true, usually associated, but either may occur without the other, and it is the latter to which, if secondary, the actinolite zones must be ascribed. The former may be said to be more characteristic of the Canadian highlands and the Adirondack region; the latter of the bordering and outlying metamorphic rocks along the Atlantic coast and elsewhere.

If the view here taken as to the origin of hypersthene-actinolite reaction rims be correct, one would expect to find, in the unaltered rock, olivine with a hypersthene zone but no actinolite. No sections of the St. John gabbros were fresh enough to show this, but it may be noted that in the Lizard gabbros Dr. Teall† found in one case a pyroxene zone instead of the usual anthophyllite and actinolite.

Prof. Kemp, in an article on Adirondack gabbros‡ has given a review of the literature of reaction rims around olivine, to which the present writer is much indebted.

ALTERATION.—Much of this knob is considerably altered, so as not to be recognizable except by tracing the successive gradations to the unaltered parts. The change in appearance of the dark silicates is very marked. They are replaced, at first in part, then completely, by fine needles of pale green actinolite, which appears dark green and satiny in the hand-specimen. With increasing alteration this becomes quite coarse and bladed, with some schistose structure. The feldspar meanwhile has become opaque white, with a tinge of green at the margin, and in thin sections shows much actinolite, especially near the edge. The last thing to disappear is the mottled appearance, and by the time it is gone there is left only a granular to schistose diorite, composed of small grains of compact dark green hornblende, with some feldspar. This rock is indistinguishable from the metamorphosed argillites of the Laurentian series.

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* Jour. Chem. Soc., May, 1890.

† Loc. cit.

‡ Gabbros from the western shore of Lake Champlain. Bull. Geol. Soc. Amer., Vol. V., p. 213, Feb., 1894.

The character of the gabbroitic knob may vary through preponderance of different minerals, from peridotite through "forellenstein," olivine-norite, olivine-gabbro, or gabbro, into anorthosite. In this great variation it is in contrast with the other Indiantown knob, which was probably uniformly an olivine-gabbro. It is much more altered than the one first described, and now is a gabbro-diorite, according to Prof. G. H. Williams' nomenclature. Its notable pitted appearance fades out to the north, where its limits are not accurately known.

RELATIONS. The relations of the gabbro to the Laurentian series are not known. At the southern end the knob along the river-edge is separated from the limestone and gneiss by a pegmatitic mass of pink feldspathic rock, probably a "granite vein." Elsewhere it is surrounded by quartz-diorite of undoubtedly later age. The contact with this has been already described.

There are two or three exposures within the area studied, of massive hornblendic rocks, which may perhaps be altered basic intrusives; but neither in the field nor in thin section could they be distinguished as such, and they are consequently mapped as of doubtful origin.

GENERAL OBSERVATIONS. We have then, near St. John, the following types of Pre-Cambrian rocks:

1. *Limestone-gneiss*, sedimentary series.
2. *Intrusive gabbro.* Relations to (1) uncertain.
3. *Acid intrusives.* Later than (1) and (2).
4. *Surface volcanics.* Relations to (2) and (3) uncertain; probably later than both. Certainly later than (1).
5. *Etcheminian* (sub-Cambrian) series. The Olenellus fauna not having been found to extend down into this series, the unconformity between them and the St. John group must for the present be assumed as the base of the Cambrian.

If the succession be as here arranged, it is in accord with that generally observed in eastern North America.* The metamorphism is not very intense, the limestones usually retaining much of their blue-black color, and being of a grain about that of sandstone or ordinary marble. The gneisses are not very coarse, though sometimes quite massive; the surface volcanics are very like those of South Mountain, Pa., as described by Prof. Williams,† but, if anything, less altered. Whether any of the coarse and massive gneisses forming the "Archean complex" exist in

* Dr. Ellis has lately (Bull. Geol. Soc. Amer., 1893) emphasized the parallelism of the sedimentary rocks of southern New Brunswick with those of the Ottawa district; this still holds, except that the lowest member of the series is wanting at St. John, and the intrusives of the typical Pre-Cambrian succession are present.

† Volcanic Rocks of South Mountain, in Penn'a. and Md. Amer. Jour. Sci. XLIV., p. 482, Dec., 1892.

southern New Brunswick, is still doubtful; they seem to be wanting at St. John.

The writer has much pleasure in acknowledging his great indebtedness to Prof. Kemp for advice and assistance throughout the preparation of this paper; likewise to Mr. G. F. Matthew for much information concerning the field geology about St. John. It is intended in a future paper to discuss the character of the surface-volcanic and other rocks forming the Huronian of southern New Brunswick; a series which, in spite of the extended and careful work done on it in past years, still affords an important subject for microscopic research.

SUMMARY.

The so-called Lower Laurentian near St. John, N. B., is found to consist in large part of intrusive rocks, which are of two types:

1. *Granite-diorite*, typically a tonalite, but varying from hornblende-granitite to quartz-diorite. It contains zonal porphyritic crystals of orthoclase in varying amount, and lies in a number of parallel bands, covering a considerable area, and believed to be all parts of the same intruded magma. From the limited contact effects and other evidence, it is conjectured that this magma contained less water than is usual with granitic intrusions. The age of the granite-diorite is uncertain; it is later than the Upper Laurentian limestones, and may be Devonian, but is probably Pre-Cambrian.

2. *Olivine-gabbro.* Two or three small knobs of this rock, varying much in mineral composition, occur near St. John. Around the olivine crystals occur remarkably fine reaction rims, composed of an inner zone of hypersthene and an outer one of actinolite and spinel. The inner zone is considered original, the outer one secondary. The succession of Pre-Cambrian formation, as provisionally arranged, furnishes a surprisingly close parallel to that of the main Archæan continental nucleus, though the rocks are not nearly as much altered.

Geological Laboratory, Columbia College.

The paper was discussed by Prof. Kemp.

The Secretary mentioned that the Section had been in existence a year and a half and had not had an election of officers since the initial organization. It was accordingly moved and carried, that the same officers, to wit, Prof. Whitfield, Chairman, and Prof. Kemp, Secretary, be elected for another year.

It was also moved and carried, that in the future the Section elect its officers at the first meeting following the annual meeting of the Academy.

J. F. KEMP,
Recording Secretary of Section and Academy.

STATED MEETING.

April 23d, 1894.

The meeting was called to order by Vice-President WHITFIELD, fifteen persons being present. The minutes of the last meeting were read by the Secretary, and were approved.

The paper of the evening was by A. A. Julien, "On New Forms of Fungus in the Silicified Woods of Arizona and Texas," illustrated by specimens and lantern views. The paper was discussed by Messrs. F. H. Knowlton, Britton, Whitfield and Kemp.

The Academy then adjourned.

J. F. KEMP,
Recording Secretary.

STATED MEETING.

April 30th, 1894.

The Academy was called to order by the Secretary, twenty-two persons being present. Capt. T. L. Casey was nominated for Chairman and elected. The minutes of the last meeting were read and approved.

The first paper was by E. D. Self, M. E. Notes of a Trip in the State of Oaxaca, Mexico, and of the prehistoric ruins of Mitla. The paper was illustrated by the lantern and by specimens. Prof. Kemp remarked that microscopic sections of the rock used in building the ruins showed it to be a rhyolite.

The second paper was by J. F. Kemp. Notes of a Trip to the Iron Mines at Cornwall, Pa., and the Nickel Mine at Lancaster Gap, Pa. The paper was illustrated by the lantern and extensive suites of specimens and was discussed by Prof. Martin.

On motion the Academy adjourned.

J. F. Kemp,
Recording Secretary.

Regular Business Meeting.

May 7th, 1894.

The meeting was called to order by President Rees, fifteen persons being present. The minutes of the last meeting were read and approved, Prof. Hallock acting as Secretary.

The Section of Astronomy and Physics then organized, The first paper of the evening was by Prof. R. S. Woodward on "Periodic Errors of Graduated Circles." The second paper was by Prof. Hallock on "The Photography of the Manometric Flames in the Analysis of Articulate Sounds." The paper was discussed by Profs. A. E. Mayer and Pupin.

The last paper of the evening was by Prof. Rees on "Solar Faculæ shown in Rutherford's Photographs of 1870-71." Prof. Rees called attention to the remarkable work now being done by Prof. Hale, of Chicago, in showing by the aid of photography the existence of faculæ in great numbers over the sun's surface. He stated that he exhibited to Prof. Hale when on a visit to New York city, some time ago, several of the originals of Rutherford's photographs of the sun, and pointed out the beautiful showing of the faculæ profusely scattered over the sun's surface. Rutherford produced negatives of the sun showing the solar faculæ and the mottled surface long before Jansen, of Mendon, who is generally credited with being the first to produce such negatives. A number of lantern slides, made from Rutherford's negatives, were shown, and the great numbers of faculæ and the mottled surface were beautifully brought out. The paper was discussed by Messrs. Pupin and Post.

Prof. Rees called the attention of the Academy to some negatives of the moon, etc., received from the Lick Observatory, which he had arranged upon a special frame with electric lights behind to illuminate them. Prof. Rees announced to the Academy the receipt of several letters regarding the remarkable Auroras of this spring.

It was moved and carried that Prof. Alfred E. Mayer, of Stevens Institute, be nominated for resident membership and referred to the Council.

The Academy adjourned at 10:20.

WM. HALLOCK,
Secretary of Section.

J. F. KEMP,
Recording Secretary.

STATED MEETING.

May 14th, 1894.

The Academy met in the lecture room of the Department of Biology, College of Physicians and Surgeons, Vice-President OSBORN in the chair. The minutes of the previous meeting were read and approved. Fourteen persons present.

The Biological Section then organized. The first paper was by Prof. E. B. Wilson, entitled "Experiments upon the Horizontal Isotropy of the Egg."

The second paper was by Arnold Graaf, "The Funnels and Vesiculæ terminales of Nephelis, Aulostoma and Clepsine."

The last paper was by O. S. Strong, "On Lithium Bichromate as a hardening Reagent for the Golgi Method."

The plans of the proposed expedition to Patagonia, under the auspices of the American Museum and conducted by Mr. George Trotter, were set forth by the Chairman. Adjourned.

J. F. Kemp,
Secretary.

Stated Meeting.

May 21st, 1894.

The Academy met with Vice-President Whitfield in the chair. Eighteen persons present. The minutes were read and approved.

The Section of Geology and Mineralogy then organized. The first paper was the following:

ADDITIONAL NOTE ON WOLLASTONITE FROM NEW YORK STATE.

Heinrich Ries.

In a previous number of these Transactions*, wollastonite crystals from Harrisville, N. Y., were described which showed four faces not hitherto recorded from this State. An examination of the wollastonite crystals from Diana, N. Y., in the collections of Columbia College, and of Prof. A. H. Chester, has shown the following faces not figured by Penfield† :

A prism (probably $i\text{-}\grave{\frac{1}{4}}^{5}$), with $I \wedge I = 30^\circ$. There is a distinct prismatic cleavage parallel to this prism, and as the measurements of the angles varied about a degree and a half, due to the roughness of the face, the value was calculated from the prismatic cleavage. This face was observed on four crystals.

On one of these crystals are two pyramid faces evidently in the same zone as the prism $i\text{-}\grave{\frac{1}{4}}^{5}$. These faces are rough, and

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* H. Ries. On some new Forms of Wollastonite from New York State. These Transactions, Vol. XIII.

† Dana System of Mineralogy, 1892, p. 372.

accurate measurements were not obtainable, but approximate measurements yielded.

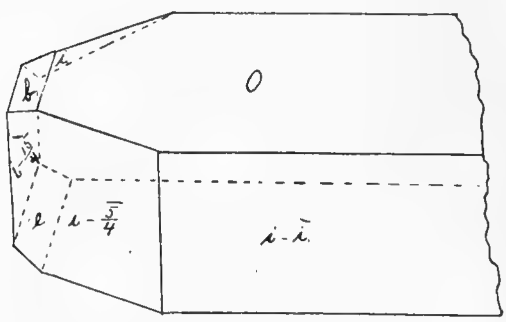
b ∧ O	137°	e ∧ O	135°
b ∧ i–ī	135°	e ∧ i–ī	79°
b ∧ i–ì	75°	e ∧ i–ĭ	131°

The face b is negative, and e positive, and the latter was also noted on one of the specimens in the Columbia College collection.

There is also on Professor Chester's specimen a third pyramid face which corresponded approximately to $\frac{5}{4}$–$\grave{\frac{9}{4}}$. It gave the following angles :

i ∧ O	50°
i ∧ i–ī	117° 30′
i ∧ i–ì	130°

also i–$\grave{\frac{15}{4}}$ ∧ i–$\frac{5}{4}$=143°



The faces mentioned above are interesting, not alone because they are new to the state, but I am unable to find them recorded from any other locality.

In none of the specimens which show the new faces are both ends of the crystal developed. The crystal figured is the one in Prof. Chester's collection.

MINERALOGICAL LABORATORY, COLUMBIA COLLEGE, May 21, 1894.

Mr. Ries also read two additional papers entitled "Notes on Artificial Crystals of Oxide of Zinc" and "Preliminary Notes on the Pyroxenes of New York State," both of which were illustrated by specimens and by the lantern. On the crystals of oxide of zinc were found two pyramids of the first order $\frac{2}{5}$ P and $\frac{1}{2}$ P, the pyramid of the second order $\frac{1}{2}$ P and the unit prism of the first order ∞ P. The notes will be elsewhere printed. The papers were discussed by Messrs. Hovey, Whitfield and Kemp.

The next paper, by Prof. C. H. Smyth, Jr., was read by the Secretary in the absence of the author.

A GROUP OF DIABASE DIKES AMONG THE THOUSAND ISLANDS, ST. LAWRENCE RIVER.

By C. H. Smyth, Jr.

The presence of a number of dikes cutting through the granites and gneisses of the Admirality Group of the Thousand Islands was mentioned by Dr. A. P. Coleman* about two years since. Through the kindness of Dr. Coleman the writer was put in possession of many details in regard to the occurrence of the dikes, which greatly facilitated an examination of the region during the past summer.

The islands included in the group referred to lie within three miles of the village of Gananoque, Ontario, and, as described in the paper cited, consist of granite, gneiss and quartzite, overlaid on the eastern side of the group by Potsdam sandstone. The dikes do not break through the sandstone and hence must be older than upper Cambrian and younger than the granite which is itself intrusive in the gneiss. No other limitation can be put upon their age.

The rock of which the dikes consist is very dark colored and strongly contrasted with the light red of the surrounding granite and gneiss. On the mainland west of Gananoque and on the adjacent islands thirty-nine dike outcrops were noted, but in several instances the relations of the outcrops were such as to indicate that two or more of them were parts of single dikes, continuous under the intervening river channels. Allowing for this duplication it is probable that not more than thirty distinct dikes were examined. There is great likelihood that some dikes were overlooked, but those examined were so distributed over the region that they must give a complete representation of the general character of the rocks. All of the dikes strike about north and south, and, so far as can he ascertained, are nearly

*A. P. Coleman—Some Laurentian rocks of the Thousand Islands, Can. Rec. Sci. V., p. 127.

vertical. A large proportion of them measure more than ten feet in width, ranging up to forty feet, often with an unknown extension under water. Only three or four dikes were found that were less than a foot wide, and these seemed to be due to local splitting up of larger ones. It is hardly necessary to say that allowance must be made for the fact that small dikes would be much more easily overlooked than the larger ones. One of the latter often makes up more than half of a small, rocky island, commonly giving it a decidedly bold and rugged contour, resulting from the durable character of the rock and the regular jointing.

As already stated, the rock of the dikes is nearly black, and it commonly has a reddish, brownish or purplish tinge. In the smaller dikes and on the outer edges of the larger ones it is extremely fine grained, but the bulk of the large dikes is made up of a rather coarse rock, sometimes showing cleavage faces of plagioclase two inches long.

Under the microscope, sections of the dike-rocks show a holocrystalline aggregate of plagioclase, augite, biotite, sometimes olivine, iron oxide and apatite, with a varying amount of alteration products. The structure is diabase-granular, which, with the mineralogical composition, proves the rock to be diabase, of which there are two varieties, one with, and the other without olivine. Rarely, sections show a marked flow structure and indications of an approach to the vesicular structure of volcanics, while much glass is present.

The plagioclase occurs in laths showing the common twinning lamellæ. Extinction angles measured on these average about 20°, indicating Bytownite. Some of the dikes show large crystals of plagioclase, tabular parallel to $\infty P \breve{\infty}$, and cleavage plates from these give extinction angles of about 24–26° on $\infty P \breve{\infty}$ and 12–13° on O P., which would indicate a basic labradorite.

The feldspar has a brownish, dusty appearance, owing to the presence of abundant minute interpositions. With high powers some of these are resolved into black dots and blunt rods, usually arranged in rows parallel to a pinacoid. As a rule these interpositions are less abundant toward the margins of the crystal. They are so small that it is impossible to determine their nature with any degree of accuracy, but it is possible that the rods are original interpositions, while the finer, dusty material doubtless results from alteration. The feldspar laths are often much bent, and nearly always show marked undulatory extinction.

The outward form of the augite is conditioned by the older plagioclase, the former filling the spaces between the crystals of the latter. The augite is of a brownish pink color, with faint pleochroism. The ordinary prismatic cleavage is distinct, and twinning is rather common. There is an abundance of interpositions closely resembling those of the feldspar, though often attaining a somewhat larger size and more distinct rod-like form. They are usually in rows parallel to a pinacoid, but sometimes parallel to the prism. The augite often shows a conspicuous amount of bending, the cleavage cracks being greatly curved, while there is a correspondingly strong undulatory extinction. Occasionally a piece of the mineral has a fan-like appearance, with radiating cracks and cleavage lines in concentric curves, across which a dark band swings like a pendulum upon turning the stage back and forth. The appearance is very like that of a spherulite, but is confined to a single individual of the augite. Alteration yields a pale green pleochroic chlorite, or a nearly opaque, yellowish-brown aggregate, probably serpentinous. In a very few sections there is a small quantity of green hornblende, apparently derived from the augite.

Olivine is an important constituent of a part of the dikes, is present in small amount in others, and is absent from about half. It occurs generally in irregular grains, rarely with crystal outline. It is nearly or quite colorless and is readily distinguished by its high mean index, strong double refraction, parallel extinction and imperfect cleavage. The freshest pieces show slender rod-like interpositions, parallel to the cleavage, which, as alteration progresses, increase in size and become irregular in outline. The final result of the process is the complete replacement of the olivine by an opaque mass colored by, and largely made up of, hematite. The grains of olivine, whether fresh or altered, are surrounded by a narrow band composed of radiating plates of a colorless mineral with quite strong refraction. It is not possible to get any very clear evidence of the character of this mineral with crossed nicols, but it seems to have an inclined extinction of rather low angle. From this it is probable that the mineral is tremolite. It is evidently not the result of simple alteration of the olivine, but is of the nature of a reaction rim between this mineral and the feldspar.

Magnetite is an abundant constituent, being present in large irregular grains, sometimes with a slight skeleton structure. The mineral is regarded as magnetite because readily soluble in hydrochloric acid and strongly attracted by the magnet. But the titanium reaction with $H_2 O_2$ and the presence of some leucoxene indicate that the magnetite contains titanium, or that there is also ilmenite present. The latter conclusion is rendered very probable by the approach to hexagonal outline often shown by the grains of the mineral. The magnetite is usually separated from the feldspar by a narrow zone made up of small scales of deep reddish brown, strongly pleochroic biotite. The biotite not only surrounds the exterior of the magnetite grains, but where the latter, as often happens, contain cavities filled with feldspar, the cavities have a lining of biotite. On the other hand, where the magnetite is in contact with augite or olivine, the biotite is absent. Quite often a grain of magnetite may be seen, one portion of which is enclosed in augite and another in plagioclase. In such cases only the latter portion has the zone of biotite. An example of this arrangement is shown in the

figure. Here the two large grains of magnetite and two of the smaller ones are enclosed chiefly in plagioclase, but each is in contact with augite along a portion of its border. The presence of the biotite rim between the magnetite and the feldspar, and its absence between the magnetite and the augite, are clearly shown. The same thing is repeated in every section. The lower part of the figure also shows several small grains of magnetite in a continuous mass of biotite scales. It is plain that these grains are the residue of a single large grain of magnetite which has been partly destroyed to form the biotite. This, like the previous phenomenon, is constantly repeated, and, indeed, is an important, if not the chief, cause of the cavernous character of the magnetite.

These facts lead to the conclusion that the relation between the magnetite, biotite and plagioclase is not accidental, but is of a genetic character. The tendency for biotite to surround magnetite has often been remarked in rocks of this kind, and by many has been regarded as a simple mechanical attachment of the biotite to the earlier formed grains of magnetite. Others, particularly in this country Hawes* and Wadsworth,† have contended that the biotite results from the interaction of the magnetite with the feldspar, or, more rarely with other minerals. That this is true in the present instance there can be little doubt, for if the scales of biotite formed independently and attached themselves to the magnetite mechanically there is no reason why the biotite should not intervene between the magnetite and the augite, just as well as between the magnetite and the plagioclase, and yet this very seldom happens, although contacts between magnetite and augite are abundant. So constant an association as that of the magnetite, biotite and plagioclase can not be fortuitous, and requires some explanation. The suggestion that the biotite is a reaction rim affords such an explanation, according at once with the facts observed, and, in a general way, with our knowledge of the composition of the minerals concerned. The details of the process are, it is true, obscure, for while the biotite is to a certain extent intermediate in composition between the other minerals, it could not be formed from them without the introduction of foreign materials, or the removal of considerable quantities of some materials present, or both. But this fact need not throw doubt upon the explanation advanced, as the same is true of most of the reactions and alterations constantly seen in rocks. Many of these details would doubtles be made clear by analyses of the minerals involved, while others might well elude all our methods of investigation.

Occasionally there is outside of the biotite a zone of white, granular substance of uncertain character. It is probably leucoxene, representing an excess of titanium in the magnetite, which has separated in this form during the series of changes to which the minerals have been subjected. The biotite itself yields quite readily to the attack of the agents of alteration, and passes over into a deep green chlorite, with strong pleochroism.

Apatite is an abundant constituent of all the dikes, occurring in long, slender prisms, often broken across.

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* G. W. Hawes—Geology of New Hampshire, 1878, p. 205.

M. E. Wadsworth—Geol. and Nat. Hist. Survey, Minn., Bull. II., p. 65.

Grains of pyrite are not uncommon, but are quite irregularly distributed and of no great importance in the rock.

The total amount of diabase contained in these dikes is sufficient to render it a not unimportant factor in the geology of the region. If the number of dikes be placed at thirty, and the average thickness be taken as ten feet, both of which quantities are doubtless below the actual amount, it is evident that there is present the equivalent of a sheet of diabase three hundred feet thick. Such a thickness would be important in a bedded series, and is of no less moment in the present instance. The element of extension along the strike of the dikes is lacking, but the indications in the field point to a measure of several miles.

The uniformity in the strike cannot be accounted for by intrusion along bedding planes, as most of the dikes are in massive granite. It suggests that the diabase was injected into fissures produced by a general and uniform disturbance, while the absence of any considerable dynamo-metamorphism in the dikes demonstrates that during the great length of time that has elapsed since the intrusion the region has been nearly free from the action of mountain-making forces.

From its coarseness of grain it is safe to conclude that the diabase solidified at considerable depth, though not so profound as to prevent the granite from being cool and chilling the diabase along the contact. Whether or not the dikes are conduits that once led up to surface flows, it is impossible to say, all trace of such flows, if any ever existed, having been removed by denudation.

Hamilton College, Clinton, N. Y., April, 1894.

THE GEOLOGY OF ESSEX AND WILLSBORO' TOWNSHIPS, ESSEX CO., N. Y.

By Theodore Greely White, Ph. B.

(Plates VI. & VII.)

CONTENTS.

Introduction and General Features: Formations Represented.

Under direction of Prof. J. F. Kemp and in connection with the summer field-work of the geological department of the School of Mines, Columbia College,* the writer spent the month of June, 1893, in investigating the geology of Essex and Willsboro' Townships, Essex Co., on Lake Champlain. The townships lie about half way up the lake from Whitehall. For portions of the country so long settled it is surprising that so little has been published regarding the local geology, and we have found no map giving accurately even the geographic features.

Together the townships embrace about one hundred square miles; Essex about forty and Willsboro' about sixty, including the Four Brothers' Islands, in Lake Champlain, two miles off shore. The Boquet river flows nearly due north through the entire length of Essex township, divides it almost equally, then bends abruptly near the village of Willsboro' Falls, broadens and enters the lake. This river forms the boundary between two distinct classes of formations and topography:

1. The level country east of the Boquet, between it and the lake shore, consisting of paleozoic formations overlain by forty feet or more of drift material, clay, gravel, sand and subsoil.

2. The region of rounded, rocky hills, rising to the westward of the river, and composed almost exclusively of gabbros and anorthosites, of varying appearance but essentially of the same constituents.

Prof. F. D. Adams,† whose classification we adopt, refers the latter to the Norian or Upper-Laurentian in Canada, where similar rocks occur. These Norian hills up to fifteen hundred feet in height, range through the western part of both townships, accompanied by apparently earlier metamorphic limestone, schist and granite. They are partially covered by hills of stratified sand, which are remains of Quaternary beaches. The crystalline rocks reach the shore only along the west side of Willsboro' Bay, and on Split Rock Point. Flanking the Norian hills on the east, along the valley of the Boquet, is the Potsdam quartzite. This in turn is followed by the Calciferous sandrock. Both curve to the lakeside in following the

*The results of these investigations were incorporated by Prof. Kemp in making up the geological map of the district, for the forthcoming geological map of New York State, and were reported to Prof. James Hall, State Geologist.

†F. D. Adams: Über das Norian oder Ober-Laurentian von Canada. Neues Jahrbuch. Beil. Band, VIII.: 423.

river, and show a prevailingly northeasterly dip at a low angle, disappearing beneath the drift valley. The valley is underlain by blue clay of the Champlain period, and extends in a band two to three miles wide through both townships. On the eastern side of this area appears first the Chazy, of two sets of limestone beds, then the Trenton, usually as a shaly limestone, finally the Utica shales, exclusively along the shore. All the foregoing formations are cut by numerous diabase and porphyry dikes. Altogether we have presented a remarkably diversified and prolific field for geological study within a limited area.

ARCHÆAN.

The Archæan of the two townships comprises the following: *First*, the labradorite rocks, gabbros, norites and anorthosites, forming the whole western district and giving rise to the typical "tri-mountain" variety of hills noted by Emmons.* On the north they terminate the range that traverses the townships to the westward and end abruptly in cliffs two hundred feet high on Willsboro' Bay. The labradorite rocks on the south extend to the Split Rock Range of Westport. *Second*, the metamorphic crystalline limestones and ophicalcites on Willsboro' Bay and the ridge of Split Rock Point. *Third*, the gneisses and granites chiefly of the latter locality. We have adopted the classification of Adams in placing all these in the Laurentian.†

Van Hise‡ advances the theory of a central core of gabbro, with surrounding gneissic series of limestones, schists, etc., belonging to the Algonkian, "the metamorphism having been produced by the great laccolites or batholites of gabbro."

The labradorite rocks, as termed by Redfield,§ or "hypersthene rock," by Emmons,‖ and also called "hypersthene fels," etc., vary greatly and blend imperceptibly into one another. By comparison of fifty odd specimens from both townships, I am unable to trace any definite geographical or other sequence corresponding to the variation.

The basic gabbro is the prevailing type. Usually it exhibits a yellowish kaolinized feldspar, resulting from its ready

*E. EMMONS: Rept. on Second District, pp. 232–233 (1837).

†See complete discusson by PROF. J. F. KEMP: Gabbros of the Western Shore of Lake Champlain; Bull. Geol. Soc. Amer. V.: 213–224, particularly page 214, and for summary of previous theories, the same writer in A Review o the work hitherto done on the Geology of the Adirondacks. Trans. N. Y. Acad. Sci., XII.: 19, (1892).

‡C. R. VAN HISE: Correlation Papers, Archæan and Algonkian, Bull. 86, U. S. G. S., pp. 413, 516, 495, etc.

§W. C. REDFIELD: Some account of two visits to the mountains of Essex Co., N. Y. Am. Jour. Sci. Ser. 1: XXXII.: 301 (1837).

‖E. EMMONS: Rept. on Second District of New York State, 1842, etc.

weathering, with rounded grains of monoclinic pyroxene and plagioclase, and containing some hornblende, magnetite, titanite, pyrite, calcite or a little quartz. In fresh exposures the plagioclase is seen to be finely twinned and is often accompanied by dark, red or pink garnet. The rock is usually dark colored, fine grained and decomposes readily. It shows all stages, however, up to coarsely crystalline aggregates of highly lustrous and readily cleavable masses of labradorite with large imbedded augite crystals often several inches across, the labradorite showing excellent striæ on the basal section, and with a micro-per-

FIG. I. KELYPHITE RIM SURROUNDING GARNET. THE GARNET CONTAINS MICRO-CRYSTALS.

thitic interpenetration. Norite may be said to occur only rarely, if it all. In spite of the prevalent use of the term in previous writings on the region, microscopic examination reveals hypersthene in small amounts in a few sections, probably resulting, however, from some variation in the usual gabbro. The anorthosite types are light colored and consist almost purely of plagioclase, with little or no augite or hypersthene, and no macroscopic accessories. Alteration of the contained magnetite to leucoxene, and of the plagioclase to a milky kaolin is observable in many rock sections; secondary rosettes of the latter often result. The anorthosites occur chiefly in the northern part of Willsboro'. The rock of Boquet mountain and the other western hills is of the decomposed gneissic gabbro variety; while in southern Essex, adjoining the Westport iron belt, inclusions of magnetite are abundant, as are brilliant reaction rims of olivine and garnet.* An unusually fresh exposure occurs in the railroad cut, north of the river bend at the Westport boundary.

Reaction rims about the garnets are frequently observed under the microscope, as in figure 1, which shows a garnet with kelyphite rim in the anorthosite wall of a trap dike from Willsboro' Bay. The garnet itself contains minute needles that extinguish at a high angle.

The crystalline limestone in both the above-mentioned localities tends to a pure white calcite, carrying graphite. On Willsboro' Bay it forms a broad band through which the tunnel runs. On the lakeside at the southern margin of this limestone bed there is a deep cleft about 2 feet wide, running far in with a strike of N. 80° W. The walls are thickly studded with calcite crystals half an inch or more in diameter, showing the prism ∞ P terminated by $\frac{1}{2}$ R. The rock taken from far up the face of the cliff when the cut was blasted is said to have yielded galena, arsenopyrite and pyrite; but the place is now inaccessible. In connection with these minerals it is interesting to note an allusion by Prof. W. C. Watson† to a map procured from England by Elkanah Watson in 1784 and since lost, which was made from surveys by French and English engineers. Upon this a point is designated in the mountain range between Chesterfield and Willsboro' as "Lead ore bed."‡

"A traditional legend of this ore bed is known to exist among the savage tribes north of the great lakes. A little flotilla of canoes, bearing Indians from that region, appears yearly, about autumn, lying on the beach in the vicinity of these mountains." The same writer adds, in the report for 1853 (pp. 718–719), that "Within a few years strange Indians have been seen frequently prowling about these mountains with large quantities of crude

* Reaction rims are figured by J. F. KEMP, Bull. Geol. Soc. Amer. V. 213-224 (1894), and W. D. MATTHEW: The Intrusive Rocks near St. John, New Brunswick, Trans. N. Y. Acad. Sci. XIII.: 185-203, (1894). See a so F. D. ADAMS, Am. Nat. Nov., 1885, p. 1087.

† W. C. WATSON: Geology of Essex Co., N. Y.: Trans. N. Y. State Agricultural Soc. IX. (1849), 787.

‡ I find two earlier maps mentioning the locality. The map to accompany Peter Kalm's Travels in North America, translated into English by J. R. Forster, London, 1776, Part III., has "Lead Mine" printed between the mouth of the Boquet and Willsboro' Bay; and Gen. Wm. Tryon's "Chirographical Map of the Province of New York," London, 1779, included in the Documentary History of the State of New York, by E. B. O'Callaghan, Vol. I., Albany, 1819, locates "Lead Mine" north of the brook flowing into Willsboro' Bay.

galena in their possession, which could not have been transported from any considerable distance. The Indians were in the habit of landing near the mountains * * * returning in a few hours laden with lead ore of the richest quality."

Mention should also be made of a vein of "garnet-resinite" (colophonite), accompanied by tabular spar, garnet and pyroxene, in a trap dike in the Archæan near the lakes in northern Willsboro', which was not visited last summer, but of which we have several records and analyses.*

Granites and gneisses: The geology of these rocks on Split Rock Point is quite complex. The ridge, the end of the point and the isolated mass of Split Rock itself are of crystalline limestone, around which is a series of gneisses and granites, of varying texture, becoming more acidic as we go southward. Graphite is plentiful all through these gneisses and in the bunches of silicates, etc. (scapolite, pyrrhotite, sphene, hornblende, phlogopite), in the limestone, especially along the contact. In the woods between the roadside and the north shore is a feldspathic vein in the gneiss. Numerous dikes also appear, as in the appended tabulation. The gneiss overlies the granite near the end of the point, but numerous cortortions of hornblendic schists appear intermingled on the surface confusing the relations. Split Rock Point and Mountain both receive their names from the mass of rock at the tip of the point, isolated by a cleft, or "split," fifteen or twenty feet wide, which is flooded at high-water periods. The island consists chiefly of crystalline limestone with peculiarly contorted segregations of silicates, and schistose hornblendic bands (probably resulting from metamorphosed dikes), which so much resemble snakes that they are considered petrifications by the natives. The general geological features of Split Rock are set forth by Kemp and Marsters in Bulletin 107, U. S. Geol. Surv., p. 41.

Pegmatite veins are common associates of the dikes in the Archæan along Willsboro' Bay, and also on the south side of Split Rock Point; in the latter locality they contain masses of graphite.

Cambrian (Potsdam) Quartzite.

The geographic distribution of the Potsdam terrane about the Adirondacks is delineated on the geological map of New York accompanying the final report in 1842, and in the large map by

*W. C. Watson: Trans. N. Y. State Agri. Soc., XIII. (1853): 720.
A. E. Jessup: Jour. Acad. Nat. Sci. Phila., II. (1821): 182.
Lardner Vanuxem: Analysis of Table Spar from Willsboro', same ref.
L. C. Beck: Mineralogy of New York, p 326.
H. Seybert: Am. Jour. Sci., Series 1, V.: 118.

Messrs. Logan and Hall published in 1866.* Walcott † accepts these sandstones of the Adirondacks as typical of the upper member of the Cambrian.

The principal exposure is at Flat Rock, the next promontory south of Rowley Bay, in Willsboro', and is a ledge of white Potsdam quartzite of several acres extent, exposed in bare ledges for a long distance around the shore of the cove and traceable back from the shore into the pine grove where it attains a height of forty feet. The rock is similar to that of Au Sable Chasm in Chesterfield, but seems more compact, is fine grained, with no ferruginous cementation, and without fossils. Especially on the weathered surfaces ripple marks are abundant, and slabs showing the same, undoubtedly transported from the locality, are plentiful along the beach near the boundary between Essex and Willsboro'. A Bostonite dike, four and one-half feet wide, cuts the quartzite in a cliff twenty feet high around Flat Rock Point. It has altered the dip of the quartzite noticeably, the bedding north of the dike being 10° northwest, while on the south it is 8° southeast, although the contact is scarcely metamorphosed. The dike is cream-colored, macroscopically resembling a metamorphosed sandstone. It shows in section, however, a compact trachytic ground-mass without flow structure. A little pyrite is present. The Potsdam meets the Calciferous sandrock in a cliff twenty feet high, about 400 feet south of the dike, the contact being weathered out, beneath a large tree. The rock contains fucoidal remains, probably *Buthotrephis gracilis*, and has an interbedded layer of crushed and metamorphosed shale, at a height of six feet above the lake. The Calciferous here is less siliceous than elsewhere, more nearly approaching the Chazy, and has been quarried somewhat for local use at 164, on the map.

The other exposures of both Potsdam and Calciferous follow the Boquet river along the flanks of the Archæan hills. Under the dam at Whallonsburg there is a fine exposure of Potsdam sandstone, at least thirty-five feet in thickness being visible, as it reappears just in front of the Tyrrell House at the top of the hill above the bridge. A coarse-grained, gray, very siliceous rock occurs on the west bank of the river about 300 feet north of the mill, which is probably Calciferous, although it contains no fossils. After leaving this exposure the river flows over a channel of fine dark-colored silt, through alluvial meadows, without outcrop, until the old Boquet mill at Essex is reached. Here broad ledges of Potsdam occur, just south of the bridge,

* Geologlogical map of Canada and pa.t of the United States from Hudson's Bay to Virginia, Montreal, 1866.

† C. D. WALCOTT: Correlation Papers: Cambrian, Bull. 81, U. S. G. S., p. 341, and p. 360.

and extend three hundred feet down stream. The stone is white, fine grained, purely siliceous, and contains minute black shells of *Obolella prima.* Below the mill on the east side the quartzite rises in a cliff thirty feet high beneath the drift, and runs at the same height; across the river diagonally to the northwest, the fifty foot cliff directly opposite being norite. The reappearance of the Potsdam is at 179 on the map, in the bed of a small brook, which joins the river just north of the township boundary. The exposure is on the road side above the river. This quartzite is much coarser than at other points, and is like an oölite with a ferruginous cement. It dips 80° E., strike N. 44° E. The norite, here very gneissic, appears 30 feet above the quartzite on each side of the brook valley. Below the brick church, at the south end of Willsboro' main street, ledges of Potsdam appear in the bed of the river, extending 20–30 feet, dipping 80° W., strike N. 20° E., while much higher up on the north side of the road, east of the church, what appears to be Calciferous occurs in a field at 196 of the map. Rock similar to the latter again outcrops on the same road, nearer Essex, and finally at the bend of the river, just below the pulp-mills (183 on the map), in an exposure ten feet high.

Calciferous.

The localities of the Calciferous are enumerated above, on account of its close alliance with the Potsdam. It is difficult to identify with certainty. The only fossils found were those of gasteropod shells, in ledges beneath the water in the Boquet River, at 182 on the map. These shells were about an inch in diameter, with ridged coils, similar to *Ophileta uniangulata*, Hall. Apparently identical forms are figured by Whitfield* and ascribed to *Ophileta complanata*, Vanuxem.

The rock is high siliceous and sandy, of a light gray color, often with lighter streaks. On one hand it resembles the Potsdam, on the other the Chazy.

Chazy.

The Chazy formation occurs on the southern third of Willsboro' Point, along both shores, and doubtless continues under the drift-covered portion, for it reappears at the head of Willsboro' Bay.

*R. P. Whitfield: Observations on some imperfectly known fossils from the Calciferous Sandrock of Lake Champlain. Bull. Am. Mus. Nat. Hist., II.: 2 (March, 1889).

The Chazy and Utica occur in similar relations on the Vermont side of the lake* at Fort Cassin and at Valcour.† Brainerd records‡ the occurrence of the Chazy in this vicinity, but no beds containing Maclurea magna are reported west of the outlet of Lake Champlain.

The Chazy rock is much less siliceous than the Calciferous; of a gray-blue color, weathering lighter and sometimes with its lenticular layers of white dolomite, resembling the clay seams of some limestones. Two distinct sets of beds are noticeable. The lower series is dense, with rarely any fossils in the lower portion and with *Maclurea magna*, *Zaphrentis*, *Strophomena*, *Orthoceras* as fossils in the upper layers; and second an overlying series of lighter colored beds, showing a crystalline texture with abundant flinty discs of *Solenopora compacta*, encrinal stems, etc.

Prof. Seely has distinguished an extensive series of beds at Beekman Station near Plattsburgh, N. Y.,§ and Prof. Whitfield has published a similar section from Ft. Cassin, Vermont,‖ some of which may doubtless be correlated with the beds above mentioned. Hence the stratigraphy of the Chazy herein described may suffer revision upon a fuller study of the fossils. The former series comprise the quarries at Essex and on Willsboro' Point (where the latter series also appears on the surface). They also form ledges through the fields to the northwest of Essex; the upper series of beds occur on the shore at the head of Willsboro' Bay, and all along the north side of the road running southwest back from Essex. The latter are deeply seamed by perpendicular clefts several feet deep. Both sets of beds in these overlying relations are uncovered in a little quarry on the farm of Mr. Ross in Essex.

I have analyzed stone from the lower beds of the Willsboro' quarry, with the results given in column I. The same analysis is given in column II. with the carbonates calculated. For comparison, is introduced in column III. an analysis of Chazy limestone by Boynton¶ (No. 44), also stated to be from Willsboro'. And in column IV. a rather remarkable one from St. Lawrence Toll Gate, Montreal;** analyst not stated.

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* E. Hitchcock: Geology of Vermont, Vol. I. (1861), map I., etc.

† R. P Whitfield: Fossils in the Chazy at Ft. Cassin, Vt., Bull. Am. Mus. Nat. Hist., VIII.: 299.

‡ E. Brainerd: The Chazy Formation in the Champlain Valley, Bull. Geol. Soc. Amer. II.: 293 and 300.

§ Bull. Am. Mus. Nat. Hist., March, 1889, also December 28, 1886.
‖ Idem., VIII.: 295-299.

¶ Trans. N. Y. State Agri. Soc. XII. (1852): 801.

** Geol. Survey Canada, Rept. progress for 1857, 190; Toronto (1858).

	I	II	III	IV
SiO_2	2.43	2.43	21.39	73.02
CaO	51.00			0.93
$CaCO_3$		91.10	70.31	
$Al_2O_3.Fe_2O_3$	0.41	0.41	3.61	18.31 (Al_2O_3)
MgO	1.00	2.10	1.09	0.87
Na_2O			trace	6.87 (by diff.)
K_2O			0.80	
Cl			0.31	
H_2SO_4			0.69	
H_3PO_4			0.20	
Organic matter,			1.40	
		96.04	99.80	100.00

The analyst of IV mentions an evolution of H_2S as well as CO_2, while dissolving in HCl.

The Chazy is worked at three quarries on Willsboro' Point and at Parkhill's quarry in Essex. Frisbie's quarry for lime, on the west side of Willsboro' Point, and the adjacent kiln on the shore have been in intermittent operation for forty years, going into blast about April and suspending work in November, with a capacity of five hundred barrels per week. The entire product of lime is shipped by canal to New York City. The fines, called rubble, are employed in roadways at Plattsburg, Burlington and other places along the lake. Many large orthoceratites and maclureas occur in the ledges, which calcine like the rest of the stone. On the east side of the point are the quarries owned by S. W. Clark and by the Lake Champlain Bluestone Co. (Larned, Dickson and McDonald, of New York). Together they comprise roughly eighteen acres. The latter quarry is opened on the strike, which is N. 80° W., for a length of a thousand feet, covering about three acres, with a maximum depth of twenty-five feet, all above lake level. The beds dip 6° to 8° N., and are divided by one set of vertical joints running N. 10° E., and another less persistent in an east and west direction. The beds vary from one to six feet thick; the total thickness of the workable beds being about eighteen feet. The quarry was extensively worked from 1854–1869 by S. W. Clark & Co. The stone was employed in the foundations of the capitol at Albany and in the piers of the Brooklyn bridge, during which time some three hundred men were employed in these quarries.

The stone has also been used in several Albany and Troy churches.*

The shore exposure of the Chazy at Essex is on the headland known as Bluff Point, in the relations shown in the section at the base of plate VI. The Chazy is faulted on the north side against the Trenton and on the south against the Utica shale. The former fault runs northwest, while the latter, which is about fifteen feet wide, as traced half a mile back to the south of the quarries, strikes N. 60° E., so that the two faults in projection form an obtuse angle with each other.† The fault and accompanying uplift are figured by Emmons, who devotes several pages to its discussion.‡ The Utica shale§ is sharply drawn down upon its southern face, forming polished "slickensides." The extreme bending is of limited extent; the shales south of the fault dipping only 15° S. E. with strike N. 60° E., and the angle of the dip gradually lessens southward for the the next half mile and finally becomes horizontal or only 2°–3° S., forming an escarpment 4–6 feet high, extending along the lakeside. The lower layers of the Chazy at the end of Bluff Point include a three-foot seam packed with *Orthis platys*, Billings, but containing no *Maclureas*. The Chazy extends around to the northwest of the Trenton however, following the supposed fault. On the north side of the point ledges with *Maclurea magna* occur at thirty-five feet elevation. They also contain a bed densely filled with globular masses of concentric structure, about one quarter of an inch in diameter, containing as nuclei, minute lamellar foraminiferal skeletons. The height to the top of the bluff is thirty feet. At fifty feet in an open field *Obolella prima* occurs (52 on map), then crossing the roadway, about forty feet west of it and at sixty-five above lake level the first *Maclureas* appear together with imperfect remains of *Buthotrephis*. The same ledges continue up the hill, reaching a maximum altitude of ninety to one hundred feet in Parkhill's quarries, about half a mile from shore. There are two quarries; the lower 75 to 90 feet above the lake, the upper 90 to 100; and they represent different beds in the Chazy. The dip in the lower quarry is 10°–12° N., strike N. 60 E., in the upper quarry 14° N.W., and N. 25° E.; the fossils are chiefly in the lower bed, the upper being more compact. The fossils

* JOHN C. SMOCK: Bull. N. Y. State Museum, Vol. I., No. 3 (March 1888), pp. 102-103. Also, Vol. II., No. 10 (Sept., 1890), p. 242, 327 and 331. G. P. MERRILL: Rept. Smithsonian Inst. (1885-6), Part II., p. 517 and 569.

† Discussed in a paper read by Mr. Gilbert van Ingen before the N. Y. Acad. Sci., Oct., 1893, unpublished.

‡ E. EMMONS: Geol. of the Second District, pp. 272-276.

§ These are Utica, not Hudson River shales, as they were called by Emmons, Mr. van Ingen having found abundant specimens of *Triarthrus Beckii*, characteristic of the former.

include plentiful *Maclurea magna* a large species of *Stromatopora*, some being eight to ten inches in diameter, large *Orthoceratites Zaphrentis*, etc.

Stone from this quarry has been much employed in the village, in the sidewalks, stepping stones, etc. The polished surfaces of sections of *Maclurea magna* and *Orthoceratites*, the latter often very perfect and up two feet long, stand out conspicuously in white against the gray background, but are hard to extract entire.

Trenton.

The Trenton is much the most prolific fossil bearing formation. It is a black, shaly limestone, usually quite thin bedded with alternating dense layers, and a low dip (4°–10°) to the north or northwest, often fractured by a slaty cleavage of 40°–60°. It first appears on the north in ledges up to fifteen thick, surrounded by the drift on the western shore at the head of Willsboro' Bay. Mr. van Ingen has identified some twenty-five species in the material collected at this point, as enumerated in the accompanying list. The surfaces of the slabs with which the shore is strewn are thickly studded with remains which weather out of the soft rock. Specimens of *Chaetetes lycoperdon* weather out completely in large numbers.

Upon the lakeside the Trenton extends from about a mile and a half south of the mouth of the Boquet, where it first appears in the bed of a small brook, to a line just south of Essex village, where it is faulted against the Chazy. *Calymene senaria*, *Orthis testudinaria*, *Bellerophon biobatus* and *Orthoceras* are the most abundant fossils. Fragments of *Asaphus gigas* are also numerous, but not complete specimens, as are *Lingula curta* and another larger *Lingula*, graptolites and encrinal columns. The ledges can be traced in the bed of a small brook about a mile back from shore, and contain *Lingula quadrata*. The same brook curves around behind the blacksmith shop in Essex, and in its bed *Calymene senaria*, *Orthis*, etc., occur the same as on shore.

At the south end of Essex village, near an old limekiln, the Trenton is faulted against the Chazy. The exact fault is obscured by drift, but the adjacent layers of shaly limestone are much crumbled and crumpled. The fault passes northwestward in all probability through the village, along the depression of the surface noted by Emmons. Emmons (p. 277) reports the occurrence of an outcrop of forty to fifty feet of Trenton limestone in the drift area at the head of Whallon's Bay, and names unmistakable Trenton fossils found there. We were unable to locate it, however.

UTICA.

The Utica slates are black and thin bedded with interstratified calcite layers and often pyrite. They have a low dip and a strong slaty cleavage, usually nearly parallel with the strike. Graptolites are frequent, otherwise fossils are not numerous. Mr. G. S. Stanton found a single specimen of *Triarthrus Beckii* on the end of Willsboro' Point, and Mr. van Ingen reports *Triarthrus Beckii*, *Endoceras*, *Philodops* and a small form of *Strophomena alternata* from the Essex shore. The Utica forms the Four Brothers Islands, rising up thirty to forty feet high on the southern one and cut by several dikes. The northern third of Willsboro' Point is exclusively Utica, as is also the shore of Essex, forming an escarpment five or six feet high, of nearly horizontal layers, with interbedded denser ones, from Bluff Point to the south side of Whallon's Bay. These slates were ascribed by Emmons to the Hudson River stage, of which, however, we find no representative.

QUATERNARY.

The Quaternary comprises drift, delta deposits of sand and gravel, and post-glacial deposits of finer sand, blue and red clays. The drift has been frequently referred to in the course of this paper. The leading area fills in the valley between the westward dipping shore formations and the opposed strata along the Boquet. The hard pan or clay bottom beneath it produces a basin, so that to obtain water there is no need of deep well borings, from which data of the underlying rock might be obtained. Inquiries at numerous dwellings in the drift-covered area between Essex village and the railroad station elicited the fact that the wells ranged from forty to sixty feet deep, penetrating only gravel and coarse sand. This drift area extends in a practically level plain, two to three miles wide, at an altitude of about 325 feet above lake level from the lakeside to the Boquet and from the southern Essex boundary northward to the bend near the mouth of the river.

Judging from the fact that a cliff of Potsdam is seen underlying this drift at the old Boquet Mill, where the plain ends in a steep hill running down to the river, it seems to me that the section of five miles along the road north of Essex, given by Emmons in the Geology of the 2d District, Plate VIII.,* reproduced in section A. of the following figure would be more accurately represented as in section B. of the same figure.

*Emmons in the same plate gives a nearly accurate shore section.

Emmons' sketch represents quite truly the general relation throughout the strip, but along this particular section there is no external evidence of the Calciferous and Chazy as shown.

Similar drift deposits extend around the head of Willsboro' Bay and on Willsboro' Point. Willsboro' Neck is covered with five to ten feet of coarse sand without boulders, and at a depth of four or five feet large shells, resembling clam shells, are said to have been found, but to have fallen to pieces on exposure to the air.

Delta deposits. Bluffs of white sand, frequently stratified, and in nearly every case underlain by clays, occur in several localities.

On the Boquet near the Westport boundary, again at the curve south of Willsboro' Falls, are bluffs of white sand twenty or thirty feet high. Around the last point on the lake shore, before reaching the mouth of the Boquet River, the Calciferous disappears in a cliff 12 feet high, rising to bluffs 20–40 feet high on either side of the outlet, and forming a sand spit extending out into the lake. The sand shows stratification in the upper undis-

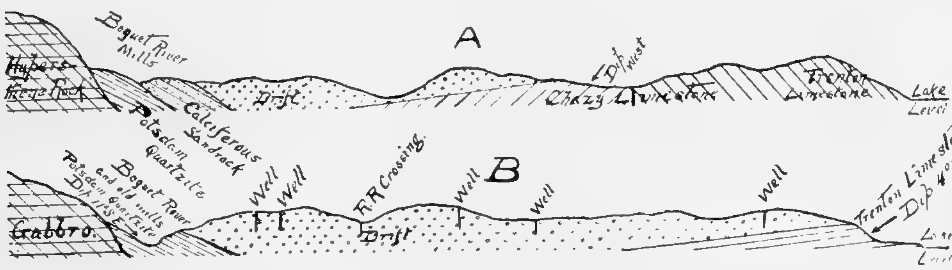

FIG. 2. SECTION OF FIVE MILES ALONG ROAD NORTH OF ESSEX VILLAGE.

turbed layers, and the top is somewhat coarser. The sand is white, fine and angular like a building sand. On the beach it is overlain by several inches of reddish black, magnetic sand, rich in magnetite or ilmenite, garnet or zircon crystals. The Boquet was formerly navigable to the falls, a distance of three miles, by the largest vessels on the lake, but now its channel, changed and obstructed by these sand accumulations, which form a bar across its mouth, admits only the smallest craft. Several sand hills occur in the interior. The first is a steep barren hill in northwestern Willsboro', which is located as an "ancient beach" by Emmons, on his map of the Tertiary of Essex Co., contained in the 200th Annual Assembly Report (1838).*

* Emmons outlines on the same map a so-called "Tertiary basin," reaching from the Paleozoic of the shore, across the Boquet, following the valley of the river along its west bank. The general relations of the limestones and shales at intervals along shore are roughly but clearly indicated on this old map.

The sand is stratified, and in a clean exposure on the roadway down its eastern slope the stratification dips 15° east. The hill slopes down to the wood-encircled sheet of water called Long or Rattlesnake Pond. There is a similar drift mountain with broad level top and steep sloping sides, like the last, in the northwestern corner of Essex. There is more gravel with the sand here than in the other hill. Another delta deposit at an altitude of 525 feet above lake level, is just over the Willsboro' line, north of the latter. It is chiefly of coarse gravel, underlain by a gray sandy clay bed, containing fragments of decomposed leaves.

Champlain clays. Underlying the gravel on the shore of Rowley Bay, is a bed of blue clay four feet thick above lake level, and running down under the water. To taste and touch this clay is unusually smooth and is also very plastic. It contains no grit or shells.

At a curve of the Boquet just over the township boundary (170 on the map), at the foot of a sand bank 20 feet high, is a clay bed three to six feet thick. The clay is very plastic, but slightly gritty to the taste. Near the foot of the porphyry cliff at the head of Whallon's Bay is another blue clay bed (91 on the map), lying at the base of the drift. This was the only clay bed found to contain fossils. *Saxicava rugosa* was the only shell which could be identified, but I found numerous purplish fragments resembling decomposed mother-of-pearl disseminated through the clay, which, owing to its exceedingly plastic condition and the greatly decomposed state of the latter remains, prevented the succesful removal of other recognizable species. The "small pieces of lignite on the farm of Mr. Whallon," which Emmons mentions*, were doubtless in these clays.

By the roadside at the crossing of the brook, just west of this blue clay, is a bed of brown clay; and another is found at the head of Willsboro' Bay.

Prof. Hitchcock† found the blue clays of the Vermont side to be charactized by *Leda portlandica* (*Yoldia arctica* Gray), and the red clays, by *Macoma fusca* (*M. groenlandica* Beck), *Saxicava rugosa* and *Mya arenaria*; these were in all cases associated with sand deltas. Similar delta terraces near the town of Elizabeth, southwest of Essex, are noted by Mr. H. Ries,‡ to be composed of sand and cobbles up to six inches diameter, consisting of norites and gabbros, at the base of which is a reddish clay. Mr. Ries states§ "that the clay beds along Lake Cham-

* P. 286.

† C. H. Hitchcock: Geology of Ve mont, 1861, I: pp. 93-167, with map.

‡ H. Ries: A Pl istocene Lake Bed at Elizabethtown, Essex Co., N. Y. Trans. N. Y. Acad. Sci. XIII: 107.

§ Ibid: Notes on the clays of New York State and their economic value. Trans. N. Y. Acad. Sci. XII.: Dec., 1892.

plain are estuary formations of the same age as those along the Hudson Valley. Openings have been made in them at Plattsburg, Essex, and a few other localities." The same writer mentions that, while the clay is generally blue, the upper few feet weather to red, owing to an oxidation of the iron.

Mr. Baldwin* considers that the clay plain which lies between the lake and the foot hills further north is due to the covering of Champlain clays and sands concealing the buried slopes. He traces the Pleistocene valley from Whitehall to Au Sable, with an accompanying map upon which his shore line of the ancient Champlain glacial lake follows around the sand hills above mentioned very nearly as depicted in Emmons' supposed Tertiary beaches.

Mr. Warren Upham† has attributed the depression of the Champlain valley to the weight of ice at the close of the second glacial epoch. This admitted the sea to the lake basin, and was followed by glacial retrocession, with continued deposition of upper till and deep flood plains of gravel, sand and clay (stratified and modified drift). The latter were deposited in valleys which received the drainage from the glacial melting, during its rapid progress through the Champlain valley. Dr. F. J. H. Merrill‡ has traced the course of deposition first of the heavier sands, and then of the lighter silts which afforded clays, in similar cases in the adjacent Hudson River valley.

The Dikes.

Dikes of light colored porphyry and dark basic diabase cut all the Paleozoic formations as well as the Archæan, and hence must have originated later than the Utica shale. Eighty-six dikes located in the two townships are enumerated in Appendix I. A further petrographic study of them is reserved for a future paper. The basic dikes are most abundant, although the lighter colored varieties occur in the same localities. The most abundant locality is along the western shore of Willsboro' Bay, and in the Utica shale of Willsboro' Point, as shown in Plate VI. The cliffs on the west side of the bay rise abruptly to a height of nearly two hundred feet. and the railroad cut which hugs a ledge about half way up the face affords a magnificent exposure of

* S. Prentiss Baldwin: Pleistocene History of the Lake Champlain Valley. Amer. Geol. 1884; XIII: 170 (Plate V.).

† Warren Upham: A Review of the Quaternary Era; Am. Jour. Sci. 1891, XLI: 33 Also Bull. Geol. Soc. Am., I: 566; II: 265; III: 484 and 508. See also Baron G. De Geer: Amer. Geol. 1893, XI: 36; and Proc. Bos. Soc. Nat. Hist. 1892, XXV: 454, with map of Pleistocene changes of level.

‡ Postglacial History of the Hudson River Valley. A. J. S., iii. XLI: 460.

norites and anorthosites, seamed by an unusual number of Dikes, there being no less than sixty within a distance of two and one-half miles. Following the lead of Professors Kemp and Marsters, who visited the Essex shore, but not this Willsboro' locality, in 1889–'90, and who have fully described similar dikes in their monograph of the region,* we may distinguish the dikes of the two townships as:

(1.) *Feldspathic porphyries* or trachytes, called in the above monograph "*Bostonites*," which are light colored, creamy, brownish white or reddish, breaking with rough surface. Microscopically they show trachytic structure with a ground mass of lath-shaped feldspars, frequently with flow structure; the clearness with which this is shown varies with the rock.

(2.) *Quartz porphyry*, or rhyolite, showing numerous well-developed hexagonal basal sections of quartz as phenocrysts. Structure micro-granitic, with few lath-shaped crystals.

(3.) *Lamprophyres;* dark basic varieties, which under the microscope contain plagioclase, augite, hornblende and biotite; and are divided into:

a. *Diabase* dikes; holocrystalline, ophitic aggregates of plagioclase and augite, with biotite, olivine and occasionally a little hornblende; not differing essentially from effusive diabase.

b. *Camptonites;* with preponderating hornblende or augite; olivine frequently present and at times a little glass; dark silicates and often the feldspars idiomorphic.

c. *Fourchites;* without olivine; very fine-grained, mostly pyroxene or hornblende in a glassy ground mass and very little plagioclase; often containing amygdaloidal fillings of calcite $\frac{1}{8}$ to $\frac{1}{2}$ inch across.

In the Archæan there are in several localities, large dikes, conspicuous by their darker color from the adjacent walls, but which microscopically are shown to be metamorphosed to hornblendic norites or gabbros usually with reaction rims of garnet. Two great dikes of this class may be seen strikingly against the cliffs from Willsboro' Bay. Another occurs on a hillside in the woods in southwestern Essex, 45 of the map.

In the Utica shale on Cannon's Point, Essex, an extensive intruded sheet or laccolite of bostonite is visible along shore for over 200 yards. It extends inland one-fourth of a mile.

* J. F. KEMP AND V. F. MARSTERS: Trap Dikes in the Lake Champlain Region and the Neighboring Adirondacks; Trans. N. Y. Acad. Sci. XI. (1891): 13.

—— ——: The Trap Dikes of the Lake Champlain Region (1893), Bull. 107, U. S. Geol. Surv. pp. 17-22.

For origin of terms see M. HUNTER AND H. ROSENBUSCH: Ueber Monchiquit, ein Camptonitisches Gangesteine aus der Gefolgschaft der Eleolith-Syenite. Tschermak's Min. u. Petrog. Mitth., XI. (1890): 445.

APPENDIX I.

(Field numbers refer to plates V. and VI.; * following the number indicates that sections have been examined.)

RECORD OF DIKES IN ESSEX AND WILLSBORO' TOWNSHIPS, N. Y.

(WEST SIDE WILLSBORO' BAY.)

Field No.	Wall Rock.	Dike Rock.	Bearing.	Inclination.	Width.	Locality and Remarks.
239	Anorthosite......	Diabase..............	N. 10° E.	45° E.	2.5 ft.	R. R. cut on Willsboro' boundary, near Port Kendall.
238	"	"			5 in. thick.	Same R. R. cut as 239 and just S. of it. Nearly horizontal, but wavy.
235	"	Crushed Diabase......	N. 70° E.	50° S. E.	1 ft.	30 ft. S. of trestle near Chesterfield boundary.
234	Norite.........	Rotten Diabase.......	N. 60° E.	70° S.	5 in.	20 ft. S. of 235.
233*	"	Fourchite............	N. 60° W.		1 ft.	125 ft. S. of 234. Contorted.
232*	"	Hornblende-fourchite with large amygdaloidal fillings. With pyrite.	N. 60° W.	Nearly perp.	1 ft.	
231–27	"	Diabase.....	N. 70° W.	Perp.	3.5 ft.	100 ft. S. of 233
230–28	"	"	N. 20° E.	Irregular.	6 ft. to 10 ft.	In the face of the cliff 25 ft. S. of 231.
231–29*	"	Hornblende-fourchite..	N. 84° W.	Perp.	10 in.	25 ft. S. of 232. With amagdaloidal calcite.
230–30	Anorthosite.....	Diabase with garnet ...				Irregular masses like 231, ½ mile S. of 231.
229	Norite	" " " ...	N. 20° W.	70° S. W.	16 in.	In cut around first curve N. of the tunnel.
228	Anorthosite	Metamorphosed diabase	N. & S.	Perp.	4 in.	Opposite side of same cut from 227.
227	"	" "	N. 80° E.		3 ft.	12 ft. S of 228
226*	"	Hornblende-norite with reaction rims of garnet	N. 20° E.		15 ft.	In first cut N. of Red Rock Tunnel. The cut follows the dike.
225*	"	Hornblende-norite with reaction rims of garnet		12° N. E.	3 ft. 3 in.	Runs up face of above cut 100 ft.
224	"	Hornblende-norite with reaction rims of garnet				Inaccessible dike 25 ft. above 225.
223	"	Hornblende-norite with reaction rims of garnet			8 ft.	75 ft. up the face of the cliff. Nearer tunnel opening than 224.
222*	"	Crushed Diabase......	N. 30° W.	68° E.	2 ft.	200 ft. N. of mouth of tunnel.
221*	"	Augite-camptonite.....	N. 20° W.		6 ft.	20 ft. S. of 222.
219	Limestone.......	Diabase..............	N. 20° W.		2.5 ft.	In the limestone at S. end of Red Rock Tunnel.
218a	Anorthosite.......	Altered Diabase.......	N. 30° W.		4 in.	Below cliff on lake side.
216	"	" "	N. 84° W.	45° S.	15 ft.	" " " 25 ft S. of 217.
217	"	" "	N. 80° W.	70° S.	10 in.	" " "
215	"	Diabase...............	Nearly hor.	42° S.	10 ft. thick.	Cut near cliff.
214	"	"		Hor.	6 ft. thick.	
212	Gneissic gabbros..	"				Parallel to and about 10 ft. below 209.
211	" " ..	"		8° S. on contact.	3 ft. thick.	
210	" " ..	"			8–10 ft. thick.	Parallel to the above dike.
209	Norite...........	"	N. & S.	64° E.	8 in.	100 ft. S. of big cut.
208	"	"	N. 20° E.	8° S. on contact.	18 in.	50 ft. S. of 209.
207	"		= R. R. cut.	80° S.	15 ft. thick.	Around the point S. of the high cliff.
206	"	MetamorphosedDiabase	N. 70° E.		8 in.	
205	"	" "			2.5 ft.	
204	"	" "			2.5 ft.	
203	"	" "			1 ft.	Parallel dikes, each about 6–8 ft. apart. Next cut (about 1000 ft.) north of 202b.
202	"	" "			6 in.	
201	"	" "			2 ft.	
202a	"	" "			7 in.	
203	"	" "			6 in.	
202b	"	" "	N. 78° E.		2 ft.	Weathered dike in culvert.
201b	"	" "	N. 78° E.	80° S.	3 ft.	25 ft. S. of 202b.
200	"	" "	N. 82° E.	Varies.	8 in.	E. side of R. R. in cut.
198	Banded Norite....	" "	N. 54° W.			Near S. end of tunnel. Wavy.
197	Anorthosite......	" "	N. 80° E.	Perp.	2 ft.	Looks like a dike, but scarcely different rock.
195	Norite..........	Diabase.	N. 86° E.			
194	"	Rotten Diabase with Calcite Amygdules..	Irregular mass.			20 ft. N. of 194.
193	"	Diabase......	N. 75° E.	73° N.	8 in.	3 ft. N. of 193.
192	"	"	N. 75° E.	73° N.	3 ft.	18 ft. N. of 192.
191	"	"	N. 75° E.	73° N.	15 in.	2 ft. N. of 191.
190	"	"	N. 75° E.	73° N.	2 ft.	15 ft. N. of 190.
189	"	Rotten Diabase.......	N. 62° E.	73° N.	10 in.	8 ft. N. of 189.
188	Anorthosite	" "	N. 80° E.	80° N.	8 in.	20 ft. N. of 188.
187	"	Garnetiferous Norite...		40° S. on contact	1.5 ft.	30 ft. N. of 186; cuts both wall rock above 187 and 187 itself; begins 10 ft. N. of 186 and runs up to 15 ft. thickness in a 20 ft. cut; 30 ft. beyond, and down again 50 ft. N. of 186.
186	"	Rotten Diabase........	N. 77° E.	77° N.	1 ft.	50 ft. N. of 185.
185	"	" "	N. 65° E.	79° N.	7 in.	7 ft. N. of 184.
184	"	" "	N. 60° E.		2.5 ft.	See location on map, at beginning of cut.

(WILLSBORO' POINT.)

Field No.	Wall Rock.	Dike Rock.	Bearing.	Inclination.	Width.	Locality and Remarks.
176	Utica shale	Camptonite	N. 40° E.	44° S. E.	4 ft.	On bay side of the point. Extends 100 ft.
175*	" "	"	N. 80° E.	60° W.	6 ft.	20–30 ft. beyond 173. Coarsely brecciated.
173*	" "	"			3–20 ft.	W. side of point. 300 ft. long, broadening eastward.
172	" "	"	N. 70° W.	60° E.	12 ft.	" " 15–20 ft. high, traceable 50 ft.
152*	" "	"	N. 30° E.		8 ft.	West side of point.
168	" "	"	N. 80° E.		8 ft.	West Four Brothers' Island, south side cliff, 30 ft. high.
170*	" "	Diabase.......	N. 65° E.		3 ft.	East " " " north " 20 "
25 & 149	Chazy limestone..	Bostonite	N. 70° W.		15 ft.	North side of Lagonier Point, 2–3 ft. high in cliff.
148	" " .	"	N. 70° W.		10 ft.	End of Lagonier Point, 8–10 ft. high in cliff (00 of K. & M).
156	Potsdam quartzite.	"	N. 54° W.		4.5 ft.	South of Flat Rock; Willsboro'.
Near 19 a	Calciferous	Camptonite...........	N. 60° E.		18 in.	On shore road to Willsboro' from Essex.
99 & 55	Chazy limestone .	Camptonite (Typical)..	N. 70° W.		2–3 ft.	Bluff Point through Parkhill's quarry. Nos. 527 and 583 of K. & M. Visible 200 yds. in quarry.
103	Utica shale	Bostonite	N. 75° W.	80° N.	2.5 ft.	1 mile south of Essex. Probably 526 of K. & M.
1–2–6*	" "	"	N. 80° E.	8° N.	6–75 ft. thick.	Laccolite on Cannon's Point. Much altered. Visible 150 ft. No. 521 of K. & M.
6a*	" "	"		28° W.	40 ft. high.	Laccolite south of Cannon's Point. Extends 40–50 ft. Probably 528 K. & M. Altered.
92*	" "	Quartz-porphyry			30 ft. wide.	Cliff 15 ft. high on southwest side of Whallon's Bay. Probably 529 K. & M. Altered.
79	" "	Porphyry				Outcrop, probably same outflow, altered, on Prof. Currier's place, southwest of the latter, in the woods.

(SPLIT ROCK POINT.)

Field No.	Wall Rock.	Dike Rock.	Bearing.	Inclination.	Width.	Locality and Remarks.
104	Granite..........	Camptonite				In cave on Whallon's Bay, just W. of Split Rock. Apparently a N. & S. curved dike.
10	Crystalline limestone	"	N. 80° W.	80° E.	15 ft.	N. side of Split Rock Island.
106a	Crystalline limestone..........	"	N. 70° E.	80° S. E.	8 ft.	End of Split Rock Island. 517 of K. & M.
84	Granite and Hornblendic gneiss...	Camptonite altered....	N. 80° W.		3 ft.	In cleft south of lighthouse, Split Rock Point.
107 { a. b. c.	Granite and Hornblende	" "	N. 40° W.	36° S. E.	4 in. 2 in. 2 in.	On end of Split Rock Point, north side, below the lighthouse.
86	Granite	" "	N. 70° W.	N.	18 in.	A few feet west of No. 84.

Numerous irregular intrusions.

(INLAND DIKES.)

Field No.	Wall Rock.	Dike Rock.	Bearing.	Inclination.	Width.	Locality and Remarks.
124 { a. b.	Norite	Diabase..............	N. 80° E.		{ 2.5 in. 2.5 ft.	2 dikes about 2 feet apart, on road from Willsboro' to Keeseville; near Long Point (northeast side).
120	"	"	N. 70° E.		2–3 ft.	Much decomposed. On same road (south side) nearer Willsboro'.
	"	Hornblende-fourchite..	N. 80° E.		1 ft.	Boquet Mt., east of Essex. 584 of K. & M.
94	Utica slate........	Porphyry				Outcrop on road west of Essex (1⅔ miles west). Juncture on the shale runs nearly due N. & S.
34	Norite	Gneissoid-metamorphosed Diabase.. ...			4–6 ft.	Apparently a metamorphosed dike; west side of road along river west of Boquet Mills, Essex.
45*	"	Garnetiferous Norite...	N. 40° E.		6–8 ft.	On farm of Mr. Sayles, in southwest corner of Essex township, half mile north of road and 75 ft above road on side of a rocky hill.

To the S. W. at the point it forms cliffs 70–80 feet high. The shale under the laccolite is visible for 150 feet, while a thin shaly layer also penetrates the porphyry, as figured by Emmons.

A crumpling of the porphyry in a N. E. and S. W. direction at this point, corresponding to "C" in Emmons' diagram, apparently indicates the source of intrusion. The rock is an exceedingly tough porphyry, and its petrography has been treated by Messrs. Kemp and Marsters in their monograph (p. 43). One quarter of a mile further south a similar ejection appears for fifty feet along shore, rising in a forty foot cliff, this being a brick bed rhyolite. Another occurs on the south side of Split Rock Point (according to Messrs. Eakle and Marsters), a fourth, badly weathered, in the swampy meadow at the head of Whallon's Bay, as noted by Emmons, and the fifth, associated with the Utica shale, on the roadway running west, at the south of Essex, 94 of the map.

In addition to Prof. Kemp's guidance at various points in the course of this work, I am indebted to Mr. Gilbert van Ingen, Curator of the Geological Museum of Columbia College for the identification of the fossils, and to Mr. E. J. Riederer for assistance in the field at Essex, and for the use of numerous negatives, many of my own, taken expressly for the purpose, having unfortunately been ruined in development.

The accompanying map is compiled from the United States Coast and Geodetic Survey Charts of the lake front, and from the County Atlas for the interior. The latter is quite unsatisfactory in regard to its accuracy, but the only one thus far published.

The United States Geological Survey has not yet issued the sheets of the topography of the district; and there is obtainable only the preliminary triangulation of the region, which was published in the Adirondack Report in 1879.*

Except the approximate altitude of Boquet Mountain, no data have appeared for the heights of the mountains and hills of the vicinity.

Appendix I: Record of Dikes, see insert.

Appendix II.

The material collected by Mr. White contains fossils from the following geological stages, which are represented on the map at the localities corresponding to numbers appended.

Gilbert van Ingen.

* Progress sketch—Preliminary Triangulation by Verplanck Colvin; 7th An. Report Topog. Surv. Adirondack Region, Map 5.

I. Potsdam.

Obolella prima, Conrad & Hall, (1847 :) 30.

II. Calciferous.

Ophileta uniangulata, Hall, 185.

III. Chazy.

Maclurea magna, LeSeur, 23, 24, 56, 58, 59, 60, 65, 66, 54, 70.
Orthoceras sp.? 23, 24, 26, 54, 65, 60, 138.
? Monticulipora lycopodites, Vanuxem, 23, 24, 26.
Orthis borealis, Billings, 23, 24, 26, 28, 62, 61.
" imperator, Billings, 24.
? " costalis, Hall, 24.
? " perveta, Conrad, 23, 62.
" platys, Billings, 23, 24, 51, 62, 61.
Strophomena incrassata, Hall, 62.
" alternata, Conrad, 61.
Solenopora compacta, Billings, 54, 57, 64.
Stenopora fibrosa, Goldfuss, 63, 61.
?Ophileta complanata, Vanuxem, 138.
Lituites sp.? 138.
Bolboporites Americanus, Billings, 138.
Camerella varians, Billings, 138, 62.
" sp.? 57.
Asaphus, sp.? fragments, 62, 61.
Trilobite, fragments, 54.
Zaphrentis, 54.
Encrinal columns, 61, 63.
Globular masses containing as nuclei minute lamellar foraminiferal skeletons, 50, 60.

Trenton.

Bellerophon bilobatus, Sowerby, 14, 15, 136.
Trinucleus concentricus, Eaton, 136.
Asaphus gigas, DeKay, 14, 15, 97, 125, 136.
Calymene senaria, Conrad, 14, 15, 97, 98, 125, 136.
Ceraurus pleurexanthemus, Green, 136.
Dalmanites callicephalus, Hall, 15, 136.
Ambonychia bellistriata, Hall, 136.
Tellinomya dubia, Hall, 136.
Strophomena alternata, Conrad, 136.
" deltoidea, Conrad, 136.

Streptorhynchus planumbonum, Hall, 136.
Orthis pectinella, Emmons, 136.
" borealis, Billings ?, 136.
" testudinaria, Dalman, 14, 15, 97, 125, 136.
Platystrophia biforata, Schlotheim, 136.
Leptaena sericea, Sowerby, 14, 15, 136.
" " large, finely striate, ventricose form, 136.
Lingula quadrata, Eichwald, 97, 125, 136.
" curta, Conrad, 97.
" sp. ? 125.
Trematis terminalis, Emmons, 15, 97, 125, 136.
Monticulipora lycopodites, Vanuxem, 15, 97, 136.
" branching species, delicate, 15.
Ptilodictya sp. undet, 136.
Stenopora fibrosa, Goldfuss, 136.
Orthoceras, sp. undet, 97.
Endoceras proteiforme, Hall, 97, 15.
Graptolite, gen. and sp. undet, 97, 98, 125.
Lamellibranch, fragment, 125.
Encrinal columns, 98, 125.
Nuclea levata, Hall, 15.
Subretopora (Intricaria) reticulata, Hall, 136.
Alga, 136.

Utica.

Triarthrus Beckii, Green, 153, 101.
Graptolites, 171, 169, 151.

Champlain.

Saxicava rugosa, 93.

The paper was illustrated by numerous views and specimens.

The meeting then adjourned.

J. F. Kemp,
Recording Secretary.

Stated Meeting.

May 28th, 1894.

The Section of Astronomy and Physics at once organized and listened to a lecture by Mr. Garret P. Serviss on "Astrology."

At its conclusion the Academy adjourned.

WM. HALLOCK,
Secretary of Section.
J. F. KEMP,
Recording Secretary.

REGULAR BUSINESS MEETING.

June 4th, 1894.

The Academy met with Vice President Whitfield in the chair. Eleven persons present. The minutes of the last meeting were read and approved.

The Secretary presented the following nominations from the Council:

Prof. A. M. Mayer.

Dr. Timothy Cheeseman.

Mr. Henry E. Crampton.

All of whom were elected.

The Secretary read by title the following papers:

A DIVISION OF THE EUTHERIAN MAMMALS INTO THE MESOPLACENTALIA AND CENOPLACENTALIA.

BY HENRY FAIRFIELD OSBORN.

In a recent address I endeavored to develop the idea that we should consider the Placentals as having exhibited two great centres of functual radiation which were successive and largely independent of each other. The first of these was the group mainly discovered by Cope in the Puerco and now proved to extend back into the Cretaceous; the second is the group the earliest members of which were seen in the Puerco and which developed and radiated in the succeeding Tertiary. To these two groups the names Mesoplacentalia or Placentals distinctive of the Mesozoic period, and Cenoplacentalia or distinctively Tertiary Placentals, may be applied.

The differences between these two groups consist mainly in the lower state of evolution and apparent incapacity for higher development of the former and the higher state of evolution with capacity for rapid development of the latter. The value of this distinction consists in the fact that the Mesoplacentals evolved and diverged in North America and undoubtly in Europe, during Mesozoic times, in the Jurassic, Cretaceous and Lower Tertiary. Careful studies of the Upper Cretaceous mammals show that they probably had already diverged into Ungulate and Unguiculate, Carnivorous and Insectivorous types. This functional divergence reached its climax in the Puerco, which Professor Cope is inclined to consider as the summit of the Cretaceous instead of the base of the Eocene. Here these mammals exhibited their greatest variety, and are found to be characterized by plantigrade feet and trituberculur teeth. One especial feature of all the hoofed types is that they develop their molar type, whether bunodont, selenodont or lophodont, upon the triangular plan. We may consider the Dinocerata, Creodonta and Tillodonta as spurs of this great Mesoplacental radiation, and we find the key to the extinction of the Mesoplacentals in their stationary brain develop and comparatively defective tooth and foot structure.

It is important to emphasize the fact that we have not as yet connected any of these Mesoplacentals directly by lineal descent with the Cenoplacentals, excepting perhaps *Euprotogonia*, a supposed ancestor of the Perissodactyla (Schlosser) and *Protogonodon*, a supposed ancestor of the Artiodactyla (Earle). But even when such threads of lineal descent are traced by future research, the fact remains that the great group of Mesoplacentals as such became extinct; that the first attempt at wide functional radiation of the mammals failed, and that from some comparatively unspecialized spurs of the dying Mesoplacental group, a new functual radiation began, reaching its climax in the Cenoplacentals of the Miocene period, but since then declining.

There exists therefore a threefold parallelism among the mammals, of similar adaptive structive developed independently among the Marsupials, Mesoplacentals and the Cenoplacentals. Very probably when the Monotremes are more fully known, we shall also find that they exhibited their own functional radiation into a variety of types, of which the Multituberculates with their strong Rodent analogies, the Ornithorhynchidæ and Echidnidæ are the only present ones known.

The Mesoplacentals are not defined as a homogeneous group; they are very heterogeneous; what unites them is the incapacity for progressive evolution. The terms inertia potential are new in biography, but they seem to express most perfectly the differences between certain great groups of mammals. As regards their progress in a similar period of time, we may compare certain groups as follows:

	A.	B.	C.
	Monotremes.	Marsupials and Mesoplacentals.	Cenoplacentals.
Inertia.	Maximum.	Medium.	Minimum.
Potential.	Minimum.	Medium.	Maximum.

The inertia is seen in the inability to shake off the reptilian inheritance and assume the typically mammalian stamp. Wherever they have come into competition, the Cenoplacentals have driven out the Mesoplacentals, just as the Placentals will in time supersede the Marsupials of Australia.

The exception to this is, I believe, seen in two great groups still existing, but which are universally regarded as extremely ancient.

These are the Insectivora and Lemuroidea, which may prove to be persistent Mesozoic types. The physiological division of the Placental orders would, according to this hypothesis, be as follows:

EUTHERIA.

Prototheria.	*Mesoplacentalia.*	*Cenoplacentalia.*
	Amblypoda. Dinocerata.	Proboscidea.
Monotremata.	Coryphodontia.	
	Condylarthra	Diplarthra, Artiodactyla and Perissodactyla.
	Creodonta.	Carnivora.
Multituberculata.	Tillodontia.	Rodentia.
		Cheiroptera.
	Insectivora.	
	Lemuroidea.	
		Anthropoidea.

Incertæ sedis; Edentata, Sirenia, Cetacea.

The order Bunotheria of Cope, inculding the Creodonta, Mesodonta, Insectivoro, Tillodonta and Taeniodonta, was proposed on the basis of common structural characters, but it now proves to be an unnatural one, although the term Bunotheria conveniently expressess the low state of evolution of these orders in the lower Eocene. The Mesoplacentalia are chiefly grouped upon common characteristics which appear to have been partly physiological.

LITHIUM BICHROMATE AS A NEW REAGENT FOR HARDENING ADULT BRAINS IN THE GOLGI METHOD.

By O. S. Strong.

The employment of the methods of impregnating the various elements of the nervous system introduced by Camillo Golgi have, in the hands of such investigators as Golgi, Ramón y Cajal, Kölliker, Retzius, von Lenhossék and many others, led to such rich acquisitions to our knowledge of the nervous system, and thrown so much light upon its many obscure points that any improvement in its technique, even though slight, hardly requires an apology for its presentation.

The principal defects of these methods may be said to be uncertainty of good results, inequality of the impregnation, and the expense, in the rapid method at least, involved in the use of so much osmic acid. The inequality of the impregnation is, as has often been pointed out, in many respects a valuable quality. It is on account of its remarkable property of impregnating only a limited number of the nervous elements in any one preparation that Golgi's silver method has proved so invaluable in unravelling the complex structure of the various parts of the nervous system. In spite of this, however, it is at times desirable to obtain more complete and uniform impregnations than are secured, except in rare instances.

1. *Sodium Sulphate Method.*

It occurred to me that this defect and the uncertainty of the method could be remedied to some extent by enhancing the penetration of the silver nitrate. This was attempted by mixing the silver nitrate solution with solutions of sodium or zinc sulphate. The following proportions were tried: Sodium sulphate 8% 1 vol. + silver nitrate 1% 1 vol., sod. sulph. 6% 1 vol. + silver nit. 4% 1 vol., sod. sulph. 1% 1 vol., + silver nit. 1% 1 vol. The specimen was brought directly from the osmic-bichromate mixture into one of these mixtures. Before washing in alcohol, the sulphate was removed by washing in pure silver nitrate. Otherwise the strong alcohol would precipitate the sulphate in the tissues.

In the two first mentioned mixtures a precipitate, probably of silver sulphate, formed. To avoid this waste it would be well to reduce the strength of either the sodium sulphate or silver nitrate. Zinc sulphate seemed to produce results similar to the sodium salt, but could be mixed in larger proportions with the silver solution without forming a precipitate.

In certain cases this modification gave very good results. It is, however, not always necessarily an improvement, and further experience is requisite to determine its exact value.

2. *Lithium Bichromate Method.*

It is, however, another modification to which I wish at present to call especial attention and which will, I think, prove valuable in certain lines of work.

While embryonic tissue is necessary to obtain good results in the demonstration of the course, ramification and terminations of the nerve fibres, their relations to the cells and to each other, etc., the investigator often simply wishes to ascertain the forms, including the protoplasmic processes, arrangement, etc., of the cells themselves in the central nervous system, and is, moreover, limited to adult material. This is often the case, for example in medical work, especially that upon the pathology of the brain. It is in such work upon the adult brain that the rapid method, owing to the employment of osmic acid, which tends to overharden, yields its poorest results.

This, together with the expense of the osmic acid, may be avoided by the use of the long Golgi method, which dispenses with the osmic acid, or by one of the sublimate methods. Both of these, however, have the disadvantage of requiring a considable period of time, from about a month upwards, while the long silver method is also uncertain and the sublimate does not appear to give the same delicacy of impregnation as the former.

I have found that the period of time necessary to reach the proper degree of hardening for impregnation may be reduced from the 20–30 days or so required by the long method to from 1–3 days by simply using *lithium bichromate* instead of potassium bichromate.

This does not do away with the uncertainty, for the tissue passes through the favorable period quite rapidly, apparently, but it has the advantage of reducing it and the whole process to such a short period of time that the trouble and delay are very materially lessened. The tissue should be cut into small pieces and put into a liberal supply of a 2–3% solution of lithium bi chromate. In the course of from 24–48 hours pieces should be placed in the silver nitrate solution at intervals. After having been in the silver bath for one to several days or more, a piece found by trial section, by hand, to be impregnated may be washed with strong alcohol (95 %) a short time, $\frac{1}{2}$ hour or so, stuck on a microtome block and cut in 95% alcohol into sections of suitable thickness, say 40–100 μ. After being washed in 95% alcohol they may be cleared in Ol. Origanum *Cretici*, rinsed in xylol and mounted in dammar balsam (or Canada balsam dissolved in xylol) without a cover slip, care being taken that the layer of balsam is as thinly spread as is possible in order to just cover the sections. It is best to dry the balsam quickly by placing the slides in an oven at 45°–55° C.

This method has been tried principally thus far upon the adult human cerebrum and cerebellum and has yielded some excellent pictures of pyramid cells, of neuroglia, and especially of the Purkinje cells. In the hen's brain it has also given pictures of the granule cells of the cerebellum with their axis cylinder processes dividing T-shaped in the molecular layer. It is apparently inferior to the ordinary rapid method for embryonic material.

THE FUNNELS AND TERMINAL VESICLES OF THE HIRUDINEA.

(CLEPSINE, NEPHELIS, AULASTOMA.)

A PRELIMINARY NOTICE BY ARNOLD GRAF, PH. D.

In recent years the question whether the Hirudinea possessed funnels or not has been again brought forward by *H. Bolsius.* His investigations seemed to prove that there were no funnels in any genus of *Hirudinea.*

Since then the criticism of *Bourne* appeared, in which he rejects the investigations of *Bolsius.* I agree in most of the points with *Bourne.*

I have been working about two years on leeches, and in my first paper upon the excretory organs of *Nephelis*, I pointed out that most of the assertions of *Bolsius* were due to misinterpretation. Since then I had the satisfaction of getting some very good series of *Clepsine* and *Nephelis*, in which I could see the direct communication between the funnel and the nephridial gland.

In *Clepsine* the funnel lies in the *ventral sinus.* Its position is always fixed by the ganglion, on both sides of which the ciliated organs lie.

Bourne stated that the funnel consists of only two ciliated cells. I found that the funnel of *Clepsine* resembled very closely the funnel of *Nephelis*, which I described in my former paper.

The ciliated cells are arranged around an aperture which leads into the vesicular enlargement of the funnel. I counted from 3 to 5 cells.

This *funnel vesicle* is filled with débris of the *chloragogenous cells.* Now we know that in *Nephelis* the funnel lies in another place, and is equally surrounded by chloragogenous cells. I therefore find it very remarkable that in *Clepsine* those cells enter the *ventral sinus* and surround the funnel.

Moreover, I could follow out in the series the *nephridial gland* passing through the connective tissue, through the longitudinal muscle bands entering with its terminal part the ventral sinus, and connecting at last with the funnel vesicle. To recapitulate:

1. *In Clepsine the funnel resembles closely the funnel of Nephelis.*

2. *The connection between the nephridial gland and the funnel takes place within the ventral sinus.*

3. *The funnel is surrounded by chloragogenous cells in the interior of the ventral sinus.*

In *Nephelis* I was less fortunate than in *Clepsine.* I could see in two cases the nephridial gland in slight connection with the bottom of the funnel, but in most of the cases the funnel was in no direct connection with the gland. However, the observations I made seem to indicate an *indirect* communication through a space in the connective tissue.

1. The terminal part of the nephridial gland always goes close to the wall of the *ampulla* in which the funnel lies.

2. Opposite the terminal portion of the gland there is always an *opening* in the wall of the ampulla.

3. This opening always corresponds to the bottom part of the funnel.

As to the funnels in *Aulastoma* I have little to say, my series not being as satisfactory as in the preceding species.

1. The funnels lie in sinuous vesicles, dorsal from the testis, and at the side of the intestine.

2. The funnels are closely surrounded by an enormous quantity of chloragogenous cells that assume in *Aulastoma* a somewhat different character than in *Nephelis* and *Clepsine.* They

seem to form a sort of *chloragogenous gland* with intracellular ducts.

3. The funnel is many-lobed. The ciliated cells greatly surpass in number the ciliated funnel cells of *Nephelis*.

4. The funnel seems to be *threefold, i. e.;* the nephridial gland divides in its terminal portion into three parts, each of which bears a many-lobed funnel.

5. The funnels are in communication with the nephridial gland.

Concerning the *terminal vesicles*, I have nothing new to say; but as *Bolsius* has contradicted my views in a letter, I have repeated my investigations and found the following:

In *Hirudo* the terminal vesicle is spacious and lined with richly ciliated epithelium. The duct, connecting the vesicle with the exterior (terminal duct), enlarges into a secondary vesicle.

This "*terminal duct*" is surrounded by circular muscle cells, the number of which is increased in *two places:* 1. at the opening of the terminal vesicle into the terminal duct; 2. near the communication of the latter with the exterior.

In *Aulastoma* the terminal vesicle is very similar, except the circular muscle cells are confined to one place, at the opening of the vesicle into the terminal duct.

In *Nephelis* there are no more circular muscle cells, but the whole vesicle seems to be provided with a feeble musculature.

In *Clepsine* the vesicle is very small. The epithelium is not ciliated and there is not any trace of muscle cells.

May 15th, 1894.

The Secretary presented an invitation from the Congrés international des Americanistes, dixieme Session à Stockholm, August 3–8, 1894, for the Academy to appoint a delegate. It was moved and carried that the Academy accept the invitation and that the President and Secretary be appointed a committee to arrange if possible that some traveling member of the Academy represent us at the session.

Prof. D. S. Martin then reported in behalf of the committee on standard sizes of trays, drawers, etc., and after considerable discussion the report was referred back to the committee to place the dimensions in the metric system.

Prof. Martin also reported upon the program of the meeting of the American Association for the Advancement of Science in Brooklyn, in August.

The Academy then adjourned until the first Monday in October.

J. F. Kemp,
Recording Secretary.

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New York Academy of Sciences.

FIRST ANNUAL RECEPTION

and Exhibit of Recent Progress in Science, in the Library of Columbia College,

March 12th, 1894.

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OF
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1818

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EXHIBITS.

DEPARTMENT OF ASTRONOMY.

In charge of Prof. J. K. Rees.

1. Two forms of CALCULATING MACHINES, made by Thomas and Grimme, Natalis & Co.

2. RECORDING BAROMETER, made by Fuess, of Berlin.

3. RECORDING ANEMOMETER, made by Fuess, of Berlin.

4. RECORDING RAIN GAUGE, made by Fuess, of Berlin.

5. ASSMANN'S PSYCHROMETER, made by Fuess, of Berlin.

6. FOUR PHOTOGRAPHS OF FINE MAGNETIC INSTRUMENTS, mounted at Potsdam, Germany.

Nos. 1 to 6 inclusive were a part of the German Exhibit at the World's Fair in Chicago, and were presented to the Department of Astronomy of Columbia College by President Low.

The Recording Apparatus in the above instruments is electrical.

7. PHOTOGRAPHS OF THE SUN, MOON, PLANETS AND NEBULÆ, made at the Lick Observatory and presented to the Columbia College Observatory.

There will be exhibited also, as being historically interesting, the following:

8. PHOTOGRAPHS OF THE SUN, MOON AND STARS, made by Lewis M. Rutherfurd.

9. MEASURING MICROMETER, designed and constructed by Rutherfurd and used by him in measuring his star plates.

10. SURVEYOR'S COMPASS of the time of George III.

11. THE RUTHERFURD PHOTOGRAPHIC TELESCOPE. This instrument will be exhibited in the Observatory of the College,

and can be reached by ascending the stairs at the rear of the Library.

If the evening is clear an opportunity will be given visitors to the Observatory for viewing some of the celestial objects.

12. PHOTOGRAPHS OF ICED BAR AND LONG TAPE BASE APPARATUS, devised and exhibited by Prof. R. S. Woodward.

DEPARTMENT OF PHYSICS.

In charge of Prof. William Hallock.

13. SPECTROSCOPE, with double micrometer slit and scale-tube, with movable slit to locate any special part of the spectra, for purposes of comparison; also an adjustable slit in the ocular to screen out all the colors except the special one it is desired to observe; also glass tanks, absorption-cells, etc. The whole intended for color photometry and color comparisons.

14. MITSCHERLICH PENUMBRA (half-shade) SACCHARIMETER, for the quantitative determination of sugar solutions by the rotation of the plane of polarization of the light, as well as other measurements in polarized light. It is provided with a special lamp, and two tubes of different lengths for the solutions to be tested.

15. A DIVIDED CIRCLE, for the determination of indices of refraction from the angle at which light is polarized, and other special methods.

16. One of two large SPECTROMETERS, with certain peculiarities specially adapting them to general spectrometric work. Made by J. Grunow.

17. D'ARSONVAL GALVANOMETER. In these galvanometers the permanent magnet is stationary, and the coil swings and is rotated by the current.

18. New form of DIFFERENTIAL GALVANOMETER, with removable coils and bell magnet. Made by J. Grunow.

19. New form of BOLOMETER, especially designed for use with the above differential galvanometer. The bolometer is to measure very feeble radiant energy (heat). Made by J. Grunow.

20. LOCAL VARIOMETER, for studying the variations of the horizontal component of the earth's magnetism. Designed by H. Cushman and made in th elaboratory of Columbia College.

21. KOHLRAUSCH BI-FILAR MAGNETOMETER, for measuring the horizontal intensity of the earth's magnetism, its variations, and of magnetic moments.

22. CUSHMAN SPLIT-PLUG POTENTIOMETER.

23. ROOD CIRCULAR WHEATSTONE-BRIDGE, with micrometer reading.

24. Standard LATIMER-CLARKE CELLS AND HIGH RESISTANCES, made in the laboratory of Columbia College, by H. C. Parker.

25. SPECIAL APPARATUS FOR THE DETERMINATION OF MOLECULAR WEIGHTS by the boiling-point method. Two forms.

26. SPECIAL APPARATUS FOR THE DETERMINATION OF MOLECULAR WEIGHTS by the freezing-point method. This and No. 25 were recently presented to Columbia College by President Low.

27. SMALL DIVIDING ENGINE. Made by J. Grunow.

28. Set of seven STANDARD DISCS, used in definition of colors. Upon each is given the wave-length of the particular color in microns. A micron is equal to one-thousandth of a millimeter.

Nos. 13–28 inclusive exhibited by the Physical Department of Columbia College.

29. ENGLISH DEEP-SEA AND MINE THERMOMETER in copper case and hermetically sealed in a tube to protect it from the pressure of the overlying water. Used in the mine work of Prof. Hallock, at Wheeling, W. Va.

30. Four of ten MAXIMUM RECORDING THERMOMETERS, sealed in glass tubes to protect them from the pressure of the overlying water. Used in the deep well at Wheeling, W. Va.

31. SECTION showing the geological formations passed through by the deep well at Wheeling, W. Va.

32. CURVES showing the rise in temperature in the deep well at Wheeling, W. Va. Observations of 1891. No water in the well.

33. CURVES showing the rise in temperature in the deep well at Wheeling, W. Va. Observations of 1893. The well was full of water, and owing to a slight "cave-in" at about 3300 feet, it was impossible to get the thermometers down to the bottom of the well.

34. PLAN OF COAL-MINE, "Riverside No. 1," in which temperatures were observed during the summer of 1891, to obtain a reliable value for the "surface" temperature, at Wheeling, W. Va.

Nos. 29–34 exhibited by Prof. Wm. Hallock.

DEPARTMENT OF ELECTRICITY.

In charge of Prof. M. I. Pupin.

35. ELEVEN THOUSAND VOLT DIRECT CURRENT DYNAMO. Designed and exhibited by Prof. F. B. Crocker.

36. APPARATUS FOR MEASURING SELF-INDUCTION in terms of the new unit, "the Henry," the name of which unit was first proposed by Professors F. B. Crocker and M. I. Pupin, and officially adopted by the Electrical Congress in Chicago. Exhibited by the Electrical Department of Columbia College.

37. MOTOR DYNAMOS, for transforming direct currents into direct or alternating currents of lower or higher potential. Especially useful in laboratory work. Exhibited by Prof. F. B. Crocker.

38. ELECTRODYNAMIC CURRENT INTERRUPTER of adjustable pitch. Connected with transformer and condenser. The secondary coil of the transformer is connected with the coils of exhibit 38 *a*.

38 *a*. CURRENT CHANGER OF ADJUSTABLE PITCH. Employed in investigations of dielectric absorption, capacity measurements, etc.

39. AUTOMATIC VIBRATORY TRANSFORMER of direct into alternating currents of high and adjustable frequency. Employed in investigations of electrical resonance and vacuum discharges.

40. INERTIA COILS, employed in the study of low frequency electrical resonance and harmonic analysis of alternating currents.

41. MICA CONDENSER, with very small subdivisions employed in the harmonic analysis of alternating currents. Total capacity 2 M. F., smallest subdivision .00094 M. F.

42. Complete outfit for generating ELECTRICAL WAVES; vacuum tube WAVE DETECTORS.

43. 50,000 VOLT TRANSFORMER, with oil insulation. Designed by the exhibitor. Constructed by Swinburne & Co., Teddington, Eng. Employed in investigations of disruptive discharges.

44. HIGH VOLTAGE OSCILLATORY TRANSFORMER.

45. THREE PHASE DYNAMO. Employed in the study of rotary magnetic fields. The field magnet of this machine is the movable part. It is constructed in such a way as to produce a field which is distributed uniformly over the pole-faces and to generate complex harmonic electromotive force of predetermined form.

45 *a*. ALTERNATING CURRENT MACHINE of 1.5 kilowatts. Gives 400 periods per second and 2000 volts at normal speed. Designed by exhibitor and employed in researches on low frequency electrical resonance. Connected to transformer, inertia coil, mica condenser and electrostatic voltmeter, the

connections being the same as in the above-mentioned research.

Nos. 38–45 inclusive exhibited by Prof. M. I. Pupin.

DEPARTMENT OF CHEMISTRY.

In charge of Prof. Charles F. Chandler.

46. CARBARUNDUM. A carbide of silicon, first made by Edward G. Acheson. A substitute for diamond powder for polishing gems. Hardness inferior only to that of the diamond.

47. SYNTHETIC DRUGS:
 1. Anaesthetics.—Paraldehyde and others.
 2. Hypnotics.—Hypnon and others.
 3. Antipyretics.—Antipyrene and others.
 4. Antiseptics.—Aseptol and others.

48. COLLECTION OF ALUMINIUM ARTICLES, prepared by:
 1. The Pittsburgh Reduction Co.
 2. The Illinois Pure Aluminium Co.
 3. The Scoville Manufacturing Co.
 4. The Passaic Art Casting Co.

49. COLLECTION OF THE SALTS OF THE RARE EARTHY METALS. Prepared by Waldon Shapleigh, F. C. S. Neodidymium, Prasiodidymium, Lanthanum, Thorium, Zirconium, Erbium, Cerium, Yttrium.

Nos. 46–49 inclusive exhibited by the Chemical Department, Columbia College.

50. STUDIES IN COAL-TAR COLORS. Series of specimens illustrating newly discovered dyes and their applications.
 Exhibited by Harwood Huntington.

DEPARTMENT OF PHOTOGRAPHY.

In charge of Mr. Cornelius Van Brunt.

51. ELECTRIC PROJECTION LANTERN, as used by the Metropolitan Museum of Art. Advantages claimed: 1. Steadiness of illumination. 2. Mechanism of lamp positive in its action

and not depending on gravity. 3. The luminous spot on the positive carbon obscured from the condenser and the crater on the negative carbon presented in the most favorable way by tilting the carbons thirty degrees. 4. Adjustment of the light to the optical centre of the lens automatically. 5. Convenience of adaptation to polariscope and other apparatus. Made by J. B. Colt & Co.

52. ELECTRIC PROJECTION LANTERN as used by the American Museum of Natural History. Advantages claimed: 1. Steadiness of light. 2. Simplicity of the mechanism of the lamp, which is provided with every possible adjustment. 3. Ability to change the illuminating power from 700 to 2,000 candle-power without causing light to flicker. 4. Adjustment of the carbons to optical centre of the lens automatically. Made by Charles Beseler.

53. EXAMPLES OF VOGEL-KURTZ COLOR PRINTING, by the use of three negatives and three primary colors, red, yellow and blue. This process is described in Wilson's Photographic Magazine for April, 1893.

54. EXAMPLES OF COLOR PRINTING by the process employed by Mr. Edward Bierstadt.

55. SERIES OF LANTERN SLIDES showing a novel method of illustrating botanical subjects, as devised and used by Mr. Van Brunt.

56. THE WILLIAMS FLASH MACHINE, for replacing daylight by artificial light and for obtaining photographs instantaneously in a manner equal and in some respects superior to the use of daylight. By the simple pressure on a pneumatic bulb a space of 36 square feet is illuminated with a very actinic violet flame, the camera shutter being at the same moment released.

57. SERIES OF PORTRAITS 25x30 inches made with above-described apparatus and demonstrating the advantage of having an illuminating source directly controllable by the operator

58. DALLMEYER TELE-PHOTOGRAPHIC LENSES. These combine the principles of the telescope and the photographic lens,

and by their use we have in theory a lens of three or four times the length of focus of an ordinary lens, and actually one giving the effect of such a lens though only about one-half the length of focus. Being mounted in aluminium the weight is not an obstacle to their use.

59. DALLMEYER MODERATE POWER TELE-PHOTOGRAPHIC ATTACHMENT. This may be attached to any lens, and does not interfere with the ordinary working of such a lens when used alone. Any lens may be converted into a telephoto-lens by employing a negative lens of one-half the focus of the positive lens.

60. COMPARATIVE PHOTOGRAPHS made with above lenses and with lenses of the ordinary rapid rectilinear type, showing the enlargement obtainable with the tele-photographic lens.

61. THE ACTINOGRAPH. An instrument for calculating the exact exposure necessary for sensitive photographic plates. The date, time of day, lens-diaphragm used, character of the light and the speed of the plate are the factors employed.

62. WATKIN'S EXPOSURE METER. An instrument for similar purposes, serving also for the calculation of time required for enlarging and printing. The actinic power of the light, character of subject, make of plate and diaphragm used are taken into account.

63. THE ZEISS PHOTOMICROGRAPHIC APPARATUS for making photographs of microscopic objects. From the School of Mines.

64. COLLECTION OF ALBERTYPES IN COLOR, made by Albert of Munich.

65. COLLECTION OF ARTOTYPES IN COLOR, made by Edward Bierstadt of New York.

66. PHOTOGRAVURES IN COLOR, made by Bussod, Valadon & Co., of Paris.

67. LICHT-DRUCK IN COLOR, made by Hanfstengel of Munich. Nos. 64–67 inclusive exhibited by Prof. C. F. Chandler.

DEPARTMENT OF EXPERIMENTAL PSYCHOLOGY.

In charge of Prof. J. McK. Cattell.

68. INSTRUMENTS FOR PSYCHOLOGICAL TESTS, which may be made by visitors upon themselves. These are: 1. For Sharpness of Sight; 2. For Color Vision; 3. Perception of Weight; 4. Dynamometer Pressure; 5. Accuracy of Movement; 6. Pressure causing Pain; 7. Time of Perception and Movement; 8. Memory; 9. Mental Imagery; 10. Association of Ideas. Visitors are invited to use the instruments exhibited, with each of which will be found instructions and blanks for making records.

69. APPARATUS for studying the dependence of sensations on the time, relations and combinations of colors. This is an example of apparatus used in psychological research. With the wheel-chronometer any color or combination of colors may be exhibited for a given time (to the one ten-thousandth of a second) and of a given intensity and area. The instant at which the color appears is registered on the chronoscope, and the resulting sensation may be studied and measured with help of the rotating disk. The rate of rotation of the disk may be adjusted and exactly determined, and it may be viewed for a given time (say one one-hundredth of a second).

DEPARTMENT OF PHYSIOLOGY.

In charge of Prof. John G. Curtis.

INSTRUMENTS ILLUSTRATING METHODS OF INVESTIGATION in the movements, in healthy or diseased living men, of the heart, of the arterial pulse, of the muscles, and of the chest-wall.

70. Drum-Kymograph.

71. Three Extra Drums.

4 glass covers, 4 supports, gummed papers, 1 stand, 1 lamp, 1 rubber tube, 1 knife, for above.

72. Metronome-Interrupter, for marking intervals of time.

73. Chronograph, for recording the same.

1 Morse key, 2 Grenet cells, copper wires, for above.

74. Explorer of the Human Muscles.

75. Sphygmograph, for the human pulse.

76. Stethograph, for the human chest-wall.

77. Two Cardiographs, for the human heart-beat.

78. Receiving Tambour, for tremors of the human muscles.

79. Two Recording Tambours.

80. Control Tambour.

81. Two stands, 1 arm, 1 Basel stand, 1 hand-rest.

82. Two valves, 1 brass Y tube, 4 rubber tubes, for use with the above.

Exhibited by the Department of Physiology, Columbia College.

DEPARTMENT OF ANATOMY.

In charge of Prof. Geo. S. Huntington.

83. GIANT MICROTOM, for sectioning entire brains. After Schultze. Manufactured by M. Schanze, Leipzig. Portion of the German University exhibit at the World's Fair; presented to the Department of Anatomy of Columbia College by President Low.

84. PHOTOGRAPHS OF A CAST TAKEN FROM THE BRONZE MODEL OF THE MUSCLES OF THE TRUNK; modelled by Schütz, under the direction of Profs. Waldeyer and H. Virchow, forming part of the exhibit of the First Anatomical Institute of the Berlin University at the World's Fair. The cast has been presented to the Department of Anatomy of Columbia College by President Low.

85. STUDY OF THE ANATOMY OF LOBULATED KIDNEYS, by corrosion. Mode of primary and secondary division and calyx formation. Relation of renal afferent and efferent vessels to Malpighian pyramid.

Surface distribution of renal vein:

1. Kidney of Boa constrictor.
2. " " *Phoca vitulina.*

3. " " *Zalophus Californianus.*
4. " " *Ursus Americanus.*
5. " " *Elephas Indicus.*

86. EXHIBIT OF RACE SKULLS; NORTH AMERICAN SERIES.

Toltecan Group.

1. From mound grave, Alabama.
    a. Fragments right temporal bone, right molar and superior maxilla; right inferior maxillae of two individuals; portions of femora and tibiæ.
    b. Relics, arrowheads, wampum, stone ring, carnivore canine.
2. From mound grave, Alabama. Fragments; portions of frontal and parietals; superior maxilla.

American Group.

3. Pawnee ♂, Sept., 1875.
4. Pawnee ♂, 1875.
5. Gros Ventre.
6. Sioux, South Dakota, 1875.
7. Young Sioux.
8. Huron, ♂. Tay, Sincoe Co., Province Ontario.
9. Mound skull. Tay, Sincoe Co., Province Ontario.
10. Grave skull, found with relics in the Susquehanna Valley.
11. Kodiac, Alaska.
12. Cheyenne.
13. Delaware, Wyoming Co., Kansas.
14. Digger, Shasta Co., California.
15. Digger, found on bank of Arroyo Grande Creek, town of Arroyo Grande, California, in densely compacted sand, about 8 feet below surface of ground, the upper 4 feet being alluvial deposit, March, 1885. Presented by Mr. G. A. Lawrence.
16. Crow, ♂, from "tree-grave," 1 mile from Crow Indian Agency, on Crow Indian Reservation, Montana, August 9th, 1892. Presented by Mr. G. A. Lawrence.

17. Flathead, Columbia River, Oregon.
18. Flathead, Columbia River, Oregon.
19. Flathead, Columbia River, Oregon.
20. Flathead, Columbia River, Oregon.
21. Flathead, Columbia River, Oregon.
22. Native Mexican.
23. Native Mexican.

87. Exhibit of 32 plates illustrating the development and comparative morphology of the CÆCUM and VERMIFORM APPENDIX, with reprint of publication.

88. Exhibit of new FUSIBLE ALLOY for injection, prepared in the assay laboratory of the School of Mines of Columbia College, having a melting point of 130° F.

1. Cast of manus of African green monkey, *Cercopithecus sabæus*.
2. Pes and manus of Black Saki, *Pithecia Satanus*.
3. Pes and manus of *Iguana tuberculata*.
4. Injection of ureter and renal vein of human kidney.

DEPARTMENT OF ZOOLOGY.

In charge of Prof. J. A. Allen.

89. SELF-SUSTAINING AQUARIUM. Exhibiting specimens of North American Actinoid Polyps — Actinia or Sea Anemones.

Metridium marginatum	(Brown anemone).
Rhodactinia Davisii	(Red ").
Sagartia venusta	(Orange ").
" *nivea*	(Snowy ").

Reproducing by means of eggs, self-division, budding and artificial division of the disc. Also an example of the Madreporians— *Astrangia Danæ* (coral) with Echinoids (sea-urchins), Holothurians (sea-cucumbers), star fishes and marine algæ. Exhibited by Mr. Mark Samuel.

90. FOSSIL INSECTS IN AFRICAN COPAL. The East African copal—largely imported for the manufacture of fine varnishes

—is a fossil resin resembling amber, but much less hard and less ancient. Its age is Quaternary,—from the elevated beaches, now many miles from the sea, of the East Coast of Equatorial Africa. The copal-tree, *Trachylobium Mosambicense*, still lives on the present coast and yields its resin freely, but too soft for commercial use. It is extinct where the fossil copal is dug. Both the recent and the ancient resin are rich in insects, and the latter are illustrated here, with representatives of all the seven principal orders. Exhibited by Prof. Daniel S. Martin.

91. DWARF AND TWIN EMBRYOS OF AMPHIOXUS artificially produced by shaking apart the blastomeres of the segmenting eggs.

92. KARYOKINETIC FIGURES in dividing cells of the testis of the lobster.

Nos. 91 and 92 exhibited by Prof. Edmund B. Wilson.

93. LARVÆ OF AMPHIOXUS from Sicily.

94. TADPOLE LARVÆ OF ASCIDIAN.

Nos. 93 and 94, exhibited by Mr. Arthur Willey.

95. YOUNG STURGEONS AND STURGEON CULTURE, illustrating mode of hatching sturgeon eggs, as carried on for the United States Commission of Fisheries at Delaware City, Del. The young sturgeons exhibited are the results of the first successful attempts in this country in the culture of the river sturgeon, *Acipenser sturio*. Exhibited by Dr. Bashford Dean.

96. THE DERMAL ARMORING OF THE STURGEON. Anatomical and microscopical preparations. Relations to scale types of kindred fishes. Exhibited by Mr. George William Kosmak.

97. LIVING AMPHIBIA, a number of rare forms :

1. Siren, *Proteus anguineus*, from the Dalmatian caves.

2. Siren, *Siren lacertina*, from the rice marshes, South Carolina.

3. Mud-puppy, *Necturus maculatus*, from the Miami River, Ohio.

4. Hell-bender, *Menopoma horrida*, Ohio River.

5. Axolotl, *Amblystoma maculatum*, albino specimen, Mexico.

Exhibited by the Biological Laboratory of Columbia College.

98. Nerve Preparations by a new Modification of the Golgi Method.

1. Purkinje cell in the human cerebellum, showing the protoplasmic and axis cylinder processes. Photographed by Dr. Edward Leaming of the College of Physicians and Surgeons.

2. Pyramid cell in the cerebrum of the mouse.

3. Section through the spinal cord and ganglion of a seven-day chick, showing the nerve cells in the cord and the bipolar cells in the ganglion.

4. Section through the heart of a tadpole, showing the ramifications and terminations of the nerve fibres supplying the cardiac muscles.

5. Pyramid cells in the cortex of an eight months human embryo.

6. "Cajal" cell in the superficial layer of the cortex of an eight months human embryo. Showing also the tangential fibres and their collaterals.

Prepared and exhibited by Mr. O. S. Strong.

99. Section of a Cell of the Pancreatic Gland of Necturus, showing the "skin" or "nebenkern;" the thread-like structure of the protoplasm; the nucleus containing chromatin and nucleolus; and the zymogen granules of the secretions in the inner end of the cell.

100. Section of a Cell from the Interstitial Tissue of the Kidney of Necturus, showing the archoplasm and centrosome (the attraction sphere) in the *resting* cell; this section also shows the lobular and very chromatic nucleus peculiar to this cell, and most beautifully shown in the very large cells of this animal.

Nos. 99 and 100 exhibited by Mr. Albert P. Mathews.

101. Preparation showing various stages in spermatogenisis of *Lumbricus*, the earthworm.

102. Preparations showing the efficiency of Hermann's fluid in killing and fixing protozoa. *Amœba proteus*, etc.

103. SECTIONS OF AMŒBA PROTEUS.

Nos. 101–103 inclusive, exhibited by Mr. Gary N. Calkins.

103 *a.* MONOGRAPH OF THE ANT THRUSHES OR FAMILY PITTIDÆ. Parts I and II., 1893–'94. By D. G. Elliot.

103 *b.* 1. THE GEOGRAPHICAL DISTRIBUTION OF NORTH AMERICAN MAMMALS.

2. THE GEOGRAPHICAL ORIGIN AND DISTRIBUTION OF NORTH AMERICAN BIRDS, considered in relation to the Faunal Areas of North America.

3. Series of FOUR COLORED MAPS of Faunal Areas in North America, illustrating the preceding papers.

By J. A. Allen, Ph. D.

103 *c.* NEW NORTH AMERICAN MAMMALS from the American Museum of Natural History.

During the last ten years, and especially within the last five years, great progress has been made in the study of North American mammals, especially through the introduction of new methods and new devices in trapping such small, nocturnal, or burrowing species as the Pocket Gophers, Moles, Shrews, Kangaroo Rats, Pocket Mice, and the various field Rats and Mice. Also field work and trapping has been carried on on an immense scale, resulting in the addition to the available material for study of tens of thousands of specimens. As a result, among the groups above named, not only have more species and sub-species been discovered and described within the last five years than were previously known, but also quite a number of new genera and sub-genera.

While it is impracticable to very fully illustrate work of this character, a few of the more striking or interesting forms have been selected for exhibition.

1. *Lepus Alleni* Mearns. The largest and finest of all of the North American Big-eared, or "Jackass" Hares.

2. *Lepus cinerascens* Allen. A desert Hare of Southern California, quite different from any previously known.

3. *Zapus princeps* Allen. A new Jumping Mouse from Colorado.

4. *Dipodomys deserti* Stephens. The largest of the Kangaroo Rats, from the Colorado Desert—very unlike anything previously known.

5. *Dipodomys Merriami* Mearns. A smaller Kangaroo Rat, from the desert regions of Arizona and Southern California.

6. *Perodipus Richardsoni* Allen. A Kangaroo Rat from the Indian Territory.

7. *Perodipus compactus* True. A pale Kangaroo Rat from Padre Island, Coast of Texas.

8. *Heteromys Alleni* Coues. A tropical form of spiny Kangaroo Rat, from the valley of the lower Rio Grande, Texas.

9. *Perognathus spinatus* Merriam. A pale spiny Pocket Mouse from Southern California.

10. *Perognathus femoralis* Allen. A dark spiny Pocket Mouse from Southern California.

11. *Perognathus paradoxus* Merriam. A yellowish, bristly Pocket Mouse from Texas.

12. *Perognathus longimembris* Merriam. A small soft-haired Pocket Mouse from Southern California.

13. *Perognathus Merriami* Allen. A small soft-haired Pocket Mouse from Texas.

14. *Perognathus Apache* Merriam. A very small Pocket Mouse from Utah.

15. *Neotoma micropus* Baird. This is a recently re-discovered "long-lost" species from the coast region of Southern Texas.

16. *Oryzomys aquaticus* Allen. A very distinct new form of rice-field Mouse from the mouth of the Rio Grande, Texas.

17. *Sigmodon hispidus littoralis* Chapman. A newly discovered dark coast form of the Cotton Rat from Florida.

18. *Sigmodon Arizonæ* Mearns. A very large pale Cotton Rat from Arizona.

19. *Sitomys Taylori* Thomas. A very distinct small form of field Mouse from Texas.

20. *Sitomys niveiventris* Chapman. A small white-bellied field Mouse from South Florida.

21. *Sitomys Truei* Shufeldt. A big-eared white-footed Mouse from New Mexico, very unlike anything previously known.

22. *Sitomys Mearnsi* Allen. A dark gray form of white-footed Mouse from the coast region of Texas.

23. *Sitomys auripectus* Allen. A yellowish form of white-footed Mouse from Utah.

24. *Sitomys Rowleyi* Allen. A peculiar, rather dark form of white-footed Mouse from Arizona.

25. *Thomomys aureus* Allen. A yellowish Pocket Gopher from Utah.

26. *Thomomys fossor* Allen. A dusky form of Pocket Gopher from Colorado.

27. *Thomomys perpallidus* Merriam. A pale form of Pocket Gopher from the deserts of Arizona.

DEPARTMENT OF BOTANY.

In charge of Hon. Addison Brown.

104. STUDIES OF THE FLORA OF BOLIVIA. By Dr. H. H. Rusby.

Eastern Bolivia is as yet but little known botanically. Dr. Rusby spent three seasons in that country and made a close study of the flora of the regions which he visited, resulting in ths discovery of some 300 species new to science. Since his return he has secured the services of a collector to visit other districts, and these collections have yielded many novelties.

Exhibits: Specimens and plates of new genera and species.

105. INVESTIGATION OF THE FLORA OF STONE MOUNTAIN, GEORGIA. By John K. Small.

Stone Mountain is an isolated granite knob sixteen miles east of Atlanta. Its interesting flora includes a large number of endemic species, *i. e.*, plants not known to occur elsewhere in the world.

Exhibits: The endemic species, mounted as herbarium specimens with photographs of the mountain and its vegetation.

106. STUDIES IN AMERICAN BRYOLOGY. By Elizabeth G. Britton.

Exhibits: Original drawings and plates to illustrate the new "Moss Flora of Eastern North America."

107. STUDIES IN THE CYPERACEÆ. By Prof. Nathaniel L. Britton.

1. The genus *Cyperus*. *Cyperus* is one of the largest genera of the Sedge Family, comprising several hundred species, widely distributed, one of the largest being the Papyrus of the Nile valley, *Cyperus Papyrus*. The present investigation is a systematic study of the East American species.

Exhibits: A selection of the plants mounted as herbarium specimens with drawings.

2. The genus *Dichromena*. This is one of the smaller genera, the species mostly American.

Exhibits: The two East American species with drawings.

108. STUDIES IN THE CHARACEÆ. By Timothy F. Allen, M.D. The Characeæ or Brittle-worts form a peculiar order of the Green Algæ (Chlorophyceæ), and inhabit fresh and brackish water. Owing to their aquatic habitat they are not much collected nor observed, and are popularly little known.

Exhibits: Plates of a number of American species new to science.

109. STUDIES IN THE GENUS BUTNERIA. By T. H. Kearney, Jr., *Butneria*, also known as *Calycanthus*, is a genus of North American shrubs of somewhat doubtful relationship, being by some authors regarded as close to the Rose Family, and by others more nearly allied to the *Magnolias*. The present study is an attempt to throw light on this problem and to effect a satisfactory classification of the species.

Exhibits: The species of *Butneria*, mounted as herbarium specimens with drawings.

110. STUDIES IN THE GENUS POLYGONUM. By John K. Small. *Polygonum* is a large genus of herbaceous plants, commonly known as "knot-weeds." The present study is an investigation of the comparative anatomy and morphology of the American species, numbering about 85.

Exhibits (*a.*): Typical species of the several sections of the genus mounted as herbarium specimens with drawings of each. (*b.*) Microscopic cross-sections of the stems of *Polygonum arifolium* and *Polygonum Virginianum* with drawings.

111. STUDIES IN THE GENUS PHYSCOMITRIUM. By Elizabeth G. Britton.

Physcomitrium is a genus of small mosses, growing on the ground and maturing the sporophyte in early spring. The species are remarkable for the great diversity in form of the sporocarp before and after dehiscence. Eleven North American species are now known, four of which are new to science.

Exhibits: Microscopic preparations of some of the species, showing structure of the vegetative and reproductive organs.

112. STUDIES IN THE GENUS POLYSIPHONIA. By Carlton C. Curtis, Ph.D.

Polysiphonia is a genus of the Red Algæ (Florideæ), consisting of a large number of species of wide distribution in all oceans. The present study is an investigation of the anatomy and systematic relationships of those occurring on the coasts of North America.

Exhibits (*a.*): A selection of the species, mounted as herbarium specimens with drawings. (*b.*) Microscopic preparations showing: 1. Cross-section of the thallus. 2. Tetraspores (propagative organs). 3. Antherids and cystocarps (reproductive organs).

113. EARLY STAGES IN THE DEVELOPMENT OF THE LICHEN THALLUS. By Carlton C. Curtis, Ph. D.

A lichen is a composite plant, consisting of a fungus in symbiotic relationship with one of the simpler algæ, on which it is parasitic. The earliest stage of this symbiosis has recently been observed in nature.

Exhibits: Microscopic preparations showing: 1. The algæ becoming infested by the fungus. 2. Section through completed thallus. 3. Specimens of foliaceous, crustaceous and fruticose lichens.

114. STUDY OF CORK-WINGED STEMS. By Emily L. Gregory, Ph. D.

A study of certain curious cork formations, which seem eccentricities rather than normal developments.

Exhibits: 1. Stems of *Xanthoxylum*, *Euonymus*, *Liquidambar* and *Quercus*. 2. Microscopic preparations and plates.

115. COMPARATIVE ANATOMY OF THE PULVINUS OF VARIOUS LEAF PETIOLES. By Bertha Dow.

The pulvinus is the organ by which the so-called sleep motions of leaves are brought about. The investigation is intended to show to what extent this organ is necessary. Many leaves change their positions day and night, which have the pulvinus very slightly developed.

Exhibits: 1. Plant with fully developed pulvinus and plant without it. 2. Microscopic preparations showing cellular structure of the organ and its adaptation to motion in *Arachis*, *Wistaria* and *Oxalis*.

116. THE COMPARATIVE ANATOMY OF COREMA ALBA AND COREMA CONRADII. By Marion McEwen.

The genus *Corema* (natural order Empetraceæ) includes only these two species, the first native of Portugal and the Azores, the second of Eastern North America, extending from New Jersey to Newfoundland. The present study was undertaken to ascertain how far their anatomic characters support their generally accepted relationship, it having been suggested that they might represent two different genera. The investigation showed that the accepted notion is correct.

Exhibits: 1. Examples of the two species, mounted as herbarium specimens. 2. Microscopic preparations with drawings, showing leaf and epidermis sections.

117. STUDY OF SCHWENDENER'S MECHANICAL SYSTEM IN THE ANATOMY OF PLANTS. By Alexandrina Taylor.

The work illustrates the theory that the first function of thick-walled or woody tissues of plants is that of support and not that of water conduction. It shows that the principles applied by the engineer to bridges and other structures where economy of material is required are the same as those followed in plant development.

Exhibits: Microscopic preparations with drawings of cross-sections of the stems of the following monocotyledonous plants: Indian Corn, Lily, *Juncus*, Grasses.

118. Recent Discoveries of Diatomaceous Earth in the Adirondacks. By Charles F. Cox.
Extensive deposits of Diatomaceous earth have been exposed during the past year in various ponds and lakes in Township 43, Herkimer Co., N. Y., on the western side of the Adirondack Mountains. These deposits consist of the siliceous frustules (cell-walls) of the microscopic algæ known as diatoms. Exhibits: 1. Specimens of the material as dug from the deposits. 2. Prepared slides under the microscope.

DEPARTMENT OF PALÆONTOLOGY.

In charge of J. L. Wortman, M.D.

119. Specimen of Triarthrus Beckii, with antennæ and other appendages, described in the Transactions for May, 1893. These are the first trilobites with such appendages discovered. Described and exhibited by W. D. Matthew.

120. Oriskany Fossils, from Ulster Co., N. Y., exhibited by G. Van Ingen. These fossils are a portion of the material now being studied by Mr. Van Ingen.

121. Fossil Plants from the Cretaceous Formation on Long Island, described in Transactions, Vol. XII. (1893), pp. 222-237, pl. v. vii.; and Bull. Torr. Bot. Club, XXI. (1894), pp. 49-65, pl. 174-180.

122. Silicified Palæozoic Fossils, from the "yellow gravel" of Long Island.

Nos. 121–122 exhibited by Arthur Hollick.

123. Skeleton of Patriofelis tigrinus Cope, a carnivorous or flesh-eating mammal, from the eocene deposits of the Bridger Basin, Wyoming. This animal has previously been known from a few fragments of the jaws and limbs only. It was found imbedded in the rock (a sandy clay), and was originally buried to the depth of about 1,000 feet. The original matrix has been entirely removed. Amer. Mus. Collection.

124. Crayon Drawing of Patriofelis tigrinus, natural size. Amer. Mus. Collection.

125. SKULL OF PALÆOSYOPS MINOR, an extinct hoofed mammal from the eocene deposits of the Bridger Basin, Wyoming. This skull is only partially removed from the matrix of stone, and is especially intended to show the character of the material in which these fossils are found. Amer. Mus. Collection.

126. SKULL OF ENHYDROGALE PAUCIDENS Osborn and Wortman, a new genus and species related to *Hyænodon*, a primitive carnivore from the lower miocene deposits of Dakota. Amer. Mus. Col.

Nor. 123–126 exhibited by J. L. Wortman.

127. FOOT OF ARTIONYX GAUDRYI Osborn and Wortman, a remarkable mammal from the White River miocene deposits of Dakota. This animal had a foot very much like that of the hoofed quadrupeds, but was provided with powerful claws instead of hoofs. It is apparently the type of a new suborder of mammals hitherto unknown. Amer. Mus. Collection.

128. SERIES OF HIND FEET illustrating the evolution of the horse. *A. Mesohippus*, *B. Anchitherium*, *C. Protohippus*, *D. Equus occidentalis*, *E. Equus caballus*, or modern horse. Amer. Mus. Collection.

129. SKULL AND FEET OF PROTOCERAS CELER Marsh, a remarkable deer-like animal from the lower miocene deposits of Dakota. Amer. Mus. Collection.

130. COLORED MIOCENE LANDSCAPE, showing typical forms of life. Amer. Mus. Collection. Drawn by Rudolph Weber.

131. SPECIAL EXHIBIT OF NEW STYLE OF PICTORIAL LABELS, especially adopted by the American Museum, the first of the kind introduced. Amer. Mus. Collection.

Nos. 137–131 inclusive exhibited by Prof. H. F. Osborn.

132. FOSSIL LUNG FISHES (DEVONIAN), COLLECTED NEAR NEW LONDON, OHIO.

A. Associated remains of *Dinichthys*, Newb. The heavy head and shoulder armoring of this specially predatory form. Examples attained a length of fifteen feet. The hinder trunk region was enclosed in leather-like integument. Recently mounted in the Geological Museum of Columbia College.

B. Remains of a kindred lung fish, *Mylostoma*, from the same horizon. The slabs exhibit the head and body armoring, together with mouth-parts. This specimen is the only remains extant of this pavement-toothed form of "placoderm."

C. A newly discovered fossil lung fish from near Linton, Ohio. This form is entirely different in a number of points of structure from kindred forms. Its dentition approaches most nearly that of *Trachosteus*.

Recently presented to the Geological Museum of Columbia College, by Mr. F. A. Schermerhorn. Exhibited with reconstructions by Dr. Bashford Dean.

DEPARTMENT OF GEOLOGY.

In charge of Prof. James F. Kemp.

133. SERIES OF TWENTY-FIVE SPECIMENS ILLUSTRATING THE GEOLOGY OF THE ADIRONDACKS. The specimens show the lowest gneisses and magnetite; the over-lying crystalline limestones and ophicalcites; the later intruded, igneous anorthosites, gabbros, norites and titaniferous magnetites; the Potsdam sandstone, Calciferous, Chazy and Trenton limestones with fossils; the Champlain clays, recent molluscs and glacially striated rocks. Under microscopes are shown thin sections of the crystalline rocks.

134. SERIES OF ABOUT TWENTY SPECIMENS ILLUSTRATING THE GEOLOGY AND ORES OF FRANKLIN FURNACE AND OGDENSBURGH, N. J., as described by J. F. Kemp in the Transactions of the Academy for November, 1893.

135. ORBICULAR GRANITE from Quonochontogue Beach, R. I., described by J. F. Kemp, in the Transactions for Feb. 19, 1894.

135*a*. BASALTIC ROCK with large olivine nodules from Thetford, Vt., to be described by Dr. Hubbard and Dr. Hovey at the meeting of the Academy, March 19, 1894.

135*b*. GRANITE AND CONTACT LIMESTONES from Mts. Adam and Eve, Warwick, N. Y., described by J. F. Kemp and Arthur Hollick in the Annals for Feb., 1894.

136. SERIES OF DIORITES, GABBROS AND PERIDOTITES, about ten specimens in number, which illustrate the geology near St. John, N. B. These igneous intrusions break through Laurentian gneisses and crystalline limestones and afford interesting contacts and types of rocks. Exhibited by W. D. Matthew.

DEPARTMENT OF MINERALOGY.

In charge of Prof. A. J. Moses and Mr. George F. Kunz.

137. ALLANITE CRYSTALS from Franklin Furnace, N. J., described by Arthur Eakle in the Transactions of the Academy for November, 1893. Exhibited by Prof. J. F. Kemp.

138. A SET OF MINERALS FROM THE TRAP of Upper Montclair and the Edgewater Tunnel.

139. PORTABLE MINERAL CABINET.

140. STANDARD MINERAL TRAYS, as adopted by the joint committee appointed by several scientific societies, including the Academy.

Nos. 138 to 140 inclusive, exhibited by W. G. Levison.

141. METEORIC IRON, found at Canon Diablo, Arizona. This meteoric iron contains diamond in the form of grains and as a fine powder.

142. Powder obtained by dissolving No. 1 in acids. This is undoubtedly diamond, as with it was polished No. 3, being the first instance of a diamond found in a meteorite.

143. TWO DIAMOND CLEAVAGES, each showing a polished surface, produced by polishing on a new diamond wheel charged with diamond dust, obtained by dissolving the meteoric iron

found at Canon Diablo, Arizona. Polished by George F. Kunz and Oliver Whipple Huntington, in the Tiffany Exhibit, Mines Building, World's Columbian Exposition, September 11, 1893.

144. TWO OPALIZED SHELLS, from Wilcania, New South Wales. The calcareous matter of the shells is replaced by hydrous silica deposited from heated waters.

145. DIAMOND CRYSTAL, weighing 3¾ carats, found in October, 1893, by Charles Devine, in Oregon Township, Dane County, Wisconsin.

146. DIAMOND CRYSTAL, weighing ⅞ of a carat, found in the fall of 1893, near King's Mountain, North Carolina.

147. OPALIZED WOOD from Wilcania, New South Wales.

Nos. 141 to 147 inclusive, exhibited by George F. Kunz.

148. CIRROLITE from Greenwood, Maine. First occurrence in crystals. Previously known only as a massive mineral. Identified and exhibited by George F. Kunz and Prof. Albert H. Chester.

Rhombobedral. Specific gravity 2.94. Hardness 5 to 5.5. Composition :

Phosphoric acid	42.57
Alumina	17.16
Lime	35.35
Water	4.92

149. ALABANDITE AND SECTION, Lucky Cuss Mine, Tombstone Arizona. Twinned crystals and cleavable masses from new locality described by A. J. Moses and L. McI. Luquer in *Zeit. f. Kryst.* XXII., 16–19.

150. AMIANTHUS, Cochabamba, Bolivia.

151. ANDESITE CRYSTALS, Sulphur Island, Japan.

152. BOLEITE, CUMENGEITE AND SECTIONS, Boleo, Lower California. Essentially dimorphic forms of the mineral Percylite.

153. CRYSTALLIZED CACOXENITE, Lobenstein, Russia. Crystals described by L. McI. Luquer. *Amer. Journ. Science*, XLVI. 154.

154. DIOPTASE, French Congo, Africa. New locality.

155. DUMORTIERITE, 116th Street and Madison Ave., New York City. Exceptionally fine specimen found in 1893 by Prof. Kemp.

156. ETTRINGITE, Lucky Cuss Mine, Tombstone, Arizona. Second locality of the mineral. Analyzed and described by A. J. Moses, *American Journal of Science*, XLV. 488.

157. GRAPHITE PRESSURE PSEUDOMORPHS, Ceylon. A. J. Moses, *School of Mines Quarterly*, XIV. 51.

158. GYPSUM CRYSTALS, South Wash, Wayne Co., Utah. Crystals described. A. J. Moses. *School of Mines Quarterly*, XIV. 325.

159. MAGNETITE PSEUDOMORPH AFTER HEMATITE, Antwerp, N. Y. A. J. Moses. *School of Mines Quarterly*, XIV. 52.

160. MICROCLINE AND SECTIONS, showing intergrowth with Abbite, Pitcairn, N. Y. Described by L. McI. Luquer. *School of Mines Quarterly*, XIV. 328.

161. MUSCOVITE, Ship Canal, Kingsbridge, N. Y. Optical examination by L. McI. Luquer, *School of Mines Quarterly*, XIV. 327.

162. NICKEL-BREITHAUPTITE, Bullard's Peak, New Mexico. New species by E. Waller and A. J. Moses. *School of Mines Quarterly*, XIV. 49.

163. ORTHOCLASE BAVENO TWIN, Tunskina, Japan. Collected by Prof. Egleston.

164. PYRITE, Ship Canal, Kingsbridge, N. Y. A. J. Moses. *American Journal of Science*, XLV. 490.

165. PYROXENE, variety LEUCAUGITE, Sing Sing, N. Y. Analyzed by Heinrich Ries.

166. Quartz, Crystal Balls, Yenagari, Japan. Suite illustrating method of manufacture. Collected by Prof. Egleston.

167. Quartz, Tapering Crystals, Kimpo, Japan. Collected by Prof. Egleston.

168. Sodalite and Sections, Africa, Asia, and Canada. New localities described by L. McI. Luquer.

169. Tellurium Crystals (artificial). Produced in Kiln Roasting at Argo, Colorado.

170. Topaz, Japan. Collected by Prof. Egleston. Described by W. D. Matthew. *School of Mines Quarterly*, XIV. 53.

171. Wavellite on Phosphate Rock, Marion Co., Florida. Described by A. J. Moses and L. McI. Luquer. *School of Mines Quarterly*, XIII. 238.

172. Wollastonite, Harrisville, N. Y. Described by Heinrich Ries.

173. Apparatus for separating Minerals of High Specific Gravity, constructed by Heinrich Ries after description by O. A. Derby.

174. Chart of Reactions on Charcoal and Plaster with the Blowpipe. Painted by H. P. Whitlock.

175. Reflection Goniometer, not needing darkened room. Devised by Ernest Mallard and described in *Annale des Mines* S. 8; t. XII.

Nos. 149 to 175 inclusive, exhibited by the Mineralogical Department of Columbia College.

176. Rose Garnet, Xalostoc, Mexico. Exhibited by William Niven.

177. Stalactites Tinted by Malachite, Copper Queen Mine, Bisbee, Arizona. Exhibited by Thomas R. Sorin.

178. Pyrophyllite, N. C., tinted by decomposing pyrite.

179. Calcite with Enclosed Phantom Crystal, Egremont, England.

180. SERPENTINE PSEUDOMORPH AFTER MALACOLITE, Staten Island.

181. BRUCITE PSEUDOMORPH AFTER PYROXENE, Staten Island.

182. TREMOLITE, Shady Side, N. J.

183. CALCITE, zones of growth different colors.
Nos. 176 to 183 inclusive, exhibited by Frederick Braun.

184. ACANTHITE ON ARGENTITE. Enterprise Mine, Rico, Colorado.

185. ALTAITE AND PETZITE. Slide Mine, Gold Hill, Colorado.

186. GALENITE, corroded on lines of cleavage, Rossie, N. Y.

187. HESSITE. Slide Mine, Gold Hill, Colorado.

188. MONTICELLITE AND APATITE. Magnet Cove, Arkansas.

189. NATIVE TELLURIUM. Mountain Lion Mine, Magnolia, Colorado.

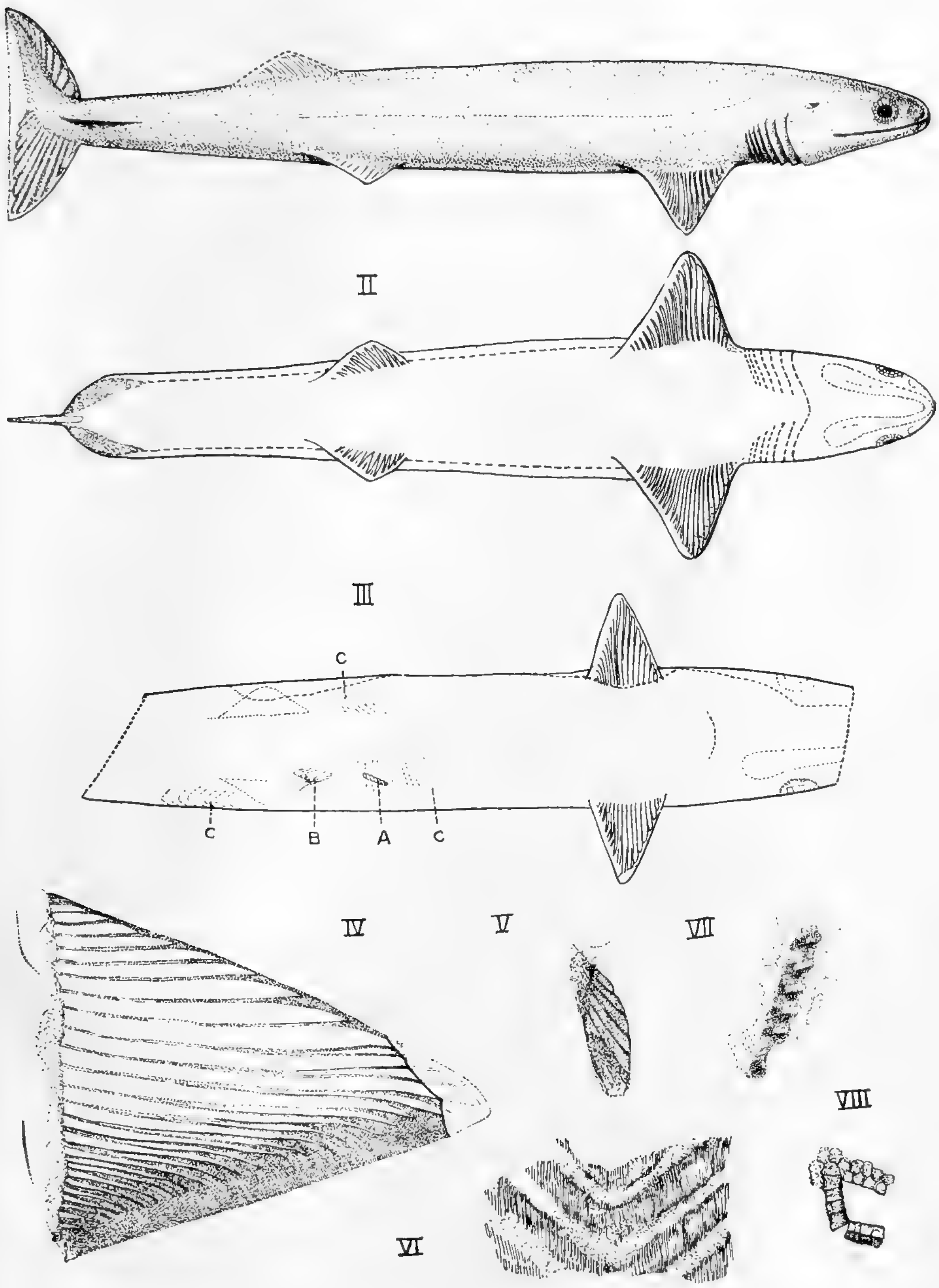
190. RHODONITE. Buckwheat Mine, Franklin, N. J.

191. SPHALERITE ON CALCITE. College Hill, Clinton, Oneida Co., N. Y.

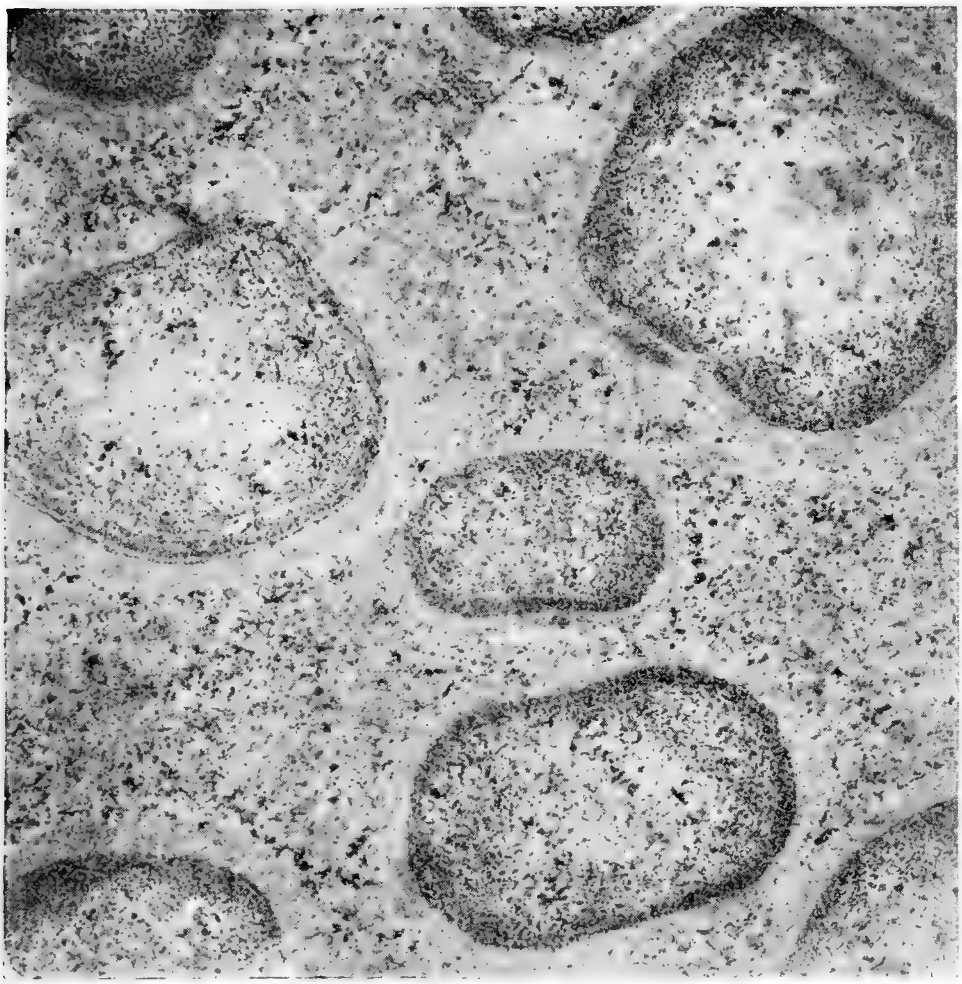
192. SYLVANITE. Smuggler Mine, Balarat, Colorado.

193. TEPHROWILLEMITE AND RHODONITE. Buckwheat Mine, Franklin, N. J.
Nos. 184 to 193 inclusive, exhibited by Prof. A. H. Chester.

194. MODEL OF THE ORE DRESSING AND CONCENTRATING WORKS of the St. Joseph Lead Co., Bonne Terre, Mo.
Exhibited by Prof. Henry S. Monroe.
[In lower hall of the Library Building.]



CLADOSELACHE NEWBERRYI DEAN.



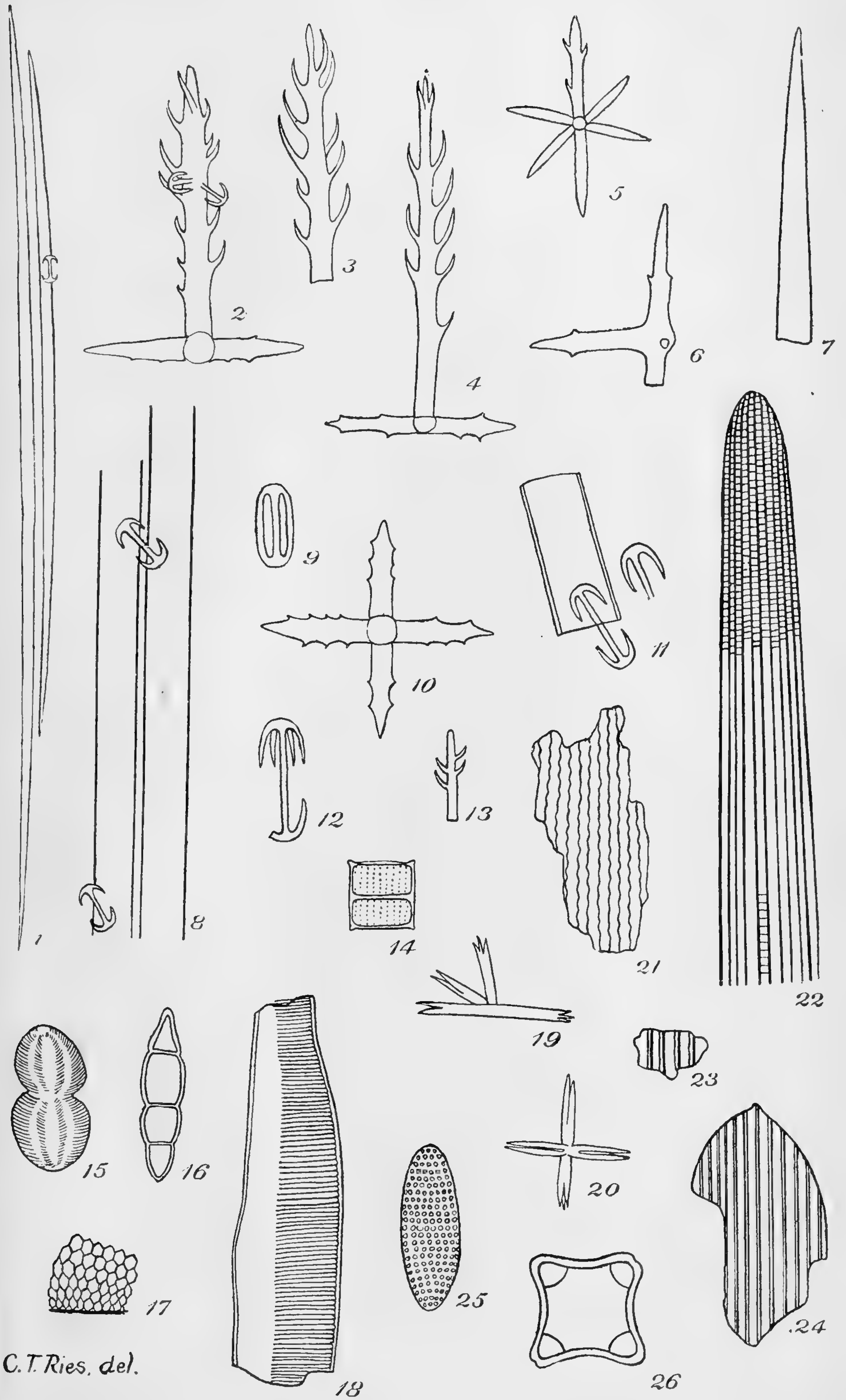
OBICULAR GRANITE FROM QUONOCHONTOGUE BEACH, R. I.
THE ACTUAL WIDTH IS SIX INCHES (15 C. M.)

PLATE III.

(Magnified 500 diameters, except Fig. 1, which is 250.)

FIGS. 1–13. Sponge spicules. Croton Point.
FIG. 14. *Melosira granulata* (Ehr.) Ralfs. Croton Point.
FIG. 15. *Navicula Gruendeleri*, A. S. Croton Point.
FIG. 16. *Diatoma* sp? Plattsburg.
FIG. 17. Diatom fragment from Croton Point.
FIG. 18. *Navicula permagna*, Edw. Croton Point.
FIGS. 19, 20. Sponge spicules. Kreischerville, S. I.
FIGS. 21, 22, 23, 24. From clay at Verplank.
FIG. 25. *Nitszchia granulata*, Grun. Croton Point.
FIG. 26. From clay at Croton Point.

(To accompany paper by Heinrich Ries, entitled "MICROSCOPIC ORGANISMS IN THE CLAYS OF NEW YORK STATE," pp. 165-169.)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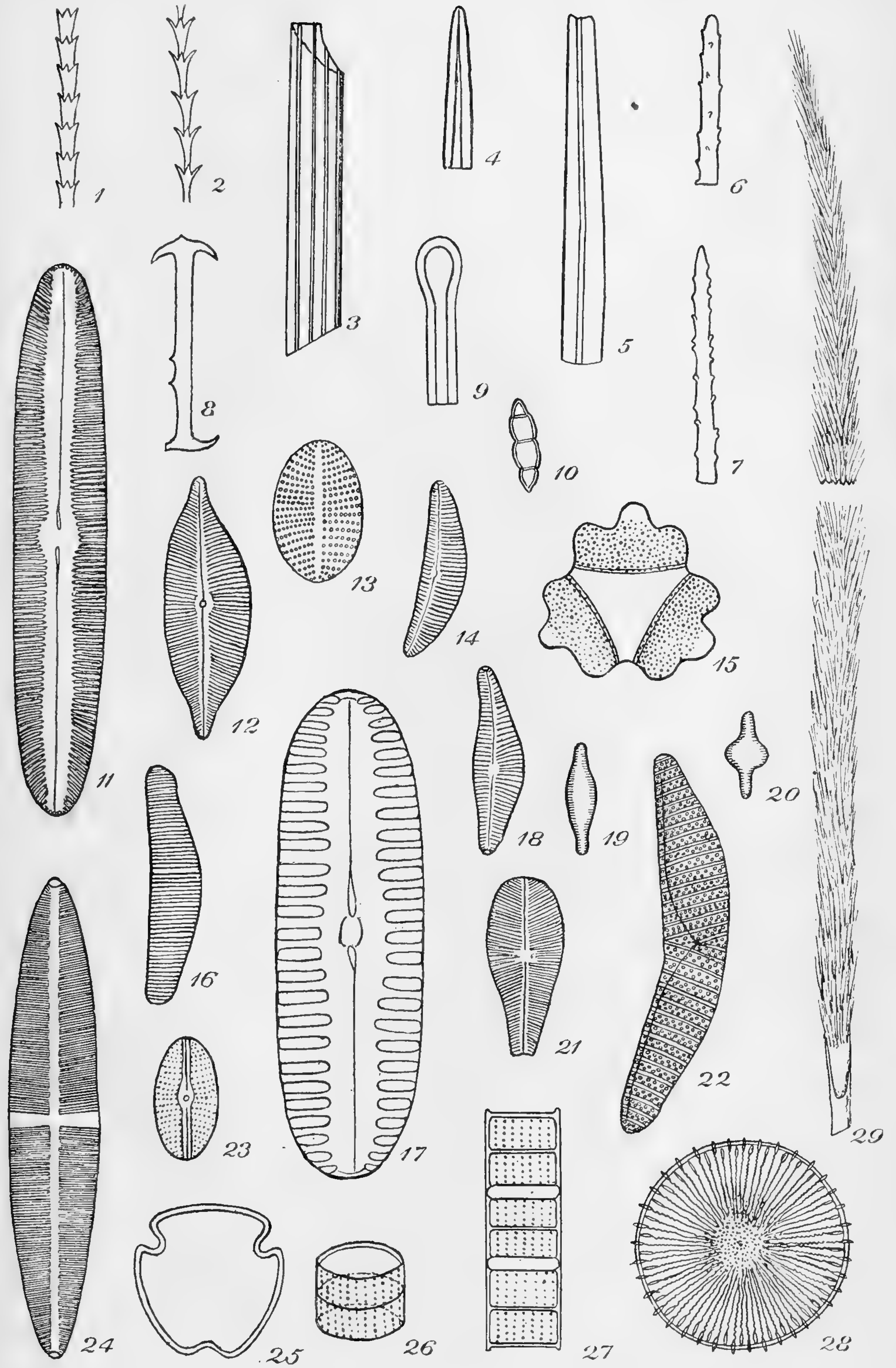
C. T. Ries, del.

PLATE IV.

(Magnified 500 diameters.)

FIGS. 1, 2. Jointed hair. Wyandance, L. I.
FIG. 3. Ridged tube from stoneware clay. Glen Cove, L. I.
FIGS. 4, 5. Spicules from cretaceous clay at Glen Cove, L. I.
FIGS. 6, 7, 8. Spicules from Lloyd's Neck, L. I.
FIG. 9. Spicule fragment? Farmingdale, L. I.
FIG. 10. *Diatoma hyemale.* Glen Cove, L. I.
FIG. 11. *Navicula viridis,* Kutz. Lloyd's Neck, L. I.
FIG. 12. *Cymbella cuspidata,* Kutz. Lloyd's Neck, L. I.
FIG. 13. *Campyloneis Grevillei,* var. *Regalis.* Lloyd's Neck, L. I.
FIG. 14. *Cocconema parvum,* W. Smith. Northport, L. I.
FIG. 15. *Triceratium trifoliatum.* Lloyd's Neck, L. I.
FIG. 16. *Eunotia monodon,* Ehr. Lloyd's Neck, L. I.
FIG. 17. *Navicula lata,* Breb. Lloyd's Neck, L. I.
FIG. 18. *Encyonema ventricosum,* Kutz. Lloyd's Neck, L. I.
FIG. 19. *Synedra affinis,* K. B. Lloyd's Neck, L. I.
FIG. 20. *Fragilaria construans,* Grun. Lloyd's Neck, L. I.
FIG. 21. *Gomphonema capitatum,* Ehr. Lloyd's Neck, L. I.
FIG. 22. *Epithema turgida* (Ehr.) Kutz. Lloyd's Neck, L. I.
FIG. 23. *Navicula cocconeiformis,* Greg. Lloyd's Neck, L. I.
FIG. 24. *Stauroneis Phœnecenteron,* Ehr. Lloyd's Neck, L. I.
FIG. 25. From clay at Northport, L. I.
FIGS. 26, 27. *Melosira granulata* (Ehr.) Ralfs. Lloyd's Neck & Glen Cove, L. I.
FIG. 28. *Stephanodiscus niagaræ,* Ehr. Lloyd's Neck & Glen Cove, L. I.
FIG. 29. From clay at Oyster Bay.

(To accompany paper by Heinrich Ries, entitled "MICROSCOPIC ORGANISMS IN THE CLAYS OF NEW YORK STATE," pp. 165-169.)



C.T. Ries, del.

PLATE V.

Geological Map of the Vicinity of St. John, N. B., to accompany the paper by W. D. Matthew, on "THE INTRUSIVE ROCKS NEAR ST. JOHN, N. B., pp. 185–203.

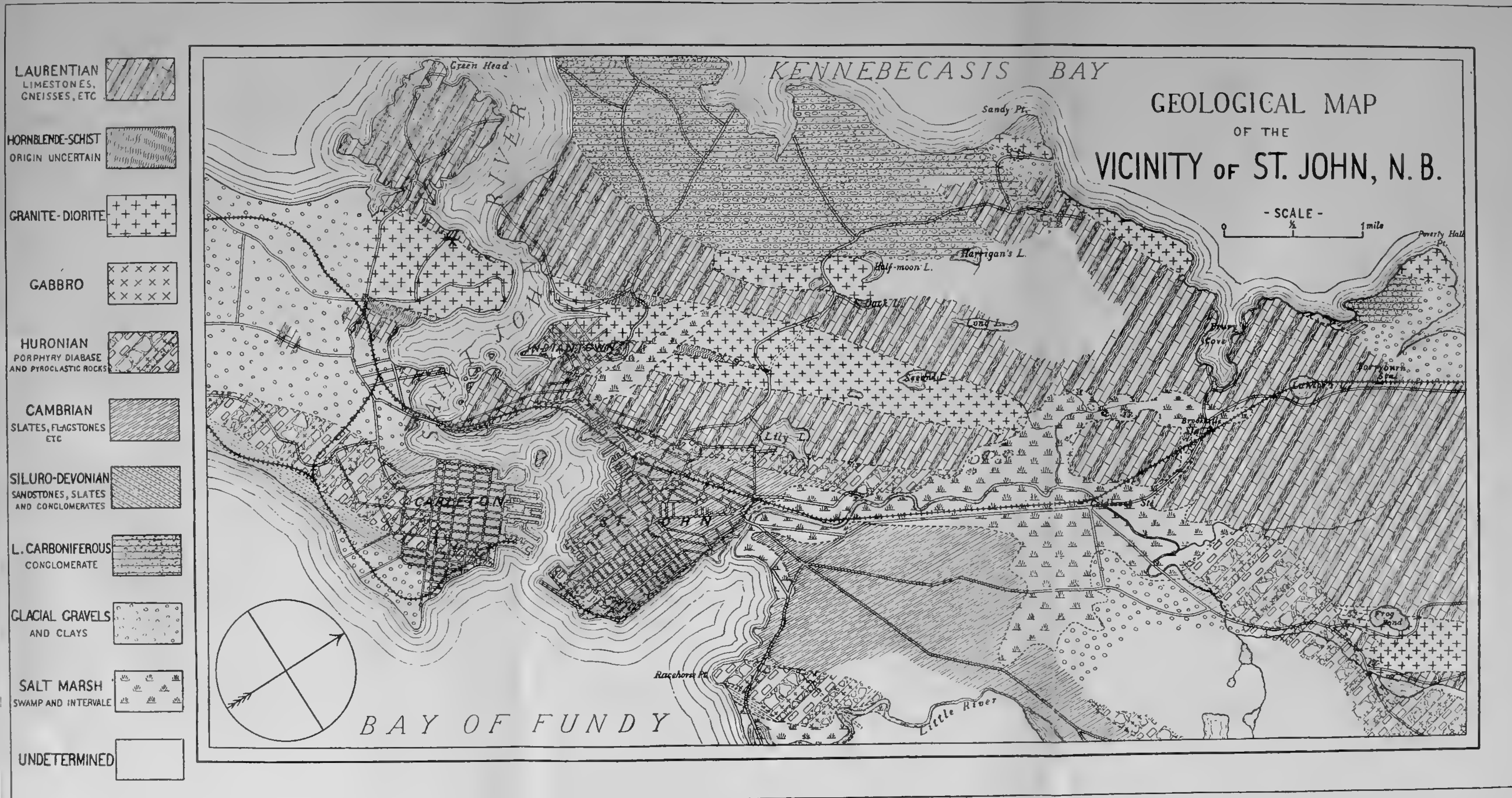

GEOLOGICAL MAP
OF THE
VICINITY OF ST. JOHN, N. B.
- SCALE -
0 ½ 1 mile
LAURENTIAN
LIMESTONES, GNEISSES, ETC
HORNBLENDE-SCHIST
ORIGIN UNCERTAIN
GRANITE-DIORITE
GABBRO
HURONIAN
PORPHYRY DIABASE AND PYROCLASTIC ROCKS
CAMBRIAN
SLATES, FLAGSTONES ETC
SILURO-DEVONIAN
SANDSTONES, SLATES AND CONGLOMERATES
L. CARBONIFEROUS
CONGLOMERATE
GLACIAL GRAVELS
AND CLAYS
SALT MARSH
SWAMP AND INTERVALE
UNDETERMINED
KENNEBECASIS BAY
BAY OF FUNDY
Green Head
Sandy Pt.
Poverty Hall Pt.
Harrigan's L.
Half-moon L.
Long L.
Lily L.
INDIANTOWN
CARLETON
ST. JOHN
Racehorse Pt.
Little River
Frog Pond

PLATE VI.

Geological Map of Essex and Willsboro' Townships, Essex Co., N. Y.
By Theodore G. White.

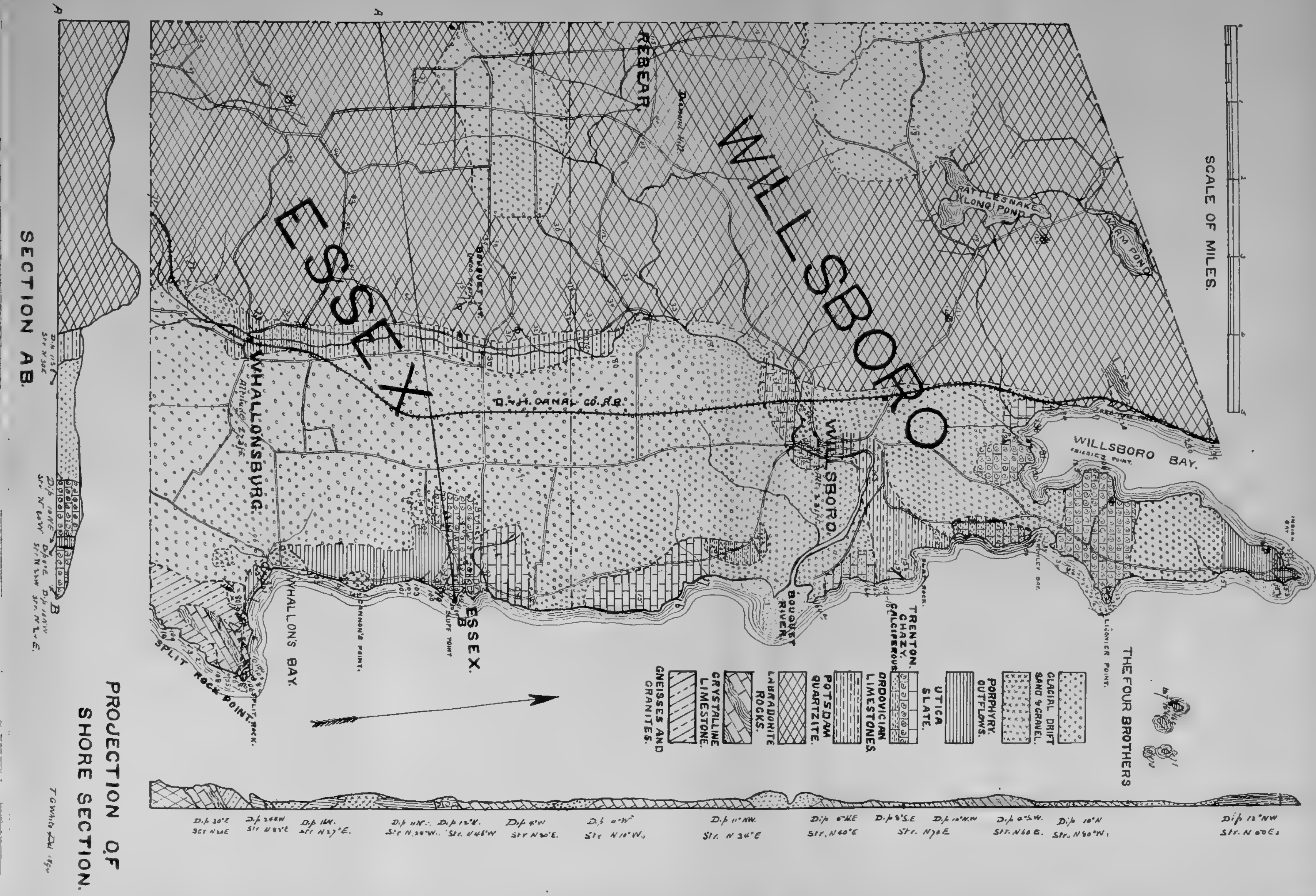
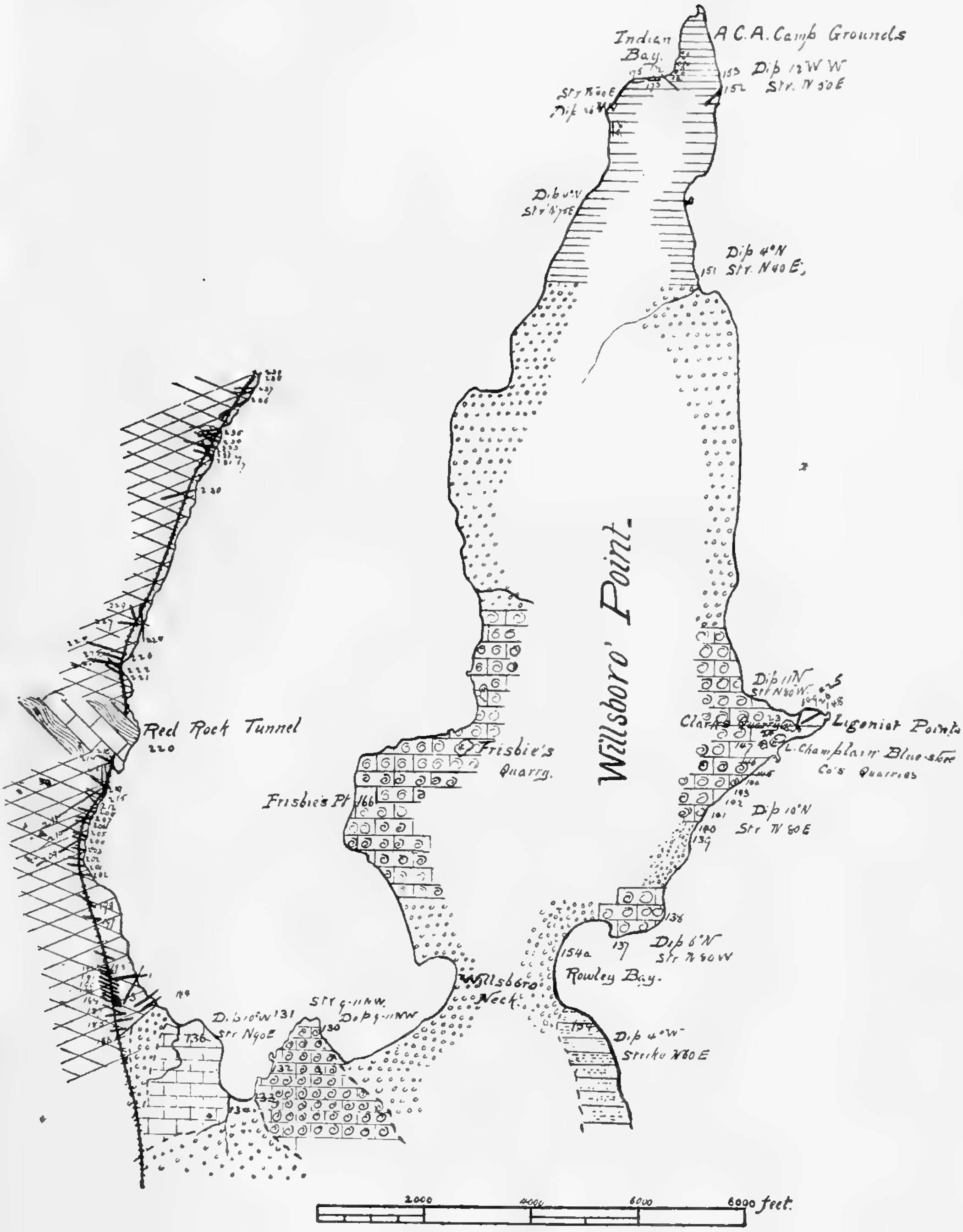

SECTION AB.
PROJECTION OF SHORE SECTION.
SCALE OF MILES.
ESSEX
WILLSBORO
REBEAR
WHALLONSBURG
WHALLON'S BAY
SPLIT ROCK POINT
ESSEX
BOUQUET RIVER
WILLSBORO
WILLSBORO BAY.
RATTLESNAKE (LONG) POND
WARM POND
THE FOUR BROTHERS
D.&H. CANAL CO. R.R.
GLACIAL DRIFT SAND & GRAVEL.
PORPHYRY OUTFLOWS.
UTICA SLATE.
TRENTON. CHAZY. CALCIFEROUS
ORDOVICIAN LIMESTONES.
POTSDAM QUARTZITE.
LABRADORITE ROCKS.
CRYSTALLINE LIMESTONE.
GNEISSES AND GRANITES.

PLATE VII.

Enlarged Map of the Shores of Willsboro' Bay and Willsboro' Point, especially intended to show the distribution of the dikes. (Legend same as in Plate V.) By Theodore G. White.



WILLSBORO' BAY.